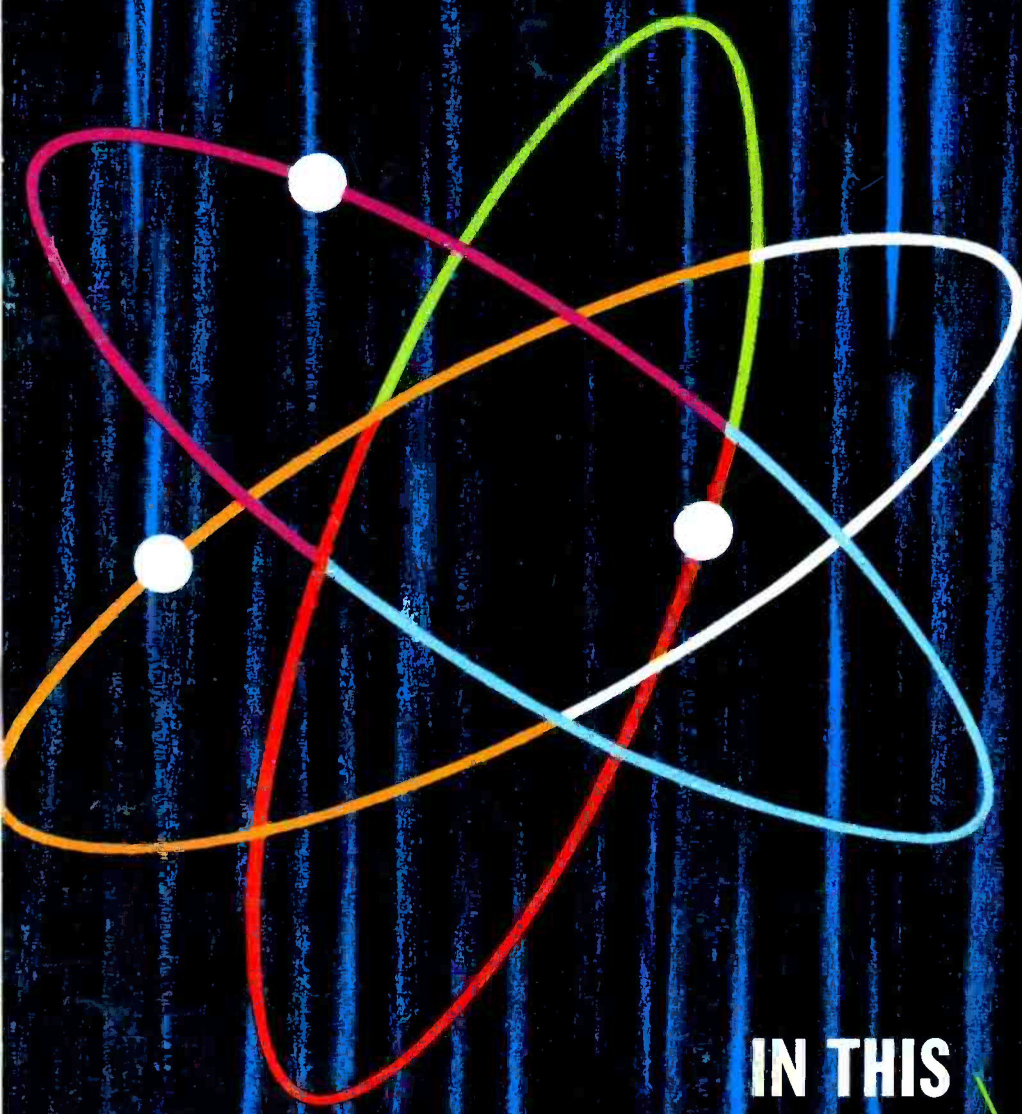
SEPTEMBER, 1964 50 CENTS

PF REPORTER

including Electronic Servicing



IN THIS ISSUE

Sync Symplified

TV Circuit-Protection Devices

AGC Troubles and Solutions

Radio Amateurs Aren't So Bad

Curing Aircraft Radio Troubles

and many others

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why two JFD UHF log-periodic TV antennas?

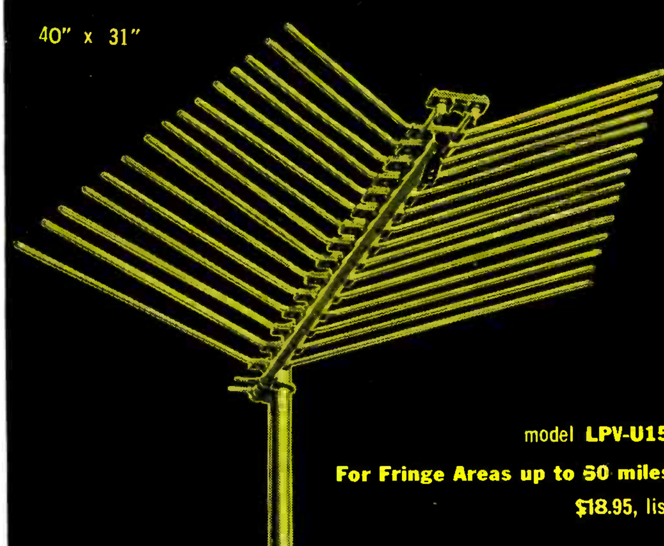
Because our engineers realize that **no** single antenna design is the answer to **all** UHF reception conditions.

UHF frequencies are more adversely affected by surroundings. Degradation due to receiver noise is greater on UHF. Also, UHF signal losses are greater than VHF.

Consequently, our R & D Laboratories in Champaign, Illinois, have developed **two** new UHF antenna concepts based on the acclaimed patented Log-Periodic formula of the Antenna Research Laboratories of the University of Illinois:

1 JFD LPV-U LOG-PERIODIC UHF ANTENNAS

for reception of UHF Channels **14** to **83** and VHF **7** to **13** in cluttered city or hilly areas where high gain and **sharp directivity** is needed for crisp **ghost-free** UHF reception in B/W or COLOR!



model **LPV-U15**

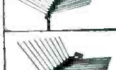
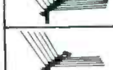
For Fringe Areas up to 60 miles

$18.95, list

26° to 29° narrow "E" plane (horizontal) beamwidths eliminate ghosts resulting from horizontal reflections—and combine with . . .

"H" plane (vertical) beamwidth, as low as 40°, to give over-all high gain.

- **Exclusive new UHF Log-Periodic frequency independent design provides flat, high gain across the band—excellent 300 ohm match gives below 2:1 VSWR.**
- **30% to 50% more effective gain and directivity than corner reflectors and stacked bowtie-screens on UHF channels 14 to 83—plus a bonus VHF gain of up to 6 db on channels 7-13.**
- **Inline solid aluminum rod construction for least wind and ice loading area.**
- **Beautifully gold alodized for lasting eye-appeal.**
- **100% pre-assembled—nothing to swing out or tighten—no movable joints.**
- **Stainless steel take-off terminals.**

FOUR JFD LPV-U LOG-PERIODICS TO CHOOSE FROM:				
	Model	Range	Outperforms	List
	LPV-U21	up to 80 miles	12-bay bowtie-screen	$27.95
	LPV-U15	up to 60 miles	8-bay bowtie screen	18.95
	LPV-U9	up to 40 miles	4-bay bowtie-screen	12.50
	LPV-U5	up to 25 miles	corner reflector	6.95

2 JFD UHF ZIG-A-LOG LOG-PERIODIC UHF ANTENNAS

where the **"ultimate"** in UHF color, and black and white reception is required.

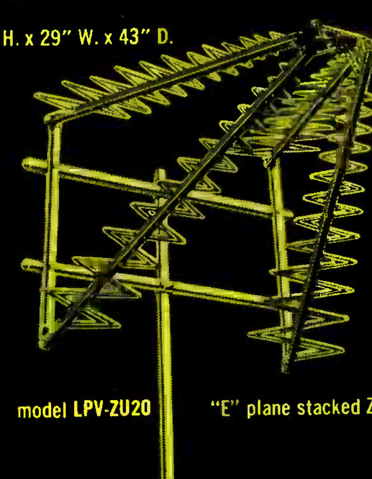
model **LPV-ZU10** 1-Bay Zig-A-Log **$17.95**, list

31" H. x 6" W. x 43" D.

Provides **rotator-less** reception of stations as far as 48° apart — up to 60 miles distant. **(If the LPV-ZU10 receives 707 micro-volts or more signal voltage when pointed directly at each of the stations, then it will receive all stations clearly when pointed toward the center of the group of stations desired. The angle between stations on extreme left and right, however, should not exceed 48°.)**

- Gain: 13.5 to 14 db. VSWR; under 1.8:1. 300 ohm impedance.
- Outperforms 8-Bay bowtie-screen reflector antenna.
- Ultimate in corrosion-protection: Gold alodized aluminum elements . . . Rohm & Haas Implex & square crossarm . . . stainless steel take-off terminals.

31" H. x 29" W. x 43" D.



TAME KEEP TV FREE

model **LPV-ZU20** "E" plane stacked Zig-A-Log array **$37.50**, list

Narrow 25° "E" (horizontal) and 30° "H" (vertical) plane patterns minimize ghosts caused by horizontal and vertical reflections in flat fringe terrain up to 90 miles from transmitters.

- Gain: 16-17 db, VSWR: under 2:1. 300 ohm impedance.
- Today's most powerful UHF array—matches effective gain of large parabolics—with much less wind, snow and ice-loading area.
- Locks on transmitter signal—no need to re-orient.
- Ultimate in corrosion-protection: Gold alodized aluminum elements . . . Rohm & Haas Implex & square crossarm . . . stainless steel take-off terminals.

Whether the location calls for VHF . . . or UHF . . . or FM . . . or VHF/UHF/FM—there is a JFD Log Periodic antenna to suit your installation needs—perfectly.

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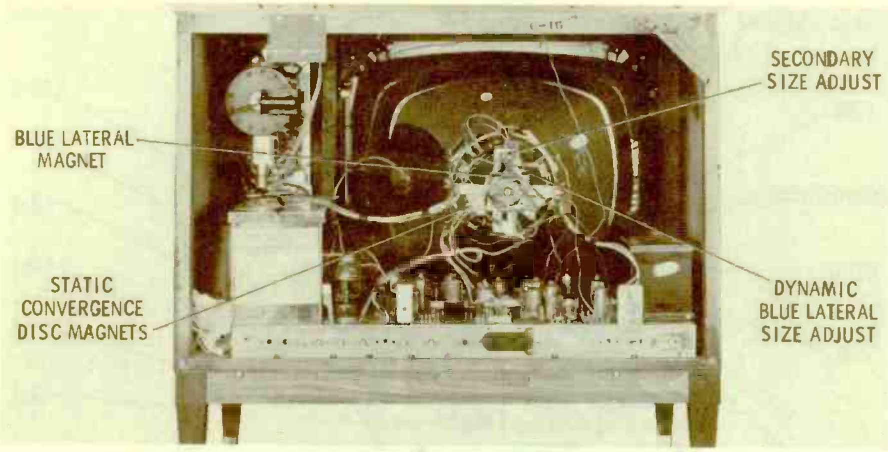
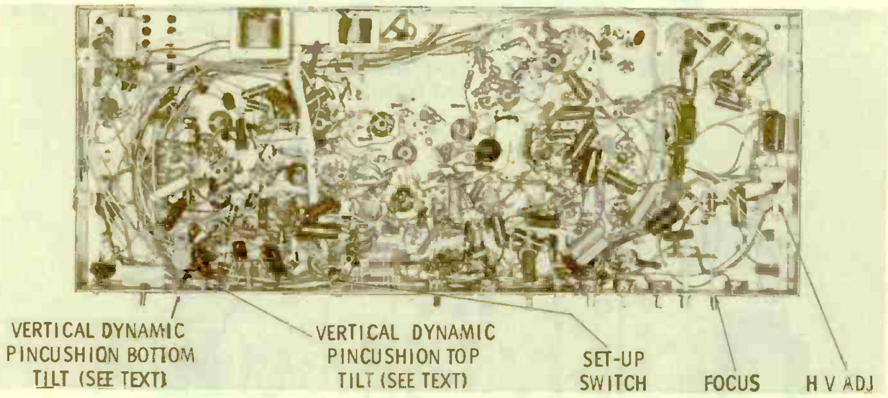
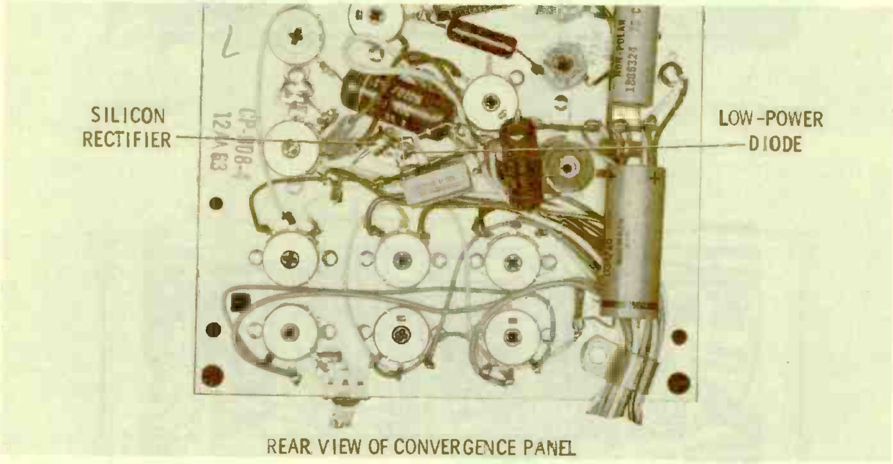
Circle 1 on literature card

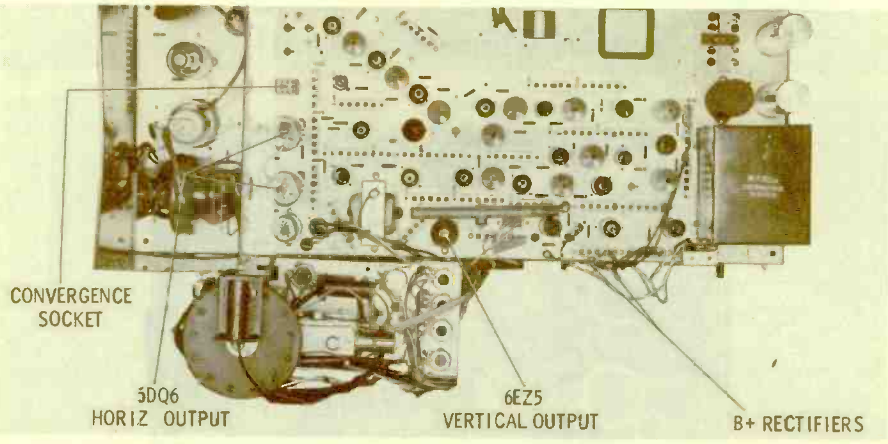


Motorola
Model Y23CK38M-2
Chassis TS908Y





REAR VIEW OF CONVERGENCE PANEL



The consolette color receiver pictured above uses a 23EGP22 picture tube. Design of both monochrome and chroma circuits is much the same as that found in 21" sets; however, some additional adjustments are provided for convergence of this 23" rectangular tube. An assembly located to the rear of the convergence yoke has a dynamic blue lateral size adjustment for converging the blue vertical line with the red and green lines near the left and right edge of the screen. Some models also have a secondary size adjustment in case additional movement of the blue vertical line is required.

Static convergence is accomplished in the usual manner, except that disc magnets are rotated for center-dot convergence and two pincushion tilt adjustments are provided on the chassis. The "vertical dynamic pincushion bottom tilt" control straightens the horizontal line at the bottom of the screen; the top tilt has the same effect at the top of the screen.

Convergence controls are located on a hand-wired assembly behind a removable speaker panel on the front of the receiver. The two latches that hold the panel may be reached from underneath.

Most of the tubes used in this chassis are familiar types; an exception is the 6EZ5 vertical output. The horizontal output circuit uses two 6DQ6's in parallel.

B+ is developed by two silicon rectifiers wired as a voltage doubler and protected by a circuit breaker. The parallel filament circuits are fused with #24 wire, except for the picture tube and high-voltage regulator which operate from a separate winding and are not protected.

Recent productions of the chassis use a low-power diode (shown in photo) to correct for a shift in DC convergence. The silicon rectifier shown in these convergence circuits is a departure from the usual selenium.

The small-neck CRT has its own basing configuration and a special-type socket is required when making tester connections to this tube.

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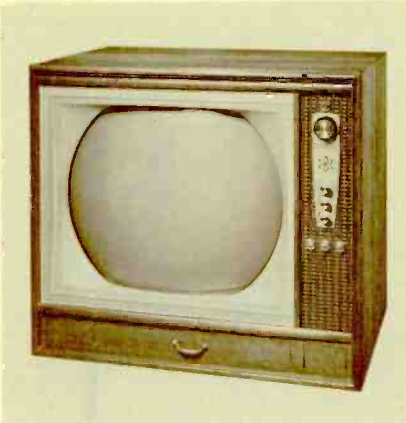
Setchell Carlson

PREVIEWS of new sets



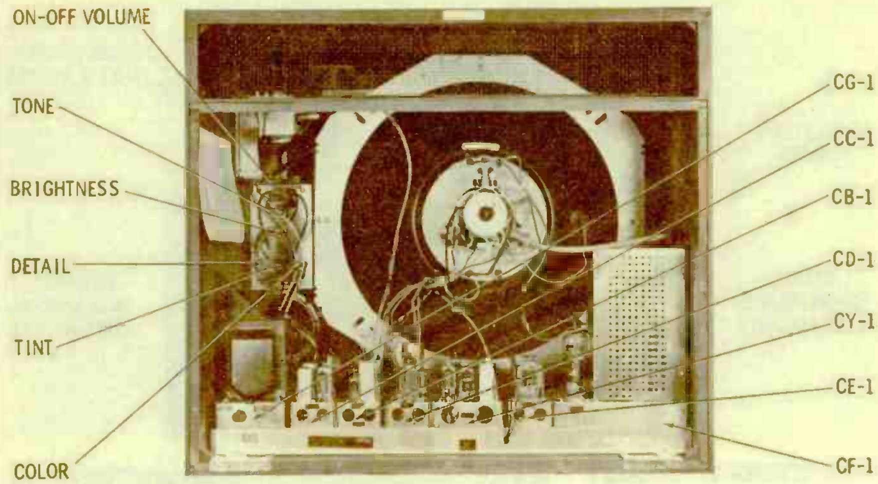
Setchell Carlson Model 3C64 Chassis U800

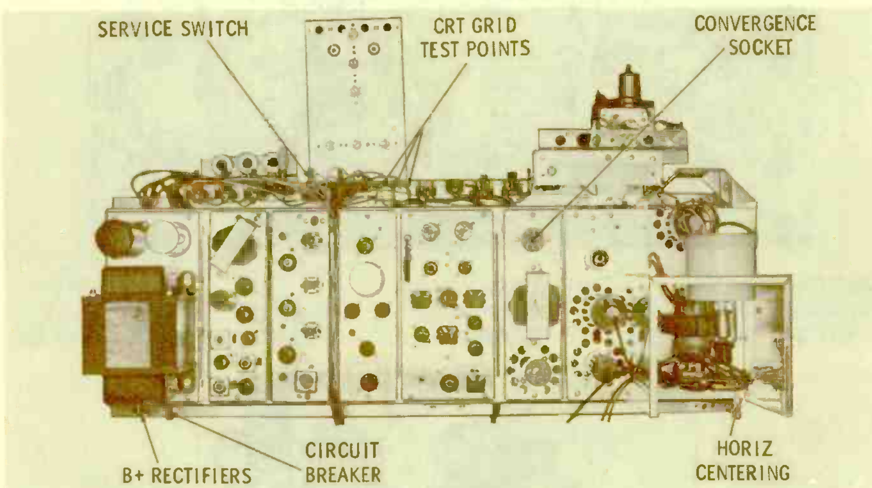
This unitized chassis is used in all 1964 color television receivers produced by Setchell Carlson. This company has offered a chassis design of this type in black-and-white sets in the past, but this is a first in color television. Nine individual plug-in units, including the RF tuner assembly, are used in this 21" receiver. Stages contained in the individual units are: unit CB-1—first, second, and third video-IF amplifiers, and video and 4.5-mc detectors; unit CC-1—first and second sound-IF amplifiers, ratio detector, audio amplifier and phase inverter, and push-pull audio output; unit CD-1—three stages of video amplification, AGC keyer, and sync separator; unit CE-1—vertical sweep; unit CF-1—horizontal AFC, oscillator, and output, plus high voltage; unit CG-1—low-voltage power supply; unit CY-1—all chroma circuitry.

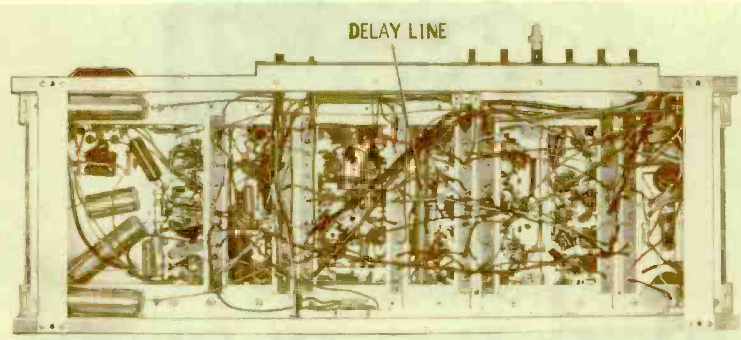
Any of the above sections may be replaced by a substitute unit in a matter of minutes, thereby in most cases eliminating the need for taking the entire chassis to the shop for service. Also, the chassis is designed so that a monochrome picture can be obtained even though the CY-1 section is removed.

Setup and service controls, along with the convergence panel, are located beneath and to the left of the picture tube and are accessible from the front by opening the hinged panel. The bottom of the chassis is covered by a screen which can be removed for minor servicing and checks without disassembling the chassis.

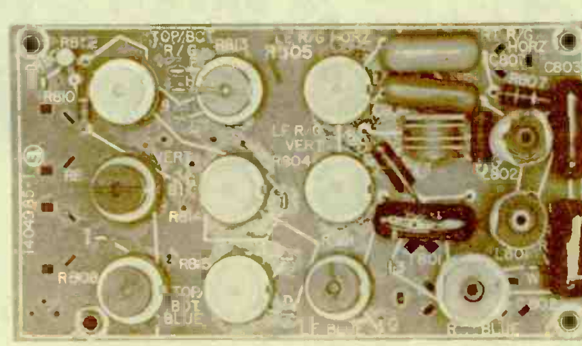
B+ for this transformer-powered set is developed by two silicon rectifiers connected as a full-wave voltage doubler. Protection is provided by a circuit breaker in series with the secondary winding of the power transformer. A separate 8.3-volt winding on the transformer furnishes heater voltage to the picture tube and the 6BK4 high-voltage regulator; this winding is protected by a wire-link fuse. An additional filament winding—12.6-volt, center-tapped—supplies the remaining filaments, and both legs are protected by wire link fuses. A fourth such fuse is found in series with the primary winding.



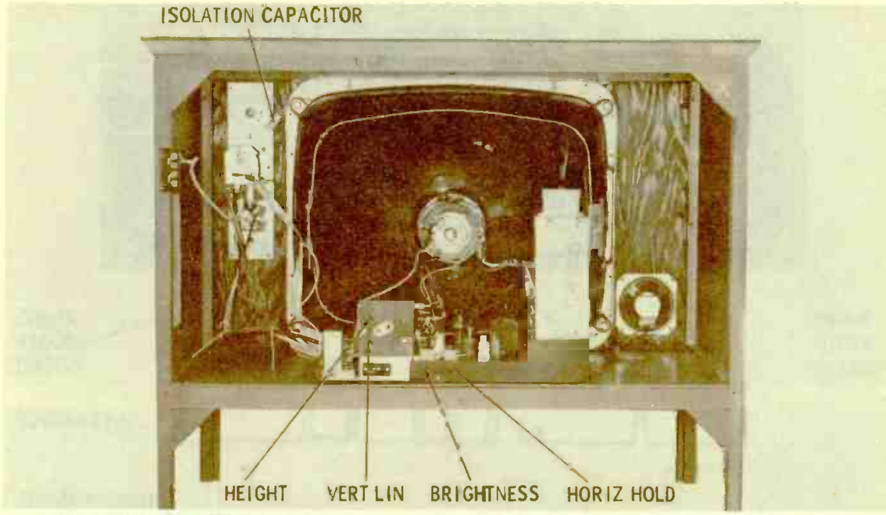


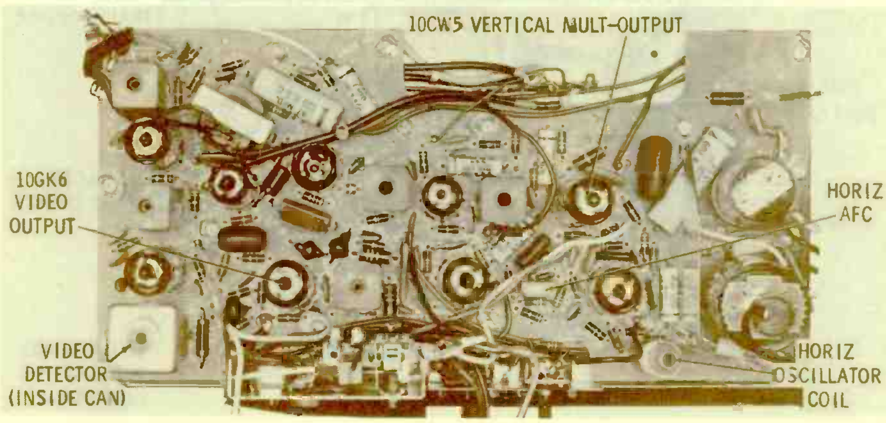


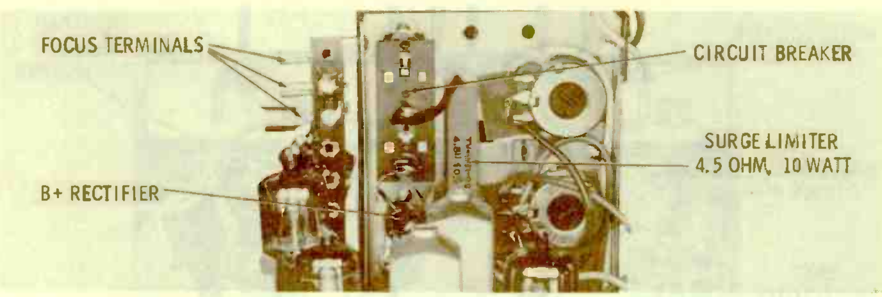
BOTTOM VIEW OF ENTIRE UNITIZED CHASSIS

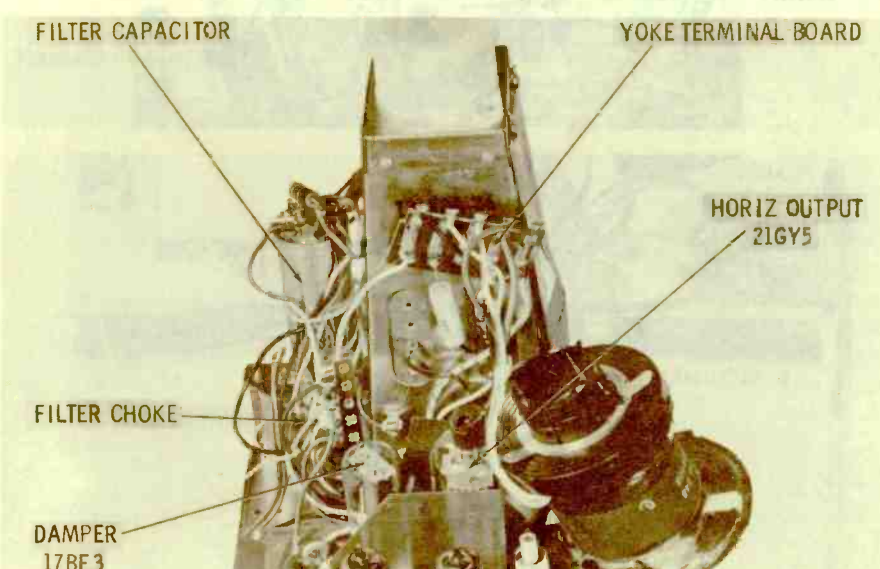


CONVERGENCE PANEL USES PRINTED CIRCUITRY









Sonora Model S64K236W

A new physical chassis, with both common and newly introduced tubes, is the highlight of this 23" console. The lightweight horizontal chassis has only one printed-circuit board with the majority of components mounted on top. Circuits in this receiver aren't changed drastically from those previously used. However, slight changes in connections and component values have been necessitated by the low-B+ tube lineup.

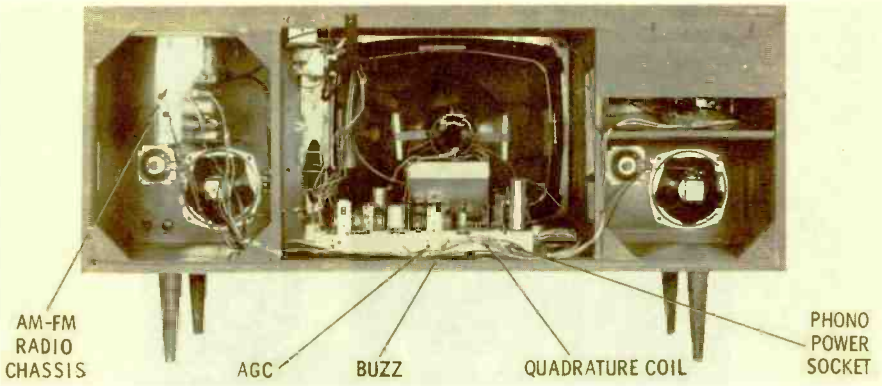
Tubes worth mentioning are the 23FWP4 picture tube, 3HQ5 RF amplifier, 6HB7 mixer-oscillator, 4EH7 first video-IF amplifier, 4EJ7 second video-IF amplifier, 10GK6 video output, 10CW5 vertical multivibrator-output, 21GY5 horizontal output, and 17BE3 damper. The remaining tubes are conventional types that should cause no replacement problems.

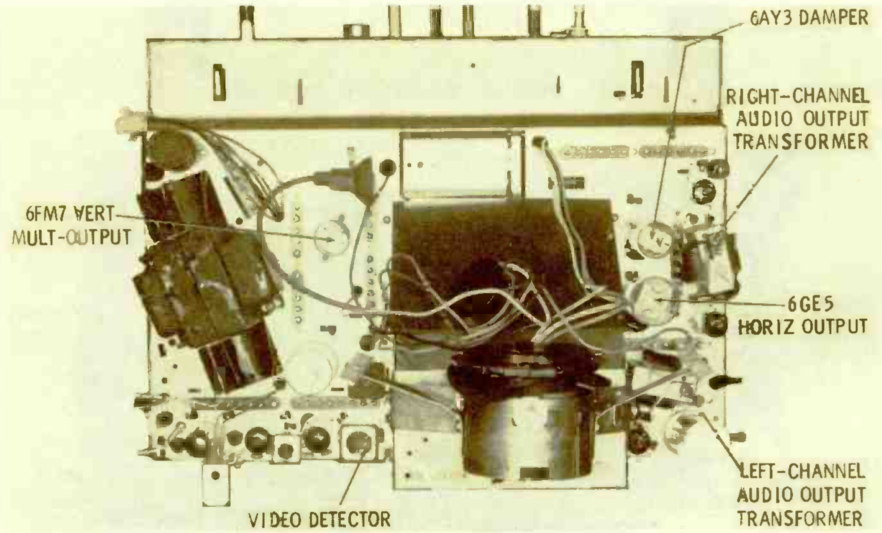
This transformerless chassis has no protection for the series filament string. However, a 4.5-ohm, 10-watt surge-limiting resistor and a circuit breaker protect the single silicon rectifier that develops the 130 volts of B+. Most circuits are supplied directly from the 130-volt line, with these exceptions: The sound detector plate is fed from boost, as is the CRT focus anode (in one position of the focus jumper); a 125-ohm, 4-watt resistor lowers the tuner B+ voltage somewhat.

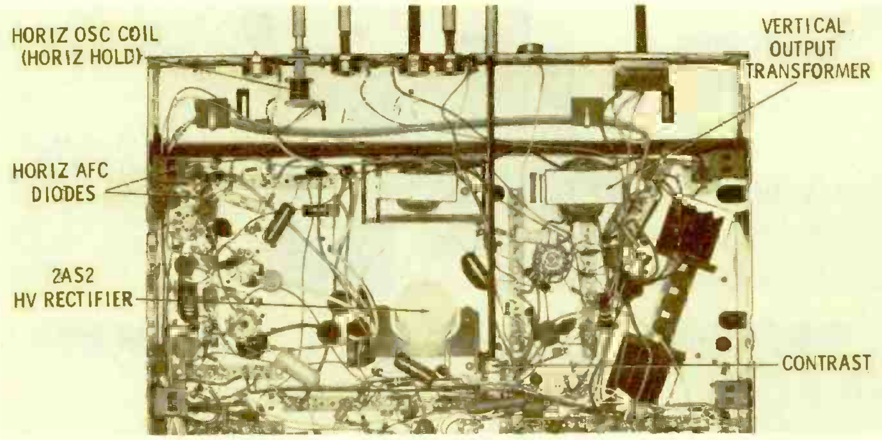
A 1N295 crystal diode, located under a shield covering the final IF transformer, is used as the video detector. A common-cathode dual selenium diode is utilized in the horizontal AFC section. This diode plugs in and may be replaced without dismantling the chassis.

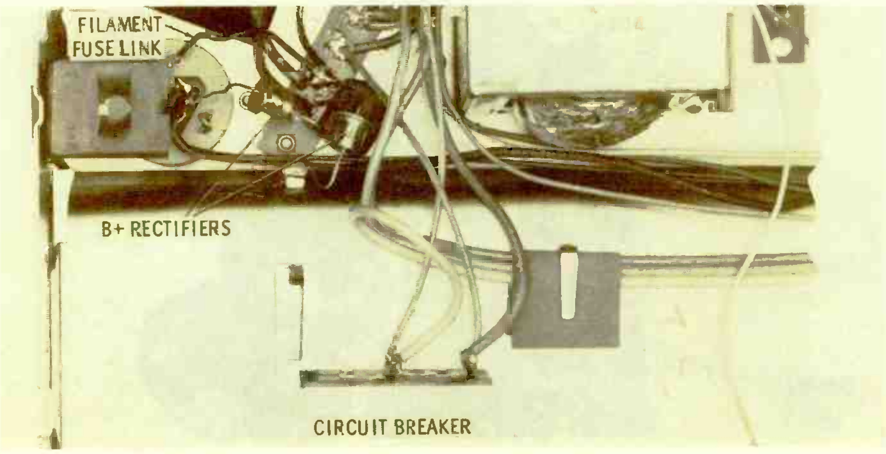
Operating controls are located on the tuner-mounting bracket and are accessible from the front; these include on-off-volume, contrast, and vertical hold. Adjustable from the rear of the chassis are the height, vertical linearity, brightness, and horizontal hold. The width may be varied by a plastic sleeve located between the yoke and the picture-tube neck; slide the sleeve in or out of the yoke to obtain correct width.

PREVIEWS of new sets









Zenith Model ML2784W3 Chassis 16L24

The combination model shown here contains a 23" television, AM-FM-FM MPX radio, and four-speed automatic phonograph. The TV chassis is similar to last year's model both physically and electrically.

The VHF tuner uses a 6HA5 RF amplifier and 6GJ7 mixer-oscillator. Tubes in the three-stage video-IF strip include 6EH7's for the first and second amplifiers, and a 6EJ7/EF184 for the third. The video output section uses the pentode portion of a 6JT8, with the triode half of this tube as a sound-IF amplifier. A 6BN6 works as a sound discriminator, and its output is fed through an interconnecting plug and socket to the radio chassis for amplification by the triode section of a 12AX7A in both the left and right channel. A pair of 6BQ5's, located on the TV chassis, operate as a push-pull audio output stage for TV, radio, or phono operation. A 6HS8 performs the functions of sync separator, AGC keyer, and noise limiter, while a 6FM7 operates as vertical multivibrator-output. The tube complement of the horizontal circuit includes a 6KD8 (6GH8 alternate) AFC-oscillator, 6GE5 output, 6AY3 damper, and 2AS2 high-voltage rectifier. The picture tube is a bonded 92° 23ECP4.

B+ is derived from two silicon rectifiers within the voltage doubler network. Silicon protection is afforded by a circuit breaker in series with the primary winding of the power transformer; a 1½" length of #24 wire serves as a fuse link for the parallel filament circuit.

The quadrature coil, buzz control, and AGC control are located on the rear apron of the chassis, while the remaining controls and the horizontal oscillator coil (used for hold control) are on the front of the chassis and are accessible by opening the panel door beneath the picture tube face.

Radio, phono, or TV operation may be selected by a function switch on the radio chassis; the loudness, bass, and treble controls are also on the radio chassis.

See PHOTOFACT Set 505, Folder 1

See PHOTOFACT Set 505, Folder 1

Mfr: Admiral **Chassis No.** 18B7

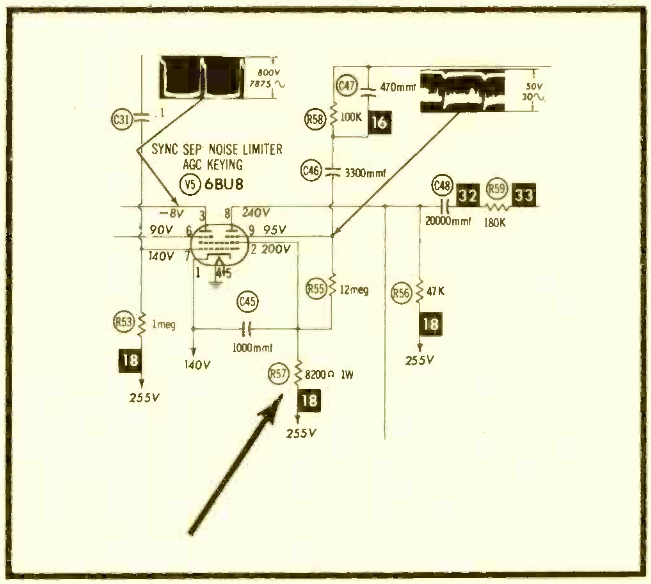
Card No: AD 18B7-1

Section Affected: Pix and sync.

Symptoms: Video overload; poor sync; low voltage on screen grid (pin 2) of V5 (6BU8).

Cause: Sync separator screen grid resistor overheated.

What To Do: Replace R57 (8200 ohms—1W); also V5 (6BU8).



Mfr: Admiral **Chassis No.** 18B7

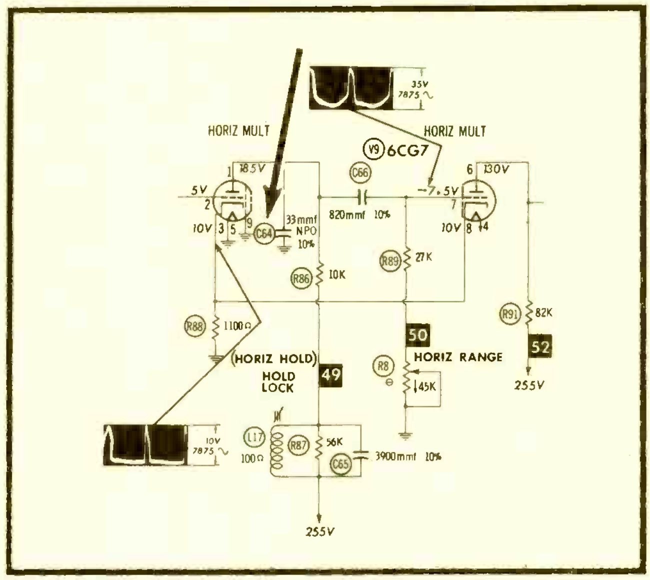
Card No: AD 18B7-2

Section Affected: Horizontal sync.

Symptoms: Horizontal frequency drifts out of range. Reduced voltage at plate (pin 1) of V9 (6CG7).

Cause: Leaky bypass capacitor in horizontal multivibrator.

What To Do: Replace C64 (33mmf—NPO, 10%).



Mfr: Admiral **Chassis No.** 18B7

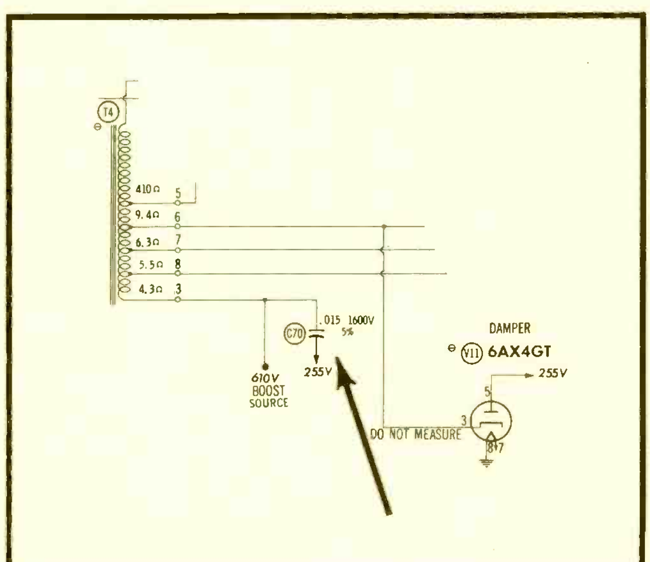
Card No: AD 18B7-3

Section Affected: Raster.

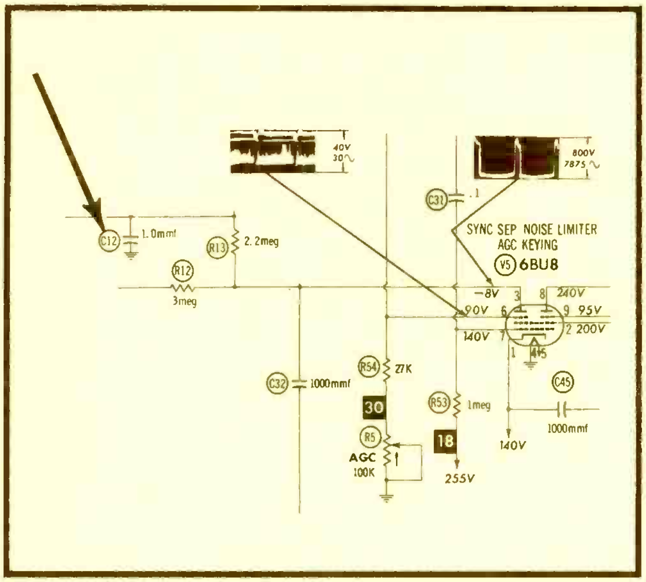
Symptoms: No raster; boost voltage is low.

Cause: Shorted boost circuit filter capacitor.

What To Do: Replace C70 (.015 mfd—1600V, 5%).



See PHOTOFACT Set 505, Folder 1



See PHOTOFACT Set 505, Folder 1

Mfr: Admiral **Chassis No.** 18B7

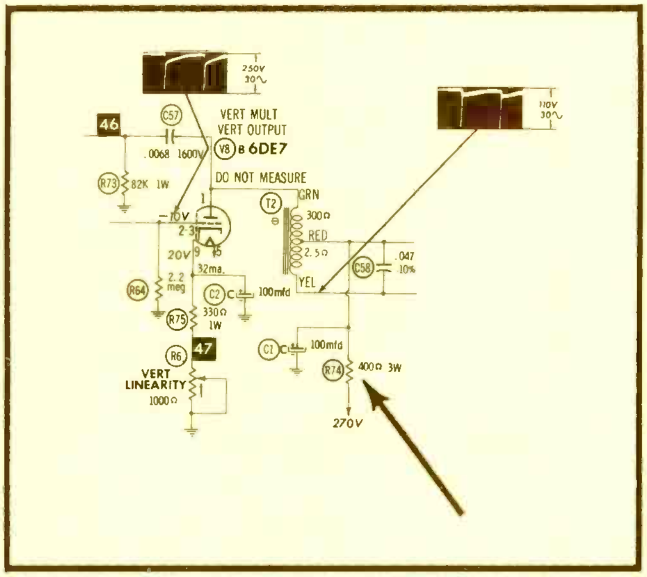
Card No: AD 18B7-4

Section Affected: Pix and sync.

Symptoms: Picture bends; sync unstable.

Cause: AGC filter capacitor open.

What To Do: Replace C12 (1 mfd).



Mfr: Admiral **Chassis No.** 18B7

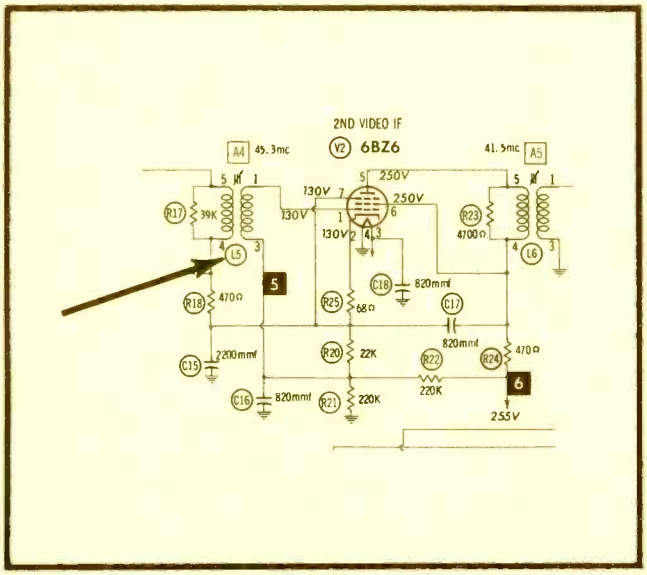
Card No: AD 18B7-5

Section Affected: Raster.

Symptoms: Vertical sweep collapses.

Cause: B+ resistor in vertical output circuit overheated.

What To Do: Replace (R74—400 ohms).



Mfr: Admiral **Chassis No.** 18B7

Card No: AD 18B7-6

Section Affected: Pix.

Symptoms: Weak and washed out pix.

Cause: Poor connections to transformer in grid circuit of second video IF; no voltage on grid (pin 1) of V2 (6BZ6).

What To Do: Resolder all connections on L5. (Poor connections on L6 cause same symptoms, but grid voltage on V3 is unaffected.)

See PHOTOFACT Set 628, Folder 2

Mfr: General Electric

Chassis No. MW Compactron

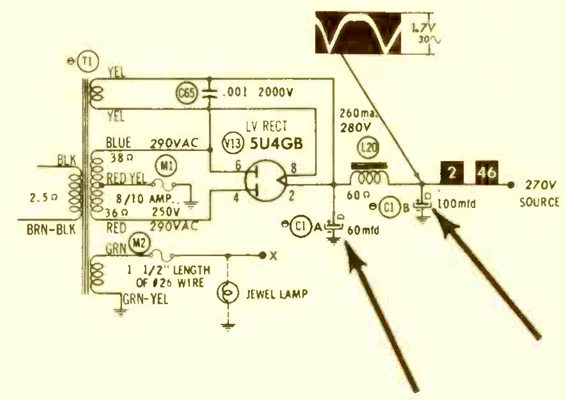
Card No: GE MW-1

Section Affected: Raster.

Symptoms: 120 cps modulation in raster; sound and pix okay. Bridging C1A and C1B improves but does not correct condition.

Cause: Leakage between C1A and C1B power supply filters effectively shorts filter choke L20.

What To Do: Replace C1 (60-100-100-5 mfd —350-350-150-200V).



See PHOTOFACT Set 628, Folder 2

Mfr: General Electric

Chassis No. MW Compactron

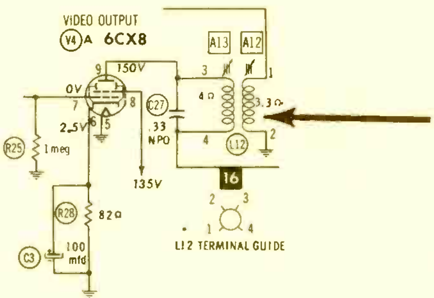
Card No: GE MW-2

Section Affected: Sound.

Symptoms: Buzz in sound; adjusting fine tuning control varies amount of buzz. Buzz cannot be eliminated by normal procedure.

Cause: Secondary winding of sound takeoff coil open.

What To Do: Replace L12.



Mfr: General Electric

Chassis No. MW Compactron

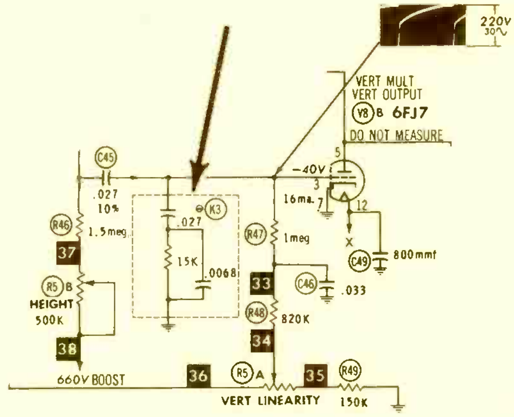
Card No: GE MW-3

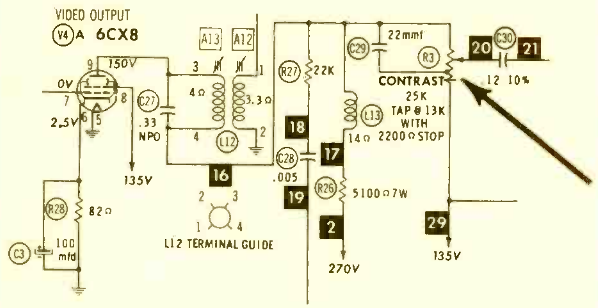
Section Affected: Pix and Raster.

Symptoms: Vertical foldover. Insufficient width and height; low high voltage; raster blooms.

Cause: Leakage develops in vertical component pack. Bias on grid (pin 3) of V8 (6FJ7) may be low.

What To Do: Replace vertical component pack K3.





See PHOTOFACT Set 628, Folder 2

Mfr: General Electric
Chassis No. MW Compactron

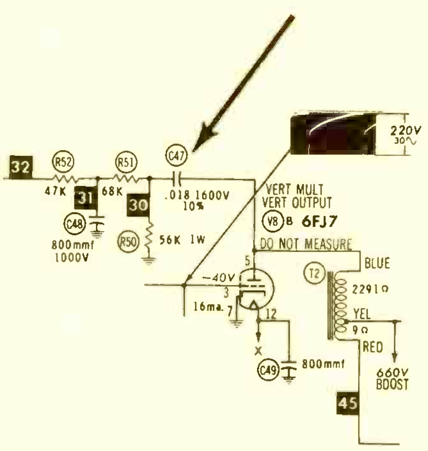
Card No: GE MW-4

Section Affected: Pix.

Symptoms: Washed out pix after ⅓ or more rotation of contrast control.

Cause: Open tap on contrast control.

What To Do: Replace R3 (25K, tap at 13K, with stop at 2200 ohms).



Mfr: General Electric
Chassis No. MW Compactron

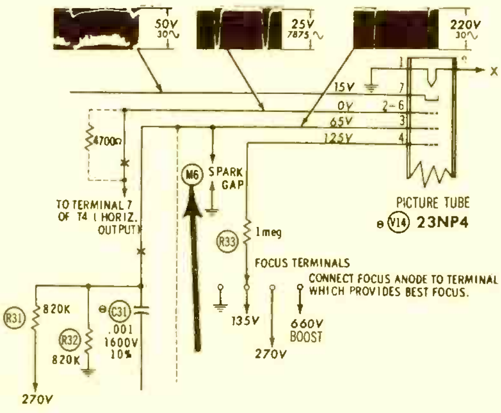
Card No: GE MW-5

Section Affected: Raster.

Symptoms: Vertical sweep collapses. R50 overheats and burns.

Cause: Shorted capacitor in vertical feedback circuit.

What To Do: Replace C47 (.018 mfd) and R50 (56K—1W).



Mfr: General Electric
Chassis No. MW Compactron

Card No: GE MW-6

Section Affected: Raster.

Symptoms: Insufficient brightness.

Cause: Defective spark gap.

What To Do: Replace M6, or check for dirt or sediment and clean area around device with carbon tetrachloride.

TUNER REPAIRS

$9.50

FOR COMPLETE OVERHAUL

Includes ALL parts (except tubes)
ALL labor on ALL makes

24-HOUR SERVICE with FULL YEAR WARRANTY

Sarkes Tarzian, Inc., largest manufacturer of TV and FM tuners, maintains two completely-equipped Service Centers to serve YOU. Both centers are staffed by well-trained technicians in this specialized field and are assisted by engineering personnel to assure you of FAST, DEPENDABLE service.

Tarzian-made tuners—identified by this stamping—received one day will be repaired and shipped out the next. A little more time may be required on other makes. Every channel is checked and re-aligned per manufacturer's specifications, not just the channels which might exist in any given area.

You get a 12-month guarantee against defective workmanship and parts failure due to normal usage. Cost to you is only $9.50 and $15 for UV combinations, including all labor and parts except tubes. No additional costs. No hidden charges. All tuners repaired on approved, open accounts. You pay shipping. Replacements on tuners beyond practical repair are available at low cost.

When inquiring about service on other than Tarzian-made tuners, always send TV make, chassis and Model number. Check with your local distributor for Sarkes Tarzian replacement tuners, parts, or repair service. Or, use the address nearest you for fast factory repair service.

SARKES TARZIAN, INC.
TUNER SERVICE DIVISION

See your distributor, or use the address nearest you

537 South Walnut St., Bloomington, Indiana, Tel: 332-6055	10654 Magnolia Blvd., North Hollywood, Calif. Tel: 769-2720

Manufacturers of Tuners . . . Semiconductors . . . Air Trimmers . . . FM Radios . . . AM-FM Radios . . . Audio Tape . . . Broadcast Equipment

Circle 2 on literature card

QUESTION: When it comes to electrolytic capacitors, why do more than half of the nation's Radio-TV Service Technicians prefer to do business with Sprague Distributors?

ANSWER: Because they don't want makeshift substitutions or multi-rating "fits-all" capacitors. They insist on exact replacements, which are always available through Sprague Distributors everywhere.

SPRAGUE **TWIST-LOK**® CAPACITORS...

1863 different ratings and sizes...

the world's most complete selection of **EXACT** replacements!

We don't have to tell you that it's easier to service with *exact* replacements. And we don't have to tell you that it's better, too. When sets are designed, specific capacitance values are used for peak operation, so it takes *exact* replacements to restore original set performance.

And who better than Sprague knows which values and sizes are needed in the replacement market? Sprague, the world's largest component manufacturer, has the most complete specification file on original set requirements. That's why you're always right when you service with Sprague TWIST-LOK *exact* replacements!

Wouldn't you really rather have what the set manufacturer recommends? An exact replacement in capacitance, voltage, and size is easier to install and less expensive, in most cases, than substitutes!

GET YOUR COPY of Sprague's comprehensive Electrolytic Capacitor Replacement Manual K-107 from your Sprague Distributor, or write Sprague Products Company, 105 Marshall Street, North Adams, Massachusetts.

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THE MARK OF RELIABILITY

WORLD'S LARGEST MANUFACTURER OF CAPACITORS

65-127-63 R2

Circle 3 on literature card

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PF REPORTER

including Electronic Servicing

VOLUME 14, No. 9 *SEPTEMBER, 1964*

CONTENTS

ABOUT THE COVER

The varied list of titles shown on this month's cover illustrates the ever-increasing complexity of electronic servicing. Profits in the field require a constantly-expanding and timely knowledge of new techniques and concepts. The successful technician knows that his greatest allies are up-to-date procedures and informative articles like those in this issue.

Letters to the Editor

Dear Editor:

Your June "Guide to Importers" should aid technicians greatly. However, I've found that many of the importers listed will not provide any information; indeed, some of them will not even reply to a letter sent to them.

WAYNE BLACKWELL
Amarillo, Tex.

Many other readers have voiced this conclusion, too, Wayne. Watch for a future listing, similar in format, but showing which importers and manufacturers will supply service information and parts for their transistor sets.—Ed.

Dear Editor:

On page 34 of the May issue, I noticed especially the article "TV Waveforms Save Analysis Time." This is the first time I have noticed this feature in PF REPORTER. I think you should put these enlarged waveforms in the magazine every month, showing those in different parts of the television set like you do SYMFACT. With a better understanding of waveforms, we wouldn't keep our scopes sitting at the back of the bench as an ornament. SYMFACT has been a great help, and this feature could, too. How about it?

H. RUTHERFORD
Brooklyn, N.Y.

We're preparing a series of these articles, showing servicemen how to analyze the various portions of waveform traces seen on their scopes. Do any other readers have suggestions for information they'd like to see included in this type of feature?—Ed.

Dear Editor:

Your June article "Scoping in Transistor Radios" was very interesting, but I just can't buy the solution to the formula on page 71. Maybe I missed something, but I'd like to know for sure.

JIM PRINDELL
Circle, Mont.

The formula is solved incorrectly, Jim, but the 1-to-.1 ratio still holds true. The solution is as follows:

Formula:	$W = E^2/R$
Substituting:	$.35 = E^2/3.2$
Multiply both sides by 3.2:	$3.2 \times .35 = E^2$
Combine terms:	$1.12 = E^2$
Solving:	$\sqrt{1.12} = E$
Solution:	$1.058 = E$ (rms)

Because the scope reads peak-to-peak voltage instead of rms values, multiply E by 2.8, equalling 2.96 volts. Thus, getting back to our reason for working the formula in the first place, we can use the rule-of-thumb that approximately 3 volts on the scope, measured across a 3.2-ohm voice coil, will indicate approximately 300 mw of power being delivered. By corollary, then, each peak-to-peak volt on the scope equals .1 watt or 100 mw.—Ed. ▲

Circle 6 on literature card

Now, JERROLD's
great new line of
12 POWERMATES
gives you a transistor amplifier for every job

CUT OUT THIS CHART AND SAVE FOR

Leave it to Jerrold! We've expanded our fast-selling *Powermate* line of transistorized antenna amplifiers and indoor amplified couplers to give you a *Powermate* tailored to every VHF, UHF, and FM stereo reception problem you're likely to run into.

Now, from deepest fringe to suburban and metropolitan reception areas, you can offer TV viewers and FM listeners the perfect *Powermate* amplifier or coupler for their needs and their budgets. The chart here, designed to be hung on your wall, tells you which *Powermate* to recommend for each customer.

Ask your Jerrold distributor for complete information, or write *Jerrold Electronics, Distributor Sales Division, Philadelphia, Pa. 19132.*

INDOOR POWERMATES

NEW!

For four-set (VHF) indoor coupling in suburban to fringe areas—new economical one-transistor Indoor Powermate supplies up to four TV and FM sets from a single antenna.

Model TA-24 List price $24.95

For maximum indoor amplification of up to four VHF TV sets and FM receivers—indoor version of the twin-transistor Super Powermate SPM-102, featuring the industry's best gain-overload characteristics and low noise figure.

Model TA-66

List price $34.95

NEW!

For two-set (VHF) indoor coupling in suburban to fringe areas—new Indoor Powermate Special supplies two VHF TV sets or a TV and an FM set from a single antenna.

Model TA-12

List price $17.95
Available November.

NEW!

For FM stereo indoor amplification—new Stereo Range Extender is the Indoor Powermate for the FM band. Extends FM broadcast range and splits FM from TV signals to permit use of single broadband TV antenna for both.

Model SRX

List price $29.95

NEW!

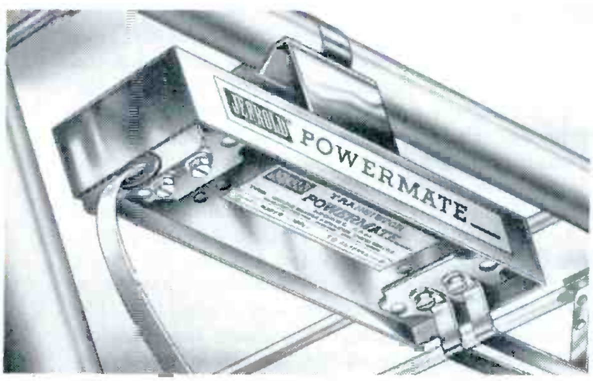
For UHF set coupling indoors—new UHF Indoor Powermate Special supplies clean signals to two UHF sets from a single UHF antenna. High isolation between outputs minimizes interference between sets.

Model TAU-12

List price $29.95
Available October.

HANDY REFERENCE, OR HANG ON THE WALL OF YOUR SERVICE SHOP.

OUTDOOR POWERMATES



For snow-free VHF TV and noise-free FM where overload is no problem—the original Powermate has been improved with new power-supply circuitry. Unparalleled gain throughout hi and lo VHF bands, coupled with exceptionally low noise figure. Dual outputs.

Model APM-102 **List price $39.95**

For bringing in weak VHF signals without overloading from strong local signals—the famous twin-transistor Super Powermate introduced last year. Exceptional gain-overload capabilities permit it to deliver signals from far-distant stations bright and clear, without overloading from strong signals "in your back yard."

Model SPM-102 **List price $44.95**

NEW!

Model SPC-103

For best color and b&w reception in weak-signal areas—new Super Powermate Coaxial is the coax-downlead version of the famous twin-transistor Super Powermate Model SPM-102 described above. Coax downlead assures superb color and b&w reception by prevention of interference from auto generators and other transients . . . also is not affected by corrosion and bad weather.

List price $47.95

NEW!

For low-cost VHF TV and FM reception in no-overload areas—the new Powermate Special delivers plenty of crisp, bright pictures and sound throughout the VHF and FM band—even from distant stations.

Model LPM-102

List price $29.95

NEW!

Model SPC-132

For deepest fringe areas—Transistor successor to the famous "De-Snower" model DSA-132, this is the mightiest Powermate of them all. Works where all other units fail. Ideal for small public buildings as well as homes. Coax downlead assures excellent impedance match and minimum interference pick-up. Available October.

List price $97.75

NEW!

Model UPM-104

For UHF reception in fringe to deep-fringe areas—new super-gain antenna-mounting UHF Powermate. Twin transistors bring in excellent clear pictures even in the most difficult UHF reception areas.

List price $49.95

NEW!

For low-cost UHF antenna preamplification—antenna-mounting UHF Powermate Special with single transistor provides enough gain to bring poor UHF signals in out of the snow.

Model ULP-104

List price $34.95

JERROLD ELECTRONICS

DISTRIBUTOR SALES DIVISION, Philadelphia, Pa. 19132

A subsidiary of THE JERROLD CORPORATION

Circle 7 on literature card

The Electronic Scanner

news of the servicing industry

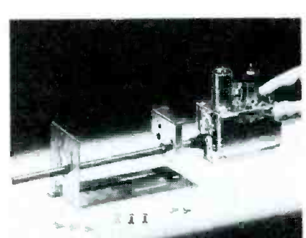
Makes Move

The Parts and Accessories facility of **Radio Corporation of America** has been moved from its former location in Camden to a new building at 2000 Clements Bridge Road, Deptford, New Jersey 08096. Telephone numbers remain the same, except that extension numbers now begin with a PT prefix; the teletype number is 609-845-4962. A new RCA 301 computer is to be installed in the building to provide improvement in service to customers.

Education at the World's Fair

Local and foreign educators participated in the somewhat belated dedication of the **Communications Demonstration Center** in the Hall of Education at the New York World's Fair. Programs of an educational nature will originate from the fully equipped Center daily throughout the two years of the Fair. The integrated facility consists of an auditorium area for groups of up to 400, an area for demonstrating classroom or seminar instructional programs, individual student study stations, a backstage area from which rear-screen projection of film, slides, and television can be presented on multiple screens, a studio facility where television programs and demonstrations can be produced for recording on video tape or for direct live broadcast, and a master control room which is the nerve center for all audio-visual and broadcasting equipment. The demonstration stresses that, although the latest technological equipment for education is being shown, the role of the equipment is not to replace teachers; instead, it is to provide aid in presenting diverse materials, measuring student response, and performing routine, monotonous tasks which would become impossible to do with the vastly increased number of students anticipated in future classrooms.

Tuner Replacement Program



A new parts-distributor merchandising program to replace tuners needing repair has been started by **Standard Kollsman Industries, Inc.**, Melrose Park, Ill. The program is being started with RCA tuners because of their wide usage. The new SKRCA mounting bracket, included in the replacement tuner kit, facilitates replacement of tuners in most RCA receivers. The kit allows substituting SKI tuners for 68 different RCA tuner models of the KRK series. The dealer or service technician will be offered a $6.00 trade-in on the old RCA tuner when he purchases an SKI replacement kit.

New Acquisition

KTV Tower and Communications Co., of Sullivan, Ill., has been acquired by **Rohn Manufacturing Co.** The KTV company, formerly known as Kuehne Tower Company, manufactured home-television and amateur towers. The line will now be available from Rohn representatives. ▲

The antenna that challenges

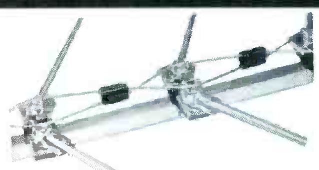
NEW *Swept Element*

"COLOR-VE

BY

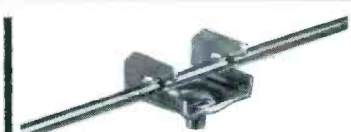
FINCO

Finco's Color Ve-Log challenges all competition on color or black and white reception and stands behind this challenge with a "Guarantee of Supremacy". ■ The swept element design assures the finest in brilliant color and sharply defined black and white television reception – as well as superb FM monaural and stereo quality. ■ FINCO precision-engineered features make these advanced-design antennas indispensable to good home sight-and-sound systems. And, of course, they carry the famous unconditional guarantee from the leading manufacturer in the field – FINCO. ■ Promote the Color Ve-Log Antennas with pride, sell them with confidence, and profit handsomely.

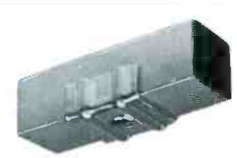


One-piece cross-over drive line assembly has no joints between adjacent driven elements. Eliminates loose connections, shorts, broken drive line sections. Polystyrene snap-lock spacers, with center 'air insulator' space.

Elements are made of triple thick aluminum to stand up in severe weather. Die stamped bracket fastened with tough, thick-gauge rivet holds proportional length sleeve reinforcing shell into which element fits.



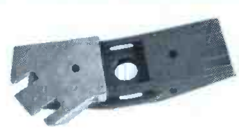
First from Finco and exclusive — double contact between drive line and driven element bracket assembly for perfect drive-line support and electrical continuity. Positive, vibration-free, non-corrosive contact.



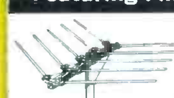
Boom reinforcing back up brackets at elements add triple strength to the riveted assembly, mounted on a rigid, non-crushable 1" heavy duty square boom. Boom rolled square from 1¼" diameter round aluminum for increased strength.

Write for color brochure #20-307, Dept. 310 .

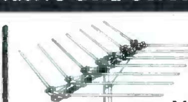
Finco's boom-mast bracket, rust-proofed by zinc plate-gold di-chromate dip process, is the finest available. It has positioned cleats to assure sag-free positive direction of the antenna. Locks tight. Can't tilt. Antenna stays in proper position at all times.



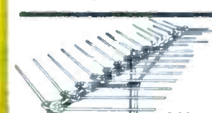
High impact polystyrene insulators are reinforced with strong aluminum shields. This gives quadruple strength in supporting triple-thick snap-in elements. Lifetime assembly with fitted aluminum cup to hold oversize aluminum rivet.



VL-5
5 element VHF-FM
5 driven elements
List price $16.95



VL-7
7 element VHF-FM
7 driven elements
List price $23.95



VL-15
15 element VHF-FM
9 driven elements
6 parasitic elements
List price $46.95

VL-18
18 element VHF-FM
9 driven elements
9 parasitic elements
List price $54.50

The FINNEY Company • 34 Interstate Street • Bedford, Ohio

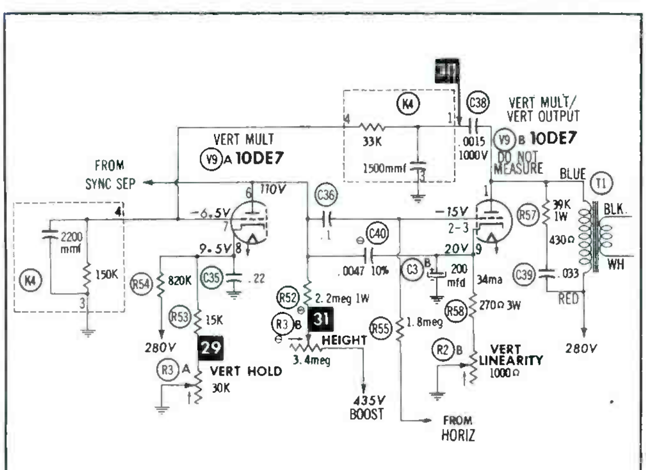
Circle 10 on literature card

The Troubleshooter

answers your servicing problems

Cure for Hot and Cold

With reference to Mr. Meyer's vertical roll problem in a Philco Model G4242M (Troubleshooter, May, 1964, PF REPORTER, page 20), I have had this same problem in several sets of this particular model and found in most cases that R54 (820K resistor) had increased in value. The voltage on the cathode (pin 8) remains normal even though the resistor is defective.



THURMAN E. WILKES

Goldenrod, Florida

This time we've shown the schematic of the complete vertical multivibrator section of the receiver. To understand how a defective R54 can cause vertical roll but no apparent change in cathode voltage, note that R3A, R53 and R54 form a cathode voltage-divider network. Adjusting the vertical hold control changes the cathode voltage. As the set warms up and R54 changes value, the cathode voltage also changes slightly; the grid bias is thus affected, the tube conduction is changed, and the picture rolls. Once the set is warmed up and R54 settles to a certain value, the cathode voltage may be restored to normal with the hold control. If any of you have trouble of this nature, thank reader Wilkes for this tip.

Distorted Stereo

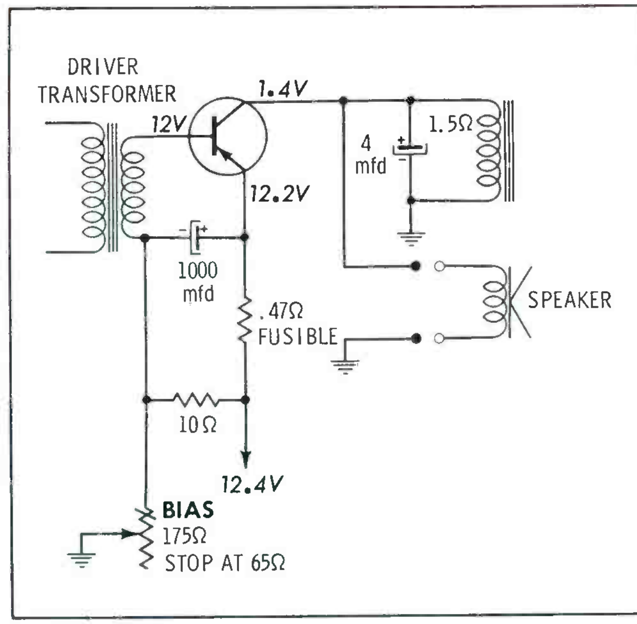
I am having trouble with a General Electric Model RC1710 multiplex adapter. When I adjust the stereo balance control for proper separation, the output becomes distorted. The distortion can be eliminated by resetting the balance control, but at this point there is no separation between channels. I have aligned and realigned this set but have been unable to correct the trouble.

PAUL M. SELL

Media, Pa.

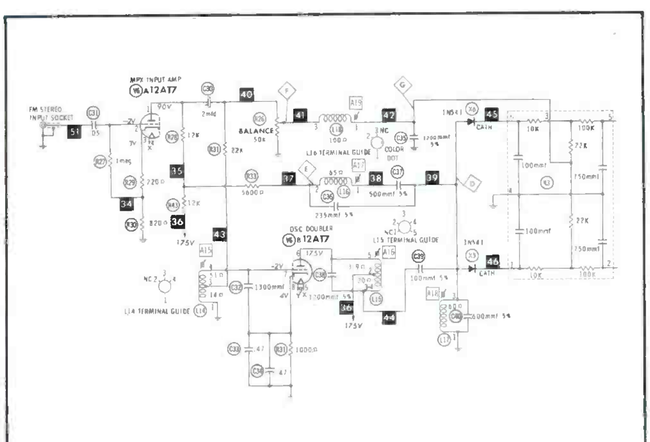
This multiplex receiver is covered in PHOTOFACT *Folder 620-9. The symptoms seem to indicate either incorrect adjustments or defective components in the L+R channels. Since you have already tried alignment, it would be wise to check capacitor C35 by substitution if necessary. Make sure that the components in printed-circuit unit K3 are okay and that X5 and X6 have precisely the same front-to-back char-*

Circle 11 on literature card



Installation of this radio requires the use of a 10-ohm rear-seat speaker to properly match the output impedance of the audio power transistor. Using a speaker with lower impedance would cause excessive current to be drawn by the output stage, thus burning out the bias control and/or the output transistor. The .47-ohm fusible resistor in the emitter circuit may also open.

Extension speakers of the proper impedance are readily available; use of a 10-ohm speaker would be much wiser than attempting to modify the output circuit of the radio. ▲



acteristics. (K3 is a most likely suspect.) If trouble still exists, very carefully adjust A19 and R26. Also make sure A15 is correctly adjusted. In some cases, the proper alignment of this coil can be most easily determined by connecting a scope to point D and adjusting A15 and A16 for maximum indication on the scope.

Rear-Seat Speaker Problems

Can a speaker with an impedance of 3 to 4 ohms be used with a Delco car radio, Model 982136, as a rear-seat extension? The information I have calls for a 10-ohm speaker. Would impedance mismatch be harmful to the transistor output stage? If so what would happen? Would the output-stage bias resistor open from the higher current drain?

DEAN SOMERVILLE

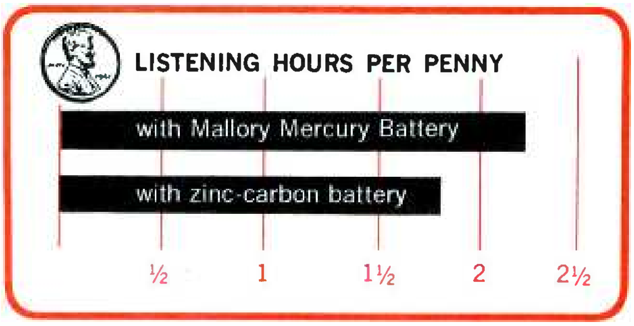
Rhinelander, Wis.

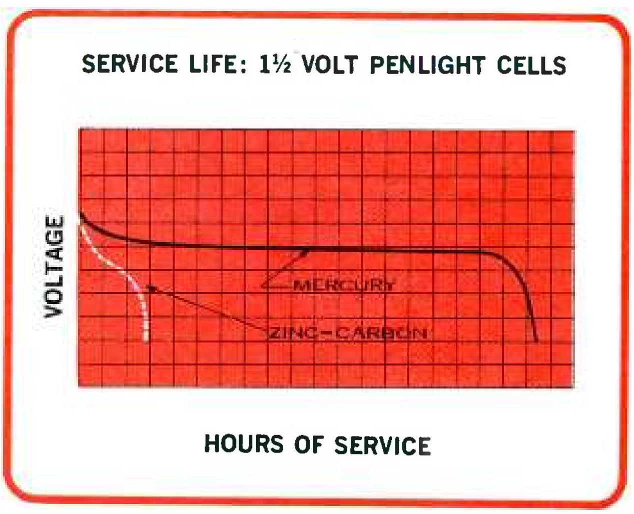
MALLORY

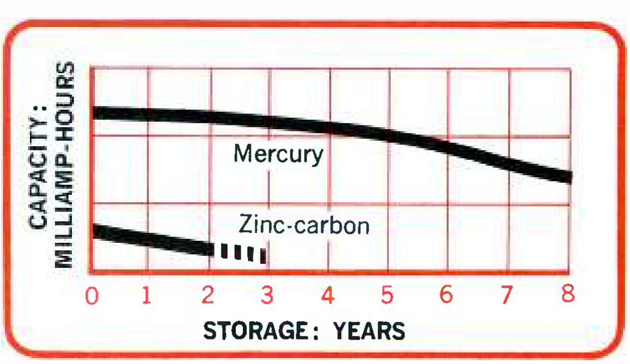
Tips for Technicians

Mallory Distributor Products Company
P.O. Box 1558, Indianapolis, Ind. 46206
a division of P. R. Mallory & Co. Inc.

Why Mallory Mercury Batteries work better in transistor radios







There are a lot of good reasons why more and more people are using mercury batteries in their transistor radios. And the reasons boil down to this—they're a better value, and they give better performance.

To get a comparison between mercury batteries and ordinary zinc-carbon batteries, let's look at a typical transistor radio. This radio uses size "AA" penlight batteries and has a current drain of 15 milliamperes. The Mallory Mercury Battery is the ZM9 and the zinc-carbon type would be the NEDA type 815. The ZM9 retails for 75¢ versus 20¢ for the 815. Got the picture?

Here's where the fun begins. The ZM9 will operate the radio for 165 hours versus only 35 hours for the zinc-carbon battery. This means that for one penny you'll get 2.2 hours of listening pleasure using the ZM9 versus 1.75 hours for the zinc-carbon battery. In other words, it costs you 0.57 cents per hour to use the zinc-carbon compared to only 0.45 cents for the mercury battery.

We're not through yet. Let's get back to *listening pleasure*. The mercury battery has essentially a flat discharge curve. This means that it presents a more constant voltage to the transistors. Result: you don't have to keep turning the volume control up while you're listening AND the radio *sounds* better because there's far less distortion.

Had enough? There's one more important point. Suppose you put the batteries in the radio and use it only slightly. Those 20¢ zinc-carbon batteries go "dead" in a few months whether you use them or not. But the mercury batteries can be stored 2 to 3 *years* and still deliver dependable power. Plus the fact that Mallory Mercury Batteries are guaranteed* against leakage in your transistor radio.

We've used this "Tip" to illustrate the superiority of Mallory Mercury Batteries in transistor radios. But this superiority extends to *thousands* of other applications. So whether you're building test equipment, heart-pacers, or satellites, see your Mallory Distributor. He has a Mallory Mercury Battery that will do exactly the job you want done.

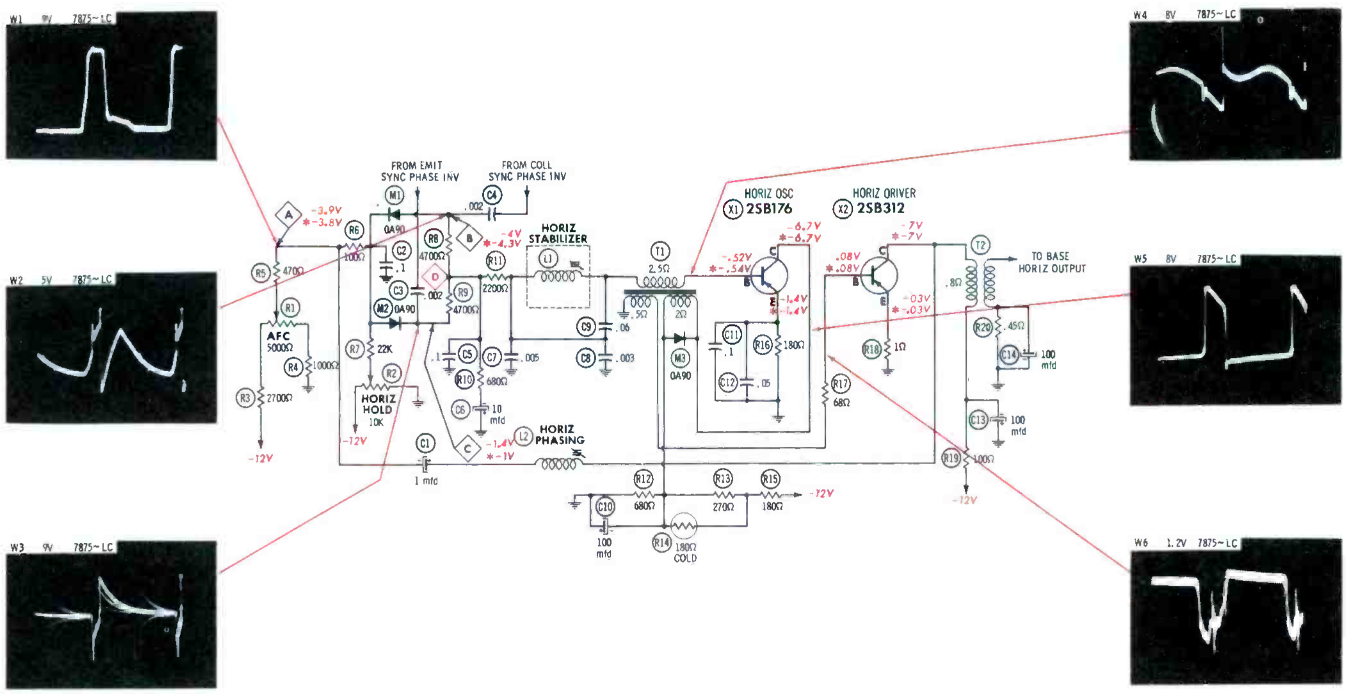
**We guarantee to repair the radio and replace the batteries, free of charge, if Mallory Batteries should ever leak and damage a radio set. Send radio with batteries to Mallory Battery Company, Tarrytown, New York.*

Circle 12 on literature card

PF REPORTER Symfact™

Transistor Horizontal Oscillator

Blocking Oscillator With Diode AFC



DC VOLTAGES taken with VTVM, on inactive channel; antenna terminals shorted. *Indicates voltages taken with signal present—see "Operating Variations."

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

Normal Operation

AFC-oscillator circuit shown here (from Panasonic Model *Mitey 5*) is typical of imported transistor TV's. Sync pulses are coupled from both emitter and collector of sync phase splitter to balanced diode AFC arrangement. Sample pulses from collector of driver arrive via L2-C1 for comparison with incoming sync. Average conduction (without signal) of M1-M2 and therefore base bias of X1 depends on content of W1 and setting of AFC and horizontal hold controls (voltage-divider networks across power supply). M2 conducts only on positive-going pulses of W1; less negative voltage appears at C than at B. Incoming sync (W2, W3) combines with sample W1 and causes diode conduction to change from average value. Resulting positive or negative shift at point D keeps oscillator in sync via path through R11, L1, and T1. C5, C6, C7, C8, R10, and R11 serve as AFC filter (anti-hunt) network. L1 and C9 form parallel-resonant tank to improve oscillator stability and noise immunity. Regenerative feedback (collector to base) via blocking-oscillator transformer T1 sustains oscillation. M3 limits overshoot on trailing edge of feedback pulse. X1 appears reverse-biased, but only because meter reads *average* DC voltage; reverse bias actually exists only during cutoff, but this is major portion of waveform W4. R12, R13, R14, R15, and C10 form voltage divider and decoupling network for X1 collector. Thermistor R14 holds collector voltage fairly constant during operation. T2 is collector load for X2, R19 is supply resistor.

Operating Variations

A — DC voltage varies from –1 to –7.5 volts (with or without signal) depending on setting of AFC control. Horizontal hold control produces approximate 2-volt swing at this point.

B — DC voltage, with or without signal, changes from –1 to –6 volts with adjustment of AFC control; bias at minimum setting (least negative voltage at A) may be sufficient to kill oscillator. With AFC set at center of range, adjustment of hold control swings voltage from –3.8 to -4.8 volts. Voltage at C follows variations at B—goes positive at minimum setting of AFC control.

X1B — Horizontal hold control shifts voltage from –.2 to –.7 volts. As AFC control is rotated toward minimum, voltage swings through zero to about .2 volts positive.

X1E — Emitter voltage changes from –1.3 to –1.8 volts with full rotation of hold control. X1 collector voltage will vary slightly, but deviations from normal are not very noticeable.

WAVEFORMS — Horizontal phasing coil (L2) shifts phase of sample pulse slightly, but change is almost unnoticeable with scope; affects picture very little. L1 should be adjusted for equal peaks of W4 in same manner as for tube sets.

Horizontal Sync Unstable

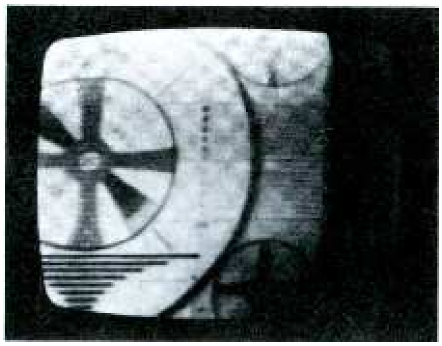
SYMPTOM 1

Phasing Bar in Picture

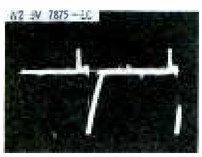
C1 Open

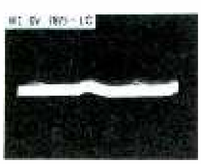
(AFC Feedback Capacitor—1 mfd)

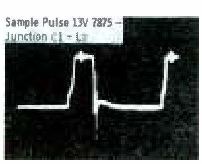
Symptom Analysis



Bars may be sloping in either direction, depending on setting of horizontal hold control; at one setting, stable picture can be obtained, but phasing bar still appears in right side of picture. Adjusting L1 or L2 has little effect on symptom; defect on screen remains.



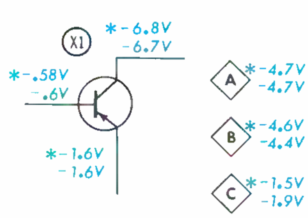




Waveform Analysis

W2 (shown) and W3 (not shown) contain normal sync, but both are without sample feedback pulse. Abnormal W1 confirms loss of sample pulse. This indicates trouble must be in feedback path. Presence of raster proves driver output pulse is present. Scoping at junction of C1 and L2 indicates pulse is present there. Since signal path is okay through L2, C1 must be open. Scope is necessary instrument here.

Voltage and Component Analysis



Voltage clues at points A, B, and C are of little help because all vary quite extensively with setting of AFC or horizontal hold control. Voltages on X1 are no help, because oscillator is working (even though off frequency); voltages are thus within tolerance. X2 seems okay, since its voltages are normal. Circuit must have sample pulse for comparison with sync pulses to control frequency of oscillator; this is true of any AFC circuit. Open L2 or broken printed-circuit board could cause symptom that is similar on the screen.

Best Bet: Scope will pinpoint trouble.

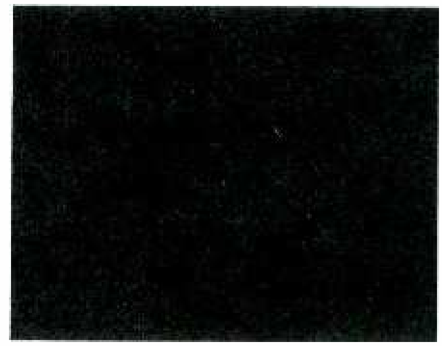
No Raster

SYMPTOM 2

Sound Not Affected

R15 Increased in Value

(X1 Collector Load Resistor—180 ohms)

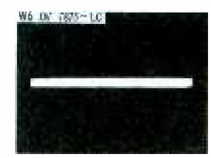


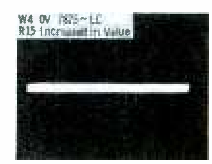
Symptom Analysis

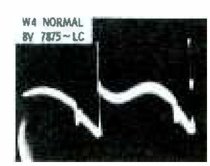
No raster appears on screen; neon lamp held next to HV anode doesn't glow, indicating loss of high voltage. Lack of change when brightness control is rotated proves picture is not blooming out due to overloading of high-voltage section at high brightness setting.

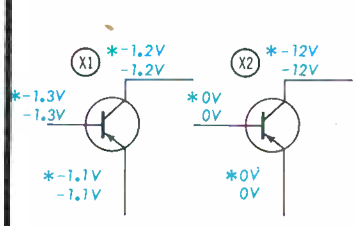
Waveform Analysis

Absence of pulse in W6 hints strongly at trouble in oscillator circuit; eliminates need for further troubleshooting in driver or output stages. W4 offers more evidence of oscillator trouble. Normal p-p signal at this point is 8 volts. Collector-to-base feedback is necessary for oscillation. R17 and interstage winding of T1 can be disregarded. Possible faults are R16, X1 collector bias network, or winding of T1.









Voltage and Component Analysis

Full supply voltage at X2 collector, and absence of voltage at X2 base and emitter, indicate transistor is cut off. Wrong voltage at X1 collector (–1.2 volt) points to oscillator trouble. Emitter voltage (–1.1 volt) proves X1 is not overconducting—excessive collector current would *increase* negative emitter voltage. Higher value of R12 would make collector voltage more negative; increased R15, less negative. If R13 or R14 increased in value, parallel resistor would limit combined resistance; voltage change would be slight.

Best Bet: Scope; then VTVM.

Horizontal Frequency Off

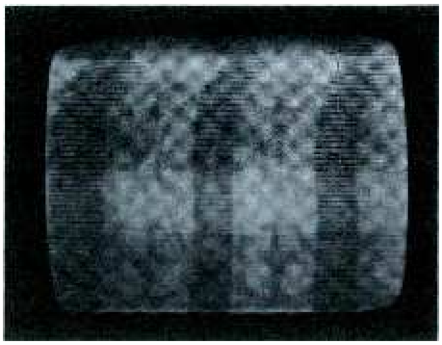
SYMPTOM 3

When Synced With AFC Control, Still Unstable

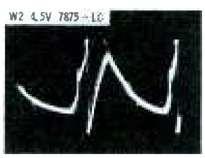
C9 Open

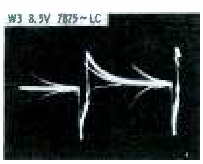
(Stabilizing Capacitor—.06 mfd)

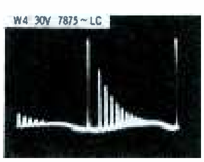
Symptom Analysis



Three images—resembling Christmas-tree effect—can be seen, indicating extreme shift in oscillator frequency. AFC control straightens picture, but instability is still apparent. Drift over extended period requires continued readjustment of AFC.



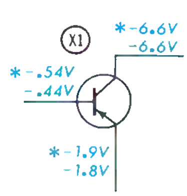




Waveform Analysis

With picture in sync, normal waveforms W2 and W3 indicate sync stages and feedback path are okay. Excessive, slowly damped ringing in W4 shows oscillator is being upset between incoming sync pulses. L1 and C9 form tank circuit producing sine wave that reduces effect of noise pulses on oscillator. Normally, sine wave combines with feedback pulse to supply oscillator base with correct signal.

Voltage and Component Analysis



X1 base voltage is normal (with signal); emitter voltage is more negative than normal due to irregular waveform at base. With C9 open and no signal applied, oscillator is operating off frequency, causing X1 base voltage to go less negative. Best clue to actual fault is that adjustment of stabilizer coil has little effect on picture—quite unusual; this coil should shift oscillator frequency considerably. Any component that affects free-running frequency of blocking oscillator stage could cause similar symptom on the screen.

Best Bet: Scope and careful analysis.

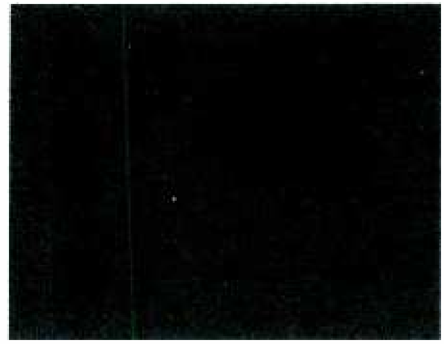
No Raster

SYMPTOM 4

Sound Normal

R19 Increased in Value

(Driver Collector Supply Resistor—100 ohms)

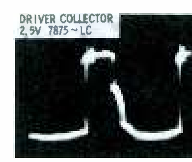


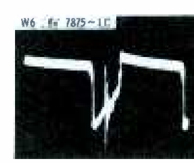
Symptom Analysis

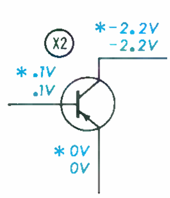
Screen is blank; raster may appear intermittently as set is turned on and off. Symptoms indicate trouble in horizontal-deflection or high-voltage section of receiver, but they give no good clue to help pinpoint trouble to one specific stage. More analysis is needed.

Waveform Analysis

Waveform to output stage has nearly correct shape, but amplitude is low (1 volt); normal level is 3.5 volts. Output and flyback thus probably aren't in trouble. Driver collector pulse, normally 10 volts, is greatly reduced (2.5 volts), narrowing search to oscillator or driver stage. Reduced W6 isn't enough to account for weak collector pulse; driver stage is probably cause of trouble.







Voltage and Component Analysis

Scope indications suggest voltage checks in driver stage. X2 emitter and base voltages—normally very small—offer little help in locating trouble spot. X2 collector voltage is greatly reduced, leads to suspicion of supply network in collector circuit. Leaky C13, leaky C1, or increased R19 could lower voltage. Also check X2 for possible shorts. Driver and output circuits in transistor sets are easier to troubleshoot than in tube receivers. No boost voltage is involved; simple networks develop voltage for all transistor elements.

Best Bet: Scope; then VTVM.

SYMPTOM 5

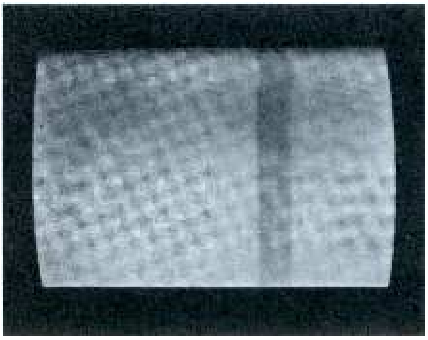
Oscillator Off Frequency

High Voltage Low

R1 Wiper Arm Open

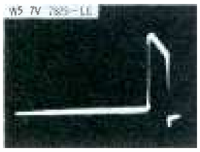
(AFC Control—5000 ohms)

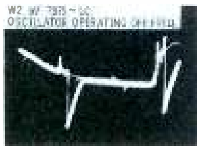
Symptom Analysis

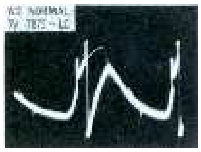


No raster when set is first turned on. Rotation of hold control produces dim raster; two pictures are obtained. Further adjustment of hold control gives sloping bars. Oscillator is running at approximately ½ normal frequency; loud whine can be heard. AFC is ineffective.

Waveform Analysis

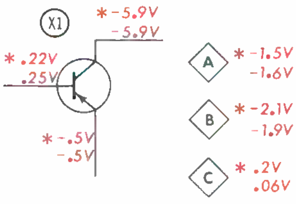






Presetting scope to exactly 7875 cps is valuable aid in troubleshooting oscillator suspected to be at wrong frequency. W5 looks almost normal, but single pulse means oscillator is at ½ correct frequency. W2 sync looks normal, but sample pulse occurs only with every other sync pulse (see accompanying normal W2). Waveforms show sync stages are okay and trouble is in either AFC or oscillator circuit.

Voltage and Component Analysis



Change of voltage at X1 base from normal –.5 volt to positive .22 volt explains why oscillator is running off frequency; also directs suspicion toward AFC circuitry. Readings at points A, B, and C are significantly smaller than normally; this explains why oscillator base is positive and confirms suspicion of AFC defect. Voltage at arm of AFC control is –1.5 volts and does not change with rotation. Arm must be open; otherwise voltage variation would be noted. Faulty R3 or R5 could show similar symptom.

Best Bet: Scope isolates stage; VTVM pinpoints trouble.

SYMPTOM 6

Intermittent Raster

Critical Horizontal Sync (When Raster Is Present)

X1 Leaky

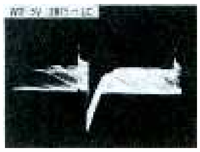
(Oscillator Transistor—2SB176)

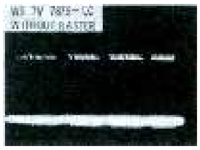
Symptom Analysis

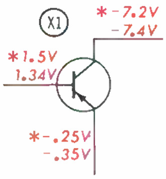
When set is first turned on, raster isn't visible. Adjusting AFC and hold controls to near end of range causes raster to appear, but horizontal sync is unstable. Constant readjustment of AFC and hold controls is required as set warms up or as channels are changed.

Waveform Analysis

With raster absent, W2 shows only sync pulses (no sample pulse); this indicates trouble isn't likely in output or high-voltage section. W5 (with no raster) further isolates trouble to AFC or oscillator by excluding possible defect in driver. W5 (even with raster) has proper amplitude, but duration of pulse is much too short, indicating greatly reduced conduction time of X1. Scope eliminates certain stages.







Voltage and Component Analysis

Logical point for voltage measurements, considering information gained from scope, is oscillator transistor. Collector voltage, though slightly increased, gives no definite clue. Base voltage (positive 1.5 volts) explains why no raster is present; transistor ceases to conduct at all if base voltage rises above about 1.4 volts positive; even a small amount of positive base voltage causes oscillator instability. Extent of leakage in X1 determines actual voltage at base; consequently raster may or may not be present.

Best Bet: Voltage analysis followed by component tests.

EICO 369 tv-fm sweep & post injection marker generator

With the 369, circuit response is not affected by markers and markers are not affected by circuit response. The 369 feeds only the required sweep signal to the input of the circuit being aligned or tested. At the output end, a demodulator cable picks off the signal and feeds it to a mixer stage inside the generator, where the markers are added. The combined signal is fed to the oscilloscope. This means that circuitry under test or alignment is not affected by the marker signal, and that traps in the circuitry will not reduce or eliminate the marker.

The EICO 369 has a controllable inductor sweep circuit—all electronic, with no mechanical parts to wear and give trouble later. The sweep generator is independent of the marker generator. It has five ranges: 3.5–9 mc; 7.5–19 mc; 16–40 mc; 32–85 mc and 75–216 mc. All five ranges are fundamentals; tuning to the desired center frequency is simplified by a 6:1 vernier dial and a 330° scale. Output impedance is 50 ohms. Retrace blanking is obtained by both direct grid cut-off and indirect B+ cut-off (via the AGC chain) of the oscillator with a blanking tube that conducts during the negative excursion of the 60 cps sine sweep. A three-stage AGC circuit keeps the level of the swept signal constant over its entire frequency range, even when the widest sweep width of 20 mc is being used. A phasing control at the rear of the EICO 369 adjusts permanently the horizontal sweep signal fed to the scope.

The marker generator in the EICO 369 has 4 ranges covering 2–225 mc. The highest range, 60–225 mc, is the third harmonic of the next lower range. All other ranges are fundamentals. Frequency setting is simplified by a 6:1 vernier dial and a 330° scale. As a rapid check of marker generator alignment a 4.5 mc crystal is supplied with each generator. When plugged into a front panel socket it automatically turns on a fixed frequency marker oscillator. The 4.5 mc signal produced by this oscillator is mixed with the variable frequency marker. The 4.5 mc crystal is used also for alignment of sound circuitry in TV Receivers.

The demodulated wave form with the post injected marker is fed to the vertical input of the "scope", and the horizontal sweep to the horizontal input of the "scope" through one shielded two-conductor cable. Separate level controls for trace size and marker size on the front panel can be used independently. Kit **$89.95**; Wired **$139.95**

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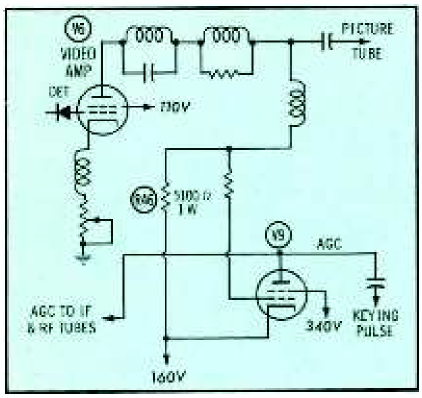

Fig. 1. Voltage drop across video-amplifier load resistor controls AGC tube conduction.

Quick and accurate decisions, indicating which section or circuit is responsible for receiver troubles, invariably reduce troubleshooting and repair time. But troubles arising from AGC-circuit defects are not subject to quick and accurate judgment, because the symptoms are often identical to those produced by defects in other circuits. Sync instability often results from distortion of the composite signal by an AGC defect. Weak or excessive contrast can result from excessive or insufficient AGC voltage. Contrast distortion, in which either the black or white picture contents are compressed, is sometimes caused by abnormal AGC voltages. In some cases, raster shading or unwanted signals of various forms results from AGC defects. Even sync buzz in the sound can sometimes be attributed to an AGC abnormality.

Since most of these conditions tend to indicate trouble in other circuits, AGC troubleshooting is often delayed until these other circuits are vindicated by extensive and time-consuming tests. Even more confusion results from those cases in which a slight AGC defect combines with a mild defect in another section to produce symptoms that neither defect by itself would cause.

Fig. 2. White compression from reduced AGC.

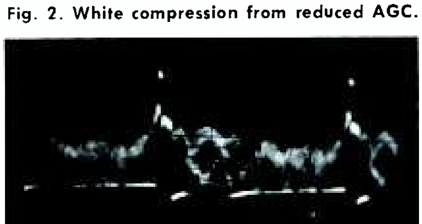

Fig. 3. Overdriving of video amplifier results in compressing white portion of video signal.

AGC-System Limitations

Sometimes inherent limitations of the AGC system are not entirely compatible with reception conditions at the receiver location. Such incompatibility can be better understood if the limitations of various AGC systems are recognized. *Simple AGC* cannot prevent extremely strong inputs from overloading the video amplifier. This system also develops a small potential (called residual voltage) with weak signals and thus tends to attenuate such signals.

Supplemented AGC can handle stronger signals, but residual voltage is still a problem on very weak signals. Tie-in of the AGC with sync circuits may result in sync instability in some cases of very minor AGC faults.

In noise locations, *peak AGC* develops excessive control voltages, which in turn lowers contrast. This type provides control of very strong signals, but on weak signals the residual voltage still reduces receiver sensitivity.

Nonkeyed tube-conduction AGC (amplified AGC) responds poorly to weak signals because of noise in the AGC tubes, but it provides good control of strong signals. It is also sensitive to minor current-drain variations throughout the receiver.

Keyed, or *gated*, *AGC* shows good sensitivity in low-signal areas and good control in strong-signal areas—it works well almost anywhere.

Servicing

Because of the many variables involved, many different troubleshooting techniques are used for AGC defects. One of the most common starts with the use of a voltage source to override the AGC voltage (if any). However, after the picture has been returned to normal by this method (called clamping), a number of voltages may have to be read to find the defective component. Actually, the defective component or abnormal condition can often be detected by carefully analyzing voltages before resorting to overriding the bias. When keyed or nonkeyed AGC is used, the bias voltage of the AGC tube should be critically examined. The following cases concerning AGC systems of all types illustrate troubleshooting procedures.

Keyed AGC

A Hoffman receiver using a Model 187 chassis was brought into the shop. The complaint was of an extremely weak picture. Tube substitution in the picture-signal stages didn't help, so a scope check was made at the video-amplifier grid. A composite signal amplitude of less than 1 volt indicated trouble in either the IF or RF stages, most likely the former because of the absence of snow. Checking these stages revealed that the plate and screen voltages were slightly high, caused by excessive bias on the AGC-controlled tubes.

The circuit (Fig. 1) is such that the amount of AGC voltage depends on conduction of the AGC tube; this conduction is controlled by the voltage drop across plate load resistor R46 in the video amplifier. With no signal applied to the video-amplifier grid, V6 draws a large amount of plate current, and a voltage drop of about 40 volts is developed across R46. The AGC tube is biased beyond cutoff, and no AGC voltage is produced. With a signal applied to the video-amplifier grid, the average plate current of V6 decreases because of the negative DC component of the signal. A smaller voltage across R46 leads to increased conduction of the AGC tube and development of AGC voltage.

In the receiver under discussion, even though the DC signal component was only a fraction of a volt, the drop across R46 was less than 20 volts. A video-amplifier defect

TROUBLES AND SOLUTIONS

by Allan F. Kinckiner

was thus indicated, but tube substitution produced no change, and checks of the screen and cathode circuits revealed nothing wrong. These tests left only one possibility—decreased resistance of R46. An ohmmeter check showed that this 5100-ohm 2-watt resistor had reduced in value to a mere 2000 ohms. Replacing it with a 5-watt wirewound unit restored normal operation.

Problems With Simple AGC

An RCA set being serviced for a variety of complaints was found to have white compression (Fig. 2) on one of the three stations available. Waveforms observed at the grid of the first video amplifier were normal, except that the amplitude for the offending station was about 5 volts compared to 4 volts for other stations. Moving the scope to the output of the first video amplifier gave a trace (Fig. 3) which clearly showed white compression; note the compression along the bottom edge of the video. Substitution of several 5AN8 video amplifier tubes produced no improvement.

Finally the technician observed another factor—the offending station was transmitting a signal in which the sync pulses formed a higher percentage of the composite signal than in the signals from the other stations. Since simple AGC, as used in this set, normally develops a voltage somewhere between the picture-signal level and the sync-pulse level, the offending signal generated a slightly lower AGC voltage than the others. A cure was achieved merely by adding 4.7 meg resistor R1 (Fig. 4). Several early RCA chassis (KCS87, 93, etc.) use this or a similar circuit, so make a note of this cure for white compression.

One of the most common problems in sets using simple AGC is overloading and poor sync at moderate settings of the contrast control. The chief cause of the condition is slight grid emission or gas in tubes controlled by the AGC. These tubes often require heating in a tube checker for as much as an hour before the gassy condition is indicated, yet these very same tubes will cause trouble in a receiver in less than ten minutes.

For example, consider an AGC circuit similar to the one shown in Fig. 5. When the range switch is in the "Strong" position, any voltage drop across R33 indicates one or more gassy IF, mixer, or RF tubes. With the range switch in the "Normal" (center) setting, AGC is applied only to the IF tubes, and a voltage drop across R33 indicates a gassy IF tube. When the range switch is in the "Weak" setting, however, one end of R33 returns to ground through R34, and a voltage difference is normal.

In circuits with a voltage divider network, and in circuits where one end of the filter resistor is connected to a slight positive AGC delay voltage, determining gas quality of the controlled tubes is not so simple. It is still possible however: Replace the tubes in controlled stages, tune in the strongest station, and read the voltage drop across the AGC filter resistor. Use this voltage drop as a standard for comparison with that using the original tubes. It's a good idea to mark the schematic with this voltage value.

An excellent example of the results of gassy IF tubes occurred in a Motorola TS-410 (Fig. 6). This set played acceptably for about ten minutes after being turned on. Then excessive contrast developed and gradually became more severe until the picture started to bend and slip vertically. The signal at the video-amplifier grid (Fig. 7A) was perfectly normal in shape and sync-to-picture

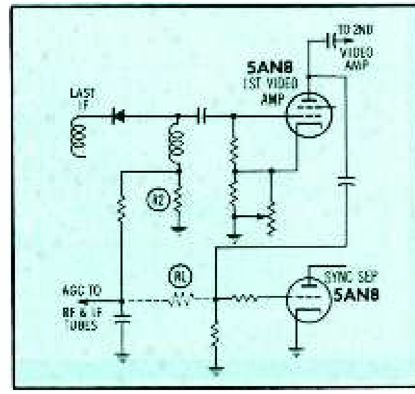

Fig. 4. Adding resistor in circuit helps prevent video overloading from strong signals.

ratio, but the overall amplitude was about twelve volts, more than twice normal. Severely compressed sync was observed at the video output (Fig. 7B). The AGC voltage measured –9 volts at the source and only –3 volts at the terminal end of the AGC filter resistor. Replacing one of the IF tubes decreased the voltage difference to about 3 volts, but it didn't noticeably improve the sync compression of the video output signal. Replacing the mixer tube reduced the DC drop across the AGC filter resistor to less than ½ volt and also restored the video output signal to normal (Fig. 7D). Fig. 7C shows the much cleaner waveform at the video-amplifier grid after replacing the two tubes.

Controlled tubes having gas or grid emission produce excessive amplification; this results in excessive

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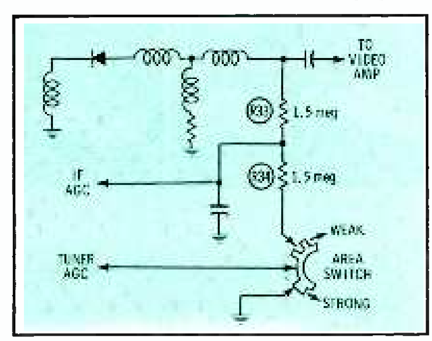
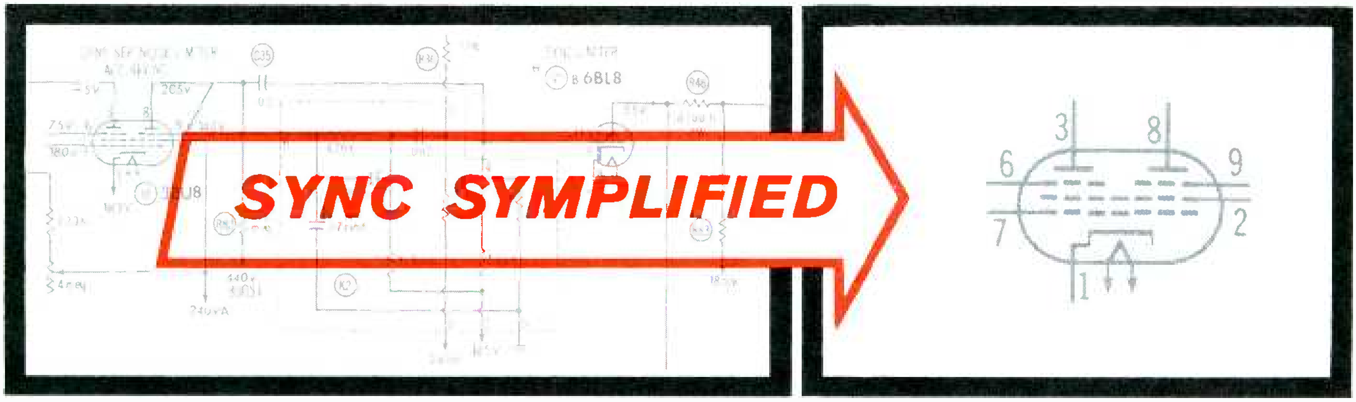


Fig. 5. Voltage drop across R33 can give useful info concerning RF, IF, mixer tubes.

Fig. 6. Example of excessive contrast resulting from loading of AGC line by gassy IF.



SYNC SYMPLIFIED

Here's an easily understood version of control circuits . . . by Thomas A. Lesh

Troubleshooting in sync circuits is becoming simpler all the time. Most of the late-model sets have just one sync stage, so there is not much circuitry to check, and faults show up quite definitely. But there are still plenty of older sets that have complicated sync circuits, of unique design, and it's a problem to figure out how they should normally work—let alone troubleshoot them. (They must be at least No. 4 on the "headache list" of most technicians—outranked only by horizontal sweep, AGC, and vertical sweep.)

The secret of minimizing such sync problems lies in analyzing the *essential* points of the circuit's operation, and checking the actual signals in the set to see if the sync circuit seems to be carrying out these essential functions.

We can show you what we mean, by describing a recent problem in a 10-year old DuMont Chassis RA-170 (PHOTOFACT Folder 216-2). This set has a total of *five* sync stages, with four of them tied together by a common cathode network (see Fig. 1). The set on our bench had a wild horizontal jitter and vertical jumping of the picture—quite plainly a sync fault. In the preliminary test, waveforms throughout the sync and video stages were all so jumpy and confused (like Fig. 2, which represents W6) that we knew we wouldn't get far by using conventional test techniques. So, we eased back from the lab bench to do a little pondering.

We decided to see what we could do with DC voltage clues. This isn't our usual way of going at a sync problem, because DC voltages can

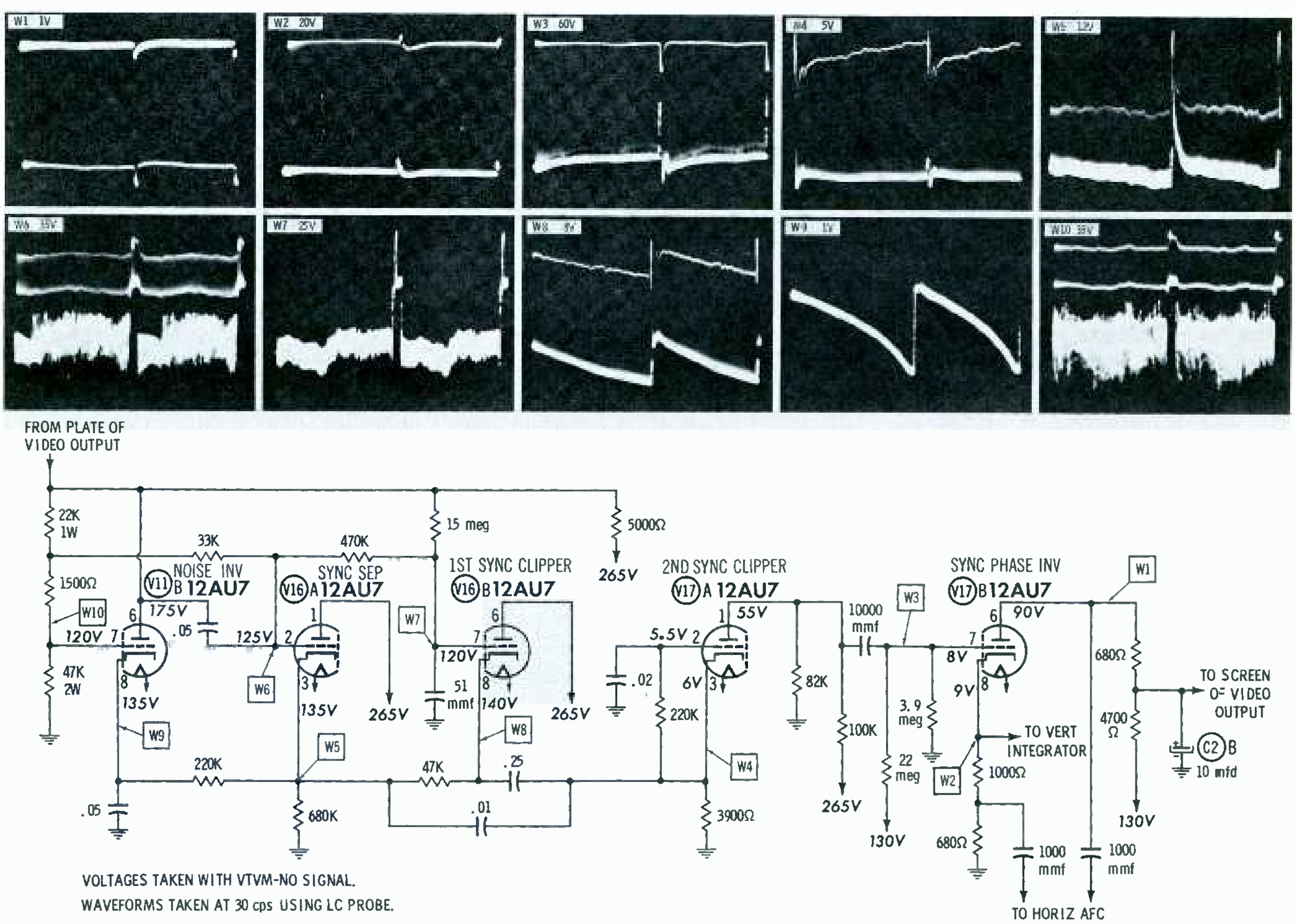


Fig. 1. Five-stage sync circuit in DuMont Chassis RA-170 poses unusually tough problem in trouble isolation.

vary tremendously in sync circuits without causing really significant distortion of the signals. In our experience, trying to find the cause of moderate voltage "discrepancies" usually winds up in a wild goose chase. Nevertheless, there was a chance we might find some really outrageous reading that would clue us in to a dead-shorted capacitor, open resistor, or other clear-cut fault.

But such was not to be. There were only a few voltage readings that aroused any real suspicion, and a few quick resistance checks removed all question of significant voltage errors due to component faults.

What next? Well, after some thought, we decided to consider the AGC system as a possible part of the problem. True, the picture didn't seem overloaded, and there were no other indications of actual trouble in the AGC circuit. But the set had *keyed* AGC leaving room for a "vicious circle" of feedback that could aggravate any existing sync faults. Jittery horizontal sync would cause wild variations in timing of the AGC keying pulses from the horizontal sweep circuits, and erratic conduction of the AGC tube would develop fluctuating bias on the RF-IF stages. This would make hash of the video signal, further aggravating the sync trouble, and so on into desperation.

As an attempt to tie down the feedback loop, we clamped the AGC line, using a variable bias supply. We found that the picture would settle down a great deal if enough AGC bias were applied to reduce the contrast slightly below the normal viewing level. But there was still a definite tendency toward horizontal jitter, even though the vertical hold now seemed quite good; so, some sort of trouble was still present. The signal fed from the video output stage to the keying tube was in good shape now, though a little weak because of the reduced contrast. Also, video waveforms W6 and W10, the inputs to the sync section, now looked normal—again allowing for a little less than ordinary amplitude.

To begin to "box in" the trouble, we followed our usual technique of inspecting the final output of the sync section—W1 at the plate of

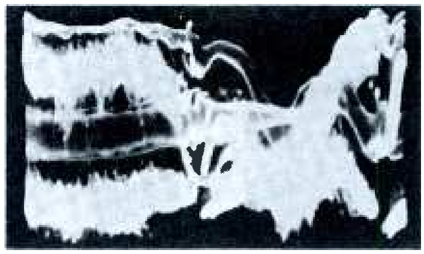
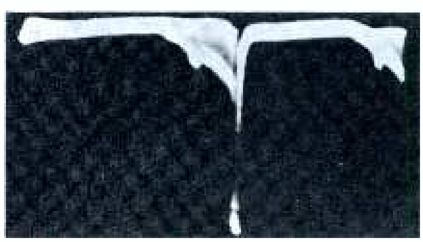


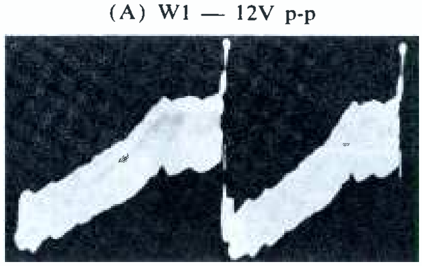
Fig. 2. Sad results of first attempts at scoping signals in sync section to find trouble.

V17B, the sync phase inverter. When we scoped it (Fig. 3A), the vertical sync pulses looked just fine —but that's just about all we could find in the waveform. It showed only an occasional flicker along the base line to suggest that horizontal pulses might be trying to come through, too.

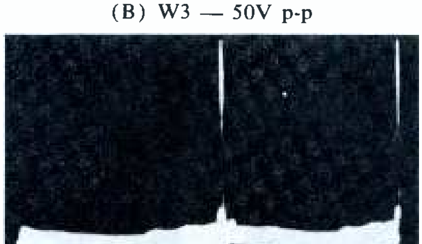
Okay, then: the horizontal pulses were being lost somewhere in that maze of sync circuitry, without great effect on the vertical pulses. This sort of selective distortion happens a lot—quite a bit oftener than you'd think! Our next phase of the job was to make a stab at further localizing the trouble. We weren't even sure, as yet, how to trace the signal path; but we decided to start scoping and taking notes on the waveforms. (At that time, we didn't have the full set of normal waveforms shown in Fig. 1 available for reference.) After accumulating a good



(A) W1 — 12V p-p



(B) W3 — 50V p-p



(C) W4 — 3V p-p

Fig. 3. Abnormal signals found on V17.

set of findings, we'd review them and try to draw clues from them. (For instance, we'd ask ourselves: Should the signal at this point really look the way it does?)

Going back to W3 at the grid of V17B, we found a wild-looking sawtooth wave (Fig. 3B). It included good, strong vertical sync pulses, which were being inverted by the stage in normal fashion. (They were not being amplified, but maybe they were not supposed to be.) That ragged mess between the vertical pulses, on the sloping base line, could contain horizontal pulses—but only the last ones in each group were at a high enough voltage level to get through V17B.

Well, back to the plate of V17A. Same thing here as at the following grid—so the interstage coupling circuit must be okay. At the cathode of V17A, there wasn't much but vertical spikes (Fig. 3C). This waveform must be abnormal, since it's so empty of horizontal pulses.

Rather puzzled by the peculiar coupling circuit that goes back to the cathodes of both V16A and V16B from the cathode of V17A, we proceeded to find out what was going on in both sections of V16. On the cathode of the "A" side, labeled "Sync Sep," there was a video waveform (Fig. 4A) almost as large as W6. That didn't seem right; the stage seemed to be operating like an ordinary cathode follower. No sync separation here!

Now, on V16B's cathode, there was another oddball signal (Fig. 4B). It included prominent vertical pulses, like the output waveform; it also had a sawtooth slope, but in a direction opposite from W3. This waveshape was hard to figure out in light of the label "1st sync clipper" for V16B on the schematic. But things cleared up just a bit when we checked the grid waveform, shown in Fig. 5. This had big, strong vertical pulses, and a very low-level video signal in the spaces between. Apparently V16B was being driven into conduction on just the vertical pulses. The sawtooth slope between pulses in W8 must be just a result of the discharge of the big .25 mfd capacitor at the cathode.

A quick check of V11B didn't reveal much—just normal video at

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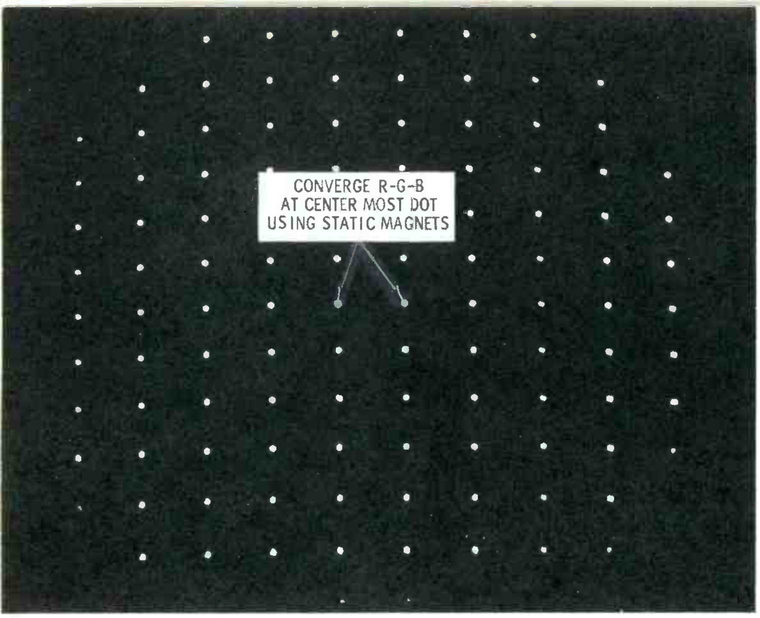
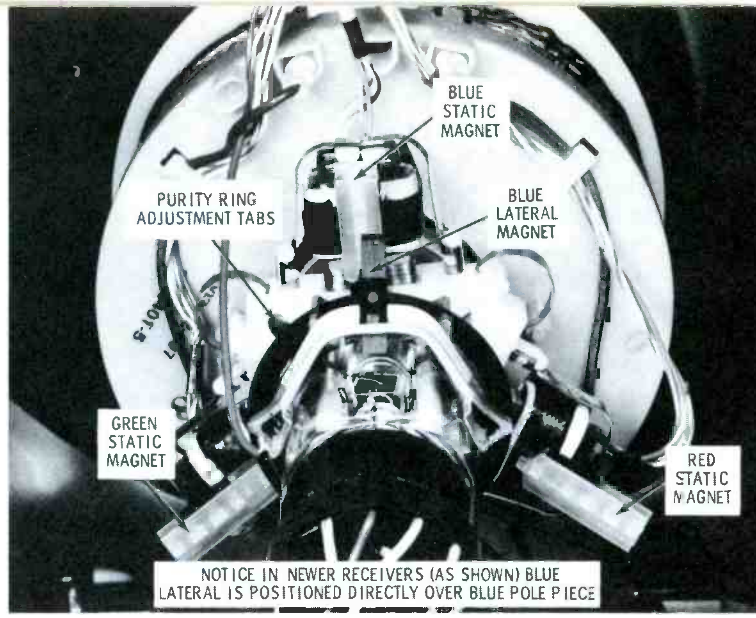
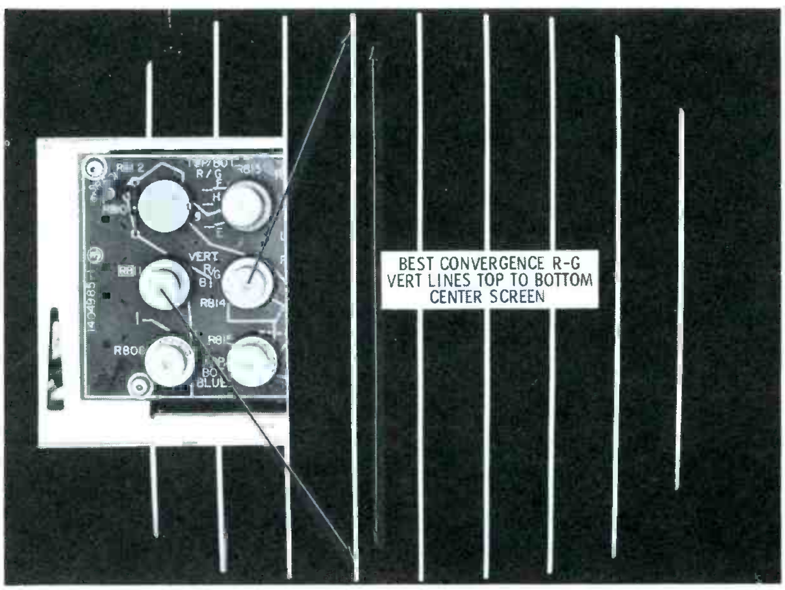


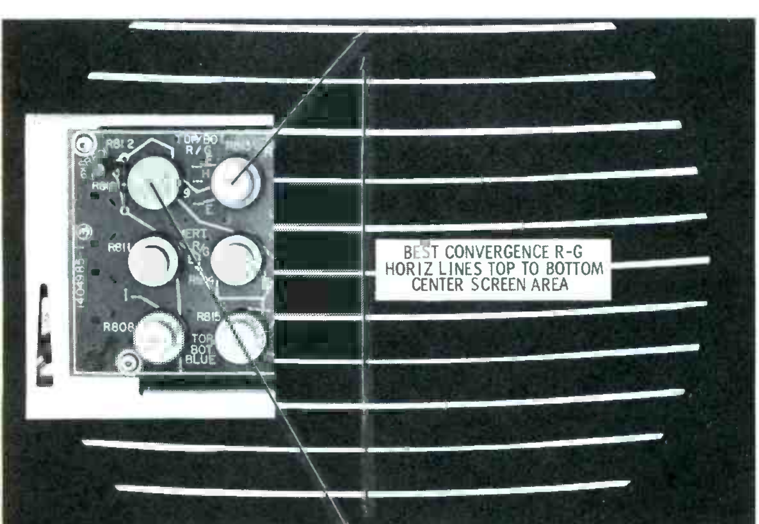


Black and white setup procedures, CRT degaussing, and purity checks should be performed previous to convergence. Use the red, green, and blue magnets and the lateral magnet for center dot convergence.

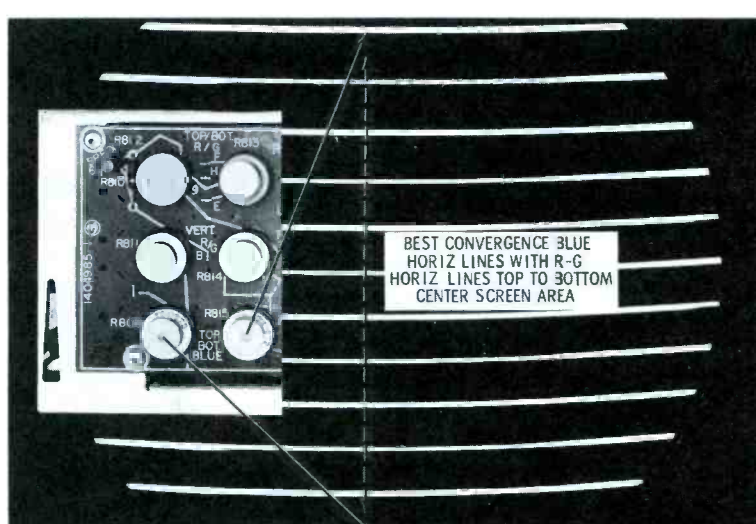


Use R-G vert lines top (Master Tilt) and R-G vert lines bottom (Master Amp) to converge the vertical red and green lines top to bottom center screen.

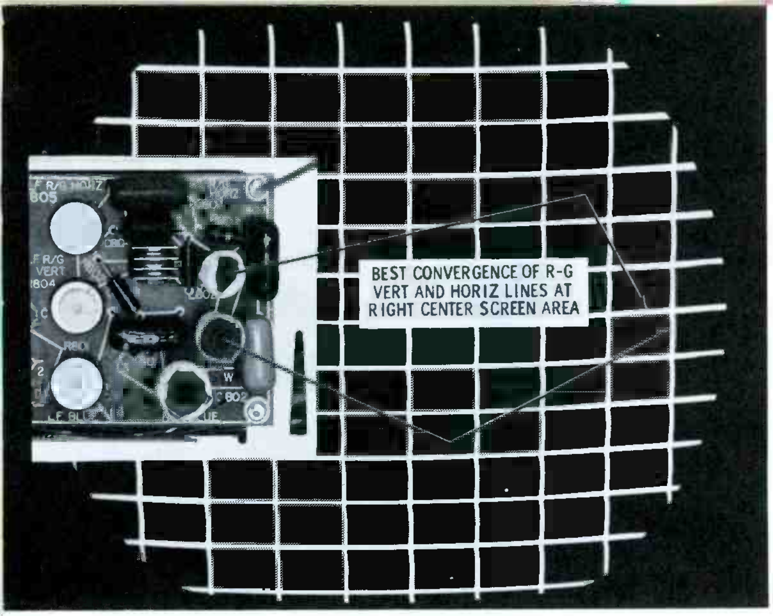
ABC's OF



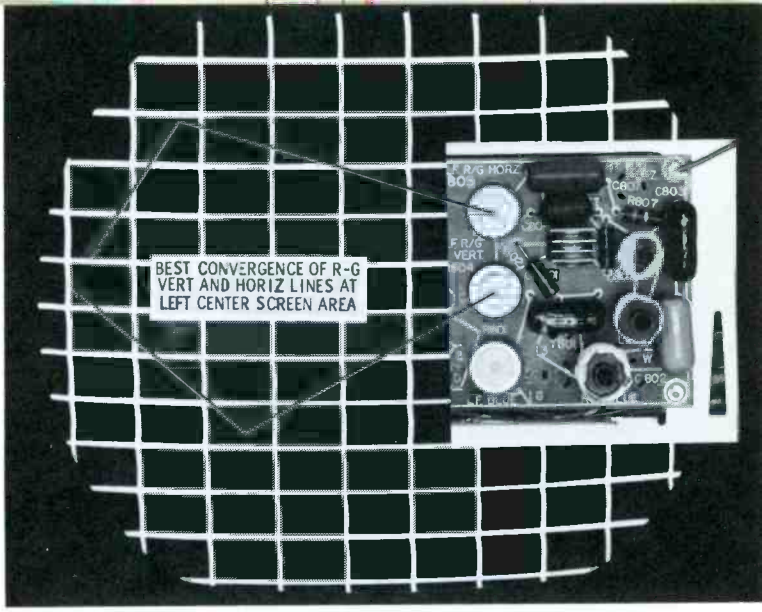
Use R-G horiz lines top (Diff Tilt) and R-G horiz lines bottom (Diff Amp) to converge red and green horiz lines top and bottom at the center of screen.



Use Blue horiz lines top (Blue Tilt) and Blue horiz lines bottom (Blue Amp) to converge blue horiz line with red and green lines at the center of the screen.

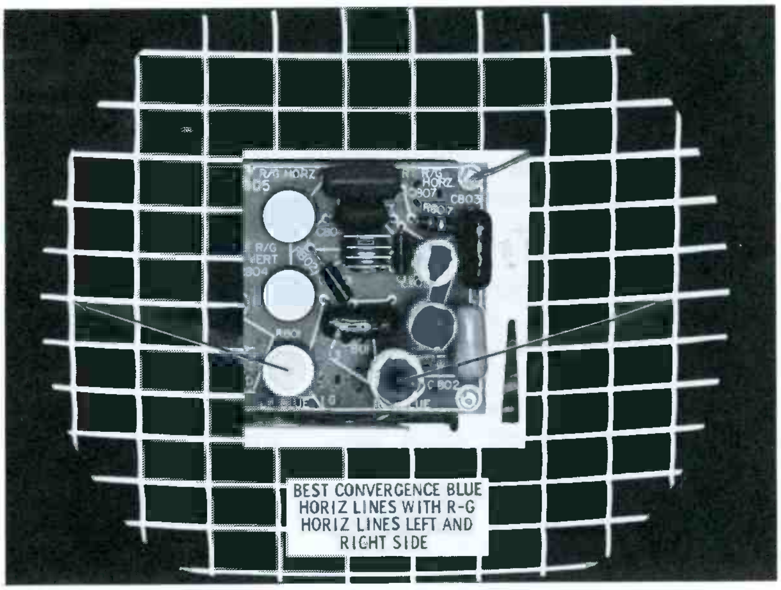


Use the R-G vert lines right (R-G-1) and R-G horiz lines right (R-G-2) to converge red and green vert and horiz lines at the right center screen area.

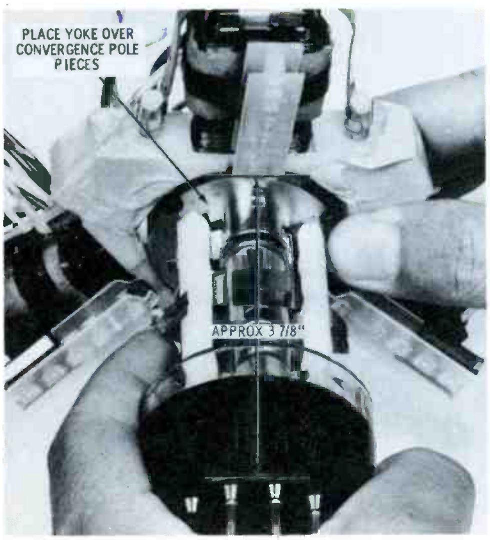


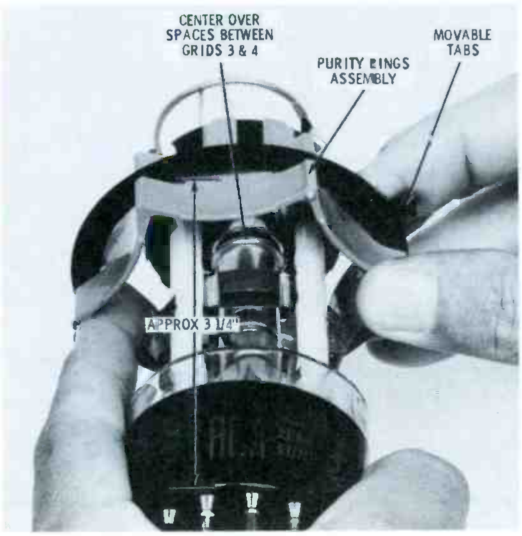
Use the R-G vert lines left (R-G-3) and R-G horiz lines left (R-G-4) for convergence of the red and green vert and horiz lines left center screen area.

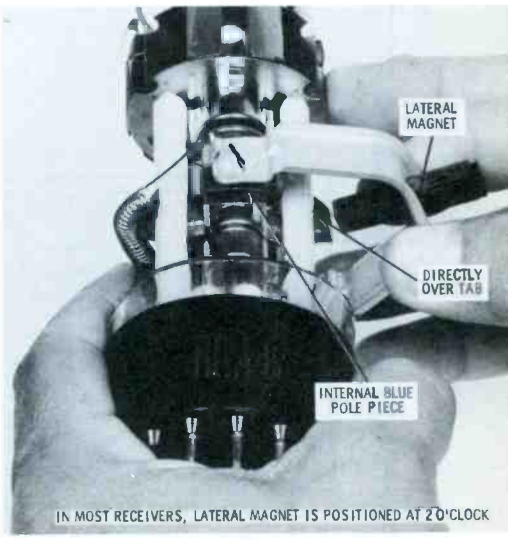
CONVERGENCE



Use the blue horiz lines right (B-1) and blue horiz lines left (B-2) to converge blue horiz lines with red and green at the left and right center area.







Poor convergence may result from improperly positioned elements; convergence yoke directly over pole pieces 3⅞" from CRT base, purity ring ⅝" rearward, and the lateral magnet over internal pole piece.

curing aircraft radio troubles

Part 1

Radio communication plays a vital part in modern aviation. At large airports, airplanes are controlled prior to flight by special ground communication channels. Airport towers control takeoff and landing by radio, and other special channels are used to maintain contact during the flight.

In the early days, aviation radio communication was carried out in the band from about 180 kc to 450 kc. Sections of this band are still reserved for aviation and marine radio and are classified as low frequencies. Emissions at these frequencies are characterized by strong ground waves which are best suited for radio direction finding. These low frequencies are not limited to line-of-sight communication; in fact, powerful very-low-frequency stations are used to transmit ground-wave signals around the world. Some airport towers still transmit at low power in the LF band for traffic control in emergencies or for aircraft equipped only with an LF receiver.

"Radio range" and so-called "beacons" are an important part of aircraft navigation, and these devices account for most of the use of the LF aviation frequencies. Beacons are low-powered omnidirectional transmitters which continuously transmit an identification code and which are accurately located on the pilot's aeronautical chart. The directional loop of the plane's navigational system locates this radio-signal beacon.

HF Communication

It should be noted that LF *transmitters* are no longer used aboard aircraft. One obvious reason for this is that it would be impossible to devise an antenna long enough to be efficient at low frequencies. At 3 mc and above, however, antenna dimensions come within the range useable for airborne transmitters. Several years ago, a wire was trailed behind an airplane for communication in the high-frequency band (the frequencies from 2 to 30 mc). This method is now seldom used, and ingenious antenna systems are required in order to provide HF communication aboard highly-streamlined aircraft which can no longer tolerate external wires.

High-frequency sky waves readily reflect from ionospheric layers. Radio amateurs pioneered long-distance HF communication by means of "skip" in the years between World War I and World War II when the HF bands were referred to as "short waves." During the thirties, HF was the primary means of both airport-tower and long-distance communication. Today, HF is used primarily for long-distance communication either for over-water routes or as a means of company communication between an airplane and its home base.

There is one important exception to the preceding statement. After World War II, and before the development of suitable VHF equipment, many private airplanes were

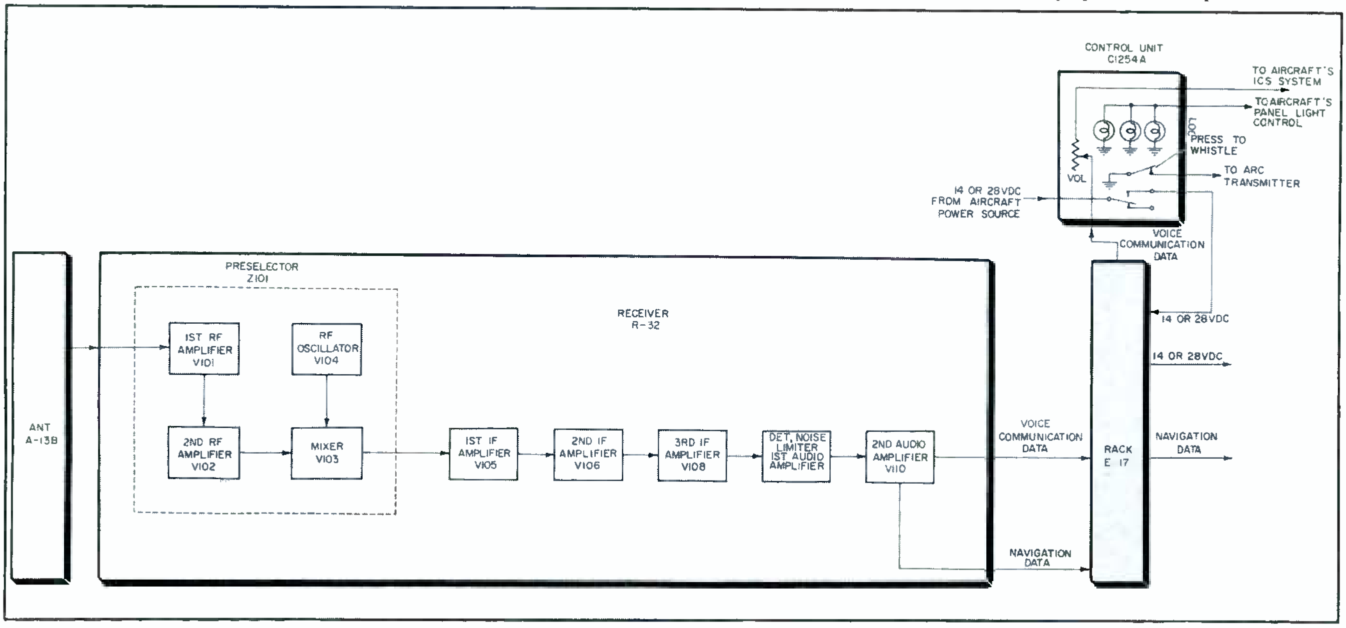


Fig. 1. Block diagram of a continuously tuned VHF-AM superheterodyne aircraft receiver.

Introduction to equipment used in airborne communications.

by Keith Bose

equipped with low-power HF transmitters for tower communication. The FCC now sets aside 3023.5 kc to provide contact with airport towers for landing and other instructions using transmitters developing a fraction of a watt. Reception in the airplane is usually on the LF band on frequencies around 270 kc. Although transistors now make possible very inexpensive LF-HF transceivers, there is little interest in such equipment at the present time.

In order to provide continuous long-distance HF communication utilizing the skip effects of the ionosphere, it is necessary to change frequencies as changes occur in the ionosphere. Correct frequencies can be predicted and assigned in advance, but this means that HF equipment must be designed to operate at several different frequencies. Several years ago, trained radio operators were carried aboard most long flights, and these crew members were responsible for tuning and operating HF equipment which greatly resembled the designs used on the ham bands. Today, however, equipment is tuned by the pilots. Efficient antenna loading is obtained by a servo loop which automatically obtains an optimum standing-wave ratio. Combinations of crystals are switched to derive desired frequencies, and servo loops are employed to tune the various resonant elements.

VHF Systems

The use of HF for routine air-ground communication in the face of unusual ionospheric reflections could conceivably contribute to dangerous situations. Moreover, high frequencies require long antennas, and crowded bands necessitate the best possible receiver selectivity. For air-ground work, a radiation pattern which affords positive reception at all points except those beyond a certain radius of interest would be ideal; this would allow operation on the same frequency at distant, unrelated points. The behavior of radiations at *Very High Frequencies* meets these requirements. Since power to VHF is more efficiently propagated from aircraft antennas to the ground station, less power is required. Also, more channels are available in the VHF range. Because VHF is limited to horizon-distance transmission, there is little interference, although an airplane at 20,000 feet has a VHF range of 200 miles if sufficient power is used. By the use of remote, centrally controlled VHF ground stations along airways, it is possible for airplanes to remain in constant touch with Air Traffic Control by VHF.

By the end of World War II lightweight VHF equipment became commercially available. The VHF band now set aside for aviation use extends from 108 mc to as high as 152 mc. The area between 108 mc and 118 mc is used for VOR, or omnirange, navigational ground stations. Most aircraft transmitters operate between 118 and 135 mc.

Localizers (ILS) and low-powered terminal VHF omni stations (TVOR) are assigned frequencies

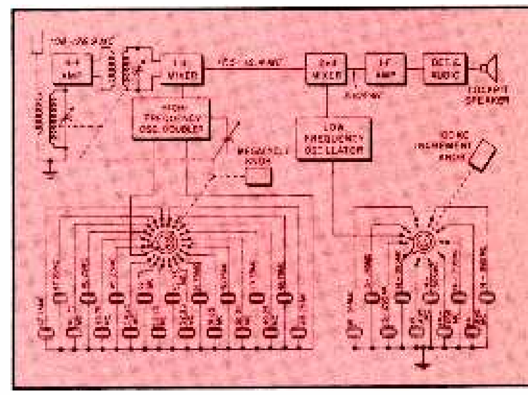


Fig. 2. Block diagram of a crystal-tuned VHF receiver in which frequency synthesis is used.

between 108 and 112 mc. The more powerful enroute VOR stations operate from 112 to 118 mc. VHF communication frequencies run from 118 to 135 mc and are now assigned in increments of .05 mc. Frequencies from 118 to 121.4 mc include towers, departure control, etc. The frequency 121.5 mc is the universal emergency frequency isolated on either side by a 100-kc "guard band." 121.7, 121.8, and 121.9 mc are used for airport ground control. FCC assignments are tabulated in Table 1.

VHF Receivers

Receiving equipment for VHF may be classified as either continuously tuned or crystal-tuned. Continuously tuned equipment is capable of receiving any frequency within its range, and it is usually the least expensive. Crystal-tuned receivers allow quick, positive tuning which is worth a lot in many flight situations.

Circuits of continuously tuned re-

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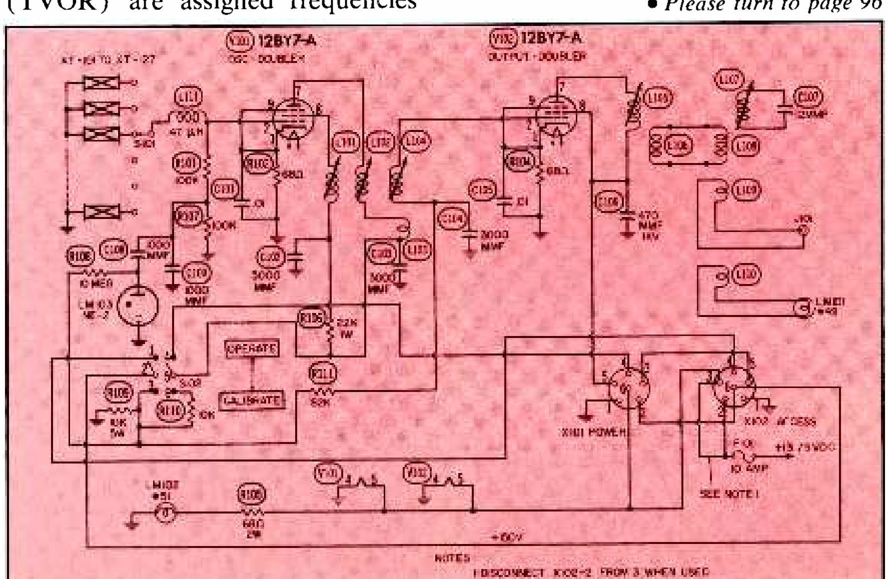
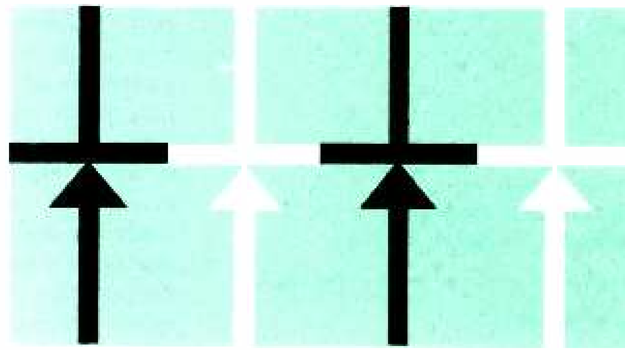


Fig. 3. Schematic of VHF transmitter. Separate modulator and power supply are required.

Servicing Industrial Electronics
by
Forest H. Belt

SOLID STATE RECTIFIERS come of age



For many years, radio and television servicemen have been accustomed to servicing receivers that use selenium rectifiers to change AC power-line voltages to DC potentials. Technicians working on heavy-duty electronic equipment are also familiar with copper oxide rectifiers used to rectify heavy currents. These devices have been commonly referred to as metallic rectifiers, because one side of each rectifying junction consists of a metal disc or plate.

More recently, it has been discovered that devices made of other elements, such as the semiconductors silicon and germanium, also display the ability to conduct in only one direction—if the elements are mixed with slight amounts of impurities. And along with these developments has come a new terminology; metallic and semiconductor rectifiers are called *solid-state* devices, to distinguish them from those rectifiers of open-element construction—such as vacuum and gaseous tube rectifiers.

There are a large number of solid state devices—including transistors, tiny signal diodes, bulky silicon rectifiers for heavy duty, and other special devices such as thermistors, thyrectors, *Varicap* diodes, and silicon controlled rectifiers. There are even solid state relays to replace electromechanical types. For the present, we're most interested in rectifiers, those solid state devices that possess the characteristic ability to change AC to pulsating DC.

The Power Race

Always, design engineers have been looking for ways to increase the efficiency of rectifiers. The discovery of new techniques for creating semiconductor junctions, and new materials to use, has triggered significant advances in this area. The use of silicon has permitted manufacture of rectifiers that match selenium units for power-handling capability, but are only a fraction of the physical size. Even the cost has been reduced considerably.

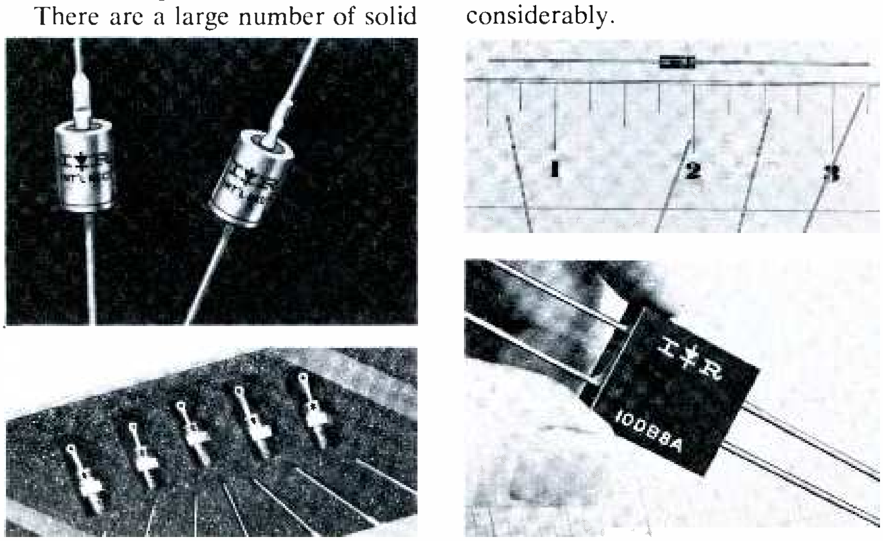


Fig. 1. Large bulky seleniums have been displaced by smaller-size silicon rectifiers like these.

For extremely heavy-duty rectifier systems, such as industrial battery chargers, copper-oxide rectifiers are still being used. To date, they are less expensive than other units; one serious limitation, however, is that they can economically be used only with low voltages. Consequently, solid state rectifier packs are becoming preferred, and will probably replace metallic units completely.

Selenium units, too, are still being used in many rectifier systems. Where high current is not a requirement, and operating temperature is not important, seleniums are generally less expensive. Low-current silicon rectifiers are not common, for other materials lend themselves better to low-current applications. For current requirements above 200 ma, silicons are rapidly replacing seleniums, for two reasons: Silicon rectifiers often achieve operating efficiencies approaching 98%, while equivalent selenium units are only 65% to 75% efficient; besides this, the characeristics of seleniums change during an extended period of operation, while those of silicons are comparatively constant throughout their life.

There are disadvantages to silicons that partially account for the fact that seleniums are still in extensive use. Silicon units are not as capable of withstanding temporary overloads as are seleniums. Power line surges, transient load changes, and spurious voltage "spikes" that have little effect on a selenium may destroy a silicon junction. Thus, some equipment manufacturers use the less sensitive selenium unit in preference to building surge protection into the circuit for silicons.

More and more, however, the advantages of silicon rectifiers are outweighing those of seleniums, and set builders are switching to silicon power supplies.

Silicon Devices

A significant number of different solid state units use silicon as the primary material. These include plain silicon rectifiers of many styles, shapes, sizes, and ratings; silicon controlled rectifiers; silicon planar diodes; and silicon zener diodes. Silicon junctions have the advantage of being able to withstand greater voltage surges than those of germanium, notwithstanding their susceptibility to damage from voltage extremes. The low junction temperatures in silicon units (compared with selenium) permit higher current ratings and lesser cooling requirements. Thus, devices made of silicon are "middle class" in the society of solid state devices. And they have extreme versatility.

Silicon Rectifiers

As mentioned above, many styles, shapes, and sizes of silicon rectifiers are available. These characteristics are determined largely by the power ratings—current capability versus operating voltage. Some units are stud-mounted in heat sinks; others mount simply by axial leads; still others are press-fitted into heat sinks. In some small units, the heat sink is merely a single fin around one end of the unit—giving the familiar "top hat" appearance. Other types, without built-in heat sinks, are fuse-clip types, epoxy-impregnated types, and cylinder types (single-ended or axial). See Fig. 1.

In ratings, silicon rectifiers range from tiny encapsulated units, capable of handling currents between 5 ma and 750 ma, to large stud-mounted ones that can handle up to 250 amps. Voltage ratings usually begin around 5 or 6 volts (although .5 volt is about the minimum practical voltage for a silicon unit) and range as high as 1000 volts rms.

The actual current that can be expected from a silicon rectifier supply depends on the type of load placed on the supply. An inductive or resistive load can demand almost 50% more current from a silicon unit than can a capacitive load. Thus, a unit rated at 750 ma for an inductive or choke-input filter system can supply only 500 ma into a capacitor-input filter network.

This brings up the matter of protection for silicon rectifiers. There are three major areas of common failure in these units: voltage overload, too-high operating temperature, and too much current. The first can be, and usually is, eliminated by proper circuit design; a circuit that is too inductive often creates this problem by forming transient pulses that overload the forward or reverse rating of the unit. The second is the result of poor cooling, and is a factor that can bc eliminated by careful selection of case style for each application; if heat sinks are needed, they must be provided.

The third problem is of much more importance to you, particularly when you replace silicon units or substitute them in place of selenium rectifiers. This problem is a result of initial surge current. For comparison purposes, solid state rectifiers in the silicon class are rated at an operating potential of 1 volt forward bias.

Semiconductor junctions will conduct only after a certain minimum forward bias voltage is exceeded; for most, this point is just above .5 volt. Above this point, junction resistance may be only 2 or 3 ohms; at 150 volts, the resistance is only a few thousandths of an ohm. Consequently, series resistance is needed to limit the current to a reasonable value during the peak excursion of each forward cycle. Why doesn't the load resistance prevent overcurrent? Because we are talking about a capacitor-input filter. Until the capacitor accumulates a charge, it acts as a short across the output of the rectifier—during the first cycle after power is applied.

Let's compute the size of the limiting resistor. The instantaneous voltage at the peak excursion of a 130 volt AC power line (the maximum likely to be encountered) is almost 184 volts. As an example, consider a silicon rectifier that has a capacitor-input current rating of 500 ma. A typical unit might be rated to withstand a surge current of 25 amps for 1/120 second—one half-cycle at power line frequency. The protective resistor for this rectifier would have to drop the 184 volts to no more than 1 volt, for that instant, if it is to protect the rectifier. Using Ohm's law, divide 184 by 25; the result is 7.5 ohms—the value of the surge resistor.

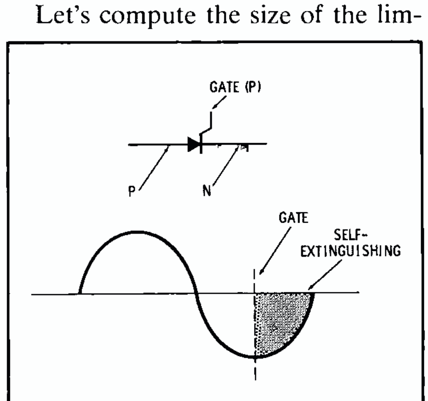


Fig. 2. SCR gate junction is control element.

Another common rectifier has a surge rating of 35 amps for one half-cycle at 60 cps. Ohm's law would indicate a need for a surge resistor of 5.25 ohms.

Since the surge across the resistor takes place during only 1/120th of a second, at the instant when power is first applied, the wattage requirement is much less than you might suppose. To compute the wattage dissipated during the surge, you would multiply the voltage by the current, and then multiply the resultant by the duty-cycle factor of 1/120. In our first example, this would indicate an instantaneous dissipation of 40 watts. But remember that it is *instantaneous.* The actual wattage of the resistor should be chosen according to the constant demand of the power supply, in this case not to exceed 500 ma (the rectifier rating). Computing power, we find a constant dissipation of about 2 watts. Allowing a safety margin, you'll find a 5 watt resistor sufficient.

Silicon Controlled Rectifiers

You've seen how silicon rectifiers are used and protected from overload; now, let's look at a close cousin—the silicon controlled rectifier. This rectifier is a multijunction device that is actually a triggered rectifier. If you're familiar with thyratron tubes, you can compare the action of the SCR to that of the thyratron.

The junction primary in the SCR is very similar to that of the ordinary silicon rectifier. However, the SCR contains another junction designated as the *gate.* The unit cannot function as a rectifier until this gate is

• *Please turn to page 93*

by Larry Allen

TECHNIQUES OF DISTORTION CHASING

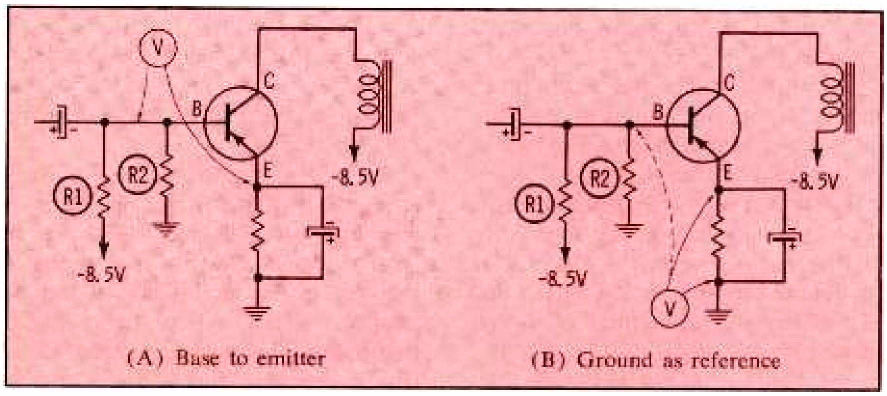


Fig. 1. Methods of measuring transistor bias.

It can be generalized that distortion in transistor receivers and audio amplifiers is the result of some defect that upsets bias in an audio stage. It naturally follows, then, that distortion in these units can be cured by correcting the bias problem. Carrying this logic a step further, we can assume that if altering the bias on an audio stage clears up any distortion we hear (or see, with a scope) the fault must lie within that stage. It matters not from a standpoint of troubleshooting, whether we clear up the distortion artificially—by supplying the correct bias from some external source—or in the usual manner by replacing the defective component. Naturally, the latter is too time-consuming and parts-wasting to be practical as a troubleshooting procedure.

Let's examine this idea from another viewpoint. We can consider two methods of finding in which stage distortion originates: by measuring voltages on each transistor or by artificially altering the bias in each stage until one of them clears up the faulty sound emanating from the speaker. The first method—measuring voltages—makes it necessary for the service technician to know in advance the correct bias for each particular transistor; one pitfall of this system is that not all transistors of a particular type operate the same, even with the same bias. The second method—substituting an adjustable bias voltage and setting it for linear operation—has the advantage of *showing* an immediate and definite result; besides, only a general knowledge of bias values is needed.

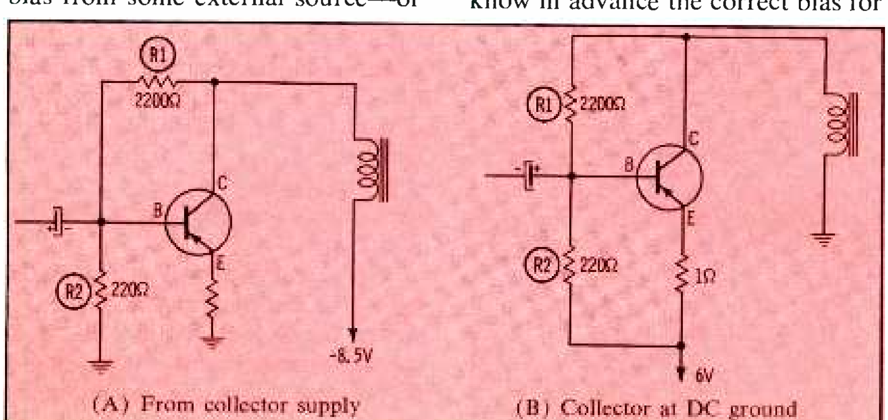


Fig. 2. Here is how bias is derived for base.

Measuring Bias

To set the stage for our dynamic techniques of troubleshooting distortion problems, let's first take a look at the two ways bias is measured.

Fig. 1 shows an audio stage using a PNP transistor. Bias can be measured by a sensitive voltmeter connected between the base and emitter as shown in Fig. 1A. The voltmeter, preferably a VTVM, must be able to indicate voltages as small as a few hundredths; some transistors operate with less than .1 volt bias. Fig. 1B shows another way to determine bias on a transistor—by measuring the voltage at the emitter and then at the base; the difference between the two readings is the bias voltage.

Developing Bias

Next, let's examine how bias is normally applied to transistor stages. We can still use Fig. 1 as an example.

The emitter voltage is primarily a function of total collector current, although a very insignificant amount of base current affects it. The base voltage is determined by divider resistors R1-R2 connected across the main power supply. The ratio of R1 to R2 sets the amount of the supply voltage that is applied to the base of the transistor. Base-emitter current in this PNP unit also has some effect on the final value of base voltage, so the operating value may vary slightly different from that computed by the mathematical ratio of R1:R2. Nevertheless, the ratio is a usable clue to the approximate value to be expected.

A similar biasing system is shown in Fig. 2A; the divider system is connected in this stage directly across the collector supply. In Fig. 2B, a still different arrangement is used, but the divider principle remains. You'll find that base-biasing arrangements in most transistor audio

• *Please turn to page 47*

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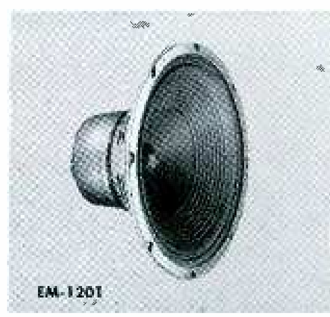

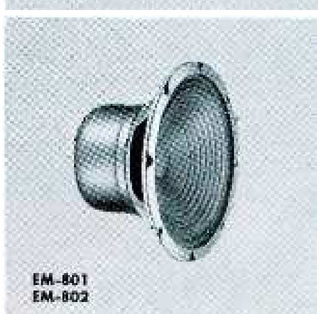

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					Imped. Ohms	Power Watts**	Dia. Inches	H & W	Depth	Baffle Opening
Bass Guitar	12	$35.95	EM-1200	16	8	50	1½	12 1/16	6¼	10½
	15	52.00	EM-1500	27	8	60	1½	15⅛	7	13¼
Guitar	8	19.95	EM-801	10	8	25	1	8 1/16	4 17/32	6¾
	10	21.50	EM-1001	10	8	30	1	10 3/16	5¼	8¾
	12	29.50	EM-1201	11	8	40	1¼	12⅛	6½	10½
	12	35.95	EM-1202	16	8	50	1½	12 1/16	6⅛	10½
	15	52.00	EM-1501	27	8	60	1½	15⅛	7	13¼
Accordion	12	35.95	EM-1202	16	8	50	1½	12 1/16	6¼	10½
	15	52.00	EM-1501	27	8	60	1½	15⅛	7	13¼
Organ	6 x 9	14.75	EM-6900	10	8	12	1	6⅜ x 9⅛	3	5¼ x 8½
	8	19.95	EM-802	10	8	15	1	8 1/16	4 17/32	6¾
	10	21.50	EM-1002	10	8	18	1	10 3/16	5¼	8¾
	12	22.50	EM-1203	10	8	20	1	12 1/16	6⅛	10½
	12	35.95	EM-1204	16	8	25	1½	12⅛	6½	10½
	15	52.00	EM-1502	27	8	30	1½	15⅛	7	13¼

*All models have Syntox-6® ceramic magnets. **Program power. Peak power is twice program rating.

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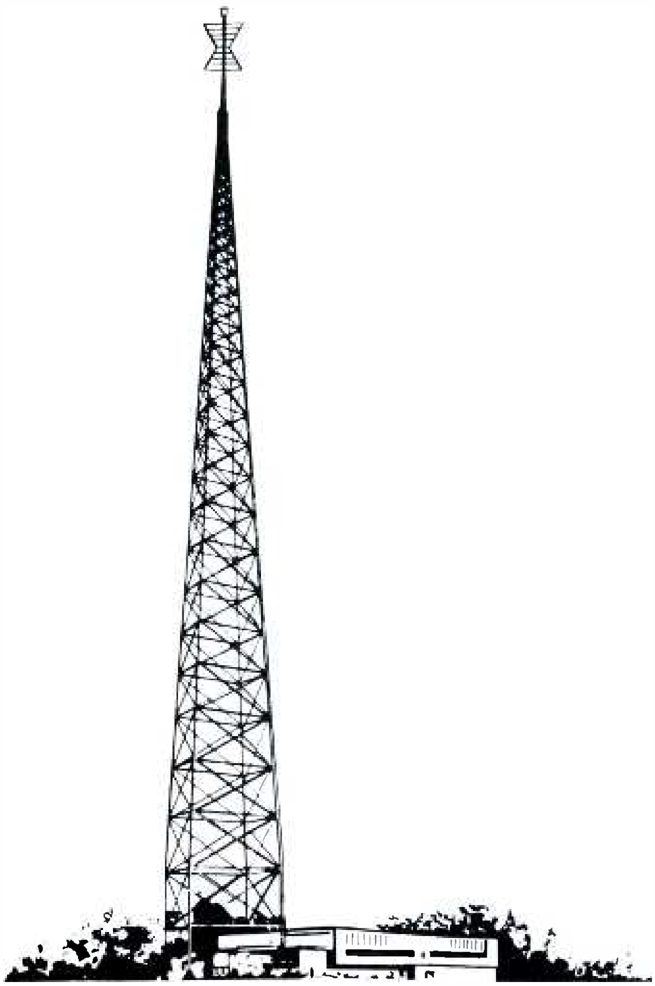
How to deliver the best signal...



from here... to here

BLONDER-TONGUE leader in UHF and VHF product design dedicates Fall, 1964 to better TV reception with the

BLONDER-TONGUE VAL•U•RAMA

Guide to selecting t

How TV signal amplifiers improve reception

by Ben H. Tongue
(President, Blonder-Tongue Laboratories)

TV amplifiers can improve TV reception in many cases. There are, however, situations where no improvement is to be expected. This article will cover both situations to help you recognize potentially profitable installations.

Amplifier performance is determined by the level of internally generated noise (snow), amplification level, and degree of freedom from overload by strong local signals. Amplifiers are used as follows:

1. INCREASE CONTRAST Low cost TV sets generally have insufficient gain for weak signal reception. Old TV sets (low or high cost) often have aged tubes and insufficient gain. Low gain generally is the cause of poor contrast on weak signals. If the contrast of "snow" when the TV set is operating at full gain (no signal input) is much less than picture contrast on a strong signal, low gain is at fault.

A good amplifier, indoor or outdoor, will improve poor contrast caused by low gain. Contrast is reduced if the transmission line from antenna to TV set has a high loss. Noise (snow) is also increased by this condition. Let us assume that a good antenna is well installed and that quality transmission line is used (flat twinlead for VHF and round foam-filled twinlead for UHF).

TABLE 1 FREQUENCY	Length for 3db Loss	
Low Band VHF (Ch 3-6)	50' Wet	300' Dry
High Band VHF (Ch 7-13)	26' Wet	158' Dry
Low Half UHF (Ch 14-48)	45' Wet	90' Dry
High Half UHF (Ch 49-83)	37' Wet	74' Dry

2. REDUCE SNOW Snow appears when the TV signal-to-noise ratio is reduced. A good antenna reduces snow because of increased signal pickup. Transmission line loss increases snow because it reduces the signal reaching the first amplifier stage (booster or tuner RF stage). This reduces the signal-to-noise ratio. Here's how snow can be minimized:

a. Increasing signal pickup by using a higher gain antenna.

b. Using an amplifier which generates less noise than the TV input stage.

c. Amplifying at the antenna. If the amplifier has the same noise figure as the TV set tuner, the amplification overcomes transmission line loss, and the picture signal-to-noise ratio is nearly the same as if the TV set were at the antenna.

Point "A" applies at all times. Point "B" generally applies to low cost (tetrode tuner) and older TV sets when the amplifier is mounted near the set. Point "C" applies when the transmission line loss is appreciable. (See table 1). In this case we can improve the initial signal-to-noise ratio by using a low noise mast-mounted amplifier.

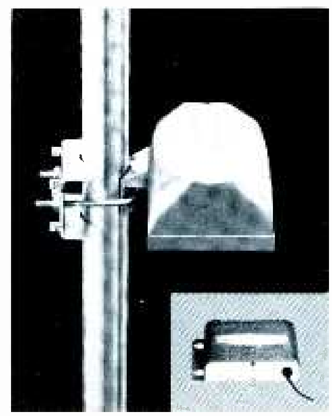
3. OVERCOME SPLITTING LOSSES Splitting a signal to drive several TV sets causes loss to each set. If the signal power is divided among two sets, each will receive ½ the original power (3db loss). This is equivalent in points "1" and "2" to an extra 3db of transmission line loss. The solution is amplification before splitting. This can restore contrast and re-establish signal-to-noise ratio (or even improve it).

One transistor amplifiers are most susceptible to overload. Two transistor amplifiers are much less susceptible, performing about the same as single tube units. Two tube and dual section tube amplifiers overload least. Frame-grid tubes provide exceptionally low noise and last longer than ordinary tubes. If interference occurs, attenuation filters can be used.

BLONDER-TONGUE TV/FM SIGNAL AMPLIFIERS

Brilliant color TV, sharp black and white TV and lifelike FM stereo reception require strong, clean signals. To provide TV viewers with the best possible reception in any area of the country, Blonder-Tongue offers the world's largest selection of signal amplifiers. There are VHF amplifiers, UHF amplifiers, FM amplifiers. And, for the first time, all-channel TV amplifiers covering every channel from 2 to 83.

When you select a Blonder-Tongue amplifier, you can always be sure of getting the best amplifier for your specific reception problem. There are mast-mounted amplifiers designed to take advantage of the best signal-to-noise ratio available at the antenna for weak signal areas. There are indoor amplifiers, that offer convenient installation and can provide excellent results where there are relatively strong signals. You also have a choice of either tubed or transistor amplifiers. For example, transistor amplifiers offer greater gain and are most effective in weak signal areas where there are no strong local channels to cause overload.



The finest signal amplifiers in the world are also the easiest to install. Many of the mast-mounted amplifiers feature the exclusive 'Miracle Mount'. All mast mounted amplifiers feature a separate remote power supply which can be installed easily indoors near the set. Finally, secure, positive 300 ohm connections can be made in a jiffy with Blonder-Tongue patented stripless terminals.

The chart on the right hand page will serve as a guide that will help you select the best signal amplifier for your area.

Blonder-Tongue amplifier that's best for you

BLONDER-TONGUE SIGNAL AMPLIFIERS—VHF, UHF, VHF-UHF, FM

	MODEL	DESCRIPTION	COVERS CHANNEL	OUTPUTS	NET
MAST MOUNTED	U/Vamp-2	World's first mast-mounted UHF/VHF amplifier. 2 transistors. Built-in FM filter. Remote AC power supply. Separate inputs for UHF and VHF. Single 300 ohm input at power supply accepts combined UHF/VHF twinlead.	2-83	1	$33.25
	Vamp-2	Mast-mounted VHF amplifier. 2 transistors. Separate remote AC power supply. Strong overload handling capability. 2 or more sets.	2-13	2	$25.85
	Vamp-1	Mast-mounted transistor VHF amplifier. Separate remote AC power supply. FM trap.	2-13	1	$17.10
	Vamp-2-75	Mast-mounted 75 ohm VHF home TV amplifier system. 2 transistors. Uses coax cable. Single 75 ohm output can be split to 2 or more TV sets. Strong overload handling capability. Remote AC power supply. FM trap.	2-13	1 (75 ohm)	$29.55
	AB-3	Deluxe, mast-mounted TV/FM amplifier. Low noise frame-grid tube. Can be used up to a mile from AC source. 75 and 300 ohm outputs.	2-13, FM	1 (75 or 300 ohms)	$78.50
	ABLE-U2	Mast-mounted UHF amplifier. 2 transistors. Uniform response on all UHF channels. Remote power supply. Miracle Mount.	14-83	1	$26.95
INDOOR	V/U-ALL2	World's first indoor UHF/VHF amplifier. 2 transistors. FM filter. Single 300 ohm input accepts combined VHF/UHF twinlead. 2 sets.	2-83	2	$27.50
	B-24c	Indoor VHF/FM amplifier. Uses high gain, low-noise frame-grid dual-section tube. 4 sets.	2-13, FM	4	$17.25
	IT-4	Indoor transistor VHF/FM amplifier. Excellent interset isolation. Up to 4 sets.	2-13, FM	4	$19.95
	B-42	Indoor VHF/FM using high gain, low noise, frame-grid tube. Up to two sets.	2-13, FM	2	$14.25
	U-BOOST	Indoor tuneable UHF amp Frame-grid tube.	14-83	1	$17.35
	HAB	Deluxe, indoor VHF/FM amplifier for professional home installations.	2-13, FM	1 (75 ohm)	$49.65
	FMB	Indoor FM amplifier. Ideal for stereo and regular FM. Uses frame-grid tube.	FM	1	$14.55

VHF


Vamp-2-75


HAB


B-24c


Vamp-1


IT-4


B-42


Vamp-2


AB-3


FMB

UHF converter and antenna guide

Selection of right converter and antenna critical for UHF

by I. S. Blonder
Chairman of the Board,
Blonder-Tongue Laboratories, Inc.

There has been a long-standing prejudice against UHF. Since the band opened in 1952, many otherwise knowledgeable technicians have considered UHF reception to be inferior to VHF. Yet the recent New York City tests conducted by the FCC have proved that this is simply not so.

There is a reason for this paradox – equipment. In 1953, the state of the UHF art was relatively primitive. Today, experienced manufacturers like Blonder-Tongue are able to produce equipment capable of providing UHF reception that is, in many ways, superior to VHF.

Today's Blonder-Tongue UHF converters reflect the improvements drawn from our experience in every UHF area of the country. The consumer has the opportunity to buy a converter which has withstood the most critical test of all, performance in nearly 3 million homes. Blonder-Tongue provide brilliant color pictures and sharp black & white reception on *all* UHF channels.

As for antennas, UHF has a definite advantage over VHF. Because the UHF wavelength is so small, high gain, efficient antennas are small and cost little. The periodic principle proved so successful in the U.S. Satellite program is especially applicable to UHF. The Blonder-Tongue Golden Dart (outdoor) and Golden Arrow (indoor) antennas utilize this priniciple. While they are compact, these antennas provide more gain than the large VHF yagis. What's more important, their patterns are clean, rejecting unwanted "ghost" signals.

With a little extra care in selecting and installing UHF equipment, you can often provide your customers with better UHF pictures than they've been watching on VHF.

Blonder-Tongue UHF converters

These all-channel UHF converters, your best investment in TV enjoyment, add channels 14-83 to your present set. They are particularly suited to meet the critical demands of color TV. The famed BTU-2T and 99S converters feature peak performance on all UHF channels, easy installation, reliable, long-term operation. Maximum stability for drift-free performance and a low noise figure for snow-free reception. The BTD-44 employs a tunnel diode circuit for excellent, low cost battery operation.

Blonder-Tongue UHF antennas

The UHF antennas are designed to match the high performance standards on all UHF channels of our famed UHF converters. They employ the well-known Periodic principle, to provide uniform, high gain across the entire UHF spectrum for sharp, ghost-free pictures. Full bandwidth makes these UHF antennas excellent for color and black & white TV.

The Golden Dart is an outdoor UHF antenna which comes completely pre-assembled with nothing to snap out, no screws to tighten. The Golden Arrow is an indoor UHF antenna, which outperforms all other available indoor UHF antennas.

BTU-2T

BTC-99S

BTD-44

GOLDEN DART

GOLDEN ARROW

ALL-CHANNEL UHF CONVERTERS

DESCRIPTION	EFFECTIVE RECEPTION RANGE*	INPUT CHANNELS	OUTPUT CHANNELS	NET
BTU-2T—Deluxe all-channel, UHF converter/amplifier. Adds all UHF channels to any set. Triples TV signal strength. Easiest tuning with dual-speed channel selector. UL approved.	Used with an outdoor antenna anywhere up to 50 miles from station. With indoor antenna, up to 25 miles.	14-83	5 or 6	$26.95
BTC-99S—All-channel, UHF converter. Adds all UHF channels to any set. Provides maximum signal power. Drift-free, distortion-free. UL approved.	Can be used with indoor antenna for prime signal areas and outdoor antenna up to 25 miles from station.	14-83	5 or 6	$19.50
BTD-44 — All-channel, tunnel diode UHF converter. Utilizes tunnel diode for maximum reliability. Operates on ordinary flashlight battery which lasts from 6 to 9 months.	Can be used with indoor antenna for prime signal areas and outdoor antenna up to 25 miles from the station.	14-83	5 or 6	$13.20

ALL-CHANNEL UHF ANTENNAS

DESCRIPTION	EFFECTIVE RECEPTION RANGE*	FRONT-TO-BACK RATIO	NET
GOLDEN DART outdoor UHF antenna Uses Periodic principle, 11 working elements for uniform high gain across the entire UHF spectrum.	Up to 50 miles.	20db min.	$3.55
GOLDEN ARROW indoor UHF antenna Employs 10 working elements to provide constant high gain and matched impedance. Full Bandwidth — flat response.	Up to 20 miles.	20db min.	$2.70

*In weak signal areas, use a model Able-U2 UHF amplifier.

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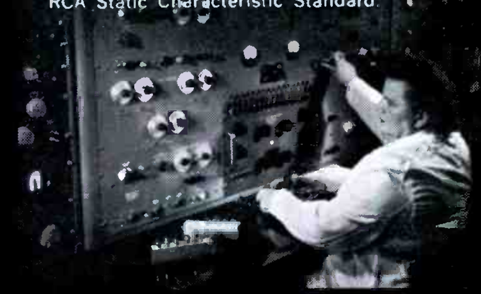
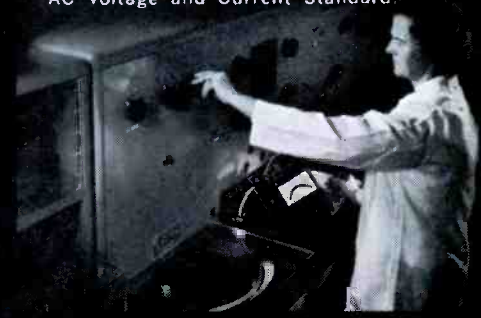
RCA Calibration Center's Resistance Standard — accuracy 0.0002%.

RCA Frequency Standard being used to calibrate an oscillator



Recertifying Calibration Tubes on the RCA Static Characteristic Standard

Calibrating portable Standard Cell on the RCA Primary Voltage Standard



Voltmeter being calibrated on the RCA AC Voltage and Current Standard

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DEPENDABLE PERFORMANCE IS THE END RESULT

No reliability program for receiving tubes can be better than the test instruments and equipments it employs.

That's why RCA maintains the extensive Calibration Center in its Harrison, N. J., tube manufacturing plant (see photos above). The Center's responsibility: to assure that all measuring instruments and equipments, used in tube development from initial design through volume production, are accurate within rigidly specified limits. Here is how this is accomplished:

1 The Calibration Center's own equipments are calibrated by standards (voltage, resistance, capacitance, frequency) whose values are regularly checked against standards of the National Bureau of Standards.

2 Measuring instruments used in all research, design, development and application laboratories are calibrated directly from the Center's equipments.

3 Sets of Calibration Tubes, selected to cover every type and family of tubes, are measured in the Calibration Center and used by the Center's personnel to periodically verify the accuracy of all factory tube-testing equipments.

4 Sets of Control Tubes, evaluated under the supervision of the Calibration Center, constantly monitor the repeatability of factory tube-testing equipments.

Our Harrison Calibration Center is another example of the effort we make to assure the specified and dependable performance of every receiving tube that bears the emblem of RCA . . . performance that benefits you through customer satisfaction.

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Circle 17 on literature card

Chasing Distortion

(Continued from page 38)

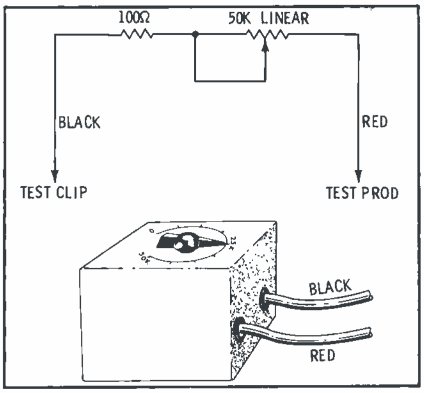


Fig. 3. "Bias-changer" will trace distortion.

stages resemble the divider systems shown here. This being the case, it is easy to alter the bias simply by changing the ratio of the divider resistors. Find an easy way to change this ratio, and you'll have an easy way to change the bias; change the bias without much effort, and you can check the stage for distortion without much effort. Therefore we need procedures for doing this job quickly, and without a lot of intricate desoldering and resoldering on tightly packed printed boards.

The Bias-Changer

The "tool" we use for distortion-chasing in transistor audio amplifiers —be they hi-fi units with barely measurable distortion or tiny portable radios with fuzzy sound—is shown schematically and sketched in Fig. 3. (The device can be mounted in a box as shown, but we've used one for several years without ever going to that much trouble.) The 50K potentiometer has a linear taper, and the 100-ohm resistor is added to prevent inadvertently shorting some point through the test unit.

Fig. 4 shows an example of how the unit can be used to ascertain what bias is necessary to keep the transistor amplifier operating in the linear region. By opening the base-bias supply connection (a razor-

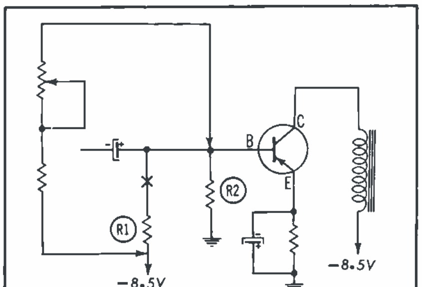
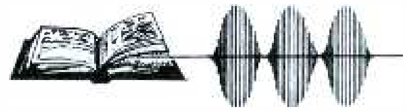


Fig. 4. Tester can substitute variable bias.

BOOK REVIEW



Communication Satellites

George E. Mueller and Eugene R. Spangler; John Wiley & Sons, Inc., New York, N.Y.; 280 pages, hardbound, $10.00. In modern global communications, orbiting satellites are becoming one of the more dependable, although expensive, means of relaying voice and television messages directly to any part of the world. Here's a book that tells about two important aspects of the subject—communications via satellites and the technology of placing a satellite in a communications-capable orbit. As outstanding engineers in the space program, both Dr. Mueller and his former assistant, Mr. Spangler, easily qualify as experts in both areas.

Chapters 1, 2, and 3 introduce problems and choices facing those who design satellite relay systems. Chapter 3 elaborates on the relative merits of passive satellites compared with active relay systems. Considering losses and other factors inherent in passive systems, it isn't difficult to conclude—as do the authors—that active repeaters are the more practical.

From here, the organization of the book seems a little indeterminate, but the information is all there. Chapters 4, 7, 8, and 10 treat of the satellites themselves, while chapters 5, 6, 9, and (part of) 10 are concerned with the communications systems and equipment—the payload and its functions. Chapters 11 and 12 deal with applications and reliability.

Concerning satellites, the reader is familiarized with the effects of, and interrelation among: altitude; micrometerorite activity; radiation such as cosmic, gamma, X-, and ultraviolet rays, plus other little-known radiation phenomena; and time delay in various orbits. Attention is given to problems of attitude and orbit control, and the systems now used for solving them. Satellite structure, methods of temperature (environmental) control, tracking provisions, and command (control) systems also receive their portion of discussion.

Obviously, you're not going to be servicing satellites, at least not right away. However, for the technician whose curiosity about communications satellites is more than merely passive, this book offers a lot of information.

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Cables, Long and Short. The 8000 has variable impedance—30/50 to 20,000 ohms. With high impedance mikes, a 10-foot cable is maximum to avoid response loss and hum pickup. The 8000, sold with a 15-foot cable, can also be used with longer cables to record without recorder noise; to monitor recordings through speakers instead of headphones, and make recordings with recorder out of sight.

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blade slit across the printed foil will do it) and substituting the connection shown, the amount of bias can be adjusted or varied while you listen or watch the scope to see when the transistor reaches normal operation. The test potentiometer should be set at maximum resistance for the beginning of each test. After the connection is made and the set turned on, slowly rotate the 50K control so the bias on the transistor is increased.

When a point is reached that clears any distortion, the values of R1 and R2 can be changed to provide this same bias for the transistor; if it is obvious the new values would be considerably different from the original design of the set, you can safely assume the transistor or some other circuit component is causing the problem.

Our "bias-changer" can be used without disconnecting any components or cutting across any printed-circuit foils. How? . . . simply by connecting it across one of the existing resistors, thus reducing the value. Lowering the value of the series resistor in the divider (R1 in Fig. 4) will increase the base bias; reducing the value of the shunt resistor (R2 in Fig. 4) will reduce the value of bias voltage applied to the transistor base.

In many transistor circuits, the technique shown in Fig. 4 can be used without the precaution of opening the foil connection to the voltage supply—the "bias-changer" device will override the existing bias network. If there is any doubt of your results, however, play it safe and take time to slit the foil.

Rapid Component Analysis

Assuming the bias-changing technique has revealed the faulty stage, you'll want next to determine what has caused the unwanted change in bias. Long experience in trouble-shooting receivers has shown that their most common fault is a defective capacitor. The electrolytic capacitors generally used in transistor sets cause more cases of distortion than any other single component.

You are now in need of a technique for locating a defective capacitor quickly, and it would be nice if the same technique would point out any faulty resistors or transistors in the process. One useful technique involves monitoring the input current drawn by the set from its power supply (usually a battery). If a capacitor is leaky or shorted, merely disconnecting one end will generally cause a very noticeable change in the total input current. This is easy to understand if you consider the capacitors in the partial schematic in Fig. 5.

Any unusual leakage in C5, C6, or C7 would provide a direct drain on the power supply of the receiver and would appear as a higher-than-normal reading on the milliammeter across the input switch. Disconnecting one end of any faulty capacitor would considerably reduce the drain. The effect of a leaky or shorted C6

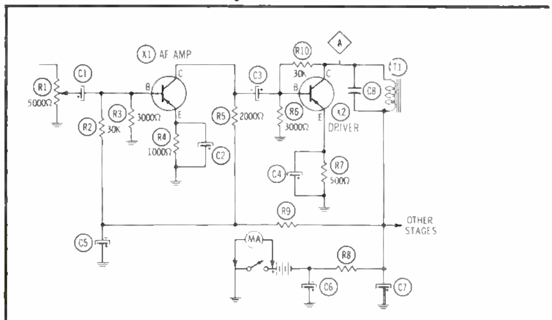

Fig. 5. Audio stages in transistor receiver.

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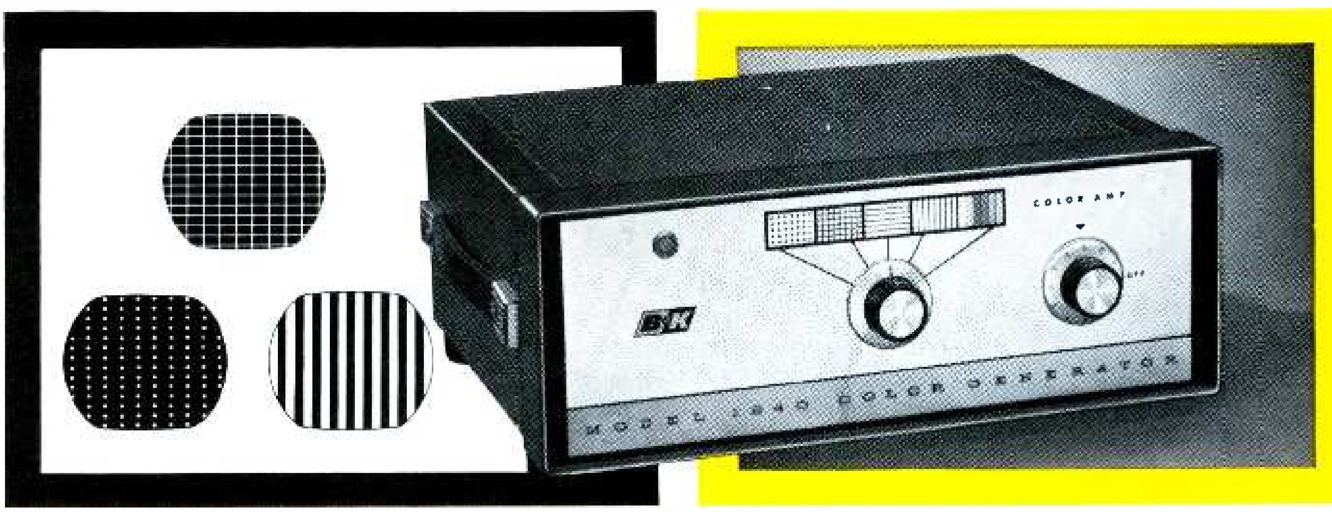

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Operates on channels 3, 4, and 5, and adjustable without removing cabinet. No connection inside TV set is needed. Power transformer operated and line isolated to prevent shock hazards. Operates reliably on 105-125 VAC, 60 cps. (Color Gun Killer is available as optional accessory.) Extreme lightness and portability (9 lbs.) make it ideal for in-home servicing.

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would be the most notable, because current through C5 or C7 would be limited slightly by resistors R8 and R9. In either case, however, current drain would be sufficient to result in some change in the milliammeter reading when the defective capacitor was disconnected.

A shorted C1 would upset the bias on transistor X1 since current could easily leak to ground through C1 and control R1. Lowering the bias on transistor X1 would reduce collector current and decrease total input current. A shorted C1 would not affect the current drain directly, even with the R1 tap at ground, because of the limiting effect of R2, a comparatively high resistance. Nevertheless, disconnecting one lead of the capacitor would produce an obvious change in the DC current drawn from the power supply and would be a definite clue if C1 is defective.

A shorted C2 would be noticeable mostly in the collector current of X1. As with C1, the effect on input current is indirect—caused by a change in transistor bias. And again the input current diminishes when the capacitor is disconnected. If the capacitor is normal, there will be practically no change in drain from the power supply. The same applies to C4 in the emitter of X2.

The effect of a leaky C3 on current drain could be considerable, because the current path through R5 and R6 would greatly increase forward bias and thus the collector current in transistor X2. It is even possible that a completely shorted C3 could apply so much forward bias to transistor X2 as to ruin it. Disconnecting C3 will greatly reduce the input current drain, if the unit is faulty. If you find the current is still too high, you'd want to investigate the possibility of a defective X2. To test this, the circuit would have to be broken at point A; but remember that even with a normal transistor some current reduction would occur upon disconnecting divider network R6-R10. To ascertain the exact point of excess current drain, the collector lead could be disconnected right at the transistor, by unsoldering or by the razor-blade method.

Faulty resistive networks can easily be checked out with the bias-changer potentiometer, often simply by bridging a suspected resistor with the test device. Bias faults caused by faulty resistors can thus be checked and eliminated. To determine the exact value for a suspected resistor, simply remove it from the circuit and connect the test device in its place. Adjust the potentiometer until normal operation is resumed. Then it is a simple matter to measure the resistance of the test device and put a correct-value resistor in place of it.

Summary

The techniques set forth in this article are far from the only way to go distortion-chasing in transistor audio stages. However, they have the advantage of being quick and not requiring an undue amount of unsoldering parts for testing. The less soldering you have to do on some of those tiny printed boards, the better.

We've found from our own experience that the bias-changing (or divider-substituting) system is a very quick way to bring a nonlinear stage back into line, thus ascertaining whether it truly is the stage at fault. This method will work well in some of the little transistor sets

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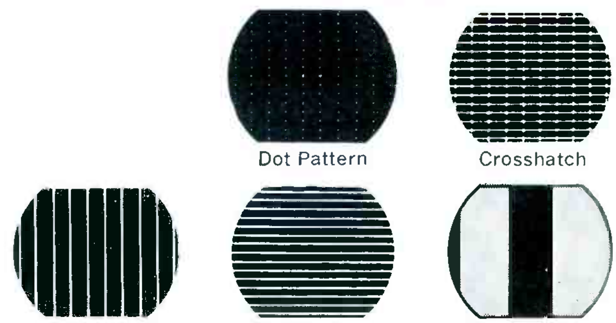

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that "don't sound too good" even when new. It will work with sets that sound poor after batteries are only slightly used. In almost any case of distortion, you'll find this technique fast and accurate for pinning down the stage at fault (and often giving a clue how to fix it).

For detecting leaky capacitors, without having to unsolder both ends for testing or substitution, the input-monitoring system is quick and effective. With the meter connection so easy to make, and having already localized the trouble to a single stage, this technique has proven itself popular among all who have learned to use it.

Distortion chasing is not nearly so difficult with these easy techniques. Use them a few times with your next audio jobs; they'll help make the jobs profitable and the customer happy.

Stabilized Variable AC

Have you ever been irritated by fluctuations in line voltage on the bench, or received an AC shock when servicing a transformerless set? The Heath IP-22 isolation transformer is intended to eliminate

these annoyances. This unit reduces shock hazard by providing isolation between the AC line and the chassis being serviced. The stable output voltage can be set to a number of values between 90 and 130 volts and can be monitored with the front-panel meter. A meter switch also permits checking the line voltage. Fine- and coarse-voltage output switches are provided to vary the output voltage in steps of .75 or 5.2 volts. A 3-watt lamp (used as a current-limiting resistor) and an OC2 gas regulator tube maintain a constant output voltage.

The variable-voltage feature is often handy for finding the cause of intermittent operation. For example, slightly increasing the input voltage may make the symptom appear—and stay—making it possible to test the set while a defect is present. This method works exceptionally well if the problem is caused by thermal changes during operation.

An output capacity of 300 watts continuously or 500 watts intermittently makes this transformer suitable for operating equipment with heavy current demands—a color television receiver, for example. An 8-amp fuse protects the isolation-transformer components and the power-line fuses in the event of a short circuit in the equipment under test.

This instrument operates from 105-125 volts AC, 50-60 cps. A 3-conductor line cord is provided, with the ground wire connected to the case. The IP-22 (available in kit form) measures 9½" x 6½" x 5", weighs 18 lb, and sells for $54.95. ▲

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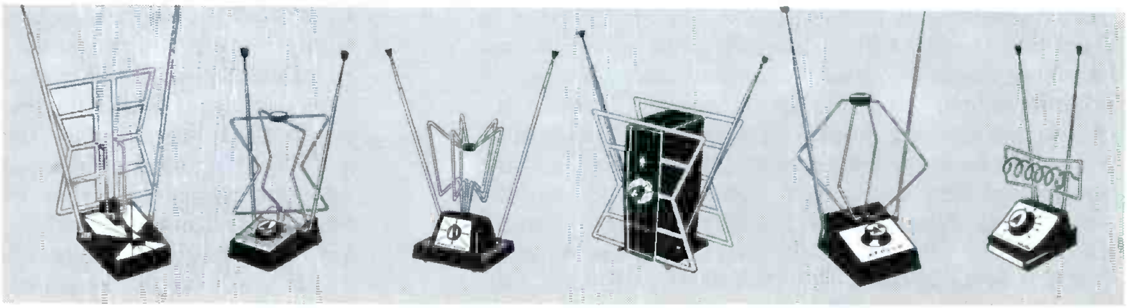

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Death Stalks the Rooftops

by Forest H. Belt

One recent hot day in July, on a rooftop in Pendleton, Indiana, a 22-year-old technician received a severe electrical shock when he cut into a television lead-in with his diagonal cutters. Subsequent investigation of the situation, led by Mr. Jack Clouse of Rodefeld, Inc., Indianapolis, disclosed a potentially serious danger to every television serviceman who works with antennas and lead-ins.

The young technician had climbed to the roof to replace an antenna lead. (As is common with rooftop installations, the mast was grounded.) He stood on a ladder, gripped the mast with one hand for added support, and reached upward with his other hand to cut the lead-in. As he cut, a strong AC voltage coursed through his arms and chest, and he was unable to relax his grip from either the mast or the cutters. Fortunately, the lady of the house, watching from the ground, had enough presence of mind to run inside and throw the main service switch. The young man collapsed, and subsequently spent many hours under oxygen before he was revived.

To determine the cause of such an unexpected event, investigators removed the chassis from the transformer-powered set and took it to a nearby service shop where it was thoroughly checked. Line filters were examined carefully, as were the interlock, the on-off switch, and all wiring associated with the input power circuits. There was absolutely no indication of any short, nor *any* clue as to why there had been an AC voltage of any kind on the lead-in. In fact there was no trace of voltage at the antenna terminals!

When the chassis was reinstalled in its wooden cabinet at the house and plugged in, a 100-watt light bulb connected between the antenna lead and earth ground burned brightly. A licensed electrician was called in to check the house wiring carefully, but no fault was found. It was determined further that the bulb was also brightly lighted when connected directly between the chassis and an earth ground. Successively disconnecting the lead-in from the set, the plug from the wall, and the power cord from the chassis produced a most startling and baffling result: With the set *completely* disconnected from all line power and from the antenna, THERE WAS ENOUGH VOLTAGE PRESENT BETWEEN THE CHASSIS (now apparently isolated) AND THE GROUND TO LIGHT THE BULB!

This uncanny event triggered an even more intensive examination, and shortly investigators found a tiny gray wire that lead from beneath the set to a tiny hole in the floor. Inspection revealed that one of the molded pair was connected across the speaker voice-coil. The other end, the investigators found, was connected to the speaker of a small AC-DC table radio in another part of the house.

At last they had the answer to this deadly booby-trap. The power cord of the AC-DC set was plugged in so that the chassis was hot when the set was off (reversing the plug would merely have resulted in a hot chassis when the set was on). In line with common practice, one side of the speaker circuit was grounded, and so was one side of the speaker circuit in the TV set (also not unusual). With the TV chassis thus connected directly to the power line through the hot-chassis AC-DC set, the lead-in became energized through the balun ground connection at the antenna input terminals. This potential killer had existed for a number of months, just waiting for an unsuspecting serviceman to start working on the antenna. The usual precaution of pulling the power cord provided no protection from this dangerous situation.

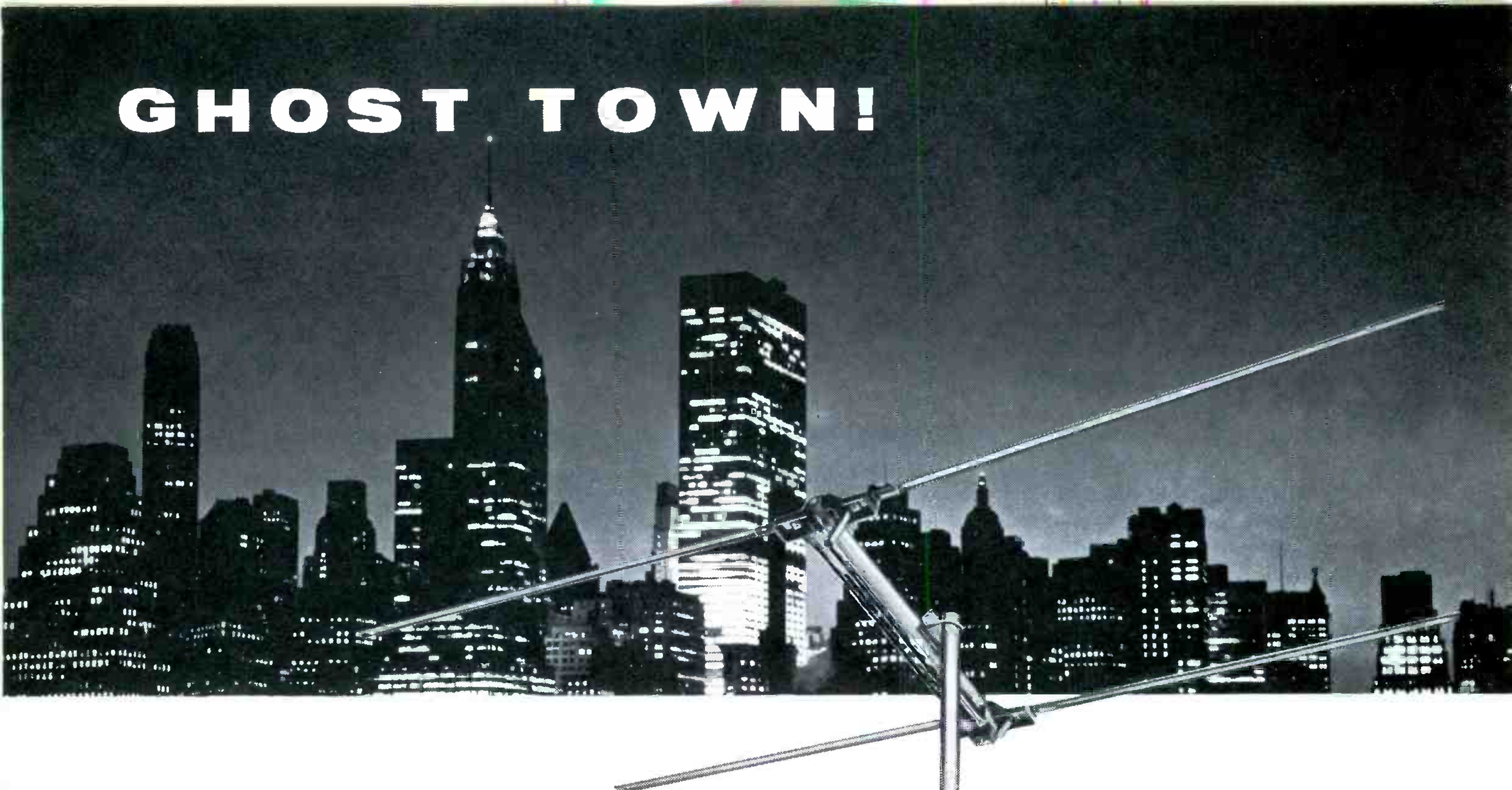
Considering the many different home-entertainment and intercom systems in which a common speaker buss might be used, and because the condition or configuration of the accessory equipment hooked to such a system is often unknown, it occurs to us that a few words of extra caution are in order for the many readers who might be unwittingly confronted with such a stealthy adversary in one of their customers' homes. Here are some precautions that could minimize the dangers of such servicing:

(1) Disconnect *every* lead from the receiver before attempting any servicing of the antenna or lead-in. This especially means disconnecting the lead-in itself from the antenna terminals.

(2) Connect a voltmeter from the disconnected lead-in to an earth ground. (A water pipe will do. Properly installed conduit boxes are grounded, but don't merely assume they have been correctly installed. The antenna ground system is another good ground point for your VOM while you check each conductor of the lead-in.)

(3) Use only diagonal cutters with insulated handles. (This is a good idea under any circumstances.)

(4) Always suspect any "extra" wiring that isn't a normal part of the installation. Even if *you* install the "extra" wiring, be absolutely sure you're not setting up a booby-trap for yourself, one of your helpers, or some other unsuspecting technician. ▲



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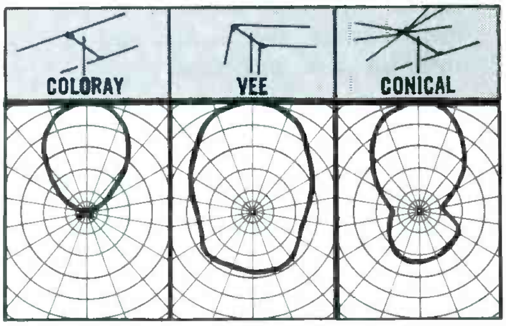

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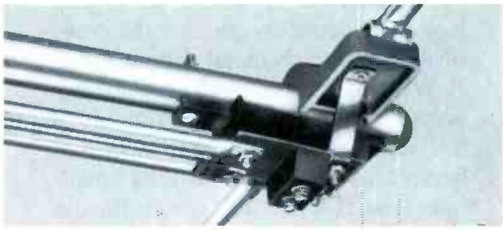

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TV CIRCUIT PROTECTION DEVICES

Many different types with one primary purpose.

by Rufus P. Turner

Automation is really nothing new to the electronics serviceman. Simple automatic control devices of one sort or another have been used in many circuits for years. Often these silent sentinels are used for protective purposes—to prevent self-destruction of the equipment in case of an overload. One example is the group of protective devices employed in TV receivers.

Television protective devices include fuses, fusible resistors, peak-limiting resistors, thermal relays, circuit breakers, and thermistor-type surge-protection resistors. These ordinary two-terminal components carry out their function automatically and dependably. Because of them the TV set owner, the design engineer, and the service technician are saved many headaches.

Some protective devices outlast the receiver; others need to be replaced occasionally since they destroy themselves to save the rest of the circuit. It is important that the service technician be familiar with these devices, their roles, and the rules for their replacement.

Fuses

The simplest and oldest of all automatic protective devices is the fuse. Whatever its size or shape, the fuse operates on the simple principle that excessive current will generate enough heat to melt the fuse wire or link, opening the circuit and disconnecting the equipment from the power source. Nothing in the fuse wears out unless the circuit is overloaded (except in rare cases of failure due to metal fatigue).

When a fuse is used in the low-voltage power-supply section of a TV set, it usually appears in one of two places—in series with the power line (Fig. 1A) or in series with the B– lead (Fig. 1B). To discourage tampering by laymen, the fuse often is soldered into the circuit and located under the chassis or otherwise concealed.

Tiny, glass-tube-type fuses are supplied in a wide range of ratings to suit various operating requirements. Typical quick-acting fuses are supplied with current ratings of ¼, ½, ¾, 1, 2, and 3 amps at 250 volts maximum. In some circuits, harmless surges blow the fast-acting fuse and unnecessarily deactivate the circuit; a slower-acting fuse is more practical for these applications. Fuses of this latter type have a long time-lag and can withstand a heavy surge or high starting current; however, they will open in the event of a short circuit or continued overload. This type is available in many current ratings between 10 ma and 30 amps at 125 volts maximum. Obviously, the use of a slow-acting fuse is inadvisable in a circuit which must be protected against surges.

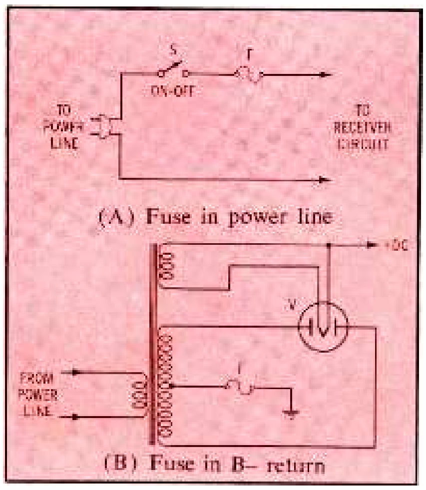


Fig. 1. Locations of some protective devices.

A blown fuse shows that something went wrong in the circuit to cause excessive current (find the fault and fix it before replacing the fuse) or that the fuse was too small or of an incorrect type in the first place (consult service data for the correct size and style).

The rules for fuses are simple and clear: Always use an exact replacement; use neither the next higher nor the next lower rating. Never substitute a piece of wire or other conductor for a fuse. To avoid electric shock, disconnect the power and discharge all capacitors in the fuse line before removing the fuse. Remove a clip-in fuse with a fuse puller designed for the purpose.

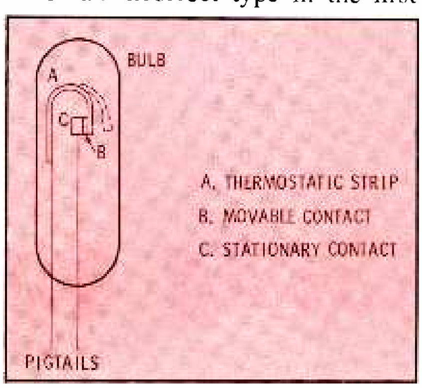


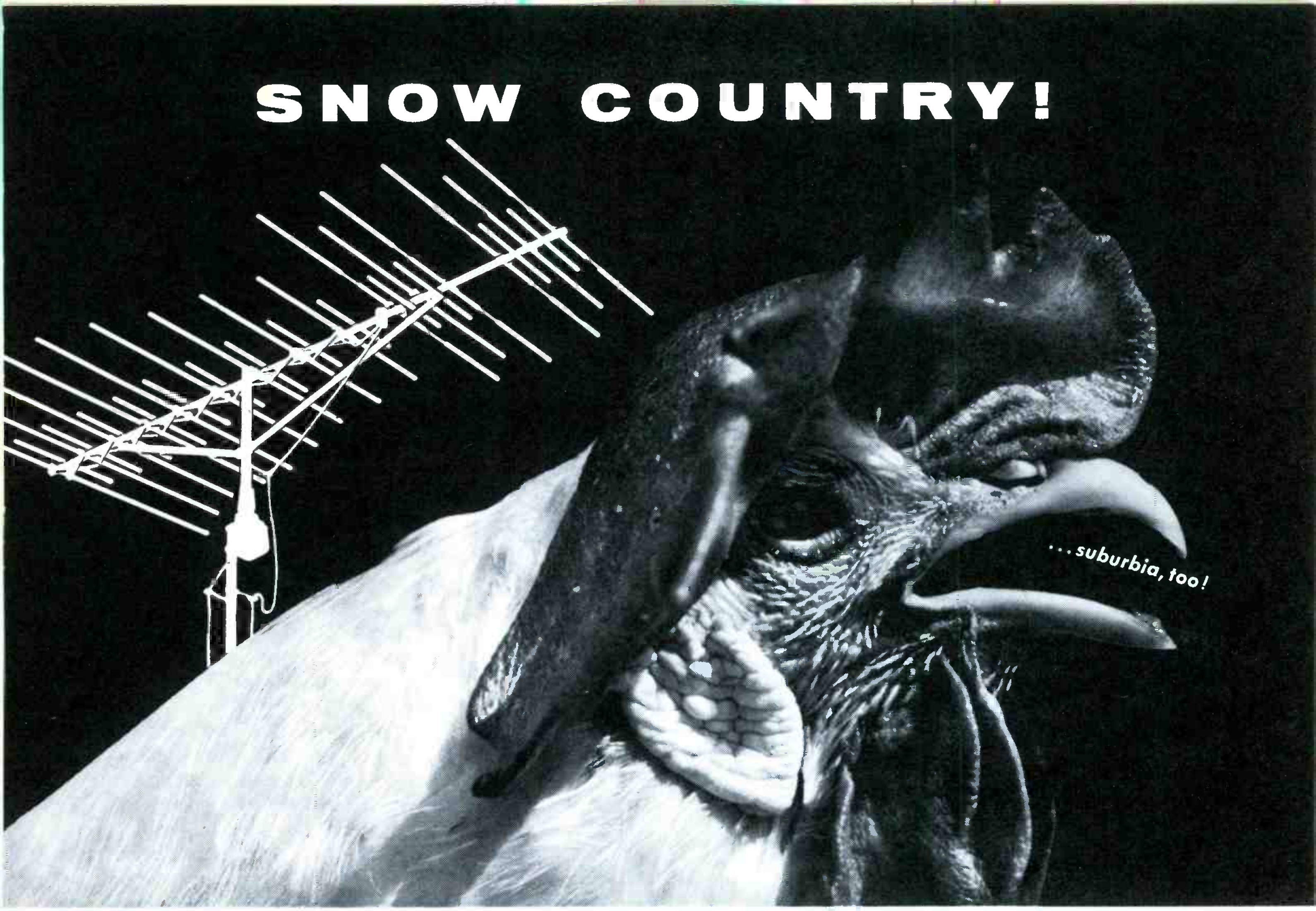
Fig. 2. A typical thermally-activated breaker.

Circuit Breakers

In doing its job, a fuse destroys itself, and it must then be replaced. A circuit breaker, on the other hand, opens an overloaded circuit without damaging itself and may be reset automatically or manually. As long as the overload remains, however, the circuit breaker will refuse to remain closed. Manual-type breakers are reset by hand; automatic types reset themselves after a brief interval.

The so-called thermal-cutout switch is one type of circuit breaker. Fig. 2 shows a miniature, thermally-activated circuit breaker of the automatic-reset type. The heat-sensitive element is a thin U-shaped metal strip (A) with a contact (B) on its free end. The strip is mounted so that its contact normally rests against a fixed contact (C) to complete the circuit. When excessive current flows through the device, the strip is heated and expands as indicated by the dotted lines; the circuit is thus opened. When the strip cools and relaxes to its initial position, the contacts reclose the circuit.

A typical device of this kind is mounted in a glass bulb and resembles a small neon lamp. It measures .30″ in diameter and is 1.26″ long. Pigtail leads are pro-



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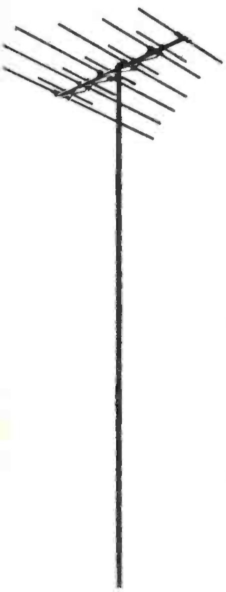

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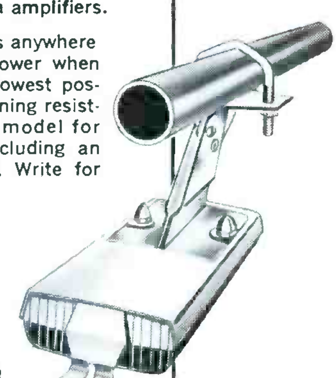

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vided to allow the breaker to be wired into the circuit it protects. It is an automatic-reset type of breaker that trips when the circuit current reaches 200% of the breaker rating. This particular breaker is available in two types, indicating and non-indicating. The indicating type lights when tripped and remains lighted until the trouble is corrected and the breaker resets; breakers of this type are connected in series with the power line and the load.

Peak-Limiting Resistors

In a typical low-voltage supply employing solid-state rectifiers, heavy current rushes through the rectifier into the uncharged filter capacitors when the set is first turned on. At that instant the input capacitor appears as a short circuit, and the resulting current surge could destroy the rectifier. To prevent this, a peak-limiting resistor is connected in series with the rectifier, capacitor, and AC source. This resistor then limits surge current through the rectifier to a safe value.

The presence of the peak-limiting resistor must not, of course, interfere with normal operation of the circuit. Hence, its resistance must be quite low in order to minimize the voltage drop at normal operating current. In usual practice its value seldom exceeds 7.5 ohms.

Fig. 3 shows a half-wave circuit employing a solid-state rectifier, D. Here, R1 is a 3-ohm, 5-watt peak-limiting resistor. If the power supply normally delivers 100 ma at 100 volts, the voltage lost across this resistor (3 x .1 = .3 volt) is not enough to be noticeable. A 1¼-amp slow-acting fuse (F) is included for regular circuit protection.

Fusible Resistors

The circuit shown in Fig. 3 contains both a peak-limiting resistor (R1) and a fuse (F). It is common in TV sets, however, to combine the resistance and fusing functions in a single component—the fusible

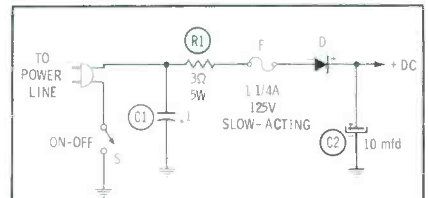
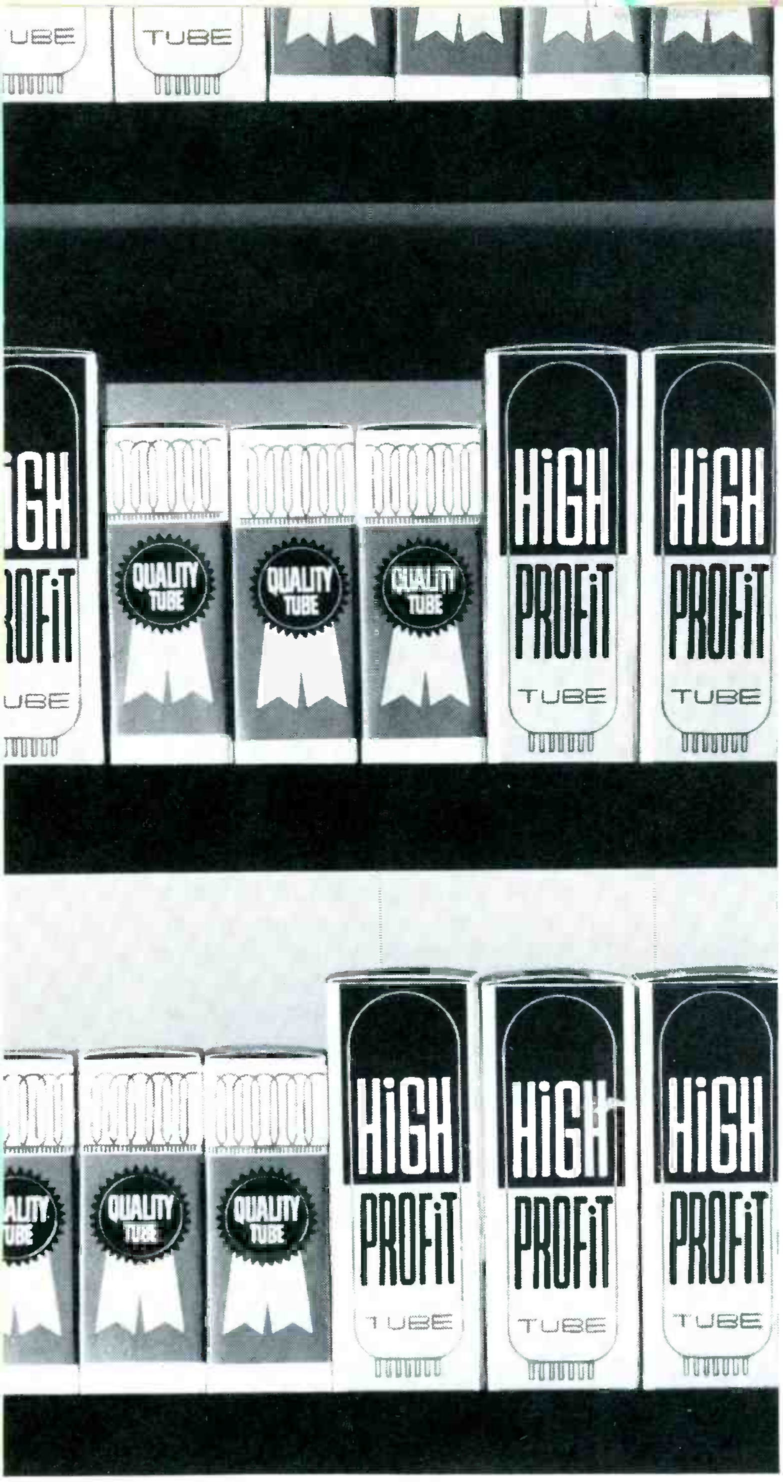
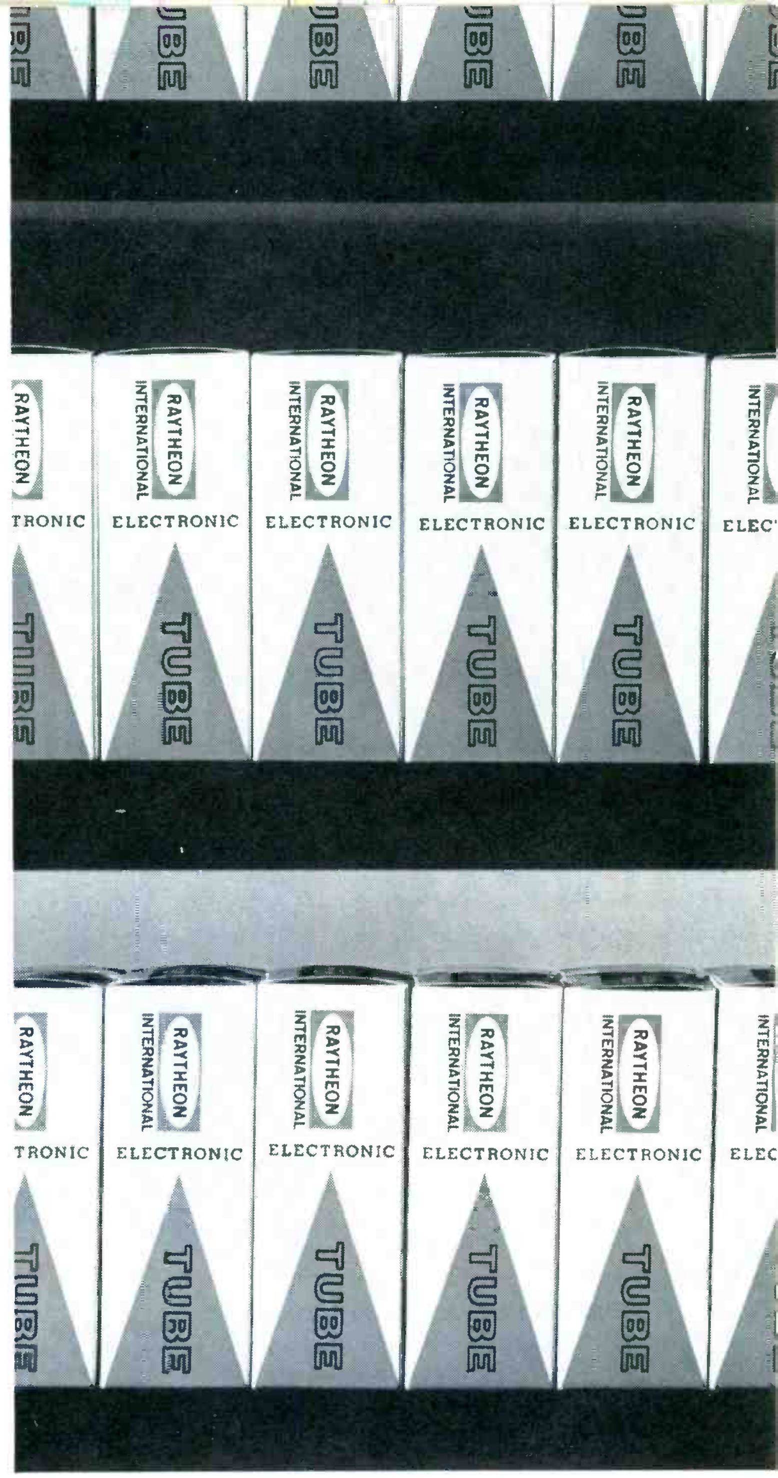


Fig. 3. Peak-limiting resistor in supply filter.





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resistor. As its name signifies, this device has a resistive element which opens when excessive current passes through it. Such resistors are often of plug-in design, such as R2 in the voltage-doubler power supply shown in Fig. 4. In other cases, they have pigtails which allow them to be soldered into the circuit.

Common resistance values for fusible resistors are 4.7, 5, 5.6, 7.5, 9, and 22 ohms. Always replace a fusible resistor with one of the same type and identical resistance; never replace one with a conventional resistor.

Thermistor-Type Protective Devices

The resistance of a tube filament is low when the tube is cold and high when it is hot. This variation introduces a problem in sets employing series-connected filament strings; when the set is first turned on, the current can be high enough to burn out one of the tubes or at least to shorten their life. As the tubes come up to normal operating temperature, their filament resistance rises, and the current settles to normal.

A filament-protective resistor au-

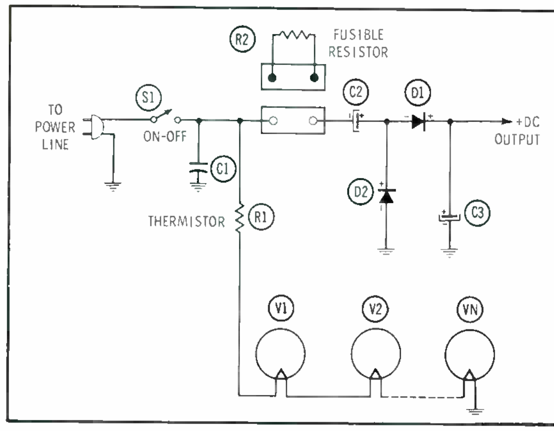


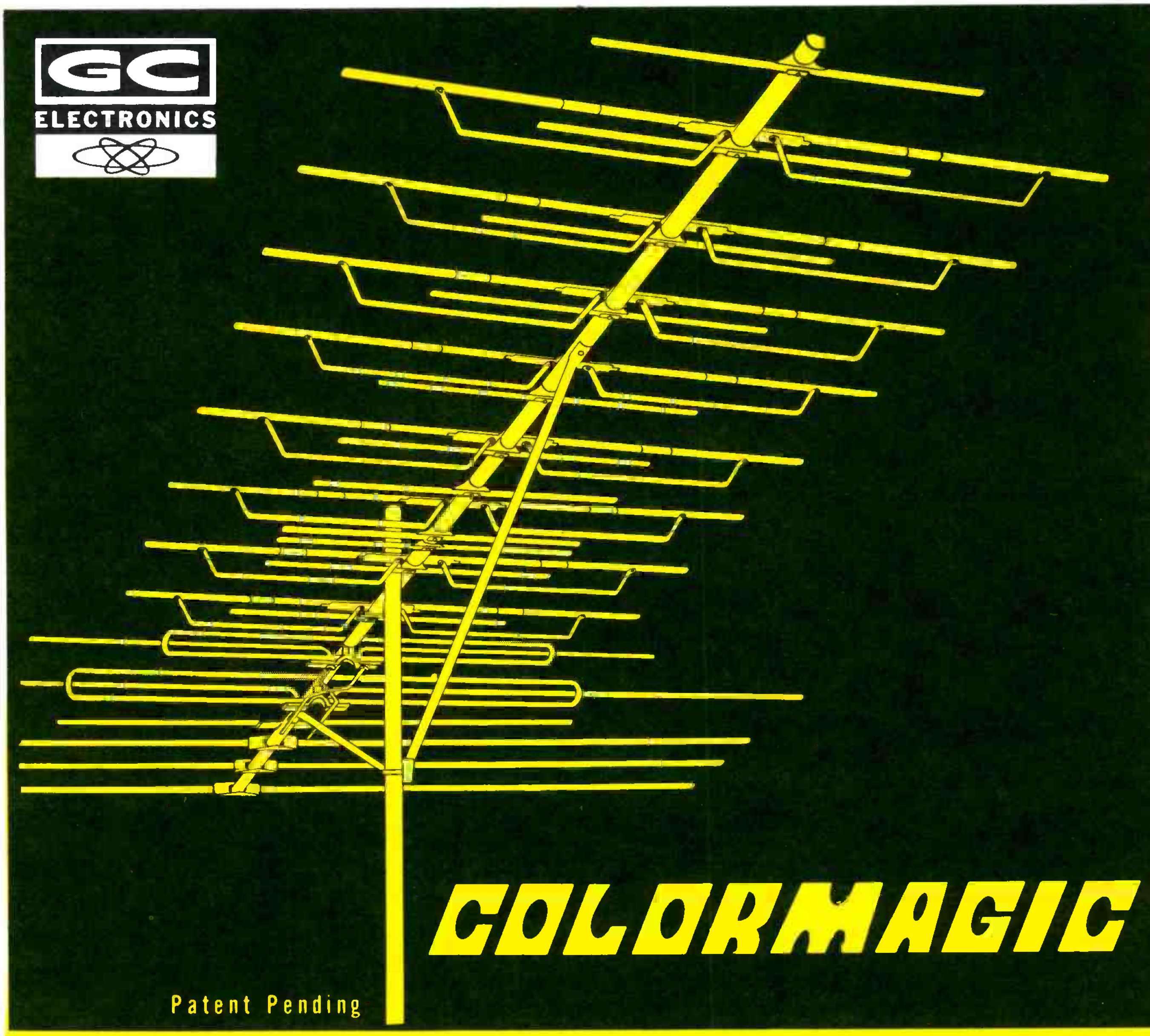
Fig. 4. Two types of protective resistors are often used in television power supplies.

tomatically prevents such a damaging initial surge of current. This component is a type of thermistor (thermally-sensitive resistor). It has a resistance-temperature characteristic opposite to that of the tube filaments; its cold resistance is high, and its hot resistance is low. When the set is first switched on, the thermistor limits the filament current to a safe value. As the filaments come up to temperature their resistance increases. At the same time, the resistance of the thermistor decreases, and the current is allowed to reach its normal level. A resistor of this type is shown as R1 in Fig. 4. Such filament-protective devices are available from most manufacturers of standard resistors and resistor elements. Always use an exact replacement for a broken or defective filament protector.

Sometimes an entire receiver is protected by a thermistor-type regulating resistor connected in series with the power line and the entire receiver circuit. This type of protector limits a potentially destructive voltage surge to about 25% of normal, but still allows full voltage to be applied to the circuit after warm-up. These protective resistors are invaluable when selenium rectifiers are replaced with silicon diodes, because of the higher voltage output.

Conclusion

While much of the information presented in this article may seem obvious and elementary, the very nature of protective devices makes them easy to overlook or treat lightly. Such a lapse on your part can result in damage to the equipment and expenditure of excessive time, both of which cost you money. Let these devices do their job, and you'll receive the benefits. ▲



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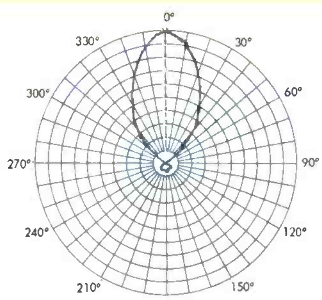

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Transistorized UHF TUNERS

A servicing analysis of the newest tuners . . . by Allen B. Smith

The all-channel ruling which became effective on April 30 this year has many implications of interest to the television serviceman. The most important of these implications is undoubtedly the fact that we are going to be faced with a little "black box," the UHF tuner, with which some may be unfamiliar. Most of the VHF-only sets will have been sold by early Fall, and from that time on, UHF tuners will be increasingly evident in shops throughout the country.

Most of the UHF tuners that have reached the market so far have used tube-type oscillators, but transistorized tuners are becoming more popular. This is true for several reasons, not the least of which is that the advent of economical high-frequency transistors has brought the cost of transistorized tuners in line with that of tube types, allowing manufacturers to ride the crest of solid-state consumer enthusiasm.

There are other practical reasons, some mechanical and some electrical, which will increase the number of transistor UHF tuners. A transistor soldered directly into the oscillator circuit eliminates several potential problems in mechanical orientation and does away with the socket, feedthrough capacitor, and heater choke. Cooler operation reduces the effects of heat on frequency-determining components, all of which are relatively critical at ultra-high frequencies. A single model of a transistorized tuner may be used with either series-string filaments or transformer-powered ones, as the tuner requires only one power connection. Finally, since most of the troubles in earlier UHF tuners can be traced to the oscillator tube, the increased reliability and longer life expectancy of planar-epitaxial NPN transistors promise greater trouble-free operation. With the certainty, then, of more transistorized tuners, let's examine them a little more closely.

UHF Fundamentals

Perhaps it would be advisable to review a few of the peculiarities inherent in working with ultra-high frequencies. The most characteristic difference between UHF and VHF circuits is the manner in which UHF signals react to standard inductors and capacitors. At frequencies in the region from approximately 450 mc to 900 mc, the familiar helical-wound inductors not only exhibit excessive inductance and distributed capacitance, but also fail to provide a suitably high Q for efficient tuned circuit use. Similarly, the usual multiplate capacitor suffers from excessive capacitance and internal inductance, and its physical design contributes to high circuit losses. Since the UHF-TV band is in the rather awkward region where tuned cavities are too large and standard tuned circuits are too inefficient, UHF tuners utilize inductors and capacitors of specialized configuration. Generally speaking, an inductor at ultra-high frequencies will be a single rod or bar, and its companion capacitor will consist of two or three adjustable plates adjacent to an extension of the inductor.

Fig. 1A shows the construction of a typical series-tuned resonant circuit in which the inductor is a rod with two flattened portions which form the stator plates of the capacitor. The rotor plates are mounted on the tuning shaft. The schematic

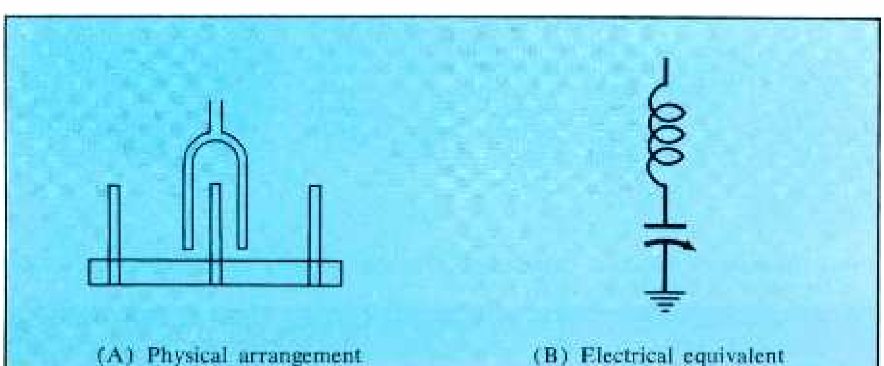

Fig. 1. Physical and electrical arrangement of a typical series-tuned UHF tank circuit.

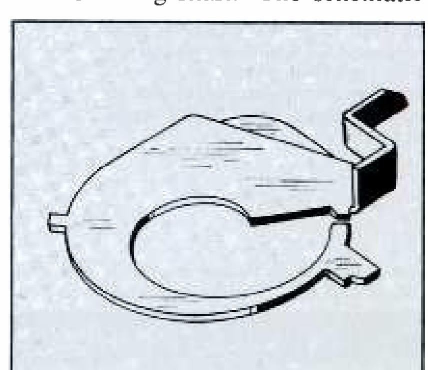

Fig. 2. Ring inductor found in some tuners.

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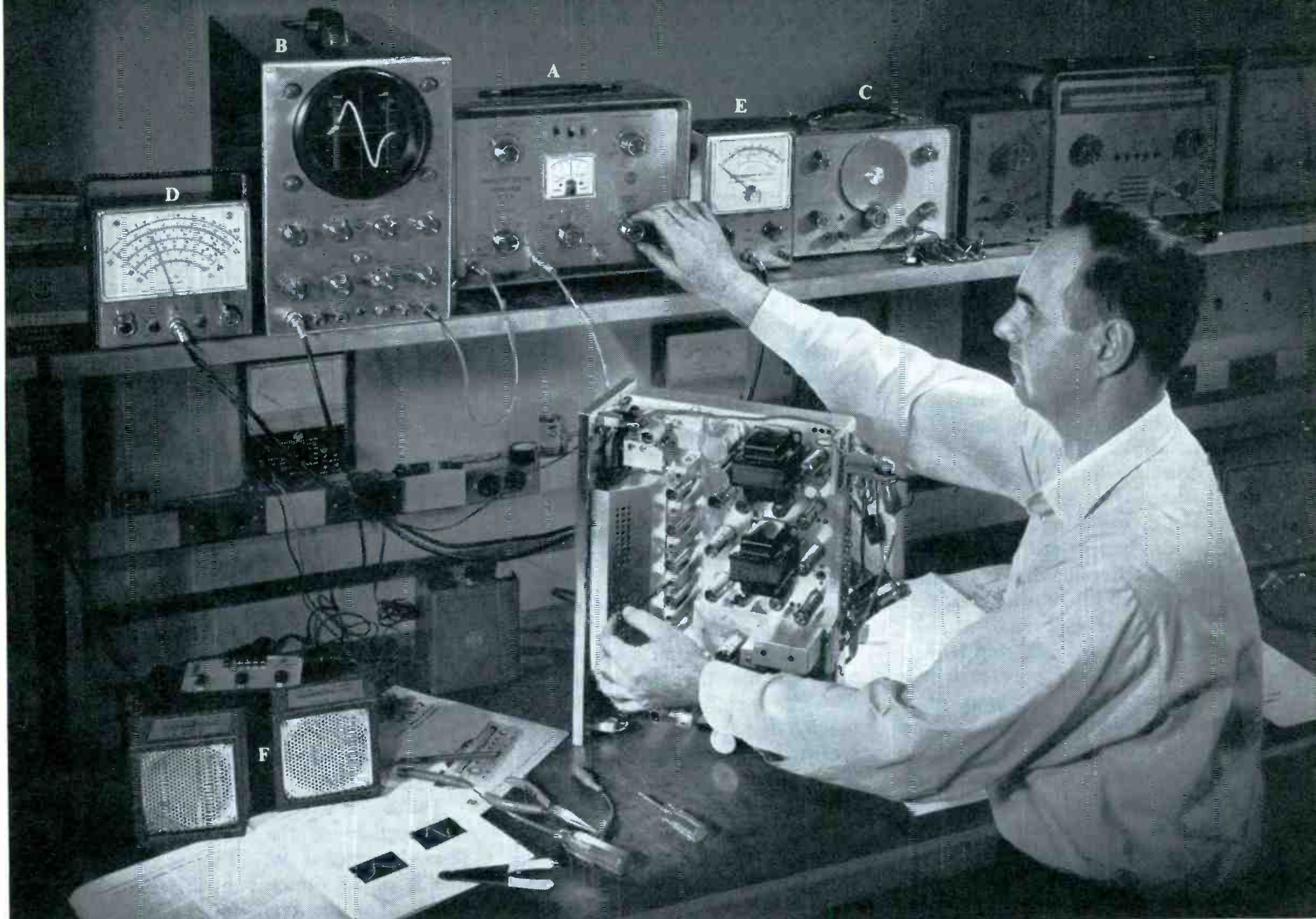
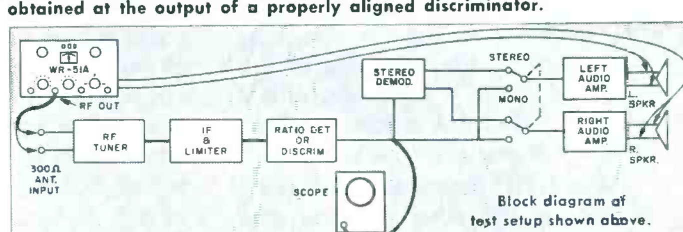


Aligning the discriminator in an FM multiplex stereo receiver, using an RCA WR-51A Stereo FM Signal Simulator and an RCA WO-91A Oscilloscope. Display on scope screen is the trace obtained at the output of a properly aligned discriminator.



Block diagram of test setup shown above.

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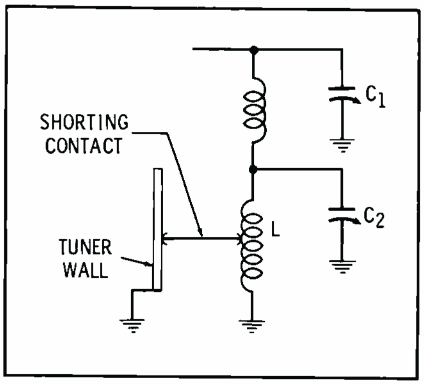

Fig. 3. Schematic of inductance-ring type.

equivalent is shown in Fig. 1B. Both the inductor rod and the capacitor plates are silver plated to minimize losses by "skin effect."

In a second type of UHF tuned circuit, the inductor is shaped as shown in Fig. 2. This inductance ring normally functions as one side of a tuned line of approximately one-twelfth wavelength at 470 mc. The other element of the tuned line is a flat plate mounted near the ring and parallel to it. In usual practice, the plate is one wall of, or a partition in, the tuner. The ring is then tuned by a rotary contact which progressively shorts portions of it to the wall. The radial width of the ring is tapered to provide a straight-line frequency characteristic. The ring, the adjacent wall, and the wiper are all silver plated; the ring has an additional gold flashing to aid in controlling wear and to avoid electrochemical erosion of the elements in the inductance circuit. A schematic representation of this circuit is shown in Fig. 3. Tracking adjustment at the low edge of the band (470 mc) is accomplished with C2, while C1 adjusts tracking at the high end (890 mc).

Most UHF tuners use some form of one or the other of these two basic configurations, differing primarily in mechanical characteristics.

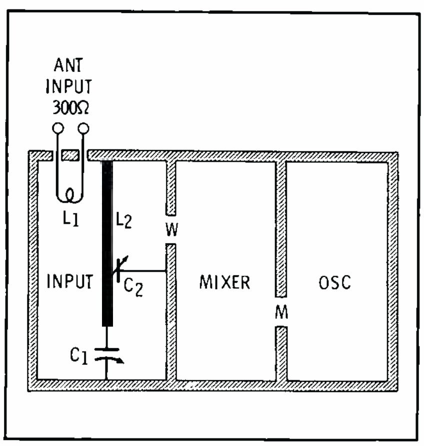

Fig. 4. Case configuration of typical tuner.

Mechanical Considerations

A typical UHF tuner is constructed in a rigid, three-compartment case formed from heavy-gauge copper. Since tuned UHF circuits depend heavily upon mechanical rigidity for their stability, this type of construction provides the required ruggedness and additionally offers a means of isolating each stage: the unamplified preselector input stage, the mixer, and the local oscillator. Radiation from the oscillator is minimized, and shielding of the preselector is also enhanced by the compartmented approach.

Fig. 4 shows typical case construction along with a schematic representation of the input or preselector circuit. Each compartment is approximately the same size as the others and will contain the tuned-circuit components for that stage and some or all of the remaining circuit elements. Coupling between the preselector stage and the mixer is capacitive, through window W. The mixer circuit itself is not tuned; the second tuned line increases image rejection by the preselector and matches the antenna circuit to the mixer.

Since the mixer diode is located in the same compartment as the second tuned antenna circuit, the input signal is usually coupled inductively to the diode. In some tuners, however, the signal is direct-coupled to the mixer by means of an autotransformer. The diode itself (usually a 1N82A or equivalent) is most often mounted in a pair of clips to facilitate replacement or testing, but may be soldered into the circuit. A bent loop projecting into the oscillator compartment through window M couples the injection signal from the oscillator to the mixer.

The oscillator compartment contains the tuning circuit, the trimmers, and—in most tuners—the oscillator transistor itself with its related components. In some tuners, the oscillator transistor and its companion circuitry are mounted externally.

Basic Circuitry

For a typical UHF tuner incorporating a tuned passive input, a diode

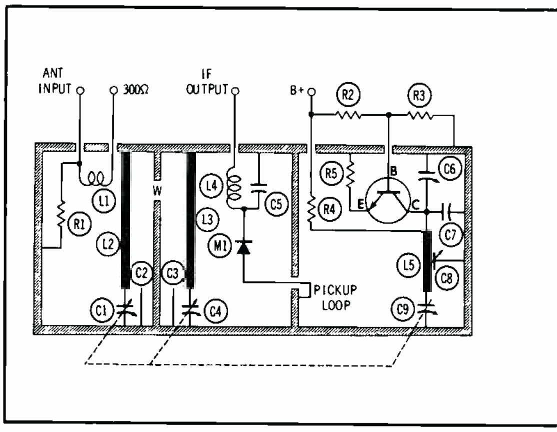

Fig. 5. Schematic of a typical UHF tuner.

mixer, and an internally mounted transistor oscillator, the schematic will resemble that shown in Fig. 5. Other types of tuners are essentially similar—enough so that a single explanation should serve for most basic circuit functions.

A station signal in the range of 470 mc to 890 mc is coupled to the first tuned antenna line through L1, which consists of a few turns of wire in a loop mounted adjacent to inductance (rod) L2. The input line is tuned to frequency by C1; capacitor C2 is a trimmer for the high end and consists of a narrow metal tab which can be bent toward or away from the electrostatic field of C1.

The signal is coupled to the second section of the antenna line through window W. The second line is tuned similarly by C4 and trimmed at the high end by C3. Coupling to mixer diode M1 is inductive since the diode lead is located in the field of the tuned line.

The oscillator section is mechanically similar to the others, and is fairly simple electrically. A tuned line (L5, C9) tunes the modified Colpitts oscillator; capacitor C6 trims the low end, and trimmer tab C8, the high end. Operating voltage is obtained from the low-voltage supply in the set through a series dropping resistor. The supply voltage varies among different tuners, generally ranging between 12 and 20 volts DC. RF voltage from the oscillator is coupled to the anode of the mixer diode by means of the pickup loop which projects into the oscillator compartment. IF output from the mixer is generally around 40-45 mc.

It is apparent, then, that this little box which at first seemed a bit perplexing is really a pretty simple

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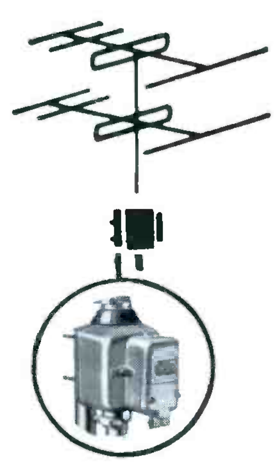

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component once a few basic considerations are established.

Servicing Hints

Because the basic tuner case is sturdy, and all components are firmly mounted to it, we can reasonably expect few mechanical problems. The rotor elements of the ganged tuning capacitors, as a rule, will also remain trouble free. Barring outright mistreatment, therefore, mechanical faults should be minimal. The simplicity of the circuitry also suggests that we could expect few problems from components. This is generally true, except in the case of the transistor itself, and in that of the diode to a lesser extent.

The 1N82A mixer diode, commonly used in many tuners, has a good noise figure and high conversion efficiency. In cases where the picture becomes snowy (sound remains good), the diode should be suspected. Since most tuners use a double clip to hold the diode, replacement is easy; and no realignment will be required.

While mixer faults are relatively uncomplicated, those contributed by the transistor are in a different category. Because most manufacturers solder the transistor into the circuit, the serviceman is faced with a variety of prospects. Its location in a rather cramped space means that, should replacement be required, extreme caution must be exercised to keep from damaging nearby components and to avoid physical misalignment of frequency-critical circuit elements. The use of a soldering aid and the application of heat for short periods only (no more than five seconds) is recommended by some tuner manufacturers. Most service bulletins also stipulate the use of 3% silver solder in all replacement operations involving RF components, including silvered-button capacitors and feedthroughs. Voltage measurements to determine proper operation of the oscillator should be taken from the manufacturer's service data.

Alignment

Extremely important to the proper servicing of UHF tuners is the realization that efficient UHF tuner operation (and therefore proper operation of the entire set) depends heavily upon correct tuner alignment. Since replacement of any component in the oscillator compartment will in all probability detune the entire stage, a complete realignment is in order whenever replacements are made. Time consuming? Perhaps yes, initially, but once the proper equipment setup and procedure has been established, you'll find it takes only a few minutes; the rewards in increased tuner efficiency and customer goodwill will be large and profitable.

Various manufacturers have different suggestions regarding alignment, but the basic procedure is the same and requires a UHF sweep generator with a 300-ohm matching pad, an oscilloscope, a marker generator, and a milliammeter to check the mixer-diode injection current. The steps prior to alignment are simple:

1. Allow about 15 minutes warmup time.
2. Make all adjustments with oscillator cover in place.
3. Check service data for location of adjustments and for specific procedures.

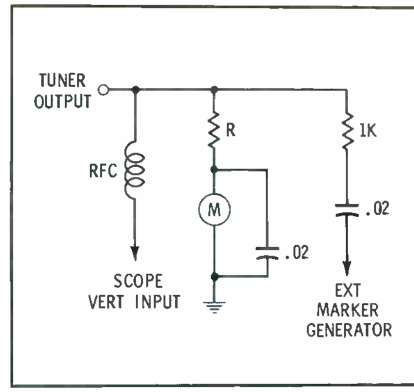

Fig. 6. Setup for sweep alignment of tuner.

4. Use matching pad between sweep generator and tuner input terminals.

Actual alignment is nearly as straightforward:

1. Connect tuner output to scope through circuit similar to that shown in Fig. 6. Meter has 0-5 ma range. Resistance of R plus that of the meter should total 20 ohms.
2. Set tuning control to low end and set marker generator to specified center of bandpass curve (check service data). Set sweep generator at 468 mc. Adjust low-end trimmer until marker is centered on curve as seen on scope.
3. Set tuning control to high end and sweep generator to 900 mc. Marker generator remains at same specified center frequency as in Step 2. Adjust high-end trimmer to center marker as in Step 2.
4. With all controls as in Step 3, adjust mixer pickup loop by bending in or out of oscillator compartment for milliammeter reading of .75 to 2.25 ma (for 1N82A).
5. As final check, tune through entire range (channel 14 to 82) to see that mixer injection current stays within manufacturer's tolerance. If it does not, readjust pickup loop until it does.

Conclusion

All-channel transistorized tuners can mean increased problems for any serviceman who leaps before he looks. A few moments spent in a review of UHF fundamentals and with the manufacturer's service suggestions can make the "little boxes" a means of creating among your customers increased respect for and confidence in your ability. ▲

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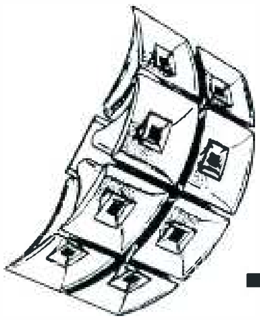
Circle 40 on literature card

by James M. Moore



AUDIO — SIDELINE or MAINLINE?

Whenever you contemplate adding a new line to your present servicing (or selling) business, there arises the immediate question—is the new undertaking to be a sideline or mainline? That is to say, will it merely be an addition to your present activities, or do you plan to make the new line your predominant one? In arriving at a decision, a number of factors must be considered: Is there a lasting demand for this particular product or service? If such a demand doesn't already exist, can it be created? If new investments are necessary, can they be reconciled with the expected volume of business? By arriving at honest answers to these questions, you can determine how extensively you should go into the new business activity.

Is There A Market?

Obviously, you can't expect a new business line to be successful if nobody is interested in buying your goods or services. Therefore, the first step in deciding whether to start such an enterprise is to analyze the potential market.

Types of Markets

The reproduction of sound finds application in many different ways. The one that first comes to mind is the area of home entertainment—high fidelity. Several factors influence the demand for high-fidelity equipment in a given area. The people's tastes in music influence how fidelity-conscious they are. If most of the people in a community have modest incomes, the market for costly stereo systems will be small. On the other hand, in an area of high-income families there is a good prospect of selling and servicing expensive stereo high-fidelity equipment. In an area of the latter type, the technician who really knows audio can earn a sizeable income by making custom installations. Naturally, these factors are variable, but as a member of the community you should have a pretty good idea about conditions in your locality.

A demand for public-address and intercom systems can be encouraged in most communities. Churches, manufacturing plants, and schools are prime prospects in this regard. A little investigation will enable you to make a good estimate of the number of customers you can expect to attract. You may find that a considerable market for rental equipment exists.

Schools in particular are making extensive use of sound equipment. Complex intercom and audio-distribution systems are finding increased use. Audio teaching aids of numerous types are being used for language instruction and other purposes. Even though such systems may already be installed, they represent potential servicing jobs in the event you decide to go into that phase of the business. If you decide to establish a really ambitious audio department, you may want to seek some design and/or installation projects as well. Keep in mind, though, that activity of this sort requires highly specialized skills and tools. If you enter such a field poorly prepared, you will very likely be in for trouble.

One good way to build up an audio servicing business is to sign a contract to do service work for one or more retailers, discount houses, etc., who sell audio equipment. This can bring you a sizeable portion of the market in one stroke. You may also choose to collect the results of your market survey and use them as a selling point in obtaining service contracts or dealer franchises from one or more manufacturers or suppliers of audio equipment.

Competition

Another important factor to be considered in evaluating your potential market is the nature of the competition. If a competitor is already catering to the audio trade, you must be especially careful in evaluating the demand. Is there really enough business for more than one shop? Remember that when you enter the picture your competitor is going to step up his efforts, and he will have the advantage of being already established. Also consider the possibility that other shops not now engaged in the audio business may follow your lead in entering the field. You must be prepared to do a competitive selling job. If you can't reconcile the effort required with the expected results, you would be well advised not to enter the field at all.

If you are in a one-shop community, you may really have no choice about being in the audio business, particularly as far as servicing is concerned. People will naturally bring their audio-equipment problems to you. You may find that you can increase this business with a little promotion. Furthermore, you may be able to use this service activity to launch the sale of audio equipment.

In case you are in a small community, you should be watchful for one further element of competition: The fact that you have no local competitor doesn't mean that you'll have no competition at all in the audio business. In a specialized field such as this, dealers and servicemen frequently extend their activities to neighboring communities, especially to the suburbs of larger cities. Sometimes they operate over rather wide areas. Of course, this principle can work both ways; you may decide to expand the geographic scope of your own activities.

Other Factors

When evaluating your market, consider whether it

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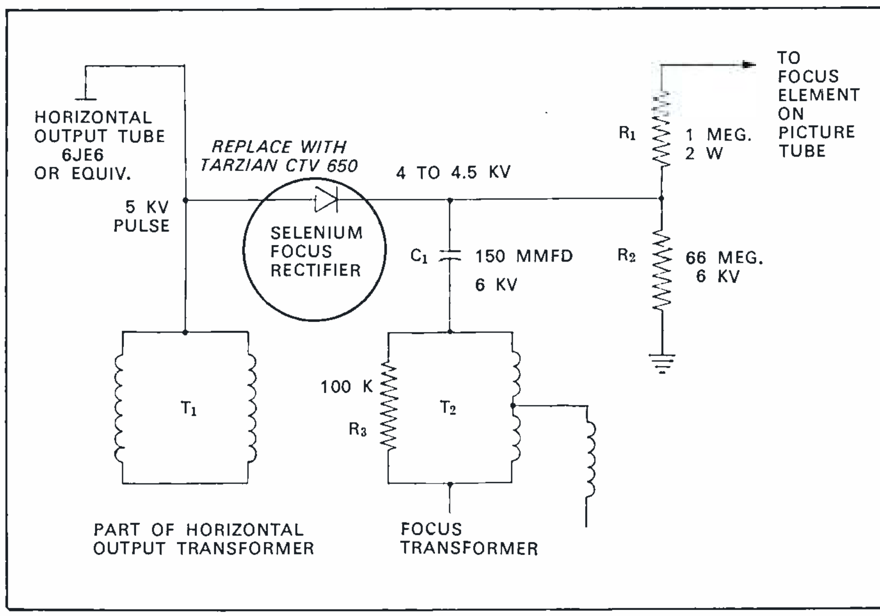

Insertion of Tarzian Silicon Rectifier CTV650 provides improved focus control for the life of the set.

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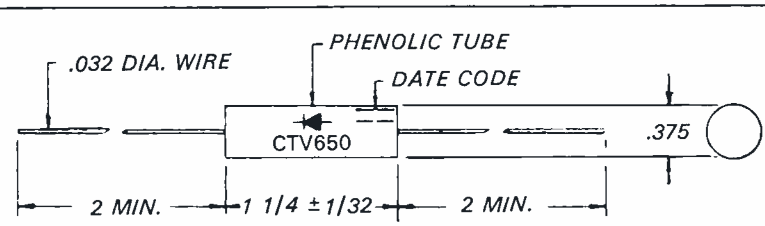
Dumont	1440977-1	Packard Bell	72110
Olympic	1440977-1	Philco	34-8053-2
RCA	1440977-1	Silvertone (Warwick)	86-44-3
Emerson	817123	Sylvania	16106-1
		Zenith	212-48

Tarzian CTV650 replacement rectifiers are available from your distributor. List price for this life-of-the-set device is only $8.35.



Tarzian Rectifier CTV650 for color TV focus circuits.

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is of a temporary or long-term nature. In a highly specialized endeavor, business may boom for a time, but then the market may become saturated. This condition is unlikely to arise in servicing (unless the particular type of equipment becomes obsolete), but it should be given some thought with regard to sales.

You can obtain useful information about the extent of the market by talking to your present customers, to retailers, etc. Try to estimate in terms of dollars and cents the amount of business you can expect from each category you investigate. As you study your market, other important factors may become evident. Investigate each of them carefully. Your estimate of potential business volume provides the basis for giving more intelligent thought to some other important considerations.

Special Requirements

Even though all electronics equipment is based on the same general operating principles, each type presents its own peculiar servicing problems. In audio you may encounter some unusual circuits; and if you are in the business very long, you are bound to be faced with mechanical devices, such as tape transports, turntables, and record-changer mechanisms. These are high-precision machines and must be treated as such.

In most audio applications, a higher level of equipment performance is demanded than is usually required in TV. This is especially true of high-fidelity installations; the really serious enthusiast will not settle for anything less than the best possible performance from his entire system. Don't be surprised if this customer hears distortion or other abnormalities that you can't. You'll find that routine methods aren't sufficient to produce the extra reduction of distortion or hum that he demands. In summary, audio servicing, if done right, requires special equipment, knowledge, skills, and tolerance of the customer's viewpoint.

Equipment

If you are going to limit your activities to servicing amplifiers and tuners alone, you may be able to get by with the test equipment you already have. However, you'll need some specialized test aids to service tape machines. A few other specialized test instruments will enable you to do a thorough job on amplifiers and tuners as well.

With these requirements in mind, a fully equipped audio service shop should have, in addition to the usual equipment: a good-quality scope, a low-distortion audio generator, a good RF generator (preferably a sweep generator), a distortion meter, an audio voltmeter (covering 1 mv to 300 volts), a wow and flutter meter, a stroboscopic speed gauge, and at least one alignment tape.

Most of these items are moderately priced and are available from several sources. Even so, and even if you already have some of the equipment, a sizeable equipment investment is indicated. If you set up a separate audio department, the equipment you already have will probably need to be duplicated. As you add up your projected equipment costs, the value of a thorough market investigation will become increasingly apparent.

Many successful shops do servicing work without, say, a wow and flutter meter. You will have to evaluate your need for each test instrument with respect to the kinds and number of repair jobs you expect to handle. Keep in mind that if you are going to undertake this type of work, you should try to provide the best service possible.

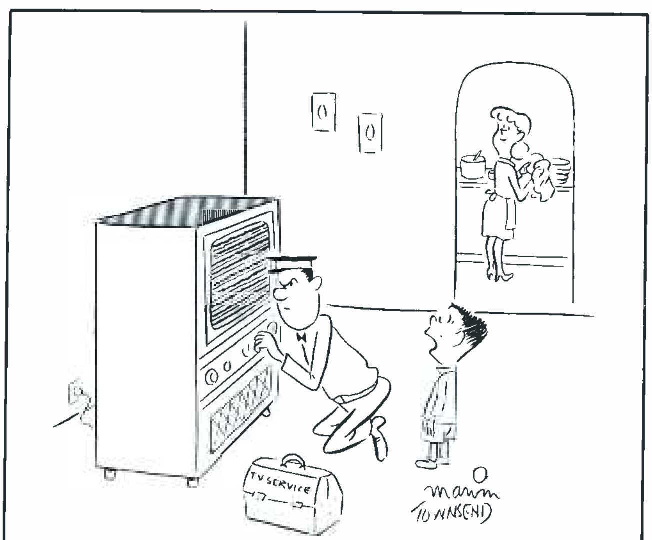
Training and Experience

As a serviceman, you know that the best test equipment made is of no value unless the technician knows how to operate it, what tests to make, why he makes them, and how to interpret the test results. To be fully competent in the field of audio—particularly in system design and installation—the technician must have knowledge of electronics, mechanics, acoustics, and sometimes even interior decorating. All this knowledge cannot be acquired overnight. You will have to read—and study—publications on the subject, talk to others in the business, enroll in a formal training course, or undertake a combination of these. All of this, of course, involves the expenditure of time and money. You'll have to weigh the expense against the results you expect to achieve.

There is, of course, a quicker way to obtain the advantages of audio-servicing training and experience: Hire a new man for the department. Obviously the amount of new business must do far more than offset the expense of paying this added employee; and if he is competent, you'll have to pay him well. Furthermore, you may have some difficulty finding such a man. Nevertheless, if you decide that you can attract enough business to keep a full-time audio man busy, this may be your best approach.

Other Considerations

An important factor to consider in both service and sales is the inventory you'll have to maintain. Do you have the necessary space? Can you justify tying up a substantial amount of money in parts and merchandise? From time to time you'll have need for unusual replacement parts. Can you afford to stock a variety of these? Will you have to stock them, or can they be obtained with relative speed from a distributor or other source?



"I can get it to do that."

Whether you engage in sales, servce, or both, your shop must present a neat and clean appearance. If you plan to sell audio equipment, you must make provisions for displaying it. To do this effectively may require revamping your display area. First be sure you have enough space; then consider the best display method to use. In the case of high-fidelity equipment, you'll want to be able to give some sort of demonstration of systems and components. This means that the room should have reasonably good acoustics and be as free as possible from extraneous noise.

How Much Audio?

With your data collected and organized, you are ready to sit down and do some figuring. For each alternative you consider, compare your income estimate with the total projected cost. In this way you can evaluate how extensive an audio effort, if any, you should undertake. When listing estimated expenses, don't forget increased expenditures for taxes, insurance, rent, heat, light, interest, etc., where applicable. Make allowance too for extra advertising and promotional expenses.

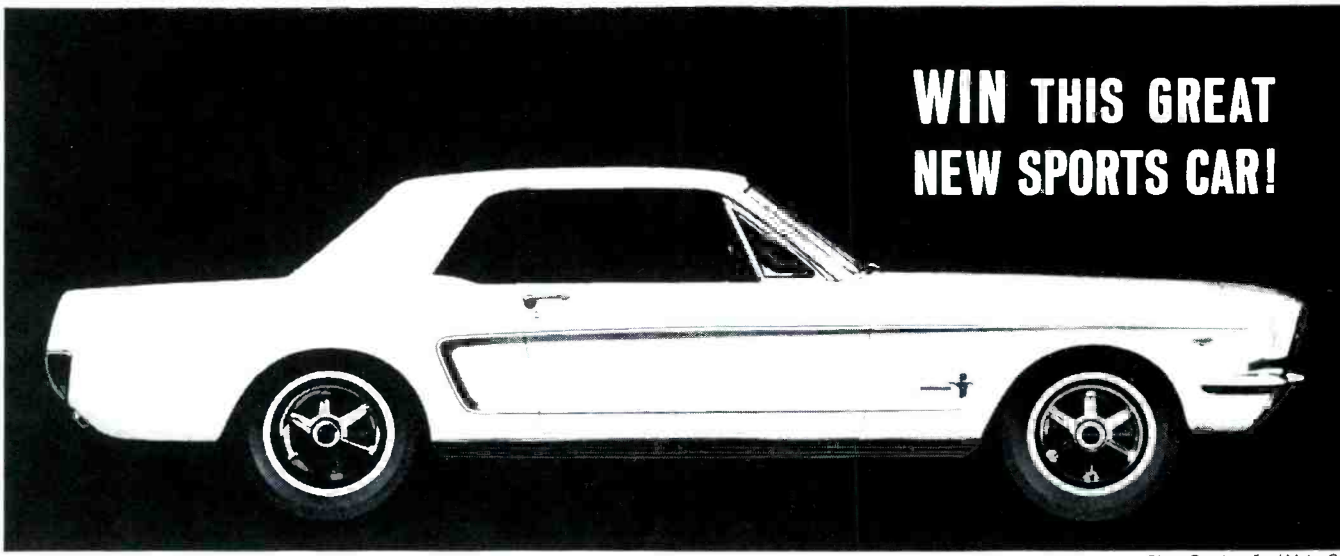
There are several degrees of involvement you may wish to consider. You may want to try promoting audio servicing with no additional investment, using your present facilities. In most instances you will be limited in the results you can achieve with this method. You may be operating very near to capacity already, and have little time to do justice to a sideline. It may develop that you will not be able to handle all the jobs that come into your shop, and you may have to turn some customers away. This is no way to expand business. On the other hand, if the potential servicing volume seems small, you may be able to absorb it into your operation with little trouble.

At the other extreme, a large market potential may indicate the need for a complete audio sales and service department. Since you stand to lose a great deal here if you fail, great caution is indicated in considering this possibility.

No matter how good the prospects might appear, it would be inadvisable—if not downright foolhardy—to completely abandon your present, successful business in favor of a new, untried venture. However, if your new department proves successful, you may decide to make a complete transition later. This is not to say you should avoid all risk; there is a degree of risk involved in every business venture. That is what justifies a profit on your investment.

Conclusion

There is no mathematical formula you can use to determine whether or not to add a new line of business to your present activities. Similarly, no magazine article can give you a foolproof answer to this question. We have presented here some ideas to provide a starting point for your thinking. As you study the problem, other aspects peculiar to your own situation will present themselves. Consider them all carefully in terms of dollars and cents. Don't plunge blindly into a new line of business just because you feel you must try something new. Think first; weigh the pros and cons, and then make a decision according to your best judgment. ▲



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RADIO AMATEURS AREN'T SO BAD!

by Howard S. Pyle

Relations between service technicians and amateur radio operators are frequently far from cordial. Hams receive the blame for all kinds of radio and TV interference problems, and the word "amateur" is often taken to mean "careless" or "incompetent." Contary to the views of more than a few owners of radio-TV sales and service shops, the radio amateur is not just a kid playing around with a toy about which he knows little. Many hams have investments which equal or surpass those in many commercial shops, and they have technical knowledge and experience which often rival those of many shop owners and technicians. There is no reason why the electronic serviceman and the amateur can't be friends, and there are some good reasons why they should be.

During many years as a traveling salesman for wholesale distributors of radio and TV equipment, it was more or less incumbent on me to make suggestions to my customers that could conceivably increase their own sales possibilities. Since I was a radio amateur, it occurred to me that here was a field which the owners of radio-TV sales and service shops had more or less neglected. Many of them seemed to have adopted the attitude that the radio ham was just a nuisance who caused snow or wiggles on the customers' screens.

A few dealers, however, approached what the others considered to be a problem from a different angle. Instead of simply blaming their interference problems on the "—— radio ham next door," they took a more realistic viewpoint. Where the source of interference with either radio or TV reception appeared to boil down to a neighboring amateur radio station, these dealers first approached the amateur and, in an amiable mood, discussed the situation with him. In the majority of cases, cooperation was immediately forthcoming. The amateur was not at all anxious to be guilty of interfering with his neighbor's radio or TV reception.

Amateurs have—and are entitled to—many social contacts over the air, but they also perform many valuable public services when they are needed; often during emergency situations.

When interference difficulties began to take on alarming proportions, amateurs, dealers, and manufacturers of radio and TV receivers worked out a method whereby all concerned were satisfied. Manufacturers of TV equipment, for example, cooperated to the extent of changing the intermediate frequencies of their equipment to avoid pickup from near-by amateur radio stations. Many others supplied their retail dealers with filter systems which were installed on the customers' sets; the manufacturer and the dealer cooperatively absorbed the small cost involved. Where this was not effective, the amateur radio enthusiast himself, when shown that *his* equipment was at fault, spent the few dollars necessary to modify his own apparatus to eliminate the annoyance. In many instances, particularly in localities having amateur radio clubs, "interference committees" assisted the individual amateur in locating the source of trouble.

True, malicious or repeated interference did, at one time, constitute enough of a problem to warrant the setting up of strict regulations by the Federal Communications Commission. Such regulations, carrying rather severe penalties for offenders, are still very much in existence. Fortunately, through the cooperation of the amateur-radio fraternity as a whole, instances of flagrant violations have become quite rare even though the growth of amateur radio activity has become almost phenomenal in recent years. Thus the amateur isn't so bad after all.

From a sales-promotion standpoint, how many dealers take

your next customer:

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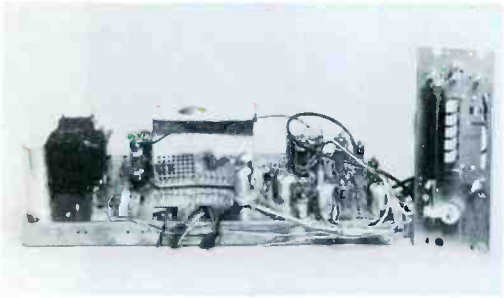

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Most amateur radio operators assemble their stations from quality components, and they have the technical know-how required to operate and maintain their station properly.

advantage of the opportunity to establish acquaintanceships in this "other world" of radio — amateur communication? This is where a considerable number of radio-TV dealers "miss the boat." Consider for a moment that the average radio amateur is just another guy like you. Perhaps he is a "white-collar worker" at an industrial plant. When the whistle blows, he can come home, eat his dinner, look at the paper, and then take off for his ham shack. Or, perhaps he is a high school student; after finishing his homework, he can converse, via radio, with a buddy a thousand or more miles away.

If you show an interest in any of these hams — help him with his minor technical problems, test his tubes, or check his gear for a loosely soldered connection — you've made a friend. When he needs professional electronics service, where will he go, or whom will he suggest? *You,* if you have befriended him.

Perhaps a neighbor will consult your ham friend, feeling that a radio amateur has knowledge of all there is to know in the field of electronics. If this neighbor wants to buy a new TV or radio set, hi-fi or stereo equipment, etc., who is the radio ham going to mention? His friend, the local radio-TV dealer-serviceman.

Get the picture? Isn't it about time that you cashed in on this opportunity? The radio ham can be not only one of your best friends but also one of your greatest business boosters. ▲

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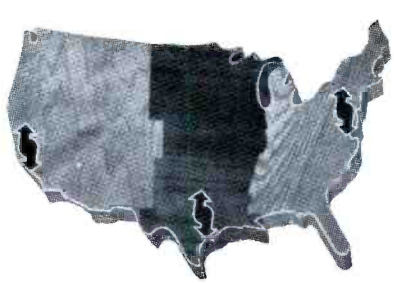

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Notes on Test Equipment

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

by Stephen Kirk

Color Generator

Fig. 1. Versatile unit provides wide selection of signals for use in servicing color TV sets.

The B & K Model 1074 (Fig. 1.) is a streamlined version of the 1076 *TV Analyst*, except that it does not have a flying-spot scanner for reproducing transparencies on the TV screen. Instead, it uses crystal-controlled oscillators and multivibrator frequency-divider circuits to develop crosshatch lines, dots, vertical lines, horizontal lines, and color signals. The video signals are either applied directly to a receiver circuit or used to modulate a carrier injected into the TV set at the IF or on any one of several channels (2, 3, 4, 5, 6, 7, 8, 12, 13).

In addition to the pattern signals, the following outputs are available at panel jacks: horizontal and vertical grid- and plate-drive signals, a bias voltage adjustable from 0 to plus or minus 25 volts, a 900-cps audio signal, a 4.5-mc carrier frequency modulated at 900 cps, color-burst signals, a color-subcarrier signal of adjustable amplitude, and sync signals of adjustable amplitude and either polarity. Provision is also made for a signal to directly drive a vertical yoke and for a shorted-turns tests.

The circuits of the 1074 are laid out on three separate printed boards. One board contains the 189-kc crystal oscillator and the frequency dividers, the second contains the color and sound cir-

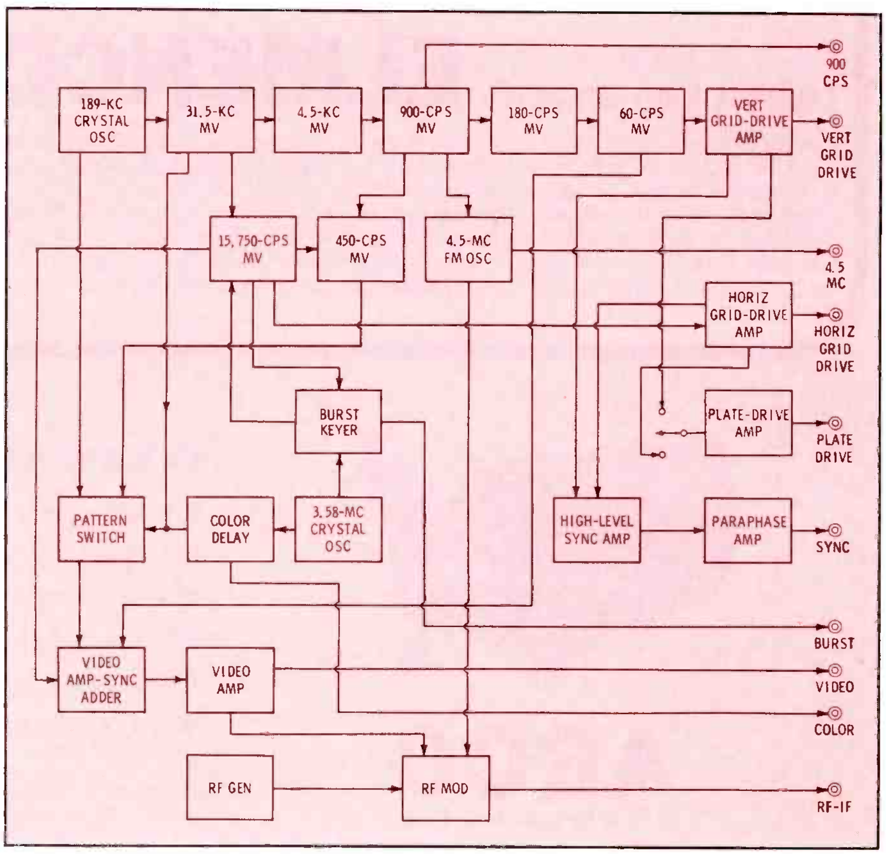


Fig. 2. Simplified functional diagram shows how signals are generated in B & K 1074.

cuits, and the third contains the RF-oscillator, modulator, and sync circuits.

The functional block diagram in Fig. 2 shows the signal-generating portions of the 1074. One output of the 189-kc crystal oscillator is used to synchronize a 31.5-kc multivibrator, and another output is shaped and used to produce vertical lines. This output goes to the pattern switch. The 31.5-kc multivibrator synchronizes the 15,750-cps and 4.5 kc dividers and is used to set the phase of color information in the color-bar display. The 15,750-cps divider feeds the horizontal grid-drive amplifier, provides horizontal sync pulses, keys the color burst, and controls the phase of the 450-cps multivibrator.

The 4.5-kc divider between the 31.5-kc and 900-cps stages is used only as an intermediate divider to increase long-term stability. Four outputs are taken from the 900-cps multivibrator: One controls the frequency of the 450-cps horizontal line source. (The two inputs to the 450-cps stage insure that each horizontal test line is one raster-line wide and coincides with the beginning and end of a horizontal scan interval.) The second 900-kc output is used as a direct audio source, the third is used to frequency modulate the 4.5-mc oscillator, and the fourth synchronizes the 180-cps intermediate divider and stabilizing counter for the 60-cps multivibrator. The 60-cps divider is the source of vertical sync pulses and also excites the vertical grid-drive amplifier.

Video information is a composite of pattern components and necessary sync signals selected with the pattern switch. The composite output is obtained from a paraphase amplifier that has either positive or negative output. The composite signal is also fed to the RF modulator.

The sync signals are fed separately to a paraphase amplifier to provide either positive or negative output. The sync control varies the amplitude from 0 to 50 volts at the SYNC OUTPUT jack.

The color signal is generated by a 3.58-mc crystal-controlled oscillator. A sample of this signal is fed through the horizontal multivibrator (15,750 cps) so it will start (as far as the output is concerned) during the horizontal sync interval; thus the color burst portion of the composite video signal is formed. Another output from this crystal oscillator is fed to a delay line. The amount of delay, controlled by a panel switch, determines which of seven different colors is transmitted to the receiver. For example, when the color switch is set to RED, the screen color on the TV set should be red if the hue or tint controls on the set are correctly adjusted. Whatever color is selected, there is a black vertical reference bar (keyed by the 31.5-kc divider) in the center of the screen. This makes it easy to check or set up color demodulators.

It is impossible to discuss here all the possible tests and checks that you can make with the 1074. The outputs are so flexible and varied that they become even more useful as you learn more about what to expect in various situations. The examples that follow illustrate typical applications of the instrument.

One case involved a color set used in an apartment building equipped with an antenna distribution system. Black-and-white could be received okay, but color could not. In a situation like this it is almost natural to suspect the distribution system, but the technician decided to connect the 1074 to the receiver antenna terminals to make sure. Color appeared and remained in sync even when the RF gain control of the 1074 was turned low enough to produce a snowy picture on the screen. This indicated that the color circuits were okay. The technician was on the verge of condemning the antenna distribution system when he noticed that the lead-in from the antenna to the set had been neatly bundled, tied with a cord, and placed inside the cabinet of the set. Removing the excess lead restored normal operation.

In a set that had no high voltage, we disconnected the plate cap from the 6BQ6 horizontal amplifier and inserted a signal from the 1074 PLATE DRIVE jack. The high voltage came on. Next, we moved to the grid of the 6BQ6 and inserted a signal from the HORIZ GRID DRIVE jack. Again there was high voltage. This pointed definitely to trouble in the horizontal oscillator or phase detector. A couple of voltage measurements in the oscillator stage revealed that the plate resistor had changed value.

We were particularly interested in the patterns for setting up color sets. We converged several sets made by different manufacturers. In every case there was no tendency for the patterns to move, weave, or jitter. Lines and dots both were thin and clearly defined, which made convergence much less of a chore.

The modulated 4.5-mc signal is a boon in troubleshooting audio IF stages. We had no trouble tracing a loss of sound to a defective takeoff trap in the video circuit of a receiver with a reflex sound circuit.

We had no trouble in locating the defective tuner in a set that was without sound or picture. Injecting an IF signal from the 1074 into the first IF grid of the set produced a pattern on the screen; this furnished all the proof we needed.

The 1074 can be put to good use in aligning tuners on sets that are to be used on a cable TV system. The range of fine tuning can be checked to make sure that a slight drift in frequency will not prevent the customer from tuning in a good picture.

It appears that overall sensitivity of a particular set can be checked with fair accuracy, especially if the settings of the RF GAIN control are noted for sets that are in good working order. By turning the control until snow first appears in the picture, a pretty good reference point can be established for two-IF sets, three-IF sets, and sets with various tuner types.

One thing we've not mentioned so far is the shorted-turns indicator circuit. This is essentially the same circuit that is used in the 1076. It is rather sensitive and may occasionally indicate that a good transformer is bad. However, we

"It wasn't your TV set smoking and groaning after all, lady."

found no case where a flyback checked good that was really defective. (This might sometimes happen if the transformer were breaking down only under high-voltage stress.)

For further information, circle 73 on literature card

Low-Voltage Supply

Fig. 3. This compact power supply provides DC voltages for variety of transistor devices.

The Seco Model RPS-5 (Fig. 3) is a regulated power supply that delivers voltages suitable for powering transistor equipment. Its maximum rated power output is 4 watts. In addition to stabilizing the average output voltage, the transistor regulator circuit also reduces the ripple content.

Outputs are available between the common (—) jack and three other jacks. The output range depends on the setting of the METER RANGE switch. In the 1.5v/15v position, these voltage ranges are available: 0 to 1.5 volts at the LOW jack, 0 to 7.5 volts at the INT jack, and 0 to 15 volts at the HIGH jack. When the switch is in the 30v position, 0 to 28 volts is available at the HIGH jack, and the other outputs are disabled. Two current ranges, 0 to 30 ma and 0 to 150 ma, are included. These measure current drawn from the HIGH jack only. A panel lamp indicates when excessive current is drawn and serves as a fuse in the event of severe overload or failure of a component in the supply.

Two half-wave rectifiers are operated from a tapped transformer (Fig. 4). One of these rectifies the DC output; the other, in conjunction with a zener diode and a control potentiometer, supplies reference voltage to the base of the regulator transistor.

The METER RANGE switch turns the unit on and off, selects the meter range, and in the 1.5v/15v position completes the voltage-divider circuit for the low-voltage outputs. On the 1.5v/15v range, the voltmeter is connected across the 1.5-volt output. (As the voltage at the LOW jack varies from 0 to 1.5 volts, the voltage at the HIGH jack varies from 0 to 15 volts.) On the 30v range, the meter is connected between the HIGH and — jacks. On the current ranges, the meter is connected across resistors located on the supply side of the transistor; thus the meter resistance is not actually in the supply lead to the unit being powered. A diode clamping arrangement protects the meter and shunt resistors from damage by overload.

Only the HIGH ouput of the supply is directly regulated. The other two outputs are regulated only to the extent that they are obtained from a voltage divider connected across the regulated source. Thus, the divider resistors will affect current-

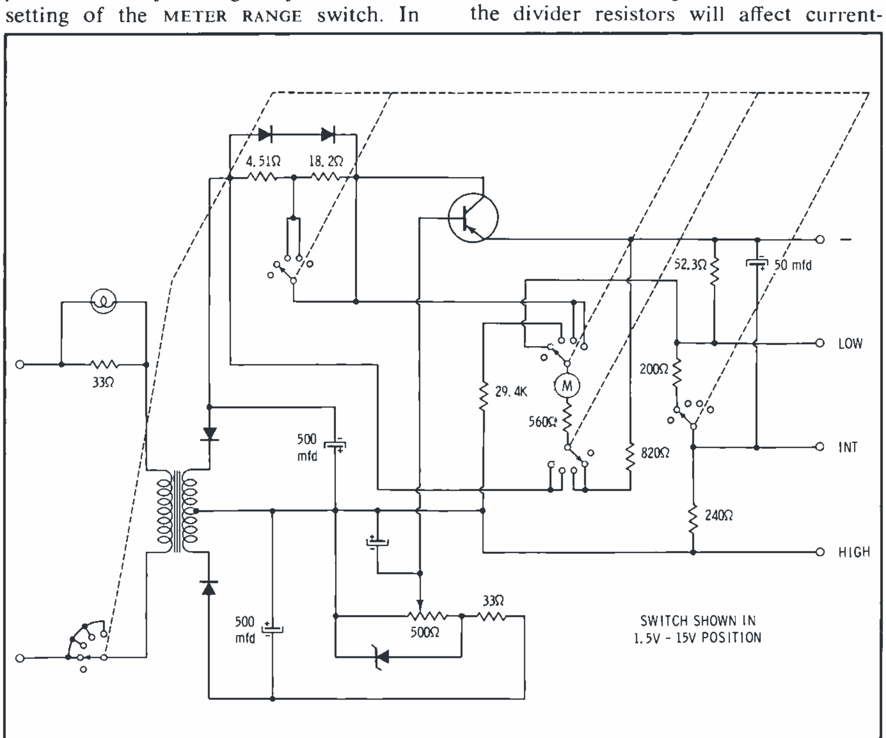


Fig. 4. Circuit diagram of the Seco Model RPS-5 shows how outputs are obtained and metered.

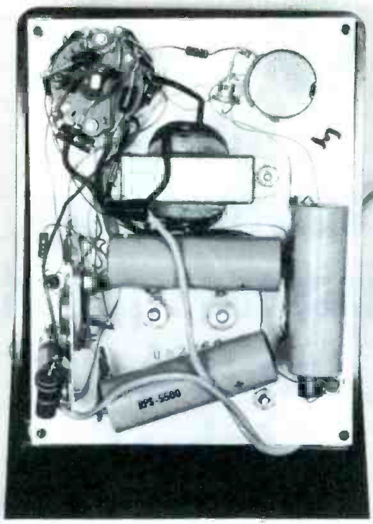


Fig. 5. Internal view Seco RPS-5 power unit.

vs-voltage at the two lower-voltage outputs.

We used this unit to power a number of transistor radios. In so doing, we found no evidence of motorboating or hum. The switch-selected milliammeter proved to be a handy feature for this type of service work. We noticed, however, that if the switch is turned from the 30-volt range to the 15-volt range while the output voltage is greater than 15 volts, the meter will "pin," or strike the stop. A little caution is therefore advisable in switching ranges.

The operating portion of the unit can be removed from the case for servicing by removing only four screws. Hand-wired construction is used throughout the unit. As can be seen in the photo (Fig. 5) the transistor is a high power type, similar in physical shape to those used in auto radio output stages. A thin strip of metal serves as a heat sink. The remaining circuit components seem readily accessible.

The unit operates from a 115-volt AC supply, measures 3½" x 5½" x 7½", and weighs 3 lbs. ▲

For further information, circle 74 on literature card

now in our lab . . .

The latest test instruments being analyzed for future "Notes" columns:

Cornell-Dubilier Model BF-71 Capacitor Checker

Hickok Model 470A VTVM

Standard Kollsman VHF-UHF Translator

RCA Model WV-76A AC VTVM

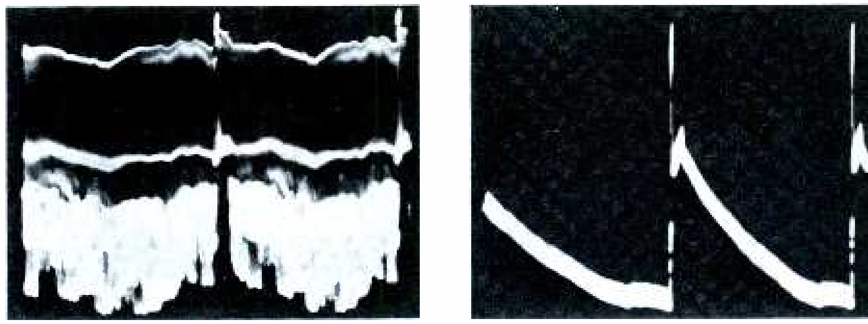
EICO Model 667 Tube Tester

SENCORE Model PS127 Oscilloscope

Sync Symplified

(Continued from page 31)

both the grid and the plate. We remembered that this type of noise inverter isn't even supposed to conduct, except when noise pulses more positive than sync tips appear in the video signal coming into the sync section. Then the noise inverter conducts, produces a negative pulse at the plate, and thus cancels out the noise at the grid of the sync separator. If it conducts at any other time, it murders the sync signal. But in this case, W6 was as good as gold, so V11B must not be misbehaving.



(A) W5 — 20V p-p (B) W8 — 7V p-p

Fig. 4. Odd waveforms were present at V16 cathodes.

Circuit Study

Right now was a good time to take our findings and try to tie them together into an understanding of how the circuit works. The first problem, as in any complicated sync circuit, was to distinguish the really essential components from those which are incidental to the main job. We started our analysis by trying to define how the circuit performed three main functions:

1. Prepare the video signal for separation.
2. Separate the sync pulses from the video.

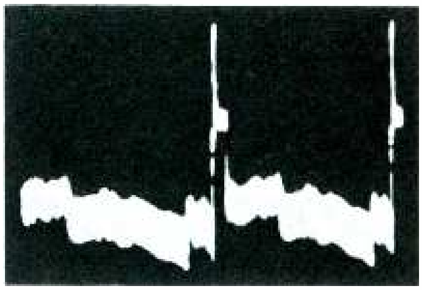


Fig. 5. W7 taken at V16B grid (18V p-p) consisted mostly of the vertical sync pulses.

3. Shape the separated sync pulses —clip them to constant amplitude, and establish the desired amplitude and polarity.

To follow up on the first point, we looked for the exact path of the input signal from the video stage to the stage labeled "Sync Sep." In this case, the input path is short—through two resistors, a 22K and a 33K, to the grid (pin 2) of V16A. The circuit of V11B is in parallel with the input path, but we'd cleared it pretty well of suspicion. We had a good signal in V16A, so we checked off function 1 as OK.

Now, how about the second point —separation? The only signal output from V16A was at the cathode, and it was video! Surely it shouldn't be. . . . On further pondering, it seemed that V16A and V16B should both be working in parallel as sync separators—receiving video inputs at their grids and feeding pulse-signal outputs from their cathodes to the cathode of V17A. Nothing like having a spare sync separator! Actually, we mused, the two circuits must work somewhat differently and complement each other's action.

Suppose the *normal* W4 were a complete, fully separated sync signal. It should be passed through V17A without inversion (cathode to plate), but we could expect it to be amplified quite a lot. When it's fed to V17B, it's probably strong enough to drive that tube into both saturation and cutoff—this would partially take care of point 3 in the above list (trimming the pulses to size). There are outputs from both the cathode and the plate of V17B —that takes care of the "polarity" requirement of function 3.

Beautiful theory, isn't it! Now, why didn't the actual circuit measure up to it? There seemed to be a defect somewhere ahead of the cathode of V17A; vertical sync pulses were getting through to here, but not horizontal pulses. We decided to operate on the assumption there *were* two sync separators in parallel —one for vertical pulses and one for horizontal. V16B tended to bear out this idea—its input waveform would consist largely of vertical pulses, because the 51 mmf capacitor at the grid would partially bypass the higher frequencies in the video signal to ground. If our theory were correct, V16A would be responsible mostly for horizontal pulses. Therefore, these pulses should be the main component of W5. At any rate, one would think most of the video would have been removed. But it wasn't—and this looked suspicious.

Not much in this circuit to go wrong. . . . We checked the 680K cathode resistor, finding it okay. As another idea, we unsoldered the output (V17A) end of the .01 mfd capacitor; then, with the set running, we held a VTVM probe and a scope probe (in turn) on the loose lead. Neither the meter nor the scope gave any reading. The capacitor was open! Putting in a new .01 restored beautiful sync.

The waveforms all became as shown in the photos of *normal* signals. W5 no longer had video in it. There were vertical sync pulses, but —more important—there were also clean horizontal pulses. And now, with a normal W5 being coupled to the grid of V17A, we found *both* horizontal and vertical pulses in W4. The horizontal sync tips were still a bit ragged and uneven in amplitude, but the action of V17 improved this situation. Look at all the gain V17A gave the signal, and look at the clean waveshape of outputs W1 and W2! On V16B, W8 still had its screwball sawtooth slope; as we previously had suspected, this is normal. The input to V16B was also the same as before.

Just out of curiosity, we checked all DC voltages again, and could not find more than 2% deviation from any of the former readings! This case had involved strictly signal troubles, with one of two parallel signal paths becoming open—resulting in selective-frequency coupling of the signal. If we'd relied on hit-or-miss methods instead of trying to reason this one out, wonder how long the job would have taken? ▲

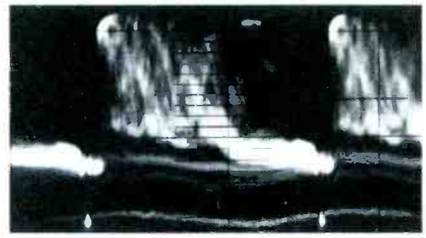
AGC Troubles

(Continued from page 29)

input to the video amplifier and too much contrast in the picture. The excessive input level also results in compression of the sync portion of the composite signal, and since the video output signal is fed to the sync separator, it's easy to see how the compressed video output signal creates unstable sync.

Supplemented AGC Systems

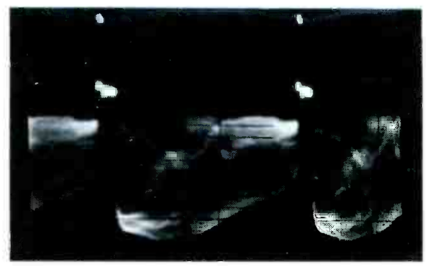
This type of AGC circuit derives the control voltage from two separate sources. On weak signals, the DC component of video across the detector load resistor (R1 in Fig. 8A) is the main source of control voltage. On stronger signals, the negative voltage developed through signal rectification by the grid and cathode of the sync separator increases, and a portion of this negative voltage is coupled into the AGC line. Because of the connection between the sync separator and the AGC line, a controlled tube with slight gas or grid emission can result in sync instability before excessive



(A) Video-amplifier grid (abnormal)

(B) Video output (abnormal)

(C) Video-amplifier grid (normal)



(D) Video-output (normal)

Fig. 7. Receiver waveforms shown in Fig 6.

contrast becomes noticeable.

Troubles produced by gassy tubes are so varied they are almost impossible to catalog. For example, Philco uses the supplemented AGC arrangement shown in Fig. 8 in several models. In one case, a 10H25 chassis with gassy tubes in the first and second IF stages produced a negative picture (Fig. 9) due to overloading of the third IF stage. In this receiver, the voltage drop across AGC filter resistor R49 was more than 10 volts. When new IF tubes were installed, there was still a drop of 3 volts across R49, but this is normal because R47 is connected to a 20-volt source to provide a delay voltage.

Just as troubles in the AGC portion of this circuit can act to produce sync troubles, defects in the sync portion can also produce AGC troubles. For example, in early General Electric sets using a circuit similar to Fig. 8B, a slightly leaky coupling capacitor feeding the

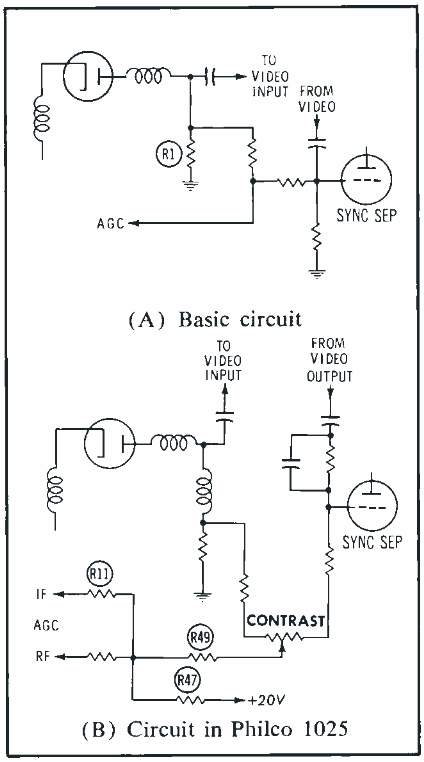


Fig. 8. Circuits producing supplemental AGC.

grid of the sync separator resulted in excessive contrast along with disabling of the contrast control.

Trouble With Peak AGC

In peak AGC, the control voltage is developed by an additional diode fed by the same signal that feeds the detector diode. A simple circuit of this type is shown in Fig. 10A. The signal at the final IF transformer is capacitively coupled through C1 to an AGC diode. A negative voltage proportional to the peak amplitude of the signal is developed across load resistor R1 and is fed through filter resistor R2 to the controlled tubes. For a given signal at the IF output, the peak-developed AGC voltage is greater than the simple AGC voltage (developed across the detector load resistor) would be.

Peak AGC is prone to develop excessive control voltage when the incoming signal has a high noise content. Thus, in noisy locations, receivers using peak AGC may be over-controlled to the point that contrast is below normal.

The circuit shown in Fig. 10B, used in Hoffman 326 chassis, operates exactly like a peak AGC circuit and has the same weakness in noisy

Fig. 9. Negative picture, poor sync resulting from gassy tubes in IF strip of TV receiver.

locations. One of these Hoffman sets exhibited poor contrast and the presence of interference, as shown in Fig. 11. The dark interference bar appeared to be the result of replacing the selenium rectifier with a silicon unit.

With the assumption that the interference could be cleared up easily, we turned our attention toward the weak-contrast condition. The weakness was caused by excessive AGC voltage, but the reason for this excessive voltage could not be determined. Finally the technician decided to clear up the interference by shunting the silicon rectifier with a .002-mfd capacitor. Immediately

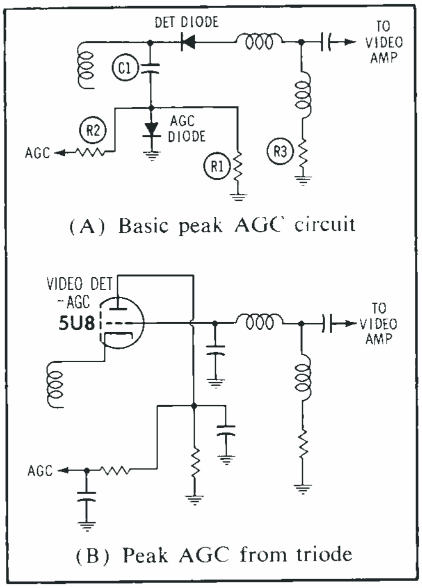


Fig. 10. Circuits in which AGC voltage is determined by peak level of video IF signal.

the contrast increased to normal; the AGC voltage was found to be reduced by about 2 volts. The installation of the silicon had provided the set with its own built-in noise generator, and the AGC voltage was being determined by the peak amplitude of the noise.

Summary

The examples of troubles in each of these AGC systems are representative of abnormalities that can affect AGC action. The bleeding off of AGC voltage by gassy tubes parallels the effects of a leaky AGC filter capacitor. Insufficient AGC voltage in supplemented circuits can be due to other sync-separator components than those in the specific cases presented. Generation of excessive AGC in peak circuits may result from other types of noise than the one described; a particular offender is pulse feedback from the horizontal-deflection circuit.

By recognizing these circuit types and by knowing their characteristics and limitations, the service technician is better prepared to find solutions to AGC troubles. ▲

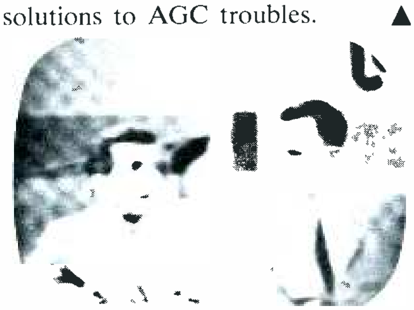


Fig. 11. Horizontal interference caused low contrast in receiver using peak AGC circuit.

Solid State

(Continued from page 37)

triggered. Take a look at the diagram in Fig. 2. When normal AC voltage is applied, but no gate current is injected, the SCR will not conduct in either direction. When a positive voltage is applied between the gate and the cathode (N), a slight forward current flows and triggers the unit into action. The function of the unit is then merely that of a rectifier; current can flow from cathode (N) to anode (P) but not the reverse.

The SCR has another characteristic that is strangely reminiscent of the tube thyratron. Once the gate current has started forward conduction across the main junction, the primary junction will continue to conduct after the gate pulse is removed. Thus, the junction maintains a very low resistance as long as the forward current remains above a certain *holding* level. The forward conductance can be stopped only by extinguishing the main junction current.

When the current thus ceases, the junction will no longer permit current to flow in either direction, until another gate pulse arrives. This action can be set to useful tasks, by merely using the gate to control the primary action of rectifying. By timing the gate to occur at 270° in the cycle, 60 cps power could be made effective during only one-fourth of its total time, as shown in Fig. 2. This would have the same effect on a load as using a step-down transformer or a voltage-dropping resistor to reduce power; the SCR is infinitely more compact and is less wasteful of power.

SCR's are expensive by comparison with less efficient methods of controlling power, but increased use and production are rapidly driving prices downward. Very soon, you'll be encountering these devices in all sorts of controls for home and industrial use.

Zener Diodes

These devices, some of selenium but mostly of silicon, are the true voltage regulators of the solid state family. Their function is simple to explain. Zener diodes are constructed so that they do not conduct at all until a certain specific voltage is reached; beyond this point the amount of their conduction is dependent on the voltage applied. Thus, if a 7.5 volt zener diode is connected as shown in Fig. 3, the voltage at that point will be held at exactly 7.5 volts. Current in the zener unit will be just sufficient to drop any excess voltage across R2, maintaining a constant potential at the point indicated by the arrow. Voltage following R3 will depend on the load, but can in no case exceed the voltage set by the zener diode.

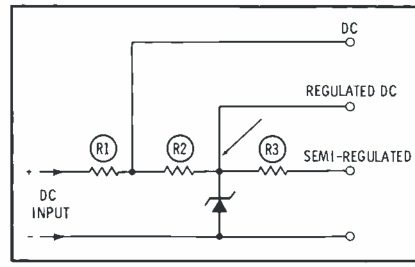


Fig. 3. Zener diode simple voltage regulator.

The cost of zener diodes is low enough to make them attractive in all sorts of low-voltage regulation applications. They can be used to protect equipment, meters, and other semiconductor devices from overload caused by voltage surges or transients. They can even be used back-to-back to clip both positive and negative waveform peaks.

Zener diodes are usually classified primarily by the voltage at which "zenering" begins, and within a broad category of power ratings. Low-power units start at about 500 mw, with zener voltages ranging from 6.2 volts through 200 volts. Thus, these solid-state voltage regulators can be used in almost any circuit that you are likely to encounter in electronics. They can even be wired in series to increase the total voltage rating. Industrial types up to 50 watts are generally available, with zener ratings comparable to the low-power units.

In appearance, zener diodes are very similar to other silicon units. They are available as epoxy- or ceramic-encapsulated, top-hat, and stud-mounted units. The type of case used depends, as with silicon rectifiers, on the power that must be dissipated; heat sinks are often necessary.

A Touch of the Old

As mentioned earlier, selenium rectifiers are still used extensively, and thus deserve some consideration as solid state devices. Many of the selenium unit's characteristics are similar to those of silicon rectifiers. They both require a certain level of forward voltage before they begin to conduct—usually around .5 volt. Selenium cells, however, do not show nearly so sharp a decrease in forward resistance as do silicons; furthermore, the resistance of a selenium rectifier increases noticeably with age, reducing efficiency considerably.

Selenium rectifiers are primarily rated according to the amount of DC output current they will produce. Power-supply seleniums start at about 10 ma and are available in sizes up to 2 or 3 amps. Higher-rated units are made, but cost and efficiency are sacrificed; other types can do that job better in many instances.

Like silicon rectifiers, seleniums are usually protected from surges that occur at the time of initially applying power to the circuit. Series resistance usually is chosen in the same manner as for silicons, and ranges in value from 3.3 ohms with one typical TV unit to 47 ohms for the small-current rectifiers used in many radio power supplies.

Selenium Diodes

Another common use for selenium is in small, low-power diodes for circuits such as the horizontal AFC of television sets (Fig. 4). Computers make extensive use of selenium diodes, as do many other instruments and industrial electronic assemblies. They are even found in communications equipment as balanced modulators and in similar applications.

Selenium diodes of this type are usually designed to handle very small currents. One typical unit is rated at 250 ua average current, with a peak capability of only 2.5 ma. Peak reverse voltages applied to these units can rarely exceed 75 volts.

Thyrectors

These specialized solid state devices also use selenium as the basic junction material. Their principal use is for suppressing transient voltages, in somewhat the same as the zener diodes already described. The difference is that thyrectors act much more quickly, and will withstand higher momentary currents.

There are two general types. One is similar to the "back-to-back" configuration familiar in dual diodes, and is called an AC thyrector. The other is symbolized as an ordinary solid state diode, and is called a DC thyrector because it clips only transients that occur in one direction.

Ratings are by voltage range. For example, one group of AC thyrectors is designed to suppress transients in the range of 0-25 volts, while another group fills the range from 25-50 volts. DC thyrectors are rated in the same manner.

Some thyrectors require cooling fins; physically, they look exactly like selenium power rectifiers. Others appear similar to miniature electrolytic capacitors, but appearance is where the resemblance ends.

Signal Diodes

Last, but not least, are the "little people" of the solid state family—the small-signal diodes. These are made principally of germanium. They are delicate miniature units that require deliberate and careful handling in both design and operation.

Ratings begin with current levels

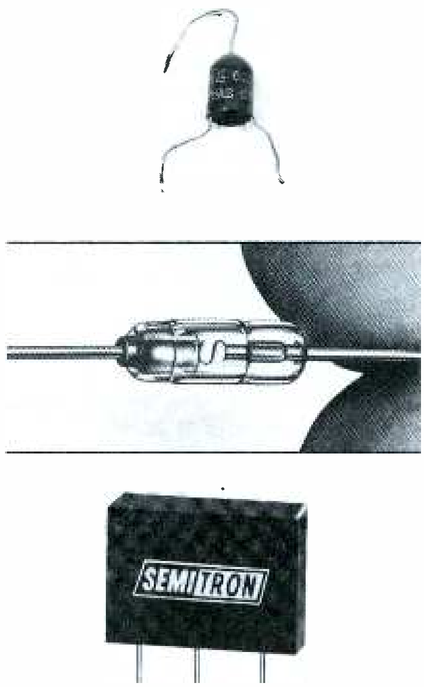


Fig. 4. Selenium diodes used in horizontal AFC circuits come in various shapes, sizes.

of a few microamps, and extend to a few hundred milliamps. Peak inverse ratings—the amount of reverse voltage the unit can withstand—seldom exceed 150 volts, except in special units.

Germanium diodes are used extensively as video detectors, AGC rectifiers, metering rectifiers—in short, any application where the applied DC voltage is slight and the signal voltages are low. They are responsive to much higher frequencies than other types of solid state rectifiers, and thus are used in almost all RF or supersonic applications.

Heavy-duty units are available, but the cost is usually great enough that the application must be a very special one to justify the expense.

What's For Tomorrow?

Solid state rectifiers are indeed coming into their own. From the small number of "fixed-detector" germanium crystals available just over a decade ago, solid state diodes have been diversified to take almost every form imaginable, and almost every job available. Some perform well as oscillators—the Esaki or tunnel diode is an example. Others regulate and control the actions of other solid state devices—and even tube devices.

Make it a point to increase your familiarity with solid state rectifiers; they represent the electronics of tomorrow, and you'll need to know all you can about them. ▲

Circle 18 on literature card

Aircraft Radio

(Continued from page 35)

ceivers resemble conventional superheterodynes with tunable local oscillators. Fig. 1 shows a block diagram of the type R-32 receiver manufactured by Aeronautical Radio Corp, a typical unit. This receiver employs two RF amplifiers for high selectivity, tunes from 108 mc to 135 mc, and has an IF of 15 mc. The receiver itself is separated from the tuning dial which usually is on the instrument panel. A flexible cable connects the two for rotation of the tuning capacitors.

A disadvantage of the continuously tuned receiver is that it must be tuned to the station in the manner of a conventional household radio. Thus, unless a carrier is being transmitted, it is difficult to set the dial correctly. Furthermore, pilots are generally busy with other duties at the critical moment when a radio must be tuned. Crystal-tuned receivers eliminate this disadvantage of continuously tuned receivers as well as that of questionable stability.

Fig. 2 shows the block diagram of a typical crystal-tuned superheterodyne receiver (the Collins 51X3). A local frequency is synthesized by doubling the frequency of a third-harmonic crystal and adding in a second mixer the output of another oscillator. By proper choice of frequencies, the lower-frequency oscillator can be switched to ten different crystals providing steps of 100 kc, and the higher-frequency oscillator-doubler can be switched to provide steps of 1 mc throughout the desired band.

The tuning capacitor shafts in the RF stage are ganged to the crystal switch. When the switch snaps to another position, the common shaft moves the capacitor rotor to the proper position for resonance at the chosen frequency. It can be seen

Table 1. Aviation Frequency Assignments (mc)

118.00-121.40	(Every 50 kc) Airport control.
121.50	Emergency.
121.65-121.95	Air Traffic Control (ATC).
122.00-123.05	(Every 50 kc, except 122.80 and 123.00) General aviation air-to-ground.
122.80	Advisory (UNICOM).
123.00	Advisory.
123.60-128.80	(Every 50 kc) ATC.
132.05-134.95	(Every 50 kc) ATC.

that the design problems of such a receiver are as much mechanical as electrical. Lead dress becomes a matter of mechanical design, and capacitor-switching arrangements are carefully integrated.

VHF Transmitters

VHF transmitters all use crystal oscillators because no other convenient means is available for maintaining the FCC frequency tolerance of ±.01%. A typical VHF transmitter for light planes is the NARCO VTA-3 shown in Fig. 3. The circuit consists of a 12BY7A electron-coupled oscillator-doubler employing as many as 27 third-overtone crystals in the 30-mc range. The crystal frequency is doubled in the plate circuit of the 12BY7A. The resulting signal is coupled to the next stage which acts as final amplifier and doubler. The tank circuits are fixed-tuned to a frequency just above the highest frequency to be used. This causes some spurious radiation, but it is tolerable under normal circumstances.

More sophisticated transmitters utilize crystals arranged in a digital fashion similar to that used for synthesizing the local oscillator frequencies in VHF receivers.

As pointed out previously, VHF transmitters in airplanes are required to emit relatively little power because airborne antennas are capable of transferring relatively greater amounts of power in the VHF range to a distant receiving antenna. This is a great advantage of VHF, and transmitted power ranges from only .5 watts in many private aircraft to no more than 25 watts in airline service. Maximum VHF reception distances are listed in Table 2.

The first part of this series has been concerned primarily with aircraft communication systems. The concluding part of the series will discuss radio navigation systems. ▲

Table 2. VHF Reception Distances

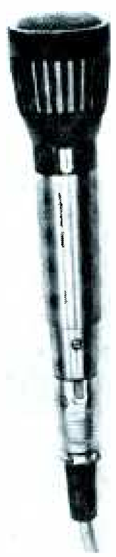
Feet Above Ground	Reception Distances (Miles)
1000	45
3000	80
5000	100
10,000	140
15,000	175
20,000	200

Product Report

For further information on any of the following items, circle the associated number on the Catalog & Literature Card.

Rectifier Offer (143)

The "Combination Pak" No. HDR1000 contains ten heavy-duty silicon rectifiers and one gold-plated man's Lucerne wrist watch. The top-hat silicon rectifiers in the **Semitronics** package are rated at 1 amp, 500 PRV, and are universal replacements for TV, radio, phono, and hi-fi use. The Swiss-made antimagnetic watch has a sweep second hand, unbreakable lifetime mainspring, and luminous dial. Normal retail value of the package is $29.95, but it is available in this special offer for $14.95.



Dynamic Microphone (144)

A shock-mounted cardioid dynamic microphone, the Model 8000 was designed basically for home-recording applications; however, it is also suited for use in churches, schools, location broadcasting, etc. The cartridge produces a smooth frequency response from 70 to 15,000 cps. Under normal operating conditions, the diaphragm retains its original level of performance throughout the life of the microphone. This **LTV University** product sells for $29.95 and carries a five-year warranty against faulty material and workmanship.

Selective Communications (145)

Two-way radios may be equipped to receive only desired calls, on an all-unit or a selective basis, with the **Cadre** Model 524. This transistorized unit operates with the company's 5-watt solid-state transceivers and other 12-volt two-way radios. Connections are made through the speaker and power supply of the transceiver. A microphone adapter plug is furnished. Unit cost for base or mobile stations is under $70, and installation takes only a few minutes.

Portable Amplifier (146)

The all-transistor "Ampli-Vox" Model S-700 is powered by flashlight batteries and is designed to deliver professional-quality sound. A single control turns the unit on and off and adjusts the volume. This **Perma-Power** amplifier is rated at 25 watts EIA music power, 40 watts peak. Its two inputs make it suitable for use with a microphone and a tuner, phonograph, or tape recorder; outputs are provided for two 8-ohm speakers. The amplifier measures 8⅜" x 3½" x 8¾" and weighs 7 lb. with batteries. Net price is $69.95 without batteries.

Mobile Antennas (147)

A new "Band Spanner W-600" line of 13 antennas developed by **Webster Mfg. Co.** covers frequencies in the 25-to-54 mc and 144-to-470 mc bands. The selected antenna can be tuned to match a particular transmitter by rotating the lower barrel of the antenna base for lowest

possible VSWR and then locking the barrel in place with a setscrew. Metal parts are chrome-plated solid brass. The transformer coil is moisture-proof, and the trapping of moisture within the antenna base is eliminated by a triple washer arrangement with a drain hole. The suggested list price is $34.95.

Automatic Tube Tester (148)

Automated tube testing and simplicity of operation are provided by the Model 36-802 counter-model tube tester. The **GC Electronics Co.** unit tests 7-, 9-, and 10-pin miniatures, 5- and 7-pin nuvistors, novars, compactrons, octals, loktals, fuses, panel lights, and vibrators. Grid-cathode leakage up to 6 megohms or filament-cathode shorts up to 500K ohms can be detected. A leakage and quality test for multisection tubes is also provided. A shorted tube actuates a flashing sign; at the same time, the tester is automatically deactivated to prevent damage. The tester is warranted for 90 days and has a suggested net price of $325.00.

Power Supply (149)

A new dual-voltage power supply, of low cost and high stability, provides both positive and negative voltages from individual outputs. Up to 300 ma can be drawn from the two outputs simultaneously; adjustable output voltages range from 0 to 15 volts. Ripple and noise are less than 5 mv at 15 volts and 300 ma.

The instrument, intended for use by transistor circuit designers and experimenters, requires a maximum input of 100 watts at 117 volts, 60 cps. The **Buckeye Stamping Co.** Model PS-100 measures 7" x 5" x 4", weighs 2½ lb, and sells for $49.95.

INDEX TO ADVERTISERS

Transistorized Inverter (150)

The 12.6-volt output from a storage battery can be changed to 115 volts AC by use of **Merit's** new inverter, Model INV-12-40. The inverter uses two 2N234A power transistors to supply 50 watts intermittent or 40 watts continuous output power. The unit is housed in a steel case with a green finish. A 3-foot cord with attached plug is provided for connection to a cigarette-lighter receptacle.

Stereo Ceramic Cartridge (151)

Positive scratch protection is one of the prime features of the new "Featheride" stereo ceramic cartridge from **Electro-Voice**. The protection is assured by a spring-suspension mechanism that permits the cartridge to pivot when sudden force is applied, bringing the front end (and therefore the stylus) up off the record surface and bringing a soft "sole" to bear on the record surface. The "Featheride" is offered in two types, usable in phono units tracking at any force between 2 and 6 grams. It can be mounted in any tone arm having standard ½" or 7/16" mounting centers.

Space-Saver Fuseholder (152)

A new compact, miniature space-saving fuseholder has been developed by **Bussmann.** The panel-mounted unit is only 1⅝" long and extends just 29/32" behind the front of a panel. It accepts ¼" x 1¼" fuses and can easily be converted to take 9/32" x 1¼" fuses by changing the screw-type knob. ▲

FREE Catalog and Literature Service

**Check "Index to Advertisers" for further information from these companies.*

Please allow 60 to 90 days for delivery.

ANTENNAS & ACCESSORIES

76. *ALL CHANNEL PRODUCTS*—New catalog showing *Rembrandt* Model 283 outdoor antenna for VHF, UHF, and FM reception.
77. *ANTENNACRAFT*—Latest information on FM antennas, featuring new omnidirectional model for multiplex or monophonic broadcasts.*
78. *CLEAR BEAM*—Catalog listings for an additional line of indoor antennas.
79. *FINNEY*—Catalog No. 20-307 listing four newly announced multielement, single-boom, VHF-FM antennas.*
80. *G. F. WRIGHT*—Catalog sheets on guy wire used with outside antenna installations.
81. *JERROLD*—Illustrated brochure describing full line of new antenna preamplifiers and *Paralog* antennas.*
82. *JFD*—Literature on complete line of VHF, UHF, FM, and FM-stereo antennas. Brochure showing converters, amplifiers, and accessories; also complete 64-65 dealer catalog.*
83. *MOSLEY ELECTRONICS*—Illustrated catalog giving specifications and features on large line of antennas for Citizens band, amateur, and TV applications.*
84. *TRIO*—Brochure on installation and materials for improving UHF translator reception.
85. *WINEGARD*—"Factfinder" describes new channel coupler that mixes, equalizes, and transforms to 75-ohm cut-channel antennas.*
86. *ZENITH*—Informative bulletins on universal loudspeakers and new line of log-periodic vee-type antennas for FM and monochrome or color TV.

AUDIO & HI-FI

87. *ACTION*—Brochure titled "We make sound work for you" shows how sound fits into every type of business.
88. *ADMIRAL*—Parts and accessories catalog listing replacement components; also includes cross reference for phono needles and cartridges.*
89. *ASTATIC*—Catalog on microphones, phono cartridges, and needles; also cross-reference indexes for needles and cartridges.
90. *ATLAS SOUND*—New 1964 catalog No. 564 contains illustrations and specifications on PA speakers, microphone stands for commercial and industrial installations, and other new products.
91. *GIBBS SPECIAL PRODUCTS*—Folders describing principles of sound reverberation and *Stereo-Verb* reverberation units for automobiles.
92. *GROMMES-PRECISION*—Specification sheets on AM, FM, FM-MPX tuner and stereo amplifier; also sheets on public-address line.
93. *NUTONE*—Two full-color booklets illustrating built-in stereo music systems and intercom-radio systems. Includes specifications, installation ideas, and prices.
94. *OAKTRON*—"The Blueprint to Better Sound," an 8-page catalog of loudspeakers and baffles giving detailed specifications and list prices.*
95. *OXFORD TRANSDUCER*—Product information bulletin describing complete line of loudspeakers for all types of sound applications; including replacements for public address and intercom systems.*
96. *PHILMORE*—Information concerning two-way loudspeaker system with built-in crossover network.
97. *QUAM-NICHOLS*—New catalog listing replacement speakers for background music, public address, and hi-fi applications.*
98. *SONOTONE*—Specification sheet on new stereo and mono crystal replacement cartridges.*
99. *SWITCHCRAFT*—Product Bulletin 141 describes new Q-G audio receptacles.
100. *WILDER*—Literature describing matching stereo hi-fi speaker system.

COMMUNICATIONS

101. *CADRE*—Catalog sheets on complete line of Citizens band radios, including Model C-60 two-channel, 100-mw transceiver.
102. *ELTEC*—Information concerning FM communications monitor-receiver and frequency-standard calibrators.
103. *GENERAL RADIOTELEPHONE*—Brochures describing two-way radio systems for all types of applications.
104. *PEARCE-SIMPSON*—Specification brochures on *Companion II* and *Escort* Citizens band transceivers.
105. *REGENCY*—Information on newly introduced Citizens band transceivers and *Monitoradio.*

COMPONENTS

106. *BUSSMANN*—Bulletin SFUS listing complete line of Buss and Fusetron small-dimension fuses by size and type. Indicates proper fuse holders and gives list prices.*
107. *CENTRALAB*—8-page catalog listing *Fastatch II* exact replacement controls and accessories.
108. *GC ELECTRONICS*—Updated Walsco phono drive chart #FR-236-W.*
109. *IEH*—Transistor interchangeability list; also cross-reference chart for auto-radio transistors.
110. *ONEIDA*—Catalog on line of electronic components and replacement items.
111. *PERMACEL*—Bulletin describing line of plastic tape and plastic parts box.
112. *RCA BATTERIES*—Manual BDG-111 includes battery theory and applications, electrical and mechanical characteristics, and terminal connections on all types in the RCA line.*
113. *TRIAD*—10-page color-TV replacement guide for yokes, flybacks, vertical-output, and power transformers.

SERVICE AIDS

114. *CASTLE*—How to get fast overhaul service on all makes and models of television tuners is described in leaflet. Shipping instructions, labels, and tags are also included.*
115. *PRECISION TUNER*—Literature supplying information on complete, low-cost repair and alignment services for any TV tuner.*
116. *YEATS*—The new "back-saving" appliance dolly Model 7 is featured in a four-page booklet describing feather-weight aluminum construction.*

SPECIAL EQUIPMENT

117. *ATR*—Descriptive literature on selling new, all-transistor *Karadio,* Model 707, having retail price of $29.95. Other literature on complete line of DC-AC inverters for operating 117-volt PA systems and other electronics gear.*
118. *GREYHOUND*—The complete story of the speed, convenience, and special service provided by the Greyhound Package express method of shipping, with rates and routes.
119. *LECTROTECH*—Bulletins on new color-TV test instrument, meter-protective devices, and substitute for VTVM battery.*
120. *PERMA-POWER*—Catalog sheet on transistorized garage-door opener.
121. *TERADO*—Bulletin on *Galaxy* Model 50-205 transistorized DC-AC power inverter.*
122. *VOLKSWAGEN*—Large, 60-page illustrated booklet, "The Owner's Viewpoint," describes how various VW trucks can be used to save time and money in business enterprises; including complete specifications on line of trucks.

TECHNICAL PUBLICATIONS

123. *CLEVELAND INSTITUTE OF ELECTRONICS*—"Pocket Electronics Data Guides" with handy conversion factors, formulas, tables, and color codes. Additional folder, "Choose Your Career in Electronics," describes home-study electronics training program, including preparation for FCC-license exam.*
124. *RCA INSTITUTES*—64-page book, "Your Career in Electronics," detailing home study courses in TV servicing, communications, automation, drafting, and computer programming; for beginners and experienced technicians.*
125. *HOWARD W. SAMS*—Literature describing popular and informative publications on radio and TV servicing, communications, audio, hi-fi, and industrial electronics; including special new 1964 catalog of technical books on every phase of electronics.*

TEST EQUIPMENT

126. *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.*
127. *EICO*—New 32-page, 1964 catalog of test instruments, hi-fi components, tape recorders, and Citizens band and amateur radio equipment.*
128. *HICKOK*—Complete description 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.*
129. *JACKSON*—Complete catalog describing all types of electronic test equipment for servicing and other applications.
130. *MERCURY*—Description and specification brochure on Model 1400 in-circuit capacitor tester; also information on line of other test equipment.*
131. *SECO*—12-page instruction manual for Model 980 and 990 color-bar generators; includes schematics, waveforms, and specifications.*
132. *SENCORE*—Question-and-answer bulletin on new Model MX-129 *Multiplex Analyzer* and Model CR-128 Picture-Tube Tester-Rejuvenator.*
133. *SIMPSON*—Latest series of VOM's is described in test-equipment bulletin; also information on line of automotive test equipment.
134. *SPRAGUE*—Catalog on TO-6 Tel-ohmike capacitor analyzer.
135. *TRIPLETT*—Sheets giving basic information on complete line of VOM's.*
136. *WATERMAN*—Technical data and photos on pocket-size OCA-11A industrial oscilloscope.

TOOLS

137. *ACME LITE*—Descriptive bulletin on line of *Magniflex* fluorescent lamps.
138. *ADEL*—Literature on "Nibbling Tool" that cuts, notches, and trims round or irregular holes to any size over 7/16"; ideal for radio chassis, templates, or shims.
139. *ENTERPRISE DEVELOPMENT*—Time-saving techniques in brochure from Endeco demonstrate improved desoldering and resoldering techniques for speeding up and simplifying operations on PC boards.*
140. *LUXO LAMP*—Catalog on line of "touch-and-stay-put" lamps.

TUBES & SEMICONDUCTORS

141. *INTERNATIONAL ELECTRONICS*—New listing includes Mullard range of electron tubes for TV, Radio, and Hi-Fi replacements; includes cross-reference guide.
142. *SEMITRONICS*—New updated 16" x 20" wall chart CH10 lists replacements and interchangeability for transistors and diodes.

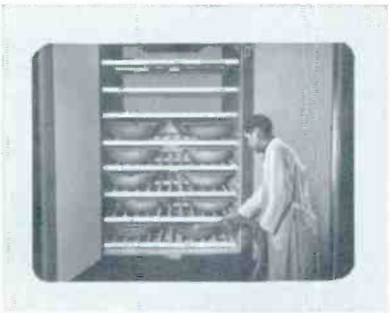
WHERE THE SILVERAMA® SCREEN BEGINS

TV picture quality depends on precise control of phosphors

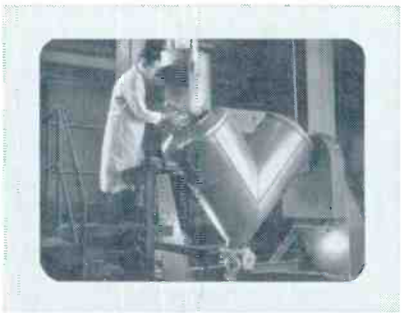
Television picture quality depends on the quality of the phosphor screen inside the faceplate. That's why every RCA Silverama replacement picture tube is completely rescreened—in the same painstaking manner and with the same precision—as RCA picture tubes produced for use in original equipment. Before receiving their new Silverama screens, reused glass envelopes are scrubbed completely clean and given a series of chemical baths internally to restore them to the peak of their optical capabilities.

RCA produces and develops its own screen phosphors. These are formed by reacting solutions of zinc sulfate and zinc and cadmium sulfates with hydrogen-sulfide gas in this complex precipitator, (above). The resulting zinc sulfide and zinc-cadmium sulfide are then activated, fluxed, fired, washed, dried, and screened to form phosphors which emit blue and yellow light, respectively. These are carefully blended to produce phosphors that possess the pleasing "white", high light output, and uniform smoothness, which characterize RCA Silverama picture tube screens.

Make RCA Silverama your first choice in picture tubes.



Drying ovens remove moisture from phosphor

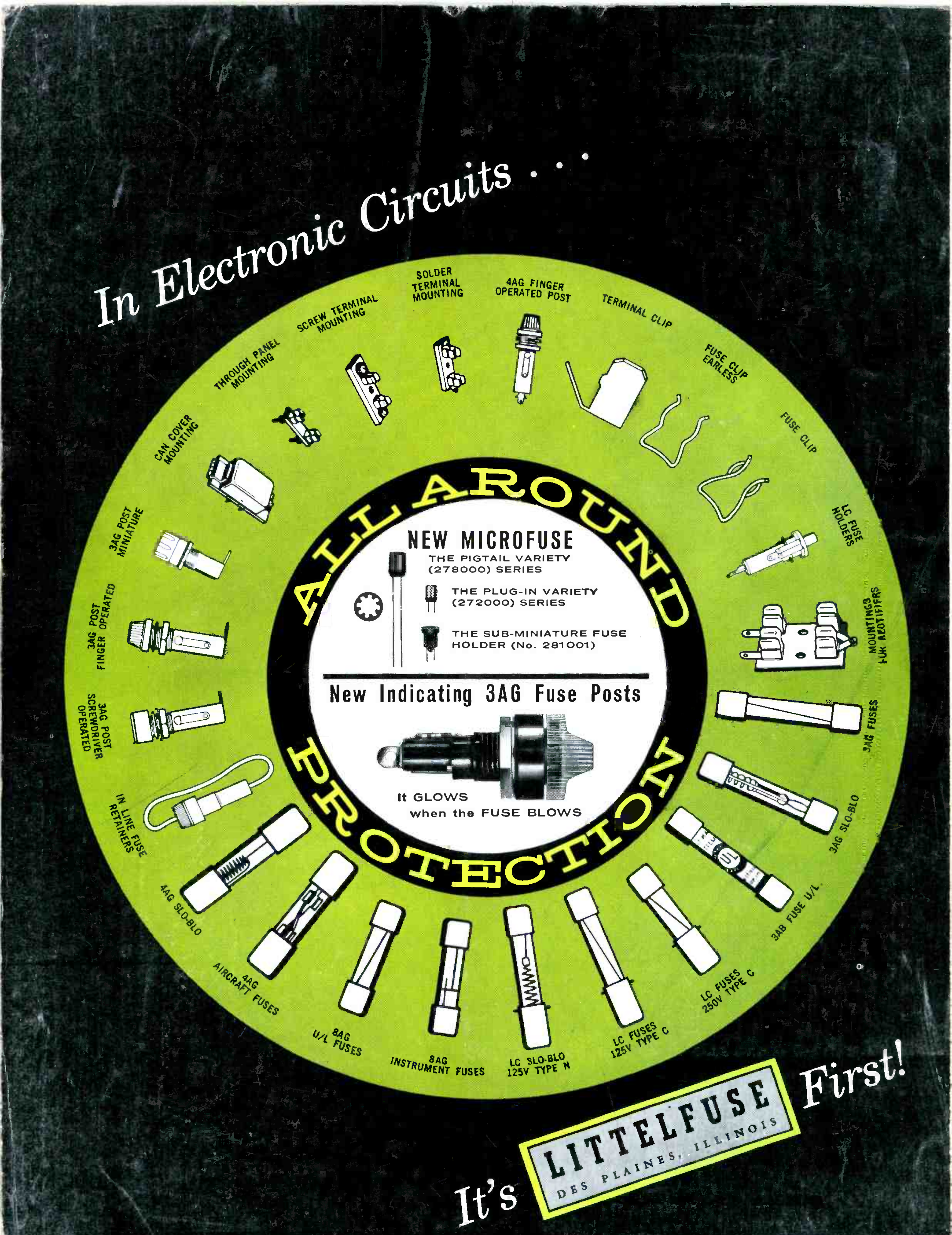


Phosphors are blended for best screen quality

Base materials are fired to form the phosphors

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

The Most Trusted Name in Electronics



Circle 71 on literature card