JULY, 1963 50 CENTS

PF REPORTER

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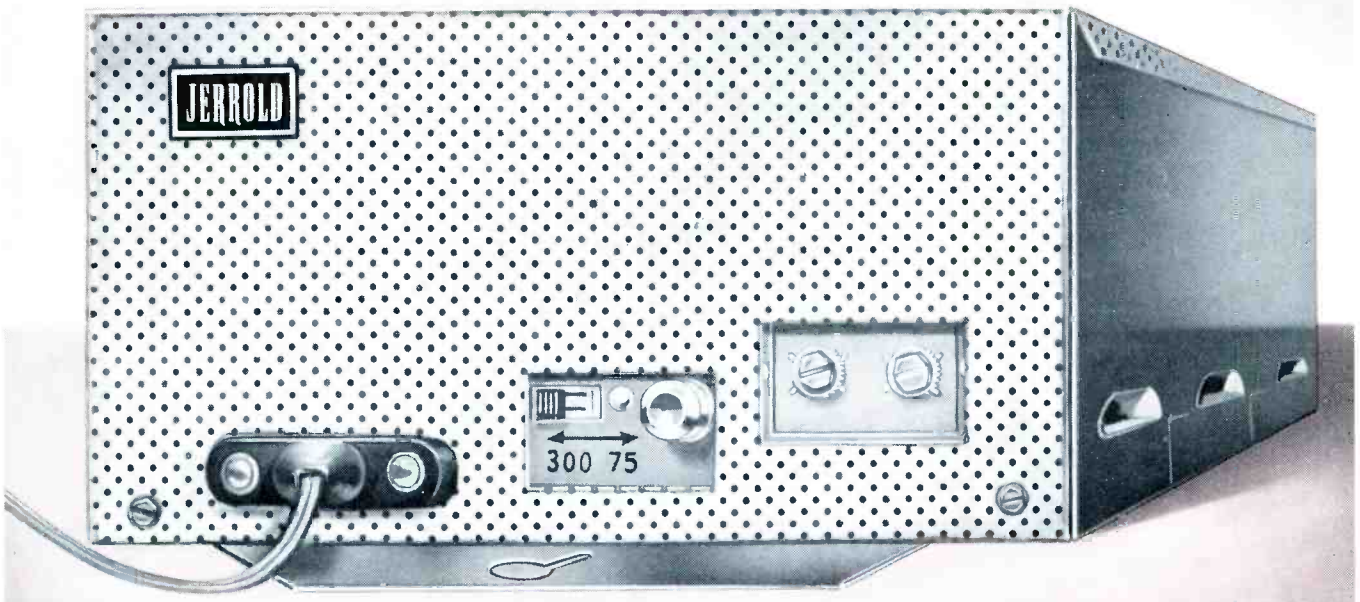
- The Wraps Are Off Motorola Color

BIG-SYSTEM MUSCLE...



SMALL-SYSTEM PRICE!

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JERROLD ELECTRONICS

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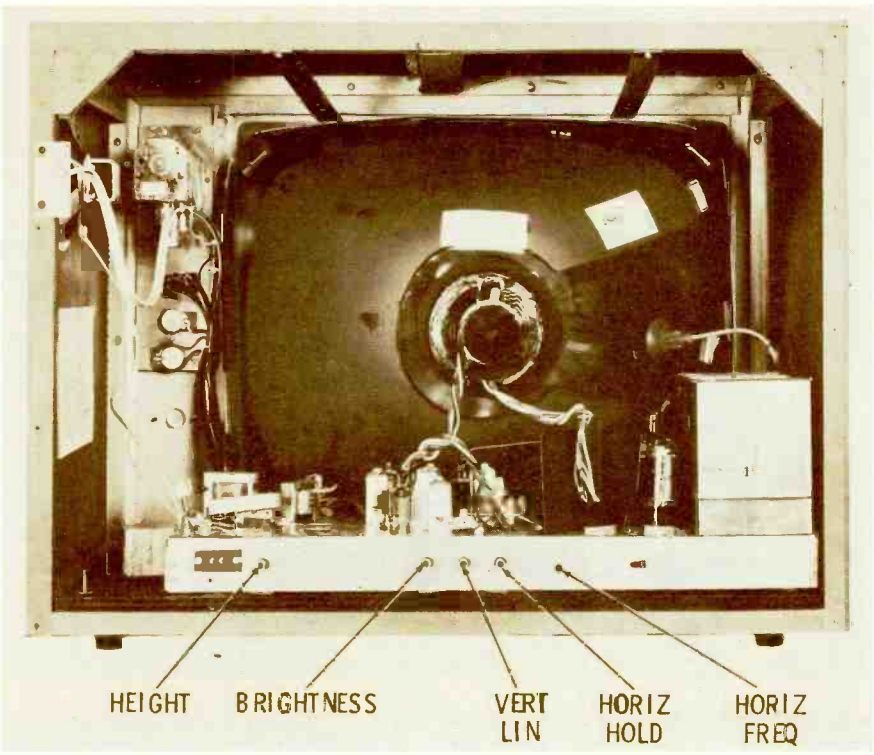
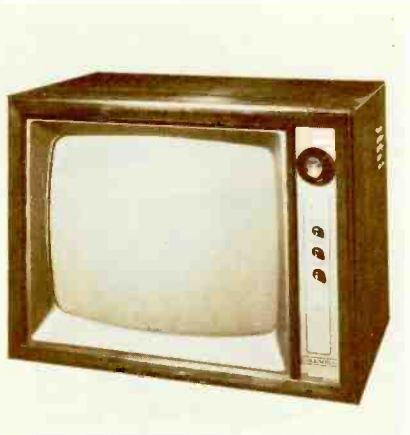
Columbia





Columbia
Model C-23T6216
Chassis 1056-12

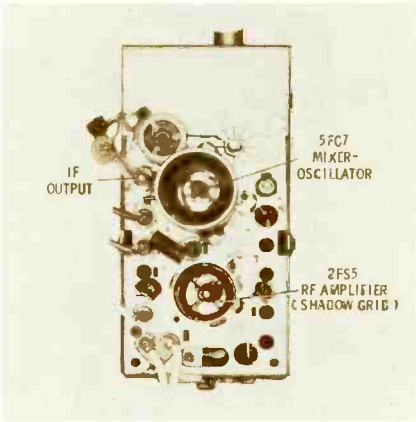
Among the features of this table-model receiver are a *shadow-grid* VHF tuner with enclosed-type switches, and a 92°, 23AHP4 picture tube. The tuner uses a 2FS5 RF amplifier and a 5FG7 mixer-oscillator. In the two IF stages used in this chassis, you'll find a pair of 3BZ6's. The video detector is a 1N87A crystal diode; before you can replace it, you must first remove the shield can from the second IF coil.

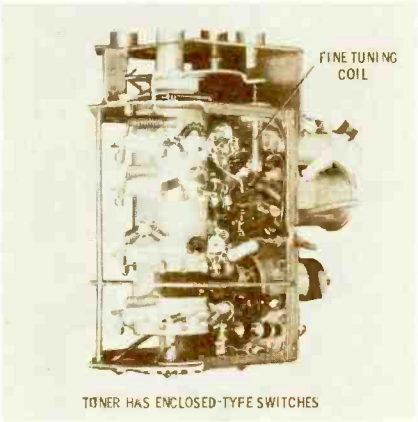
The video output tube is a sheet-beam 8BQ5, with the contrast control connected in its cathode circuit. The pentode section of a 6AW8A serves an unusual function in this set: audio output. The triode section, however, is in a familiar location—as the sound IF amplifier. A 3DT6 in the detector socket rounds out the tube complement of the sound stages.

Only one B+ rectifier—a silicon type—is used. The protection device for this circuit is a 4.5-ohm fusible resistor of the plug-in type. As shown in one of the photos, these components are easily accessible in case replacement becomes necessary. Even though the 42-ohm, 20-watt filament dropping resistor is soldered in, you can replace it without removing the chassis from the cabinet. Its location is marked in the same photo that shows the B+ fusible resistor.

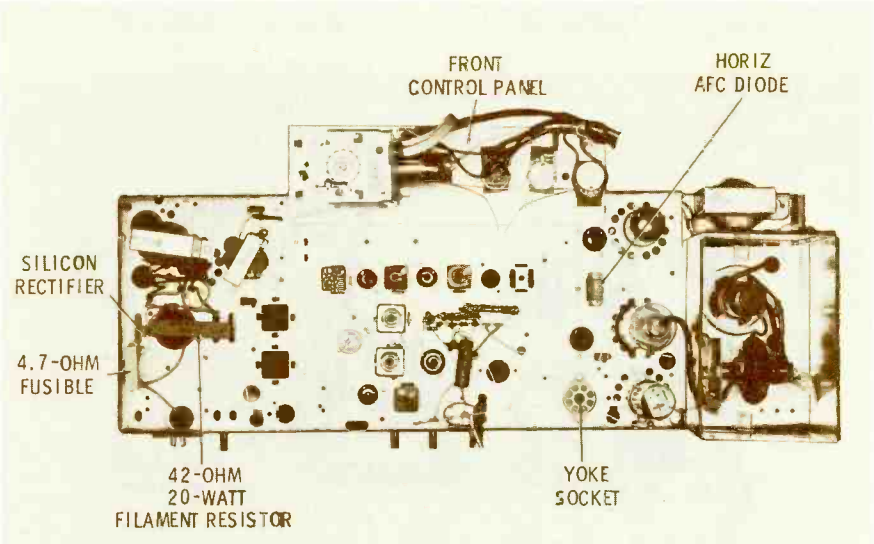
This chassis uses two 6CG7's; one functions as the sync separator-vertical multivibrator (discharge section) and the other one as a cathode-coupled multivibrator for the horizontal sweep circuit. AFC voltage to control this horizontal stage is developed by a common-cathode dual diode that plugs into a socket on top of the chassis.

The on-off-volume, channel selector, fine tuning, contrast, and vertical hold controls are located on a separate panel at the front of the cabinet. Those on the rear apron include height, brightness, vertical linearity, horizontal hold, and horizontal frequency (a coil). The focus is controlled by a jumper located on the base of the picture tube; you should connect the jumper from pin 6 to pin 2 or 10, whichever provides the best focus. Changing this will seldom be necessary, unless you install a new tube. The safety glass is easily removed for cleaning by extracting three wood screws that hold the metal trim strip.





TUNER HAS ENCLOSED-TYPE SWITCHES



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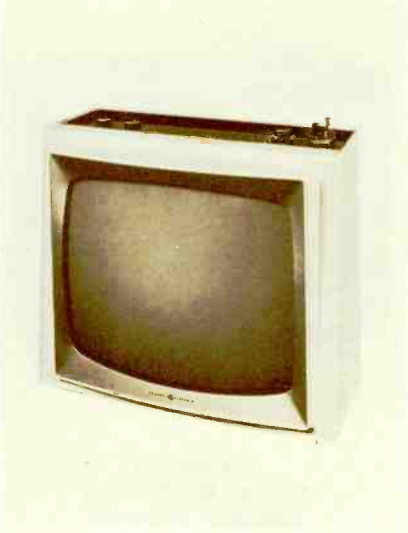


General Electric
Model PAM203YVY
Chassis LY

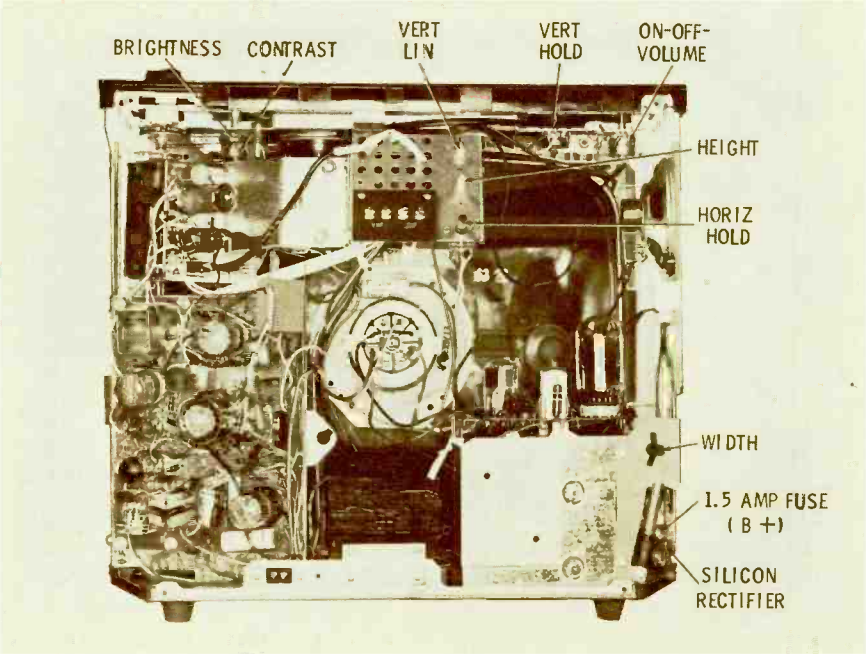
"Loaded with compactrons" might be the best description for this 19" portable television, introduced by G-E as a forerunner of the '64 line. A total of eight are used in this slim set. A single 6AR11 contains both the first and second IF amplifiers; a 6BD11 pentode-dual triode is used for video output-sync separator-sound IF amplifier functions; a 6BF11 is the audio detector-audio output; a 6B10 dual diode-dual triode serves as phase detector-horizontal multivibrator; a 6HB5 fills the horizontal output socket; a 6BJ3 is the damper; a 1AD2 functions as high-voltage rectifier; and a 6JZ8 operates as vertical multivibrator-output.

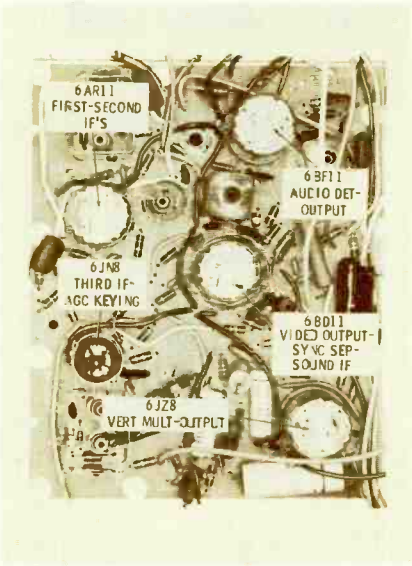
This receiver comes equipped with a built-in monopole antenna that is mounted on the inside of the rear cover. The VHF tuner is of the enclosed-switch type, using a 6FS5 shadow-grid RF amplifier and a 6FG7 mixer-oscillator. Rounding out the tube complement of the receiver are the 6JN8 third IF-AGC keying tube and the 19CFP4 picture tube—a 114° type.

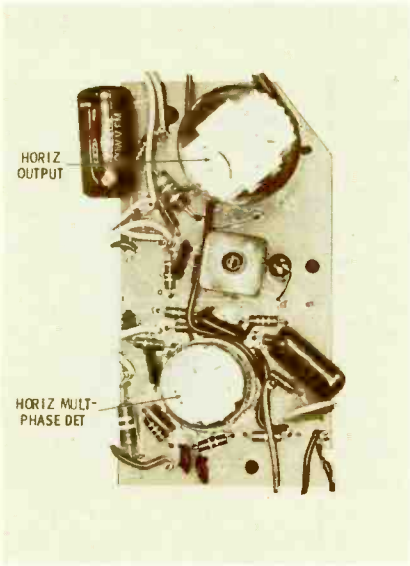
This is a transformer-powered chassis, with a single silicon rectifier to develop the B+. A 1.5-amp fuse protects the low-voltage supply from damage in case of overload; the filament supply is protected by a #26 wire-link fuse. The locations of the rectifier and the B+ fuse are marked on the photo.

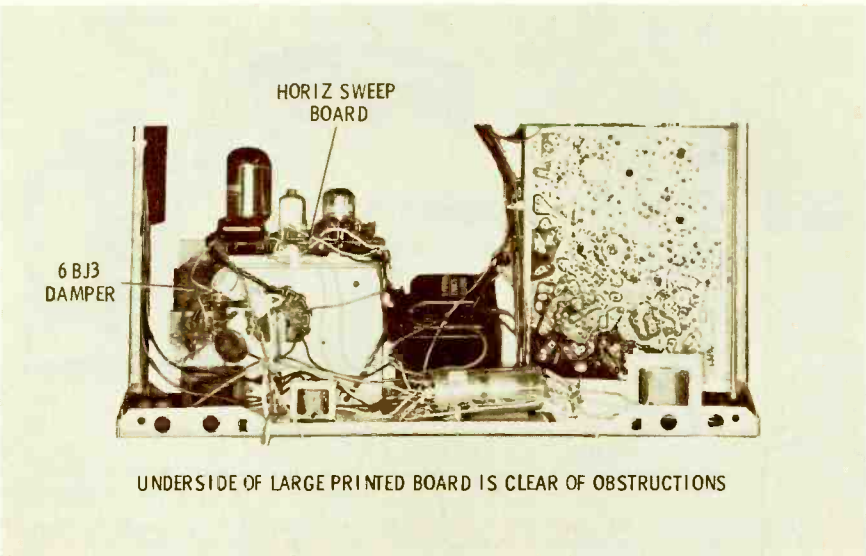
Operating controls at the top of the cabinet are: channel selector, fine tuning, brightness, contrast, vertical hold, and on-off-volume. The vertical linearity, height, horizontal hold, and width controls can be adjusted through holes provided in the rear cover. No provision is made to vary the AGC voltage in this chassis. Likewise, the focus is not adjustable; the focus anode—pin 4 of the CRT—simply returns to chassis.

The chassis uses two printed circuit boards, upon which are mounted most of the tubes and components. The large board is clear of underside obstructions, making any needed soldering operations fairly simple. As depicted in the rear view of the chassis, all of the heaviest components — vertical transformer, audio transformer, and filter choke — are mounted on the metal chassis pan.



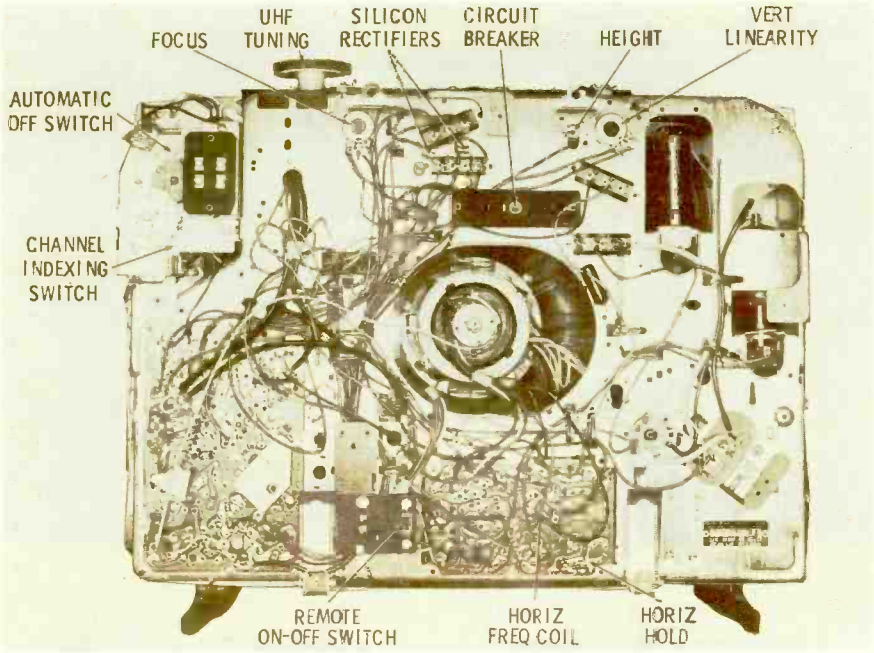


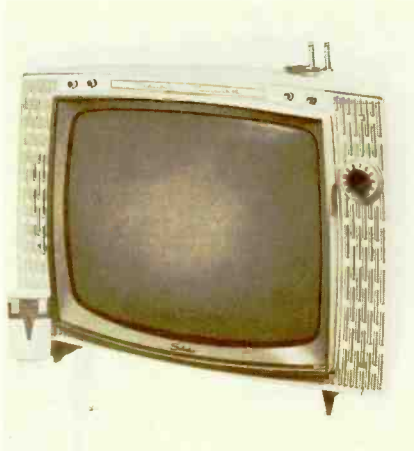




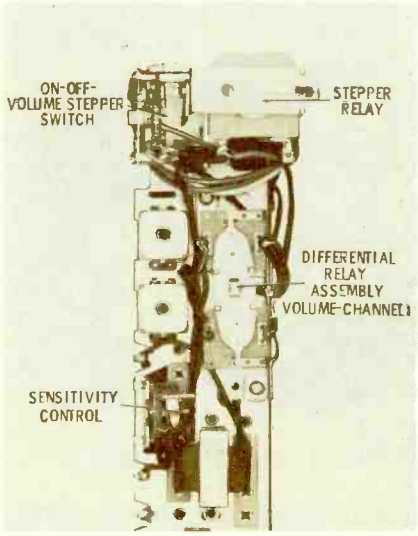
UNDERSIDE OF LARGE PRINTED BOARD IS CLEAR OF OBSTRUCTIONS

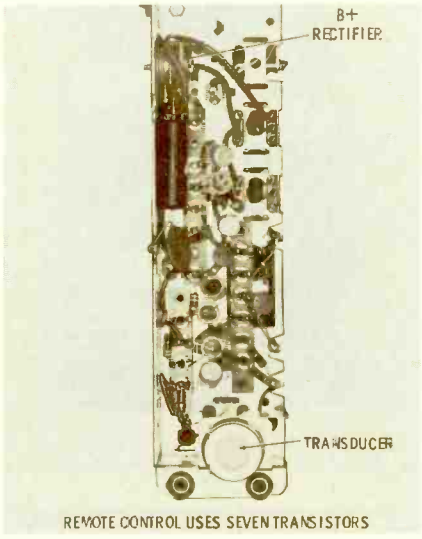
Silvertone

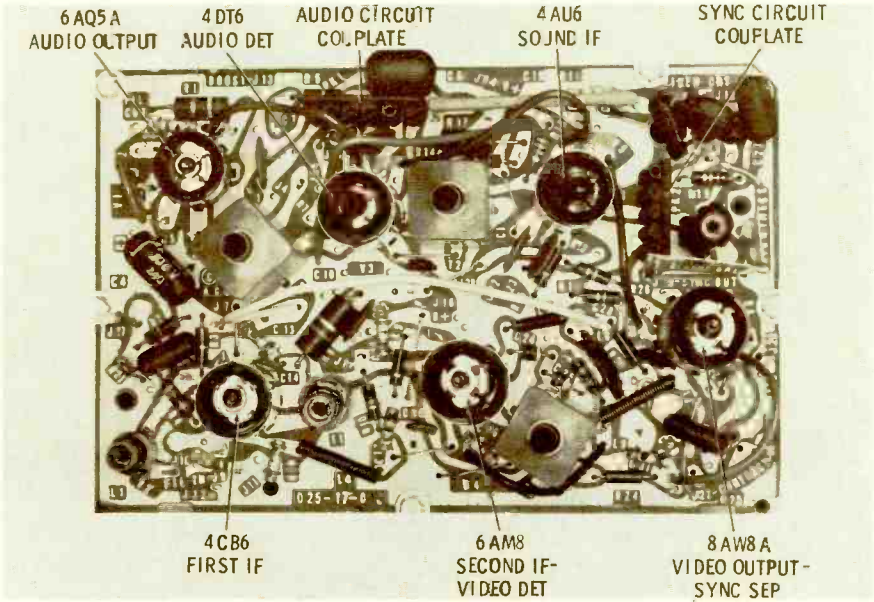




Silvertone
Model 3115
TV Chassis 528.60173
Remote Transmitter
Chassis 528.60183
Remote Receiver
Chassis 528.60180







This portable set features a built-in rabbit-ear antenna, VHF-UHF tuners, remote control, and a 19AYP4 CRT—a 114° type. The one-transistor remote transmitter is powered by a 4-volt battery. The remote receiver has a total of seven transistors, and controls channel selection and volume (in steps). This remote-control chassis has its own power supply, using a single selenium rectifier. A sensitivity switch, shown in the photo of the remote chassis, sets the operating point of the third IF transistor; the setting of this control can be reduced in case unwanted noise-keying of the remote occurs.

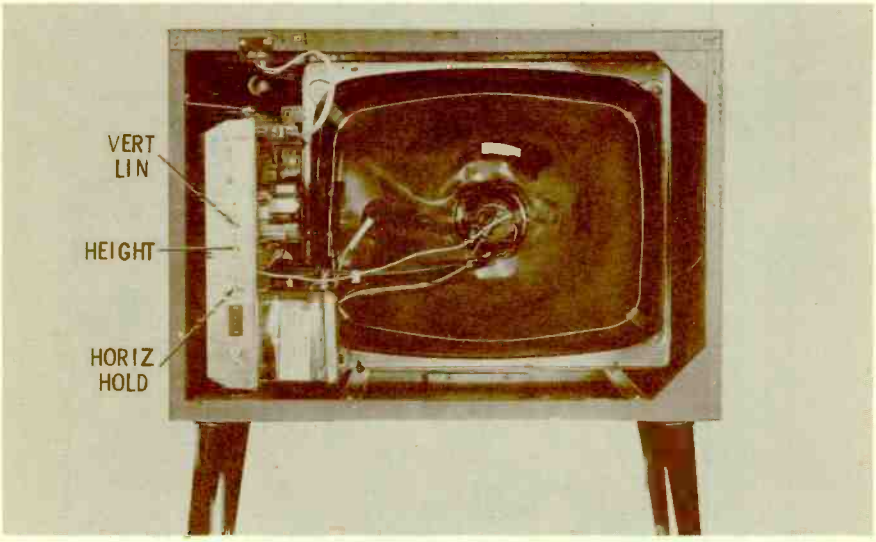
The VHF tuner in this chassis has a 3FS5 RF amplifier and a 6FG7 mixer-oscillator. In the UHF tuner, a 3AF4B is the oscillator. IF tubes include a 4CB6 for the first, and the pentode section of a 6AM8A for the second; the diode section of the latter tube functions as the video detector. Other tubes include: 8AW8A video output-sync separator, 13EM7 vertical multivibrator - output, 4AU6 sound IF amplifier, and 6AQ5A audio output.

Two silicon rectifiers, wired as a half-wave voltage doubler, develop the low voltage for the TV chassis. This B+ circuit has both a 4.5-ohm, 10-watt surge-limiting resistor and a thermal circuit breaker for protection. The 450-ma series filament string also contains a 22-ohm, 7-watt dropping resistor.

Operating controls located at the front of the cabinet are the channel selector, fine tuning, on-off-volume, vertical hold, brightness, and contrast. The UHF tuning knob is at the top of the cabinet, above the contrast and volume controls. Located on the rear of the chassis are the adjustments for focus, height, vertical linearity, horizontal frequency, and horizontal hold. Width is controlled by a metal sleeve located between the yoke and the CRT neck.

The remaining tubes we haven't mentioned are the 8FQ7 (alternate 8CG7) horizontal multivibrator, 17DQ6B horizontal output, 22DE4 damper, and 1G3GT/1B3GT high-voltage rectifier.

Truetone .....PREVIEWS of new sets



Truetone
Model 2DC1300B,-C
Chassis 23S35

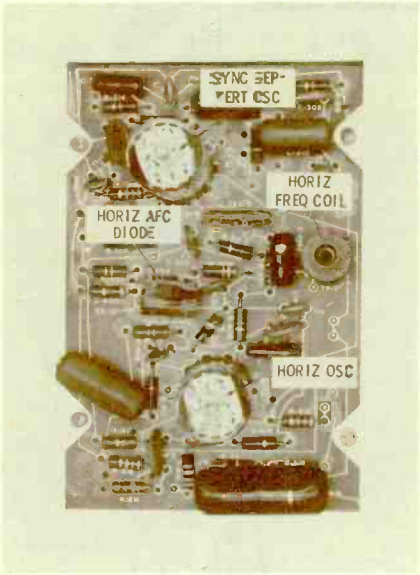
The 23" consolette TV shown here uses a 92°, 23AWP4 picture tube, and has a turret-type VHF tuner. This particular model is equipped for VHF operation only; however, other models using the same chassis are factory-equipped to receive UHF as well. In most models, it is possible to install a UHF tuner in the field, if your customer wants it done. A 2FS5 functions in the RF amplifier stage, and a 5FG7 is used as the mixer-oscillator. The individual oscillator slugs can be exposed for adjustment, if necessary, by removing the channel-selector and fine-tuning knobs.

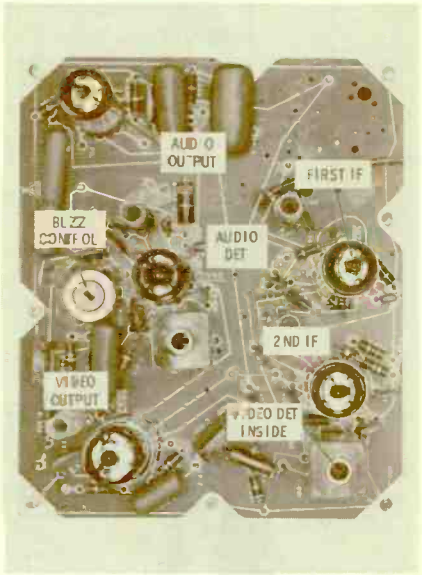
The single silicon rectifier that develops the B+ for this receiver is protected by a soldered-in, 4.7-ohm fusible resistor. The series filament string contains a 46-ohm, 20-watt protective resistor; this is a good component to check first if the tube filaments fail to light. The resistor is wired to a terminal strip on the exposed side of the chassis, so it's not necessary to remove the chassis to replace it.

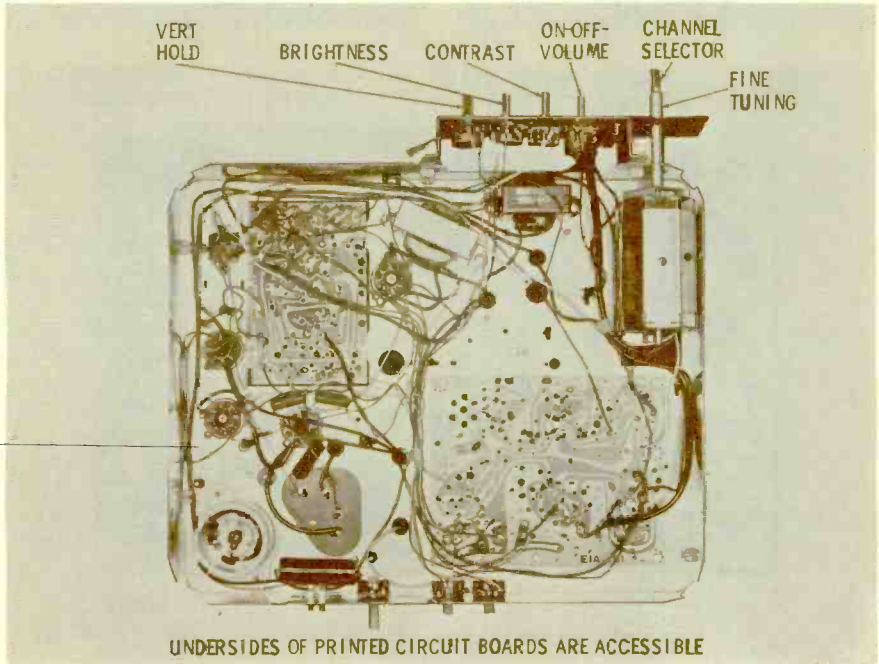
Different from previous Truetone chassis is the use of printed-circuit boards. This receiver has two—one large, and the other small. On the larger board are mounted the tubes and components for the first and second IF, video output, audio detector, and audio output stages. The small board contains the circuit components for the sync separator-vertical multivibrator (discharge section), and the horizontal oscillator. A pair of 6FQ7's (alternate 6CG7) function in these stages. Also mounted on this board are the horizontal frequency coil and the soldered-in dual diode used for horizontal AFC (a common-cathode type).

The channel selector, fine tuning, on-off-volume, contrast, brightness, and vertical hold controls can be reached at the front of the cabinet. The adjustments for vertical linearity, height, and horizontal hold are accessible from the rear of the set—without removing the rear cover. However, if the buzz control needs adjustment, you must first remove the rear cover; the control is located to the left of the center area on the large printed board, as shown in the photo. Adjust it for loudest sound, with minimum buzz.

Familiar tubes are used in all stages, including the 12DQ6B, 12AX4, and 1K3 in the horizontal sweep and high-voltage circuits.







UNDERSIDES OF PRINTED CIRCUIT BOARDS ARE ACCESSIBLE

See PHOTOFACT Set 639, Folder 2

See PHOTOFACT Set 639, Folder 2

Mfr: Emerson **Chassis No.** 120587A

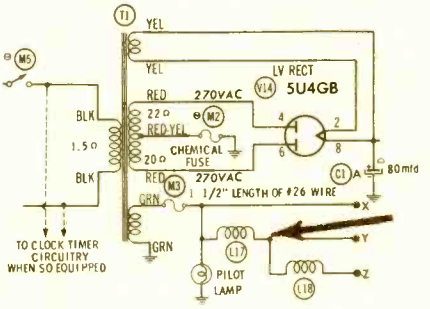
Card No: EM 120587A-1

Section Affected: Pix and sound.

Symptoms: No picture or sound. No (or low) filament voltage on second and third video IF tubes.

Cause: Cold-solder connection at junction of RF chokes in filament circuit.

What To Do: Resolder connection between L18 and L17.



Mfr: Emerson **Chassis No.** 120587A

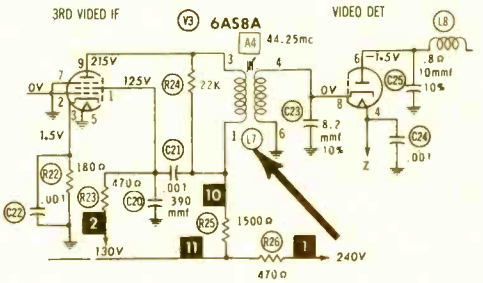
Card No: EM 120587A-2

Section Affected: Pix.

Symptoms: Weak video.

Cause: Poor connections to transformer in plate circuit of third video IF.

What To Do: Make sure all the wires from L7 are making proper electrical contact with the etched circuit board.



Mfr: Emerson **Chassis No.** 120587A

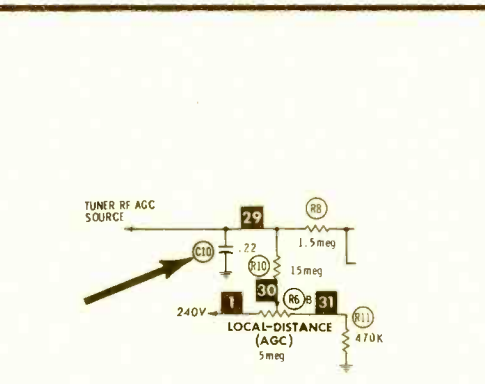
Card No: EM 120587A-3

Section Affected: Raster.

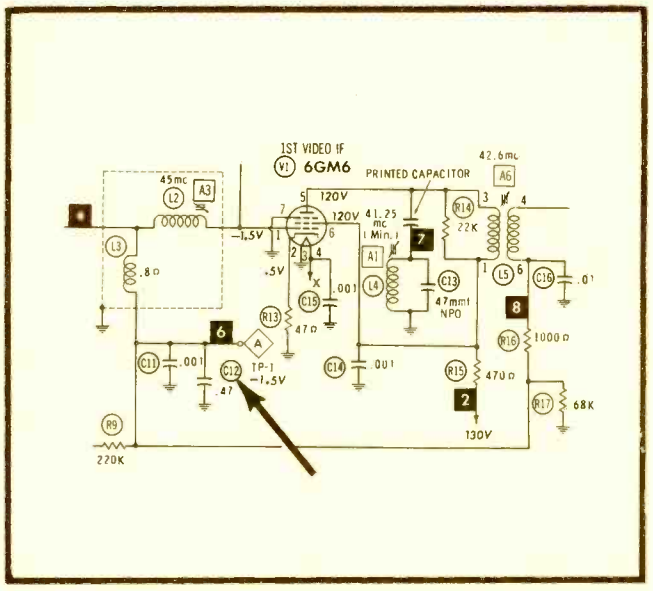
Symptoms: Left half of raster blacked out.

Cause: AGC keying pulses interfering with picture signal because of open filter capacitor on RF branch of AGC line.

What To Do: Replace C10 (.22 mfd).



See PHOTOFACT Set 639, Folder 2



See PHOTOFACT Set 639, Folder 2

Mfr: Emerson **Chassis No.** 120587A

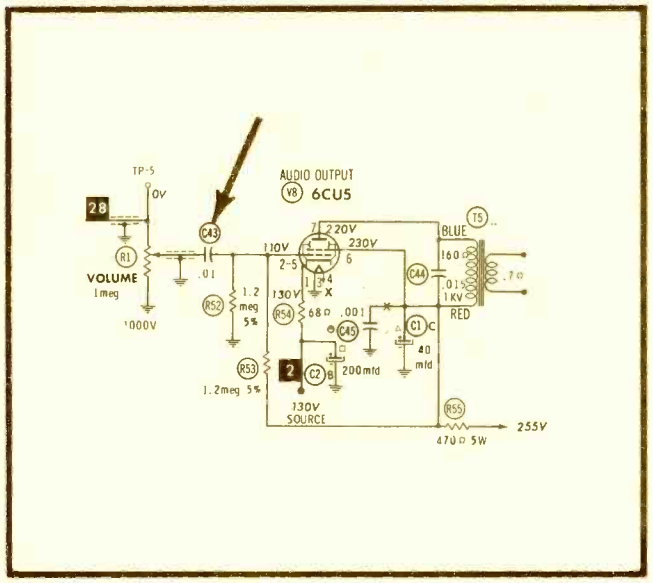
Card No: EM 120587A-4

Section Affected: Pix and sync.

Symptoms: Picture overload and horizontal pulling.

Cause: Loss of AGC filtering due to defective IF-AGC filter capacitor.

What To Do: Change C12 (.47 mfd).



Mfr: Emerson **Chassis No.** 120587A

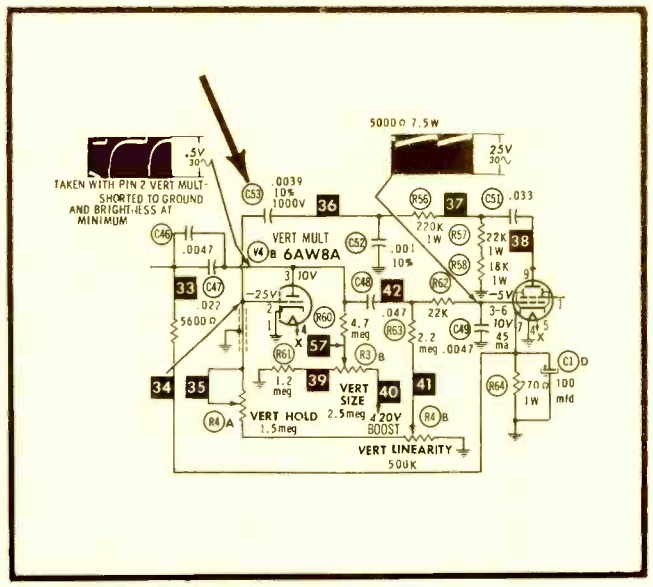
Card No: EM 120587A-5

Section Affected: Sound.

Symptoms: Audio distorted or absent. Low negative bias, or even positive bias, between grid and cathode of V8 (6CU5).

Cause: Leaky coupling capacitor in grid circuit of audio output tube.

What To Do: Change C43 (.01 mfd).



Mfr: Emerson **Chassis No.** 120587A

Card No: EM 120587A-6

Section Affected: Sync.

Symptoms: Unstable vertical hold. Incorrect bias on grid (pin 2) of V4B (6AW8A).

Cause: Leaky capacitor in feedback network of vertical multivibrator.

What To Do: Replace C53 (.0039 mfd — 1000V).

See PHOTOFACT Set 479, Folder 1

See PHOTOFACT Set 479, Folder 1

Mfr: Philco **Chassis No.** 10L31

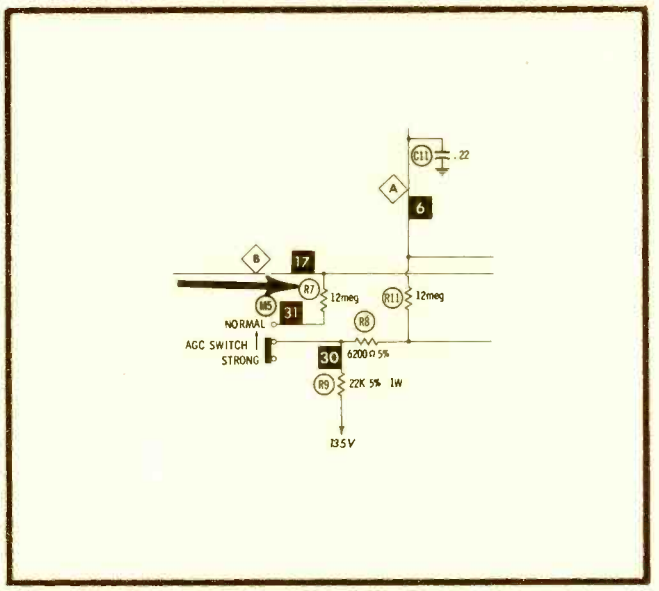
Card No: PH 10L31-1

Section Affected: Pix.

Symptoms: Snow in picture when RF signal strength is at medium level.

Cause: Insufficient AGC delay voltage.

What To Do: Reduce the value of R7 from 12 meg to 10 meg, thereby applying additional delay voltage.



Mfr: Philco **Chassis No.** 10L31

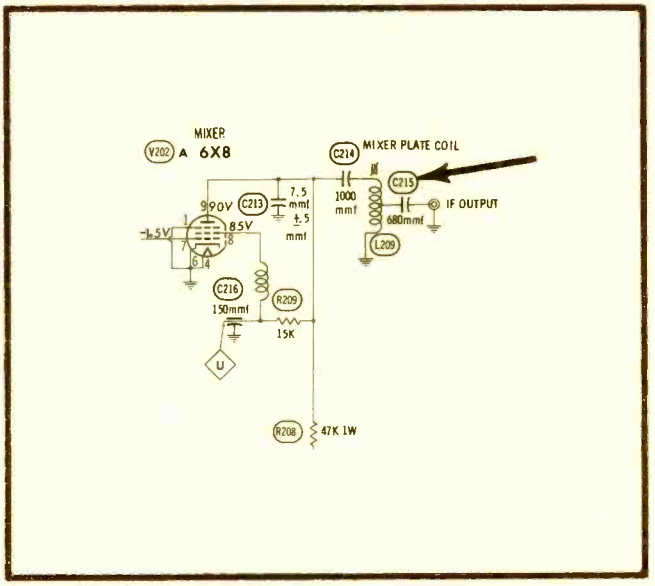
Card No: PH 10L31-2

Section Affected: Pix.

Symptoms: Picture overloading; possibility of buzz in sound. Insufficient negative voltage, or positive voltage, on grid of V1 (6DE6).

Cause: Leaky or shorted coupling capacitor between mixer and first video IF.

What To Do: Replace C215 (680 mmf), located inside tuner.



Mfr: Philco **Chassis No.** 10L31

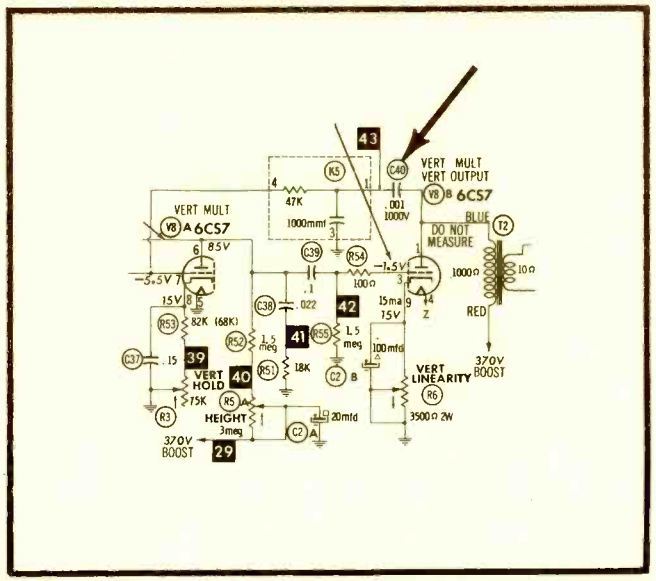
Card No: PH 10L31-3

Section Affected: Sync.

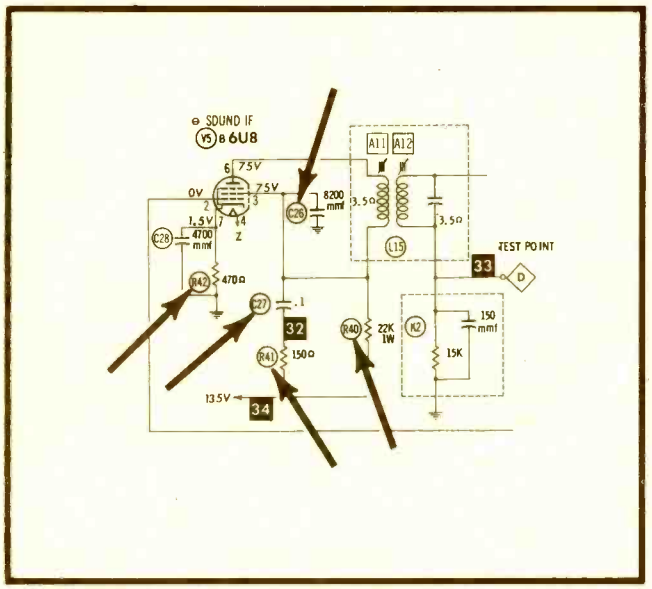
Symptoms: Vertical sync drifts beyond range of hold control.

Cause: Leaky feedback capacitor in vertical multivibrator.

What To Do: Replace C40 (.001 mfd — 1000V) with unit rated at 1500V.



See PHOTOFACT Set 479, Folder 1



See PHOTOFACT Set 479, Folder 1

Mfr: Philco **Chassis No.** 10L31

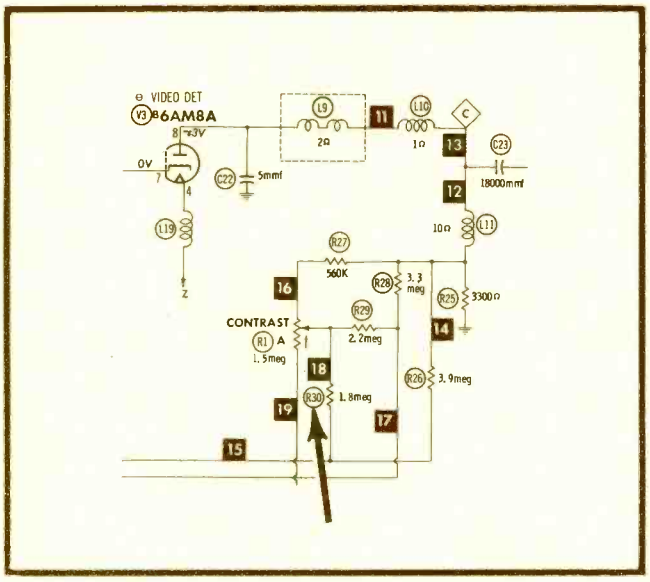
Card No: PH 10L31-4

Section Affected: Sound.

Symptoms: Weak sound.

Cause: Low gain in sound IF amplifier stage.

What To Do: Change R42 from 470 ohms to 150 ohms; change R40 from 22K to 10K; change C26 from 8200 mmf to 2200 mmf; remove C27 and R41. (These changes are incorporated in Run 6 receivers.)



Mfr: Philco **Chassis No.** 10L31

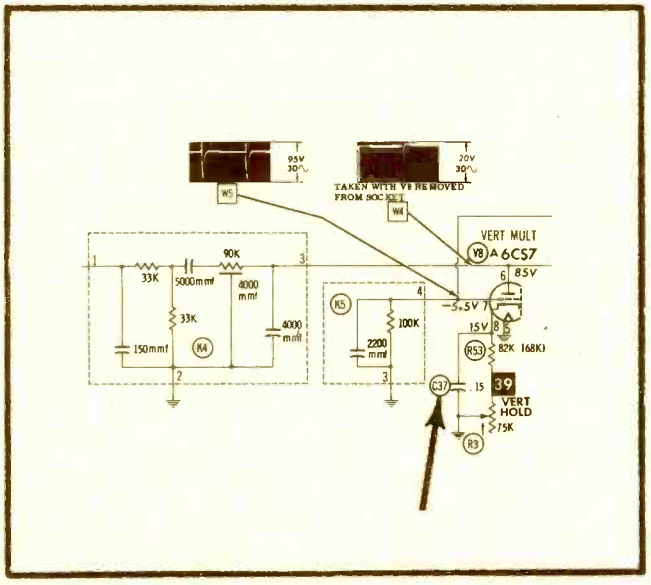
Card No: PH 10L31-5

Section Affected: Pix.

Symptoms: Video overloading on medium to strong signals.

Cause: Insufficient AGC applied to IF strip.

What To Do: Change R30 from 1.8 meg to 2.2 meg. (This change has been incorporated in run 6 chassis.)



Mfr: Philco **Chassis No.** 10L31

Card No: PH 10L31-6

Section Affected: Sync.

Symptoms: Vertical sync is out of range of hold control.

Cause: Leaky cathode-bypass capacitor in first stage of vertical multivibrator.

What To Do: Replace C37 (.15 mfd).

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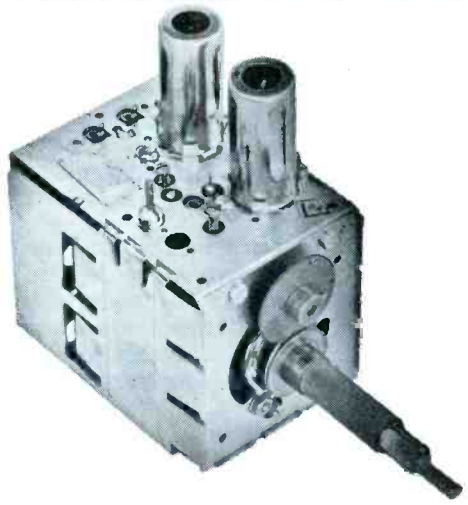
INCLUDING

ALL PARTS

(except tubes)

and LABOR



24-HOUR SERVICE
1-YEAR WARRANTY

It just makes sense that a manufacturer of tuners should be better-qualified, better-equipped to offer the most dependable tuner repair and overhaul service.

Sarkes Tarzian, Inc. pioneer in the tuner business, maintains two complete, well-equipped Factory Service Centers—assisted by Engineering personnel—and staffed by specialized technicians who handle ONLY tuner repairs on ALL makes and models.

Tarzian-made tuners received one day will be repaired and shipped out the next. Allow a little more time for service on other than Tarzian-made tuners.

Tarzian offers a 12-month guarantee against defective workmanship and parts failure due to normal usage. And, compare our cost of $9.50 and $15 for UV combinations. There is absolutely no additional, hidden charge, for ANY parts except tubes. You pay shipping costs. Replacements on tuners beyond practical repair are available at low cost.

Ⓣ Tarzian-made tuners are identified by this stamping. When inquiring about service on other tuners, always give TV make, chassis and Model number. All tuners repaired on approved, open accounts. Check with your local distributor for Sarkes Tarzian replacement tuners, replacement parts, or repair service.

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Tel: 332-6055

10654 Magnolia Blvd.
North Hollywood, Calif.
Tel: 769-2720

SARKES TARZIAN, INC.

Bloomington, Indiana

MANUFACTURERS OF TUNERS . . . SEMICONDUCTORS . . . AIR TRIMMERS . . . FM RADIOS . . . AM/FM RADIOS . . . AUDIO TAPE . . . BROADCAST EQUIPMENT

The HIDDEN 600* wrote these 6 SUCCESS STORIES...

Service Technicians supply the happy endings!

Capacitor success stories are no novelty at Sprague. The "Hidden 600", Sprague's behind-the-scenes staff of 600 experienced researchers, have authored scores of them! And customers add new chapters every day. But none has proved more popular than the 6 best sellers shown here. Developed by the largest research organization in the capacitor industry, these 6 assure happy endings to service technicians' problems.

1 DIFILM® BLACK BEAUTY® MOLDED TUBULAR CAPACITORS

The world's most humidity-resistant molded capacitors. Dual dielectric—polyester film and special capacitor tissue—combines best features of both. Exclusive HCX® solid impregnant produces rock-hard section—nothing to leak. Tough case of non-flammable phenolic—cannot be damaged in handling.

2 DIFILM® ORANGE DROP® DIPPED TUBULAR CAPACITORS

Especially made for exact, original replacement of radial-lead tubulars. Dual dielectric combines the best features of both polyester film and special capacitor tissue. Exclusive HCX® solid impregnant—no oil to leak, no wax to drip. Double dipped in bright orange epoxy resin to beat heat and humidity.

3 TWIST-LOK® ELECTROLYTIC CAPACITORS

The most dependable capacitors of their type. Built to "take it" under torrid 185°F (85°C) temperatures—in crowded TV chassis, sizzling auto radios, portable and ac-dc table radios, radio-phono combinations, etc. Hermetically sealed in aluminum cases for exceptionally long life. Withstand high surge voltages. Ideal for high ripple selenium rectifier circuits.

4 ATOM® ELECTROLYTIC CAPACITORS

The smallest dependable electrolytics designed for 85°C operation in voltages to 450 WVDC. Small enough to fit anywhere, work anywhere. Low leakage and long shelf life. Will withstand high temperatures, high ripple currents, high surge voltages. Metal case construction with Kraft insulating sleeve.

5 LITTL-LYTIC® ELECTROLYTIC CAPACITORS

Ultra-tiny size for use in transistorized equipment. High degree of reliability at reasonable price. All-welded construction—no pressure joints to cause "open" circuits. Withstand temperatures to 85°C (185°F). Hermetically sealed. Extremely low leakage current. Designed for long shelf life—particularly important in sets used only part of the year.

6 CERA-MITE® CERAMIC CAPACITORS

Tiny, tough, dependable in practically every application. Low self-inductance of silvered flat-plate design gives improved by-pass action in TV r-f circuits. Higher self-resonant frequency than tubular ceramics or micas. Tough moisture-proof coating. Designed for 85°C operation.

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Handy Hanging Wall Catalog C-457 gives complete service part listings. Ask your Sprague Distributor for a copy, or write Sprague Products Company, 105 Marshall Street, North Adams, Massachusetts.

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PF REPORTER

including Electronic Servicing

VOLUME 13, No. 7 JULY, 1963

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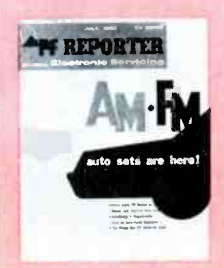
ABOUT THE COVER

The fast-moving entertainment electronics industry is constantly devising new types of equipment. Turn to page 26 and find out about the latest innovation: all-transistor AM-FM auto radios, factory-installed in many of the new cars this year.



LETTERS TO THE EDITOR

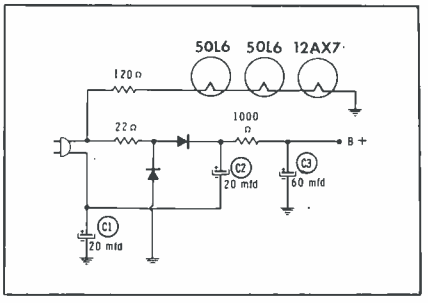
Dear Editor:

I found your report of "Unusual Faults in Filament Circuits" in the January, 1963 issue very interesting, but someone is going to have trouble in Fig 5. If C1 is replaced with an electrolytic, it will go bad again; there is no return circuit for the tubes except through C1, and you know raw AC is not good for an electrolytic.

Also, the tubes are working on less current than they should. Here's why: By Ohm's law for AC circuits, the total (hot) impedance of the tubes is 747 ohms; the resistor is 120 ohms; and the reactance of the capacitor at 60 cps is 133 ohms. Combining these factors by vector algebra, the overall impedance of the circuit is 877 ohms, and the current at 117 volts AC will be .133 amp, instead of the normal 50 volts at .15 amp. Somebody goofed!

JOHNNIE TALLEY
Student
Albilene, Texas

I'm afraid it was you, Johnnie. Your calculations are correct, but they fail to consider the operation of the DC power supply, which (instead of the AC source) furnishes heater voltage for the tubes. Lest someone else make the same mistake—an easy one to make—let's review the circuit. With a voltmeter connected between the junction of the two resistors and ground, you would read DC voltage and only a very slight AC ripple. You'll notice the power line is not grounded; its "return" is to the junction of C1 and C2. C1 takes a charge during the half-cycle when the grounded rectifier conducts; the other half-cycle charges C2 through the other rectifier. The DC voltage equals approximately 150 volts — one-half the doubler output voltage — and divides among the filaments as follows (50 volts at each 50L6, 12 volts for the 12AX7, and 18 volts across the 120-ohm resistor, all at .15 amp. You see, this is actually a unique way to develop DC filament voltages to reduce hum in the amplifier. Don't you agree?—Ed.



TAKE 9 NUMBERS... AND YOU'VE GOT IT

B	I	N	G	O
SG-20HP4D	20[illegible]P4A	21ATP4A	24ANP4	SG-21XP4A
17BRP4	SG-24AEP4	21[illegible]NP4	SG-20CP4D	24TP4
20[illegible]P4	21[illegible]TP4	SG-24CP4A	20[illegible]P4C	21CBP4A
21AMP4A	SG-21FLP4	21XP4	SG-21ACP4A	24YP4
SG-17BJP4	21AVP4	21C[illegible]P4	20DP4C	SG-21AUP4B

WHAT HAPPENED TO ALL THE OTHER "NUMBERS"?

Who needs them? They're all gone . . . finis, kaput, raus mit, ausgespilt! NOW, with PHILCO Star Bright 20/20 Picture Tubes, 9 basic types do the job of 91 numbers that you needed before. That means that just about all of the popular tube replacement jobs can be done with just 9 Philco CR Tube numbers.

That's only part of the story. It's important that just one tube replaces 19 you needed before . . . but it is equally important to you that you can meet most ANY tube need . . . from 10" sizes up to 27" tubes with just 30 Philco "universal" tube numbers.

This saves you time. Saves you money. It means that your Philco Distributor will have the tube you need IN STOCK . . . when you need it!

Philco Star Bright 20/20 Picture Tubes give you a big advantage in customer satisfaction . . . with clearer, brighter pictures. Every Philco Star Bright 20/20 Picture Tube is made from all new parts and materials, except for the envelope, which, prior to re-use is inspected and tested to the same exacting standards as a new envelope and of course, every one still carries a full year warranty!

Stop in at your Philco Distributor today. Nine Philco Star Bright CRT numbers are all you need to win . . . on most replacement jobs.

DEPEND ON YOUR PHILCO DISTRIBUTOR . . . Your one stop shopping center for all your tubes, parts and accessories.

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—for Simplified Service

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PARTS AND SERVICE OPERATIONS

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STOP! LOOK! SAVE!

All crystal controlled

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

only $99.50

the all new SENCORE CG126 STANDARD COLOR BAR GENERATOR

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

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

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

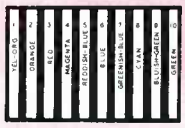
Simplified operation speeds up every servicing job. Just dial the standard keyed bars, white dots, crosshatch, vertical bars or horizontal bars and watch them "pop" on the screen. That's all there is to it.

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

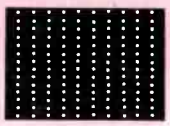
Pretuned RF output to Channel 4. Other low channels can be selected if Channel 4 is being used in your area by simple slug adjustment. Patterns are injected directly into antenna terminals, simplifying operation and saving servicing time.

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

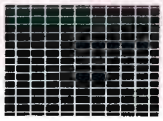
Smaller and more portable. With color receivers weighing much more than black and white TV, portable equipment becomes essential for home servicing. The CG126 weighs less than 10 pounds and measures only 11" x 8" x 6".



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

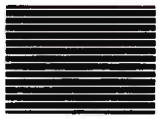


Stable white dots with new exclusive dot size adjustment in rear.



Stabilized crosshatch pattern for simplifying convergence adjustments.

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

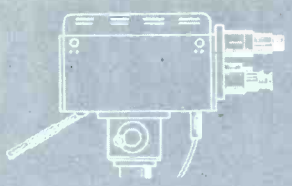


14 thin horizontal lines for vertical dynamic convergence. Also missing on many high priced generators.

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

SENCORE

426 SO. WESTGATE DRIVE • ADDISON, ILL.



The Electronic Scanner

R & D Center

Early in 1964, **IRC** will start construction on a 72,200 square-foot advanced research and development center near Norristown, Pennsylvania. The two-story building will be constructed of reinforced concrete and finished in masonry, with walls of glass and aluminum, and will be located on an 85-acre tract overlooking the northeast extension of the Pennsylvania Turnpike. Construction was originally planned for the summer of 1963, but unforeseen delays have made it advisable to revise these plans. Cost is expected to reach approximately $2½ million, when the building is completed. The Center will house a research library, cafeteria, dispensary, and building-service areas. The lab will be equipped with the most modern scientific instruments for basic research and development in thin films, solid-state physics, and microcircuitry.

Admiral to Handle SENCORE Line

The National Service Division of **Admiral Corp.** has tested and approved the SENCORE line of test equipment for distribution through Admiral distributors. Willis L. Wood, general manager of the National Service Division, pointed out that SENCORE equipment has been checked out in their electronics laboratory under the supervision of I. F. Johnston, electronics service manager. This merchandising program, along with Admiral's continuing color-school activity, will help color TV technicians do a more efficient servicing job.

Color TV Seminars

Hundreds of qualified technicians in major markets throughout the West are currently attending color television seminars conducted by **Packard Bell Electronics.**

Kenneth R. Johnson, vice president and general manager of the Home Products Division says, "with the tremendous growth of color television sales, there is an immediate demand for service technicians who are abreast of the progress being made. We are especially interested that as many as possible be brought up-to-date with the advances Packard Bell has made in the past eight years of color TV."

The color-TV seminars are under the direction of Paul L. Pekarsky, Packard Bell's color television engineer. Principle items of instruction cover circuit analysis, comparison of color and monochrome, complete alignment of picture IF, sound, and chroma adjustment and balance of the gray scale, and convergence.

New Home News

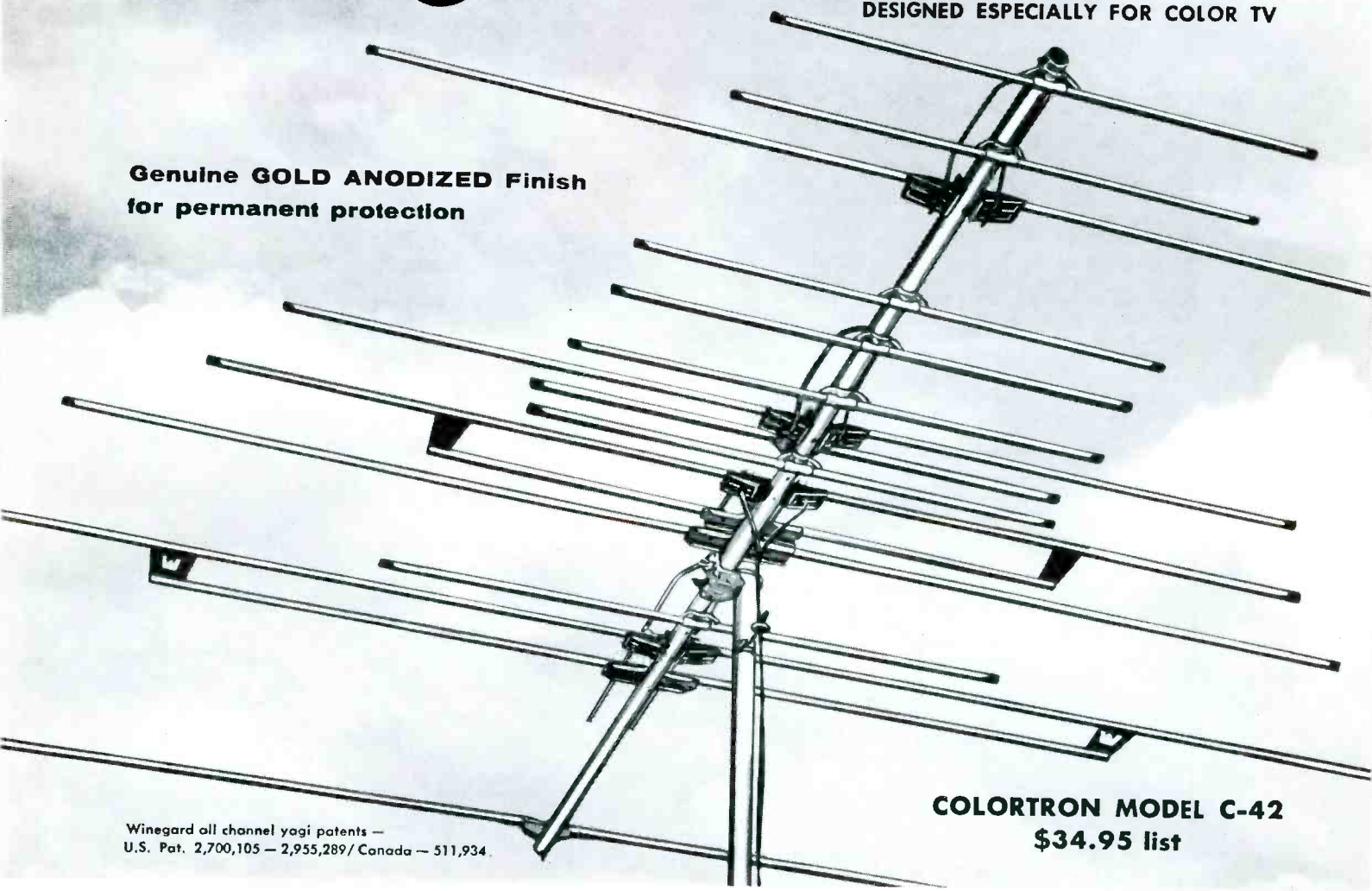
A recent move into new quarters has been announced by Rudy Kopernak, new president of **Enterprise Development Corp.** of Indianapolis. The change will permit expansion of the firm's manufacturing facilities, and increase office space to fit stepped-up administration requirements. Enterprise is the developer and manufacturer of the well-known Endeco desoldering aid.

Tenth-anniversary Award

In a recent sales meeting, Milt Friedberg, president of **The Antenna Specialists Co.,** was presented with an engraved sterling-and-ebony cigarette box marking the company's ten-year growth. The presentation was made by Buck Joyner, of J. E. Joyner & Associates, on behalf of the more than forty representatives attending the meeting—many of whom have been with the company since its entry into the distributor market. The firm started and grew as an antenna manufacturer, but has recently diversified into the manufacture of power generators and automotive test instruments.

WHY THE *Winegard* COLORTRON

DESIGNED ESPECIALLY FOR COLOR TV



Genuine GOLD ANODIZED Finish for permanent protection

Winegard all channel yagi patents — U.S. Pat. 2,700,105 — 2,955,289/ Canada — 511,934.

COLORTRON MODEL C-42
$34.95 list

The world's BEST performing VHF all channel TV antenna, size for size and dollar for dollar, is the Winegard Colortron. The Colortron is more nearly perfect than any other all channel antenna made. It is the only all channel antenna you can buy that carries a factory written guarantee of best performance.

HERE'S WHY COLORTRON IS BEST

1. A perfect all channel, high gain TV antenna would have the following characteristics:

—the sensitivity of a well-engineered cut channel yagi of equal physical length on each of the 12 channels.

—sharp directivity. A single frontal lobe and absolutely no pick-up of signal from back or sides on any channel.

—it would have an exact 300 ohm non-reactive impedance on every VHF channel 2 through 13.

2. There are several basic designs for high gain, all channel TV antennas. For practical reasons, only two of these are used today.

Ⓐ The *all channel yagi* that incorporates only 2 driven elements—but *many* directors. This design was invented by John R. Winegard in 1954. Until then, the high efficiency of the yagi was limited to single channel antennas.

Ⓑ The all channel antenna that incorporates a *multiplicity of driven elements* in a single plane. These are *End-Fire* arrays.

This basic design was first used for TV in 1952. Some end-fire antennas are called "log periodic".

IT IS A SCIENTIFIC FACT that a single ½ wave director element* will absorb 4 times more signal energy from a TV wave than a ½ wave driven element**. Because of this indisputable fact, the Winegard Colortron all channel yagi uses multiple *directors* to get its gain—*not* multiple driven elements.

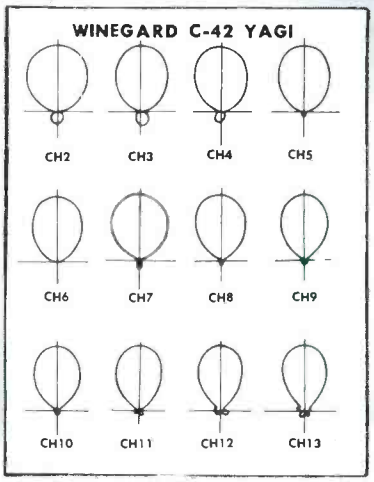
To obtain a near perfect impedance match across the entire VHF TV band, it takes only two driven elements. More than two driven elements will not improve the match any more than extra wheels would improve a car. The only purpose of driven elements on a TV antenna is to transfer the signal energy to the line.

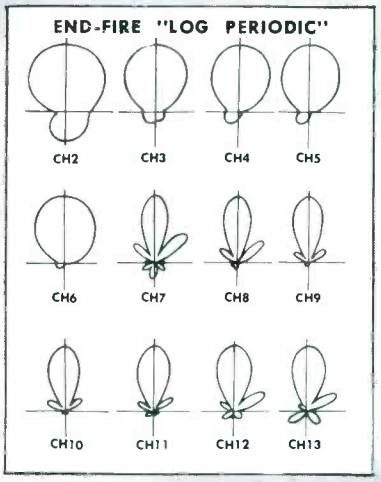
As every antenna engineer knows, a well-engineered cut-to-channel *yagi* (with but *one* driven element and *many* directors) is superior to any other design when peak performance is desired on a single channel. The same fact holds true for best results in all channel reception . . . the yagi design is the most efficient, sensitive ever created on a size for size basis.

*Directors are elements connected electromagnetically (not by means of phasing lines) to the driven elements.

**Driven elements are connected together with phasing lines and the transmission line is attached to these elements.

Antenna is World's BEST





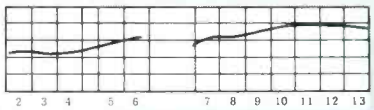
COMPARE POLAR PATTERNS

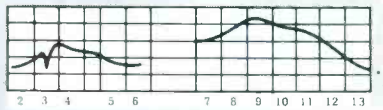
WINEGARD C-42 YAGI. Polar patterns from Polar coordinate Recorder Speedomax Type G.

NOTE uniform directivity patterns and high uniform front-to-back ratio on all channels. NOTE absence of spurious lobes and total absence of side pick-up.

END-FIRE "LOG PERIODIC" model comparable with C-42. Polar patterns taken from same recorder.

NOTE large variation between directivity from channel to channel. NOTE reduced front-to-back ratio from C-42. NOTE spurious lobes (especially on high band) which pick up interference. Also has undesirable side pick-up on low band.





COMPARE FREQUENCY RESPONSE CURVES

WINEGARD C-42 YAGI shows consistent sensitivity across all channels. No roll-off on ends of bands, no suck-outs to ruin color reception.

END-FIRE "LOG PERIODIC" (in same price range) shows varying sensitivity across the bands. Peaks in middle of bands with sharp roll-offs on ends. Serious suck-out in middle of channel 3.

PERFECT PARTNER TO THE COLORTRON ANTENNA . . . THE TWIN NUVISTOR COLORTRON AMPLIFIER

Winegard's revolutionary new circuit, employing 2 nuvistors, enables the Colortron to overcome the service problems and limitations of other antenna amplifiers. Colortron will not oscillate, overload or cross modulate because it takes up to 400,000 microvolts of signal input. This is 20 times better than any single transistor amplifier.

The Colorton amplifier will deliver clean, clear, color pictures or black and white, sharp and bright without smear. It can be used with any good TV antenna but will deliver unsurpassed reception when used with a Colortron antenna.

Nothing on the amplifier is exposed to the elements—even the terminals are protected. A rubber boot over the twin-lead keeps moisture out. Colortron comes complete with an all AC power supply with built-in 2 set coupler. Colortron model AP-200N 300 ohm input and output $39.95 list. Model AP-275 300 ohm input 75 ohm output $44.95 list.

NOW WHAT ARE THE BASIC DIFFERENCES BETWEEN THESE TWO TYPES OF ALL CHANNEL ANTENNAS?

One big difference is in SENSITIVITY. The Winegard Colortron patented yagi with multiple *directors* has far more ability to absorb signal power from a TV wave than multiple driven element antennas. In fact, *all* fringe-type antennas with multiple driven elements have *one or more* directors out front. Why add directors if the multiple driven elements are supposed to be so efficient? The reason is obvious . . . directors are added to get the gain they can't get with extra driven elements.

Another big difference is in DIRECTIVITY. The Winegard Colortron patented yagi has far better directivity characteristics than multiple driven element antennas and the *directivity pattern is essentially the same on every channel.* The Colortron has *no* signal pick-up from the sides (as you can see above). It offers no receiving surface to side signals and has no complex phasing problems to cause extra pick-up lobes. It has *minimum* pick-up from the back.

On the other hand, multiple driven element antennas have large side lobes because the driven elements are always out of phase at some frequencies in the TV band—particularly on the high band.

The Winegard Colortron excels, too, by having the *best 300-ohm match in the industry*—an average VSWR of better than 1.5 to 1 across both bands.

In addition to its performance superiority, the Winegard Colortron has the finest quality construction and *permanent gold* anodizing for weather protection. A personal examination of a Colortron tells this quality story far better than words.

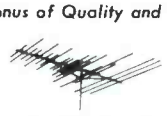
(The polar patterns and frequency response curves above have been illustrated to give you a basis of comparison between Winegard's popular Colortron Mod. C-42 and a highly advertised multiple driven element antenna which we have tested (along with other models in this line.) Constant testing of *all* new outdoor TV antennas proves to our satisfaction that no other design equals or excels the Winegard Colortron in quality or performance. We are so positive of this performance superiority that we put a written guarantee on it.

For technical data sheets write today!

Nationally advertised month after month. ADVERTISED IN LIFE

There's an Extra Bonus of Quality and Performance in Every Winegard Product

COLORTRON ANTENNA
Model C-44—Gold Anodized
$64.95



COLORTRON ANTENNA
Model C-43—Gold Anodized
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by E. S. Wright

keeping your SERVICE SOLD!

Most servicemen are inclined to treat too casually their most valuable asset: customer good will. To call the technician's attention to this important aspect of his business, we'd like to describe an operating method we've worked out through trial and error over the years. We call it "Customer Preventive Maintenance." It saves us money, time, and customers; it can do the same for you with a little thought and practice. These procedures may sound too simple to be effective, but they actually work. Don't take our word for it; try them!

Our objectives are simple:

1. Keep customers happy—they're our best advertisement.
2. Prevent callbacks—they can be a big source of loss.
3. Earn a profit on a larger percentage of calls.

Here's an example of how a serviceman's technique can make the difference between losing customers and making them into ardent boosters:

Jim had repaired his first TV of the day in record-breaking time, and the set was working like a charm. He had remembered all the things his boss had taught him: courtesy, pleasant smile, clean shoes, neat uniform, no furniture left out of order, cheerful goodbye . . . yet the customer was disgruntled. Jim had already made a bad mistake—and so early in the morning!

He'd taken a quick look at the picture, and his mental "data-processing machine" had given him the answer—*sync separator*. Sixty seconds later a new sync tube was in; another thirty seconds and the picture had snapped in clearly. Jim quickly checked the other channels, sewed up the set, scribbled out a bill, and was out of the house in five minutes.

So what was Mrs. Crane grumbling about? Listen in: "Why those robbers—$8.50 for only two minutes' work. There ought to be a law! That's the last time I ever call them." Unreasonable? No, human! And Jim, like many other servicemen, was not prepared to deal with this "human factor."

Across the street, Earl made his first call of the day. By coincidence, his "built-in calculator" gave him an equally quick and easy answer—*weak video amplifier*. Earl, like Jim, wasted no time getting the back off and slipping in a new tube. Here, too, a good picture returned immediately. What more, then, could Earl do for his customer? At least give her a show for her money! And at the same time, give the set a close enough scrutiny to spot any other quirks it might have.

Only ten minutes later he was finished and gone, but Mrs. White was as happy as a bluebird. "Sure knows his business, that man. And so thorough! I'm going to tell the girls at the bridge club about him." And she did!

What happened in ten extra minutes to make so much difference in the impressions Earl and Jim left with their customers? The answer is that Earl didn't merely supply his service—he also *sold* it. Salesmanship not only requires having a good product (in this case technical ability), but also takes showmanship. Let's backtrack and see what small *extra* Earl included, to impress his customer.

While Mrs. White watched the picture, Earl ran the ion trap around and back to its best spot; ran the horizontal drive control up until the familiar white line appeared on the CRT, then backed it off; ran the height up and down; and centered the picture a little. Next, seeing a little grime on the face of the picture tube, he whisked out four screws and the safety glass, reached into his caddy for some picture-tube cleaner, and cleaned the glass and the CRT. This isn't always necessary, but it's quickly done, and wonderful for your customer's morale.

He carefully wrote out a bill, printing the customer's name clearly and correctly (people hate to see their names spelled wrong). He wrote a few other things I'll explain later, and without appearing to hurry, was shortly on his way with the happy results you've already heard about.

Getting back to technician Jim and his disgruntled customer, Mrs. Crane, you can bet there'll be some-

• *Please turn to page 62*

RECEIVED BY:

Remarks: Video amp helps, but there is some aging of pic tube causing dull picture. We will try booster when it gets worse. Some snow, 6BQ7 weak. Mrs. White prefers to wait until next call for new one.

Fig. 1. Entry in "remarks" column permanently records service performed.

SENCORE
SIMPLIFIES COLOR SERVICING

NEW! CA122
COLOR CIRCUIT ANALYZER

A simple approach to a complex problem

Here is an instrument that is designed to eliminate the guesswork in color TV servicing. A complete analyzer that provides all required test patterns and signals for testing from the tuner to the tri-color tube. Additional analyzing signals for injection at each stage including audio, video and sync, brings to life a truly portable and practical TV analyzer for on the spot service; virtually obsoleting other analyzers with the advent of color. Sencore's simplified approach requires no knowledge of I, Q, R-Y, B-Y, G-Y or other hard to remember formulas. The CA122 generates every signal normally received from the TV station plus convergence and color test patterns.

The CA122 offers more for less money:

TEN STANDARD COLOR BARS: The type and phase that is fast becoming the standard of the industry. Crystal controlled keyed bars, (RCA type) as explained in most service literature, offer a complete gamut of colors for every color circuit test.

WHITE DOTS: New stabilized dots, a must for convergence, are created by new Sencore counting circuits.

CROSS HATCH PATTERN: A basic requirement for fast CRT convergence.

VERTICAL AND HORIZONTAL BARS: An added feature to speed up convergence, not found on many other color generators.

SHADING BARS: Determines the ability of the video amplifier to produce shades (Y Signal) and to make color temperature adjustments. An important feature missing on other generators.

COLOR GUN INTERRUPTOR: For fast purity and convergence checks without upsetting color controls. Insures proper operation of tri-color guns, preventing wasted time in trouble shooting circuits when CRT is at fault.

A must for color . . .

a money maker for black and white TV servicing

ANALYZING SIGNALS: RF and IF signals modulated with any of the above patterns for injection into grid circuits from antenna to detector. IF attenuator is pre-set for minimum signal for each IF stage to produce pattern on CRT thus providing a check on individual stage gain. Sync and video, plus or minus from 0 to 30 volts peak to peak, have separate peak to peak calibrated controls for quick checks on all video and sync circuits. Crystal controlled 4.5 mc and 900 cycles audio simplify trouble shooting of audio circuits.

NEW ILLUMINATED PATTERN INDICATOR: A Sencore first, offering a rotating color film that exhibits the actual color patterns as they appear on color TV receivers. Locks in with pattern selector control.

You'll pay more for other color generators only.

Dealer Net 187.50

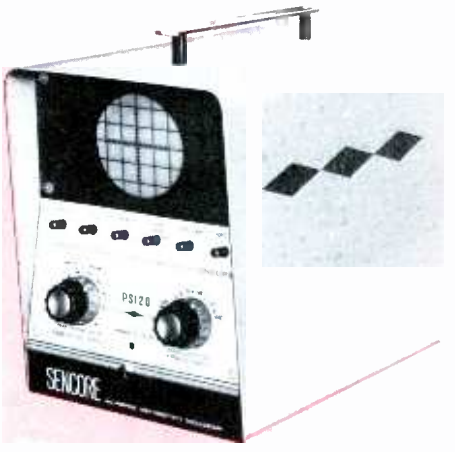
NEW! PS120 PROFESSIONAL WIDE BAND OSCILLOSCOPE

A portable wide band 3 inch oscilloscope for fast, on-the-spot testing. An all new simplified design brings new meaning to the word portability . . . it's as easy to operate and carry as a VTVM. Though compact in size, the PS120 is powerful in performance: Vertical amplifier frequency response of 4 MC flat, only 3 DB down at 7.5 MC and usable to 12 MC, equips the technician for every color servicing job and the engineer with a scope for field and production line testing. AC coupled, with a low frequency response of 20 cycles insure accurate low frequency measurements without vertical bounce. Sensitive single band vertical amplifier; sensitivity of .035 volts RMS for one inch deflection saves band switching and guessing. Horizontal sweep frequency range of 15 cycles to 150 KC and sync range from 15 cycles to 8 MC (usable to 12 MC) results in positive "locking" on all signals. New exclusive Sencore features are direct reading peak-to-peak volts —no interpretation; dual controls to simplify tuning; lead compartment to conceal test leads, jacks and seldom used switches. Rear tilt adjustment angles scope "just right" for easy viewing on bench or production line.

Size: 7"w x 9"h x 11¼"d. Weight: 12 lbs.

Dealer Net 124.50
(with low cap. probe)

Kit 74.50



A must for servicing color TV in the home . . . lowest priced broad band scope. All hand wired — all American made

ITT batteries...and ITT tubes...give you first-line quality ...and extra profit margin

ITT batteries—penlites, C, D, and 9-volt miniatures – now offer the same "extra value" and acceptance already experienced with fast-moving ITT Receiving Tubes.

ITT can provide this "extra value" of finest quality at higher profit margins in each of its lines because ITT products are on call from 154 factories and laboratories in 24 countries. If you are selling ITT tubes and batteries, you can compete with anyone in the world . . . on quality, on price, and on acceptance. Brands without these worldwide resources are finding it tougher than ever.

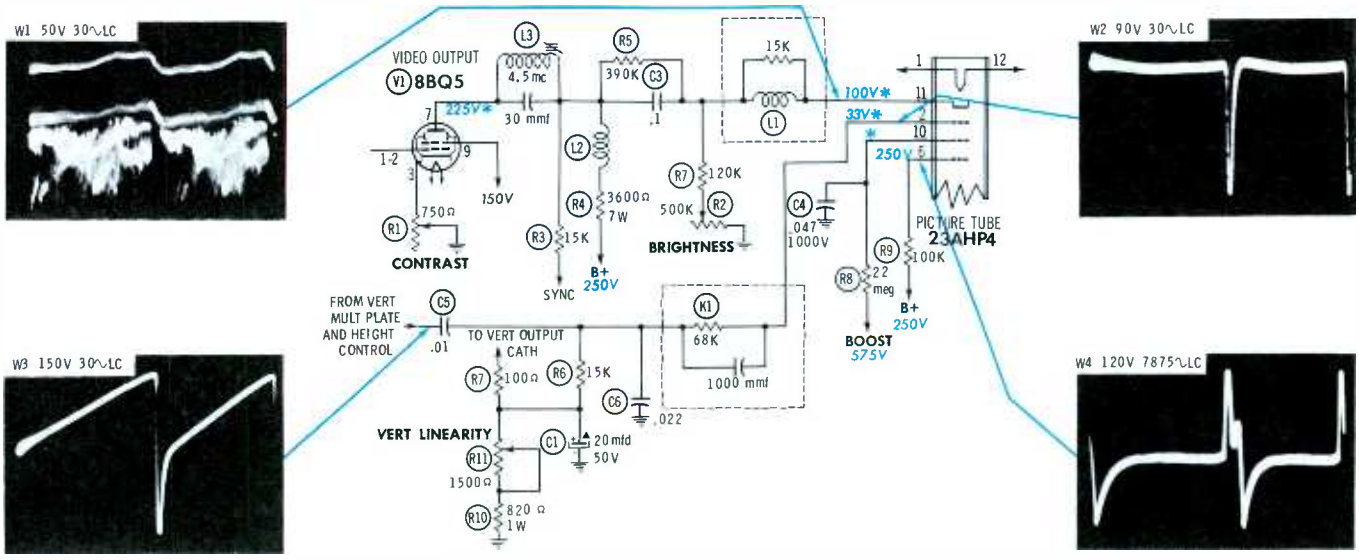
Make sure *you* have this *value* leadership in *your* service market. Stock ITT tubes and batteries—the only worldwide lines with such a world-famous name.

ITT Distributor Products Division, International Telephone and Telegraph Corporation, Box 99, Lodi, New Jersey.

PF REPORTER Symfact™

DC-Coupled CRT Circuits

Cathode-Driven



DC VOLTAGES taken with VTVM, on inactive channel; antenna disconnected from set. *Means voltage varies with conditions—see "Variations."

WAVEFORMS taken with wide-band scope; controls set for 50-volt p-p video to CRT. Low-cap probe (LC) used where direct probe distorts signals.

Normal Operation

In virtually all late-model TV receivers, video signal is applied to cathode of picture tube, causing voltage fluctuations that vary CRT beam current to produce black, white, and all shades of gray in picture. TV transmission standards were originally set up so that horizontal and vertical blanking pulses in video signal would always drive cathode voltage exactly to cutoff when brightness and contrast were correctly adjusted. This constant "black level" was intended as reference point to insure correct reproduction of all gray tones. Most early TV receivers included DC-restorer stage in CRT-input circuit to clamp blanking pulses at desired DC voltage level. This stage was later omitted, to simplify receiver circuitry and brightness-adjustment procedure. Leaving it out entailed some sacrifice in accuracy of picture shading, because simple capacitive coupling of video to CRT allowed blanking-pulse level to shift up and down according to changes in average value of signal. Past few years have seen growing trend to improve gray-scale accuracy—without adding DC restorer—simply by shunting the coupling capacitor with a resistor (R5 in schematic) to create DC path between video amplifier and CRT. In receiver discussed here (Wells-Gardner Chassis N39), retrace-blanking pulses for grid of CRT (W2) are derived from circuit between vertical multivibrator and output stages. This chassis drives 92° 23AHP4 picture tube, which has gun characteristics like most electrostatic-focus CRT's.

Operating Variations

PIN 11 DC voltage can be varied with brightness control—from 75 volts at maximum setting to 245 volts at minimum. Contrast control has no significant DC effect, but amplitude of W1 varies from 35 to 200 volts as contrast is advanced. 50 volts peak to peak gives natural-looking contrast at moderate brightness; additional signal available is "reserve" to allow more contrast at high brightness levels. W1 trace is bent by hum pickup—a normal occurrence in scoping this high-impedance circuit.

PIN 2 Since positive voltage on cathode in DC-coupled circuit is higher than when AC coupling is used, grid of CRT must also be somewhat positive, to keep bias within correct range. In this particular set, grid is connected to cathode circuit of vertical output stage, which supplies 28 to 37 volts—depending on how linearity control is set. Amplitude of W2 varies if vertical drive signal W3 is modified by adjusting height control, but variation is only about 10% within normal height range.

PIN 10 This receiver is unusual in having connection from boost source to accelerating anode made through extremely high-value resistor (R8). Since grid doesn't draw current, full value of boost reaches CRT. Attempt to measure voltage kills raster; R8 and VTVM's input resistance form voltage divider, leaving only 200 volts at pin 10.

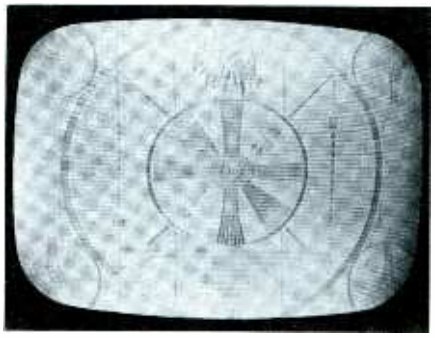
Low Contrast

SYMPTOM 1

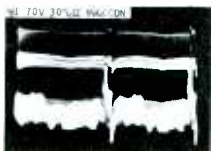
Normal Brightness

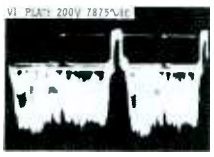
C3 Open

Symptom Analysis



Since contrast and brightness controls operate properly, and picture detail is sharp, CRT is probably okay. Picture contains no snow, so low gain in video output stage is most likely fault—although possibility of weak IF or too much AGC shouldn't be dismissed.





Waveform Analysis

W1 is definitely weak: only 70 volts at maximum contrast. Obvious distortion is present, especially at 7875 cps — note exaggerated horizontal sync and compressed video. Normal signal is present at plate of video output tube, so signal loss must be occurring in CRT coupling circuit. Signal tracing reveals distortion on CRT side of C3-R5; C3 is suspect because it should pass signal without noticeable change in size or shape.

Voltage and Component Analysis

NO VOLTAGE CLUES

All DC voltages check within 5 volts of normal readings; this is to be expected, because video output stage is developing normal signal, and action of brightness-control circuit is unimpaired by fault. Resistance measurements also give normal results. Some video can reach CRT through R5, but frequency distortion occurs, and amplitude is reduced by voltage division across R5-R7-R2. In ordinary AC-coupled circuit, open coupling capacitor would make picture disappear entirely, still without upsetting DC conditions.

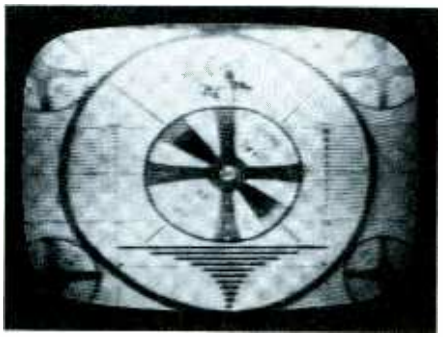
Best Bet: Signal tracing through video path with scope.

Blurred or Smeared Picture

SYMPTOM 2

Scanning Lines Sharp

L1 Open (Coil Only)

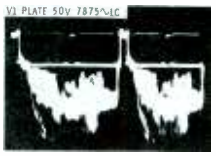


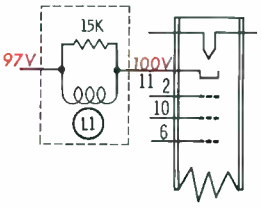
Symptom Analysis

Action of brightness and contrast controls is normal. Sharp raster lines eliminate suspicion of poor focus or faulty CRT. Trouble might not be noticed by customer who is accustomed to bleary pictures from inadequate antenna. Misalignment is a possibility.

Waveform Analysis

Peculiar-looking thick trace extends across top of W1; examination at 7875 cps shows it's due to distorted tips of horizontal sync pulses. This fault, barely present at plate of V1, could indicate minor trouble in video-coupling components of CRT cathode circuitry leading to selective distortion of high frequencies in video signal. This possibility should be checked before any attempt is made to adjust RF or IF alignment.





Voltage and Component Analysis

DC voltages on picture-tube elements are practically normal. One small, but highly significant clue is the voltage at junction of C3-L1: 3 volts less positive than cathode voltage. No perceptible voltage drop should occur across low resistance of coil. Ohmmeter check gives 15K reading across L1—a clincher. In some cases like this, break occurs at coil terminal and is accessible for repair. Whenever symptoms of poor video response are noted, prompt testing of peaking coils may help avoid more time-consuming checks.

Best Bet: Careful voltage and resistance analysis.

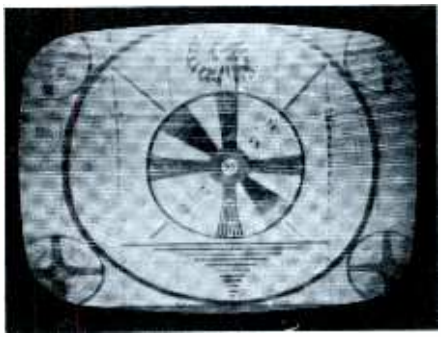
Vertical Retrace Lines

SYMPTOM 3

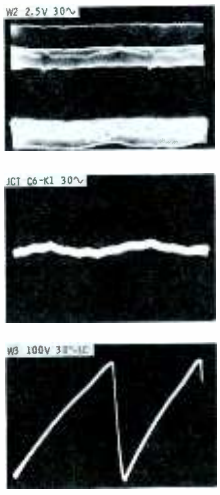
Brightness Below Normal

C6 Shorted

Symptom Analysis



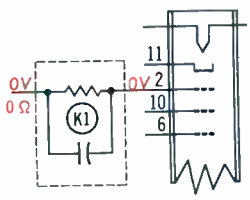
Brightness control must be advanced nearly to full clockwise setting for normal brilliance. White retrace lines may be present in all parts of picture, or only in small area near top; in any case, they are almost sure sign of trouble in CRT grid circuit.



Waveform Analysis

Virtual absence of W2 explains why retrace blanking is ineffective. Small remnant of signal here is probably due to stray coupling within CRT. In tracing back to locate point where blanking pulses are lost, virtually complete absence of signal is noted at junction of K1-C6. Another clue is pure sawtooth waveshape of W3—an abnormality in this circuit, which requires negative spike in vertical drive signal.

Voltage and Component Analysis



Voltage at CRT grid is zero; resulting increase in grid-cathode bias explains low brightness. Zero voltage is also measured at junction of K1-C6, but normal 30 volts is present at top of C1. Resistance readings show approximately 70K from CRT grid to ground, and dead short across C6. This defect alters RC discharge network that develops W3, but resulting sweep distortion can be corrected by readjusting vertical circuit. Moderate leakage in C6 would not cause problems, since it is normally shunted by low resistance.

Best Bet: Analyze voltage; pinpoint with ohmmeter.

Shading in Raster

Darker at Top
Than at Bottom

SYMPTOM 4

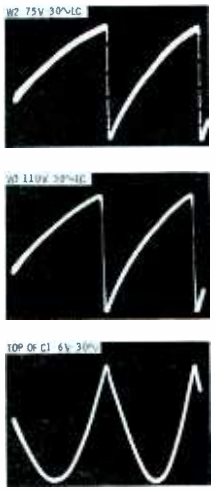
R6 Open

Symptom Analysis

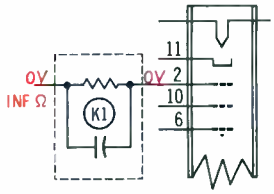
Contrast is normal; brightness is reasonably so. Uneven background illumination is less noticeable at high contrast or brightness settings than at lower settings. Vertical sync and sweep seem satisfactory, but set user has probably had recent complaint of vertical trouble.

Waveform Analysis

W2 has changed from negative spike into sawtooth; consequently, it modulates CRT beam (by varying control-grid voltage) so brightness increases as beam moves down screen. W3 has similar shape, indicating some abnormality in vertical discharge network. Proper operation of linearity-control circuit is proved by parabola-shaped trace at top of C1—typical for this kind of circuit. Further tests are needed to pinpoint fault.



Voltage and Component Analysis



Grid voltage is zero, as in symptom 3, but strong W2 proves grid circuit is not shorted to ground. At maximum contrast or brightness, grid goes slightly negative (as much as −10 volts) because charge acquired from beam current cannot leak off grid. Normal voltage is present on C1. Resistance to ground from either side of K1 is above 10 meg; direct measurement across R6 shows lack of continuity. After fault is corrected, vertical linearity and height controls both need adjustment to restore full, linear sweep.

Best Bet: Localize with scope; pinpoint with ohmmeter.

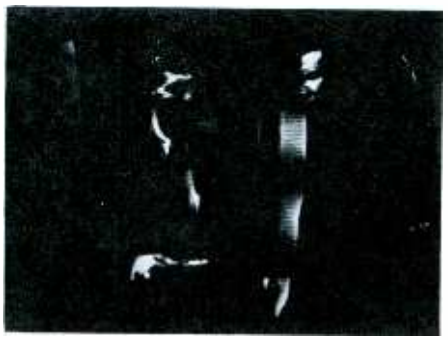
Very Dark Picture or No Raster

SYMPTOM 5

Brightness Control Has No Effect

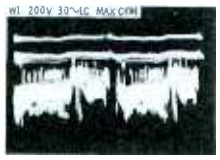
R2 Open

Symptom Analysis



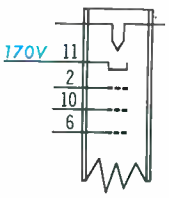
Ample high voltage is present, but no light appears on screen except on strong stations; then white highlights of picture are seen as patches of light, if contrast control is turned up high. These spots are not extinguished when brightness is turned down.

Waveform Analysis



W1 is normal in shape and amplitude. (Slight sync compression is normal at maximum contrast.) Same signal is found at plate of video output tube. No abnormal waveforms appear at other CRT elements to explain dark screen. Important clue is signal at arm of R2, which maintains constant amplitude instead of varying when R2 is adjusted.

Voltage and Component Analysis



DC cathode voltage of CRT is much too high, so dark screen is obviously due to excessive bias on electron gun. Reading varies over range of 155-200 volts from maximum to minimum contrast. Same voltages are found at plate of V1, and rotating brightness control makes no difference in readings. These facts present an open-and-shut case of faulty brightness-control circuit. All that remains is final pinpointing; this can be done with ohmmeter, or by grounding low end of R7 and watching to see if normal raster appears. If R7 were open, this test would not restore light on screen, as it does when R2 is open.

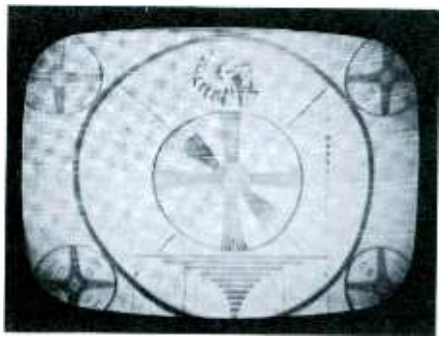
Best Bet: Analyze with voltmeter; pinpoint as described.

Vertical Retrace Lines

SYMPTOM 6

Brightness Control Cannot Kill Raster

K1 Open

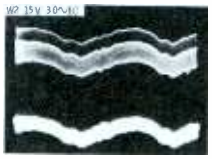


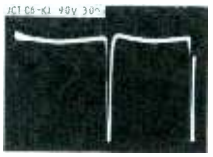
Symptom Analysis

Inability to black out screen completely at minimum brightness might indicate gas or interelement leakage in CRT, if it were not for good clarity of picture. White retrace lines over whole screen suggest abnormal brightness might be linked to grid-circuit fault.

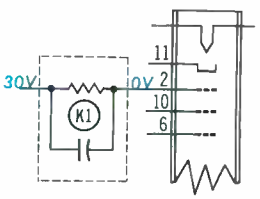
Waveform Analysis

W2 contains no blanking pulses—only a weak, noisy video signal, somewhat stronger than that in symptom 3. If receiver is operating at fairly low brightness, scoping grid (even with low-capacitance probe) has dimming effect on raster. At other side of K1, normal 80-volt blanking pulses are present; this signal-tracing test makes defect in K1 a practical certainty.





Voltage and Component Analysis



Voltage indications are very similar to those in symptom 4; grid voltage is zero (or slightly negative at maximum contrast or brightness). Meter probe at grid decreases brightness; this loading effect is hint of open grid-return path. Normal 30-volt reading at junction of K1 and C6 clears all components except K1 of suspicion. Just to make sure CRT is not at fault, base socket can be unplugged, and grid voltage or waveform checked again; continued abnormal reading pinpoints defective K1. With CRT connected, grid resistance reads as low as 500K just after set is turned off, slowly rising toward infinity as tube cools.

Best Bet: Either waveforms or voltages are conclusive.

Another BUSS First

New BUSS VISUAL·PAK

With the clear plastic box, there's no need to open to see how many fuses are in it.

The new BUSS fuse 'Visual-Pak' originated by BUSS holds five fuses and is an outstanding development in fuse packaging.

The box doesn't have to be opened to see the number of fuses in it. This is a real help when taking inventory—and it also guards against running short on fuses.

Slide cover top securely grips bottom of box to prevent accidental spilling of fuses.

For quick identification, size and type of fuses are printed in large clear type on a flat apron on the lid of box.

The new BUSS 'Visual-Pak' fits display stands and channels—it has the same dimensions as the BUSS metal box.

Many sizes of BUSS fuses are now being shipped in the 'Visual-Pak', and shortly all sizes will be shipped in this modern package.

BUSS continues to be your profit line in fuses because—it's the complete line—it's the quality line—and it's the line with outstanding merchandising aids, such as the new 'Visual-Pak'.

BUSS®

BUSSMANN MFG. DIVISION

MAKERS OF THE COMPLETE LINE OF FUSES OF UNQUESTIONED HIGH QUALITY

McGraw-Edison Co. • St. Louis 7, Mo.

AM-FM AUTO SETS ARE HERE!

You can service them by combining familiar techniques . . . *by Fred G. Biesecker*

All-transistor AM-FM portable radios are now fairly commonplace; so are all-transistor auto radios. The next logical development—an all-transistor, AM-FM auto radio—is already on the market. Almost any make of 1963 automobile can be bought with such a radio already installed.

Units of this type are the culmination of several years' efforts in FM auto-radio design. When FM broadcasting first began its era of expansion in the mid-fifties, the demand for reception in cars was very limited and was met by imported receivers. Several types of American-made equipment were later introduced for custom installation; most models were converters that applied the demodulated FM signal to a locally generated RF carrier (approximately 800 kc) so it could be fed through the existing AM receiver in the car via the antenna input. This arrangement permitted convenient "add-on" installation, and included the necessary circuitry to allow using one antenna for both AM and FM.

Converters are still available, including some transistorized models. But the prospective car-FM buyer now has the option of obtaining a self-contained AM-FM radio that affords a more space-saving installation, with an overall current drain on the order of only 1 amp. Let's take a look at these compact sets.

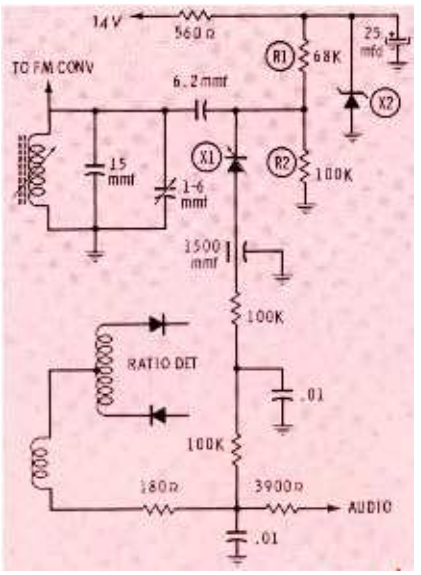


Fig. 2. Variable-capacitance diode X1 is key component in FM AFC circuit.

General Features

As in any other AM-FM radio, the size and complexity of auto sets is minimized by making numerous circuits perform double duty. The complete audio section is used for both AM and FM reception; a conventional whip antenna, extended to approximately 30", feeds signals into both front-end circuits; and two or more IF stages are shared by both signal paths. To reduce the number of AM-FM function-switch sections, the IF transformers for AM and FM in a particular stage may be simply connected in series. This design technique, long used in other AM-FM receivers, is practical because of the great difference in frequency between the two types of IF signals. The FM (at 10.7 mc) is simply bypassed around the AM transformers via a capacitor too small in value to pass the 455-kc AM signal; in turn, the AM is able to pass through the low-inductance FM-transformer windings almost as if they weren't there.

Either two or three special high-frequency transistors are used in the FM input section, depending on whether the receiver has a converter circuit or a separate oscillator and mixer. (One transistor invariably operates as a common-base RF am-

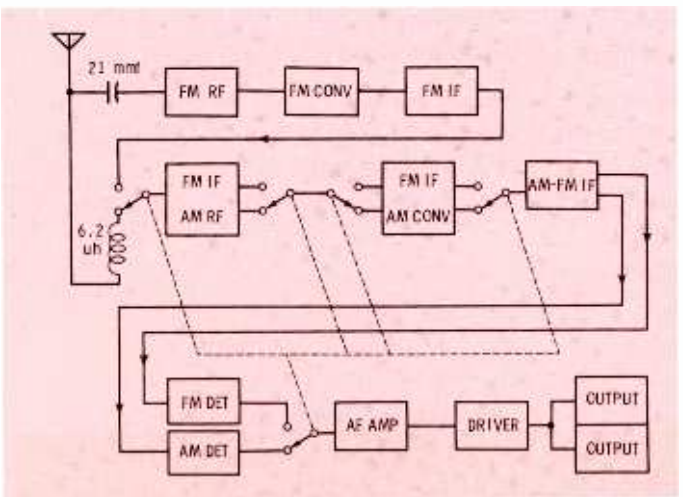


Fig. 1. Automatic's AM-FM radio has four FM IF's.

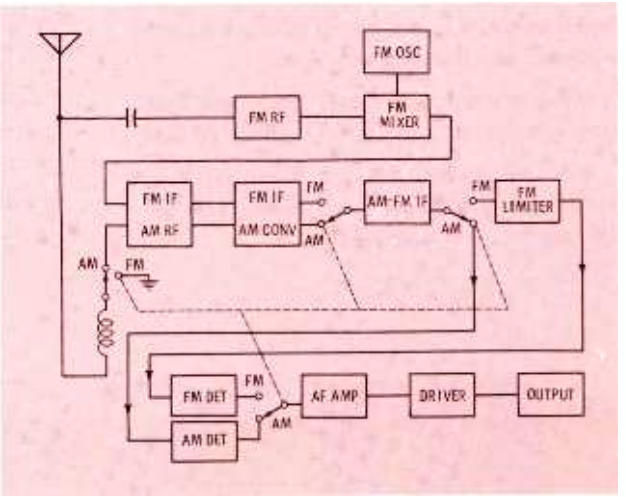


Fig. 3. FM section of Bendix includes limiter stage.

plifier.) These stages may be mounted on a small "FM tuner" subassembly that can be replaced as a unit.

One thing is notably different about the audio output stage of many AM-FM sets: they use a relatively high-impedance speaker (8 to 10 ohms) instead of a conventional 3.2-ohm unit. The value of impedance is fairly critical for correct loading of the output transistor.

In the RF-IF section, there are a few innovations that adapt FM circuits to the special requirements of automobile reception. Before going into details, we can summarize these special features as follows:

1. Zener-diode voltage regulators are used to stabilize the supply voltage for the FM front end, the AFC bias, or both of these voltages. This precaution is necessary to compensate for the wide fluctuation in source voltage from the car's electrical system.
2. A highly effective AGC system is usually included to minimize FM fading, which is naturally more of a problem in a moving automobile than in a fixed location. Some table and portable FM sets include no provisions for AGC, and depend on a limiter or ratio detector to correct all variations in signal strength.
3. The AFC system is a special type, using a variable-capacitance semiconductor diode in the oscillator tank circuit. The effective capacitance of this unit depends on the applied bias voltage, which is varied by feeding a control voltage from the FM detector circuit to one terminal, while the other terminal is held at a fixed DC potential. Compared to other forms of AFC, this system is designed to be less subject to "capturing" by strong adjacent-channel stations in case the desired station momentarily drops in signal strength.

Some Typical Radios

Three major manufacturers are currently making fully transistorized AM-FM auto receivers. Here are the special features of representative units from their respective lines:

Automatic "Golden Classic"

In this 10-transistor model, the AM-FM function switch is ganged with the push-button tuning mechanism; two of the buttons are used for selecting favorite FM stations, while the other three are for AM. The signal paths for both types of reception are as shown in the simplified block diagram of Fig. 1. Note the filter components in the RF input circuits, which eliminate the need for antenna switching.

The FM demodulator is a ratio detector using two 1N541 crystal diodes. Its output is filtered and fed to the anode of the variable-capacitance diode X1 (Fig. 2). This component is reverse-biased, and does not conduct; it merely acts as a variable capacitor in parallel with the FM oscillator tank. Its cathode is held at a constant DC potential by the circuit that includes Zener diode X2 and voltage divider R1-R2. When the frequency of the IF signal reaching the ratio detector is correct, the anode voltage applied to X1 is zero; however, any frequency error results in a small negative or positive DC correction voltage that changes the bias on X1 and alters its effective capacitance to adjust the oscillator frequency.

AVC for the AM section is obtained, as in most transistor radios, by rectifying and filtering the IF output. A separate AGC system is employed for FM; this circuit rectifies the output of the second IF stage and applies the resulting bias to the base of the RF transistor.

The use of seven printed RC component combinations adds to the compactness of the Automatic radio.

Bendix Model FT3BF

As in the other receiver just discussed, push-button tuning and AM-FM band selection are combined into one operation; however, Bendix provides three buttons for FM and two for AM. The block diagram in Fig. 3 shows the lineup of stages and the signal-transferring switch sections. An additional pair of contacts, not shown, connects the FM tuner to the DC voltage source during FM reception. A Zener diode is bridged across this branch of the supply circuit to maintain constant operating voltages, thus assuring good frequency stability for the FM front end.

Another Zener diode is used for biasing a variable-capacitance diode in the FM-AFC circuit. The Bendix hookup is functionally similar to Fig. 2, but operates from a different DC reference point. The design of the FM discriminator is such that the AFC correction voltage is centered on the 14.4-volt source, rather than ground; therefore, the AFC line must be connected to the cathode of the variable-capacitance diode instead of the anode.

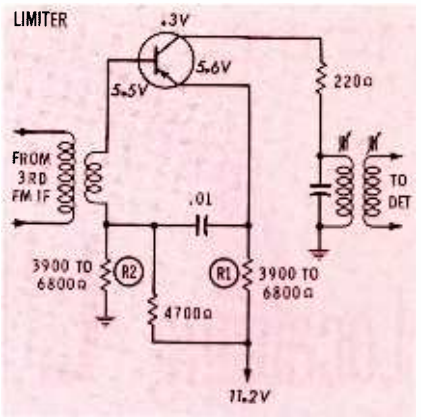


Fig. 4. Values of R1 and R2 are chosen to provide effective limiting action.

No AGC bias is applied to the FM tuner, although some gain-controlling action takes place in the IF stages. As an alternate means of leveling out signal variations and suppressing noise, the limiter stage shown in Fig. 4 is included just ahead of the FM discriminator. The transistor in this circuit is biased so it will be driven into saturation by all but the weakest usable signals. (The principle of operation is basically the same as in an FM limiter using a tube.) The values of R1 and R2 are selected to match the characteristics of individual transistors for optimum bias.

Delco

In this line of radios, AM-FM function selection is controlled by a separate front-panel switch (either a rocker bar or a slide switch), and

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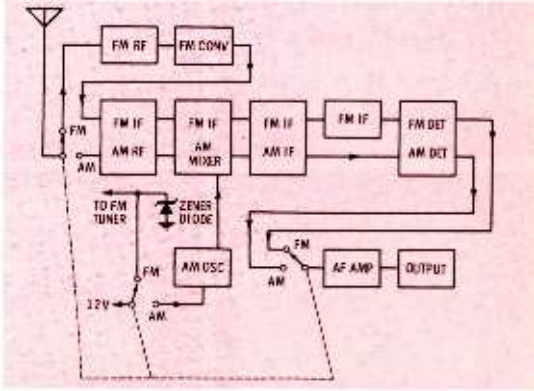

Fig. 5. Delco AM-FM circuit incorporates separate oscillator for AM only.

Quicker Servicing
by Robert G. Middleton

Localizing IF Regeneration

Physicians dub some diseases "the great deceivers," because their bewildering variety of symptoms can be misinterpreted so easily as signs of other assorted illnesses. In TV service work, the condition called *IF regeneration* is similarly confusing; this trouble wears many false faces, and is likely to be diagnosed offhand as a fault in any one of several other circuits. (See Fig. 1 for several examples of picture distortion or interference caused by regeneration.)

Fortunately, there is one *quick test* which identifies IF regeneration 99 times out of 100. This test consists of simply applying the output from a pattern generator to the receiver input terminals, and watching the test-pattern reproduction as the RF signal is reduced from a high level (such as 100,000 microvolts) to a very low level. In case the picture distortion is being caused by IF regeneration, the distortion characteristic changes greatly. The most rapid changes occur as the input signal level approaches low values.

A rough approximation of this test may be made by checking reception of both strong and weak station signals, to see if the trouble is worst on the weakest channel. If no signals from distant stations are available, simply disconnecting the antenna should provide the weak signal needed for the test.

Occasionally — in perhaps one case out of a hundred — picture analysis will fail to detect the trouble. However, the regeneration can still be spotted by checking the frequency-response curve of the IF strip, using a conventional alignment setup. Just as the test pattern "does the twist" as the input signal level is changed, so does the frequency-response curve go through weird alterations in shape as the AGC-override bias is varied. Substantial changes in response curves *always* occur with bias variation when IF regeneration is present.

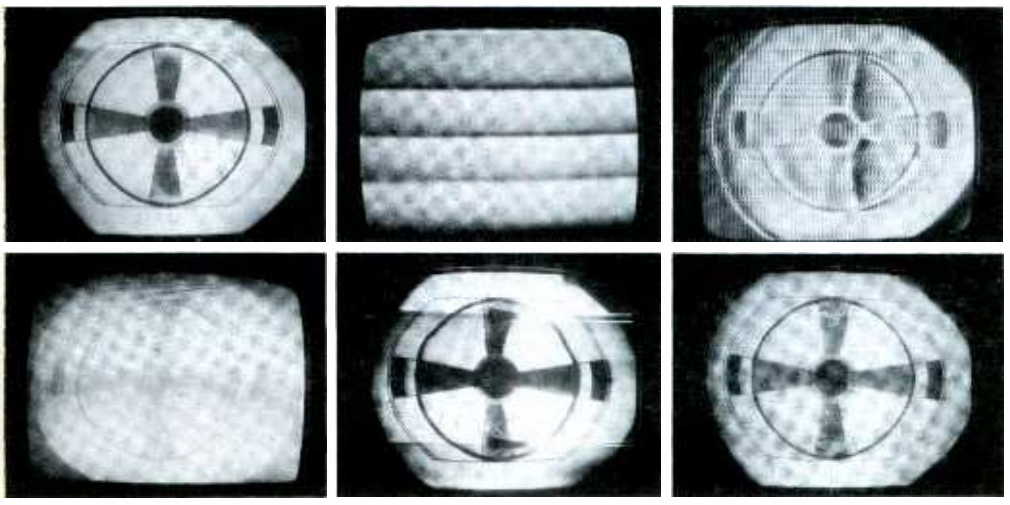

Fig. 1. These six symptoms are only a sample of IF-regeneration troubles.

Also, as a rule, the bandwidth of the IF amplifier is reduced, causing a narrow and peaked response (Fig. 2A). In some cases, the curve breaks up into erratic, jagged peaks like those in Fig. 2B. The decrease in bandwidth results in poor picture detail, often with separation of picture and sound. Peaked response may cause ringing, or "repeats" in the reproduced picture. The IF gain is abnormally high, and is concentrated at certain frequencies within the pass band.

As the gain of the IF strip is increased by reducing the AGC bias, the amount of positive feedback (another term for regeneration) increases. The feedback may take place over one IF stage, over more than one stage, or from an IF stage back to the mixer. When feedback passes a critical value, the IF amplifier starts to oscillate. This oscillation injects a spurious CW signal into the IF channel, which produces herringbone interference in the picture. At high levels of oscillation, the picture can disappear completely, leaving a naked screen. The response curve collapses, and only a large "marker" appears in the scope pattern—as shown in Fig. 3.

What is the oscillating frequency? This depends upon the Q of the various tuned circuits within the regenerative feedback loop. In any system, oscillation takes place around the circuit with highest Q.

Slight Regeneration Is Normal

Contrary to a popular notion among servicemen, a weak tube in a stagger-tuned IF strip will *not* necessarily cause a change in the shape of the response curve. Its only effect will be to reduce the gain uniformly across the entire pass band —*provided* there is no regeneration whatsoever in the IF strip. Here's the catch: few IF strips are completely free from regeneration. A 40-mc strip generally shows more residual regeneration than a 20-mc strip, and an economy-type receiver usually shows more regeneration at low signal levels than a deluxe receiver. The standard of comparison in this regard is the 20-mc stagger-tuned IF amplifier in RCA's old 630-TS chassis. If you still have one of these around the shop, you can familiarize yourself with the characteristics of an IF amplifier which is practically free from regeneration.

Plug a weak tube into any of the IF stages; you will see the height of the response curve go down, while its shape remains the same. Or, advance the contrast control (which sets the IF bias) for maximum sensitivity—the height of the response curve will go up, again with no effect on its shape.

Trouble Isolation

When regeneration rises above the residual level and becomes a nuisance, the first step in finding the source of trouble is to locate the abnormal feedback loop. An oscillating or highly regenerative stage can usually be pinpointed simply by touching your finger to the grid of each tube in turn, or even by bringing your hand close to each individual tube. Either method can swamp or detune the regenerative circuit, causing an unmistakable change in the picture. A VTVM connected across the video-detector load resistor will indicate from −10 to −30 volts when oscillation is present in the IF strip, but the DC reading will take a nose dive to 1 volt or less when you "kill" the oscillating stage.

You'll find some regenerative situations that fail to respond to this test. In such cases, try a touch-up alignment of the IF strip, carefully watching the response curve for abnormal reactions to the various slug adjustments. Be especially critical if the receiver has been previously serviced for the same complaint, or if you suspect a "diddler" has been at work; correcting a botched-up alignment may be the only repair needed.

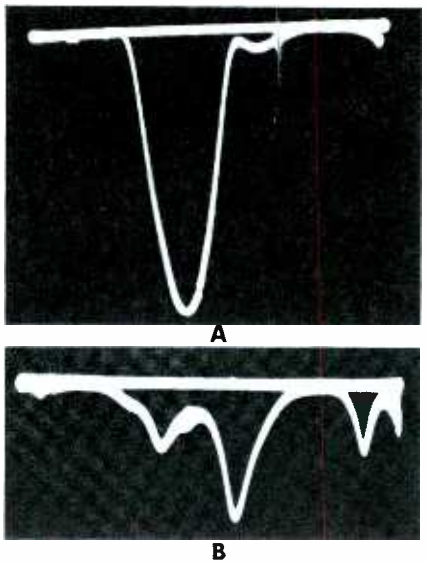

Fig. 2. Narrow, high peaks are characteristic of regenerative IF response.

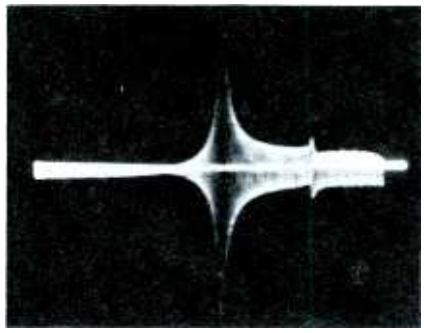

Fig. 3. Curve turns into a "marker" when IF strip breaks into oscillation.

Any IF stage becomes regenerative (and may oscillate) in case the tuned circuits are misaligned with the plate and grid coils tuned to the same frequency, because the stage then forms a tuned-plate/tuned-grid system. In theory, the stage should remain stable (as in a radio receiver), but it does not. At 40 mc, it is practically impossible to obtain complete isolation of plate and grid circuits without utilizing elaborate circuitry. Hence, enough residual feedback is present to make the stage act as a TPTG oscillator.

When regeneration hinders your attempts to correct serious misalignment, IF stability can usually be improved by increasing the AGC clamp voltage. Use as much as 6 volts if necessary. In turn, a higher output will be required from the sweep generator to get a usable deflection on the scope screen. After making preliminary alignment adjustments, it may be possible to reduce the AGC clamp voltage to normal, without IF oscillation.

When you're analyzing regeneration by means of an alignment check, make sure you don't cover up trouble by deliberately misaligning one or more stages. The appearance of the curve can sometimes be partially "cleaned up" without actually curing the defect. For instance, the sharp peaks in Fig. 2B were rounded into the shape displayed in Fig. 4A—at considerable sacrifice in gain—by detuning the second IF interstage transformer. However, attempting to peak this transformer at its correct frequency of 45.5 mc (indicated by marker) resulted in the exaggerated peaks shown in Fig. 4B. The transformer turned out to be faulty. When it was replaced, the combined response of all stages from the second IF to the video detector was as indicated in Fig. 4C.

Although IF coils and transformers sometimes go bad (as in the case just described), regeneration troubles are more likely to be caused by open decoupling or bypass capacitors. Therefore, bridging these components in the suspected stage is one of the first tests normally made, following the preliminary localization of the trouble.

Many other, less common conditions can be responsible for IF regeneration. Some of these cloak-and-dagger villains merit an extended discussion, because the average technician doesn't fully understand how they do their dirty work.

Unusual Trouble Sources

Since IF-regeneration troubles involve feedback of VHF signals, it's necessary to "read between the lines" of the schematic and consider all the stray circuit paths that might be present at high frequencies. Here are several types of troublesome situations:

Capacitor Complications

If a capacitor is at fault, but is

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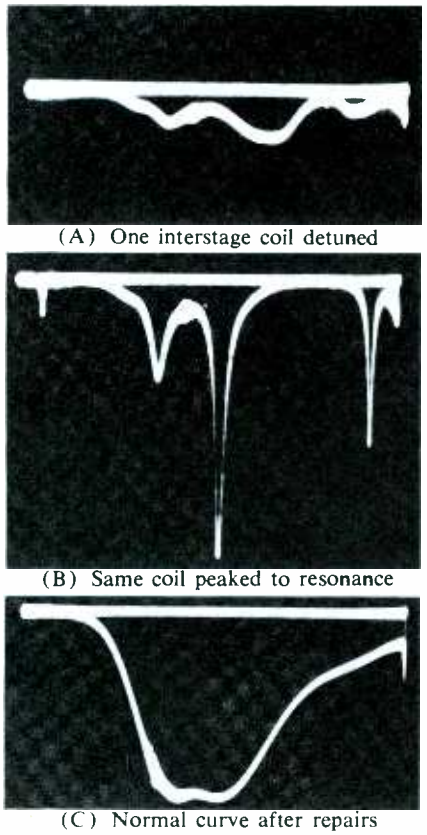


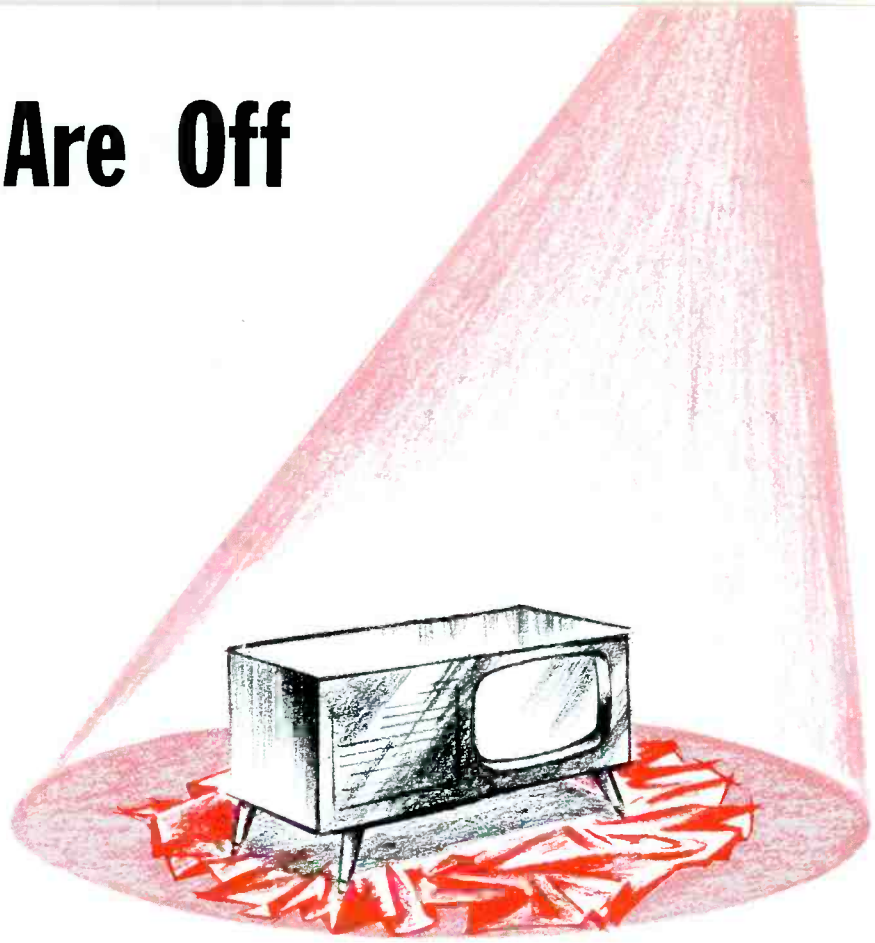
(A) One interstage coil detuned

(B) Same coil peaked to resonance

(C) Normal curve after repairs

Fig. 4. Modifications of the curve in Fig. 2B (marker frequency in 45.5 mc).

The Wraps Are Off MOTOROLA COLOR



An advance preview of the all-new '64 chassis

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

Following months and months of careful planning, engineering, and testing, the gates are finally down on Motorola's all-new color television chassis. The most significant feature of the line is the use of a 23", rectangular, 92° picture tube —the first of its kind. The viewing area includes 274 square inches of screen, and the depth—from face to base—is only 20". These dimensions have made possible a color set that is only slightly larger than an ordinary black-and-white receiver. Fig. 1 shows one model that is no larger than a 23" monochrome set.

The bonded 23" CRT, designated a 23EGP22, is used in all models with the new TS-908 color chassis. A number of new circuits are included in the chassis, and several you've seen in other color sets. Some of the new circuits and design arrangements are the result of the greater deflection angle, and a few adjustments you've never seen before have been added for servicing ease.

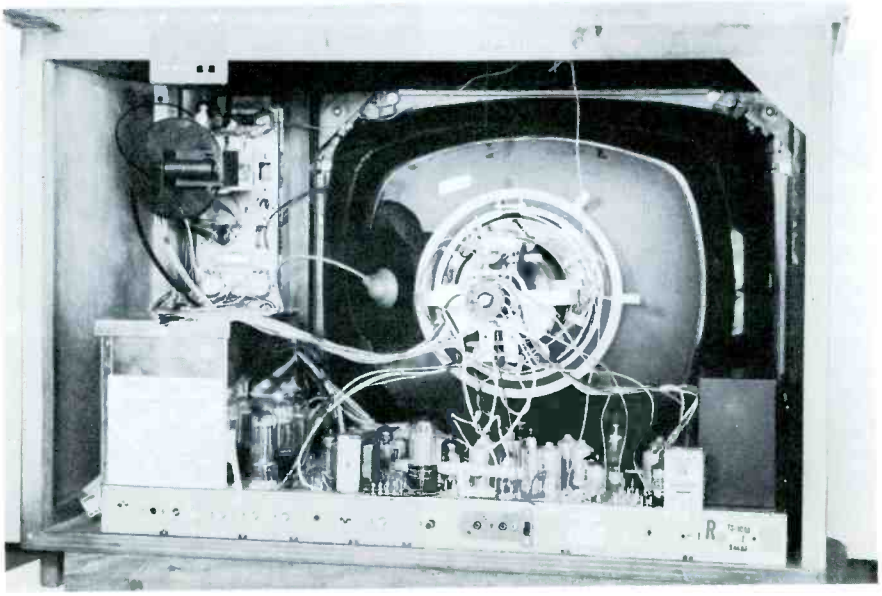


Fig. 1. Cabinet size of color set resembles that of typical monochrome TV.

Horizontal Deflection

Because of the increased deflection requirements, the horizontal and vertical sweep circuits have been "pepped up" beyond the capabilities you're used to seeing. Instead of a single output tube, the TS-908 chassis contains a pair of 6DQ6's. Little actual change is made from the usual output circuit, except that paralleling the 6DQ6's necessitates extra parasitic suppression — small-value resistors in the grid and screen leads, and a choke between the two plate connections.

The 24-kv high voltage is developed in a familiar manner, being rectified by a 3A3, and held constant by a 6BK4 shunt regulator. Fig. 2 shows the high-voltage regulator circuit, which is conventional except for the use of a voltage-de-

pendent resistor (VDR) in the grid lead. Connected between the boost line and the refulator grid, the VDR renders the circuit extremely sensitive to even the slightest shift in high-voltage load. This arrangement can hold the high voltage within 2% of 24 kv, under widely varying picture conditions.

Adjustment of the high-voltage circuit consists simply of setting the bias control (labelled "HV ADJUST") for 24 kv at the CRT second anode. If the regulator is suspected of being faulty, a meter can be connected across the 1000-ohm resistor in the cathode circuit to measure regulator current. With the brightness control at minimum, and 24 kv at the CRT, the regulator should draw around 1200 da (about 1.2 volts on the meter). As the brightness control is advanced, more current goes to the CRT; at maximum brightness, the regulator should draw little or no current.

The damper is a 6DW4 compactron, the only compactron used in the set. The circuit is conventional, with the linearity coil in the plate lead of the damper. In most color sets this adjustable choke is called an "efficiency coil," and is adjusted for minimum output-stage current; Motorola recommends that the coil in their chassis be adjusted carefully for best linearity, even if this occurs slightly away from the minimum-current position.

Two boost sources are provided —one developed in the ordinary manner by the damper circuit, and the other by an added semiconductor rectifier. Taking a pulse from a tap on the flyback transformer, this special rectifier adds its DC output to the 750 volts already developed by the damper, forming a "boosted boost" of 970 volts DC.

Horizontal centering of the raster is accomplished electrically, using a potentiometer located on the rear apron of the chassis. Width is controlled by a dual-coil arrangement across a portion of the flyback winding; this adjustment, too, is located on the rear apron.

Vertical Deflection

Vertical sweep is developed by a multivibrator-output system consisting of one section of a 6CG7 working with a 6EZ5 output pentode. In this circuit, there is little difference

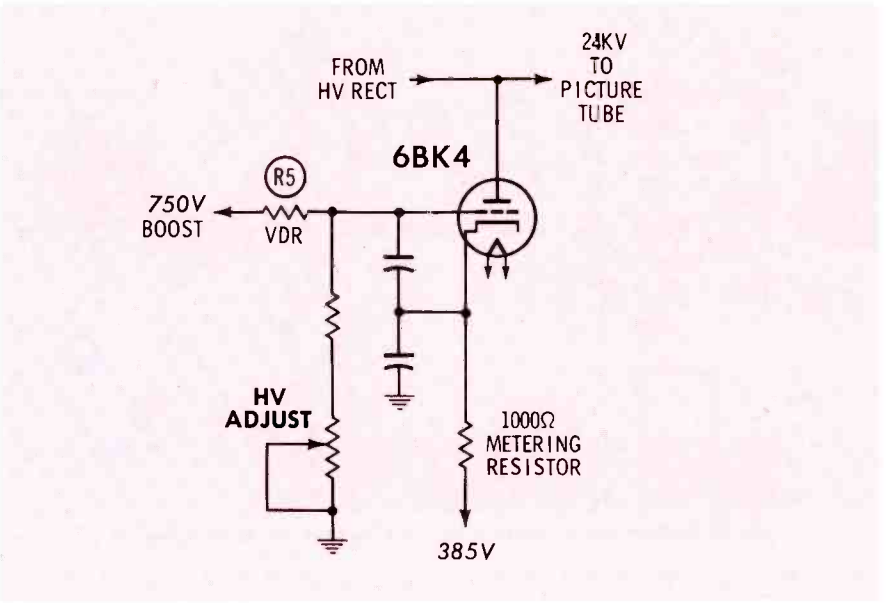


Fig. 2. Grid of HV regulator tube has VDR for improved regulating action.

from conventional color-set vertical circuits, except for one important factor. In addition to the usual functions of providing convergence and blanking pulses, the vertical output stage drives a unique circuit called the *vertical dynamic pincushion corrector* (VDPCC).

The VDPCC (let's call it PCC for short) is something new to color sets, made necessary by the wider deflection angle used with the new 23″ color CRT. In black-and-white sets, simple magnets always worked satisfactorily to eliminate pincushioning. In the color yoke, however, magnets adversely affect the purity and convergence adjustments; therefore, Motorola has included the PCC stage, instead.

Two controls are provided for adjusting the PCC circuit, one for the bottom of the raster (called "bottom tilt") and one for the top (called "top tilt"). Adjustment is much simpler than the uninitiated might think. With the set displaying horizontal lines from a generator, use first the bottom tilt adjustment and then the top one to straighten any bow in the horizontal lines at the bottom and top of the raster. That's all there is to it!

The circuit itself is not much more

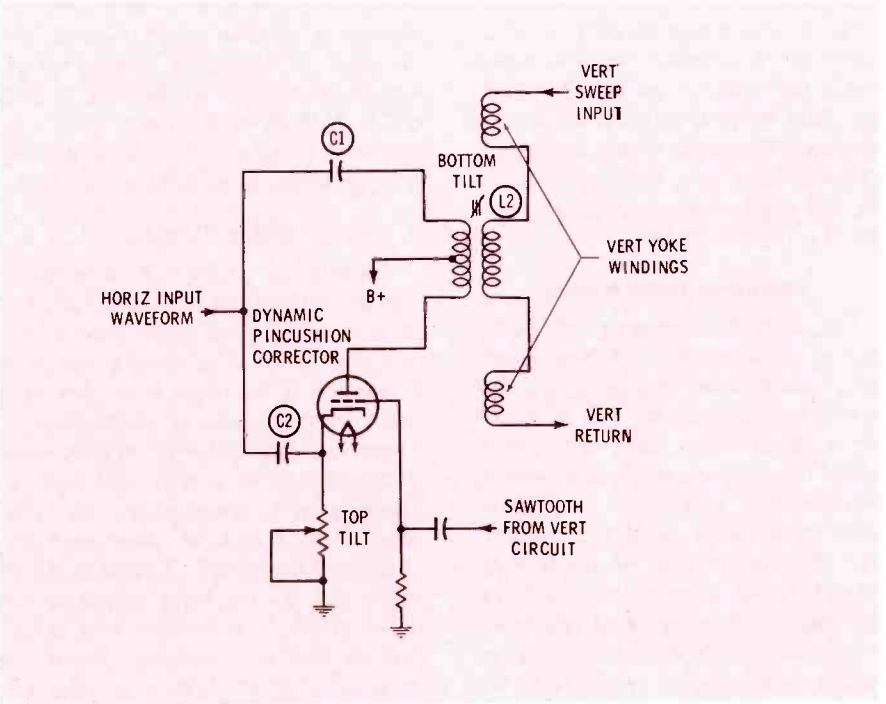


Fig. 3. Special circuit is used to offset pincushioning in 92° pic tube.

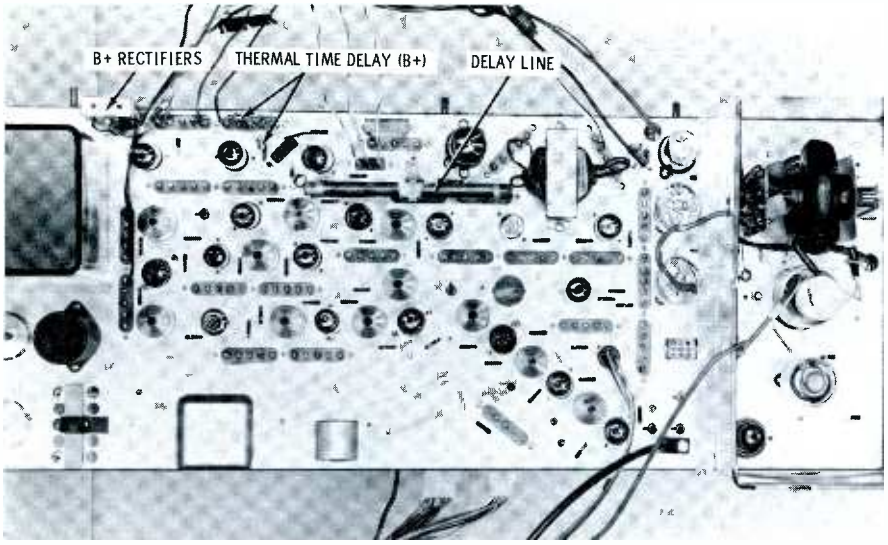


Fig. 4. Certain major components are located on top of chassis.

complicated, as can be seen from the simplified diagram in Fig. 3. A horizontal pulse is coupled by C1 to the top side of L2. A sawtooth is coupled from the vertical output stage to the grid of the 6BM8 pincushion corrector tube. The secondary of L2 is effectively in series with the two vertical yoke windings. The vertical yoke current is thus modulated by the horizontal input waveform, which is in turn modulated by the sawtooth from the vertical output stage. This adjusts vertical beam travel so it is uniform at the left, middle, and right portions of the screen. The corrective action is strongest at the top and bottom limits of vertical scanning, where pincushioning effects are most pronounced.

Horizontal pincushioning is eliminated by a negative vertical pulse that is fed back to the flyback winding. This vertical pulse increases or decreases the speed of the horizontal scanning lines near the center of the left and right edges, preventing horizontal pincushioning.

Convergence Circuits

The dynamic convergence panel and all four screen controls (red, blue, green, and master) are located conveniently at the front of the receiver. You can very easily reach the convergence and screen controls by removing a snap-in panel from the front of the cabinet. The adjustments can be made with a small-blade screwdriver and the hex-shaped alignment tool commonly associated with coil cores. A convenient label shows which area of the CRT is affected by each control or adjustment, and lists the convergence adjustments in their proper sequence.

The dynamic convergence circuits and adjustments are similar in most respects to those you are familiar with. There is one control, however, that is different from any you've encountered before. This adjustment is the final step in convergence procedure, and might be called a "fine" adjustment for the blue beam near the outer edges of the CRT. The control is located on the neck of the CRT, directly above the blue lateral magnet, and actually affects the size of the blue raster *only*.

Static convergence is not much different from what you're used to, and you'll have little trouble recognizing the familiar static magnets on the neck of the CRT. Purity rings are mounted next to the bell of the CRT, in front of the yoke; their adjustment is essentially the same as with those mounted behind the yoke.

Color Circuits

Motorola's color-IF amplifiers are the equivalent to the bandpass amplifiers in past color receivers; this new name was chosen because it was felt to be more truly descriptive of the nature of these stages. There are two color-IF stages; one is tuned (with a grid coil and a double-tuned transformer in the plate circuit) and the other operates at a fixed frequency. Together, they shape the 3- to 4-mc response so it is exactly 1 mc wide, and compensate for any response distortion introduced by the tuner or video IF stages.

Following the color-IF stages, the demodulator stages are very similar to the familiar "X" and "Z" demodulation system described in the November, 1962 article—"Chroma Demodulator and Matrix Stages." Matrixing takes place within the CRT, as with all modern color sets.

The color killer is conventional in design and operation. However, there is an interesting innovation that has been added for customer convenience — a "color indicator" light, located on the front panel. Actuated by the color killer stage, the light glows whenever a burst signal is being received, signifying that a program is in color. (With a little experience, you can learn to set the killer threshold control by the action of this light.)

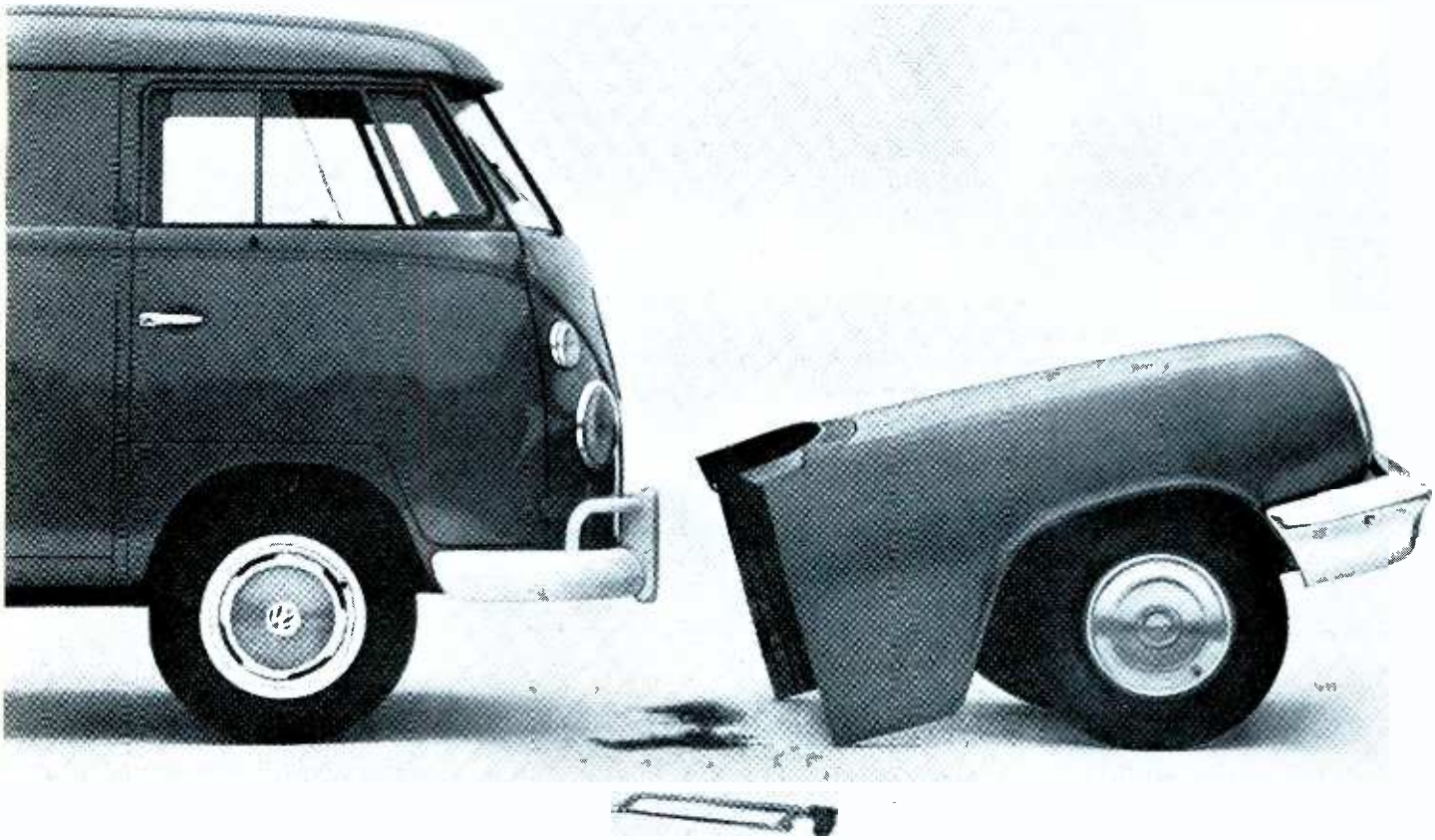
Power Supplies

Filament voltage is supplied by three isolated windings on the power transformer, in present chassis. One winding furnishes heater power to the 6BK4 and the 23" CRT; this winding is "biased" by a resistive connection to the B+ line, to reduce the chances of arcing within the tubes (between heater and cathode). In future runs of the TS-908 chassis, you may find only two filament windings, the "biased" one, and a heavier winding for all other filaments.

B+ is developed in a voltage doubler that uses silicon rectifiers and is protected by a 3.25-amp fuse. Additional surge protection is furnished by a thermal time delay that permits the tubes to reach operating temperature before power is applied to the doubler circuit (see Fig. 4).

Summary

It is impossible to mention here all the features, improvements, and design differences that distinguish the new Motorola from other modern color sets, but we've pointed out those which will interest you most from a servicing viewpoint. Familiarization clinics have already been held in some areas, and more are planned. In this, Motorola is following the fine example set by previous color-TV manufacturers. However you look at it, the introduction of a chassis using a 23" rectangular CRT is certainly news—the kind that keeps your chosen profession alive and interesting. ▲



That's a load off our front.

You may have wondered why we cut off our nose.

It wasn't to spite our face.

Our no-nose VW parks in spots regular trucks would never be found in.

(It's 3 feet shorter than most.)

And it pulls through the stuff that tow trucks get rich on. (The engine's in the rear for extra traction.)

Then there are other things.

Our boxy truck holds 1830 lbs. Nearly twice the load of regular models.

And it never needs water or antifreeze. The engine's air-cooled.

You get 20 to 30 miles on a gallon of regular. And you'll almost never need oil between changes.

And you were wondering why we cut off our nose? Why it's as plain as the one on your face.

TV FUSE STOCK GUIDE

How often have you checked a TV receiver and found a blown fuse—then checked your caddy and found you didn't have the right fuse to replace it? In this situation, you must either use a substitute value, which is a poor practice, or make a special trip back to your shop or to the distributor.

To help you overcome this problem, the *Fuse Guide* chart on this page shows you which types of fuses are most often found in TV receivers up to and including the 1962 models. Keeping a stock of the types listed will take care of most of your fuse requirements.

Numbers opposite the fuse types in the chart are recommended quantities of fuses to be carried in the caddy or kept on the shelf in the average service shop. (Each figure represents boxes of five fuses.) A dash appears in the *Caddy-Stock* column opposite any type used in less than ten sets per 1000. These types may be omitted if a minimum stock is desired; however, you may prefer to make up miscellaneous boxes with assortments of the less common fuses for your caddy. A dash appearing in both the *Caddy-Stock* and *Shelf-Stock* columns indicates a size that is found in less than five out of every 1000 TV sets; you may not find it practical to keep these in stock.

Your fuse stock should also include a supply of the fine wire used for fusing filament circuits. Three sizes are needed: #26 (found in 10% of sets); #24 and #28 (each found in approximately 3% of sets).

Incidentally, if you'd like an extra copy of this chart, printed on durable card stock to carry in your caddy, you can have one—free—simply by writing the Editor and asking.

Regular

Amp	Caddy Stock	Shelf Stock
1/4	1	2
3/10	1	1
3/8	1	1
45/100	–	1
1/2	–	1
3/4	–	1
1	–	1
2	–	1
3	–	1
5	–	1

C-Type

Amp	Caddy Stock	Shelf Stock
3/10	1	1
3/8	1	1
1/2	1	1
3/4	–	1
2	–	1
2 1/2	1	1
3	–	1
3 1/2	–	1
7	–	–

Slow-Blow

Amp	Caddy Stock	Shelf Stock
15/100	–	1
175/1000	–	1
3/16	–	1
2/10	–	1
1/4	2	3
3/10	–	1
3/8	–	1
4/10	1	2
1/2	1	1
6/10	–	1
7/10	1	1
3/4	1	1
1	–	–
1 1/4	–	–
2 1/2	–	–
3	–	–
4	–	–
5	1	1
10	–	–

N-Type

Amp	Caddy Stock	Shelf Stock
2/10	–	–
1/4	1	2
3/10	1	1
4/10	2	2
1/2	1	1
6/10	1	2
3/4	1	2
7/10	2	2
1	–	1
1 1/4	–	1
1 6/10	1	1
1 3/4	–	–
2	–	1
2 1/2	–	–
3 1/2	–	1
4	–	1
5	–	1

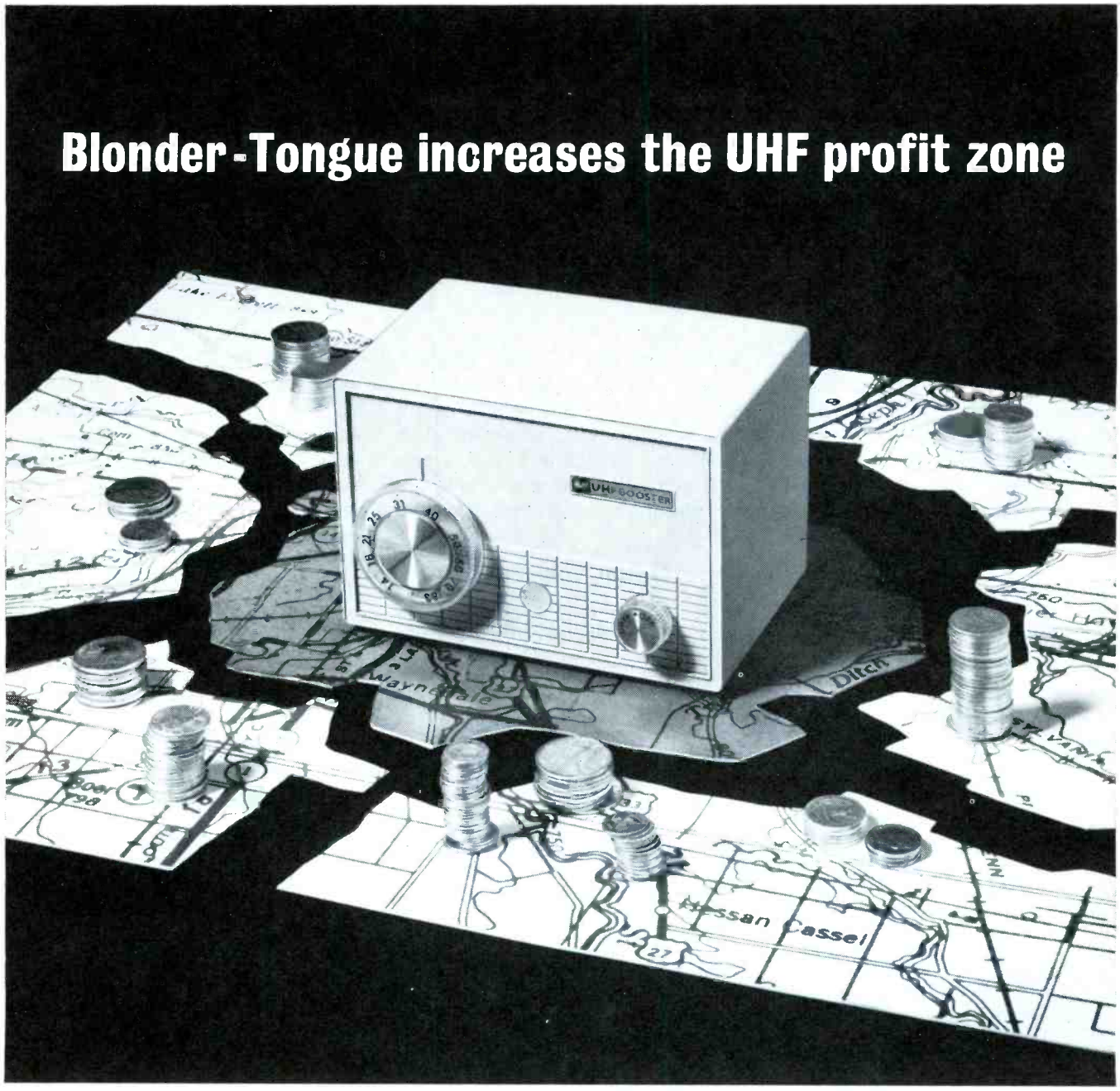
Pigtail

Amp	Caddy Stock	Shelf Stock
1/4	1	2
3/8	1	2
1/2	–	1
3/4	–	–

Slow-Blow Pigtail

Amp	Caddy Stock	Shelf Stock
2/10	–	–
1/4	–	1
3/10	–	1
3/8	–	1
1/2	–	1
6/10	–	–
3/4	–	–
1	–	–
1 1/4	–	1
1 1/2	–	–
1 6/10	–	–
2	–	1
2 1/2	–	–

Blonder-Tongue increases the UHF profit zone



First all-channel UHF Booster—the U-BOOST

The fabulous new Blonder-Tongue can add up to 15 miles to your city's UHF reception range. It turns TV viewers formerly beyond the range of UHF into profitable UHF customers—prospects for UHF converters, UHF antennas, all-channel TV receivers and the U-Boost itself. The U-Boost will also clean up and improve reception for viewers in poor signal areas—More money in your pocket!

The U-Boost, (gain 10 db) triples the antenna signal voltage. Teamed up with a UHF converter or added to an all-channel receiver, the U-Boost improves reception on any UHF channel 14 to 83. Just a turn of the dial pinpoints the desired channel and brings it in sharp and clear. TV picture quality is always excellent with the U-Boost since it amplifies the signal before conversion delivering the best signal-to-noise ratio.

The U-Boost is easy to install: convenience AC receptacle; patented 300 ohm stripless twinlead terminals. And finally, the modern U-Boost styling matches the new Blonder-Tongue UHF converters — making combination sales easy. Sell a Blonder-Tongue converter and a U-Boost together. They're "profit-mates". **U-Boost**, List **$39.95**

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2. New U-Boost to increase your UHF profit zone.

3. Powerful merchandising program backing up every Blonder-Tongue product.

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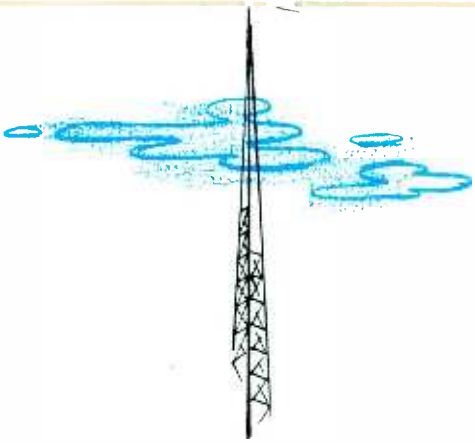


when CABLE TV comes to town!

how will it affect you as a serviceman?

by Thomas A. Lesh

Cable systems, feeding TV signals to homes from a community antenna, were originally developed to bring television to remote, mountainous areas where direct reception was all but impossible. Lately, these CATV operations have also been scoring many successes in small cities already within the reach of deep-fringe "off-the-air" signals; the public is showing itself willing to pay for consistently clear pictures and a greater choice of channels. As a result, the number of cable operations is steadily growing.

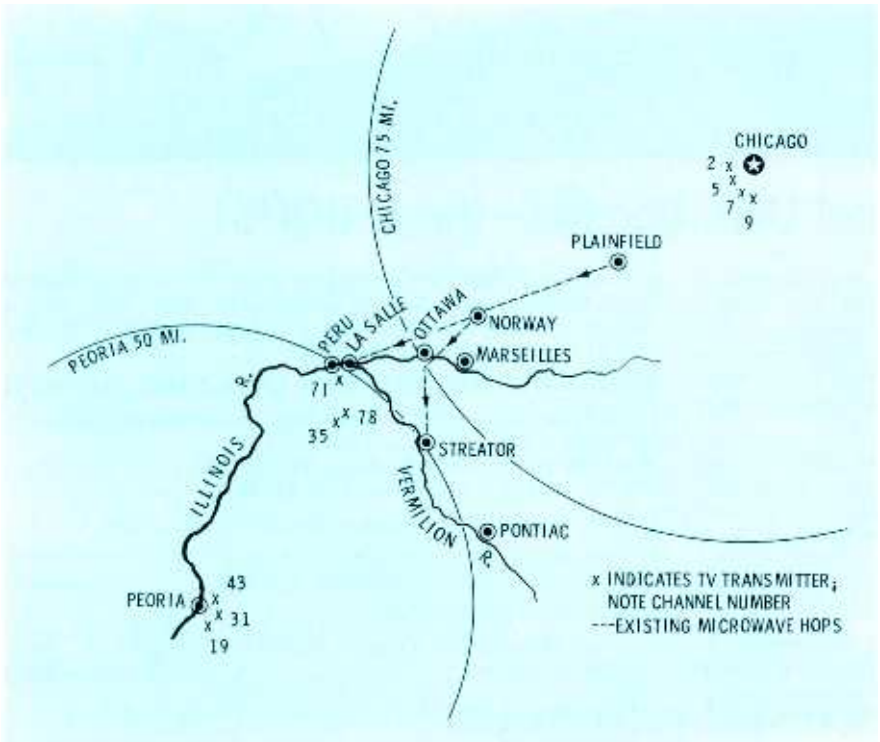
If your town is potentially a market for cable TV, your neighbors will be turning to you first for information about this method of TV reception. To help you answer their questions, we recently visited several cities to study their cable operations from a serviceman's point of view.

Typical Cable Areas

We headed first for LaSalle County, Illinois, where two thriving cable companies are serving several cities. Much of this county is nearly flat farmland that receives reasonably good service from four VHF stations in Chicago, some 75 miles northeast, or from the three high-powered UHF stations in Peoria, almost 60 miles southwest. However, several major towns are located in the Illinois River valley, which is just deep enough to cause severe reception problems in low-lying areas.

One city, Peru, has had cable service since 1951; but the adjoining "twin city" of LaSalle did not grant the cable operator (Television Transmission Co.) permission to extend its lines there until recent months. Local service to LaSalle has been provided only by nearby WEEQ-TV on channel 35—operated as a satellite by one of the Peoria stations—and by low-powered translators on channels 71 and 78 repeating the other two signals from Peoria. The system now being installed in LaSalle will carry the signals from these local sources (converted to high VHF channels), as well as the Chicago stations.

At Ottawa, 15 miles to the east, the Ottawa TV Cable Co. has been supplying all four Chicago channels —plus WEEQ-TV—to its subscribers for the past two years. A long cable run extends this service six miles farther east to Marseilles, a smaller city also located in the valley. The same company has just begun a nine-channel service in



Cable systems thrive in valley towns at some distance from major stations.

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With the Analyst, you inject your own TV signals at any time, at any point, while you watch the generated test pattern on the picture tube of the television set itself. This makes it quick and easy to *isolate, pinpoint, and correct* TV trouble *in any stage throughout the video, audio, r.f., i.f., sync and sweep sections* of black & white and color television sets—*including intermittents.* No external scope or waveform interpretation is needed. Checks any and all circuits—solves any performance problem. Gives you today's most valuable instrument in TV servicing—*proved by thousands of professional servicemen everywhere.*

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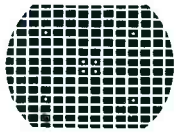

Enables you to troubleshoot and signal trace color circuits in color TV sets, or facilitate installation.

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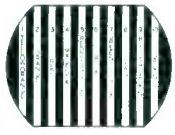

Generates full color rainbow display and color bar pattern to test color sync circuits, check range of hue control, align color demodulators. Demonstrates to customers correct color values.

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Streator, 15 miles south, and is building a system in Pontiac, another 15 miles to the southeast—both in the valley of the Vermillion River.

After visiting these systems, we journeyed 150 miles south to Effingham, where TV reception problems are due to distance more than to terrain. The nearest stations, all about 65 miles away, are channel 3 in Champaign, channel 10 in Terre Haute, Indiana, channel 17 in Decatur, and channel 20 in Springfield. The Effingham TV Cable Co. began bringing in all these stations last fall, plus four stations from St. Louis, 100 miles away.

All the companies we visited use their own maintenance crews to hook sets into the cable system, but work closely with local TV servicemen and dealers in all other matters. Of course, many subscribers call the cable office first when something goes wrong with their TV reception, undoubtedly hoping to avoid a service-call charge for checking up on trouble that might be in the cable system. The phone conversation often pinpoints the fault to the receiver, and convinces the customer of this fact. But if the customer is still doubtful, or a rash of calls comes in from a small area, cable companies customarily follow a liberal policy of dispatching a serviceman to check the subscriber's reception without charge. All three cable operators in our survey reported great success in the tactics of bringing along a portable TV for comparison checks, to make sure a satisfactory signal is reaching the home. If the trouble is proved to be in the subscriber's set, the plainly stated official policy of all the companies is to advise the subscriber to call his own TV serviceman.

To encourage local servicemen to promote the cable operation, each company we interviewed offers them a $10 bonus for every new subscriber they sign up. In addition, TV dealers often work out plans with the cable company whereby a free connection (or a discount on the installation fee) is included in the price of each new set sold. The regular connection charge varies widely in different systems; for instance, it is $25.00 in Effingham and $49.95 in the LaSalle area, with monthly single-set subscription fees of $6.95 and $5, respectively.

As a rule, the TV set owner has already invested a few hundred dollars in an elaborate antenna system, which becomes unnecessary after the cable connection is made—an awkward situation for the cable operator, the serviceman, and the customer alike. To offer the customer some compensation for his investment, as well as to encourage the removal of antennas, the Illinois companies offer a $25 "trade-in" allowance—applied to the cable installation fee— and arrange to have the antenna taken down at no expense to the customer. If a serviceman has signed up the subscriber, he has the option of taking down the antenna himself and keeping it for possible resale in rural areas. Of course, the customer can keep his antenna and pay the full cable-hookup charge, if he prefers this course.

The cable system meets fairly stiff competition from home antennas in favorable reception spots such as those on high ground; even so, some of the residents in these areas become sold on the improvement in

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reception obtained on the cable. Thus, an impressive percentage of the townspeople "tap in" sooner or later. The number of subscribers on the Ottawa system, for example, has just passed 4,100, out of a possible total of approximately 7,500. Servicemen have been responsible for signing up nearly 70% of this number.

Receiver Service Problems

Not many troubles are stirred up in TV sets when they are put on the cable, but there are a few characteristic "kinks" that sometimes have to be ironed out.

One has to do with the sudden boost in signal strength. The set has usually been accustomed to receiving signals so weak that no AGC is developed, and the RF-IF tubes have been running "wide open." The standard 1000-microvolt signal supplied on all cable channels is strong enough to produce some AGC voltage; then, if the AGC circuit is defective or if the controlled tubes have become gassy or leaky, horizontal pulling and related troubles are apt to result. Once this problem has been remedied, the receiver settles down to normal operation—and servicemen say the RF-amplifier tube failure rate is definitely lower.

Another occasional trouble stems from the fact that *all* channels from 2 through 6 are in use on many cable systems. Even though the CATV equipment greatly attenuates the relative amplitude of the sound carrier on each channel to minimize adjacent-channel interference, the traps in the IF strip may still need a touchup on a small percentage of sets, and a few skimpily-designed models may not have sufficient adjacent-channel rejection to work well on the cable. A few of the servicemen we interviewed also mentioned the necessity of touching up the tuner oscillator slugs, and (in a few cases) doing further minor alignment on the tuner.

We examined scope traces of several typical cable signals, and noted no significant sync compression or related distortion; however, this problem can crop up on rare occasions. To compensate for occasional signal irregularities, a couple of service dealers mentioned the importance of checking sets for proper filtering of supply voltages fed to the video, AGC, and sync stages.

Does the use of cable increase or decrease the volume of service work and new-set sales? Dealers and technicians are divided on this point. The majority say there is an increase, because people are more conscious of picture quality and less inclined to tolerate a poorly operating set. However, some others also point out that the sets are not required to operate at peak performance, as they were when the only available signals were of deep-fringe quality; thus, some faults now cause a less urgent demand for repairs.

How Cable Service Is Started

Although its benefits to TV reception are obvious, a CATV system is a complicated undertaking. From the cable companies we visited, we learned that a prospective cable operator must clear several hurdles before he can begin service. The city government must first pass an ordinance, or grant a franchise, permitting the operator to install his equipment. He can expect to pay an operating fee to the city, and is usually required to make various legal agreements for such purposes as restricting changes in subscriber

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Tips for Technicians

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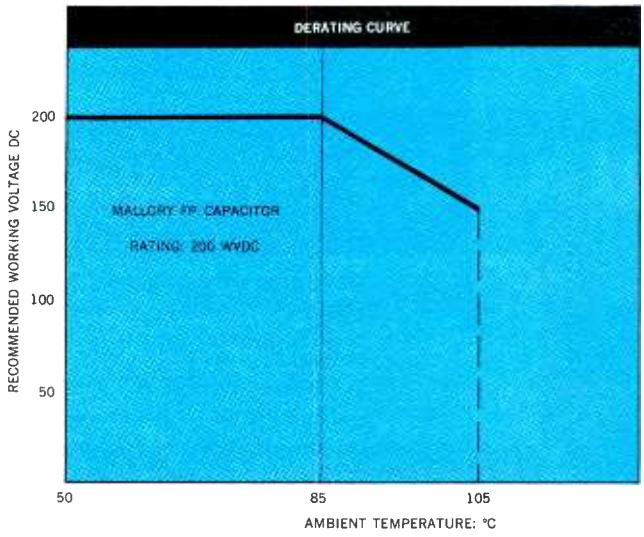
About voltage ratings on electrolytics

Maybe this has happened to you. You've got to replace a 10 mfd electrolytic capacitor. On its label, loud and clear, you read 200 volts. You look on your shelf. No 200 volt units in sight—but there's one that says 10 mfd 300 volts. Question—can you use it, and if so, will it reform itself and become a 200 volt capacitor when used at the lower voltage?

Answer—you can, and it won't.

The reforming of electrolytics to lower voltage is an idea held over from the ancient days of wet electrolytics, which had a tendency to adjust themselves to the voltage at which they were being used. This doesn't happen with modern electrolytics, especially the way Mallory makes them.

You can rely completely on the voltage rating you read on a Mallory capacitor's label. We've built in the safety factors *before* we print the voltage rating on each capacitor. This means you can use a Mallory capacitor right up to its rated DC working voltage, at rated ambient (this is 85° C. for FP's, WP's and TC's) without worrying about premature failure or call backs. And you have inherent extra muscle to withstand the usual surge voltage above rated value. Conversely, you can *always* use a Mallory capacitor *below* its rated voltage when convenience demands it; you're just buying some extra reliability at a bargain price.



When necessary, you can use Mallory electrolytics at temperatures beyond 85° C. You won't get as long life, and you'll need to run them below rated voltage. No hotter than 105° C., please, and no higher then 400 volts. The chart at left gives you typical temperature derating data. If you run into higher temperatures, you really need one of our fine tantalum capacitors.

The best way to make sure you get the electrolytics you need is to see your Mallory distributor. He carries a complete line of all ratings of Mallory FP, WP, TC, TT and wax tubulars. Right now, he is featuring a new dealer cabinet that gives you a compact, convenient working stock of most popular FP types. See him soon—make him your headquarters for all your parts requirements.

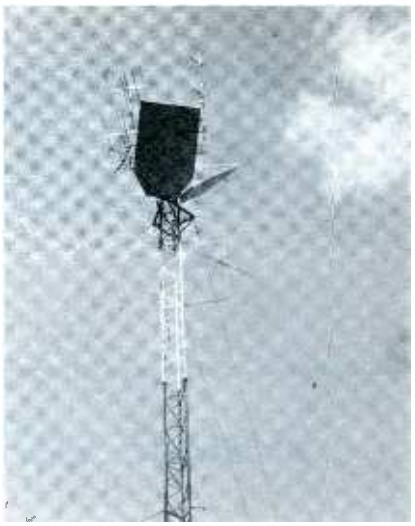
rates and avoiding interference with free TV.

Another important item in opening a cable service is to reach an agreement with power and telephone companies for joint use of their utility poles. The cable company generally pays a pole-rental fee, and also pays for any necessary relocation of power or telephone equipment. At points where existing utility poles are inconveniently located, the cable company installs separate poles. (The Effingham system uses *only* its own poles—an unusual practice.)

Another legal restriction—FCC regulation of CATV systems—may be around the corner. Federal rules would set a firm policy for dealing with such controversial questions as obtaining stations' permission to distribute their signals, and "blacking out" programs from distant stations that duplicate those broadcast on a local channel.

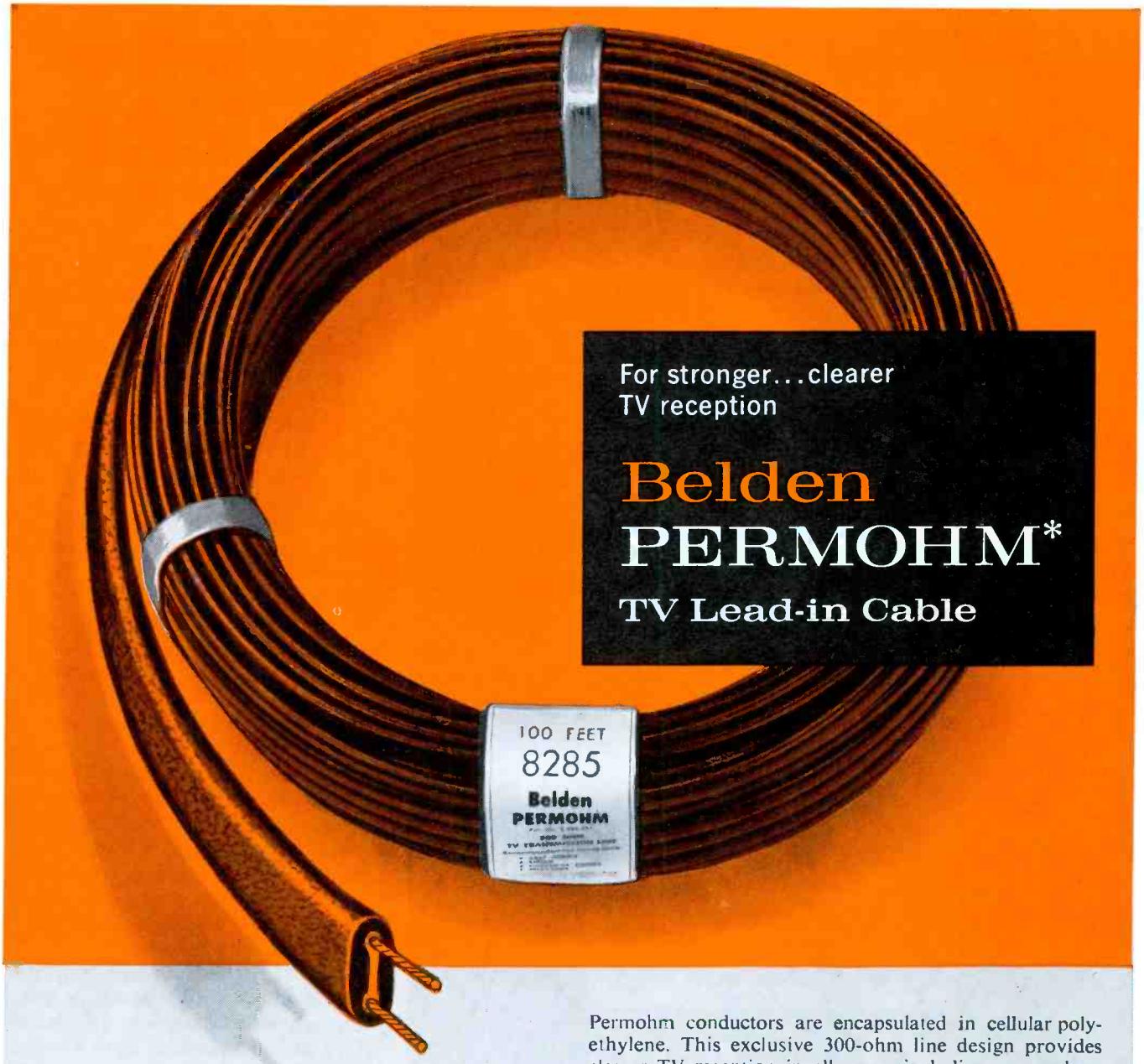
In addition to clearing a legal "right of way," the company must solve the engineering problems involved in obtaining and distributing the best possible signals. (An outside firm that specializes in system design is generally hired for this purpose.) Little expense is spared in equipping the system for operation. Lacking a convenient mountain for use as a receiving-antenna site, the Illinois systems have erected towers 100' to 500' tall, located on high ground near the respective towns.

The Peru company maintains a microwave system to bring in stronger, more noise-free signals from Chicago than can be obtained by direct pickup. At Plainfield—about 35 miles from downtown Chicago—channels 2, 5, 7, and 9 are received and applied to four separate carrier frequencies in the 6000-mc common-carrier microwave band. The resulting signals are beamed to a tower at Norway, near the eastern edge of LaSalle County; from here, they are relayed to the installation at Peru, and also furnished to the Ottawa system. Another microwave hop extends service to Streator, and an additional link to Pontiac will soon be completed.


Master antenna tower at Ottawa both receives and sends microwave signals.

At each receiving site, demodulating equipment recovers a video signal and a frequency-modulated 4.5-mc carrier from each microwave channel; after attenuation of the sound, these signal components are used to modulate locally generated, crystal-controlled VHF carriers for distribution within the cable system. In this process, the Chicago stations are not restored to their original frequencies, but are placed on four of the five low-VHF channels.

The Peru and Ottawa systems are not presently equipped to handle the high-VHF band (channels 7-13), but the newer LaSalle and



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Permohm conductors are encapsulated in cellular polyethylene. This exclusive 300-ohm line design provides clearer TV reception in all areas, including areas where conditions of extreme salt spray, industrial contamination, ice, rain, or snow are experienced. It further improves fringe area pictures on all channels, as well as strengthening UHF and color TV transmission. Ask your Belden Distributor about this improved 300-ohm cable. Permohm is available in packaged lengths of 50, 75, and 100 feet, and in 500- and 1000-foot spools.

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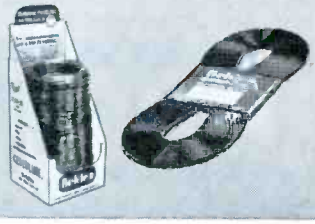

8-5-1

Streator installations are outfitted with wide-band amplifiers and can utilize the upper band for Peoria and other stations. (The repeater services in the LaSalle area are used as UHF signal sources, by direct reception.)

All signals for the cable at Effingham are now obtained via off-the-air pickup, and the St. Louis stations suffer some interference from electrical noise. An application is now pending with the FCC for a microwave link to provide clearer reception on these channels. Most stations are put on the cable on their original channels, without elaborate frequency-conversion equipment. Transistorized preamps on top of the tower give the signals an extra boost. Converters, also in a "topside" location, change the two available UHF channels to 7 and 9.

Each city uses a cable network consisting of many-branched trunk lines with secondary feeders. To restrict radiation, these lines use either double-shielded coaxial cable, or coax with some special type of single shield—such as the solid aluminum sheathing used in some trunk lines. During the 11-year history of the Peru system, equipment has been replaced several times to keep up with new developments —a practice the newer systems also seen destined to follow.

Line amplifiers, spaced approximately 1500 feet apart, keep the signal at a nearly constant level throughout each system. The latest type of equipment for trunk lines is the "chain amplifier," using several tubes in parallel for each stage. These broadband amplifiers have a flat frequency response from 54 to 216 mc, and one burned-out tube has scant effect on either bandpass or gain—providing a welcome reduction in "panic" service calls. Of course, regular preventive maintenance schedules are followed on all

Existing utility poles carry most of cable network, including amplifiers.

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Measures voltages down to 0.001 volt. Decibel scale for measurements from −40 to +40 db. Built-in amplifier which may be used separately as a preamplifier. Typical applications include: frequency response tests of preamplifiers, power amplifiers and tone control circuits, signal tracing; measurements of audio level, power level and gain; amplifier balancing applications and general audio voltage measurements. **$79.95***

F. RCA WG-360A STEREO PHASE CHECKER

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cable equipment to keep performance at a high level. An interesting piece of test equipment used by technicians of all systems is a sweep generator that can develop a single response curve covering the entire 54-216 mc band—with markers provided by a companion unit.

Also of special interest is the "pilot AGC" system used on many CATV lines. At the tower site, a special carrier (73.5 mc at Peru; 182.25 mc at Effingham) is fed into the main trunk cable together with the station signals. If conditions in the cable cause fluctuations in signal strength, AGC receivers in some of the line amplifiers detect the pilot-signal variations and adjust the amplifier gain.

Cable drops to individual homes are made by boring into the feeder cable and inserting a "pressure tap" which contacts the cable conductors, but couples the signal to the receiver through a small series capacitor. Delivering a signal strength of 1000 microvolts to the TV set is standard CATV practice; to obtain this value at any point on the feeder lines, regardless of the distance from the nearest amplifier, several types of

Low insertion loss is important requirement for individual home tapoffs.

tapoffs with different attenuation factors are available. These are color-coded for quick selection by installation technicians; by reference to a signal-level chart of the feeder system, the proper color of tapoff unit can be specified on each installation order. In the LaSalle area, color TV sets are fed three times the normal amount of signal, to insure ample color-subcarrier input. Since the insertion loss of the taps is very low, adding more taps on a given stretch of feeder cable has little effect on neighboring installations.

Extra Services

Many cable systems strengthen their competitive position by offering a wide choice of channels, plus extra services not available locally by reception from home antennas.

The Ottawa system picks up five FM radio stations, converts them to other frequencies in the FM band, and feeds them into the cable along with the TV signals. There are also facilities for placing local voice announcements on all channels; in addition, telecasts of local election returns have been provided. The tower installation includes an antenna that picks up channel 4 in Rock Island, Illinois, for occasional sports programs not available on Chicago channels.

The LaSalle system is installing a *Weather-Scan* unit, consisting of a TV camera that moves back and forth in front of a series of dials that indicate local wind conditions, temperature, time, etc. This service will be placed on one of the high-band channels, with background music from an FM station on the sound carrier.

Extra services such as these help to explain why people in more and more communities are willing to pay a regular fee to have TV signals piped into their homes, even though direct reception is often possible. ▲

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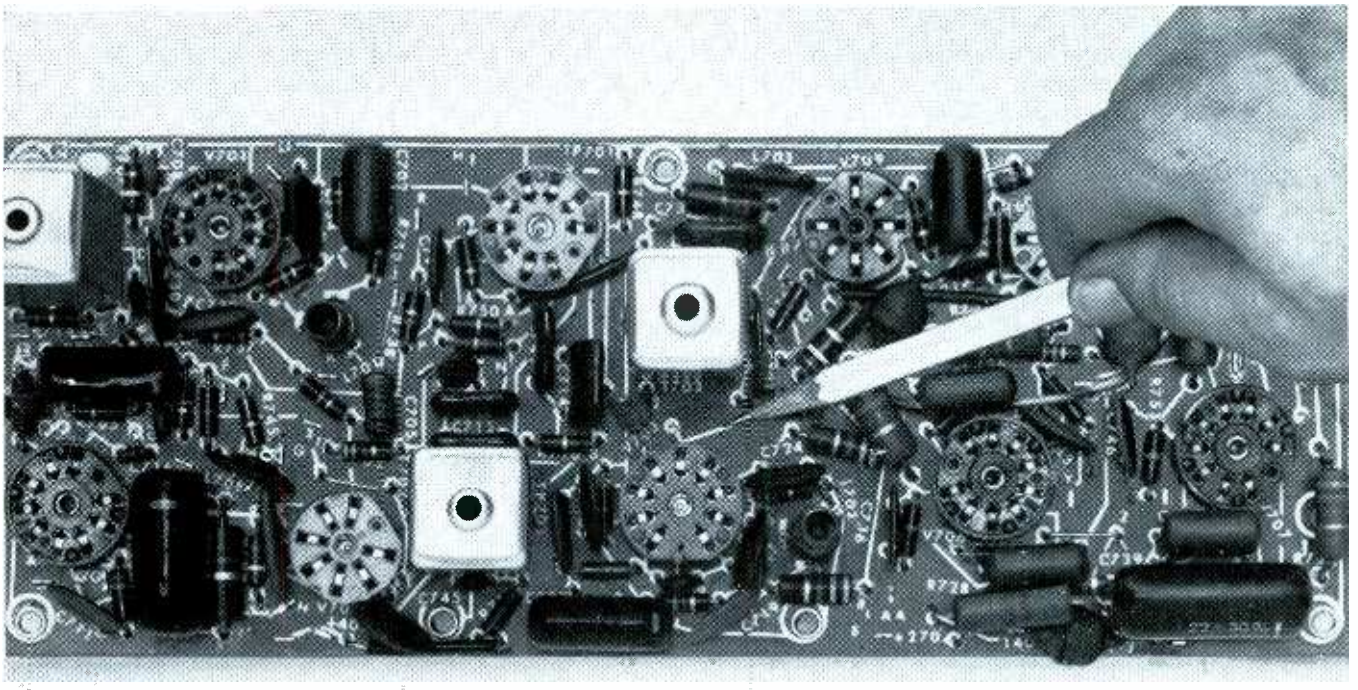

RCA Victor Color TV Chroma Circuitry

You can see at a glance how new streamlined "road-mapping" makes servicing faster, easier, surer than ever before

Pictured above is the "new look" in RCA Space Age Sealed Circuitry . . . the new precision-crafted boards that you'll see in *all* 1964 New Vista Color and in most RCA Victor black-and-white television sets for 1964.

This new schematic diagram "road-mapping" consists of *straight white lines* that run *directly* from *point-to-point.* No confusion, no difficult paths. And the extra space gained has been used to make the label markings larger. You can see and trace the circuits at a glance.

Here again RCA Victor has made a vitally important contribution to easier, faster and more accurate servicing. It is part of our continuing research program to offer the utmost in reliability with Space Age Sealed Circuitry.

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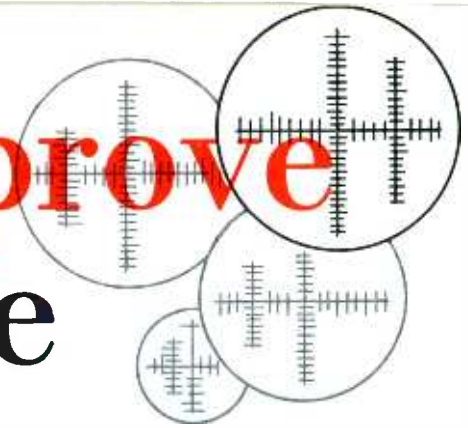

Good maintenance is "dependability insurance." —by Len Buckwalter

There are countless reasons why some servicing jobs take an unnecessarily long time to complete, but one of the most common is inadequate or defective test equipment. When an instrument fails in the line of duty, or its performance doesn't measure up to standard, what can you do about it without wrecking your budget? You can repair the defective piece of equipment—yes, even a "complex" scope.

Like the TV receiver, an oscilloscope has a built-in test indicator: a CRT that often displays visible clues to internal problems. Some symptoms are obvious, like a horizontal trace that cannot fully span the face of the tube. Other defects, however, are more subtle; in such cases, tracking down the trouble is considerably aided by visualizing the scope's basic functions and making full use of the telltale trace (or lack of it) on the screen.

Before you attempt any troubleshooting, there's a precaution well worth considering: *Know the limitations of your scope*. Typical shop scopes, although capable of delivering excellent results in routine service work, were never intended to deliver the performance of a lab instrument; therefore, poor presentation of some types of input signals may not necessarily be a sign of trouble. For example, it would be unwise to feed in a high-frequency signal—beyond the scope's bandwidth—and expect an adequate display of information. Thus, you're strongly advised to check the manufacturer's specifications for your scope. The most important items of data you'll need include input sensitivity, frequency response, and sweep-frequency range. Attempting to exceed the limitations imposed by these figures will simply result in a futile attempt at repair.

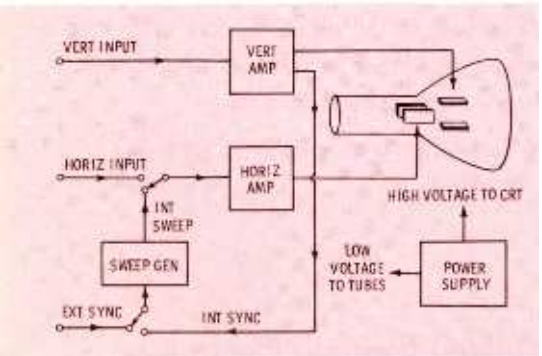

Fig. 1. Scope circuitry can be divided into four major sections for analysis.

For the sake of troubleshooting, virtually any scope may be considered to consist of four major blocks (Fig. 1): power supply, vertical and horizontal amplifiers, and sweep generator. The operation of each block may be summarized briefly as follows:

Power Supply. The key difference between the scope supply and those of most other transformer-operated instruments lies in its dual function. The supply is divided into low and high-voltage sections. Low B+ (about 250 volts) is fed to the plates of the amplifiers and sweep generator, while potentials in the 1000 to 2500-volt region are applied to the CRT for accelerating—and sometimes deflecting—the electron beam. (Don't be misled if anode voltages on a CRT measure only about 200 volts to ground. To protect the operator from dangerous potentials on front panel controls, high voltage is often applied to the cathode and grid of the CRT, rather than to the anode elements. Negative polarity preserves the proper anode-cathode voltage relationships.)

Vertical Amplifier. Input test signals are introduced to this stage for amplification, and then applied to the CRT vertical deflection plates. The amplifier is characterized by an input attenuator, or gain control, and peaking networks for extending the frequency response. A sampling of this stage's output can be coupled to the sweep generator to synchronize the horizontal sweep frequency.

Horizontal Amplifier. Similar in design to the vertical amplifier, this stage boosts the sweep-generator output to an adequate level for deflecting the electron beam horizontally. It can also operate from an external sweep source, if desired.

Sweep Generator. This stage generates a sawtooth waveform for horizontal deflection. The signal voltage (Fig. 2) rises in linear fashion to a peak, and then "snaps back" to begin the next cycle. The repetition rate of this action can be varied over a wide range, so the sweep frequency of the scope trace can be matched to the frequency of the signal being viewed.

More detailed explanations of these four basic scope circuits appear in the Special Book Section at the front of the March issue.

Troubleshooting Procedures

Despite the scope's specialized circuitry, it still falls heir to the familiar problems that afflict any electronic instrument. Thus, tubes are often the first candidates for

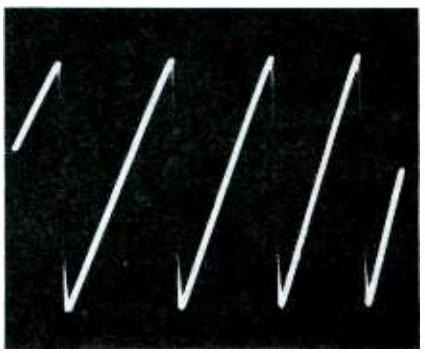

Fig. 2. Virtually pure sawtooth shape characterizes sweep-generator output.

Compactrons take the heat off service dealers

More and more of today's newest TV sets are featuring compactrons . . . G.E.'s multifunction electronic devices. This means, eventually, you'll be seeing more compactron circuits in your shop. Therefore, to anticipate some of your questions about compactrons, let's take a look at how compactrons can help take the heat off you and your business:

1. Long waits for repair will be a thing of the past. Simple compactron circuits mean you can locate trouble faster, repair it easier, get sets back to your customers quicker. Fast, efficient service builds repeat business and gets you free word-of-mouth advertising.

Repairs are consistently better because compactrons combine functions having similar life spans. Thus if one section fails, the entire compactron must be replaced—automatically restoring top performance through replacement of the other weakened sections. You save time by not having to check extra tubes and you eliminate the possibility of "weakened ordinary-tubes" not showing up on the tester.

2. No more call backs! When you fix a compactron set, *it stays fixed.* Call backs are virtually eliminated by service-designed compactrons which have a 40% lower operating temperature than ordinary tubes. Cooler operation means greater reliability and gets rid of a difficult trouble spot — peeling and cracking of printed circuits.

3. You make more profit on compactrons because the unit price is higher. Replacing a compactron is like replacing 2 or 3 ordinary tubes. Simpler compactron circuits, plug-in replacement, and fewer tubes to check, let you service more sets in any given time. Employees become more efficient, and need less training.

Multifunction design means that eventually you can substantially reduce your tube inventory. This gives you more "free" operating capital, more shelf space, plus less capital investment . . . hence a greater profit per dollar invested.

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checking. The usual voltage and resistance measurements can also uncover a large number of circuit defects. (Take care in the presence of high CRT voltages.) Don't overlook worn or shorted test leads, a common reason for no signal input at the vertical amplifier. Microphonic tubes produce their share of not-always-obvious problems; so, during initial checks, tap each tube to discover any that have a tendency to produce a fuzzy or hash-modulated trace.

To show what else you can do when the above checks fail to pinpoint certain troubles, let's examine some specific problems in the scope with an eye toward localizing trouble sources in a logical manner. Since the spot of light formed by the electron beam must be present in order to be useful in subsequent checks, it should be considered first. The cause of a missing beam may be pinpointed as a defective CRT, improper CRT voltages, or open controls (positioning, focus, or intensity). A faulty high-voltage bleeder or shorted high-voltage filter capacitor can kill the spot by upsetting the voltages on the CRT. A more elusive problem is the inability to bring the beam into normal focus. This is often caused by a leaky or shorted filter capacitor in the low-voltage supply, which introduces hum that modulates the CRT beam, or by any trouble in the high-voltage supply. Difficulty in positioning the beam can be introduced by defects in the horizontal or vertical output amplifiers, since they are usually DC-coupled to the CRT deflection plates.

Vertical Amplifier

Two major problems that develop in the vertical amplifier (aside from obvious tube, voltage, and resistance defects) are stage overloading and poor frequency response. Overloading generally shows up as flattening or distortion of the waveform, as shown in Fig. 3.

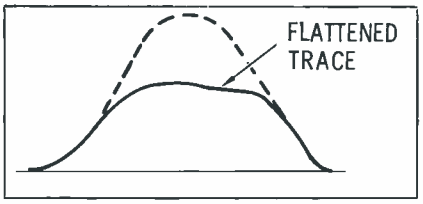
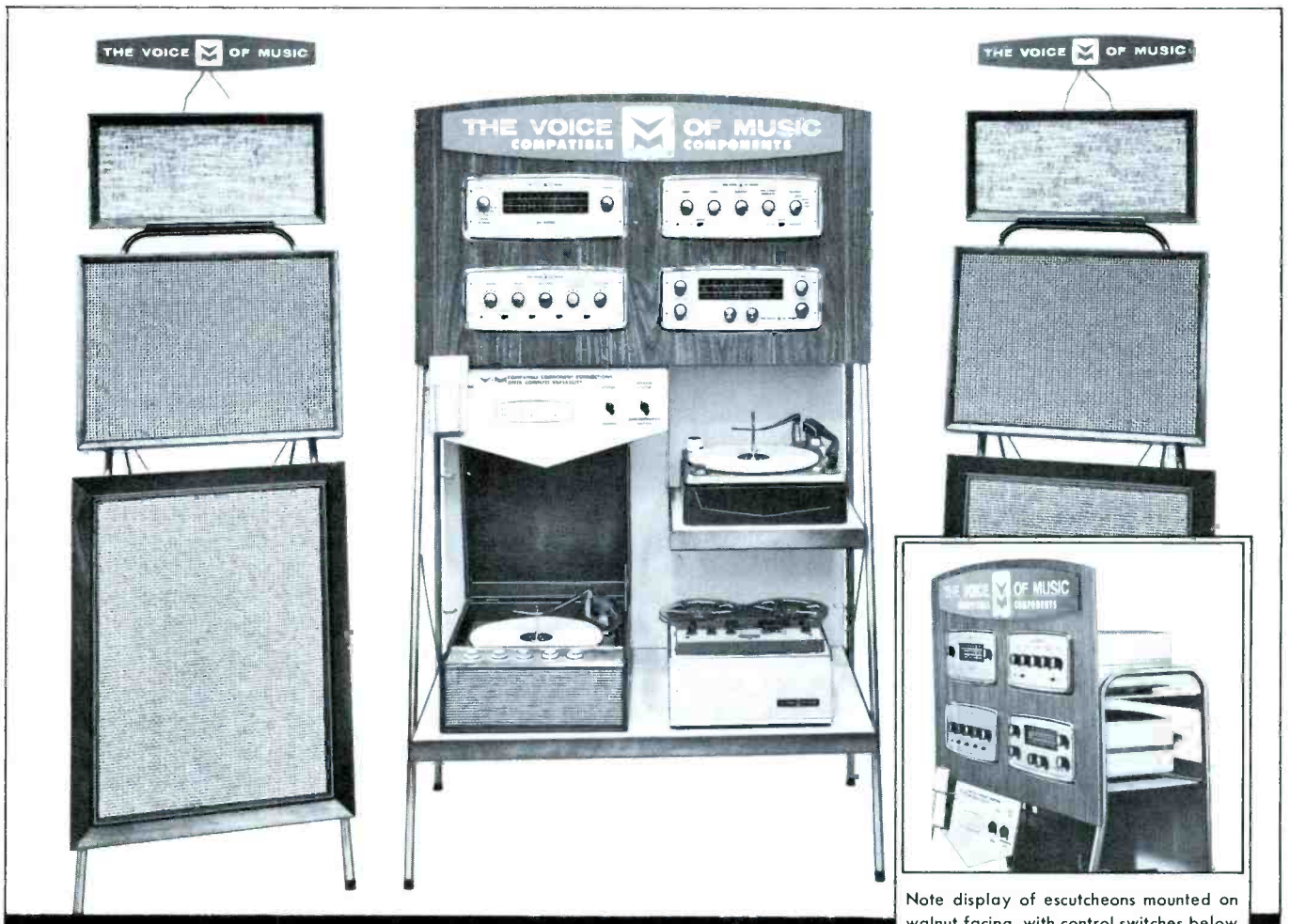


Fig. 3. Flattening of waveform peaks reveals overloaded vertical amplifier.

This distortion should not be confused with overload that occurs inevitably when input signals are beyond the vertical amplifier's signal-handling ability. A simple way to be sure of this symptom is to observe the same input signal at more than one setting of the vertical attenuator control. If the waveshape (not height) remains essentially unchanged, distortion is apt to be due to a fault in the vertical amplifier. (For this check, make sure the input signal voltage remains within the manufacturer's input ratings for the instrument.)

Signal tracing is a convenient approach to isolating the cause of overload. Inject an undistorted signal (from an audio oscillator, for example) as close to the CRT vertical deflection plates as possible. If the scope has provision for direct connection to the plates, use that; the trace will be small, but starting right at the plates will give you a more complete check. Then, work your way back toward the vertical input terminals, observing the trace each step of the way. (It will probably be necessary to reduce the test signal as you proceed.



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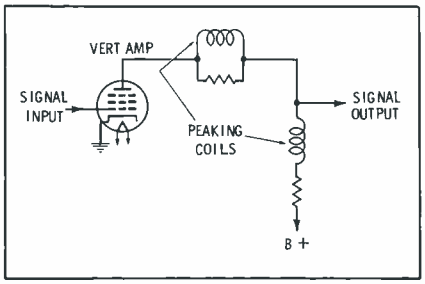

Fig. 4. Wide-band scopes use peaking coils to broaden the vertical response.

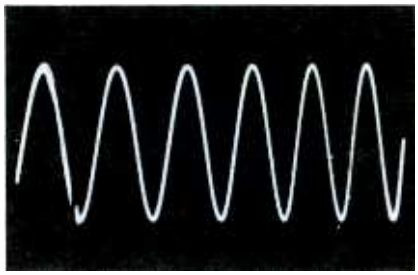

Fig. 5. Nonlinear horizontal sweep is demonstrated by uneven waveform.

so normal overloading won't be introduced.) When the waveshape on the screen becomes distorted, you've found the distortion-producing stage.

Another common problem in vertical amplifiers is frequency distortion, which may appear as a complete loss of high-frequency signals or as a reduction of waveform amplitude on the screen. It is most noticeable in the rounded corners of square waves, especially in those whose frequency is near the upper limits of the scope's bandpass. Again, don't confuse the action of a narrow-band scope with a true complaint; be sure you know the scope's *normal* response. Aside from gross changes in component values, the defect may lie in the frequency-compensating networks. These are generally peaking coils (and RC combinations) in the plate circuits of the vertical amplifiers—see Fig. 4. They normally keep amplifier response substantially flat over a broad range of frequencies (very much like peaking coils in TV video amplifiers).

Horizontal Amplifier

Similar in design to the vertical amplifier, this section of the scope is troubled most often by sweep nonlinearity. This type of distortion is easily recognizable: The trace is distributed unequally across the face of the tube. This fault is readily observed by introducing a sine wave into the vertical amplifier, and noting if the waveform is squeezed together or expanded near one edge of the trace—as in Fig. 5. Don't expect perfection; many good scopes display a small amount of horizontal nonlinearity in normal operation, but not enough to disturb the usefulness of the trace. If the sweep is so distorted that repairs seem necessary, the method of trouble isolation is similar to that for a vertical amplifier, except that a sawtooth injection signal is needed to give the most readily understandable results. To evaluate the output, simply display a single cycle of a sine-wave audio signal on the screen and carefully compare the width of the two half-cycles as shown in Fig. 6. Distortion of the sawtooth waveform causes unequal distances between the points where the sine wave crosses the base line.

Sweep Generator

If horizontal deflection is absent or nonlinear, the sweep generator may be at fault—especially if the horizontal amplifier operates normally when an external AC signal is fed to the horizontal input terminals. A fault that results in a totally inoperative sweep generator usually yields to conventional voltage and resistance checking. Causes of poor waveshape from the sweep generator, however, are best analyzed by actual observation of the sawtooth output—a procedure that introduces the need for a second scope. Check for the characteristic waveshape shown in Fig. 2. If necessary, components may be substituted in the sweep generator to make its output as linear as possible.

Closely connected with the operation of the sweep generator is the sync system. Its purpose is to assure a stable, motionless pattern on the screen. Usually, the sync pulse is a portion of the input waveform being tested, applied to the sweep generator so that a lock-in or synchronizing action results. Thus, any signal interruption between the vertical amplifier and the sweep generator tube could cause sync instability. A simplified schematic of these two stages in a typical scope is shown in Fig. 7.

There are rare cases of sync trouble which stem from external noise energy being induced into the scope's wiring, causing the sweep

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B Model 8C6PAS. Very shallow construction.

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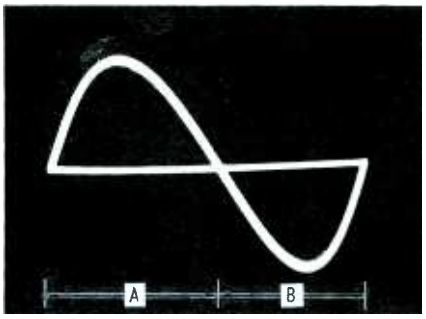

Fig. 6. Distortion of sawtooth sweep will produce unsymmetrical sine wave.

generator to trigger at the wrong time and making the trace jitter.

Curing such problems is usually a matter of suppressing noise by grounding the scope cabinet and installing line filters or shielding.

General Hints

There are some troubles—those in the power supply, for example—that can cause seemingly ambiguous indications. In such cases, try injecting signals from external sources to isolate the problem. In addition, here are a few hints which can help you pin down trouble quickly: Tighten all input terminals, as they have a tendency to loosen and cause partial or complete shorts. Replace input cables that have deteriorated with use. It's a good idea to place a drop of lubricant on the bearings of shafts that couple front-panel controls to potentiometers near the back of the cabinet.

There are certain adjustments within the scope that can become inaccurate, through normal use of the instrument, or simply from aging. A periodic touchup of these controls and adjustments can improve the performance of your scope considerably.

Some scopes have special settings of the sweep-range selector that automatically select the correct sweep frequency for viewing television horizontal and vertical waveforms. Internal adjustments permit setting the sweep rate so you won't have to reset the vernier control when switching back and forth from horizontal to vertical.

Input attenuators should be adjusted for best frequency compensation. Incorrect compensation often shows itself as a "turned-up" end on the sweep trace (with no input signal), or a thickening of the trace line near one end.

The low-capacitance probe may have an adjustment to set the exact attentuation ratio—usually 10:1. This is done simply by applying a sine wave directly to the scope, noting the height of deflection, inserting the LC probe between the sine-wave source and the scope, and adjusting the trimmer for exactly one-tenth of the original deflection.

The astigmatism control (most often an internal adjustment) works in conjunction with the focus control to shape the electron beam so it will illuminate a round spot on the CRT screen. To set the astigmatism control properly, kill all vertical and horizontal deflection in the scope, and alternately adjust the focus and astigmatism controls to obtain the smallest spot possible while keeping it round. A flat or oval CRT beam will distort some portions of the trace and make it difficult to analyze many types of waveforms. Caution: Keep the intensity low during this adjustment, or you'll burn the CRT face.

In DC scopes, special adjustments are provided to balance the vertical amplifiers so the trace will not shift up or down when you change the vertical attenuator (range) switch. You can balance these while observing the trace without an input signal.

Conclusion

An oscilloscope is one of the most versatile test instruments you can own, and its usefulness can be multiplied through the use of various accessories—voltage calibrators, special probes, electronic switches (see January *Notes on Test Equipment*), and other devices. By always keeping your scope in an excellent state of repair, you'll be able to utilize its capabilities to the utmost. ▲

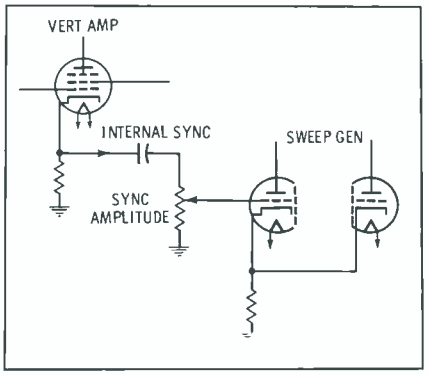

Fig. 7. Sync signal is coupled from vertical amplifier to sweep generator.

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NOTES ON TEST EQUIPMENT

by Forest H. Belt

Power With Adjustable Tap

Fig. 1. Adjustable bias tap is special feature of this transistor power supply.

Some transistor radios use a dual battery supply that furnishes a specific bias voltage in addition to the main operating voltage. An adjustable bias tap, to accommodate various receivers of this type, is a special feature of the Model EC-3 transistor power supply (Fig. 1) by Electro Products Laboratories of Chicago.

Specifications are:

1. *Power Required—117 volts AC; 50-60 cps.*
2. *DC Output—From 0 to 24 volts, continuously variable; up to 100 ma continuous load, 150 ma intermittently; bias tap from 0 to 7 volts, continuously variable.*
3. *Ripple—Less than 1.5% at maximum rated load.*
4. *Panel Meter—Semicircular 2" slide-rule face; 5-ma sensitivity; plastic housing; current and voltage scales, 0-100 ma and 0-24 volts respectively.*
5. *Controls and Terminals—*OFF-ON *slide switch;* MILLIAMPS-VOLTS *slide switch for meter; large* INCREASE *knob to adjust main power-supply voltage;* BIAS ADJ *screwdriver control; red and black test leads to connect main power voltage; green test lead for bias voltage.*
6. *Size, Weight, Price—6½" x 5" x 3½"; 2½ lbs.; $19.95.*

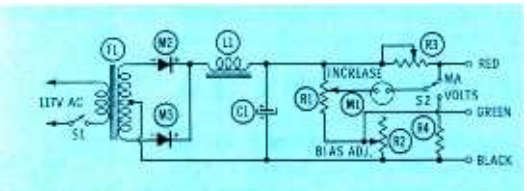

Fig. 2. EC-3 circuit is straightforward.

This compact power-supply unit is designed especially to comply with the exact battery requirements of various transistor receivers that use tapped battery arrangements to supply the base-bias voltage for certain transistors. Some require 1.5 volts DC, others need 2.8 volts, and still others use 3 volts. This bias voltage can seldom be obtained directly from an ordinary transistor power supply; even some of those which supply a bias tap merely center-tap the main output voltage, failing to supply exactly the correct bias. In the Model EC-3, however, a screwdriver adjustment on the front panel provides a means for setting the transistor bias tap at exactly the same voltage as provided by the battery which normally powers the set. This accuracy permits testing the transistor receiver under conditions more nearly resembling actual operation.

The Model EC-3 incorporates a dual stacked selenium rectifier in a very ordinary full-wave rectifier circuit, using a transformer for complete isolation from the power line (see Fig. 2). A choke-input filter network provides better regulation than the usual capacitor-input systems. The filtered DC output voltage is developed across two controls, connected in series across the filter capacitor. The values of these two controls have been chosen so that as much as one-third of the total voltage can be applied to the bias tap. Bias control R2 is connected as a rheostat, so it controls the total resistance between the main output control R1 and ground; as a result, adjusting the bias control can affect the voltage picked off by the slider of control R1. Thus, when the bias-control setting is changed for any reason, it may be necessary to readjust the main output control to maintain the correct output voltage.

The metering circuits consist of meter M1, switch S2, control R3, and resistor R4. The SPDT slide switch connects the meter across R3 for measuring current being drawn by the device (usually a transistor radio) connected between the red and black output leads; to measure output voltage, M1 is connected in series with R4, which serves as a multiplier resistor. No provision is made for measuring the bias voltage at the green lead; if the user desires to know the exact value of bias voltage being applied to the set under test, a separate voltmeter must be connected between the black and green leads.

The internal layout of the Model EC-3 is shown in Fig. 3. Calibration control R3 is shown quite plainly, mounted at the rear of the meter case. R3 affects only the current readings of the meter, and shouldn't be adjusted unless you are familiar with meter adjustments. The effects of setting this control can be determined with the simple test setup in Fig. 4, which we used to check the accuracy of current readings in the unit we tested. An accurate VOM is merely set for readings up to 100 ma, and compared with the reading indicated on the meter of the EC-3. Any error can be corrected by varying the screwdriver adjustment of R3.

We found that, since controls R1 and R2 interact, the best procedure for connecting a transistor radio to the EC-3 is as follows: Set both bias and output controls for minimum voltage — their maximum counterclockwise positions. Connect the radio being tested to the red and black leads; if a bias connection is required, also connect the green lead. Using a separate voltmeter as an indicator, adjust the screwdriver control R2 for correct bias—before turning on the radio. Set the output voltage to whatever value is required, as indicated on the EC-3's own meter. Then turn on the radio, and note any change in either output voltage or bias. It may be necessary, in a few cases, to slightly readjust the bias output, in which case it will also be necessary to readjust the main output control. These latter adjustments are needed whenever the current drawn by the circuits of the transistor radio is sufficient to cause a significant voltage drop in the controls of the Model EC-3.

In a few transistor sets, most of which contained very little decoupling of their own, we noticed a slight hum when powering them from the Model EC-3. In no case was this hum sufficient to

Fig. 3. Screwdriver control sets meter.

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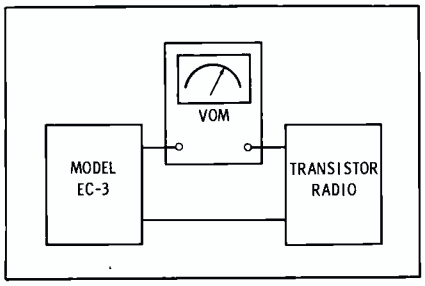


Fig. 4. Test setup for checking meter.

prevent normal servicing procedures, but we had to give it due consideration when servicing audio problems in receivers.

We also found we could use the Model EC-3 as a bias box for television alignment. However, in a few sets that didn't have much filtering on the AGC line, it was necessary to add a 1000-mfd, 10-volt capacitor across the output of the EC-3. If this filter was omitted, we noticed traces of hum and pulling wolud develop in the television picture.

Similarly, when the Model EC-3 is used to clamp an AGC line for isolating AGC trouble, it would seem advisable to use the extra capacitor. This recommendation is made because a clamp-voltage source must have a very low internal impedance to swamp the impedance of the AGC line. The added high-value capacitor effectively lowers the internal impedance of the EC-3 and produces the desired effect on the AGC.

Thorough Transistor Tester

For the serviceman who prefers to test transistors under closely controlled operating conditions, the Heath Model IM-30 serves the purpose quite satisfactorily. The unit is shown in Fig. 5, with all the controls and terminals clearly visible.

Specifications are:

1. *Power Required—Seven 1.5-volt size D batteries; provision for supplying specific test voltages from external sources.*
2. *Transistors Tested—Both signal and power types; triode and tetrode transistors, in universal socket.*
3. *Additional Facilities—Diodes can be tested; external power supply connections permit testing beyond capability of internal supplies.*
4. *Tests—Shorts; transistor identification (by noting effects of certain functions); collector current; base current; leakage current (Icbo and Iceo); DC beta or alpha; forward and reverse current in diodes; in addition, AC current gain, transconductance (DC and AC), and base or collector resistance (DC and AC) can be determined by calculation.*
5. *Panel Meter—Face size 3½"; rests at zero center; sensitivity 10 ua to either side of zero; 5000-ohm movement; scales 15-0-15 and 50-0-50.*
6. *Controls and Terminals — Rotary* POLARITY *switch (contains* OFF *position); rotary* COLLECTOR VOLTAGE *and* COLLECTOR CURRENT *selector switches; rotary* LEAK VOLTAGE *and* LEAK-BASE CURRENT *selector switches;* BIAS *potentiometer;* BASE CURRENT, GAIN, COLLECTOR VOLTAGE, COLLECTOR CURRENT, LEAK VOLTAGE, SHORT TEST, Iceo LEAKAGE, *and* Icbo LEAKAGE *lever-action test switches;* GAIN *selector dial;* HIGH-LOW GAIN *slide switch;* INTERNAL-EXTERNAL BIAS *slide switch; three transistor test terminals; universal transistor test socket;* EXTERNAL BIAS, EXTERNAL COLLECTOR VOLTAGE, *and* EXTERNAL LEAK VOLTAGE *input terminals.*
7. *Size, Weight, Price—5½" x 10¾" x 10¼"; 8 lbs; $54.88 kit.*

The Model IM-30 can be used to test transistors under simulated operating conditions, because the operator can choose collector and bias voltages to fit any desired circuit arrangement. The instrument allows testing transistors of unknown characteristics, either for a mere "good-bad" operating indication, or for more detailed alpha or beta gain readings. The unit even permits a rapid test for shorted or leaky junctions, so the user can quickly discover a defective transistor or diode.

Like any lab-type tester, the IM-30 takes more time and understanding in its use than a simple "quick-check" instrument, but the test results are more comprehensive and thorough. An analysis of the various tests will give you some idea how the several controls operate, and demonstrate the versatility of the instrument.

In testing an unknown transistor, the proper setting of the POLARITY switch can safely be determined by trial and error. Since PNP transistors considerably outnumber NPN types, time will be saved by setting the switch for PNP to start most tests unless the transistor is definitely known to be an NPN type. With an unknown unit, a quick collector-current test at zero bias will indicate whether the transistor is NPN or PNP. If a shorts test shows that the transistor isn't defective, a zero-bias current test will normally result in no collector current. If collector current does flow at zero bias, it is an indication that the POLARITY switch must be set to the opposite position. Another indication that the polarity switch is set for the wrong type is a decrease in collector current when the BIAS control is advanced.

The tests are performed by merely pushing one of four lever-type switches into the proper position. However, the various rotary selector switches set the conditions of each test. For example, the COLLECTOR VOLTAGE knob (Fig. 6) selects a collector test voltage from the internal batteries, at the same time connecting the proper metering resistors to enable the voltage to be measured by the panel meter. Further rotation of the same selector switch enables the user to feed up to 50 volts DC into the tester via an external terminal pair, and connects metering resistors to measure the actual input voltage applied to the collector.

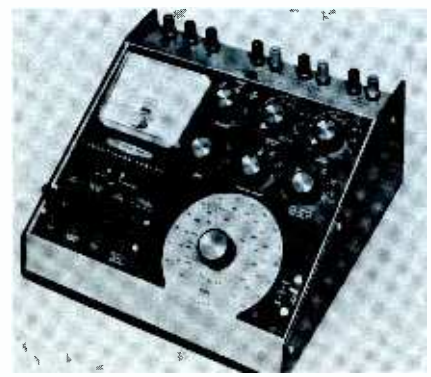


Fig. 5. Laboratory-type transistor tester evaluates semiconductors thoroughly.

Fig. 6. Inner numbers show meter scale.

The SHORTS test is made at a low collector voltage, usually at 1.5 volts DC. The meter (with proper shunts and multipliers) is automatically connected in series with the collector-emitter circuit and the collector-voltage source. Any movement of the panel-meter pointer indicates a shorted transistor, and eliminates the need for further testing.

The Iceo (collector-to-emitter) leakage test is very similar to the test for shorts, in that the meter is connected in series with the collector-emitter circuit and the base is left open. However, in this test a selector switch chooses the meter range (in ua or ma) so the leakage current can be read directly on the meter. For safest operation, we found it best to start with the LEAK switch set for maximum current reading—1.5 amp. Thus, if the leakage happens to be excessive, there is no danger to the meter movement. The LEAK VOLTAGE switch selects the voltage that will be applied to the transistor junction being tested. This switch chooses from 1.5 to 9 volts DC from the internal batteries, or sets the meter to indicate the amount of test voltage being fed into the input terminals from an external source—up to 150 volts DC.

The Icbo (collector-to-base) test is made in the same manner, except for moving the appropriate lever switch to the Icbo test position. The panel meter is connected in series with the collector and base. The LEAK switch—which sets

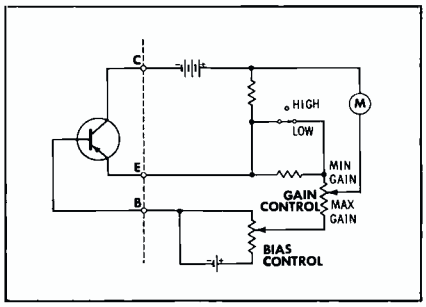


Fig. 7. Simplified diagram of gain test.

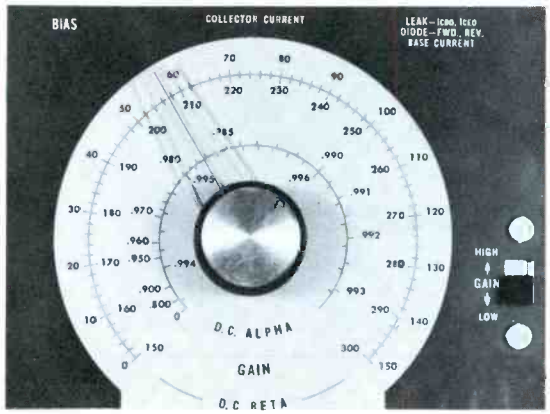


Fig. 8. Gain dial includes two scales.

the meter range—is usually turned to minimum, because the leakage in a good transistor is very small. Again, however, starting at a higher switch setting will protect the meter movement.

Collector current is used as the basis for setting up the gain and base-current tests. The COLLECTOR VOLTAGE selector is set for the desired test voltage, depending on the ratings of the transistor. When the proper lever switch is pulled to the COLLECTOR CURRENT position, the meter is connected in the collector circuit. The bias control is started at the minimum position, and slowly advanced while noting the collector-current reading on the panel meter. If the transistor is normal, the meter reading should be in the direction indicated on the scale for the transistor type, and should increase as the bias control is advanced.

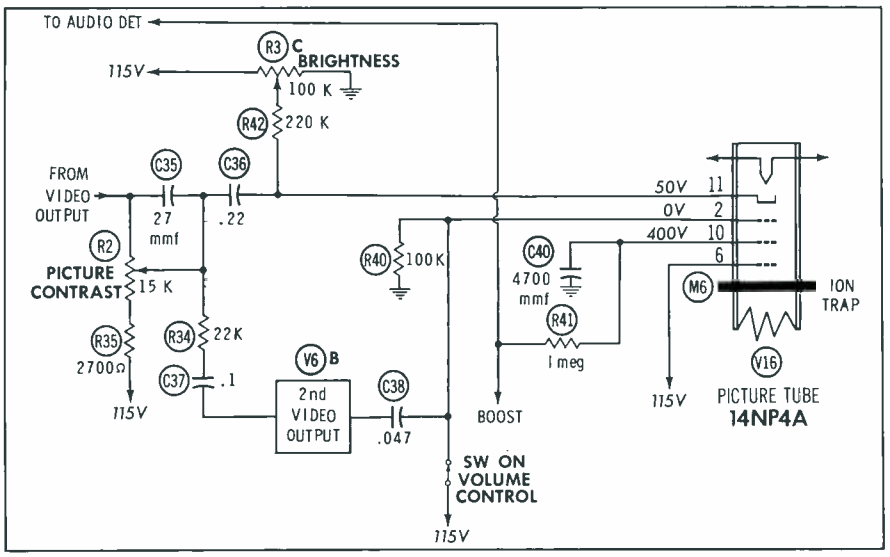
For checking the gain of any transistor, the bias is set so the collector current is 5 ma. If this requires a high setting of the bias control, the collector voltage is increased to the next step and the bias is readjusted for 5 ma of collector current. When the GAIN test switch is pulled, the circuit looks like the diagram in Fig. 7. The GAIN control dial is connected into the bias and metering circuit. When it is adjusted to cancel out the 5 ma of collector current (a process called *nulling*), the gain in terms of either DC alpha or DC beta can be read directly from the dial markings. If the gain is more than 150, the HIGH-LOW GAIN switch can be set to HIGH and the beta read on a 150-300 scale—Fig. 8.

We found that, with careful adjustment of the instrument controls, we could obtain test results comparable to those found with our lab tester. There's an important point to remember, however, when evaluating transistors for gain: The actual measured gain may vary with the exact conditions chosen for measurement. Like tubes, some transistors exhibit the characteristic of showing different gain at different bias settings; as a result, base bias and collector voltage will affect the gain reading of any given transistor, with bias showing the most pronounced effect.

As pointed out earlier, using the Model IM-30 requires more time than operating some types of transistor testers, but the quality, dependability, and informative nature of the results certainly justify the added effort. ▲

THE TROUBLESHOOTER

answers your service problems



CRT — Maybe . . .

In a Westinghouse Chassis V-2311-45 (covered in PHOTOFACT Folder 355-15), I am having picture-overload problems. At a normal brightness setting, the picture and sound both distort as the contrast control is advanced. At a normal contrast setting, overloading increases as the brightness control is advanced. The set sounds and acts like a victim of AGC trouble, but clamping the AGC line has little effect. When I use a test CRT instead of the original, the set seems to operate satisfactorily.

ELMER F. SHUE

Towson, Md.

It is entirely possible you are faced with a defective CRT. Sometimes a gassy CRT will cause symptoms such as you describe. However, before condemning the CRT, I'd suggest you measure the voltages around the picture-tube base and check components such as R40, R41,

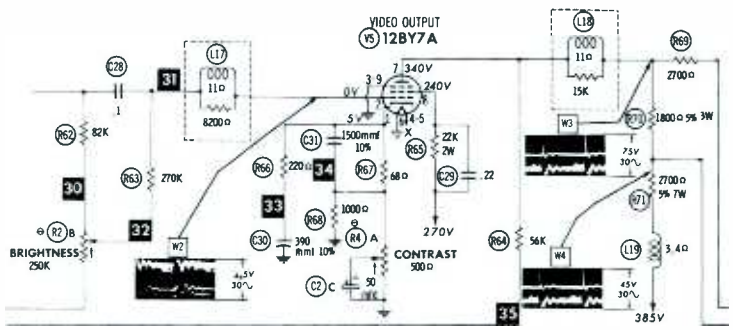
COLOR COUNTERMEASURES

Symptoms and service tips from actual shop experience

Chassis: RCA CTC9

Symptoms: Blooming raster; poor focus; brightness control has little effect.

Tip: Before looking for trouble in the horizontal and high-voltage circuits, measure the plate voltage of the 12BY7A video output tube. You may find it approximately 100 volts low. If you do, check R71—the 2700-ohm, 7-watt plate resistor. This component has increased in value in some of these chassis, shifting the cathode voltage on the CRT. This causes the CRT current to increase, overloading the high-voltage supply. These symptoms could be misleading, for if you measure the high voltage you'll find it lowered to approximately 19 kv, while it should be 23.5 kv.



R42, C36, C38, and C40.

Is video IF alignment okay, and is video detector diode M2 in good condition? Either of these factors could contribute to the overloading condition.

Voltages for V7 (the audio detector) and pin 10 of the CRT are both taken from the B+ boost line. Since both sound and picture are affected, you might want to investigate to see if improper boost voltage is contributing to your problem. If so, some fault in the horizontal output stage may be causing the trouble.

Voltage Clue?

I am servicing a Silvertone Model 9156 (PHOTOFACT Folder 4-26-2) which has critical vertical hold. The various B+ source voltages are 10 to 20 volts lower than shown on the schematic, and I have not been able to increase them by replacing the rectifiers and filters. One voltage that really seems out of line is the 80-volt reading at the plate of the video output tube—only a little more than half of what it should be. I can see how an abnormal voltage here might affect the sync signal, but cannot find anything wrong with the plate circuit.

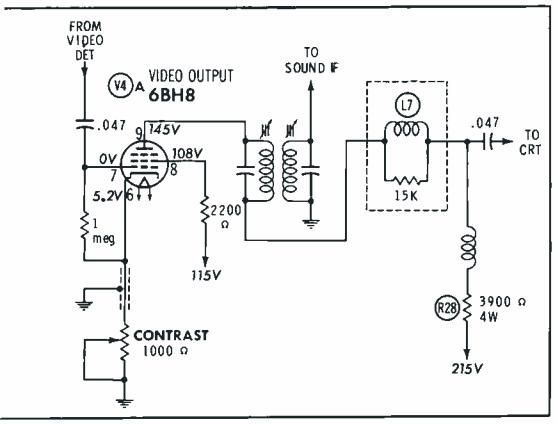
W. MATZ

Reading, Pa.

A reading of 80 volts may be normal, if the reading was taken with the contrast control turned all the way up. At this extreme setting, the output tube is virtually at zero bias, and a sharp drop in plate voltage can be expected.

If the plate voltage is abnormally low at all contrast levels, carefully recheck for an open L7 or an increase in value of R28; either condition could increase the voltage drop across the plate-load circuit, thus lowering the plate voltage. As you have suspected, a trouble of this nature could distort the sync pulses in the video signal, and could account for touchy vertical hold.

In case a thorough check of the video output stage turns up no defects, there could still be trouble in the front-end, AGC, detector, or sync circuits. Your best bet is to scope the signals all the way from the video detector to the input of the vertical multivibrator, looking for "punched" or compressed vertical sync pulses. Once you discover where the distortion is first appearing, further troubleshooting shouldn't be too difficult.



Service Sold

(Continued from page 18)

thing wrong with that picture within a week if the power of will or imagination can do it. And Jim will hear about it. It may be only ignition noise from passing cars, which she'd never notice except for being unhappy; he'll never convince her it had always been there. Or it could be any of a dozen other complaints we've all heard about.

But Mrs. White will endure much worse than minor traffic noise and never complain, until it's time for another call; she's convinced that Earl has thoroughly checked her TV. He pointed out to her that the picture wasn't quite as crisp as it should be until the set warmed up, due to an aging picture tube; however, he gave her assurance that it could last awhile yet. He noted the fault on her bill, and on his own copy for future reference (Fig. 1), saying, "If the tube begins to get worse, call me! I may be able to give it a little boost." This kind of talk is welcome, because people like to know you are going to give their receivers the best of care.

On the same call, Earl also noticed a little bit of snow in the picture. His experience told him it could easily be eliminated; but he wondered to himself, "Will she want to spend extra money now?" If he had been in a home where money is no problem, he could have simply pointed out the snow, suggested a new RF amplifier tube, obtained quick approval, and gone on from there. But Mrs. White is a widow and pensioner; and since the old tube appeared to be good for another six months or so, Earl figured she'd probably prefer to wait till the next call for a new one.

Here's how he explained the situation: "Mrs. White, these little flecks of snow are caused by a tube which is not quite as *spry* as it used to be, but it may last quite a while yet. Shall we try to make it last, or would you rather have me put in a new one now?" The decision is hers, so she'll be happy with it—and now she knows all about snow.

It's amazing how far a little sympathetic discussion will go. Earl and Mrs. White worked together, taking care of her set. They're a team! You can bet he'll be called next time.

New Customers

Remember when you were called to a new customer's home and found nothing wrong but the brightness control turned down? If you charged her for just turning a knob, you're a dog! If you didn't, she would be grateful, but might feel so foolish she'd hate to call you again. You couldn't win. Or could you? Look:

How often have you seen a set that doesn't urgently need repairing, but could stand to have one or more old tubes replaced, as preventive maintenance? Installing a new 5U4, for instance, could pep up the performance of the whole set a little, or the picture could be made clearer by replacing a video amplifier tube that's not fully up to par.

So, when you find that brightness control turned down, stop and think things out. Then take the back off the set, get it going, and see that the customer gets her money's worth of adjusting, cleaning, and advice! You'll avoid the danger of making her feel stupid, and the TV can be perfectly adjusted and actually improved. Of course, you get paid—

Latest Jackson Tube Test Data

Model 648					Model 658								
Tube Type	Fil.	D.	E.	Plate Test	Tube Type	Sec.	Heater	Heater H-K	Heater P-G	Plate	Grid Test	Heater Current
2AS2◆	2.5	— Nor. -S switch in S position	9	42XZ	2AS2◆	D	2.5K	——	0	15U	VX	
3AT2◆	3.0	— Nor. S switch in S position	9	42XZ	3AT2◆	D	3.0N	——	0	16U	VX	
6DZ4	6.3	A23S	A17	38XY	6DZ4	T	6.4J	125	a37	12S	15WY•	
6GF7◆	6.3	A12A	AC67	50XZ	6GF7◆	T	6.4L	124	ac67	34R	10XY•	
		123	AC58	22Z		T	6.4L	123	ac58	18R	50VY•	
6GW5	6.3	A23S	A17	16XZ	6GW5	T	6.4J	125	a37	16R	7WY•	
SUPPLEMENT TO LATEST ROLL CHART 648-27 658-6												

and, equally important, you get called next time.

Of course, if the customer is a little old lady whose set you just fixed last week, and it doesn't need a thing, you carefully explain about the brightness control (again), assure her you were going right by her house anyway, and go on without a fee (except maybe a cup of coffee and a homemade doughnut). The neighbors will hear about "that nice boy," if you handle the situation right.

This is preventive maintenance, not just for the customer's set, but for the customer as well. You *build good will,* and by taking a few extra minutes, you may spot something that could prevent a callback from occurring within a short time.

Old Faithful

Another rousing problem with customers is the aged TV. They are sometimes bad business to fix—worse to turn down! However, you're already on the job, and you're going to lose a fee—and perhaps a customer—if you decline to fix the set.

When a customer says, "Why, we've only had this set a few years!" it takes a lot of diplomacy to tell him the set should be junked. There's no place here for a bull in a china closet! No, you've got to gamble a few minutes' time to find out if the set can be fixed easily this time, or if the trouble is really bad.

If there is a dead picture tube or burned-out transformer, the high cost of repairs will compel the abandonment of the set without further question. If you *can* get it going, don't just pack up and leave; invest a few minutes in telling the owner the "facts of life" regarding the old set. As clearly and diplomatically as possible, get across the idea you'd like to guarantee there will be no more trouble for another year, but some of the other parts in the receiver are aging and could fail sometime soon. Suggest that it might be wise, if the set does begin to give trouble too frequently, to consider a newer model. You can work various similar ideas into your conversation: "There are many parts in a TV set that get old and brittle; then the insulation breaks down more easily, and troubles are apt to 'pop up' more frequently.

Of course you won't have trouble with the *new parts* we put in; *they* are guaranteed, and we use nothing but the best."

Make a note on the bill that you guarantee all your parts, but it may be advisable to consider a new set fairly soon if more trouble develops. And write it so the customer can read it!

Assure your customer that you'll do everything you can to keep the set going just as long as possible. While you're selling this idea, you're gradually implanting the realization that the end may be near for the old TV. You do this in such a way that you can't lose. If it does keep going (and old sets often will), you are a hero. When it quits, you're still a hero—you went down fighting, trying to save it. At this time, *you* can help with the task of selecting a new one.

Maybe it takes an extra 10 minutes to educate a customer so he will recognize the aging of his set. In this time, you can plant three important ideas:

1. Trouble can happen, and soon.
2. It won't be your fault.
3. Only new parts are guaranteed.

If you've done your selling sympathetically, you've kept a good customer, lined up a later sale, and headed off a callback. Preventive maintenance!

Some Other Situations

Let's consider some of the other problems that you, I, Earl, and Jim often run into: What about the TV owners who insist on testing all their own tubes? You *can* keep them as customers; some of them will fail to fix their sets, give up, and call you. It doesn't hurt to point out—if you can do it diplomatically—that $5 to $15 worth of tubes have failed to make the set work right. Be businesslike when you explain, technically: "It's a little more complicated than it seems. For instance, this tube may not work as a horizontal oscillator, yet it tests fine and may do well elsewhere. This 6V6 seems weak; yet, for the job it's doing, it's perfectly okay. Just this morning a customer bought a new 6X8 for the tuner in his set, and it didn't work as well as the old tube. In some sets we have to try several different tubes to get one that matches well. When the tubes in the high-voltage section are replaced, it may be necessary to reset some of the service controls; otherwise, you may get premature burnout of the new tube, or some other component." You can go on and on like this.

Sometimes, though, it's better to retreat gracefully: "I usually try to discourage my customers from trying to fix their own sets because I've seen so many expensive mistakes, but *you're* quite mechanically inclined. Anytime you need a little advice, give me a ring and I'll try to help you." Guess who gets called when the going gets tough.

Intermittents

Now, what about the biggest bugaboo of all—the intermittent? The minute you come near the house, it clears up! You could suspect your customer of "seeing things"—but you know better. Something happened! So what do you do?

Admittedly, trying to cure an intermittent in the home is tough; yet some kind of action is necessary, if only to please the customer.

If you can make heads or tails of the symptoms described, explain

to your customer that if it's a tube causing the trouble, it is probably "this one" or "that one," and the best bet to prevent two trips is to replace both of them. You can say, "They are both fairly old tubes, but I'm going to tuck them in the back of the set. If the defect returns, we'll have to take the set to the shop. However, we'll give you credit for the new tubes and put the old ones back in—if it's advisable." *And make a note on the bill.*

Suppose you can't make any sense out of the symptom described, or the same trouble could be caused by four or five different tubes. You should still take action. Try tapping all the tubes; get out your tube tester and check the likely prospects. You know that the intermittent isn't likely to show up—but it may. At the same time you'll probably find one or two "borderline" tubes—weak or gassy—and you should replace them. Your customer is pleased that you're doing something that looks intelligent. You've even improved your chances of finding the fault; the shakedown may make the culprit act up, or may cure it permanently (unlikely, though, with our luck). But you're frank with the customer: "We call this type of trouble an intermittent. We can't be sure we have corrected it; however, we have eliminated the possibility of bad tubes, and if the trouble should recur, we'll know we must take the set in for observation." Your customer feels you are honest and have tried hard, and chances are, the new tubes you installed produced a better picture.

If the symptom comes back, and you're called for a second look, it's wise to make a concession on the price of the impending shop job—unless you're a supersalesman, or your customer is exceptionally understanding. In any case, your customer has been prepared to expect the need for a shop job.

One general philosophy can be applied to all the many problems of keeping customers happy: We have to realize we are working with the customer's pride and joy. Many set owners are inwardly suspicious of servicemen, and this must be overcome by frankness—presented with a bit of sympathetic understanding. They will be truly grateful for someone they feel they can trust. A few minutes spent in explaining as much as a customer can understand of the problem in his set is time well invested.

Summary

Understand customer's viewpoints, so that you can head off misunderstandings. Educate them enough, in a friendly and sympathetic manner, so they will understand the problems involved. Put all vital information on the bill, so they can see and remember what went on. Let them know you understand *their* problems, and convince them *you want to help*. Give them a little showmanship; make sure they feel they are getting their money's worth.

Some of these approaches take time to develop, but you'll soon find many ways of heading off customer troubles when you start practicing "Customer Preventive Maintenance." ▲

If Regeneration

(Continued from page 29)

not open, a baffling situation will surely arise. For instance, there are cases on record in which the mixer stage in a tuner is involved in a regenerative loop, and the feedback can be stopped only by replacing the supply-voltage bypass capacitors (such as C18 in Fig. 5). If these have insufficient capacitance, the mixer can break into oscillation, although all capacitors are "good." It's advisable to use replacements with values twice as large as originally employed, to insure adequate capacitance even if the replacement should be at the low end of the value-tolerance range.

This type of trouble was especially prevalent in one production run of chassis using feedthrough-type bypass capacitors in the front end. Most of the chassis performed satisfactorily; however, a few in which "everything checked okay" had to be sent back to the factory with the complaint of oscillation on weak signals. The blame was pinned on insufficient total capacitance, due to "stacking up" of tolerances in individual feedthrough units. The problem was cured with a redesign order for larger capacitance values.

Another baffling capacitor trouble was brought to light by a complaint that the picture on a certain receiver disappeared whenever a station was tuned in by rotating the channel selector counterclockwise. Rotation in the other direction produced completely normal operation. Acting purely on a hunch, we bridged a capacitor across the RF branch of the AGC line, and the trouble disappeared. This was just another instance of cumulative tolerance effects, complicated by switching transients. An investigation of the AGC system showed that it was a bit "hot" with IF and RF voltages, which formed a standing-wave pattern along the lead. The expedient solution (it could not be called a design cure) required that the added capacitor be connected at a suitable point along the AGC line.

Make Proper Grounds

When a capacitor or other component is replaced in a 40-mc IF amplifier, be sure to observe the original grounding point and lead length. Otherwise, the "low end" of

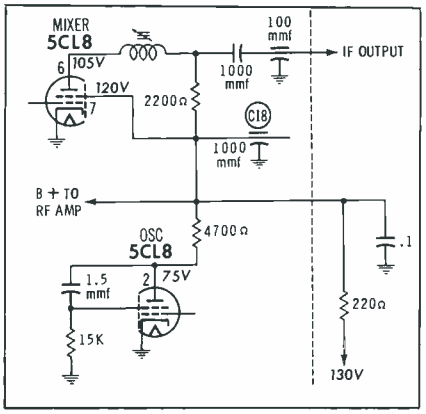


Fig. 5. Too-low value of C18 and other bypass capacitors can cause troubles.

a bypass capacitor, coil, or bias resistor may not be completely grounded for RF, although the ground connection is mechanically solid, and effective at low frequencies. Circulating RF ground currents or excessive lead inductance can then cause the stage to become objectionably regenerative at low bias levels.

Mixer grounding can be improved in some cases by connecting copper braid (which has a large surface area) between the tuner chassis and the main chassis. Supplementary service notes for a receiver sometimes specify this redesign measure, aimed at establishing an IF ground plane throughout the system insofar as possible.

Oscillator Precautions

Should the local-oscillator tube be disabled during IF alignment procedures? The answer may be either yes or no, depending upon the sweep and marker generators you are using. If both instruments have pure fundamental outputs, there is no necessity for killing the local oscillator—it will not introduce cross-beats that distort the curve shape and/or generate spurious markers. On the other hand, if the generators have substantial harmonic or feedthrough frequencies in their outputs along with the desired test signals, it is often essential to disable the local oscillator.

There is at least a small advantage in letting the local oscillator operate, if possible. When it is killed, the plate resistance of the mixer becomes much lower; in turn, the source impedance of the IF amplifier is made lower than normal. This change occasionally causes a slight distortion of the IF response curve. However, if problems due to cross-

beats arise, the lesser of the two evils is simply to disable the local oscillator.

Mixer TPTG Regeneration

The mixer plate operates at IF, while the mixer grid operates at RF; nevertheless, residual feedback in the mixer stage can cause regeneration. Since the grid tuning changes as the channel-selector switch is rotated, the regeneration fluctuates from channel to channel. This effect shows up easily in visual IF alignment as a change in the shape of the IF curve.

While it may not be practical to obtain complete mixer stability, the point is that the IF curve should remain acceptable on all positions of the channel-selector switch. In case it does not, you must investigate the mixer stage for a defect which is causing excessive feedback. Bypass capacitors are the prime suspects. Once the regeneration has been reduced to a suitably low level, make compromise IF alignment adjustments to obtain the best average curve on all positions of the channel selector.

Video-Detector Troubles

Self-interference effects in a TV receiver, such as those seen in Fig. 1, may be due to detector radiation rather than to marginal IF oscillation. The detector is a nonlinear circuit, so in addition to generating the difference frequencies between the picture carrier and the video sidebands, it generates sum frequencies. These are prevented from entering the video amplifier by means of a low-pass filter (C20, L6, and following circuitry in Fig. 6), but they can still escape via radiation and feed back into IF leads. Receiver manufacturers usually enclose the detector circuitry in a shield to pre-

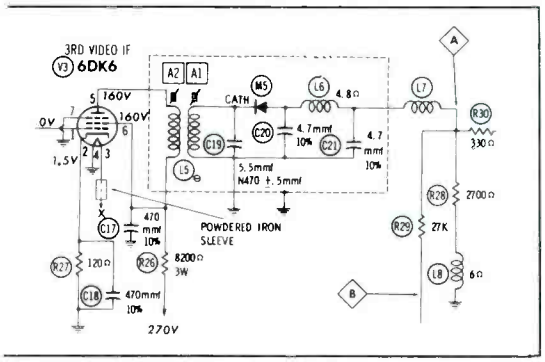


Fig. 6. Video detector circuits are usually shielded to prevent radiation.

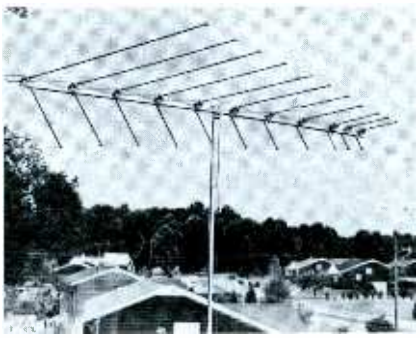
vent this problem. In the event someone has removed the shielding and discarded it, regeneration can shape up as a most perplexing problem.

Sometimes an IF can is utilized as a detector shield; in other chassis, a U-shaped structure is fitted over the detector circuitry. Still other chassis utilize a simple baffle plate between the detector and the IF section.

In analyzing regeneration problems, remember that the limiter and sound detector are also harmonic generators which can produce feedback interference. And of course, if some of the tube shields have been discarded, your problem is likely to be aggravated.

Tough, But Not Impossible

Regeneration problems are among the most difficult situations encountered in TV service; they surely separate the men from the boys! But, don't cuss the next regenerative chassis that finds its way to the bench—approach it confidently, because you have the know-how. Keep a cool head and calculating approach, and you will also have the can-do!



High-Gain VHF

The LPV (log-periodic vee) antenna was designed at the Antenna Research Laboratory of the University of Illinois, and is built under license by JFD Electronics. The log-periodic principle has been used in the design of space-satellite telemetry antennas, but hadn't been adapted to television antennas before the LPV.

The LPV combines log-periodic spacing of the driven elements with transposed-harness phasing to maintain an impedance match within certain limits over the entire low and high VHF bands. Thus, each succeeding element supplements the signal developed in the others, effectively causing a reinforcing of signals along the entire length of the antenna boom. The resulting gain of the unit, coupled with the narrow frontal lobe (aided by veeing the elements), make the LPV an excellent fringe-area antenna.

Under actual operating conditions, the LPV helps eliminate co-channel interference by stations at different points of the compass; the narrow frontal lobe works with the high front-to-back ratio (again, caused by the transposed harness) to select only those stations directly in front of the antenna. Trials have shown that a rotator is a necessity when stations are located in several directions from the receiver location, because of this high degree of directivity.

We used the LPV to receive FM stereo stations from outside their normal service area, with very little fading. With FM stereo, the need for a rotator seemed even greater, for the slightest shifting of the antenna direction hampered operation of the tuner. ▲

AM-FM Auto Sets

(Continued from page 27)

any of the five push buttons can be set up to tune in either an AM or an FM station.

Some unusual circuit features, indicated in the block diagram of Fig. 5, indicate an antenna-changeover section on the function switch, a separate AM oscillator stage (disabled for FM operation), and a two-stage audio section with a high-power DS-501 output transistor. The source voltage for the FM tuner is maintained at a constant 7.5 volts by means of a Zener diode regulator, and a portion of this supply voltage is used as fixed bias for a variable-capacitance diode in an AFC circuit similar to Fig. 2.

The AGC system for the FM section is an unusual voltage-doubler type (see Fig. 6). The diodes conduct on alternate half-cycles of the output signal from the second FM IF stage; the stronger the signal, the greater the positive charge placed on the AGC filter capacitors. Most of this AGC voltage is applied to the base of the FM RF amplifier, where it reduces the forward bias on this stage in proportion to the strength of the incoming signal. A similar voltage-doubler system, including two other diodes, develops AVC voltage for the AM RF and mixer stages.

Reception Problems

FM reception in automobiles does not pose any particular problems in areas of high signal strength, but fringe reception (beyond approximately 25 miles from the transmitter) presents some unusual conditions that are unfamiliar to most servicemen as well as to set owners.

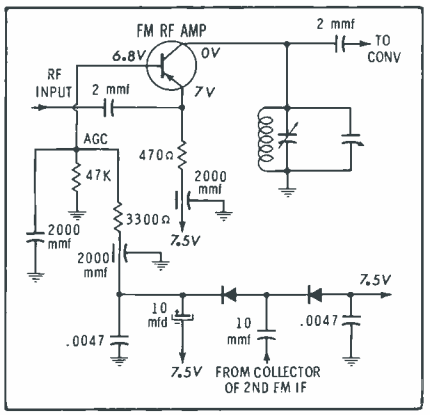


Fig. 6. Delco's AGC circuit uses two diodes operating as voltage doubler.

One of these problems is *flutter*. A moving car passes through a constantly changing pattern of direct and reflected signals, and the strength of the resultant signal fluctuates at a rapid rate. If the average signal level is too low to let the AGC system smooth out these fluctuations, the sound from the radio will fade in and out with a characteristic "swishing" noise. This symptom usually means only that the car is traveling out of the practical reception range of the station—probably nothing is wrong with the receiver.

Another problem, electrical noise, becomes troublesome when the station signal is too weak for effective operation of the FM receiver's noise - limiting circuitry. On busy highways, much of this noise originates from other cars and trucks in the vicinity, and little can be done to eliminate it. However, noise can be minimized—for maximum performance in far-flung suburban areas—by careful installation of the radio. Capacitors added to the car's electrical system for noise suppression should be of the special coaxial type needed for effective results at VHF, and resistance wire should be used for *all* high-tension ignition wires—not just the center lead to the distributor. Accurately peaking the alignment of the receiver, using proper test equipment, will also help to reduce noise by increasing the signal-noise ratio.

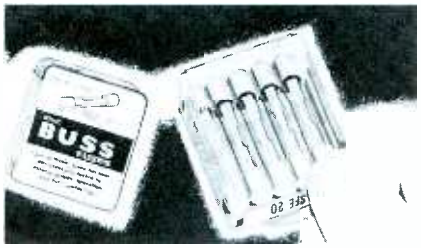
Troubleshooting

After the owner has used his radio for awhile, and has learned what performance he can expect from FM, he'll be able to recognize any signs of actual trouble. Most service complaints can be handled by troubleshooting the radio in the same manner as any other transistorized unit, since nearly all the circuits follow familiar design patterns. In the few unique circuits such as the capacitance-diode AFC system, most faults will yield to such common techniques as voltage checking and diode substitution.

By utilizing the experience and equipment you've already accumulated for servicing FM radios, transistor radios, and auto radios, you'll find you can take these new all-transistor AM-FM auto radios in stride. ▲

PRODUCT report

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

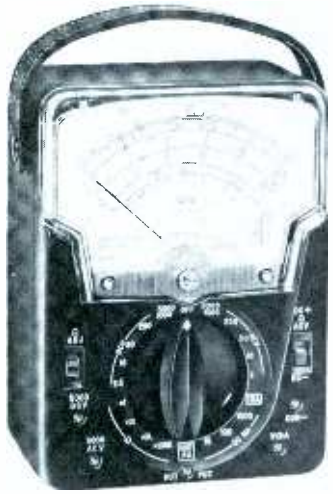


New Fuse Package (43B)

The new **BUSS** "Visual-Pak" has a clear plastic bottom with a sliding metal top. The reason for this combination is to make sure the top firmly grips the bottom and locks securely, thus eliminating the danger of the top coming off and spilling the fuses. The metal top has a flat end so that the type and size of fuses can be shown in large clear letters.

The design of the new "Visual-Pak" has all the advantages of the slide-cover metal box originated by Bussmann in 1927. It protects the fuses and yet is easy to open without spilling them.

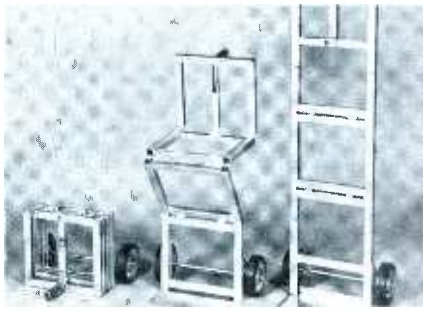
The new "Visual-Pak" fits all existing company display stands and channels because it has the same dimensions as the BUSS metal box. Many sizes of fuses are now being shipped in the new "Visual-Pak," and shortly all sizes and types will be shipped in this modern package.



VOM For Semiconductors (44B)

The first VOM designed specifically for semiconductor testing has been announced by **Triplett**. The new Model 630-L offers two special low-power resistance-measuring circuits on the x1 and x10 ranges. These ranges have been carefully engineered for safe testing in semiconductor circuits. The maximum test voltage is only .14 volts, compared to 1.5 volts in conventional ohmmeter circuits. This value is well below the breakdown voltage of transistors or other semiconductors. Maximum power applied to any semiconductor in the circuit under test is less than 420 microwatts.

Sensitivity is 20,000 ohms per volt for DC, and 5,000 ohms per volt for AC. Accuracy is 3% and 4% on the DC and AC ranges, respectively.



Folding Hand Truck (45B)

This heavy-duty folding hand truck, rated at 500 pounds capacity, is built by **Kom-pac Mfg. Co.** Only 13" high when folded, the hand truck unfolds to 44" for use.

A patented design principle allows the truck to fold into a compact lightweight package for easy carrying or storage. Rugged channel frames slide into a rigid locking position during use; a trigger release unlocks the slide mechanism. The space-saving design of the hand truck makes it an ideal item wherever space is at a premium—in small shops, in service vehicles, or in the warehouse.

Custom AM-FM Auto Receiver (46B)

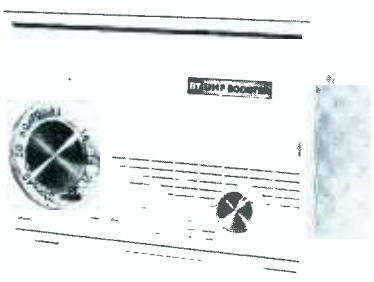
The Model SM751 AM-FM auto radio set, built by **Tenatronics**, can be either mounted under the dash or custom-installed in most automobiles. The compact unit measures only 2 3/16" high, 6 1/4" wide, and 6 7/16" deep. A special trim panel, for custom mounting in almost any car can be ordered separately or with the basic unit. No special antenna is needed; the set operates from the regular AM auto antenna.

The all-transistor receiver features FM sensitivity of 3 uv for 20 db quieting, four stages of IF on FM, audio power capability of 8 watts, AFC for FM reception, AGC, and manual tone control. At full 8-watt audio output, the Model SM751 draws only 1 amp from a 12-volt electrical system. The AM-FM function switch is conveniently located on the front panel, next to the lighted tuning dial. Furnished complete with mounting brackets and separate speaker, the set carries a suggested retail price of $99.95.

Transistorized TV-FM Indoor Antenna (47B)

An indoor antenna for color and monochrome TV, and for FM, has been designed by **Spirling Products Co.** Known as "TRANSISTAR" Model TR-11, it will receive TV and FM signals and amplify them up to 35 db. The unit is powered by a transistorized amplifier constructed on a printed circuit.

The unit comes packed in a colorful display box. Features include fine tuning and foldaway polished brass telescoping dipoles. Measuring only 9" x 7 3/4" x 2 3/4", the unit plugs into any AC line. The retail price is $29.95.



UHF Booster (48B)

An all-channel UHF booster—designed to bring UHF reception to scores of new communities—has been unveiled by **Blonder-Tongue Labs, Inc.** Called the "U-Boost," this new product provides

the B-T dealer with a complete line of UHF equipment. Easy to install on top of any ordinary TV receiver, it is styled to match the existing line of UHF converters.

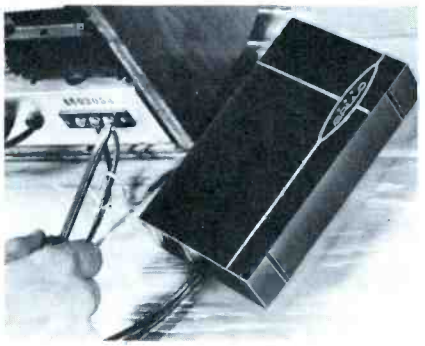
The new unit is expected to increase the UHF "profit zone" through its ability to bring UHF signals to areas that were formerly out of range. This will enable vast number of extra viewers to tune in the new UHF channels that are going on the air. List price of the "U-Boost" is $39.95.

New Speaker Design (49B)

A new, high-performance loudspeaker design — called "Alnisphere" — has been developed by **Oaktron,** in an extensive program to develop efficient speakers in standard sizes.

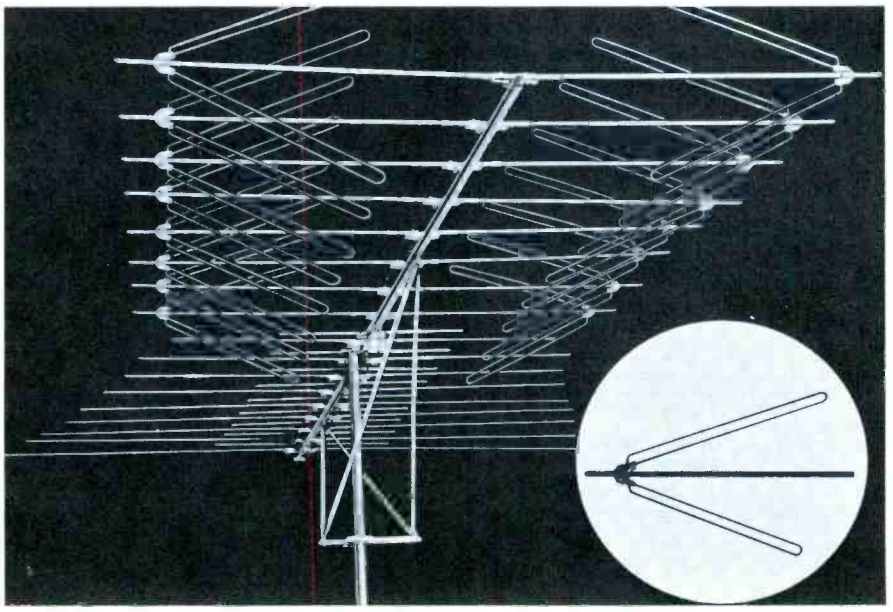
Now available in limited production is the Model 8HA8, which utilizes a heavy-duty Alnico-V magnet in a unique spherical configuration that results in greater efficiency and increased performance. This magnet shape concentrates the energy, makes flux density more uniform, and eliminates much of the stray flux leakage that is typical of some magnet designs.

Its dustproof mechanical assembly, efficient "Alnisphere" magnet, and aluminum voice coil all combine to provide an exteremely thin speaker profile (only 3") without compromising performance. This thin design allows it to be mounted flush within the confines of a standard 4" frame wall.



Compact Indoor Antenna System (51B)

A new indoor antenna system for noise-free FM reception in cities and most suburban areas is said to be the world's smallest FM antenna system. A product of **Gallo Electronics Corp.,** the FMS-101 Antenna System contains a built-in transistorized booster amplifier which rejects noise and interference automatically. The patented Gallo antenna is equally sensitive in all directions and once positioned does not have to be moved to receive different stations. List price is $29.95.



New TV-FM Antenna (50B)

A new, advanced version of the **Channel Master** Crossfire antenna, called the "Super Crossfire" Model 3607-G, provides up to 48% more gain than the earlier models. On FM, the new antenna delivers more gain than a five-element Yagi. This performance has been made possible by a new director system which combines low-band TV, high-band TV, and FM on the same director element. ▲

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2B. GALLO—Descriptive brochure on FMS-101, an FM antenna system with transistorized preamplifier, entirely contained within decorative 6½" x 3¾" x 1-3/16" case.

3B. JERROLD ELECTRONICS — 7-page catalog on TV-FM reception aids for the home, including mast-mounted preamps, UHF preamps, top-of-set UHF converters, amplified couplers, and other reception accessories.*

4B. JFD—Specifications and operating information on *Transis-tenna* and newly-designed, long-range LPV log-periodic TV antenna. Illustrated brochure showing entire line of indoor antennas and accessories for TV and FM.*

5B. WINEGARD — Envelope stuffer and *Factfinder* on complete line of FM and stereo FM antennas and amplifiers.*

AUDIO AND HI-FI

6B. ATLAS SOUND, Div. of American Trading & Production Corp.—Catalog No. 563 listing new products and complete line of speakers and microphone stands for public address, commercial, and industrial use; specifications on speakers included.

7B. DUOTONE—Illustrated sheet, "It's All Yours," showing gifts available to servicemen and dealers with their orders for 12 or more needles of their own choice.

8B. OAKTRON—"The Blueprint to Better Sound," an 8-page catalog of loudspeakers and baffles giving detailed specifications and list prices.

9B. PRECISION ELECTRONICS — Bulletin 101 describing popular Model 502M stereo tuner-amplifier, now offered at new lower price.*

10B. QUAM-NICHOLS—New 8-page general catalog of loudspeakers for commercial sound, hi-fi, automotive, and replacement applications.*

11B. SONOTONE—Specification sheet SAH-70 giving information on flexible, virtually unbreakable *Sono-Flex* phono needle.*

12B. SWITCHCRAFT — New Product Bulletin No. 129 describing color-coded phone plugs with cable clamp and plastic snap-on handles in red, black, and white.

13B. ZENITH—Technical information sheets on *Custom 2G Stereo Precision* and *Stereo Professional* automatic record changers for installation in component high-fidelity systems.

COMPONENTS

14B. BUSSMANN—12-page booklet (SFUS) listing replacement data on the entire line of Buss and Fusetron small-dimension fuses, including size, type, type of holder required, and list prices.*

15B. SPRAGUE—Latest catalog C-615 with complete listings of all stock parts for TV and radio replacement use, as well as *Transfarad* and *Tel-Ohmike* capacitor analyzers.*

16B. STANCOR—1963-64 catalog 1-1053, with specifications and illustrations for complete line of TV-radio replacement transformers and coils.*

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20B. ELECTRONIC CHEMICAL CORP.—Catalog listing chemical sprays for cleaning and lubrication in all types of electronic equipment.*

21B. YEATS—The new "back-saving" appliance dolly Model 7 is featured in a four-page booklet describing feather-weight aluminum construction.*

SPECIAL EQUIPMENT & SERVICES

22B. ATR—Complete descriptive literature on DC-AC inverters, ideal for operating standard 110-volt AC PA systems directly from 6-, 12-, and 28-volt battery systems.*

23B. CASTLE—How to get fast overhaul service on all makes and models of television tuners is described in leaflet, which also contains a comprehensive list of universal and original-equipment tuners.*

24B. ELECTRO PRODUCTS — Specification sheets giving full information on RB-500 and GFL power supplies.

25B. GC ELECTRONICS—Giant-sized catalog FR-65 contains 330 pages, forming the most complete listing yet published of new products and equipment offered by all company divisions.

26B. GREYHOUND—The complete story of the speed, convenience, and special services provided by the Greyhound Package Express method of shipping, with rates and routes.

27B. PRECISION TUNER—Information on repair and alignment service for any UHF or VHF TV tuner.*

28B. STANDARD KOLLSMAN — Brochure describing Model A UHF converter, using new 6DZ4 oscillator and nuvistor IF amplifier, and Model B converter, similar to Model A but omitting the IF stage.

29B. TERADO—Sheet depicting wide line of 60-cps mobile power inverters and several types of battery chargers.*

30B. 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; includes complete specifications on line of trucks.*

TECHNICAL PUBLICATIONS

31B. 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 programs, including preparation for FCC-license exam.

32B. HOWARD W. SAMS—Literature describing popular and informative publications on radio and TV servicing, communications, audio, hi-fi, and industrial electronics; including special new 1963 catalog of technical books on every phase of electronics.*

TEST EQUIPMENT

33B. B & K—Catalog AP20-R describing uses for and specifications of Model 850 *Color Analyst*, Model 960 *Transistor Radio Analyst*, Model 1076 *Television Analyst*, Dynamatic Model 375 VTVM, *V-O-Matic* Model 360 VOM, Model 625 *Dyna-Tester*, Models 600 and 700 *Dyna-Quik* tube testers, Models 420 and 440 CRT Tester-Reactivators, and Model 1070 *Dyna-Sweep* Circuit Analyzer.*

34B. HICKOK—Complete descriptive and operating information on Model 661 *Chrom-Aligner* standard NTSC color-bar generator.

35B. MERCURY ELECTRONICS — Catalog introducing new test instruments—Model 501 Component Substitutor and Model 301 3-in-1 Combination Tester—and giving information on full line of popular-priced servicemen's test equipment.

36B. SECO—Informative data sheet describing new Model 806 *Vari-Volt* light and heat control for applications up to 1000 watts.

37B. SENCORE — Special, newly released data on color test equipment, including the entirely new, low cost CG126 Color Generator, the CA122 *Color Circuit Analyzer*, and the PS120 *Wideband Scope*.*

38B. TRIPLETT—Catalogs displaying complete line of test equipment for servicing, and industrial meters for all purposes.

TOOLS

39B. BERNS—Data on unique 3-in-1 picture-tube repair tools, on *Audio Pin-Plug Crimper* that enables technician to make solderless plug and ground connections, and on *ION* adjustable "beam bender" for CRT's.*

40B. CHAMPION-DeARMENT — Literature listing quality line of servicing tools, featuring famous *Channel-lock* pliers.*

41B. ENTERPRISE DEVELOPMENT — Time-saving techniques in brochure from Endeco demonstrate improved desoldering and resoldering techniques for speeding up and simplifying operations on PC boards.

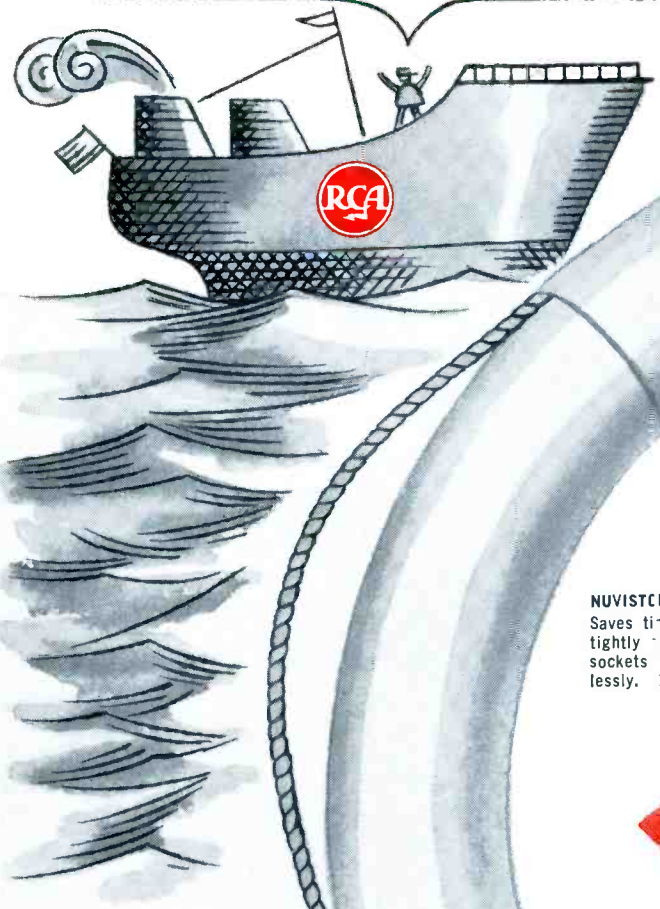
42B. XCELITE—Folder on 6" *Seizers* for holding and positioning wires, retrieving small parts, and dozens of other uses; shows two models (42H straight-nosed and 43H curved), both with serrated jaws and two-position snap locks.

***Check "Index to Advertisers" for further information from this company.**

Service Technicians ahoy!

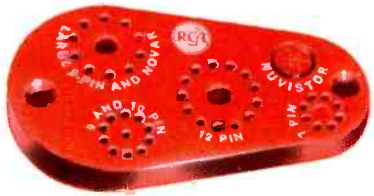
RCA to the rescue!

In electronic servicing, it's the little things that count . . . the minor problems that add up to a major loss of time. Now RCA answers the S-O-S of busy servicemen with 5 new service aids:



NUVISTOR SOCKETS:
Saves time-wasting socket-seeking. The two most wanted nuvistor sockets: For conventional mounting and stand-off printed circuits.
1A1382—conventional mounting.
1A1383—stand-off printed circuits.

NUVISTOR PULLER:
Saves time. Grips nuvistors tightly to ease them from sockets quickly and effortlessly. 1A1347



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