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PHOTOFACT

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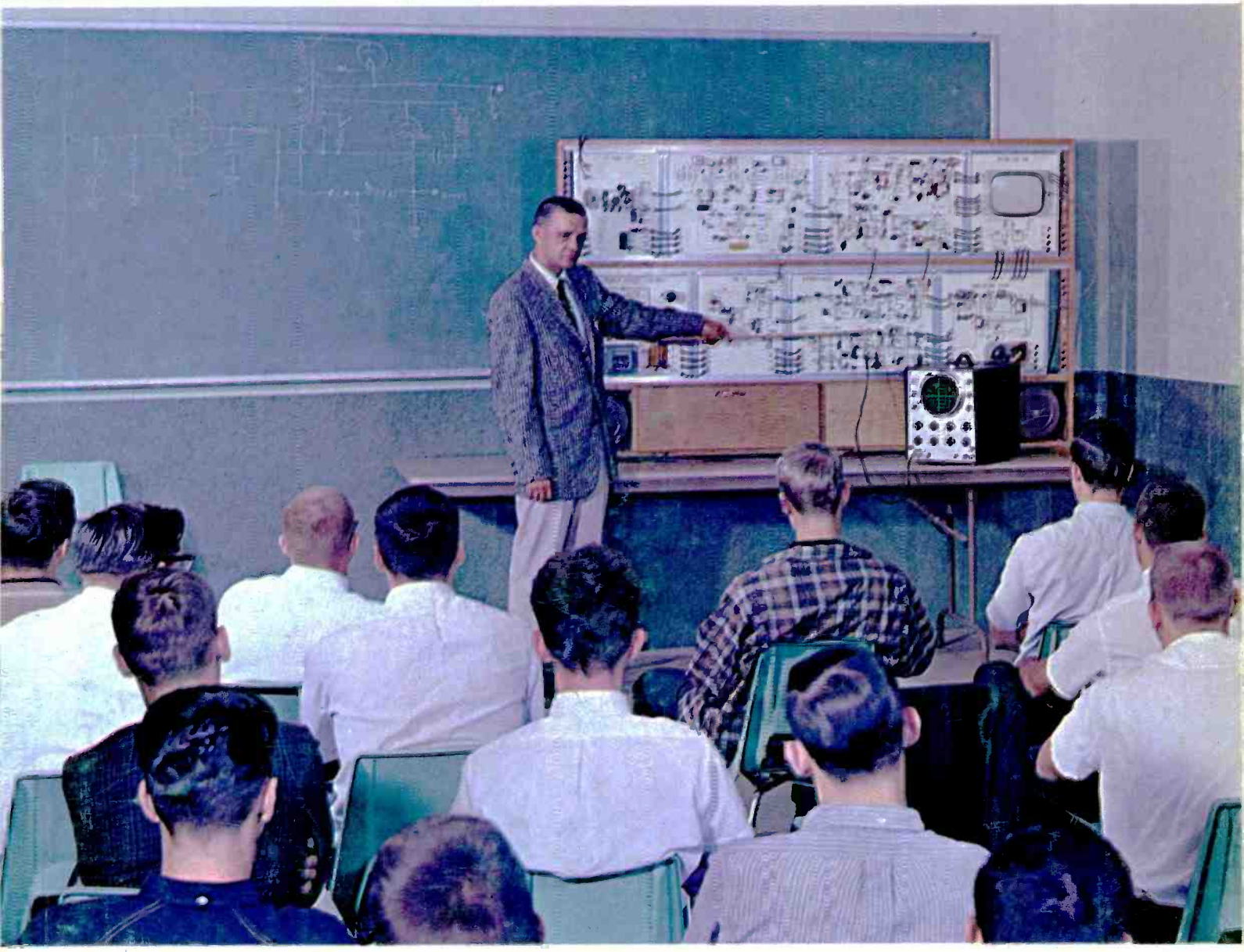
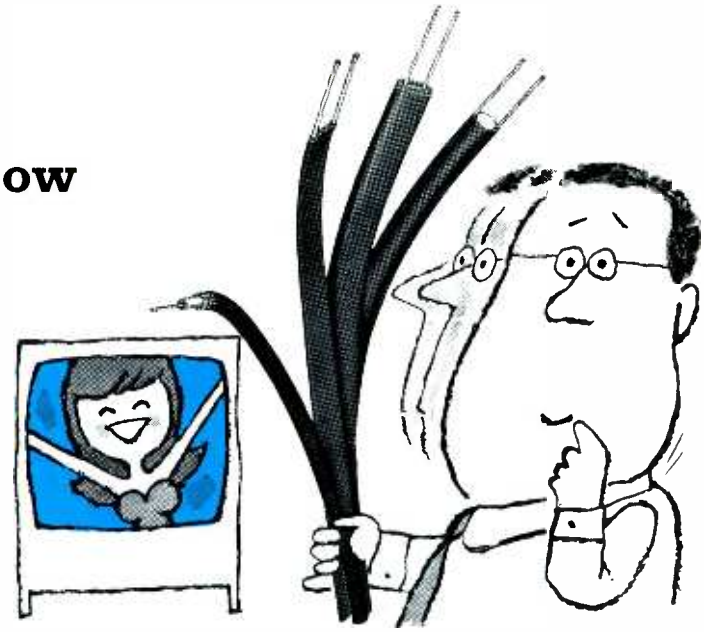


EMPHASIS ON TRAINING

- Training Systems for Modern Techs
- How Transistor Amplifiers Work
- Tracking Gray Scale in New Color Sets
- Solid-State RF Circuits
- Plus other features to study

What you should know about TV lead-in before you buy!



By Roland Miracle
Engineer, Electronics Division
Belden Manufacturing Company
Richmond, Indiana

There are four basic types of cable for TV lead-in on the market today—flat ribbon, tubular, encapsulated, and coaxial. The advantages and disadvantages of each type should be understood before making an installation.

Here, Roland Miracle, electronics engineer at Belden Manufacturing Company's Richmond plant, answers questions regarding the suitability of the 300-ohm twin-lead types and coaxial cable.

Q. *What is the best TV lead-In for most applications?*

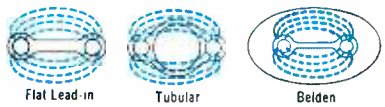
A. The choice is not simply between coaxial cable and twin-lead. This is because there is a great deal of difference between old style 300-ohm line and encapsulated 300-ohm line. Ordinary ribbon lines will give troublesome and inconsistent performance in color or UHF installations.

Flat Ribbon Tubular Encapsulated

Q. *What are the differences In 300-ohm line?*

A. Flat ribbon and tubular 300-ohm line perform well at UHF frequencies *only* when they are free from all traces of surface deposits. When these lines encounter dirt, rain, snow, salt, smog, fog or industrial deposits, problems arise. Impedance drops abruptly, and attenuation soars. Ghost pictures result.

Encapsulated 300-ohm line features a low loss cellular polyethylene protective jacket which keeps all surface deposits out of the critical conductor area—regardless of weather conditions. This type of lead-in is made by Belden under the name of "Belden All-Weather Permohm* Lead-In" and is highly recommended for UHF and color installations.



Flat Lead-in Tubular Lead-in Belden All-Weather Lead-in

Q. *When and where are coaxial cable installations best?*

A. Coaxial cable systems are preferred where strong interference signals are present. This will usually be an urban location near a hospital, an industrial complex, or other such locations where extreme interference is radiated.

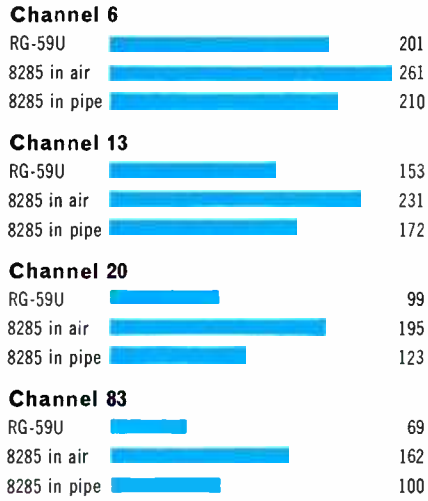
Q. *Are the transmission characteristics of coaxial cable superior to 300-ohm twin-lead?*

A. No! The attenuation of TV signals through coaxial cable is *much* greater than through 300-ohm twin-lead. This higher loss reduces the signal delivered to the TV receiver and makes booster amplifiers necessary at VHF frequencies in all but high strength areas. Coaxial cable systems also require two matching transformers—one at the set and one at the antenna—because all coaxial cables are unbalanced lines and normally have a 75-ohm impedance. TV antennas and receivers are normally designed to use balanced lines having 300-ohm impedance.

Q. *How does the attenuation of Permohm compare with coaxial lead-in?*

A. The chart in the next column compares the values of Belden Permohm (No. 8285) with a typical coaxial line (RG-59U) under similar conditions. Note, how even when enclosed in metal pipe, the encapsulated line delivers a stronger signal than an equal length of coaxial cable under the same circumstances. The difference is even more apparent at UHF frequencies.

300 MICROVOLT ANTENNA SIGNAL



Q. *What about cost?*

A. A coaxial cable installation is much more expensive. The cost of a typical 75-ft. coaxial lead-in installation is about $20.00 compared to $7.00 for the best *encapsulated* 300-ohm lead-in. This extra cost results from the higher cost of the coaxial cable plus the extra cost of the two matching transformers. Also, coaxial cable requires carefully made electrical connections which are time consuming and costly.

Q. *Does Belden make all types?*

A. Yes. Belden offers the most complete line of TV lead-in, including coaxial cable. However, because of the many superior transmission characteristics of Permohm 300-ohm line, it continues to be the best lead-in for 90% of all TV installations. Ask your distributor about Belden Permohm.

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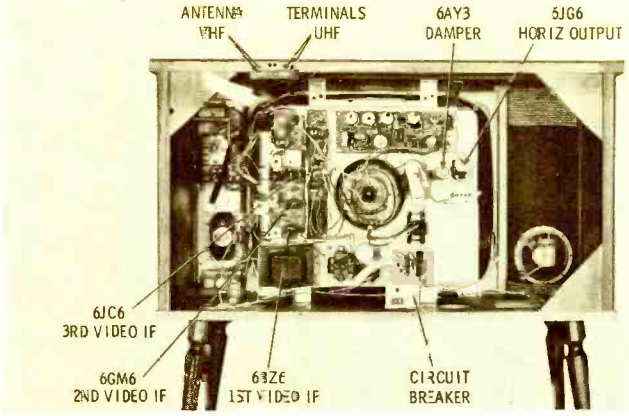
Circle 1 on literature card

Curtis-Mathes



Curtis Mathes Chassis TV19-2

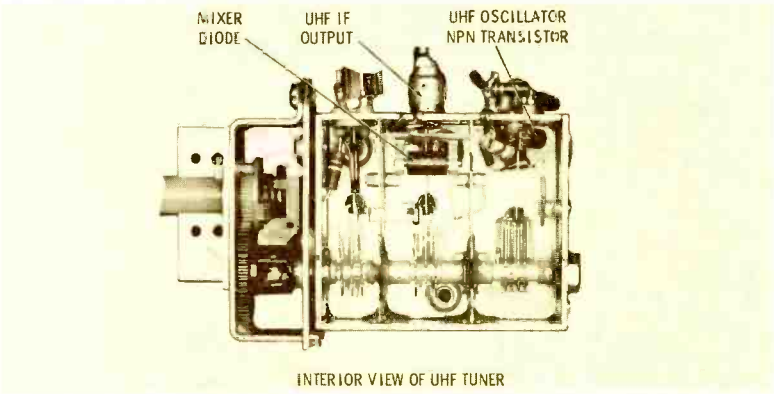
The 23″ console TV shown here contains a bonded 110°, 23FHP4 picture tube. This same basic chassis is also used with a 19EGP4 CRT in 19″ portable models. The vertically mounted chassis contains two printed-circuits boards. One board houses the video, sound, AGC, and sync circuits, while the second board is composed of the vertical sweep and the horizontal AFC and oscillator section. The horizontal-output, high-voltage, and low-voltage components are mounnted on the main chassis.

The three-stage video IF strip uses a 6BZ6 as the first amplifier; a 6GM6 and 6JC6 are utilized in the second and third stages, respectively. (The latter two tubes are both high-gain frame-grid types.) The video detector is a conventional 1N60 crystal diode. AGC, noise-inverter, and sync-separator actions are provided by a single tube (a 6KA8). The pentode section is used as an AGC keyer and noise inverter, while the triode section functions as sync separator.

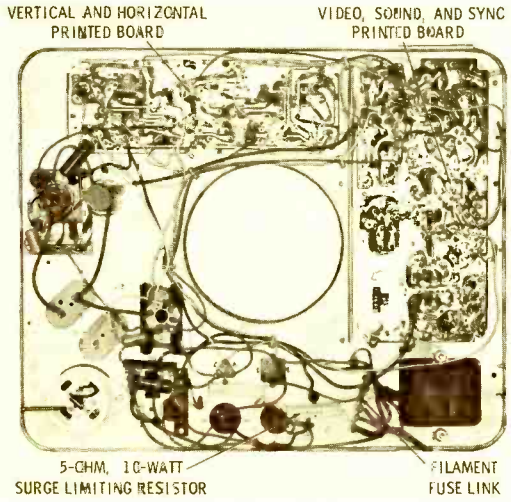
B+ is developed by a pair of silicon rectifiers. These are mounted on the main chassis and may be replaced simply by removing the cabinet rear cover—it isn't necessary to disassemble the chassis. Low-voltage protection is afforded by a circuit breaker in the secondary winding of the power transformer, and by a 5-ohm, 10-watt surge-limiting resistor in series with the silicons. The parallel filament string is fused by a wire link. The filament fuse link and the surge-limiting resistor are located on the rear of the chassis; replacement necessitates removing the chassis.

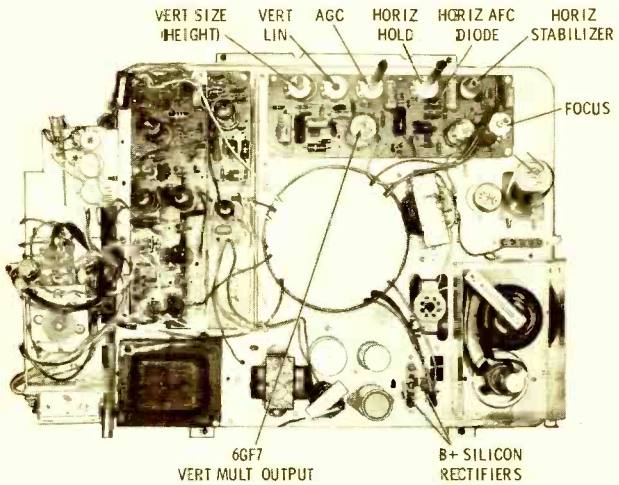
A common-cathode AFC diode (a plug-in type, mounted on the sweep printed board) provides horizontal AFC action. Another semi-conductor (a 1N60 crystal diode) is used as the video detector. The UHF tuner uses an NPN transistor as its oscillator and a signal diode serves as UHF mixer.

The brightness, contrast, and vertical-hold controls are mounted on an individual panel and are adjustable from the front of the receiver. The controls for AGC, height, vertical linearity, horizontal hold, and focus are located on the sweep printed-circuit board and are accessible from the cabinet rear.



INTERIOR VIEW OF UHF TUNER





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Panasonic
Model AN-16

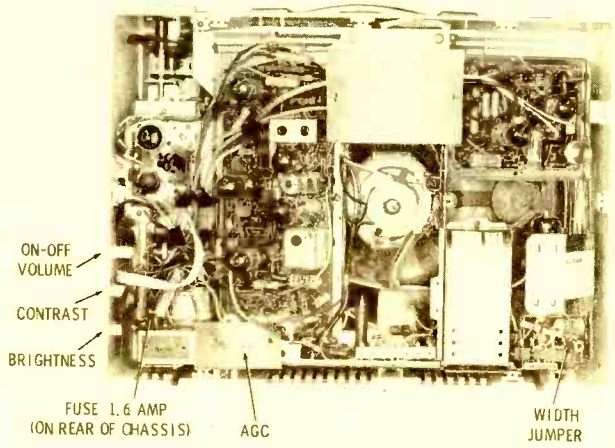
This imported portable TV uses a 16" 114° (AW40-12) picture tube. The receiver is housed in a plastic cabinet and comes equipped with a built-in monopole antenna, carrying handle, and earphone jack. External antenna connections are provided for both VHF and UHF reception.

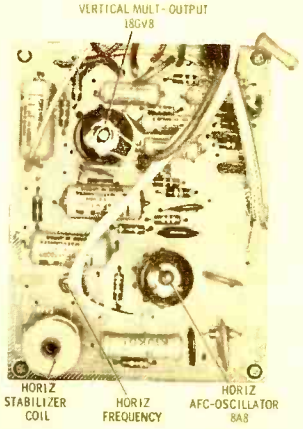
This set could be referred to as a *hybrid*, as it uses both tubes and transistors. The UHF tuner uses an NPN transistor as its oscillator, and three PNP transistors are used in the sound section. The first and second sound IF stages use 2SA102's; these are followed by two OA70 diodes functioning in a discriminator circuit. The audio amplifier also uses a transistor, a 2SB171. A second stage of audio amplification is achieved from the triode section of a 6AB8/ECL80; the pentode section of this tube serves as the audio output.

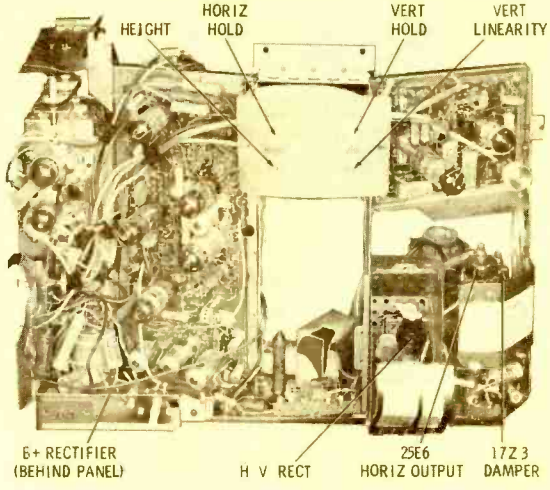
The two-stage video IF section uses high-gain, frame-grid tubes — a 6EH7 and 6EJ7 are used in the first and second stages, respectively. The video output is the familiar 12BY7. The functions of AGC, noise canceller, and sync separator are all performed by a 6JX8. The vertical multivibrator-output is an 18GV8, and the horizontal AFC/oscillator is an 8A8. (A pair of diodes, located on the rear of the horizontal printed board, operate as the horizontal-phase detector.) A 25E5 is used in the horizontal-output stage, a 17Z3 as damper, and a not unfamiliar 1X2B is the high-voltage rectifier.

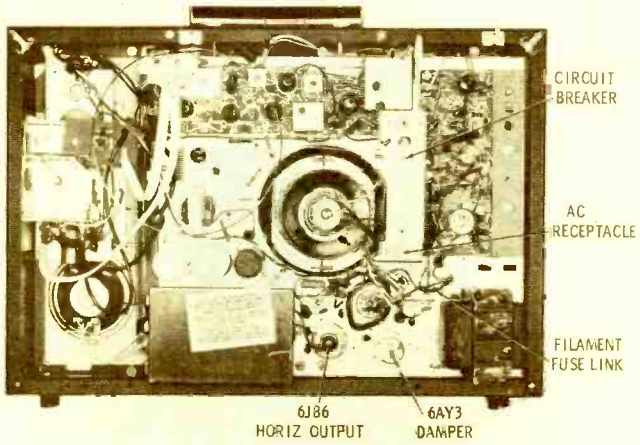
This transformerless chassis uses a pair of silicon rectifiers for devolping B+. Dual protection for these rectifiers is provided by a 4.7-ohm, 10-watt, wire-wound surge-limiting resistor and a 1.6-amp fuse. This fuse is connected in series with one side of the AC line and also serves as protection for the series filament string.

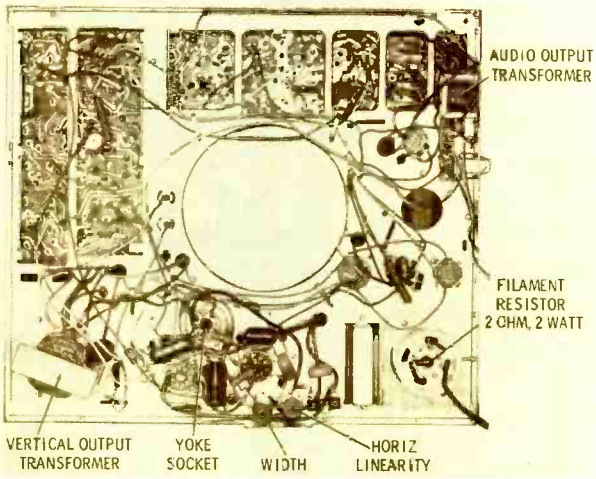
The width in this receiver is varied by a jumper wire which may be disconnected entirely or shunted across one or two resistors in the screen of the horizontal-output tube. Maximum width is obtained when the jumper shunts both resistors. (The location of this jumper is pointed out in the rear-view photo of the cabinet.) Other adjustments on the rear of the chassis include AGC, height, horizontal hold, vertical hold, and vertical linearity.

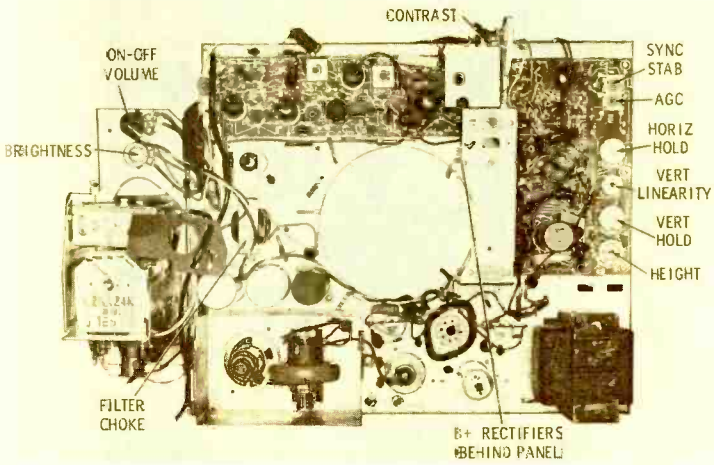


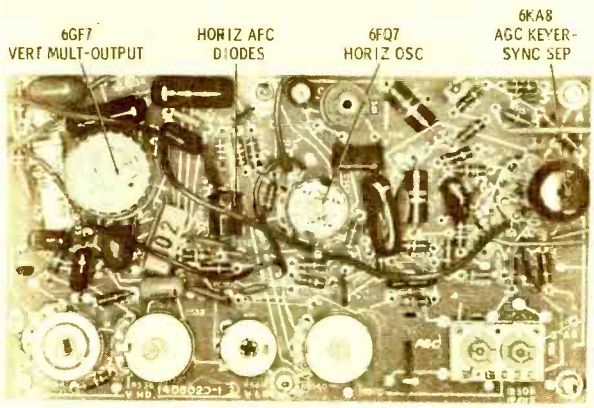


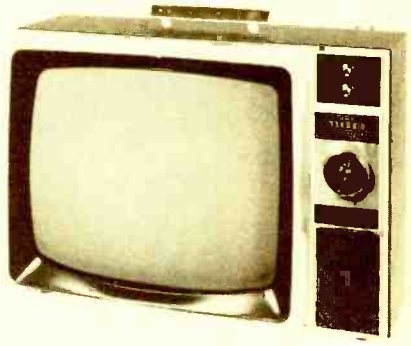












RCA
Chassis KCS149AA
Model AG-159E

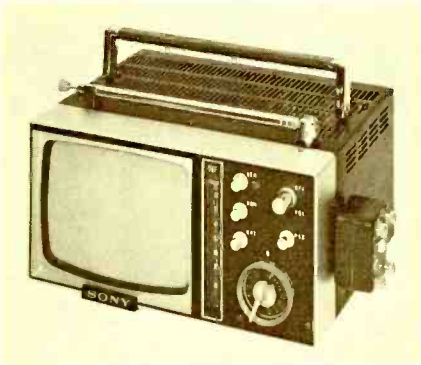
Pictured here is one of RCA's new portables. This one is called the *Stylist* and has a bonded 114° 19DQP4 picture tube. The receiver is equipped with a built-in dipole antenna and features an earphone jack. The chassis is essentially a modification, both physically and electrically, of one used in previous years.

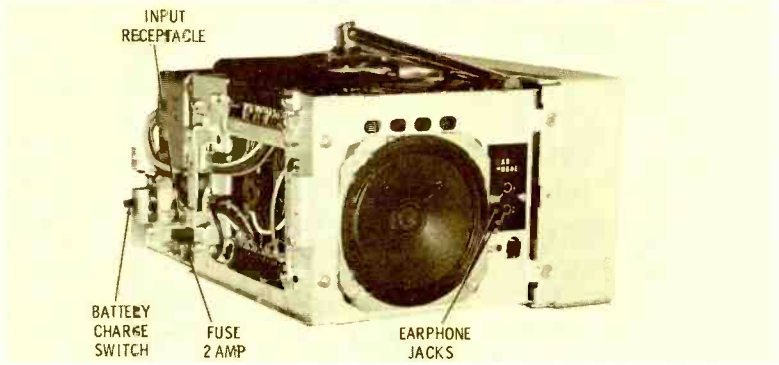
The tube lineup in this transformer-powered portable is similar to that used in receivers of earlier vintage. However, a special-purpose tube, a 6HG5, is employed in the audio-output stage. The warm-up time of the filament is decreased, thus preventing an annoying buzz from being audible while the rest of the filaments are attaining normal operating temperature. This characteristic is further aided by a 20% reduction in the warmup time of the damper tube.

The low-voltage power supply employs two silicon rectifiers connected in a full-wave voltage-doubler arrangement. The power supply is protected by a circuit breaker rather than a fuse, which has been used by this manufacturer in other models. The two branches of the parallel filament string are each fused with individual pieces of No. 28 AWG wire. An additional tap is provided on the primary winding of the power transformer in case it is necessary to operate the receiver from a 125- or 128-volt AC line.

This chassis has both a width and horizontal-linearity coil. These two coils should be adjusted for optimum linearity and correct width. When adjusting, initially position the slug in the width coil two turns from the maximum counterclockwise position. Then adjust the linearity for correct proportions from the left to right edges of the screen, and finally adjust the width for ½" overscan on each side of the raster.

The on-off/volume and brightness controls are mounted on the VHF tuner bracket and are accessible from the front of the cabinet. The remaining controls—AGC, sync stability, horizontal hold, vertical hold, height, and vertical linearity—are mounted on one of the two printed boards. The vertical- and horizontal-hold controls are equipped with shafts that extend through the rear cover. Holes in the rear cover are provided for adjusting the other controls.





Sony Model TV5-305UW

The 5" Sony portable shown above has very low power consumption; it requires only 12.4 watts from the 110 volt AC line, or 9.2 watts from its rechargeable battery supply. Since the Japanese-manufactured printed chassis is divided into plug-in circuit blocks, an entire section of the receiver can be removed for repairs.

On the bottom, below the CRT, is the signal-circuit plug-in board, which includes the video and sound IF strips, audio-output circuits, keyed AGC, and video detector. Directly above the CRT is the deflection plug-in board, which includes the vertical-sweep circuits, horizontal-sweep circuits, focus supply, and the video output circuit.

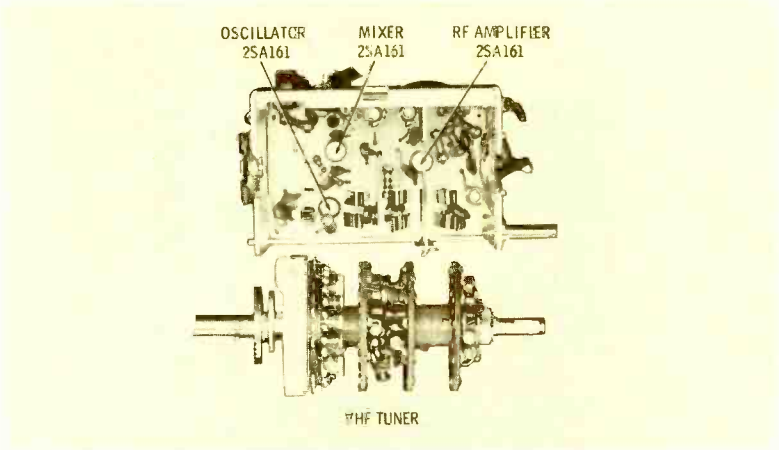
To the right front of the CRT is the VHF/UHF tuner block. The VHF fine-tuning knob is connected to the UHF tuner and tunes the receiver for UHF when the channel-selector knob is in the U position. Both tuners use PNP mesa germanium transistors, and the UHF tuner uses a 1T13 Esaki diode mixer. A neon lamp powered by the focus supply illuminates the UHF dial. Located behind the tuner, is the high-voltage block, which uses three 1DK1's to supply 8kv to the CRT anode.

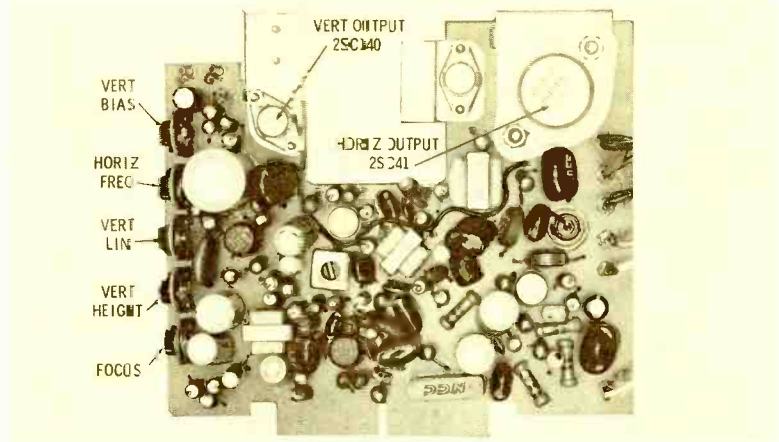
A 12-volt transformer supplies AC to a full-wave selenium rectifier bridge when the set is operated from the 117-volt AC line. Brute-force filtering is accomplished with a choke and two 4000-mfd capacitors. The set can be switched off while the battery charges by leaving the front-panel on-off switch on and switching the recharge switch to CHARGE. Protection for AC operation is supplied by a 2-amp fuse.

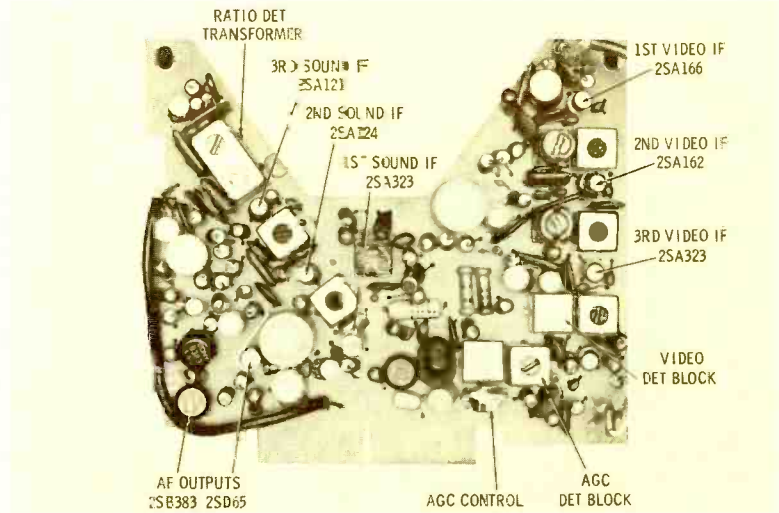
Semiconductor and tube complement totals 28 transistors (5 silicon, 23 germanium), 20 diodes, and 4 tubes (three 1DK1 high-voltage rectifiers and the 140CB4 CRT).

On the front are the on-off-volume, brightness, vertical-hold, horizontal-hold, VHF tuning, and contrast controls. Along the left side are the focus, height, vertical-linearity, and horizontal-frequency screwdriver adjustments.

Each VHF oscillator slug is adjustable through a hole in the front of the tuner; the fine-tuning and channel-selector knobs must be removed for this operation.







See PHOTOFACT Set 742, Folder 1

Mfr: Andrea **Chassis No.** BR-P1VW-319

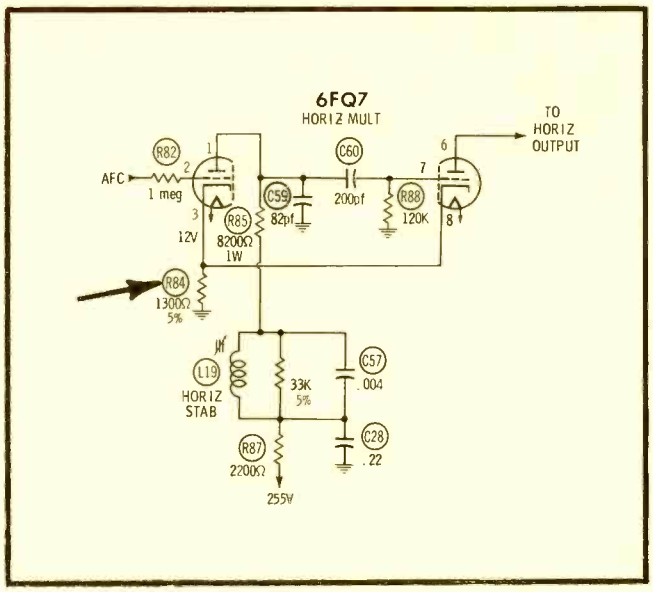
Card No: AN BR319-1

Section Affected: Horizontal sync.

Symptoms: Horizontal hold drifts out of range; cathode voltage on horizontal multivibrator V11 (6FQ7) is low.

Cause: Cathode resistor reduced in value.

What To Do: Replace R84 (1300 ohms, 5%).



Mfr: Andrea **Chassis No.** BR-P1VW-319

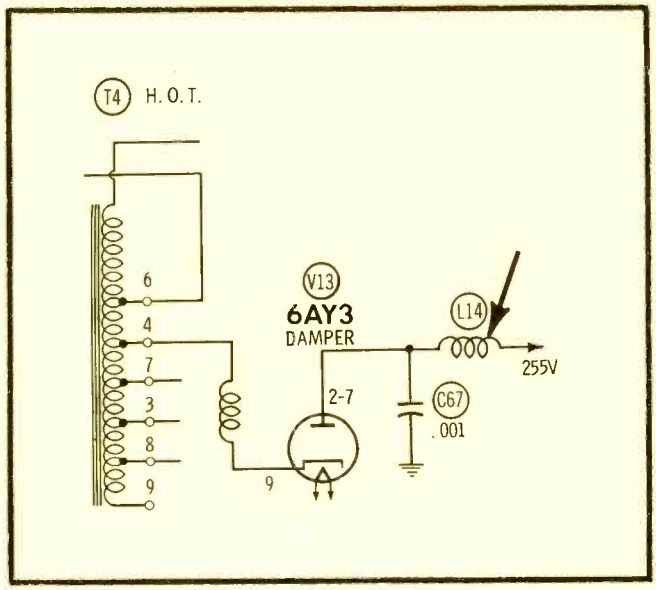
Card No: AN BR319-2

Section Affected: Raster.

Symptoms: No raster, no high voltage. Voltage on plate (pins 2 and 7) of damper V13 (6AY3) is zero.

Cause: Open damper choke.

What To Do: Replace L14.



Mfr: Andrea **Chassis No.** BR-P1VW-319

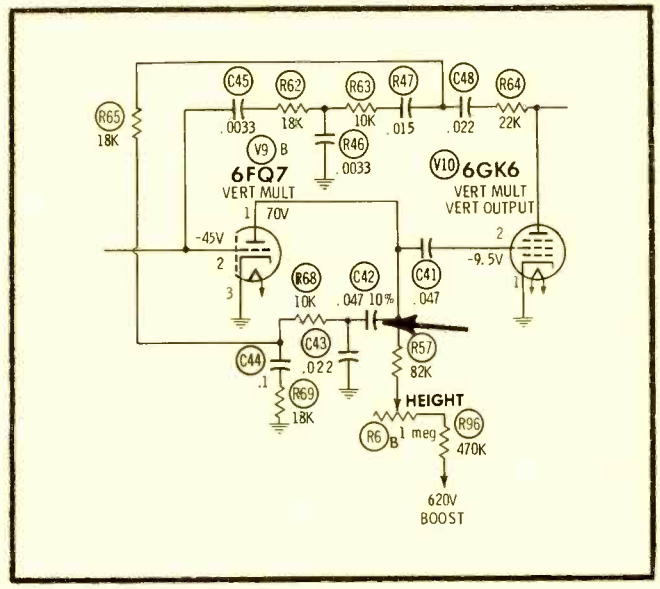
Card No: AN BR319-3

Section Affected: Raster.

Symptoms: Picture elongates at top and folds over at bottom; also rolls vertically.

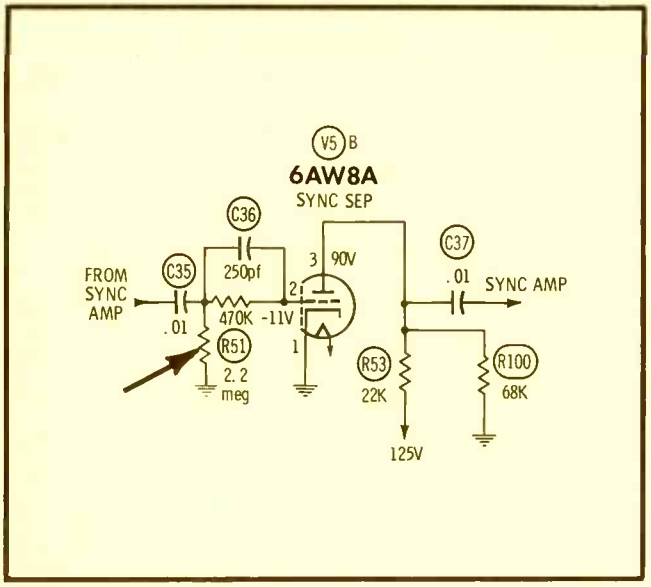
Cause: Leaky waveshaping capacitor in vertical multivibrator circuit.

What To Do: Replace C42 (.047 mfd, 10%).



See PHOTOFACT Set 742, Folder 1

See PHOTOFACT Set 742, Folder 1



See PHOTOFACT Set 742, Folder 1

Mfr: Andrea **Chassis No.** BR-P1VW-319

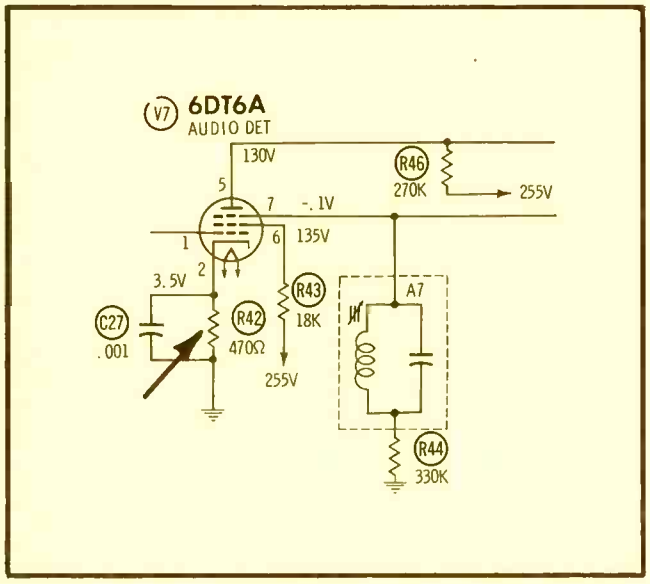
Card No: AN BR319-4

Section Affected: Vertical and horizontal sync.

Symptoms: Unstable vertical and horizontal sync. Voltage on grid (pin 2) of sync separator V5B, is more negative than normal.

Cause: Open sync separator grid resistor.

What To Do: Replace R51 (2.2 meg).



Mfr: Andrea **Chassis No.** BR-P1VW-319

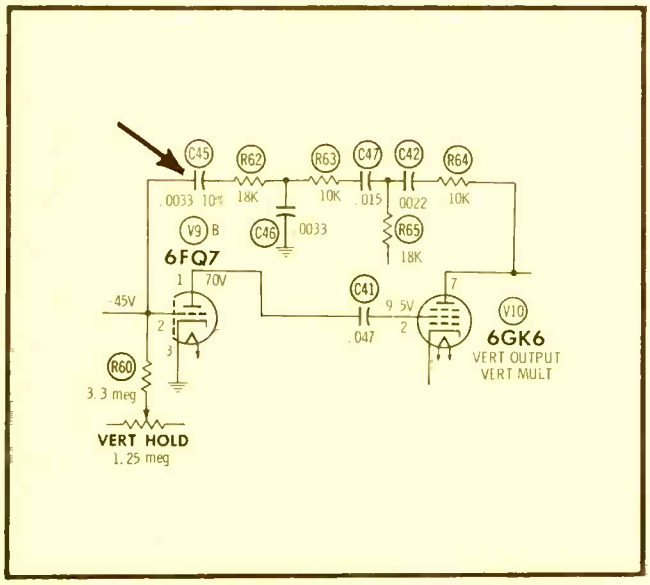
Card No: AN BR319-5

Section Affected: Sound.

Symptoms: No audio; voltage at cathode (pin 2) of audio detector (V7) is high.

Cause: Audio-detector cathode resistor has burned and increased in value.

What To Do: Replace R42 (470 ohms) and check V7 (6DT6A).



Mfr: Andrea **Chassis No.** BR-P1VW-319

Card No: AN BR319-6

Section Affected: Vertical sync.

Symptoms: Picture rolls vertically after set is in operation for a period of time.

Cause: Vertical-multivibrator feedback capacitor changes value after the receiver warms up.

What To Do: Replace C45 (.0033 mfd, 10%).

See PHOTOFACT Set 521, Folder 1

Mfr: Emerson **Chassis No.** 120515C

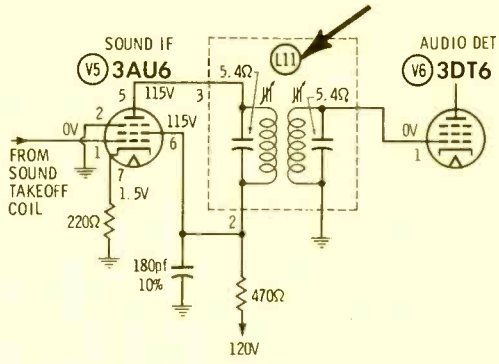
Card No: EM 120515C-1

Section Affected: Sound.

Symptoms: Reduced volume accompanied by buzz; no voltage on plate (pin 5) of sound IF (V5).

Cause: Primary of sound IF transformer open.

What To Do: Replace L11.



Mfr: Emerson **Chassis No.** 120515C

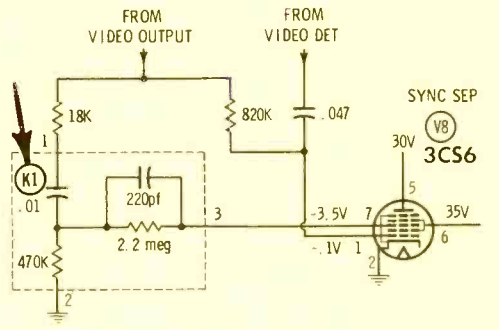
Card No: EM 120515C-2

Section Affected: Pix and sync.

Symptoms: Jittery picture; unstable sync. Incorrect bias on sync separator V8.

Cause: Defective resistor-capacitor combination between video output and sync separator grid.

What To Do: Replace K1.



Mfr: Emerson **Chassis No.** 120515C

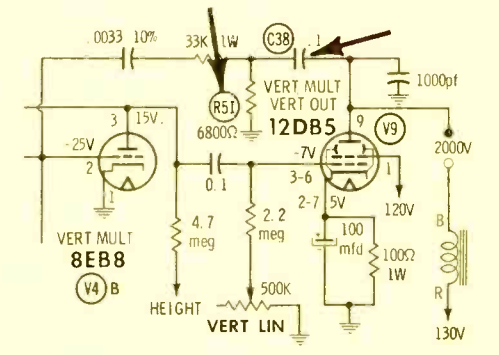
Card No: EM 120515C-3

Section Affected: Raster.

Symptoms: Loss of vertical sweep.

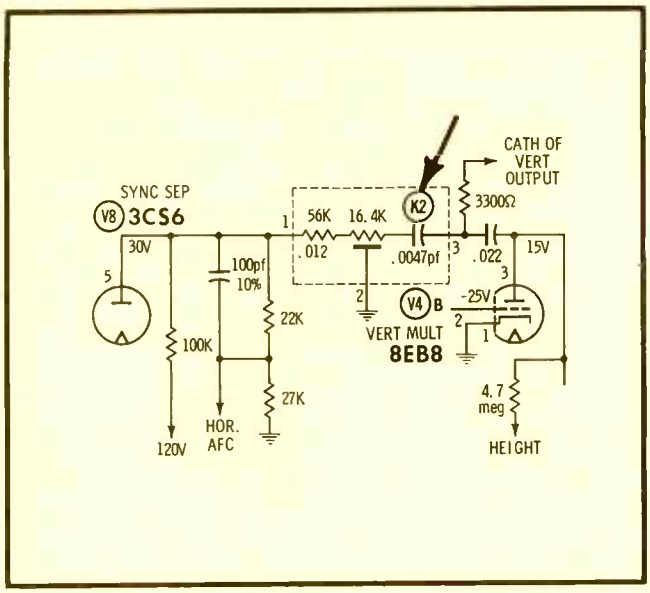
Cause: Shorted capacitor in vertical feedback network.

What To Do: Replace C38 (.1 mfd, 600V) and check condition of R51 (6800 ohm, 1 watt).



See PHOTOFACT Set 521, Folder 1

See PHOTOFACT Set 521, Folder 1



See PHOTOFACT Set 521, Folder 1

Mfr: Emerson **Chassis No.** 120515C

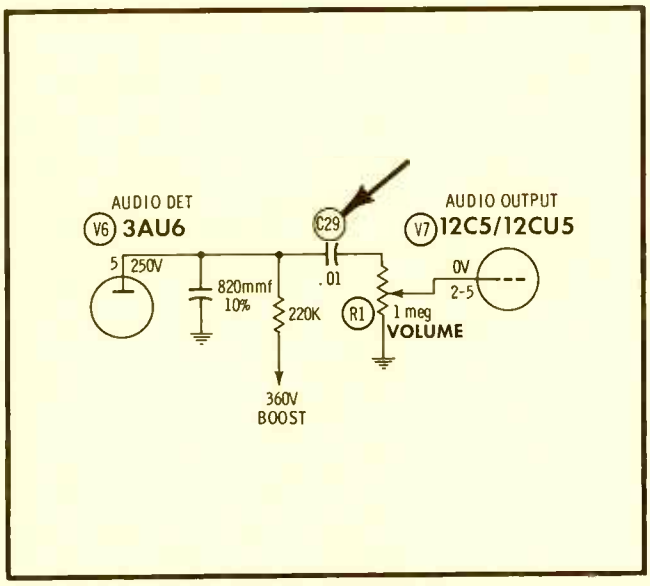
Card No: EM 120515C-4

Section Affected: Vertical and horizontal sync.

Symptoms: Picture rolls vertically; horizontal sync unstable.

Cause: Defective vertical integrator resistor-capacitor combination.

What To Do: Replace K2.



Mfr: Emerson **Chassis No.** 120515C

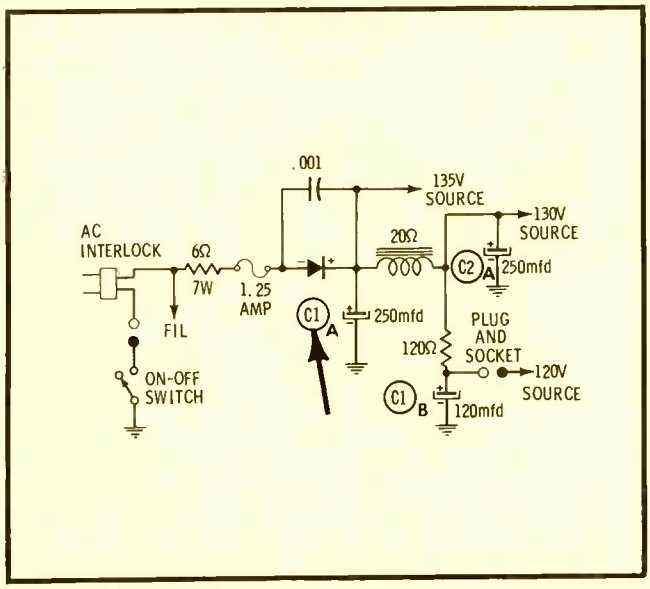
Card No: EM 120515C-5

Section Affected: Sound.

Symptoms: No sound; sparking in volume control.

Cause: Shorted coupling capacitor from plate (pin 5) of audio detector V6 (12CU5) to volume control; may burn out volume control and cause damage to audio output tube.

What To Do: Replace C29 (.01 mfd). Check condition of V7 and volume control; replace if necessary.



Mfr: Emerson **Chassis No.** 120515C

Card No: EM 120515C-6

Section Affected: Raster and sound.

Symptoms: Reduced width, weak contrast, and poor focus; sound has buzz and hum; horizontal pulling at top of raster; voltages are low throughout set.

Cause: Open input filter capacitor.

What To Do: Replace C1A (250 mfd, 200V).

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$9.50

fixes TUNERS for only

■ And, who else but the world's largest manufacturer of TV and FM tuners is as well-equipped, well-qualified and has available ALL necessary specifications required to provide unexcelled service on all makes and models?

Sarkes Tarzian, Inc. maintains Tuner Service Centers—completely-equipped and conveniently-located—to offer fast, dependable tuner repair service to any part of the country.

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Tarzian Service Centers are staffed by well-trained technicians and are assisted by engineering personnel to assure you of FAST, DEPENDABLE repair service. Every channel—not just the channels existing in any given area—is checked and re-aligned per manufacturer's specifications. Tarzian's exclusive cleaning method makes the tuner look—as well as operate—like new. In most instances, tuners received one day will be completely overhauled and shipped out the next.

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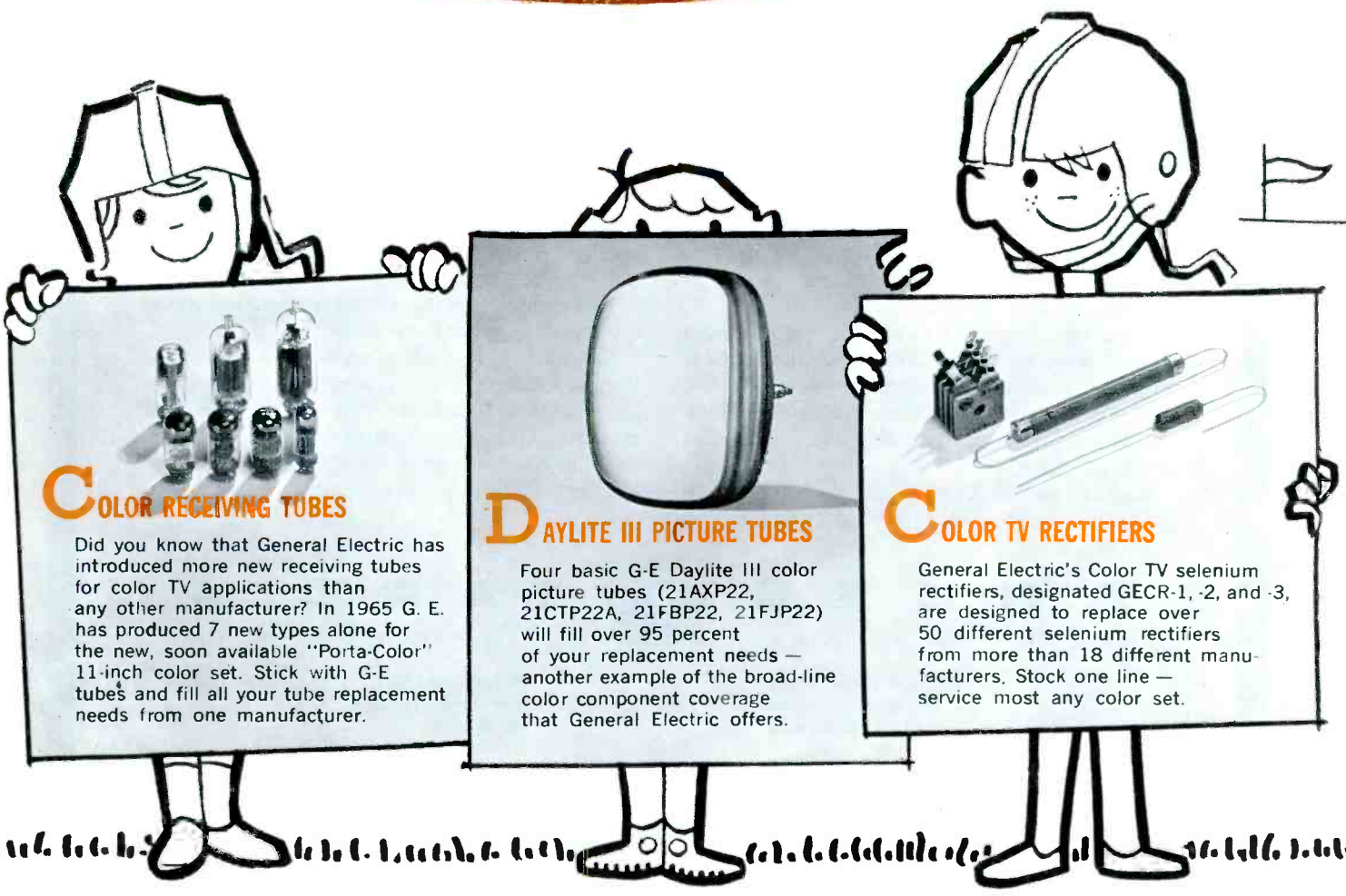
Circle 2 on literature card

COLOR TV
COMPONENTS

KICK-OFF THE NEW COLOR VIEWING SEASON



COLOR RECEIVING TUBES

Did you know that General Electric has introduced more new receiving tubes for color TV applications than any other manufacturer? In 1965 G. E. has produced 7 new types alone for the new, soon available "Porta-Color" 11-inch color set. Stick with G-E tubes and fill all your tube replacement needs from one manufacturer.

DAYLITE III PICTURE TUBES

Four basic G-E Daylite III color picture tubes (21AXP22, 21CTP22A, 21FBP22, 21FJP22) will fill over 95 percent of your replacement needs — another example of the broad-line color component coverage that General Electric offers.

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General Electric's Color TV selenium rectifiers, designated GECR-1, -2, and -3, are designed to replace over 50 different selenium rectifiers from more than 18 different manufacturers. Stock one line — service most any color set.

with a full line of G-E Color Components

Hey, it's football time! Get set for the kick off . . . plenty of action, pretty girls, marching bands . . . and a full line of G-E color TV components to help you to keep your customers' color sets in top shape.

Stock up! Call your local Authorized G-E Electronic Components Distributor for receiving tubes, picture tubes, rectifiers, and other color components you'll need this fall. He has exciting deals you'll want to hear about.*

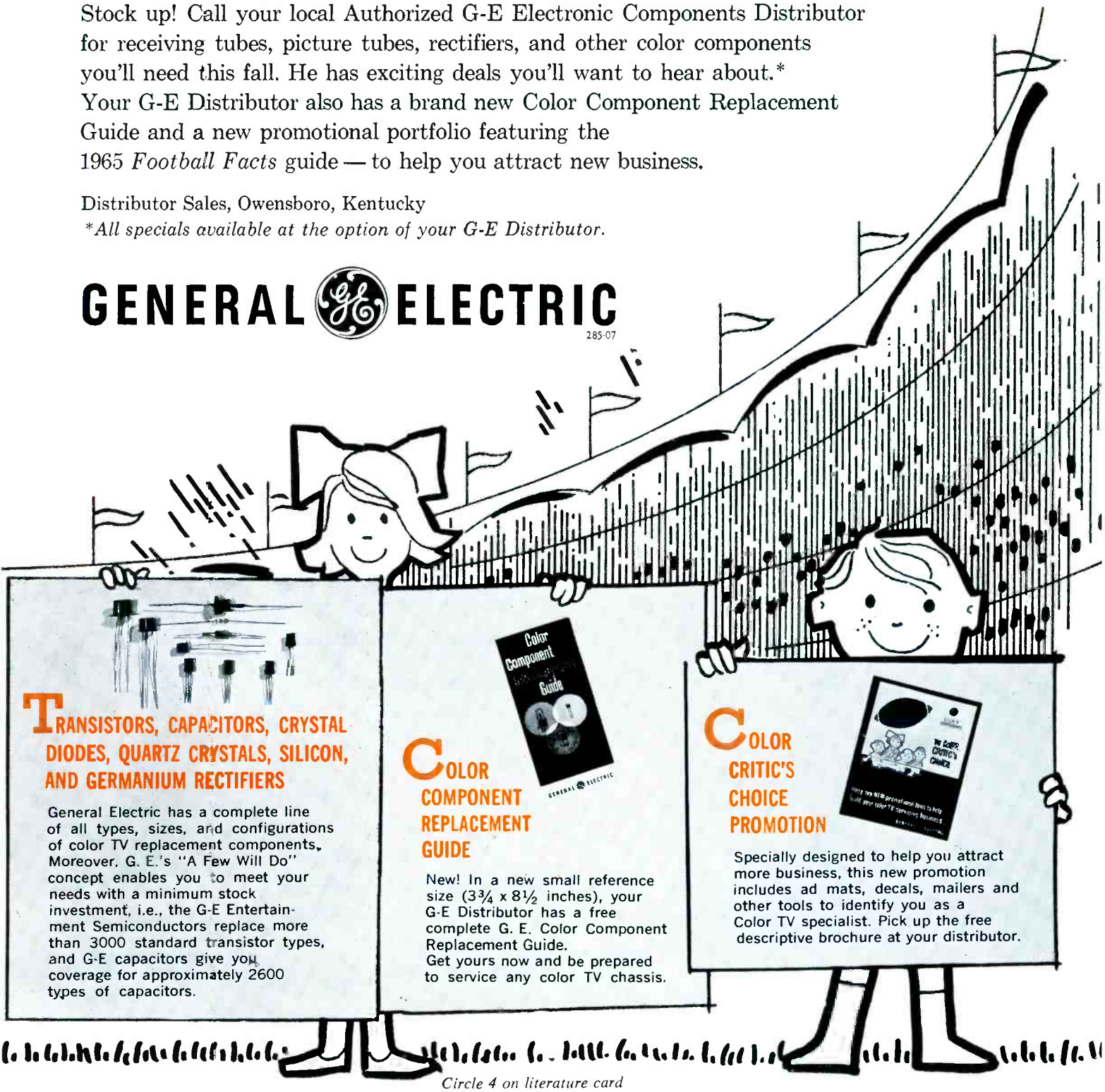
Your G-E Distributor also has a brand new Color Component Replacement Guide and a new promotional portfolio featuring the 1965 *Football Facts* guide — to help you attract new business.

Distributor Sales, Owensboro, Kentucky

**All specials available at the option of your G-E Distributor.*

GENERAL ELECTRIC

285-07



TRANSISTORS, CAPACITORS, CRYSTAL DIODES, QUARTZ CRYSTALS, SILICON, AND GERMANIUM RECTIFIERS

General Electric has a complete line of all types, sizes, and configurations of color TV replacement components. Moreover, G. E.'s "A Few Will Do" concept enables you to meet your needs with a minimum stock investment, i.e., the G-E Entertainment Semiconductors replace more than 3000 standard transistor types, and G-E capacitors give you coverage for approximately 2600 types of capacitors.

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New! In a new small reference size (3¾ x 8½ inches), your G-E Distributor has a free complete G. E. Color Component Replacement Guide.
Get yours now and be prepared to service any color TV chassis.

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A HOWARD W. SAMS PUBLICATION

PF Reporter

PHOTOFACT

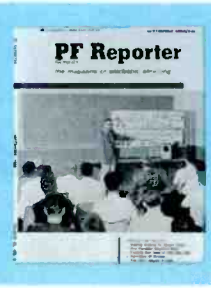
the magazine of electronic servicing

VOLUME 15, No. 9 SEPTEMBER, 1965

CONTENTS

ABOUT THE COVER

Our cover this month shows a group of students in class at Sams Technical Institute in Indianapolis. A classroom provides the most effective technical training, but there are other ways, too. You will find valuable information about broadening your knowledge of electronics in the article starting on page 30.



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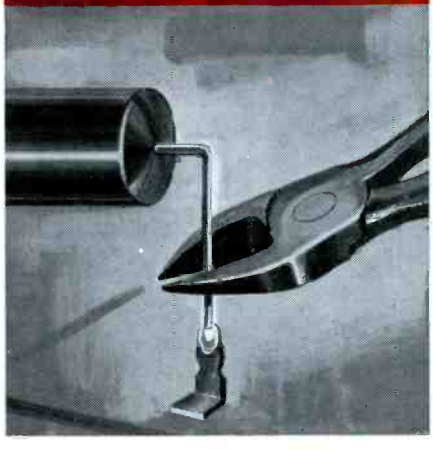
Not just another wire spring connector!
The 3-in-1 QUIG is brand new and different . . . Copperweld wire inner core, a layer of flux, and an outer jacket of solder . . . all you need is heat!
Makes one-handed soldering possible!

Ten times actual size

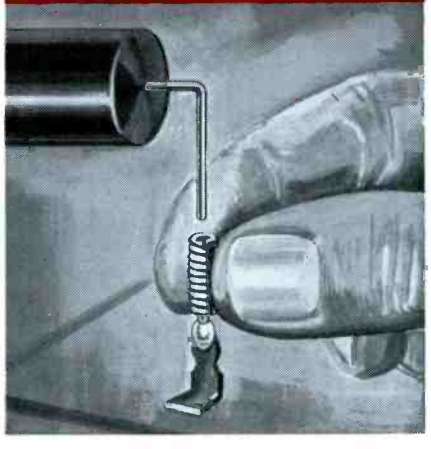
Once again, Sprague helps the TV-radio service industry by solving two increasingly serious problems . . . parts replacement in those "inaccessible" chassis nooks, such as crowded tube sockets, as well as soldering onto the delicate circuitry of printed wiring boards.

Mechanically sturdy and electrically reliable, the revolutionary QUIG provides fast, expertly-soldered connections as easy as A-B-C!

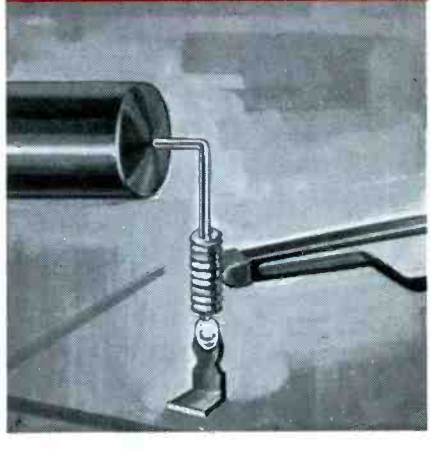
A Snip Lead



B Slip on QUIG



C Heat QUIG, Connection Made!



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QUIGS are now being packed with Sprague Atom® Capacitors *at no extra cost to you!* Whenever you need tubular electrolytics, insist on pre-packaged Sprague Atoms from your parts distributor and you'll automatically get your QUIG component connectors . . . the biggest boon to the service technician since the soldering gun!

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THE MARK OF RELIABILITY

WORLD'S LARGEST MANUFACTURER OF CAPACITORS

65-410R

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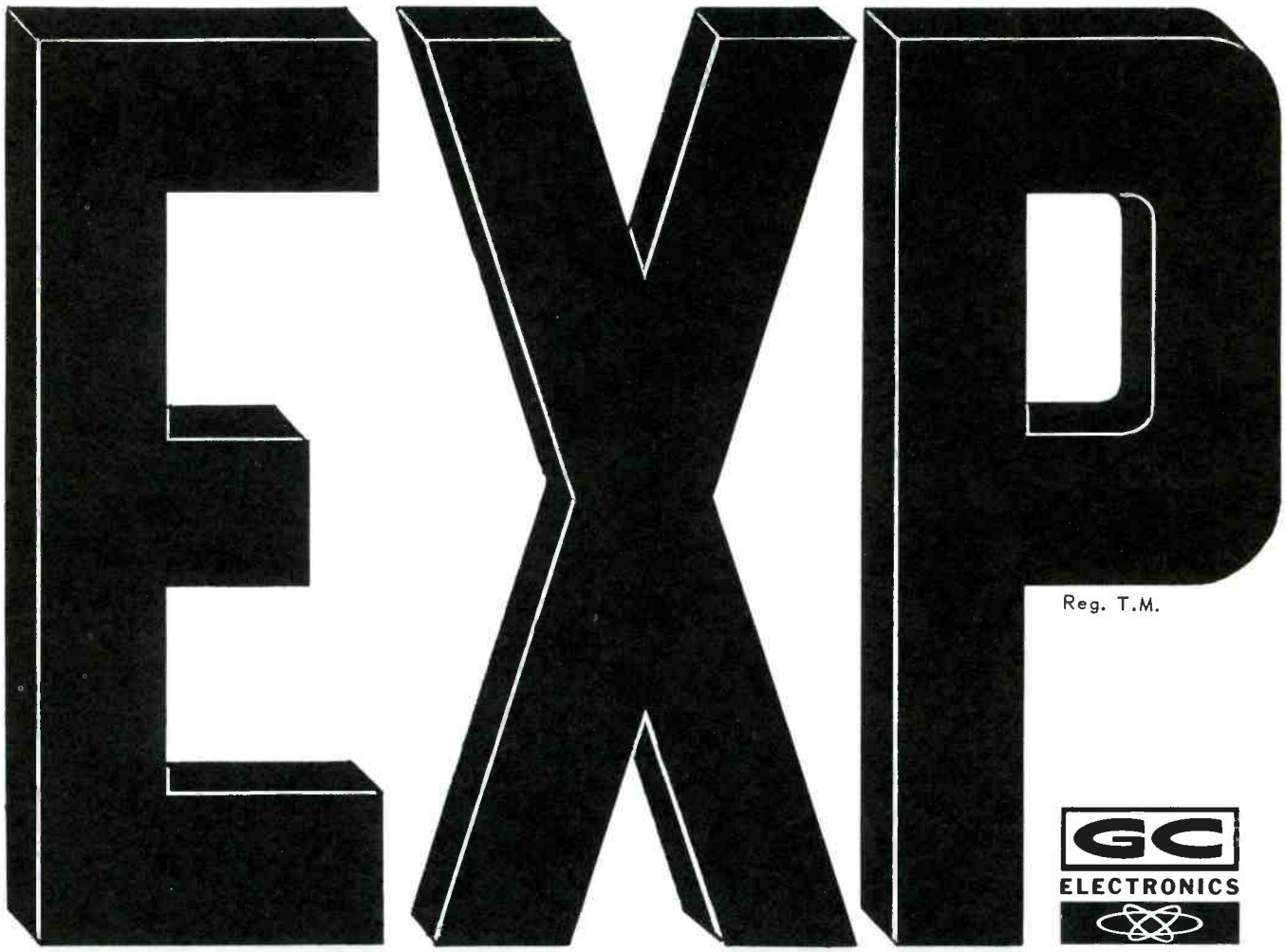

the GREATEST ADVANCE
in *All-Channel* COLOR & BLACK *and* WHITE

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all from **ONE LOW-COST ANTENNA LINE**

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Letters to the Editor

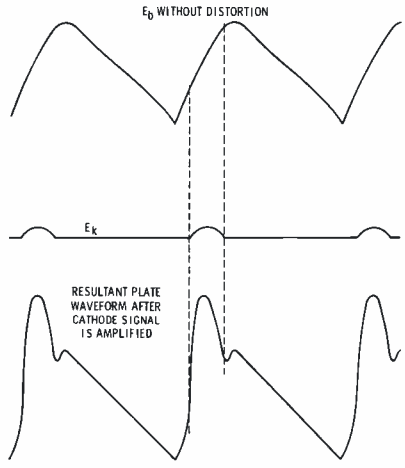
Dear Editor:

On page 50 of the February PF REPORTER there is an informative article on "Filter Buzz." All the technicians at the NAS Hobby Shop, Norfolk, Va. agree with the fact that leaky capacitors will cause buzz in the manner described; but we do not agree with the theoretical explanation in the article. Must we throw grounded-grid amplifier theory out the window? Please look at our enclosed waveforms; the positive signal applied to the cathode will appear as a positive signal on the plate.

All kidding aside, you put out a great magazine; those tough TV troubles would be a lot tougher without your timely tips.

HOBBYSHOP HOTSHOTS

TV Bench
NAS Hobby Shop
Norfolk, Va.



Thanks, Hotshots — and the other readers who wrote in — for the comments. The waveforms (shown here) that you sent us do provide a better explanation of grounded-grid amplifier—Ed.

Dear Editor:

In the May 1965 issue, in Video Speed Servicing on page 5, you need to add a jumper between point 4 of coil L6 and pin 6 of tube 6EW6. Otherwise, to get 190 volts to the screen grid of the 6EW6, you'd have to short out pins 5 and 6 or the tube. I'd bet the first way is the correct one.

NATHAN S. NUTKOWITZ

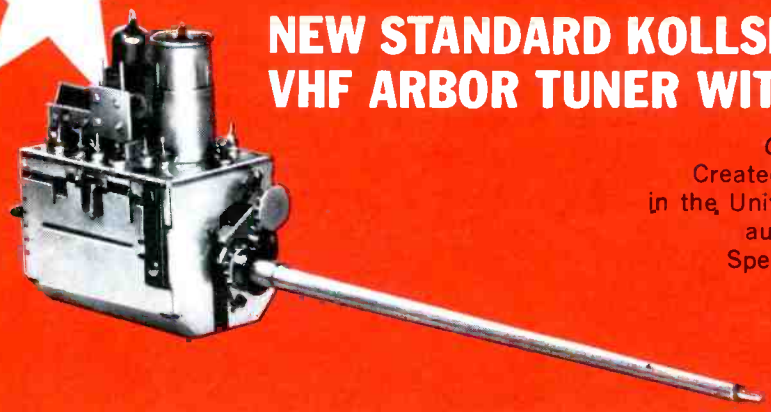
Philadelphia, Pa.

You'd win, Nathan. The Card No. is RCA KCS136YA-1, *and the schematic should have a connecting line drawn from point 4 on the coil to pin 6 of the tube. It can easily be drawn in with a pencil by those readers who want to be sure of the accuracy of their VSS file.—Ed.*

Fall lineup of STANDARD KOLLSMAN Television Stars

Featuring the fastest rising star in the TV tuner industry.

Now available for replacement profits.



NEW STANDARD KOLLSMAN COLOR and black and white VHF ARBOR TUNER WITH PRE-SET FINE TUNING

Guaranteed positive adjustment to eliminate service callbacks.
Created to replace TV tuners in practically every set manufactured in the United States since 1956. A simple adjustment of the knob automatically adjusts the oscillators for easy, perfect tuning. Specially designed brackets permit simple installations in any position—guaranteed to eliminate *all* previous mechanical problems of replacement installations.
Three new models to sell.
New SKi Arbor Tuner installed with the SKi UCT-051 UHF Tuner converts any set into a modern 82 channel TV.

Sell the custom look
STANDARD KOLLSMAN BUILT-IN Transistorized UHF Converter

UCT-051

Easily installed in about 45 minutes

- Best performance—low noise
- Fits all consoles, table models and most portables
- Compact size: 5½" x 1½" x 3¾"; weight 1¼ lbs.
- Easy to read dial calibrated to read at any angle regardless of installation position
- Easy tuning high-ratio ball bearing drive
- Reliable service-free tuning element
- All UHF channels—14 through 83
- Built-in safeguards against interference with other TV sets in vicinity
- Excellent for replacement of defective tuners
- Quick and easy way to make TV trade-ins saleable

INTRODUCING WORLD'S MOST BEAUTIFUL BEST PERFORMING TRANSISTOR UHF CONVERTER

Model TA

- Earns more profit because it's easier to sell
- More picture power with latest nuvistor amplifier circuits
- Easy tuning
- Exceeds minimum F.C.C. requirements for spurious radiation specifications
- Very low drift
- Easy hook up
- All channels 14 through 83
- U.L. listed
- Full year warranty on all parts and workmanship.

IF STANDARD KOLLSMAN MADE IT, STANDARD KOLLSMAN WILL FIX IT

- Only brand new parts used
- 48 hour service on all SK tuners
- Latest testing techniques to assure proper alignment
- No hidden costs—$11.50 plus parts . . . $13.50 maximum cost
- $3.00 Trade-in allowance on new tuner.
- 6 month guarantee
- Special shipping cartons to avoid damage in transit

NEW UHF TRANSLATOR MULTI PURPOSE TEST EQUIPMENT AND DEMONSTRATOR

- Translates VHF to UHF even when no UHF signals are on air
- Saves Time Servicing all Channel TV Sets
- Easier to Sell
- All Channel TV sets

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FOR MORE PROFIT FOR THE SERVICE DEALER • GREATER CUSTOMER SATISFACTION

GUARANTEED BY THE WORLD'S LARGEST MANUFACTURER OF TELEVISION TUNERS

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2085 NORTH HAWTHORNE AVE., MELROSE PARK, ILLINOIS

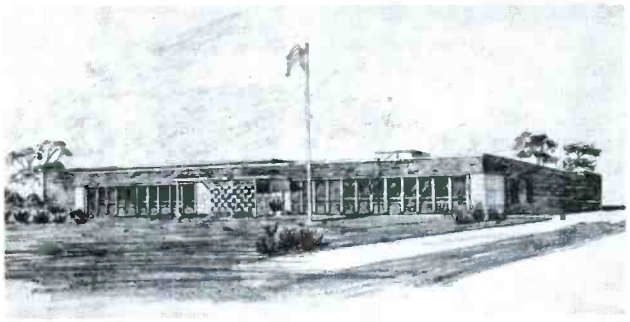
Circle 9 on literature card

The Electronic Scanner

news of the servicing industry

More Space

The Micro State Electronics Corp, a subsidiary of **Raytheon Company,** will more than double its floor space at Murray Hill, N. J. Construction has begun on a 20,000-square-foot addition to the firm's present 12,500-square-foot plant at 152



Floral Avenue. A personnel expansion, to more than 250 in the next two years, is also planned.

Solid-State for Appliances

Manufacturers recently turned their attention to the use of trouble-free solid-state devices to replace or to work in conjunction with conventional controls in major electric appliances. The growing semiconductor "family" for appliance applications was introduced at the annual meeting of the Consumer Products Division of the **National Electrical Manufacturers Association.**

Semiconductors of most interest were "super-switches" (transistors, silicon-controlled rectifiers, and AC semiconductor switches). Through their use, it is possible to use inexpensive sensors for detecting humidity, temperature, variations of light, weight, and strain. Solid-state sensing and control devices—the thermistor, cadmium-sulfide photocell, humidity sensor, and silicon strain gage—now offer, with an appropriate amplifier, a design flexibility simply not attainable electromechanically.

While uniquely suited to variable torque loads, such as furnace blowers, pumps and air conditioning fans, a system combining solid-state and conventional motor-control principles can also work successfully with more difficult loads such as home laundry. Not only can speeds be infinitely variable, but the speed can be controlled automatically from a very low-level input. Thus, the electric clothes dryer can automatically vary speeds from a combination of inputs, such as water level, temperature, or hardness, weight of the load, color of the load; each can be sensed by an appropriate solid-state sensor and integrated into a decision for the proper speed.

CATV Suggestions

A CATV permit application, acceptable to both cable operators and television dealers, has been worked out by representatives of the **National Appliance & Radio-TV Dealers Association** (NARDA) with officials of Perfect Picture TV, Inc., in Sacramento, California. The organization went on record that it would not oppose introduction of the cable into communities where the net result of the new service would increase the number of TV signals available to the consumer. In fact, the dealers declared, additional programming should stimulate the sale of new receivers and the service of older models. They noted, however, that some prohibition against the sale or service of TV sets by CATV operators should be written into every permit. Without such restrictions, NARDA feels, public welfare would suffer from elimination of the choice of brand or servicer.

In addition to three plants in the United States, Mallory battery facilities are located in Australia, Canada, England, France, Italy, and West Germany. Additional manufacturing facilities are presently being set up in Europe and Mexico.

New Citizens Band Petition

A petition has been submitted to the Federal Communications Commission requesting amendments to Part 95 of the Commission's rules, which governs Citizens-band radio service. The **Hallicrafters Co.** states:

". . . it is to the public's interest and necessity that the Commission be urged to amend the rules under Part 95 to require that all new transmitters for use by Class-D stations in this service be type accepted after January 1, 1966."

"It is further recommended by this petitioner that the rules under Part 95 be amended to prohibit the usage of non-type-accepted equipment after January 1, 1970."

"It is further recommended that the type acceptance of any transmitter be voided if the said transmitter is used or operated in conjunction with non-type-accepted accessory devices. Antenna or transmission lines are to be specifically exempt from this provision of the rules."

"With over 850,000 licensees in this service at this date and the anticipated continual growth of this service, it seems reasonable that type acceptance be required to insure compliance with the technical standards applicable to Class-D transmitters. . . ."

"This petitioner also is quite disturbed that in the segment of the electronics industry engaged in producing and selling Class-D Citizens-band transceivers to the general public, there has been a growing movement to produce transmitters and accessories which clearly and unequivocably violate rules of the Commission by simple adjustment or simple modification, to exceed by considerable amounts the 5-watt input level allowed by the rules for this Class-D citizens service."

The Executive Committee of NARDA urged the Federal Communications Commission to consider the sales and service aspect of CATV in its current deliberations on the subject. It also called upon all dealers to keep abreast of CATV applications in their areas and to attend local hearings on such applications, to insure that prohibitions against detrimental, monopolistic practices are written into licenses.

Now Under One Roof

Pearce-Simpson, Inc., manufacturer of electronic communication equipment and molded plastic products, has moved into its $1 million, 75,000-square-foot consolidated plant building at 4701 Palmetto Bypass in Miami. The new plant consolidates the Electronics and Plastics divisions into one central operational unit. Modern plant layout, better personnel distribution, straight-line production facilities, and additional manufacturing space will enable the company to triple its total production capacity.

American-Japanese Battery Company

A new company, known as National Mallory Denchi Kabushiki Kaisha, has been formed by **P. R. Mallory International, Inc.** and Matsushita Electric Industrial Co., Ltd., the largest manufacturer of zinc-carbon batteries in Japan. Mercuric-oxide, manganese-oxide, and silver-oxide batteries developed by Mallory and utilizing Mallory patents will be manufactured by the new company.

with 13.1%. Little change was noticed last year in the trade-in ratios to unit sales of new merchandise. The Business Survey, though, indicated that income from service charges in 1964 slipped from 13.4% of sales in the preceding year to 12.2%.

The dealer survey, representing returns from 38 states, one Canadian province and Puerto Rico, was based primarily on returns from retailers who both sell and service appliances, including home electronic equipment. NARDA, which has been waging a campaign to encourage more of its members to service what they sell, recently revealed that over 88% of its members are in the merchandise-plus-service category.

Semiconducting Film

A new semiconducting film, the use of which is expected to provide improvements in the design and manufacture of electronic and other electrical products, has been developed by **General Electric.** Designated Irricon®, the unique film is an irradiated polyolefin (with a resistivity of 10,000 ohms per square inch) which has been cross-linked by electron-beam bombardment. It offers a new capability in applying semiconducting layers. Wide utilization of the film in a multitude of electrical apparatus and electronic applications is expected. ▲

"It is further the opinion of this petitioner that by requiring type acceptance of equipment for this Citizens Class-D service, the practice of modification to the transmitter by the technically unqualified licensee will cease, thus reducing interference to other channels and other services by overmodulation and excessive input power to the output stage. . . ."

Sales and Profits Up

Organized appliance-radio-TV retailers in 1964 were selling more according to an initial tabulation of a Costs-of-Doing-Business Survey by the **National Appliance & Radio-TV Dealers Association** in Chicago.

Sales by association members were up 11.1% last year over the previous year, and the net profit ratio was ahead by more than 19% for the same period, NARDA reported.

Still on the downgrade, however, was the 1964 ratio of total net sales to aggregate cost of goods sold. Cost—including merchandise and service parts as well as servicemen's wages—rose to a new high of 73.82%, dropping the total gross margin to a new low of 26.18%. This contrasts with a 1963 gross of 26.86% and 28.06% for the year before that.

As a result of the more efficient operation of the merchandise-plus-servicing firms, and despite lower gross margins, net operating profit from the sale of goods and services for these retailers reached a seven-year high of 1.75%. Adding income from other sources (rents, customer-finance charges, etc.) and subtracting other nonrelated expenses brought this final after-tax income figure for 1964 to 2.40% on net sales.

In terms of importance to overall dollar volume, television-set sales captured top honors with 26.8% of all A-R-TV retail business done in 1964, compared to 26.6% in 1963. Refrigerators took second place with 17.4%, and washers third place

PROTECTS AGAINST • Bent Pointers • Burned-Out Resistors • Damaged Pivots • Overheated Springs • Burned-Out Meter • Changes in Accuracy Due to Overheating

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Model 630-PLK

BURNOUT PROOF V-O-M

$79.50
Suggested U.S.A. User Net

USES UNLIMITED

School Classrooms • Field Engineers • Application Engineers • Electrical, Radio, TV, and Appliance Servicemen • Electrical Contractors • Factory Maintenance Men • Industrial Electronic Maintenance Technicians • Home Owners, Hobbyists

FACTS MAKE FEATURES:

1. Comprehensive overload protection.
2. One selector switch minimizes chance of incorrect settings
3. Polarity reversing switch

Additional protection is provided by Model 630-PLK's new transistorized relay circuit. Transistorized overload sensing device does not load circuit under test, eliminating the possibility of damaging circuit components. A special meter shorting feature on "off" position offers high damping when moving tester. The exclusive patented Bar Ring Movement provides self-shielding and is not affected by stray magnetic fields. Wider spread scales, and unbreakable clear plastic window assure maximum readability. Diode network across meter protects against instantaneous transient voltage.

TRIPLETT ELECTRICAL INSTRUMENT COMPANY, BLUFFTON, OHIO

RANGES	
DC Volts:	0-2.5-10-50-250-1,000-5,000 at 20,000 ohms/volt. 0-0.25 at 100 microamperes.
AC Volts:	0-3-10-50-250-1,000-5,000 at 5,000 ohms/volt.
Decibels:	−20 to +11, +21, +35, +49, +61, +75; "0" DB at 1 MW on 600 ohm line.
DC Microamperes:	0-100 at 250 Mv.
DC Milliamperes:	0-10-100-1,000 at 250 Mv.
DC Amperes:	0-10 at 250 Mv.
Ohms:	0-1,000-10,000 (4.4-44 at center scale).
Megohms:	0-1-100 (4,400-440,000 at center scale).

Output Volts (AC): 0-3-10-50-250-1,000 at 5,000 ohms/volt; jack with condenser in series with AC ranges.

CARRYING CASE

Model 639-OS black leather carrying case, built-in stand. Flaps open to permit use of tester in the case. Suggested U.S.A. User Net.....$12.10

THE WORLD'S MOST COMPLETE LINE OF V-O-M'S. AVAILABLE FROM YOUR TRIPLETT DISTRIBUTOR'S STOCK.

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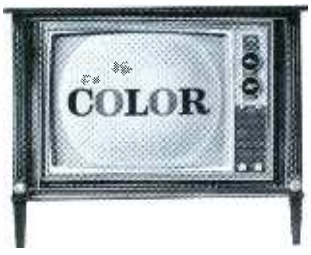
RCA Solid Copper Circuits

replace old-fashioned "hand wiring"...give TV space age dependability.

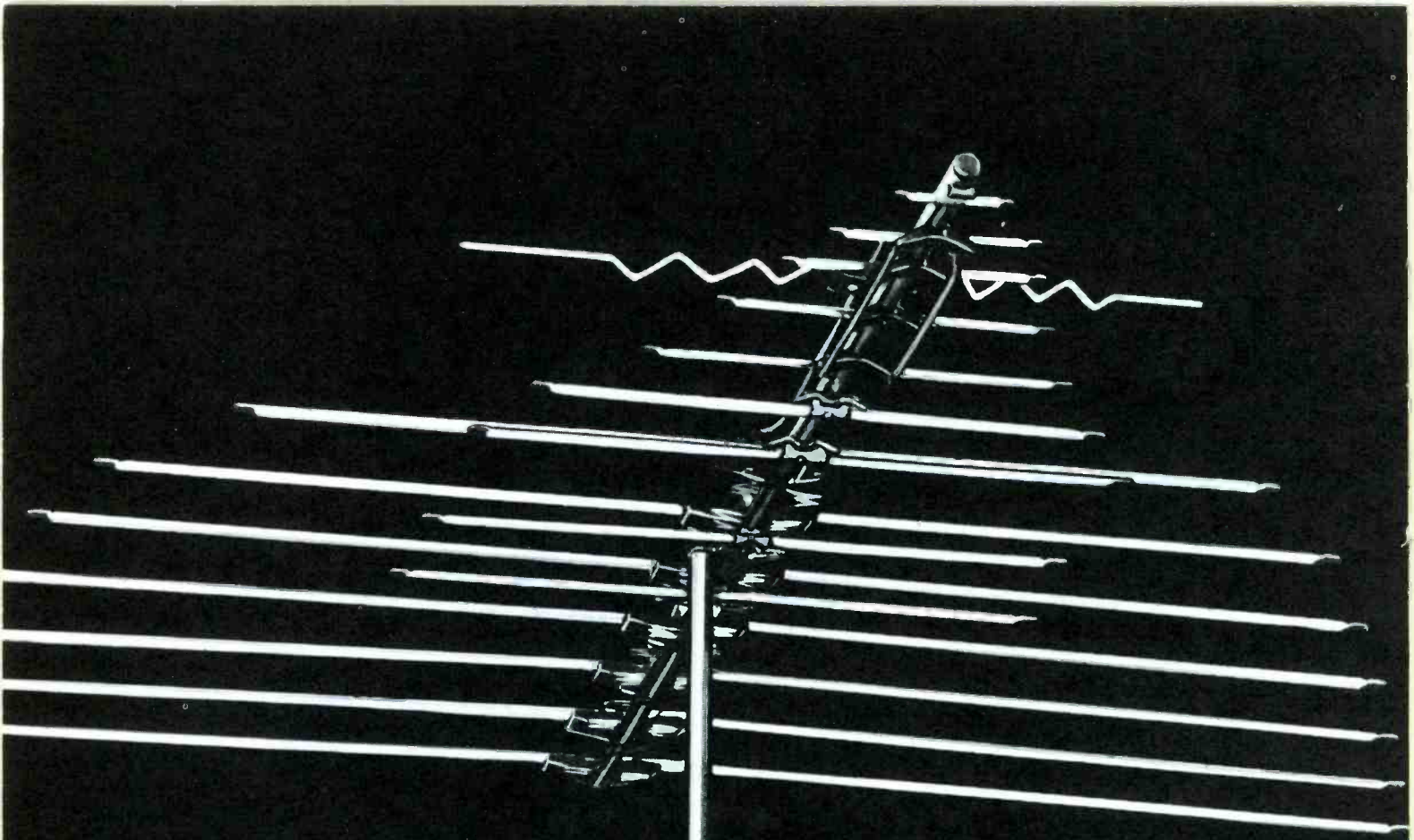
RCA Solid Copper Circuits are made by methods as modern as tomorrow. They give greater dependability . . . better TV performance. It's typical of the advanced design you'll find throughout every RCA Victor home instrument. It all adds up to sets that are easier to service so that owners are more satisfied with results.



RCA The Most Trusted Name in Electronics Tmk(s)®

BRAND NAMES

More TV servicemen own RCA Victor Color TV than all other leading makes combined "HIS MASTER'S VOICE"



HOW DID WINEGARD PUT FULL SIZE POWER IN A ½ SIZE ALL-BAND (UHF-VHF-FM) COLOR ANTENNA?

WITH WINEGARD CHROMA-TEL

the new super-compact high gain antenna designed specifically for all-band UHF-VHF Color Reception and FM

A big disadvantage of most all-band (UHF, VHF, FM) antennas is that they are larger and heavier than necessary. This is because they are really VHF antennas with UHF antennas tacked on the front end. *Chroma-Tel isn't.* It's super-compact and the *first integrated* antenna designed specifically for all-band UHF-VHF color operation.

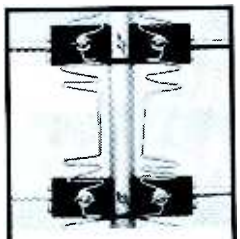
How did we reduce the size so drastically without sacrificing performance?

Two ways. First with our new *Chroma-Lens*

Director System. With this unique system, we are, for the first time, able to intermix *both* VHF and UHF directors on the same linear plane without any sacrifice of performance.

Second, with *Impedance Correlators.* These are the special phasing wires that automatically step up the impedance of Chroma-Tel's 72 ohm driven elements to 300 ohms. The correlators make sure each element has an accurate 300 ohm impedance at its given frequency. No other antennas with multiple driven elements have this! They also allow us to place the elements *only* 5¾″ apart instead of 10″ to 14″ apart as on other all-band antennas, reducing antenna length by one-half.

With the new Winegard Chroma-Tel antenna, we have eliminated *half* the bulk, *half* the wind loading, *half* the storage space, *half* the truck space, and *half* the weight . . . yet still have the best working, easiest installing UHF-VHF-FM antenna ever developed!



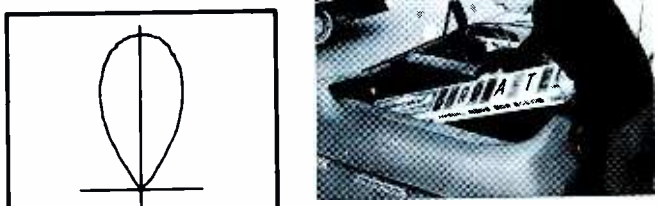
Exclusive Winegard Impedance Correlators insure 300 ohm impedance on each element

You give your customers a neater installation that performs as well or better than any other all-band antenna on the market . . . and at a much lower price.

Compare Performance. You can't find an all-channel UHF-VHF-FM antenna that will give you better results than Chroma-Tel. Look at the polar patterns. There are no side lobes with Chroma-Tel because the elements are straight . . . unlike V'd elements that offer an element surface sideways to the signal, Chroma-Tel's straight elements will not pick up ghosts from sides or back. Chroma-Tel's front-to-side ratio is practically infinite—Chroma-Tel's exceptional front-to-back ratio is up to 30 db.

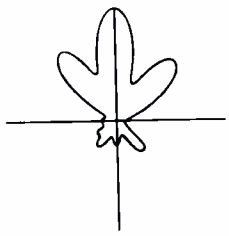
Compare Construction. The Chroma-Tel is Winegard quality throughout . . . from its sales-making compact 4-color box, to its weather resistant Gold Vinylized Finish, to its first quality snap-lock hardware.

For complete information on the exciting new Winegard Chroma-Tel All-Band Antenna, ask your distributor or write for Fact-Finder #242 today.



So compact it fits in the back seat of a car

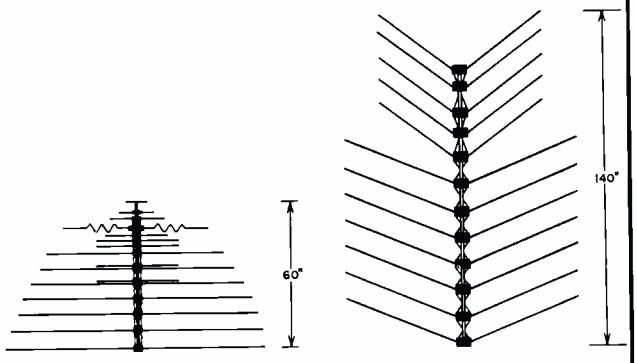
Typical Chroma-Tel Polar Pattern



Typical V Type Antenna Polar Pattern

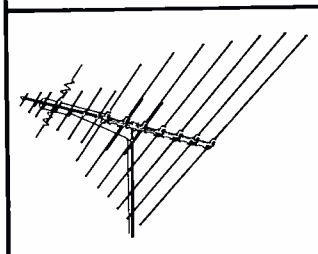
All Chroma-Tels include Winegard's model CS-283 UHF-VHF signal splitter. Splitter hangs conveniently behind TV set. Separates UHF and VHF signals coming from antenna to the two sets of terminals on your set. It's yours FREE when you buy Chroma-Tel.

Compare Size and Price. We've illustrated the super-compact Chroma-Tel CT-80 and a comparable V type antenna. Note the difference in size, price and weight for equal or better performance. Because it's even much smaller than ordinary VHF antennas of comparable performance, it is perfect for attic installations, too!

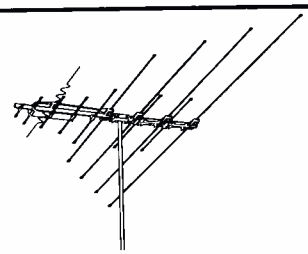


Winegard Chroma-Tel		V type (Approximate Figures)
Boom Length:	60″	140″
Total Weight:	5 lb., 1 oz.	10 lb., 3 oz.
Carton Size:	.97 cu. ft. (less than 1)	5.8 cu. ft.
Number of Elements:	17	12
List Price:	$27.50	$50.00

Model CT-90 $37.50



Model CT-80 $27.50



Model CT-40 $17.50

Winegard Co.
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The move's on to

JERROLD

Coloraxial™

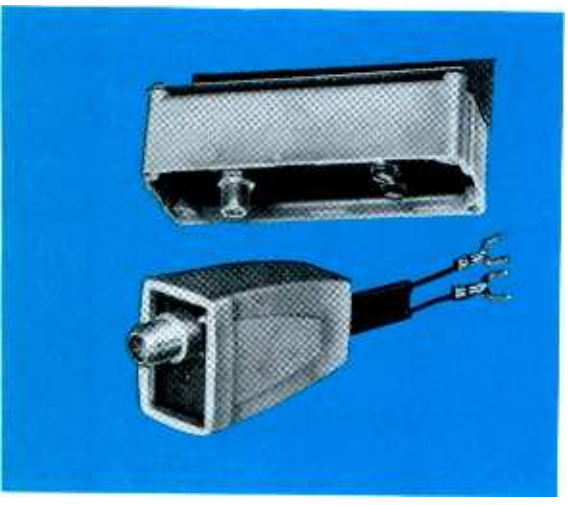
best for color . . . best for black-&-white . . . best for FM . . . best for business

The days of twinlead are numbered. Spurred by Jerrold's introduction of Coloraxial, both the TV trade and the public are moving unmistakably towards this revolutionary shielded coaxial antenna system—not only for great color TV, but for black-&-white and FM stereo too.

And, starting this Fall, a big national advertising program in TV Guide will have your customers asking even more for the perfection in reception that only Coloraxial offers.

So important is 75-ohm Coloraxial in your future that Jerrold now offers a wider line than ever of Coloraxial products to meet every reception need from metropolitan to deepest fringe areas. On these pages are described a complete range of Coloraxial antennas with 75-ohm output; matching transformers for converting existing 300-ohm antennas to Coloraxial operation; Coloraxial Powermate preamplifiers; and 50- and 75-foot lengths of Coloraxial cable complete with screw-on fittings. One of the easiest—and most profitable—jobs you can do is install a Coloraxial reception system.

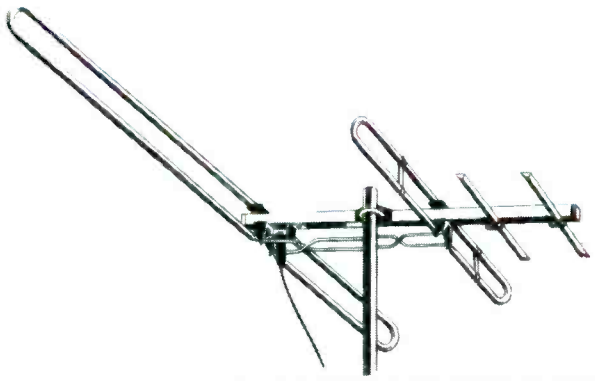
There's a pocket-size Jerrold Blue Book waiting for you at your distributor's. It's yours to use in figuring installed Coloraxial prices for your customers. The Jerrold Blue Book is just one part of a big five-part program your distributor has ready to help you sell Coloraxial installations this Fall. Talk to him now.



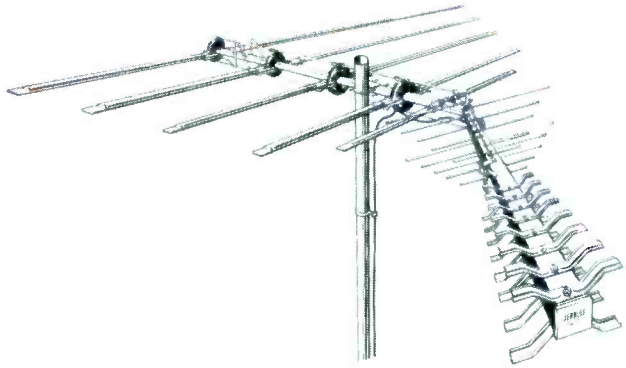
COLORAXIAL MATCHING TRANSFORMERS AND KITS Model TO-374A mast-mounting transformer converts any existing 300-ohm outdoor antenna to 75-ohm Coloraxial operation. Model T378 mounts on set to match it to 75-ohm coax. Available separately or as a set in Kit Model CAT-2.

COLORAXIAL SHIELDED CABLE Here's the heart of every Coloraxial installation—the reason for it all. Coloraxial is the highest-quality shielded RG-59/U cable, factory sweep-tested and complete with screw fittings and a weatherboot for the outdoor connection. Models CAB-50 and CAB-75 contain 50 and 75 feet of cable respectively. Model K-CAB-50 contains 50 feet of cable and one each of Model TO-374A and T378 matching transformers.

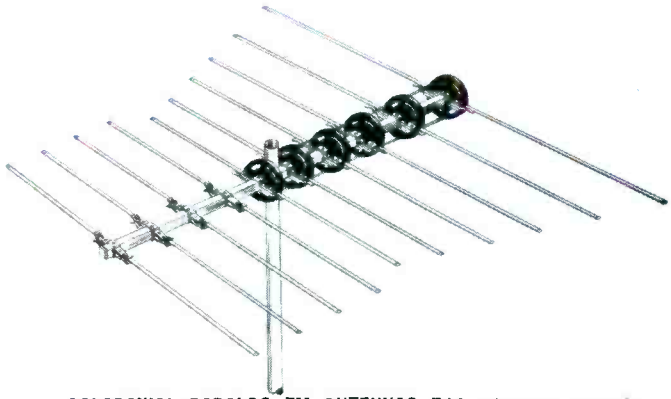
COLORAXIAL POWERMATES The coaxial versions of the transistor antenna amplifier that set an industry standard, made "fringe area" a thing of the past. Model SPC-103 has two transistors, Model SPC-132 "De-Snower" has five transistors in two-stage preamp-postamp. Both Powermates are pre-matched to antenna and receiver, making separate matching transformers unnecessary.



COLORAXIAL COLORGUARD ANTENNAS AND ANTENNA KITS Like all the antennas shown here, Coloraxial Colorguards are already equipped with 75-ohm output to coaxial downlead. Three models (CAX-16, 17, and 18) for metropolitan and suburban reception areas. Model CAX-16 is also available in kit form with 5-foot mast and trimount, CAB-50 cable with fittings and weatherboot, and set-mounting T378 matching transformer—everything you need for a complete Coloraxial installation.

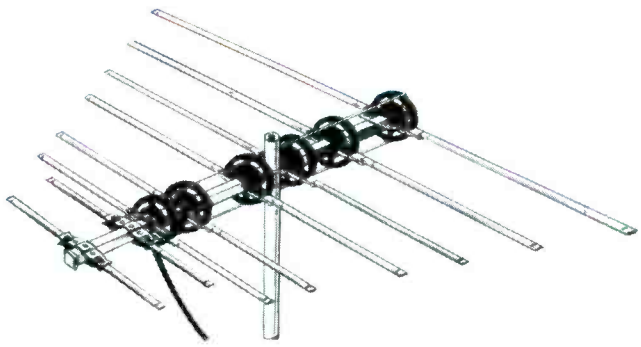


COLORAXIAL PATHFINDER VHF/UHF/FM ANTENNAS The first all-channel antennas with 75-ohm output and individual orientation of VHF and UHF sections in one hinged unit. All the flexibility of separate antennas without splitter losses. You have a choice of five PATHFINDER models, PXB-30, 45, 50, 70, 90.

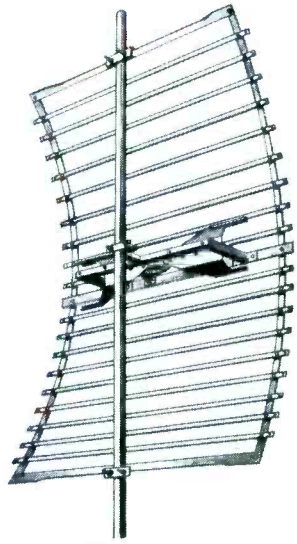


COLORAXIAL PARALOG FM ANTENNAS FM stereo needs Coloraxial too! So the outstanding Paralog FM antenna line is now offered also with Coloraxial 75-ohm output. Three models, FMPX-8, 10, and 16.

COLORAXIAL Stratophonic FM YAGI AND KIT This fine five-element yagi antenna, pre-matched to 75-ohm Coloraxial operation, keeps stereo signals in, keeps interference out. Model FAX-5, available also in kit form with mast, trimount, 50 feet of cable with fittings and weatherboot, and set-mounting matching transformer —everything you need for a complete Coloraxial stereo installation.



COLORAXIAL PARALOG TV ANTENNAS The full line of seven renowned high-gain Paralog log-periodic VHF antennas is now available pre-matched to 75-ohm Coloraxial cable. In the wide range of Paralogs (Models PAX-40, 60, 100, 130, 160, 190, and 220) you can choose the perfect antenna for metropolitan to deepest fringe reception.



COLORAXIAL PARACYL UHF ANTENNAS These five famous all-band UHF antennas, now available with 75-ohm Coloraxial output, feature an extended-resonance driver which assures effective operation over the entire UHF band (Ch. 14 to 83). Models JUX-1, 2, 3, 4, 5.

JERROLD ELECTRONICS CORPORATION

Distributor Sales Division ■ 15th & Lehigh Ave., Philadelphia, Pa. 19132

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JERROLD

The new Amphenol 860 Color Commander cuts alignment time in half!

Ever finish a convergence job to find the raster off center. Lose convergence when you re-centered? Can't happen with the Amphenol Color Commander, battery-powered, solid-state color generator. A special, single-crossbar pattern consists of one horizontal and one vertical line, crossing just where the center of the raster should be. No need to guess when centering the raster with this new pattern.

See dots before your eyes when you want only one to start static convergence? The 860 gives you that single dot, right at center screen. You'll be switching back to this important dot during dynamic adjustment to make sure you haven't gone off the track.

Even the old patterns offer something new. Line spacing in the cross-hatch pattern is rigidly maintained for the 4:3 aspect ratio. You can rely on it for linearity, height, and width adjustments. The pattern gives you finely etched line width at normal brightness levels. What good is perfect convergence at reduced brightness if you lose it when the set's readjusted for normal viewing? This special crosshatch also eliminates receiver fine-tuning error. Among the 860's nine (most generators have only 5 or 6) are: multiple-dot, single vertical line, single horizontal line, vertical lines only, and horizontal lines only.

Finally, the Color Commander's unique color bar pattern (just three bars: R—Y, B—Y and —R—Y)simplify color adjustments. You can get a rapid, overall check of color circuits. Then adjust color demodulator phase or pre-set the hue control and check its operating range. In each step, you know precisely how the color bars should look and how they should change during adjustment.

A new timing circuit eliminates instability and loss-of-sync problems. Silicon transistors maintain built-in precision and stability indefinitely. RF output is on channel 3 or 4, switch selected. An attenuator simulates weak-signal conditions. It has gun killer circuit. Uses 9 penlight cells. Weighs 3½ lbs. in compact leatherette carrying case. $149.95. Optional AC power supply, $19.95.

AMPHENOL CRT COMMANDER, MODEL 855. Solid-state. Checks all black-and-white or color CRT's with the same techniques used by tube manufacturers. Rejuvenates where others fail. Versatile 5-socket cable accommodates 7 different sockets. With CRT chart, $89.95.

See the new Color Commander test instruments at your Amphenol distributor.

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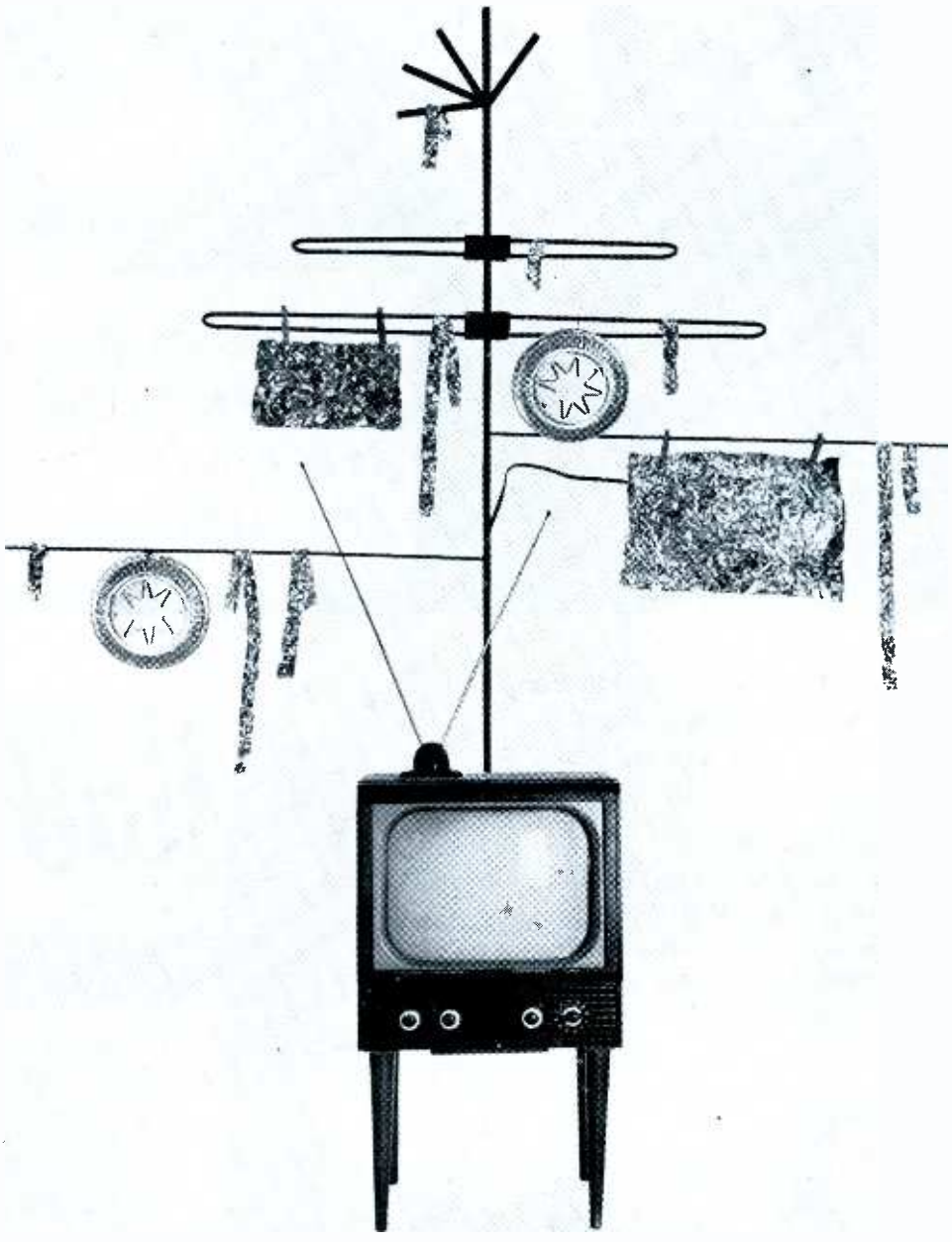

aerial view: do-it-yourself style

He's going to need a real antenna. So he'll be looking in the Yellow Pages. The chances are 9 in 10 he'll then take action. Will he see your ad?

When his wife sees his creation, this man will be joining the 21 million people who turn to the radio, television, and high fidelity headings of the Yellow Pages every year. (That's 33% of the entire market!)

When he does look in the Yellow Pages, chances are 9 in 10 he'll either call, write, or visit. (Every 100 references to the radio, television, and high fidelity headings of the Yellow Pages bring 93 calls, letters, or visits!)

That's action! With Yellow Pages ads you can expect that kind of action . . . a recent extensive national usage study — consisting of over 19,000 interviews—proved it.

Call your Yellow Pages man. He'll show you what the study learned about your business. And he'll be glad to help you plan your own Yellow Pages program. You'll find him in the Yellow Pages under "Advertising — Directory & Guide."

Advertise for action... Yellow Pages

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WHY... SERVICE COLOR TV?

WHY WAIT? YOU CAN MAKE MONEY NOW!

...IF YOU'RE EQUIPPED – AND A WIDE BAND SCOPE IS A MUST

☆ ☆ ☆

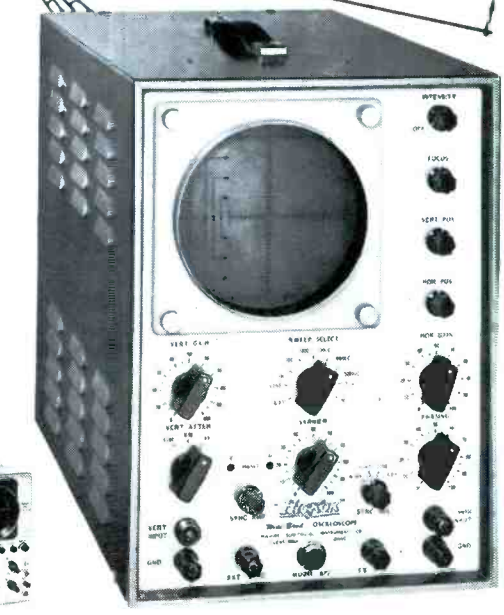
1,300,000 SETS SOLD IN '64
97% OF NBC PROGRAMMING TO BE IN COLOR
OVER 4,000,000 NOW IN USE

This Hickok-quality, full 5", wide-band scope – factory assembled, wired and calibrated can put you in color TV service . . . for less than $200.00.

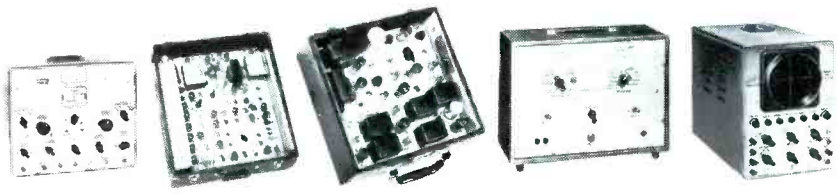
- Rise time–less than 0.08 μsec.
- AC response–5 cycles to 4.5 MC within 3 db
- Vertical sensitivity–40 MV RMS/inch
- 5 times horizontal sweep expansion
- Sharp, bright (1600 volts anode potential) trace with full astigmatic correction

and, of course, it's . . .

Only $199.50 MODEL 677



THE COMPLETE COLOR LINE



MODEL 615 MODEL 656XC MODEL 660 MODEL 661 MODEL 675A

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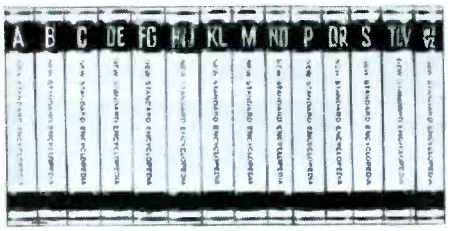

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TRAINING SYSTEMS FOR MODERN TECHNICIANS

Anyone who wants to can learn advanced techniques.

by Larry Allen

At a recent meeting of service-shop owners, business problems were being discussed, and several of the businessmen pointed out that getting more business is not their chief problem — finding competent service technicians to take care of the business they now have is their real headache. Sure, they admitted, there are a lot of men around who work on radio, TV, and hi-fi sets; but the demand is for technicians who are *competent*.

There are three types of would-be technicians who fall outside the "competent" description. First, of course, there is the beginner, who knows very little about electronics. Then there are the partly trained technicians, who can change tubes and make minor adjustments, but whose training is limited; and, lastly the trained technician who hasn't kept up with advancements in electronics. With training, all three of these types can become the competent technicians shop owners need. Their interest must be considerable, however, and their training needs are entirely separate.

Training Requirements

The beginner first has to obtain a full grounding in electronics theory and the fundamentals of servicing. He must learn about electrons, magnetism, current, voltage, inductance, capacitance, resistance—and all the hundreds of characteristics and parameters he'll encounter during his years in electronics. Then he must learn circuits—how they work, how they form stages, and how stages interrelate in complete systems: i.e., television, hi-fi, communications, radar, or what-have-you. Finally, he learns troubleshooting techniques for whatever particular variety of equipment will be his specialty: television, industrial equipment, communications gear, audio systems, etc. He may learn advanced techniques for more than one specialty. He might go even further and learn the fundamentals and principles deeply enough to become a design engineer or research technician. Whatever his specialization, he must have thorough training and then some experience before he can take his place among the truly competent in his field.

The partly trained technician gets that way by several possible routes. He may have taken a limited course in electronics, or stopped his training before he completed the prescribed curriculum. He may have learned as an apprentice to some technician, or even on his own, thus never completely learning any of the why's of electronics.

To advance into the ranks of competent servicemen, the partly trained technician must fill in the gaps in his electronic knowledge. A regular course in electronics would probably bore him; what he needs is training that will explain the fundamentals of the phenomena with which he is already familiar, that will explain electronic circuits and teach him advanced servicing methods.

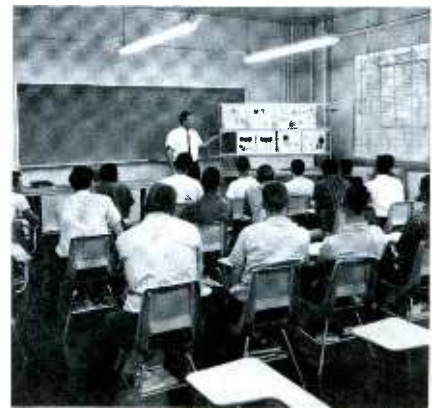
And then there are the otherwise competent technicians who have sat by and allowed the technology of electronics to sweep over them, neither moving with the industry nor taking advantage of the momentum. Color TV, transistors, industrial electronics, communications — all have become major fields of electronics. Some technicians have alternately ignored them, despised them, and feared them. The problem is inadequate understanding of new technology, and the answer to the problem is training.

No matter at what level of ability a technician may find himself, he has only to recognize the need for further training and he can find it in dozens of ways. There are many forms of training available to every aspiring technician who wants to improve his electronic capability.

Training Programs

Perhaps you are a shop owner who needs to find and train new technicians, perhaps you have some technicians who must be upgraded, or maybe you are one of those technicians who has recognized his own need for additional training. Where and how can such training be found?

There are many training programs. Some shops develop their own, suited especially to particular needs. Often they have some specialty, or take on a new line that demands special training for their technicians. The shop owner can: hire a special instructor one or two nights a week to develop and present a course that fits the exact needs of his technicians (and himself, sometimes); adapt material from some local technical school and have one of the school's instructors administer the training, either at the school or at the shop; or procure material and place it at the disposal of the shop technicians, in which case they are



left to learn for themselves whatever they can.

In the first instance, unless the shop owner is expert in both the specialty and teaching, the results are not always what might be desired. By the second and third plans, a course can usually be developed that will provide the most benefit for the time and effort expanded, and can often be made to fit well into an apprentice program. The last means is patently the poorest and is only a last resort on the part of a shop owner who can't afford the time, trouble, or dollars to do the job right. In all of these shop-oriented programs, the shop owner normally foots the bill, although the technicians should donate their study time after shop hours.

Less expensive to the individual shop owner, or to the individual technician, are those training programs sponsored by servicemen's associations, technicians' unions, and (more often) by distributors or manufacturers. These programs frequently are specialized, designed to upgrade the already practicing technician, but more basic courses are sometimes available.

Any cost of specialty clinics is usually borne by the technician taking them, although some shops pay to have their technicians attend. Manufacturer- or distributor-sponsored clinics are almost invariably specialized and seldom require payment. Sometimes they last through several daily or nightly sessions; sometimes they are single-session clinics. By making use of whatever free clinics are available, you can trim the cost of technician training considerably.

For the beginner in electronics, an apprenticeship program is usually inexpensive and effective. A few union locals have instituted rather thorough apprentice-training programs; apprentice members spend at least two nights a week in classroom study under a competent instructor, do a certain amount of additional studying at home, and work regular hours for some service shop that is participating in the program.

The beginner needs comprehensive training starting with the barest fundamentals. Even if he's read a lot of books, there are probably wide gaps in his knowledge. His further education should not be left to the specialty or clinic type of training; without an apprenticeship program, he should pursue his professional training in some regular school for electronics—correspondence, public vocational school (in adult-education classes), or private resident school with day or night classes. Most of these offer a wide variety of specialization after the student has completed certain basic courses. Some allow credit for basic training already completed (provided the enrollee can show reasonable proof) and allow the student to enter right into specialized courses.

Few shop owners will pay to send a prospective employee through any of these courses, although some will pay a portion of the tuition if the student is on an apprenticeship agreement of some sort. For specialized courses, some shops pay and some do not; considering the benefit the technician receives from his increased ability after taking such courses, it isn't at all unfair for him to bear the cost.

Correspondence schools have the obvious advantage of permitting the technician to progress at his own rate of speed in the new technology, while allowing him to work at a full-time job. Courses available range from short, specialty-oriented refreshers to comprehensive, start-from-scratch engineering courses that lead to limited degrees. Accreditation is by the National Home Study Council. Also by correspondence, the extension divisions of some universities offer courses that apply toward full college degrees.

Public vocational schools, operated in conjunction with a high school or junior college, are available to regular students. An increasing number of these institutions, however, have adult education programs that offer vocational instruction in night classes. Their electronics courses are usually limited in scope, with emphasis being divided among basic, intermediate, and advanced electronics. The first covers fundamentals, the second circuits, and the latter basic servicing and troubleshooting. Some public vocational schools offer specialized courses: transistors, color TV, or instruction leading to a ham license or a commercial radio-telephone license. The cost of these adult-education classes is usually very reasonable—seldom more than $25 or $30 for a 13-week course conducted one night a week. In junior colleges, these students may receive college credit.

Private technical schools offer probably the largest variety of possible course combinations. Some hold daytime-only classes, some nighttime-only, and others both. The costs are usually higher than with any other of the training methods mentioned, but great effort is expended to make the training thorough and all-inclusive. Laboratory facilities are almost invariably provided, and training time is divided between classroom lectures and lab work. The training thus received is generally the most complete that can be had.

Some private schools offer special training services, too. As examples: One school has set up a full training program for apprentices, an 8-week refresher course in transistors for experienced technicians, a 13-week color-servicing course, and a course leading to a second-class commercial radiotelephone license —all in conjunction with a servicemen's association, and all at exceptionally reasonable cost. One school flies an instructor halfway across the state twice a week to teach a

seminar for another association, sponsored in part by distributors in the area. For students who need financial assistance and wish to take the full electronics-engineering curriculum, some schools will help arrange part-time work and schedule classes so the students can study a half-day and work a half-day.

Types of Courses

Having selected the type of school that will best serve your needs, you'll want to know a little more about the kinds of courses offered and be able to choose whichever suits the goal you have in mind for your technicians (or yourself).

Basics

The importance of a thorough knowledge of electronic fundamentals deserves to be stressed and restressed. It is surprising how many technicians have short-changed themselves by not taking the time and trouble to really understand the basic principles of electronics. Every circuit, every stage, every instrument, every piece of equipment you'll ever be called on to service will operate absolutely according to these principles. If you have trouble understanding any system—from a lowly AC-DC radio to complex radar or computer systems—it is likely you have failed to grasp fundamental concepts of how electronic parts and circuits operate.

Realizing this, every school that does not specialize in a narrow subject area offers basic electronics as their fundamental course. Indeed, some institutes offer a course in basic electronics as a separate unit; the technician can use it as a refresher or a gap-filler, and the student uses it as his starting point.

Basic courses usually cover electron theory, operation of components and tubes, magnetics, semiconductors, basic circuits (power supplies, amplifiers, oscillators), and a generalized study of the overall electronics industry. The latter helps students choose their field of specialization more intelligently. Advanced courses (or sections) then emphasize specific systems.

Radio-TV

Specialized training in servicing radio and TV sets is available from most schools, although industrial and communications specialties have become more popular with students. In general, radio-TV training covers —beyond basics—circuitry, troubleshooting analysis, and some lab work in servicing techniques.

Lab work isn't always confined to resident schools. Correspondence schools provide similar experience with kits. The student builds circuits, tests them, and finally assembles an entire chassis. Then he introduces various faults to learn their effects on the set. While this method doesn't duplicate the mental exercise of hunting the causes of trouble put in by an instructor, it does lead to a certain familiarity with the nature of various equipment faults. Troubleshooting steps and procedures can be learned thoroughly this way if the student applies himself conscientiously.

Radio-TV courses include servicing of AM radios, FM radios, TV sets, phonos, hi-fi systems, and other audio systems. Some include more details of specialization than others, but all make some effort to acquaint the student with the overall picture of consumer electronics. It seems likely that such courses eventually will be called "consumer-electronics training" to differentiate between them and the commercial or industrial electronics curricula.

Industrial

Courses in industrial electronics resemble to some degree the study that has been associated in the past with industrial electricity. Industrial electronics still covers heavy-duty motor and equipment controllers, but it also includes many of the more exotic instruments being introduced regularly — ultrasonic drills, cleaners, and grinders; electronic welders; laser cutting and welding tools; and many other unusual types of equipment used in manufacturing and other industrial processes.

Curricula for industrial courses include the same basics as other electronics studies, plus some of the fundamentals of heavy-duty electrical wiring and switching. Beyond this, students learn of special circuits that are used in industrial systems: closed-loop control arrangements, magnetic amplifiers, high-current power supplies, photosensors, special metering systems—to name just a few.

Other Specialties

The variety of specialized courses is great. Besides those already discussed, there are: transistor and solid-state technology; advanced color-TV servicing; commercial sound and acoustics; communications operation and servicing—including commercial two-way, CB, amateur, radio and TV broadcasting, marine and aircraft communications and navigation equipment (and radar), all of which require an FCC license of one grade or another; computer technology; medical electronics; automotive electronics; and so on. Each of these courses either includes basic electronics training or requires that the enrolling student show proof of this prerequisite knowledge.

One other important specialty, often excluded from technician courses but extremely important to any shop owner, is that of business management. For the technician not so trained, short courses in fundamental management are offered by most public-school and college adult-education programs. Further, books on the subject are available,

• *Please turn to page 72*

Tracking GRAY SCALE in new color sets

Keep the black and white picture true.

by Carl Babcoke

Remember the peculiar raster colors you could produce with the screen and background controls on the older color receivers? You needed much patience and perfect color perception to ever make the picture look similar to that on a black-and-white set. Thanks to the design engineers, the improved circuits in the new receivers have made tracking both fast and easy.

But the original circuits do illustrate basic screen color action more clearly, so a look at them provides a good review.

Basic Action

At first thought, the action of the background and screen controls may seem to be the same. Increasing either will brighten the associated color and change the raster color over the whole screen. The contrast control of a b-w receiver appears to have the same action as the brightness control, if both are rotated a small amount. But if the picture with full contrast and low brightness is compared to one with low contrast and high brightness, the difference in action will be readily apparent. So it is with background and screen controls on a color set.

It is helpful to compare the picture-tube gun with a sharp cut-off pentode tube. A little experimentation with such a tube will show that the grid bias has more effect on the plate current than does the screen voltage, when the bias is set for high gain. But when the tube is biased near cut-off, the screen voltage becomes very critical and has more effect than the bias. High plate current in the pentode corresponds to high brightness in the picture tube. Thus the background (bias) control has more effect on the bright parts of the picture (highlights), and the accelerating anode (screen) voltage has more effect on the darker picture elements (lowlights).

The screen voltage has two effects other than changing the brightness. The spot size and shape produced by the electron gun depend partially on this voltage; the higher the screen voltage, the sharper the scanning beam. This is especially noticeable on highlights. The screen voltage also affects the visible contrast, even though the video voltage is unchanged. Higher screen voltages decrease the contrast, and lower screen voltages increase it. Within certain limits, the screen voltage can be used to make the contrast match on all three colors. For example: The highlights are normal white, but the lowlights are bluish. The blue has insufficient contrast, so the screen voltage is lowered and the background raised to bring the highlights into balance again. Notice how this checks with the rule about background and screen controls given in the last paragraph.

Even with these trustworthy guides, good tracking was often difficult for three background and three screen controls add up to unlimited possibilities for wrong adjustment. You could just glance at a set and see it was a color receiver by the pink highlights and cyna lowlights!

The chaos cleared a little when it was discovered that tracking usually worked best when the bias was nearly the same on each gun. Then one screen control could be set, and four of the six controls were preset. It is not convenient to measure between cathode and grid of each gun; a shortcut is needed. Refer to the partial diagram of an RCA CTC5 in Fig. 1. At normal

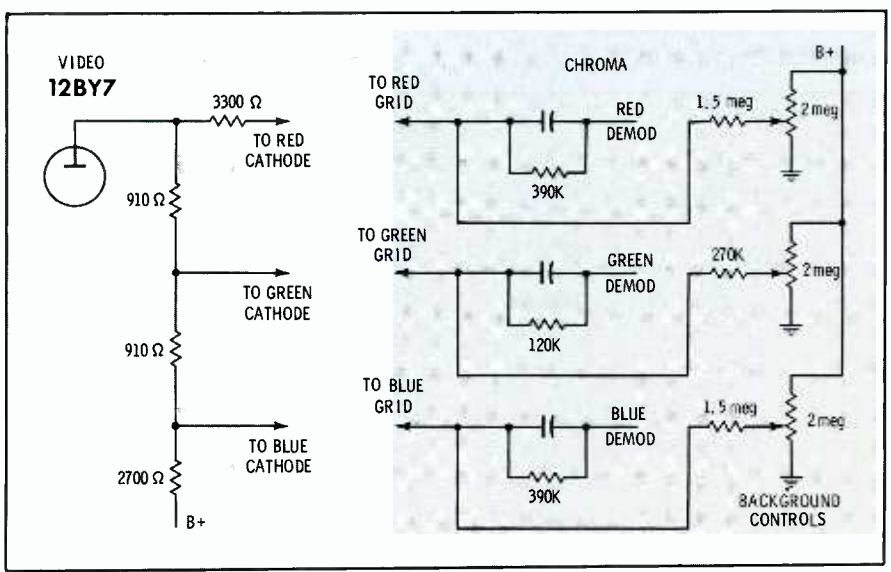


Fig. 1. Partial schematic shows bias networks for picture tube in CTC5A.

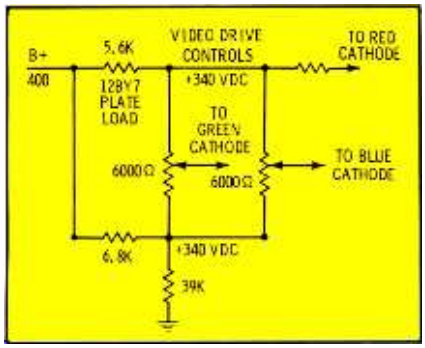


Fig. 2. Simplified circuit in CTC16 with switch set in "service" position.

contrast, there is about 10 volts DC difference between the red, green, and blue picture-tube cathodes because of the voltage divider which sets the amount of video fed to each gun. A VTVM can be used to adjust the background controls so that the green grid is 10 volts more positive than the red, and the blue 10 volts more positive than the green. One screen control (red) is preset, and the other two screens are set for a good blue-white picture.

Adjustments in the Newer Sets

A new concept in tracking was introduced about 1960 in the RCA CTC10 chassis. Variations of this circuit are now found in nearly all new receivers. Seven controls are used, one more than in the older circuits, but the adjustments require very little critical judgment when done in sequence, and a meter is not necessary.

The RCA CTC16 is typical of these circuits; here is how it works: In the SERVICE position, the NORMAL-SERVICE switch stops the vertical sweep and disconnects the video amplifier from the CRT cathodes so that the brightness control has no effect. With no vertical sweep, only a single horizontal line can be obtained; it is much easier to adjust than a whole raster. Fig. 2 shows the simplified circuit with the switch in SERVICE position. The biases should be the same because the picture-tube grids are directly coupled to identical (R-Y, G-Y, and B-Y) amplifiers and the cathodes go to the video-drive controls, which have the same DC voltage on both ends and no video. The three screen controls are adjusted for a blue-white line at very low brightness (where their adjustment will be accurate). The last step is to supply the right amount of video drive to each gun. The switch is thrown back to the NORMAL position, and the drive controls are adjusted visually on a normal b-w program. Note the drive controls also increase brightness as the video is increased, since there is about 10 volts across them. See Fig. 3.

The same tracking procedure does not necessarily work perfectly on all brands and models, although there is a similarity. Some of the main variations are listed here.

Tracking procedures for the new Zenith 25MC30 and 25MC36 chassis are very similar to those for the older RCA CTC10 series. The only differences involve terminology:

1. Tune in a black-and-white picture; set COLOR CONTROL to minimum.
2. Turn CRT BIAS control and RED, BLUE, and GREEN G2 (screen-grid) controls to minimum (fully counterclockwise).
3. Move NORMAL-SETUP switch to SETUP (service position).
4. Advance the screen controls one at a time until each produce a barely visible line on the screen.
5. If any control fails to produce a line, leave that control at maximum; return the two other controls to minimum.
6. Advance the CRT BIAS control until a barely visible line appears.
7. Advance each of the other controls until a barely visible line appears.
8. Return NORMAL-SETUP switch to NORMAL.
9. Adjust the BLUE and GREEN GAIN (drive) controls to produce a normal b-w picture. To eliminate coloring in the low-light and highlight areas of the screen, check at all brightness levels and readjust slightly if necessary.

The Motorola TS-912 has no switch (all adjustments are made with a full raster), and the G-1 bias controls are in the plate circuit of the chroma demodulator. Circuit differences change the procedure required for tracking adjustments:

1. Set the CONTRAST control to minimum.
2. Set the G-2 screen-grid controls to maximum.
3. Set all three G-1 controls to minimum.
4. Turn the BRIGHTNESS control until the raster is just visible.
5. Reduce the G-2 controls of the predominant colors until a gray raster is obtained; leave the G-2 control of the weakest color at maximum.
6. The G-1 controls are advanced to give a gray raster with the BRIGHTNESS control turned 5 degrees above minimum.
7. With a normal BRIGHTNESS setting, touch the G-1 controls for a white raster. It may be necessary to go back and forth from low to normal brightness for proper tracking.

The Motorola WTS-907 differs mainly in that it has a MASTER G-1 control instead of individual controls. The procedure for this chassis is as follows:

1. Set the CONTRAST control to minimum.
2. Set the G-2 controls to maximum.
3. Set the MASTER G-1 control to minimum.

• *Please turn to page 74*

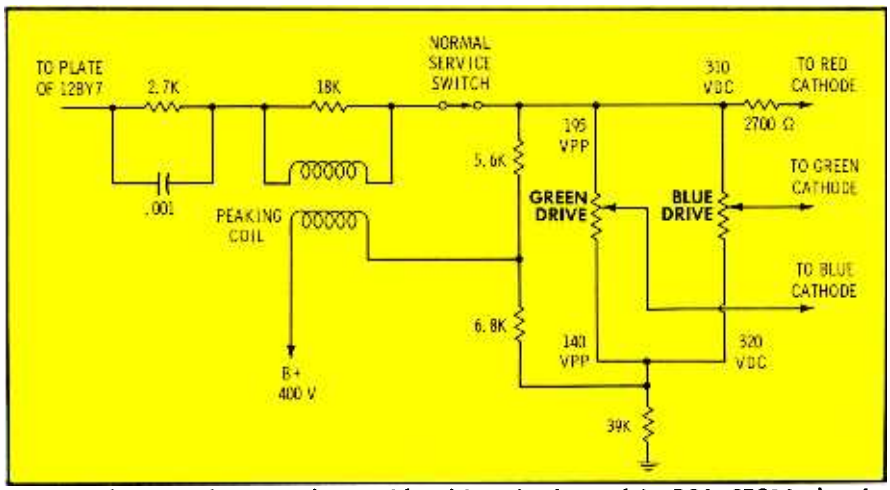


Fig. 3. Schematic diagram shows video-drive circuit used in RCA CTC16 chassis.

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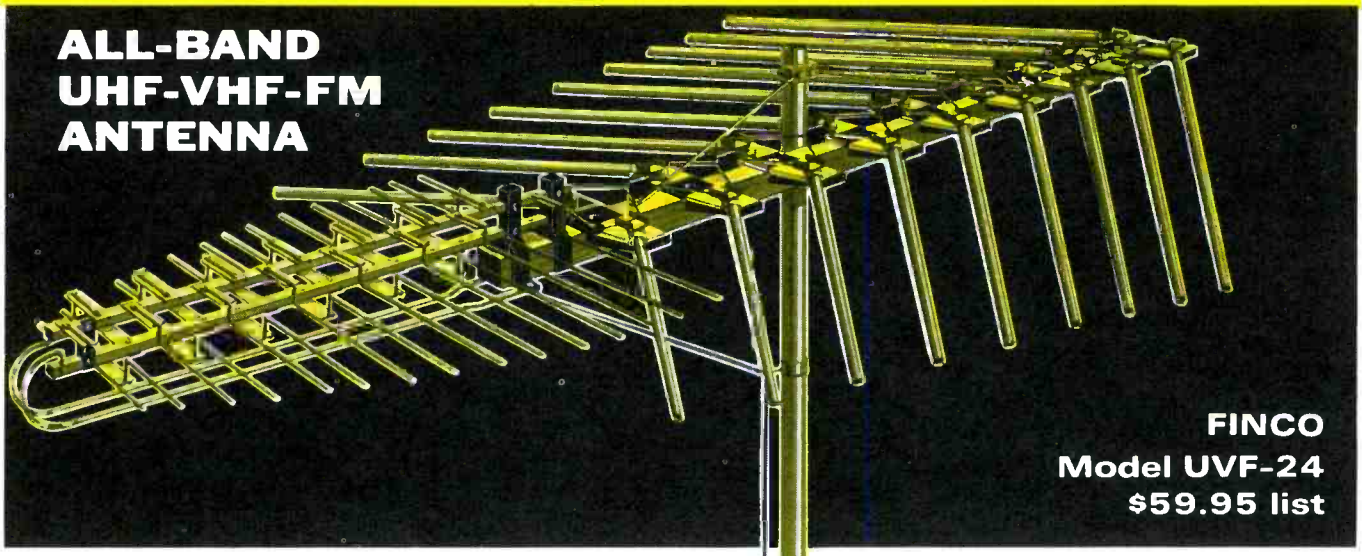

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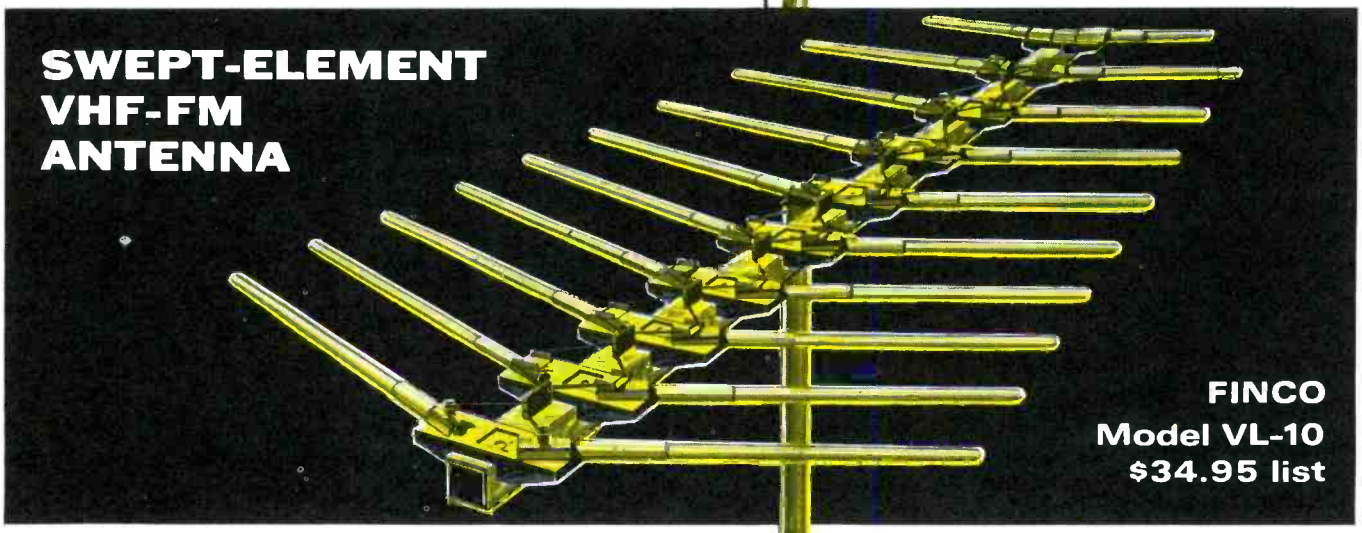

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how TRANSISTOR AMPLIFIERS work

Basic semiconductor circuit fundamentals.

by Wayne Lemons

A good many technicians are still scared by transistor servicing. This is too bad since so many new electronic devices are transistorized and the number is bound to increase even more. The fear of transistor circuits is generally caused by a lack of familiarity with what is supposed to be happening in the circuit and how best to approach the testing of the circuit.

Any technician who has made his living from servicing tube amplifiers should not have too much trouble adjusting to transistor servicing, but he *must* make the adjustment. Tubes and transistors are certainly not alike, but neither are they completely different. Both act as variable resistors whose resistance can be changed by application of voltage or current to the control element.

The main differences in tube and transistor circuits can be summed up in four lengthy statements:

1. Transistors use lower voltages and generally more current. This simply means that, with AC supplies, the transformers will have lower-voltage secondaries with lower current ratings. The rectifier system is often a bridge type but may also be half-wave or center-tap full-wave. The filter systems will have higher-value electrolytic capacitors to supply the additional current necessary to smooth the ripple. Electrolytics can range in excess of 2000 mfd in higher-power amplifiers, and in addition, chokes of fairly high impedance and low DC resistance may also be used as part of the filter system.

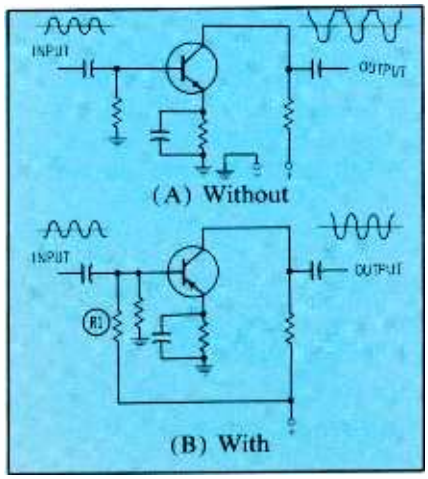

Fig. 1. Showing the effects of biasing.

2. Transistors draw current from the driving source and in most circuits have low-impedance inputs. This means a portion of the power to drive the transistor is derived from the signal circuit. This might seem to be a disadvantage, but it doesn't have to be. For example, low-impedance microphones, tape heads, and some variable-reluctance phono cartridges are designed to work best into a low impedance; these devices can be connected directly into a transistor circuit without the use of a matching transformer. The gain in a transistor circuit often exceeds that in a tube circuit and may compensate for the absence of the step-up transformer.

The low input impedance of a transistor must be considered in the circuit design. For this reason, coupling capacitors in resistance-coupled transistor circuits are much larger than for equivalent tube circuits, and resistors are smaller.

3. Transistors have little or no current flow unless they are biased. Unlike a tube, whose plate current increases as bias approaches zero, a transistor with zero bias has no current flow. This point may give the inexperienced technician considerable trouble.

Fig. 1A is a common-emitter circuit that appears equivalent to a triode tube amplifier. This transistor circuit will not work too well, because the transistor is zero-biased, and the output will be distorted. No bias voltage is applied to the base, and without it collector current is virtually zero. (The only reason for any current to flow would be inherent leakage between collector and base, which would bias the transistor in the proper direction for current flow. This is why base-circuit impedances are kept low.) If we introduce an audio signal into this circuit, the negative half of the input signal will only cause the NPN to conduct even less, if that's possible. The positive half of the input signal will increase the collector current considerably, but not in a linear fashion. Since operation is at the bottom knee of the characteristic curve, the output is terribly distorted.

Fig. 1B shows all that is needed (resistor R1) to make this circuit a practical one. Resistor R1 adds the forward bias necessary to keep the transistor conducting continuously; now the rise and fall of collector current will be in exact step with the input signal (linear operation) because operation is on the straight portion of the characteristic curve. Thus we get no distortion in the output.

One question still arises: Why not use emitter biasing alone, similar to cathode biasing in tubes? This of course is because transistors do not conduct until they have some forward bias, and without conduction there is no current through the emitter resistor to produce any bias voltage. Some degree of emitter biasing is used almost universally in good amplifiers because it helps keep the transistor operating at a linear point; it also provides protective bias which overcomes the tendency of a transistor to draw excessive current as the temperature of the junctions rises (thermal runaway).

4. One factor that seems to throw beginning transistor technicians, who have cut their teeth in tube circuits, is the different power-supply polarities required by the two general types of transistors—the NPN and the PNP. Remembering which is which is easy—peg your memory on the *middle* letter and the collector. That is, for the NPN, the collector should be very *positive* and the base should be slightly *positive*, both with respect to the emitter. In the PNP, the collector and base should be *negative*. This means that power supplies may have either a positive or a negative ground.

To complicate matters even fur-

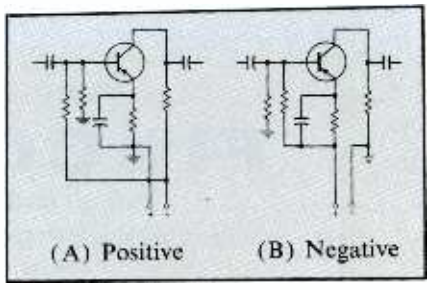

Fig. 2. Any circuit point can be ground.

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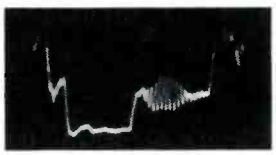
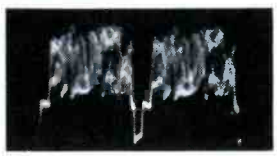
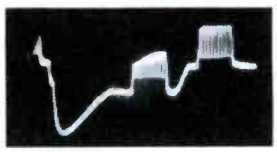


One horizontal sync pulse with its color burst.

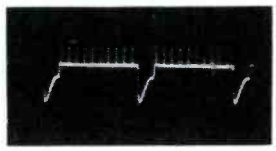


Two lines showing horizontal sync pulse with black and white tv signal.

TRANSISTORIZED B&K MODEL 1245

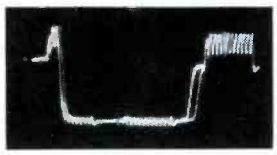


Good duplication of station signal including back porch. If the set won't sync, the set is defective.

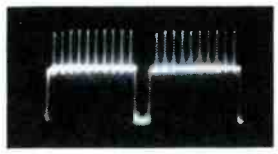


Well defined back porch on horizontal sync pulse permits accurately setting color killer and almost eliminates need to adjust brightness and contrast.

TRANSISTORIZED GENERATOR A

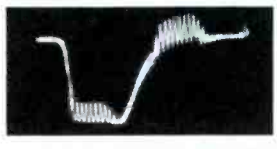


No back porch causes unstable color sync. Burst amplitude compression may permit sync on wrong color bar.



Square wave horizontal sync pulse with no back porch and poor dc coupling forces adjustments of brightness, contrast & fine tuning to obtain usable pattern.

GENERATOR B



No back porch; color information on top of sync-pulse makes sync difficult on some sets.

Complete absence of any back porch necessitates readjustment of brightness, contrast and fine tuning to obtain a usable pattern.

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ther, the supply might have a negative ground for PNP or a positive ground for NPN. This happens because it is often better from a design standpoint to have the collector and biasing circuit rather than the emitter near ground potential. Fig. 2 illustrates what we mean. Fig. 2A shows a PNP transistor circuit using a positive ground, while Fig. 2B shows the same PNP transistor in a circuit using a negative-ground power supply. Both circuits work identically well, but for the uninitiated they can present some problems in circuit measurements.

That is why it is usually best, especially if you don't have the circuit diagram handy, to measure all transistor voltages with respect to the emitter rather than from ground or the common point of the power supply. This way you can be sure you have true voltage interpretations, and you don't have to worry about which side of the power supply is grounded.

Another thing that often confuses the technician who comes to transistor servicing from the tube field is the internal resistance of the transistor itself. A voltage, read by a meter on a given element, that may actually be originating at one of the other elements is being transferred through the internal resistance. For example, in the tube circuit of Fig. 3A, there is no difficulty in determining that the transformer primary is probably open, since there is no plate voltage measured at the plate terminal. However, in the circuit of Fig. 3B, the collector voltage checks positive (to ground) even with the transformer completely open. The voltage at the collector is transferred through ordinary base-to-collector leakage of the transistor and is especially pronounced if a sensitive meter is used to make the reading. Again, though, if the voltage had been read from the emitter, the voltage at the collector would have been near zero.

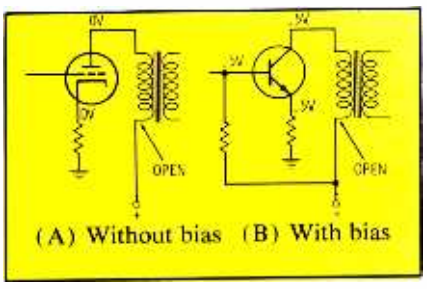


Fig. 3. Effects of internal resistance.

Common Troubles

The most common faults in transistor amplifiers seem to center around electrolytics, which sometimes short but more often open—causing motorboating and/or howl.

Transistors themselves are not immune to trouble. Collector-to-emitter shorts are fairly frequent, and occasionally a transistor opens internally. If the C-E short occurs in high-power stages, it will blow a fuse or protective resistor. If it occurs in small-signal stages, the emitter resistor is usually large enough to limit excessive current flow.

Transistors can be checked in the circuit with pretty good reliability, using just about any service-type ohmmeter, without danger of damage to the transistor. As in Fig. 4, check between base and emitter, between base and collector, and between collector and emitter, measuring each and then reversing the test leads for each. Between each set of elements, one reading should be higher than the other when you reverse the test leads. Between the collector and emitter, one reading should be higher than the other when you reverse the test leads. Between the collector and emitter, one reading should be at least twice the resistance of the other, even with the transistor in the circuit. If you obtain substantially the same reading between any two elements when you reverse the ohmmeter leads, you have good reason to suspect that the transistor is defective. Remove it from the circuit and recheck it. A precaution: An ohmmeter sometimes will not show up excessive transistor leakage (or even shorts) because of the low voltage supplied through the ohmmeter tests leads. Every shop should have a transistor tester that provides not less than 4½ volts—and preferably more—for out-of-circuit evaluation of transistors. Some defective transistors will check perfectly good at 3 volts and refuse to operate in a 6-volt circuit.

Distortion

Distortion in transistor amplifiers is caused most often by defective bias resistors or by leaky or shorted coupling capacitors, but you can't overlook the transistor—especially in direct-coupled circuits. Always measure the bias voltage from base to emitter and make sure it is of the correct polarity. The actual value is not too critical but will usually range from about .75 to .25 volt. Check the voltage drop across the emitter resistor. With small-signal transistors in transformer- or resistance-coupled stages, the total emitter current is likely to be in the neighborhood of .5 to 1.5 ma, but may run considerably more when the stage is used to drive high-power transistors. High-output transistors may have emitter currents that run to several hundred milliamperes.

Class-A output stages in small transistor radios will indicate from 12 to 30 ma of emitter current, while push-pull stages will normally draw from 1 to 3 ma per transistor (with no signal input).

In all push-pull amplifiers, it is a good idea to compare the emitter-resistor voltage drops whenever possible. They should be within 20% of one another. If either has excessive or insufficient voltage, check the biasing circuit, the collector circuit, the emitter circuit, and finally the transistor itself.

As a final note: Always try to check transistor circuits individually, even in direct-coupled circuits. Check the bias on individual transistors and calculate their collector or emitter currents separately. This procedure will, in most cases, provide the clues necessary to arrive at a quick analysis of the circuit fault.

By all means, start working with transistors. They can be fascinating, spellbinding, bewitching, delightful, or just plain infuriating. Electronics is rapidly developing to a point where you either learn to service them or perish. ▲

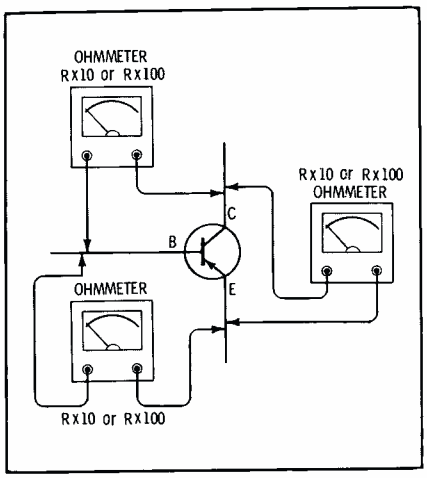


Fig. 4. Testing transistors in circuit.

by Allan F. Kinckiner

ShopTalk

Sync System Service Suggestions

Cases that show the quick way to troubleshoot.

Sync complaints arise often because most customers have a critical attitude toward picture shake, jitter, roll, tearing, or any other picture unsteadiness that can be classified as a sync complaint. While the average TV-set owner will endure weak and degraded pictures, a nonsteady picture is one condition customers will not accept. Not only does the customer call sooner for service on sync complaints, but a receiver that has been serviced for these troubles will be examined more critically upon its return.

The variety of sync-system designs adds confusion to other problems of a strictly technical nature. A sync system might consist of a single tube stage or as many as six. Multitube systems can employ one-channel design, or the vertical and horizontal sync pulses can be split into separate channels. Tubes in sync stages run the gamut from diodes to triodes to pentodes and pentagrid types, used sometimes in nonconventional configurations such as grounded-grid or cathode-follower. Furthermore, sync-system tubes usually operate on nonlinear portions of their Eg-Ip curves. All these possible variations result in less familiarity with circuits than is normal with other receiver stages. Service difficulties are also compounded by the fact that tubes and components in sync systems are subject to much stricter tolerances.

Despite circuit differences, sync systems all have two things in common: First, the signal applied to the sync separator (the heart of any sync system) must have a peak-to-peak amplitude of at least 30 volts, with a sync-tips-to-picture-signal ratio of 1:3. Second, the output signals from the sync systems must be relatively free of picture (video) information and must have equal vertical and horizontal sync pulses ranging in amplitude from 20 to about 70 volts. The exact pulse amplitude and polarity depend on the type of oscillators to be controlled.

Of the procedures that have been used for troubleshooting sync complaints, oscilloscope examination of signals in and around the sync system is the only logical, professional, and dependable technique. In fact, a scope is the only instrument capable of detecting the minor signal defects that so frequently cause tough-dog problems. But, examining scope traces, particularly any as complex as composite video and sync signals, is absolutely valueless unless you have a clear concept of what constitutes a normal signal. Or more specifically, you must recognize what departures from normal are allowable and how abnormalities correlate to the complaint.

Normal Scope Traces

The most common type of sync separator employs the conventional single-tube circuit, *i.e.* one tube, grid-fed, with plate output. This circuit requires an input signal of amplitude several times greater than the linear capability of the tube so rectification can take place in the grid circuit—necessary to separate sync from video within the tube. The input signal must also have sync-positive polarity. Such a signal is usually taken from a point following the video amplifier (Fig. 1), although the same polarity can be obtained from a sync preamplifier or inverter fed from the video detector. In either case, the video signal for the separator will be similar to waveform W1.

When the composite signal is obtained through a preamp stage, as shown in the alternate circuit of Fig. 1, it can be taken directly from the plate of the preamp tube. When the signal is taken from the video amplifier, series resistor R1 minimizes loading. Whichever circuit is used, W1 usually has an amplitude between 40 and 70 volts, although the signal derived through a preamp generally has a slightly flatter sync-tip level.

Between the takeoff point and the sync-separator grid, several different circuit arrangements are employed—some are shown as A, B, and C in Fig. 2. The simplest (A) consists of only a blocking capacitor and a grid-return resistor; with this network, the signal at the grid is a slightly attenuated replica of W1. When a more complex cou-

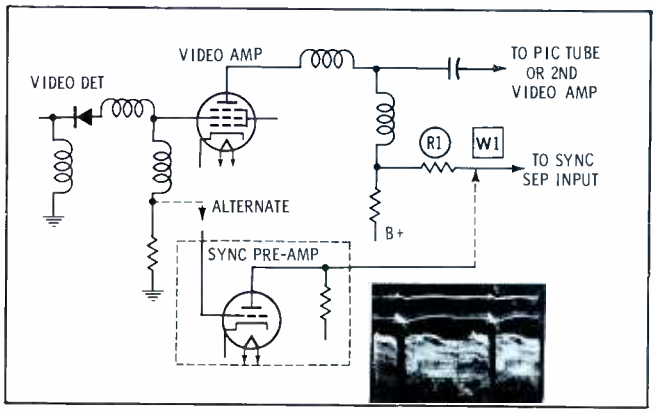


Fig. 1. Different takeoff circuits for sync separator stages.

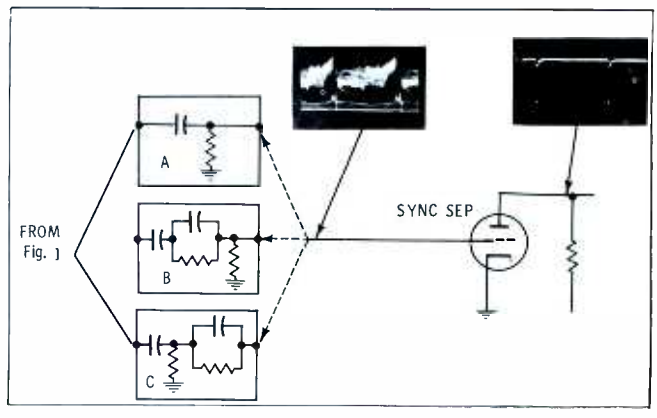


Fig. 2. Output signal from single-tube sync separator.

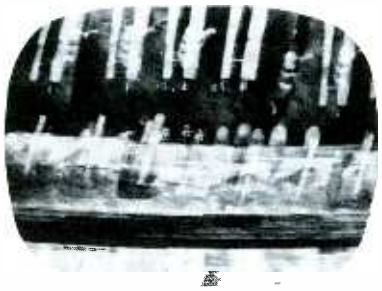


Fig. 3. Set is completely out of sync.

pling network such as B or C is used, the composite signal on the grid displays a small amount of sync-tip limiting, as shown in W2. The sync tips are thus clipped slightly before separation takes place.

The output signal obtained from a single sync separator stage is as shown in Fig. 2 as W3. The amplitude of W3 is normally about twice the amplitude at the input and of negative polarity. When the composite signal has been clipped as in W2, output signal W3 will have extremely even sync tips. While W3 shows vertical and horizontal pulses as equal, in some circuits one or the other (usually vertical) may be 25% greater.

While a single-tube stage can supply adequate sync signals, as evidenced by several late-model receivers, many sets still in use have sync-handling stages following the separator. These so-called "sync amplifiers" rarely produce a voltage gain, but are power amplifiers, employed for phase inversion or splitting and for clipping or limiting sync pulses at specific levels. In scoping these stages, strict attention should be paid to signal polarity, keeping in mind that inversion occurs naturally in conventional amplifiers and that inversion does not take place in cathode-follower or grounded-grid circuits.

Sync Troubles

Sync loss or instability can range from mild to severe, its duration from intermittent to time-lapse to constant, affecting horizontal or vertical separately or both concurrently. Vertical jitters and horizontal weaving or twisting are sync troubles in their mildest forms, while tearing or rolling are severe forms.

Instability of Both

Fig. 3 shows both horizontal and vertical sync are lost; direction of horizontal floating and slow vertical rolling can be changed by hold controls, but neither can be locked in solidly. A break in the sync-signal path can result from an open component or connection between the sync takeoff point and the separator input or a nonoperating sync tube.

In a Motorola TS-428, the picture could be synchronized only for extremely short periods. A scope check at the separator input revealed distortion in the vertical blanking—suggesting AGC trouble, since the fault obviously preceded the sync stages. Shunting the 2-mfd AGC filter capacitor restored a stable picture.

Severe sync loss or instability is sometimes due to a noise-inverter defect, particularly when the condition can react on the keyed-AGC stage. Fig. 4A shows a severe case, although in this still photo it isn't possible to see the lack of vertical sync. The receiver, an RCA KCS-108 with the circuit in Fig. 4B, had developed a leaky C1 coupling from the plate of the noise canceller. Leakage in C1 allowed the tube to clip sync information from the signal feeding the sync separator—note Fig. 4C. After we replaced C1 and adjusted the noise limiter control, the signal scoped as in Fig. 4D. A good clue in this case was the additional fact that the noise limiter control had no effect on either the picture or scope trace 4C.

A Zenith 17X22 had the picture shown in Fig. 5A, which looks like the result of 60-cps hum. This set uses a 'CS6 sync separator—Fig. 5B; an unusual aspect of this particular version is that screen voltage for the sync separator is taken from the cathode of the vertical output tube. The trouble resulted from an open filter at this point. Inasmuch as the sync-separator grid circuit is also part of a supplemented-AGC system, 60-cps distortion at the separator screen affected AGC voltage and thus signals in the RF-IF tubes and video amplifier. The sync-separator input signal looked like Fig. 5C; across the filter, the scope showed Fig. 5D. The loss of vertical size visible in Fig. 5A was overlooked as a clue; we had decided

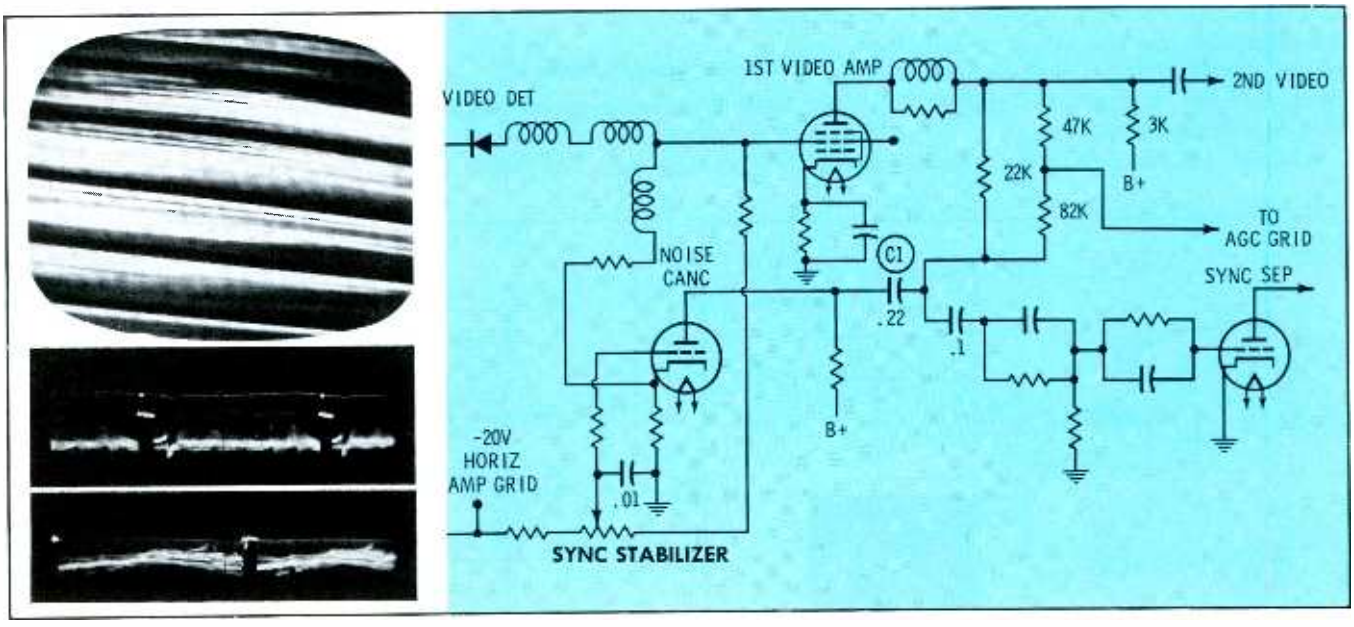
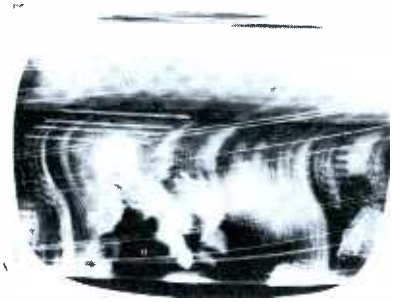


Fig. 4. Severe form of sync trouble is rooted in malfunctioning noise inverter.



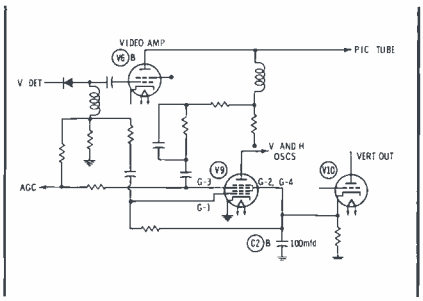


Fig. 5. Interstage screen-voltage connection causes this unusual symptom.

the set owner must have misadjusted the rear-panel controls.

A leaky coupling capacitor at the grid of a sync tube, a common cause of sync troubles, generally affects both horizontal and vertical stability; but, enough to be a real problem, this particular fault affects only one. The positive grid that results from leakage causes a high degree of video contamination in the sync output. Such contamination is easily identified by the scope—a typical case is shown in Fig. 6A. Sync compression *prior* to the sync takeoff

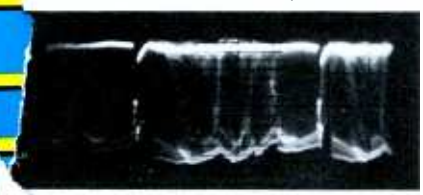


Fig. 6. Video contamination in the sync.

point (caused by trouble in the RF, IF, AGC, or video stages) produces exactly similar contamination in the sync output signal. This point is mentioned to spotlight the importance of scoping the composite signal at the takeoff point; a signal with compression originating in the IF or video stage is shown in Fig. 6B.

Horizontal Instability

The horizontal oscillator and AFC, or the sync and prior stages, are all capable of causing horizontal sync loss or instability, and identical symptoms can originate from considerably different defects. For example, the condition in Fig. 7A, in a Philco 9L35, was due to an AFC component defect. An identical condition in an older-model CBS was caused by a gassy picture tube. This latter set uses a DC restorer that doubles as a sync clipper; the CRT defect produced the weird distortion you can see on the sync signal shown in Fig. 7B. Note how several of the horizontal pulses are missing at the start of each field.

In contrast, breakdown of similar components in comparatively similar circuits have produced entirely different sync complaints. DuMont RA-112 models and 1951 Philco sets use almost identical sync output and horizontal oscillator-AFC stages. When the coupling capacitor from the sync separator to the horizontal AFC shorts in the DuMont, the set won't retain horizontal sync for more than a few seconds at a time. When the identical component shorts in the Philco, the only effect is severe hooking at the top.

The scope in these cases was instrumental in locating faulty components, first by relating picture troubles to waveform distortions, and second by associating components with the circuit points where distortions originate. Some associations are not so clear. A G-E portable with pulling at the top—Fig. 8A—showed the distorted sync waveform in Fig. 8B at the output of its single-stage triode separator (a circuit similar to Fig. 2). At the separator input and at the video amplifier output signal, distortion was found as shown in Fig. 8C. Further scoping revealed the boost capacitor to be defective.

A Motorola TS-542 had the rare condition of pulling at the bottom of

Fig. 7. Horizontal pulses dropped out.

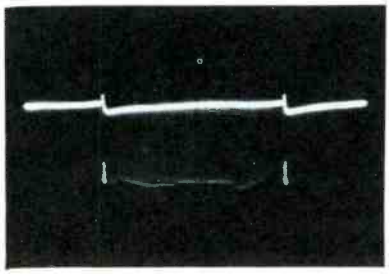
the picture. Sync distortion was apparent—Fig. 9A—but note that the shortened horizontal sync pulses precede the vertical sync pulse; that is, they are at this end (bottom) of each vertical field. This trouble was traced to a bad input filter capacitor, across which we scoped Fig. 9B—note the contamination. Fig. 9C is the clean scope trace across the replaced filter.

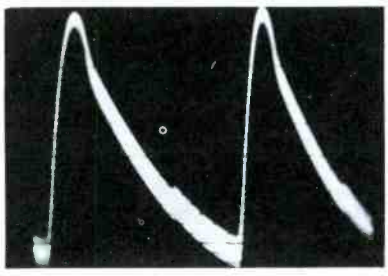
While the connections between picture troubles and the waveform distortions are fairly clear in the cases shown in Figs. 8 and 9, the associations with faulty components are seldom so clear. Also not so clear is the reason why the horizontal-sync dropout in Fig. 9 precedes the vertical pulses while in other cases sync dropout follows the vertical sync.

Fig. 8. Top tears; missing horizontal sync pulses at beginning of each field.

Another type of horizontal-sync dropout arises from malfunctioning noise-canceller stages. The entire train of horizontal sync pulses is attenuated, making horizontal sync nearly impossible. Sometimes the twisting or weaving is slight, but often tearing is as severe as in Fig. 10. An understanding of these noise-canceller circuits, their operation, and their possible defects is necessary to intelligently troubleshoot some conditions of poor horizontal sync.

In contrast to the Fig. 4B circuit, many other noise-canceller stages have virtually no effect on AGC operation, and a defect usually affects horizontal sync alone. Fig. 11—the noise canceller used in Philco N lines (11N51, 12N50, etc.)—is typical. The positive video signal is applied to the noise-canceller (V1) grid through C1 and also to the separator through R1. R2 and R3 form a common grid return for both stages. Enough positive voltage is applied to the cathode of V1 to keep the stage cut off during noise-free reception. When noise pulses are present on the video fed to V1, they drive the tube into conduction, resulting in large negative noise pulses at the plate. These in turn are coupled through C2 to the grid of V2 cutting off the separator for the duration of each noise pulse. Thus the noise never gets through the separator to mistrigger the sweep oscillators.





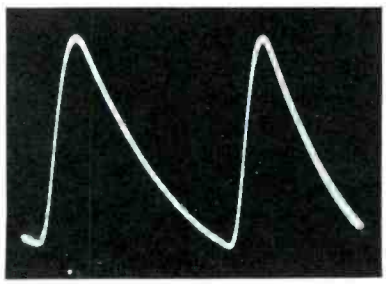


Fig. 9. Tearing is at bottom of picture.

Fig. 10. Horizontal tearing dominates.

A malfunctioning noise canceller will often distort the sync output signal as shown in the waveform of Fig. 11. Complaints in this particular circuit are often traced to open resistors R1, R2, or R3 in the module. Voltage readings on both grids pinpoint these faults quite accurately—the separator grid normally reads between −15 and −30 volts, and the noise-canceller grid slightly less.

•*Please turn to page 79*

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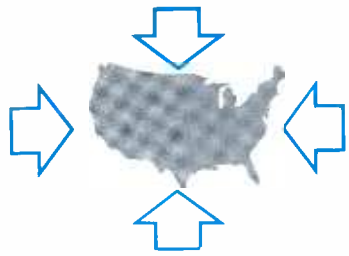


trends in ELECTRONIC IMPORTING

Who and what is in the offing.

by Arnold E. Cly

The number of foreign-made electronic consumer products in use in the United States has been increasing over the years. Some have made larger gains than others. Let us examine the situation closely and see which products are making the greatest strides and which seem to be on the decline.

Radios

Surprising as it may seem, the import of transistor radios from Japan —the main electronic dollar return for that country—failed to show an increase for 1964. This leveling off occurred after the total number of units imported had reached nine million annually. Also, practically every indication points to the fact that prices of most Japanese items have finally reached their low point and are now beginning to rise. Transistor-radio prices in 1964 averaged $8.17 per unit compared to $7.85 in 1963 and $9.19 in '62. Prices of tube-type radios also increased last year to $8.77 per set (from $8.28 in '63 and $6.63 in '62). Tape recorders showed a similar trend, with the average price being $12.16 in 1964, $11.29 in '63, and $13.09 in '62.

It appears Hong Kong, Okinawa, and Taiwan will become the main sources of inexpensive six-transistor radios in the future, since the Japanese—with the dollar volume in mind—have placed greater emphasis on more elaborate, costly units.

Hong Kong transistor radios exported to this country during last February numbered 159,260. This made a cumulative total of 290,830 for the first two months of 1965. In 1964, 80,592 sets were imported in February and 194,530 units in January and February combined.

The steady increase of German radio-phono imports during the postwar years has apparently ended. In 1964, there was a drop of approximately 50% from the level of the previous year (Table 1).

Television Receivers

Television receivers were the exception to the rule in the volume of Japanese exports to this country in 1964. They increased 70% in number of units over 1963, and 72% in dollar volume. About 60% of all imported Japanese sets carried U.S. brand names. This was a disappointing situation for Japan, since penetration of their own brand names was not keeping pace with the overall volume of shipment.

The import of color TV receivers from Japan in 1964 was approximately 20,000 units. Most of these were 16″ sets, manufactured by Toshiba. Possibility 50,000 units will be shipped in 1965, unless unforeseen circumstances alter this figure. Incidentally, the 16″ color CRT will probably employ 90° deflection instead of 70°, since Japan recently introduced the 90° tube.

Sony Corporation of Japan has acquired the right to sell the single-gun Chromatron television receiver to the U.S. It will probably be a 19″ version. Sony has conducted research and development on this type of receiver since 1961.

Sony expects to market a video tape recorder in Japan this summer. They have reached no decision as to when the recorder will be exported—much depends on the time involved in ironing out maintenance problems in their domestic market. However, they do anticipate export shipments near the end of this year. When it is marketed in this country, the home video recorder is expected to be priced over $600. A video camera will be offered for an additional $250 or so, and a 12″ monitoring set is expected to retail for about $180. An existing TV receiver could probably be modified for use as a monitor for about $30. The largest market for the unit is expected to be for home and school use.

Table 1. German Radio-Phones

Units	Value	Units	Value
30,198	$3,614,168	59,559	$5,342,333

Electrohome, a Canadian TV and radio manufacturer, had a sales increase last year from $24.7 million to a record $26.8 million. It was reported that 20% of the '64 total came from the U.S. in the form of sales of television receivers and stereos—up 15% from 1963. It is anticipated the U.S. volume this year will continue to increase, due in part to the introduction of Electrohome color receivers, which are

United Kingdom Exports of Electronic Consumer Products to the U.S.

	(Thousands of units)			(Thousands of dollars)		
	'61	'62	'63	'61	'62	'63
Radio Receivers, complete	2.8	6.7	1.2	$81	$191	$34
Radio phonographs, complete	X	X	X	14	9	13
Speakers and microphones		Not Available		784	914	731
Phonographs, electronic, and record players	6.8	1.7	X	116	37	1
Phonograph parts and accessories		Not Available		702	2,342	932
Tape recorders and reproducers	20.7	14.1	2.8	841	777	199
Electron tubes		Not Available		190	209	350
Cathode ray	2.8	12.7	14.5	47	249	303
"Special"		Not Available		229	302	355
Transistors	47.3	121.7	6.9	50	39	13
Electronic components and parts		Not Available		1,564	1,776	1,238
Radio testing equipment		Not Available		313	594	831

X—Less than 500

expected to appear on the American market this fall.

Clairtone, another Canadian TV and radio maker, had considerable volume in United States markets last year and expects an increase this year. They believe about one-half of their sales will be in this country.

Component Parts

Japanese exports of capacitors, IF transformers, TV tuners, and loudspeakers have been sizeable for the last decade. No figure is available, but the United States undoubtedly received the largest portion.

A large supplier of television tuners in this country has established an assembly plant in Hong Kong to produce VHF TV tuners. They plan to sell to seven TV manufacturers in the U.S. who buy tuners from independent subcontractors. Kataoka Electric Company of Japan also expects to export transistorized VHF and UHF tuners to America this year.

There are many other electronic products imported by the United States. These fall under the categories of communications equipment, broadcast gear, test instruments, and many others. The volume of imports of these products, however, is very small compared to the other imports mentioned in this article.

Conclusion

The U.S. Department of Commerce reports that total imports of consumer electronic products were 30% greater in 1964 than in 1963. An 8% increase is projected for 1965. The 1964 imports amounted to about 15% of total domestic output; the corresponding figure for 1963 was 10%.

It is clearly evident from the information presented in this article that Japan supplies the majority of the electronic consumer products imported by the United States. The trend of continued large imports from foreign countries will surely remain the same as long as the wage scale of skilled and semiskilled labor is higher in the U.S. than in other countries. However, the technical ability in these countries must maintain a steady upward trend in order to develop and manufacture products that American consumers want and will buy. ▲

Japanese Exports of Electronic Consumer Products to the U.S.

	Year	Units	Avg. Price Per Unit (fob Japan)
Tube radios	'64	1,177,073	$8.63
	'63	1,166,450	8.28
	'62	1,608,574	6.63
Transistor radios (3 or more transistors)	'64	9,018,248	8.25
	'63	9,021,513	7.85
	'62	7,784,590	9.19
Toy transistor radios	'64	598,832	1.47
	'63	1,845,289	1.61
	'62	2,735,166	2.18
Transistor radio-phono	'64	77,468 (11 mos)	16.08
	'63	77,007	22.19
	'62	44,434	24.31
Tube radio-phono	'64	46,667 (11 mos)	37.75
	'63	64,564	43.80
	'62	48,330	56.61
Transistor tape recorders	'64	2,758,572 (11 mos)	9.88
	'63	2,179,721	9.54
	'62	Not available	
Tube tape recorders	'64	162,372 (11 mos)	48.49
	'63	110,788	45.61
	'62	Not available	
Transceivers	'64	741,479 (11 mos)	10.77
	'63	297,438	15.13
	'62	Not available	
Television	'64	770,255	55.46
	'63	452,002	55.01
	'62	158,594	53.28

	1965		First 2 Months	
	Jan.	Feb.	1963	1964
Television	47,591	98,020	145,611	71,016
Tube radios	66,074	63,548	153,223	131,335
Radios with 3 or more transistors	366,046	603,369	988,369	1,036,949
Transistor radios for autos	3,726	8,518	Not available	

Value of U.S. Imports of Consumer Electronic Products

Country	(Thousands of dollars) 1961	1962	1963
France	$138	$138	$146
Italy	1,220	613	1,227
Netherlands	2,392	3,957	4,029
Belgium and Luxembourg	522	8	18
Canada	1,715	2,924	3,845
Japan	96,609	112,791	128,363
Argentina	1	1	1
Mexico		5	3
Switzerland	480	868	989
Sweden	45	77	88
Other Countries	4,230	9,321	7,233

AUTOMATIC DEGAUSSING

The lowdown on color TV's latest built in feature.

by Ells Ladyman

The days of walking around a room waving a degaussing coil in front of a color receiver, like a native medicine man with a voodoo charm, may soon be over. Automatic degaussing circuits, introduced in the 1965 lines of several manufacturers, will eliminate the use of a manual degaussing coil, except in cases of unusually severe magnetic conditions. While the added components (three or four in most circuits) may induce a potential "trouble," it's an easily recognized and quickly corrected one, when and if it occurs.

Components used in degaussing circuits usually consist of a thermistor, varistor or saturable (low impedance) coil, four separate series-connected coils, and the flange or shield that comprises the core of the degaussing coil. The flange, composed of soft annealed iron, also acts as a shield for the shadow mask.

Three manufacturers incorporating ADG in their 1965 lines are Packard Bell, RCA, and Zenith. An analysis of the circuits used in their chassis should provide a basis for understanding other ADG circuits.

Thermistor-VDR Circuit

Circuit operation is not at all complicated and is readily understood. Referring to the RCA schematic in Fig. 1, the value of temperature-dependent resistor (thermistor) R1, is 120 ohms at room temperature (cold). The resistance value of the voltage-dependent resistor (VDR) is extremely low with zero voltage applied. When power is applied to the primary winding of the power transformer, most of the AC current induced in the secondary winding flows through the low resistance of the VDR, and therefore through the series-connected degaussing coils. This current sets up an AC magnetic field around the coils and provides demagnetizing action. The degaussing coils are mounted on the picture tube shield (see Fig. 2) and utilize the shield as their pole piece; thus both shield and picture tube are demagnetized each time the coils are energized.

As thermistor R1 begins to heat, its resistance starts to decrease, and a greater current begins to flow through it. A lower voltage is now applied to the VDR and its resistance (as is characteristic of voltage-dependent resistors) starts to increase. The combined action of these two resistors—R1 decreasing as VDR increases—results in a smooth, gradual decline in current through the degaussing coils.

An important fact to remember about this sequence is: Degaussing occurs as a result of the initial AC current flow in the coils, and remagnetization is prevented by the gradual, controlled decline in this current. No part of the degaussing action is visible on the CRT, as the complete cycle occurs before the receiver tubes and circuitry have warmed up.

In most receivers, automatic degaussing occurs each time the receiver is turned on, provided it has been off long enough (approximately five minutes) for the thermistor (temperature dependent) to drop back to room temperature. Generally, the coils are activated each time the set is turned on; in some, a separate switch (push-button, spring-loaded) is depressed to perform ADG.

Troubleshooting

Servicemen the world over are

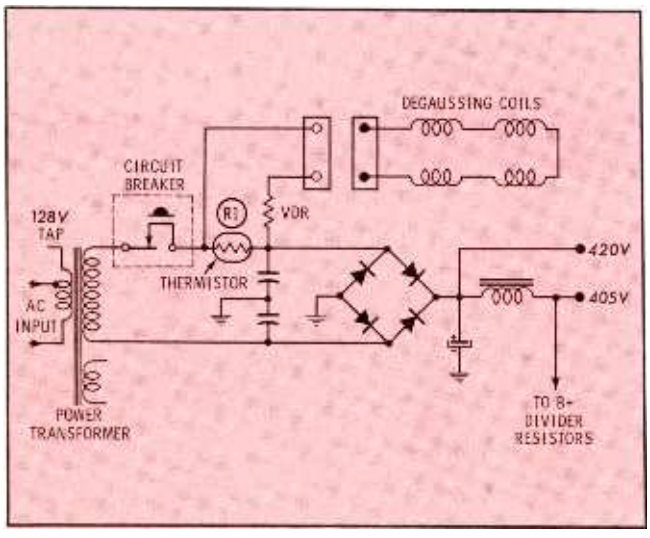


Fig. 1 ADG circuit used in RCA's for 1965 color receivers.

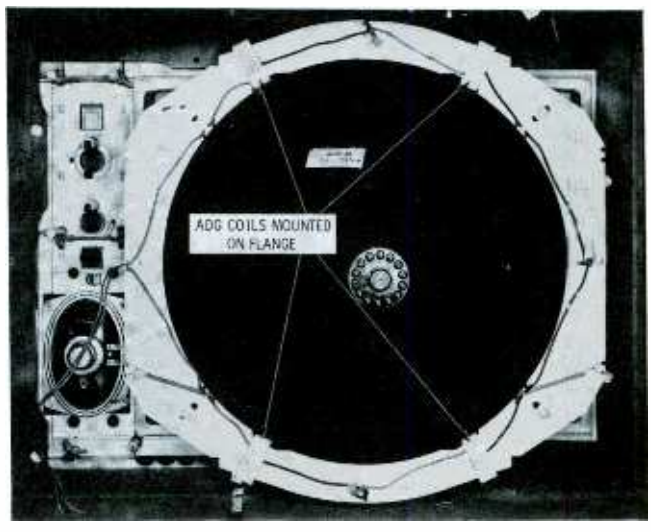
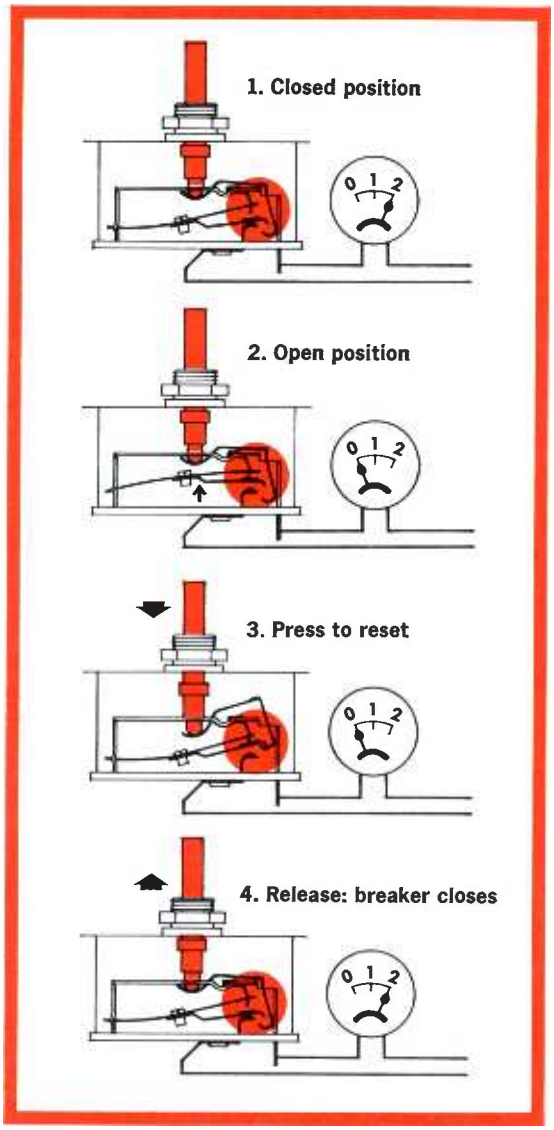


Fig. 2. Majority of receivers have four degaussing coils.

MALLORY **Tips for Technicians**

Tips on replacing circuit breakers



That little red "breaker reset" button that sticks out of the back of nearly every television chassis can be a time-saver or a trouble-maker, depending on what's wrong inside the set, and who's pushing the button. As you well know, when a transient fault has popped the breaker, you can get the set back in business just by pressing the reset. But if there has been a short-circuit failure and some uninformed tinkerer presses the button and *keeps* it pressed, there's a good chance that more power keeps flowing into the fault. Result: a minor trouble becomes a calamity.

This is why Underwriters' Laboratories require that breakers should be "cheat-proof"—that is, they should not allow current to pass when the reset button is held depressed. Some of the replacement breakers you'll find on the market *aren't* cheat-proof. We have one that *is*. It has features that you'll find valuable any time you need to install a new breaker, or when you're working on a breadboard circuit that needs over-current protection.

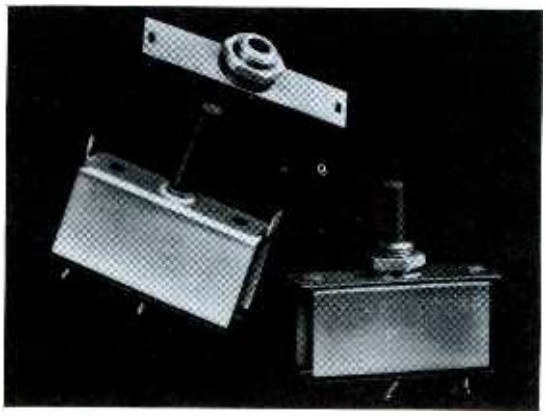
Take a look at how this breaker works, and you'll see what we mean.

At top (Picture 1) is the way the breaker mechanism looks when it's in the "on" position.

Along comes an overload (Picture 2). The bi-metal strip heats, snaps into the "break" position, opening the current carrying contacts.

Now you press the button to reset (Picture 3). As long as you hold the button down, the contacts at the right remain open.

Release the button and the contacts go back to closed (Picture 4). If the overload is still there, the breaker will open again. You can't keep it closed on a short circuit!



No wonder this particular breaker is used as original equipment on the majority of all television sets. They're made for Mallory by Mel-Rain Corp. to the same specifications as for original equipment, and they're available from a Mallory distributor near you. Off-the-shelf ratings go all the way from 0.5 to 7 amperes break current, and include all the values you'll need for service replacement or for industrial equipment maintenance. And as an extra convenience, you can get them with either a twist-tab or bushing mount. See your Mallory distributor, or write to Mallory Distributor Products Company, a division of P. R. Mallory & Co. Inc., P. O. Box 1558, Indianapolis, Indiana 46206.

Circle 24 on literature card

inclined to view new circuits with trepidation, but very little can go wrong in this circuit. When trouble does occur it is quickly discernible and just as easily isolated.

A defective degaussing circuit is usually identified by a faint blush of impurity around the perimeter of the CRT. This is generally caused by leakage through the voltage-dependent resistor (VDR), or the resistance of temperature-compensating resistor R1 may not decrease far enough to cause a proper voltage change across the VDR; thus, a small current flows continuously in the coils.

Isolating which component (R1 or VDR) is defective is easy, too. Both can be checked simply by shunting R1 with a clip lead. If the impurity disappears, then replace R1; if contamination remains, chances are the VDR is defective.

The R1 shunt test is also a useful check to see if the ADG circuit is working properly after repair. After the receiver has cooled five or ten minutes, shunt R1 with the clip lead. Now turn the receiver on and wait for the raster to appear (with R1 jumpered, the ADG is inoperative). Remove one end of the clip lead while watching the screen. Current should now flow through the decaussing coils, and you should see swirling colors appear for approximately five to ten seconds—during the time it takes for R1 to heat.

Thermistor-Coil Circuit

The circuit incorporated in the 1965 Zenith line of color receivers differs slightly from those used in sets from other manufacturers. Reference to the schematic diagram (Fig. 3) reveals a coil in place of the voltage-dependent resistor. Operation of this circuit is as follows:

When power is applied to the primary winding of the power transformer (T1), a high percentage of the current induced in the secondary winding will flow through the saturable, low-impedance coil L1. This is because R1 (thermistor) has a higher resistance at room temperature. Full current flows through L1 and consequently through series-connected decaussing coils L2, L3, L4, and L5. Minimal current through thermistor R1 causes its temperature to rise; therefore, its resistance decreases. Simultaneously, the current through the low-impedance saturable coil starts to decrease, and its impedance increases. The thermistor continues to heat until its temperature stabilizes and its current flow is at maximum. At this time, current through the saturable coil reaches a minimum as its impedance becomes very high. For all practical purposes, current through the saturable coils and the degaussing coils is zero. The complete cycle of degaussing requires only about 12 seconds, so it is not visible on the CRT for the reason mentioned previously.

• *please turn to page 87*

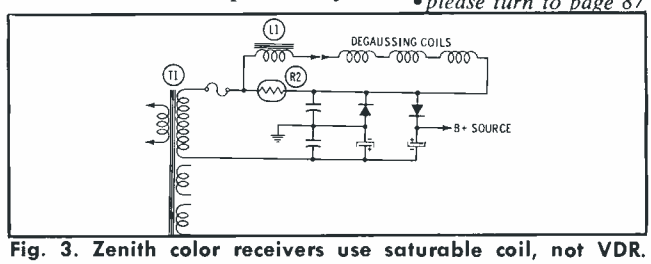


Fig. 3. Zenith color receivers use saturable coil, not VDR.

Notes on Test Equipment

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

DC Voltage Reference Supply

by David King

Most service scopes are AC coupled only. A few service scopes, and all laboratory scopes, have provisions for both AC and DC coupling. When low-amplitude waveforms are to be viewed on the AC-coupled scope, all that is necessary is to set the vertical attenuator to a lower scale. However, when the waveform is of such a low frequency that it cannot be displayed on an AC scope, the DC scope must be employed. If the low-frequency voltage change is actually ripple on a high DC voltage, the vertical-centering control on the DC scope must be used to prevent the trace from being deflected off the CRT screen. When the attenuator on the DC scope is at low settings, the centering control hasn't enough range to bring the trace back on the screen. In this case, a scope with a differential input may be used, or an opposing DC supply may be connected in series with the source upon which the measurement is being made. An instrument specifically designed to do this job is the Acme Electric Model PS39590 *Scope-O-Trol* (Fig. 1).

Fig. 1. Variable DC voltage supply.

Acme Model PS39590 Specifications

Voltage Range:
0-52 volts DC

Regulation:
±.005% for ±15% line voltage change

Ripple:
.002% peak to peak

Output Voltage Stability:
±.015% per hour after 15-minute warm-up time

Power Requirements:
115 volts, 60 cps, 8 watts.

Size (HWD):
With cabinet, 8" x 6" x 12½"
Without cabinet, 7" x 5⅞" x 10"

Weight:
With cabinet, 10 lb
Without cabinet, 7 lb

Price:
$200.00

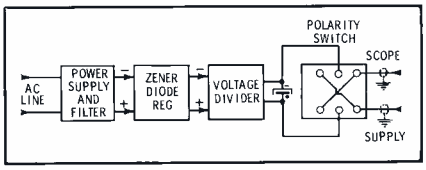


Fig. 2. Block diagram including polarity switch and bypassing capacitor.

The *Scope-O-Trol* power supply (Fig. 2) uses transformer-input and full-wave rectification with silicon diodes. The transformer secondary is shunted with a capacitor for proper transient suppression. The rectifier output is connected to an RC filter which uses a 1250-mfd capacitor. The filtered DC output is applied to a regulator section consisting of zener diodes. A resistive voltage-divider network is connected between the zener regulator and the SCOPE and SUPPLY terminals located on the front panel; a large capacitor (150 mfd) is connected between the SCOPE and SUPPLY terminals. The end result is a very-low-impedance DC voltage source that can be inserted between the supply being measured and the scope. The unit provides a regulated, calibrated DC voltage which is variable from 0 to 52 volts with an adjustment as small as 2 mv per degree of rotation.

Service Bench VTVM

The Heathkit IM-13 (Shown in Fig. 3) is descended from the IM-32 which it replaced in 1964. The major changes are bracket mounting and the use of vernier controls for the IM-13. With a 6" x 4 1/4" multicolored-scale meter and gimbal mounting (which allows the meter to be rotated to any angle within its mount) it is possible to place this VTVM practically anywhere and still be able to read it easily. The vernier drive to the OHMS ADJ and ZERO ADJ uses three hefty ball bearings in its planetary drive. Recessed calibration controls for DC CAL, AC CAL, and AC BAL are placed along the right side of the meter face to facilitate recalibration as the 12AU7 and 6AL5 age.

With the probe provided, the IM-13 response is ±1 db from 25 cps to 1 mc with a 600-ohm source; an additional probe can be purchased to extend the response to 250 mc. AC-DC

Fig. 3. Gimbal mounting of this VTVM allows adjustment for easy viewing.

Heathkit IM-13 Specifications

Meter Scales DC & AC (rms):
0-1.5, 5, 15, 50, 150, 500, 1500 volts full scale (1.5- and 5-volt AC ranges read on separate scales).

Ohmmeter:
Scale with 10-ohm center x1, x10, x100, x1000, x10K, x100K, x1 meg. Measures 1 ohm to 1000 megohms with internal battery.

Dividers:
1% precision type.

Meter:
6" 200-ua movement.

DC Input Resistance:
11 megohms (1 megohm in probe) on all ranges.

AC Input Impedance:
1 megohm shunted by 40 pf (measured at input terminals).

Circuit:
Balanced bridge (push-pull) using twin triode.

Accuracy:
DC ±3%, AC ±5% of full scale.

Frequency Response:
±1 db 25 cps to 1 mc (600-ohm source).

Tubes:
12AU7, 6AL5

Battery:
1.5-volt size-"C" flashlight cell.

Power Requirements:
105-125 volts, 50/60 cps, 10 watts

Size (HWD):
5" x 12 11/16" x 4 3/4"

Weight:
7 lbs

Price:
$32.95

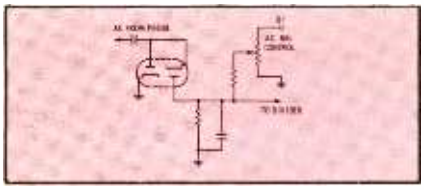


Fig. 4. Voltage from AC BAL control cancels contact bias from rectifier.

scales extend to 1500 volts, and an additional probe to extend the DC high-voltage capabilities to 30 kv is available. For greater accuracy there are separate scales for 0 to 1.5 and 0 to 5 volts AC. The −10 to +5 db scale is a handy addition for experimenter and repairman alike, and the center-scale zero can make FM discriminator alignment much easier. Set the meter pointer on zero with the ZERO ADJ; positive or negative deviations can be read directly.

The construction of this VTVM is clear and simple. Neat, conventional wiring is permitted by the open layout, and good components (1% divider resistors) insure top performance. Thorough instructions, which include an informative section on VTVM use, and simple circuitry make this kit relatively easy to build and calibrate. The circuity is conventional.

A bridge using a 12AU7 is used for the meter circuit, while a 6AL5 serves as a peak-to-peak rectifier. AC balance voltage is used to cancel contact bias produced by the voltage-doubler rectifier; Fig. 4 shows a simplified schematic. We calibrated this unit with a flashlight battery for DC and a variable line transformer with another VTVM for AC.

Whether the IM-13 is mounted or set on the bench in its bracket, it can be easily adjusted for maximum readability no matter what position the user may assume. The gimbals on the side allow rotation to correct for parallax, glare, or poor lighting. The vernier ZERO ADJ is a welcome relief to those who are easily frustrated by a "touchy" ZERO ADJ (because they are so critical to adjust, VTVM's always seem to be the worst offenders). If a serviceman insists on using this VTVM while it is still warming up, he will still have to readjust the ZERO ADJ several times, but the vernier control will certainly make it easier.

Because this model uses only one test probe, the front is neat and there is never the messy job of unsnarling test leads. The probe has a clip and rubber sleeve (Fig. 5) which will clip onto wires and give the user another free hand; to free the probe, twist gently. There is an AC-OHMS-DC switch on the probe, so care must be taken to insure the switch is in proper position. A 1-megohm resistor is inserted in the probe while making DC measurements to isolate the probe from cable capacitance; this resistor will affect accuracy seriously on the other two functions.

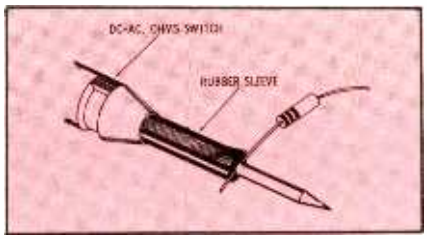


Fig. 5. Rubber sleeve and a notch in the probe will easily clip onto wires.

As was noted before, additional probes may be obtained to extend the usefulness of this meter. Despite its simplicity, this is a reliable, sturdy unit and can take its place on any service bench.

Flexible CRT Checker

SENCORE's new Model CR133 CRT checker and rejuvenator (Fig. 6) is an improved version of the Model CR128 which was described in "Notes on Test Equipment" in the February 1965 issue of PF REPORTER. While the basic circuitry — including automatically controlled rejuvenation voltage — remains the same, there are changes in the controls and cables.

SENCORE Model CR133 Specifications

CRT's tested:
All presently manufactured TV types—both color and black-and-white. New sockets will be available as new CRT's are introduced.

Tests performed:
Interelectrode shorts; beam-current flow (emission); control-grid action and cutoff voltage; life test.

Corrective functions:
Rejuvenates cathode; removes cathode-to-control-grid shorts; welds open cathodes.

Features:
Variable G1 and G2 voltages; line-voltage compensation adjustment; replaceable plug-in CRT socket cables; automatically-controlled rejuvenation voltage.

(HWD) Size:
10″ x 9½″ x 3″

Weight:
10 lbs

Power Requirements:
105-125 volts, 60 cps, 16 watts

Price:
$89.95

One of the most notable features is the two replaceable plug-in CRT-socket cables. Connections from the checker are made through a female octal plug. Two sets of CRT sockets (one for color and one for black-and-white) are supplied.

Another added feature is the variable G2 voltage. The

Fig. 6. The replaceable plug-in cables assure adaptability.

G2 VOLTS potentiometer is calibrated in 25-volt steps from 25 to 300 volts. Checks in our lab verified that with the pot fully clockwise output voltage is approximately 325 volts. Since the Model CR133 can be set up from a tube manual and both G1 and G2 voltages are variable, there is little possibility of it becoming obsolete.

Line-voltage compensation has also been added. With the FUNCTION selector in the LINE ADJ position, the 500 ua meter is switched into a half-wave rectifier circuit connected across the power supply following the LINE ADJ rheostat. The control is adjusted so the meter pointer rests on the LINE ADJUST red line on the meter face. Although the internal line-voltage calibration control is set at the factory, the instruction manual gives detailed steps for recalibration if the calibration-voltage rectifier, power transformer, or meter are ever changed. As an added safety feature, the LINE ADJ rheostat has a plastic shaft to eliminate any shock hazard if the rheostat should arc or short to its shaft.

Like its predecessor, the Model CR128, the Model CR133 is a portable instrument. A sturdy black wrinkle-finished steel cabinet houses the entire unit. A compartment at the bottom contains the power cord, connecting cable, and socket cables. The advanced features and small size of this checker make it suitable for use either on service calls or in the shop. ▲

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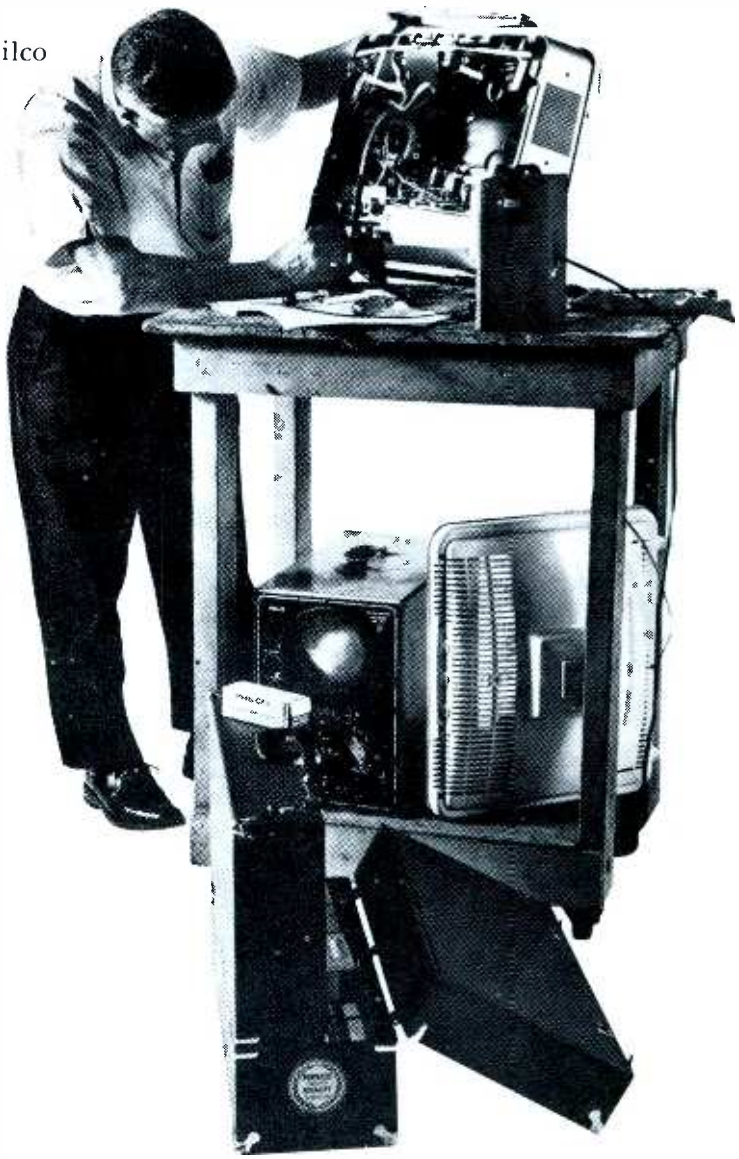

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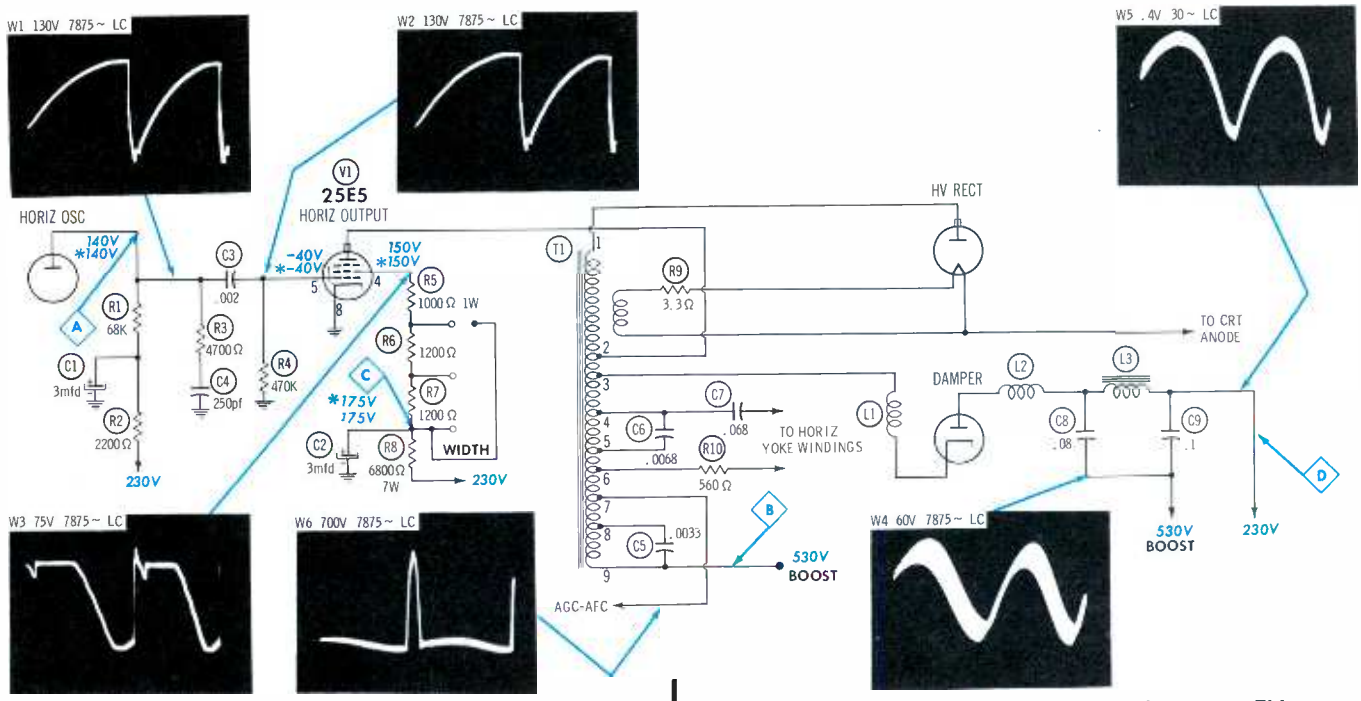
Circle 27 on literature card

Horizontal Output

114° Deflection



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

WAVEFORMS taken with wideband scope; TV controls set to produce normal picture and sound. Low-capacitance (LC) probe used throughout circuit.

Normal Operation

This 114° horizontal-output and high-voltage stage (from Panasonic Model AN-16) is typical of those found in most modern receivers. Drive signal is coupled from oscillator to output grid by C3. R3 and C4 are discharge path for oscillator and aid in shaping drive waveform; R1 and R2 are plate-supply resistors, and C1 is bypass filter. Class-C bias for output tube is developed across grid resistor R4. Jumper in screen of output tube controls width; width is minimum with jumper disconnected, maximum with it across both R6 and R7. Varying resistance between screen of V1 and B+ changes screen current and thus controls width. (Unless otherwise indicated, all voltages and waveforms were taken with width jumper disconnected.) R5 and R8 are screen-supply resistors, and C2 is another bypass. Plate-current path for V1 is from B+ (D) through damper tube and part of transformer T1, between terminals 3 and 2. Autotransformer action supplies large pulse to plate of high-voltage rectifier which produces CRT anode voltage. Pulse to horizontal yoke windings is coupled through C7 from terminal 4 of T1. Damper tube damps oscillation produced by T1 when output tube cuts off. Conduction of damper causes charge to be stored in C8 and C9; discharge of these capacitors produces boost voltage. Boost capacitors also serve as plate-voltage source for horizontal-output tube. Some receivers use width coil connected between terminals 7 and 9 of output transformer to absorb part of energy developed by flyback and thus reduce width.

Operating Variations

PIN 4 Voltage on screen grid is dependent on position of width jumper. With jumper disconnected, reads 150 volts; with jumper across R7, 145; with both R6 and R7 shunted, 140.

PIN 5 Voltage remains same with or without signal. Operating controls or width jumpers have little effect on voltage. In receivers using horizontal drive control, grid voltage will vary when control is adjusted.

B Boost voltage varies as width jumper is repositioned; 530 volts with jumper disconnected; 550 when across R7 only; 580 if across both R6 and R7.

C DC voltage at this point is also affected by width jumper because changing screen resistance changes screen current flowing through R8. Voltage readings are: without jumper, 175; shunting R7, 165; across both R6 and R7, 150.

WAVEFORMS Waveforms are virtually unaffected by rotation of any controls; W1 and W2 will change shape slightly when horizontal hold control is adjusted to point where picture is almost ready to lose horizontal sync. However, even with this condition present amplitude remains almost same.

Width Reduced

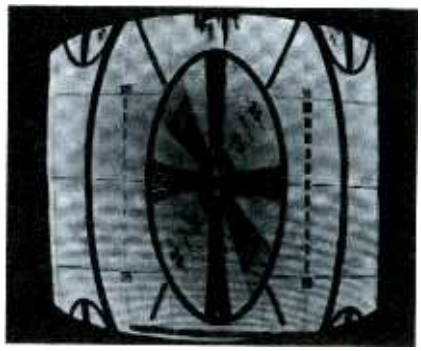
Brightness Down Slightly

Symptom 1

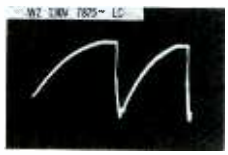
C2 Open

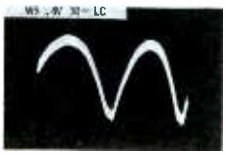
(Screen Bypass Capacitor—3 mfd)

Symptom Analysis



Raster fails to fill screen by about 1″ on each side even with width jumper positioned for maximum width. Picture and sound are both normal; however, brightness range is slightly reduced. Symptom suggests trouble in horizontal output stage or decreased B+ or boost.

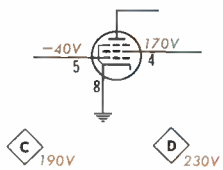




Waveform Analysis

Normal W2 at grid of output tube proves narrow raster isn't caused by reduced drive to horizontal output tube; thus, oscillator and grid circuit of V1 are proved okay. Considerably increased amplitude (150 volts peak-to-peak) of W3 is significant clue to area of defect. Normal content and amplitude of B+ waveform W5 further isolate trouble to decoupling network in screen of horizontal-output tube. Most likely cause is defective C2.

Voltage and Component Analysis



B+ voltage is normal; therefore, defects in low-voltage power supply aren't responsible for reduction in width. DC voltage on pin 5 is also normal, isolating trouble to circuits following grid of horizontal-output tube. Screen voltage on V1 has increased to 170 volts; point C reading is also increased—now 190 volts. This explains narrow picture, as screen current in output tube has decreased. Lowered value of R8 could be responsible for increased voltage, but resistance check proves R8 is not at fault.

Best Bet: Scope is conclusive.

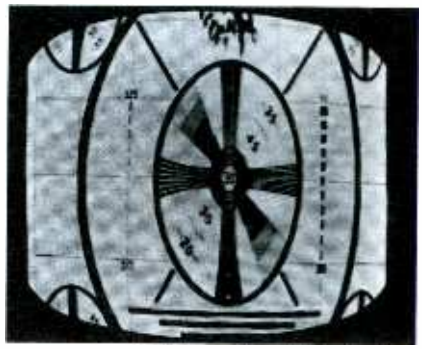
Width Insufficient

Picture and Sound Normal

Symptom 2

C9 Open

(Boost Filter—.1 mfd)

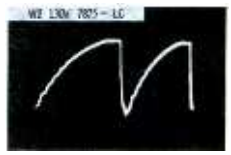


Symptom Analysis

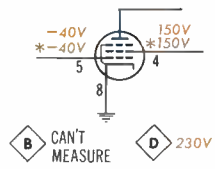
Picture is narrow on all channels—in about 2″ on right side of screen and slightly lacking on left side. Vertical and horizontal hold is normal. When only symptom is insufficient width, trouble in horizontal-output stage or reduced B+ or boost voltage is likely.

Waveform Analysis

Waveform W2 at grid of horizontal output tube isn't exactly normal; however, peak-to-peak amplitude is correct, thus defects in oscillator or grid circuit of V1 aren't likely. Screen waveform W3 of V1 is slightly altered, but again peak-to-peak amplitude is normal, so defective screen components aren't likely cause of reduced width. Horizontal pulse of 800 volts at boost source (point B) suggests open boost filter—either C8 or C9.



Voltage and Component Analysis



B+ is correct, eliminating possibility of trouble in low-voltage power supply. All elements of V1 have proper voltages, proving trouble is beyond horizontal-output stage. Touching meter to boost source is conclusive indication—needle pegs left side when checking for positive voltage, and right side on negative scale. Indicates considerable amount of RF is present and being rectified by VTVM, causing erroneous indication. Bridging boost capacitors with units known to be good is one way to pinpoint open C9.

Best Bet: Scope or voltage checks.

Symptom 3

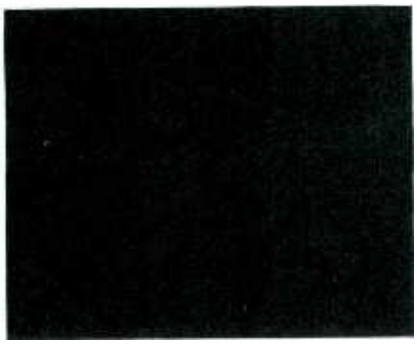
No Raster

Sound Normal

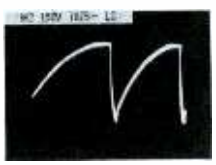
L2 Open

(Damper Choke)

Symptom Analysis



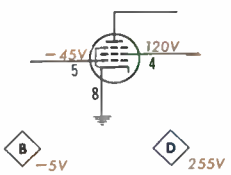
Screen is blank; sound is normal. Brightness control has absolutely no effect. High voltage is missing as evidenced by fact that no arc can be drawn between anode lead and high-voltage cage. Trouble is most likely in horizontal oscillator, output, or high-voltage stage.



Waveform Analysis

Slight distortion and small increase in amplitude is noted in drive signal W2; however, sufficient amplitude of W2 leads to suspicion of trouble beyond this point. Absence of pulse in W6 isn't definite indication, but does give clue that trouble may be in flyback section. Lack of W4 signal on boost source is good clue that loss of raster is caused by absence of flyback pulse, which results in high voltage not being developed.

Voltage and Component Analysis



Voltage on pin 5 of V1 is slightly increased, of importance only in proving loss of drive isn't reason for blank screen. Screen voltage on V1 is reduced to 120 volts, but this reduction isn't great enough to cause complete loss of high-voltage. Of utmost importance is DC reading obtained on boost source—only indication is mere −5 volts, also measured at plate of damper. This explains loss of raster—damper tube isn't functioning. Above-average B+ at point D, coupled with previous indications, point to open L2 or L3.

Best Bet: Voltmeter and ohmmeter both help.

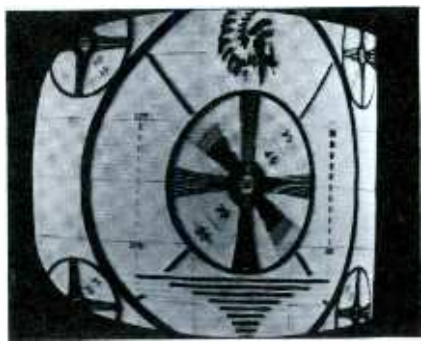
Width Insufficient

Picture and Sound Normal

Symptom 4

C3 Leaky

(Drive Coupling Capacitor—.002 mfd)



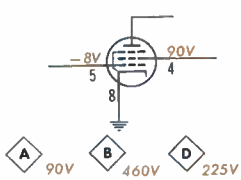
Symptom Analysis

Raster is narrow on all channels, more noticeable on right side of screen. Picture and sound are both normal; vertical sweep is unaffected. Vertical and horizontal sync is okay. Symptom seems to indicate trouble in horizontal oscillator or output stage.

Waveform Analysis

Waveform W2 at output grid gives definite clue to source of trouble. Duration of flat portion of waveform is greatly increased, amplitude is considerably reduced, and rise time is much faster (notice normal W2). This scope check isolates trouble to plate circuit of oscillator or grid network of V1. W1 looks similar to W2; however, this doesn't isolate defective component because defect in coupling capacitor changes discharge of oscillator.

Voltage and Component Analysis



Initial voltage check could be made at various points when reduced width is symptom; however, trouble can usually be located faster with these systematic checks. B+ voltage (point D) is only slightly reduced and of little concern since variation is considerably less than 10%. Reduced screen voltage gives two possibilities of trouble; increased resistance from screen to source or above normal screen current. Decisive clue is −8 volts on grid, which explains lowered screen voltage; tube is overconducting because of reduced bias.

Best Bet: Scope, then VTVM.

Picture Narrow

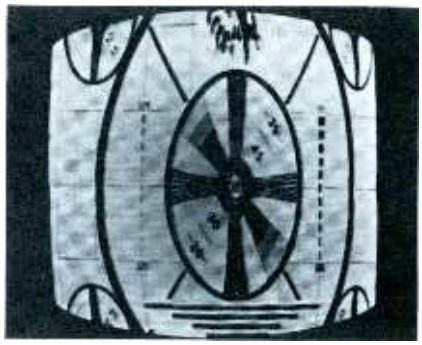
Brightness Reduced

R5 Increased in Value

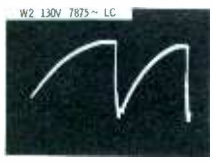
(Screen Resistor—1000 ohms, 1 watt)

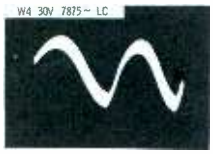
Symptom 5

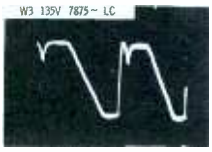
Symptom Analysis



Picture is quite narrow; horizontal sync is affected, but picture can be locked in by adjusting oscillator coil. Brightness is reduced; rotating control clockwise causes fading and blooming of raster strong indication that CRT anode voltage is reduced.



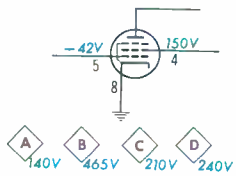




Waveform Analysis

Defects in horizontal oscillator or grid network of V1 are not responsible for trouble, proven by normal W2; difficulty thus exists beyond grid of V1. W4 suggests that boost voltage is reduced—waveform is 30 volts p-p, only 50% of normal. Screen waveform W3 has increased to 135 volts, gives reliable indication of trouble in network associated with pin 4 of V1—either increase in value of screen resistors or faulty C2.

Voltage and Component Analysis



Correct voltage reading on plate of horizontal oscillator and normal DC value on grid of output tube prove trouble is beyond these points. Screen voltage is also normal; however, measuring at point C shows B+ to be greatly increased there. When R5 goes up in value, screen current is reduced, causing less voltage drop across R8 and more drop across R5. Net result is normal DC voltage on pin 4. When screen resistance is increased, however, current reduction causes narrowing of width.

Best Bet: Scope isolates; VTVM locates.

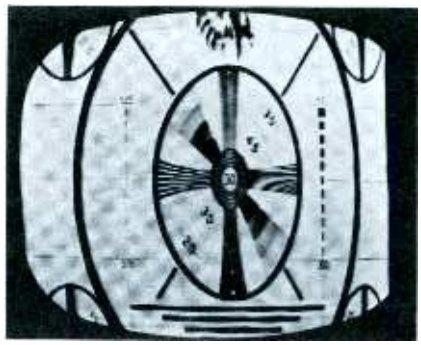
Raster Narrow

Picture and Sound Normal

R1 Increased in Value

(Oscillator Plate Resistor—68K)

Symptom 6

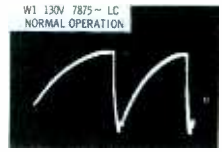


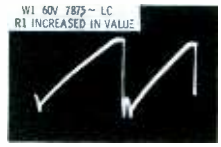
Symptom Analysis

Raster edges show on both sides of screen, but more pronounced on right side. Vertical sync and sweep are normal. Picture can be synchronized horizontally but requires considerable adjustment of oscillator coil. Oscillator or output grid circuits are likely culprits.

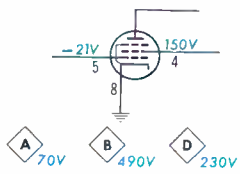
Waveform Analysis

Shape of W2 is altered somewhat, but of more significance is amplitude—it's reduced to 60 volts. This proves that reduced drive to grid of V1 is responsible for width reduction. Oscillator plate waveform W1 (compare to normal W1) is same as W2. Scope doesn't isolate defective component but does tie down area of trouble to oscillator or output grid network. Fault in grid circuit is possible; W1 can be affected by condition of C3, C4, and R3.



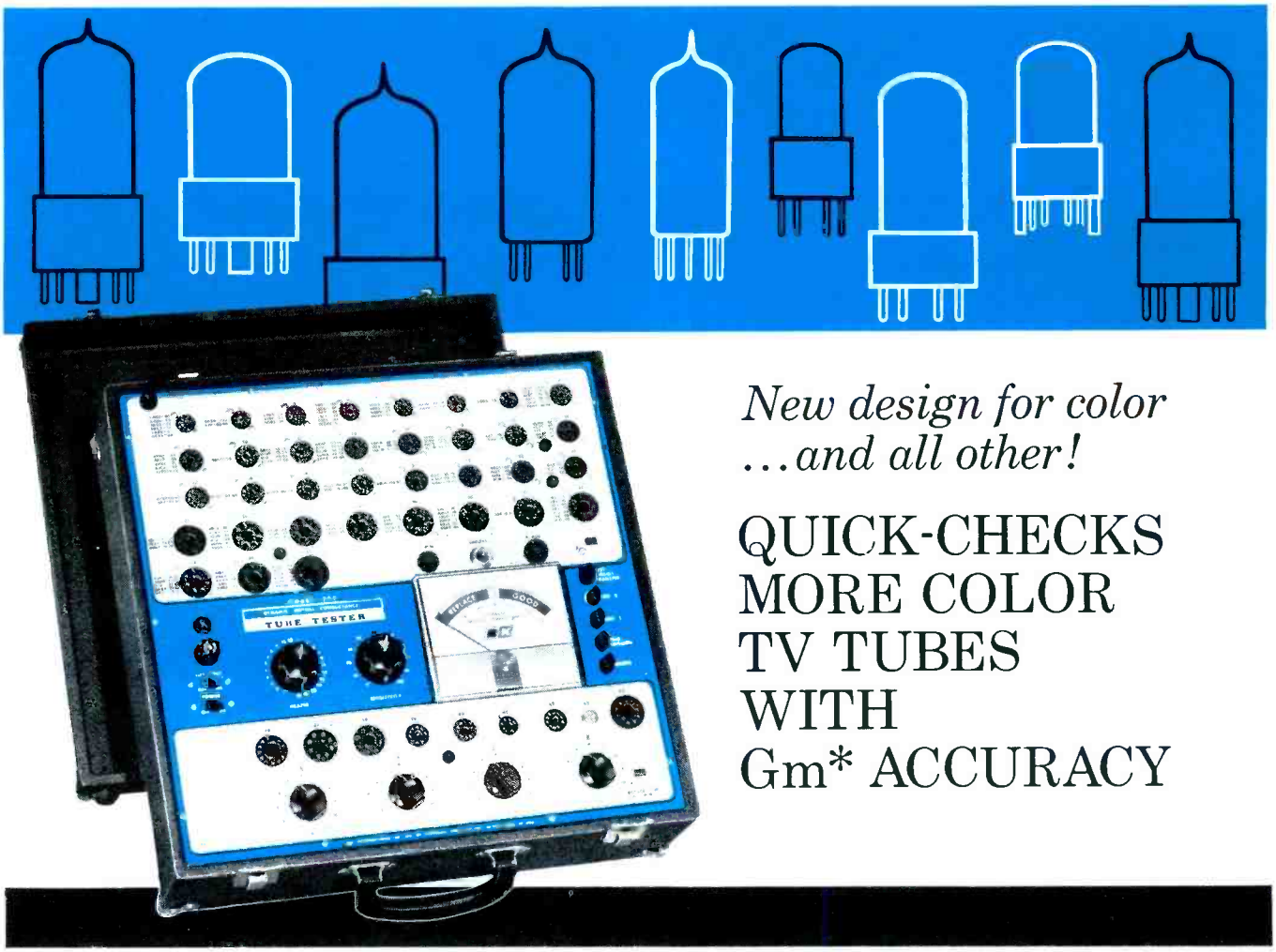


Voltage and Component Analysis



Decreased voltage at pin 5 of V1 indicates insufficient drive to output tube, resulting in decreased current in horizontal stage and loss of adequate width. Best clue is low plate voltage on oscillator. This, coupled with fact that B+ is normal and boost nearly normal, leads to suspicion of trouble in oscillator plate-supply resistors. However, don't overlook possibility of leaky C1—it can cause similar symptom. Individual resistance measurements of R1 and R2 are sure method of locating faulty component.

Best Bet: VTVM is adequate.



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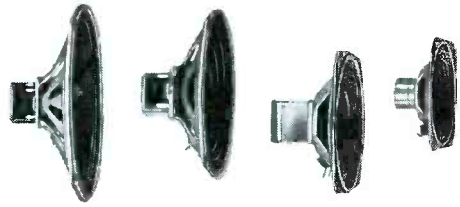

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Circle 29 on literature card

Chasing Faults.... in intercoms

Squawk-box troubles can be found simply.

by Steve P. Dow

Intercoms are the most frequently used step savers in modern homes and offices. These devices operate continuously and require maintenance on a regular basis. Servicing procedures, although not entirely simple, are well within the troubleshooting ability of the average TV technician, and the maintenance of these units from a regular group of homes and offices can be a good source of extra income for the serviceman.

Types of Systems

Intercom systems are basically divided into two types. One is the all-master system which incorporates an amplifier at each one of its stations. The other type is the single-master system which has but one amplifier, located at the master station. In this system, remote units can be used to call the master station but not each other.

A variation of the single-master system is the distribution-master system. This unit allows conversations between the remote units through the amplifier in the master. In a distribution-master installation, only one conversation can take place at one time, and the circuits must be set up beforehand on the switchboard at the master location.

The Single-Master System

The schematic of a typical single-master switching system is shown in Fig 1. When the master unit is set up in the standby position, a call to the master can be

• *please turn to page 64*

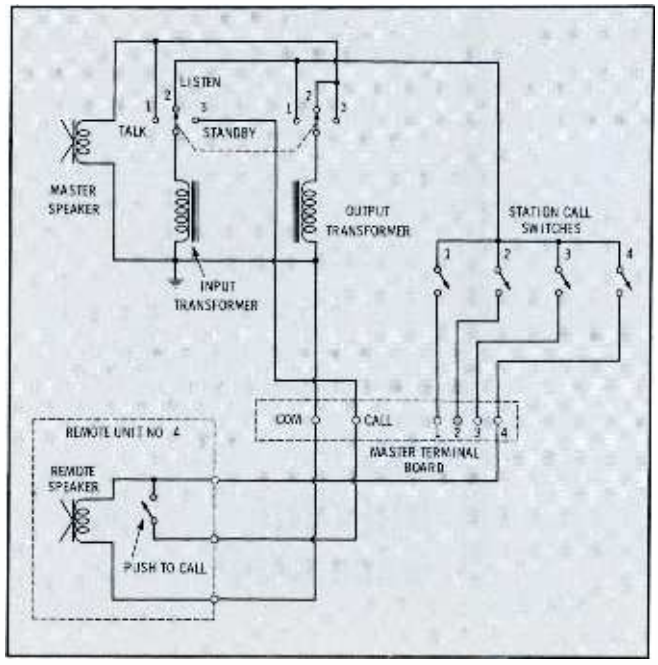

Fig. 1. This shows the switching in a single-master system.

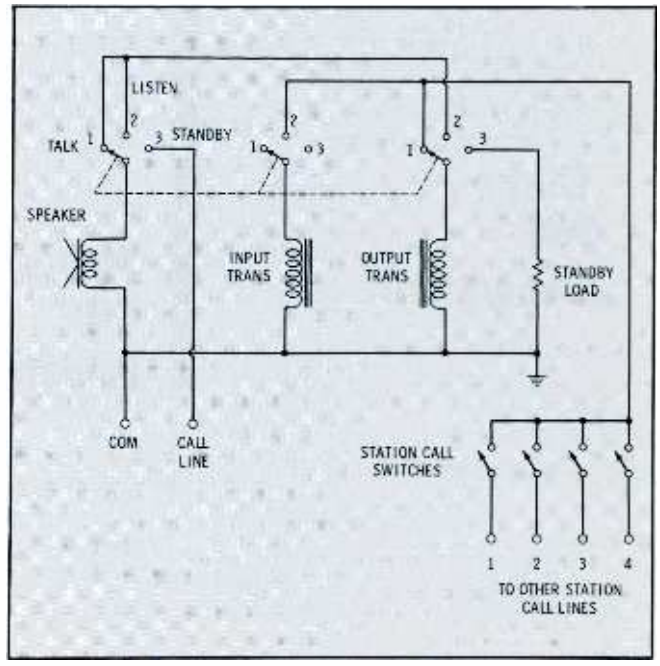

Fig. 2. Each unit in all-master system has its own amplifier.

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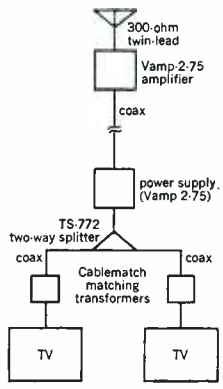
Typical 75-Ω VHF amplified system



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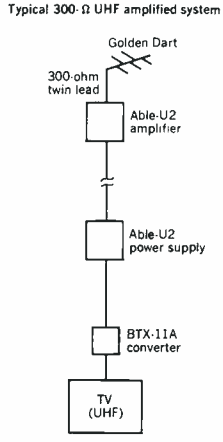

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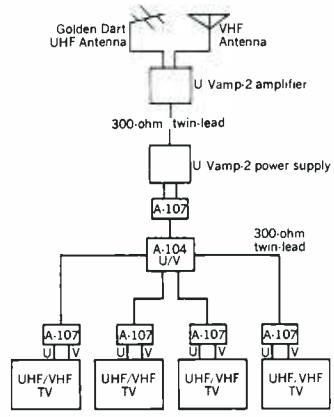
Typical 300-Ω UHF/VHF amplified system



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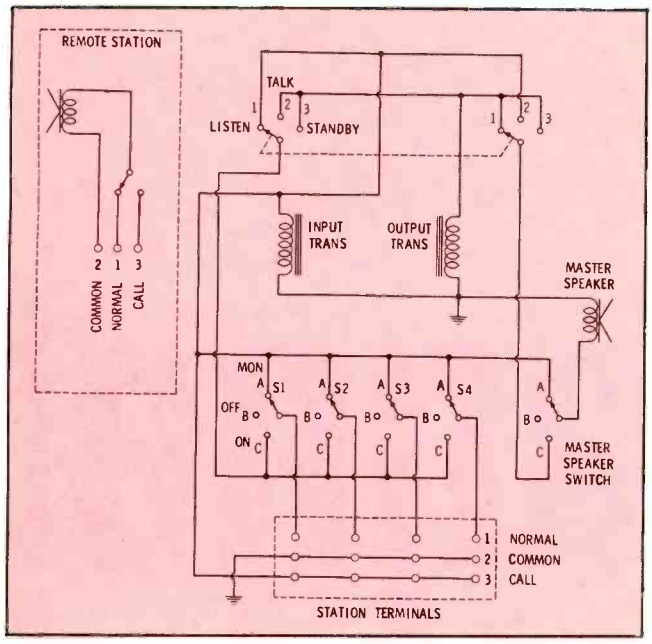

Fig. 3. Switching arrangement in distribution-master system.

made from any one of the remotes when the remote call key is pressed. (This connects the remote-unit speaker to the call line). The operator at the master unit then identifies the calling station and presses the appropriate station switch. From this point on the conversation switching is done entirely at the master station.

The All-Master System

The wiring of an all-master unit, as shown in Fig. 2, is very similar to that of the single-master system. The only difference is in the connection of the call line. In the all-master system the call line connects to the station's speaker; in the single-master unit the call line ties to the amplifier input. The station that originates the call supplies the talk power. This means it uses its amplifier for talking and listening. Conversation switching is also done from the calling station.

The Distribution-Master System

Typical wiring for a distribution-master intercom system is shown in Fig. 3. In this arrangement, the station switches at the master have three positions: ON, OFF, and MONITOR. In the ON position, provided the master's TALK/LISTEN/STANDBY switch is placed in the STANDBY position, the remote speaker is connected to the amplifier output. When the talk/listen switch at the remote station is pressed, the speaker connection is transferred to the amplifier input. In the OFF position, the remote speaker is not connected to any circuit; however, by pressing the talk/listen switch, the speaker is connected to the amplifier input via the call line. In the MONITOR position, the remote speaker is connected to the amplifier input. Under this condition, the talk/listen switch on a remote station is ineffective, inasmuch as the monitor circuit and the call line are connected in parallel. Conversation switching is performed at the master unit.

The distribution-master system, because of its ver-

satility, is often used in homes. When using this type of intercom, the housewife can be working in the laundry room and be able to hear the baby cry in an upstairs bedroom, and she can also answer the front or back door. To do this she must set up the master-unit switchboard in the following manner:

1. Speaker switch to OFF position.
2. TALK/LISTEN–/STANDBY switch to STANDBY.
3. Station switch for baby's room to MONITOR.
4. Station switch for laundry, front, and back doors to ON position.

If the front or back doorbell rings, she can answer it by pressing the talk/listen switch on the remote unit in the laundry area. The caller can then reply by pressing the talk/listen switch on the remote unit at the door. Since both stations on the master unit are switched to the ON position, the conversation can take place. However, the baby is not disturbed by this transmission because the remote station in its room is on MONITOR position at the master unit—connected only to the amplifier input.

Radios as Part of Intercoms

Distribution-master type units are often equipped with AM-FM radios. There is nothing special about the radio circuitry; however, the built-in units are usually enclosed in a metal box, and external antennas are needed for reception of both AM and FM.

When a radio is a part of an intercom unit that has but one master gain control, the radio output signal applied to the amplifier will be of a lower level than the signal from the intercom section. This permits normal intercom operation at the same time music is being piped to some of the remotes. On units where a radio is incorporated in the master, the remotes frequently have level controls to adjust the volume at the individual stations. These controls also affect the intercom volume.

Usual Circuits

Intercom amplifiers usually have fairly simple circuits. The most popular is the three-tube AC-DC type, which is similar to amplifiers used in small record players. These units can deliver about 2 watts peak power. The input and output impedances vary from 3.2 ohms to 45 ohms. The volume control is usually connected across the input of the amplifier, but some units use interstage controls. The response of an intercom amplifier peaks at about 2000 cps and tapers off both above and below that frequency; this provides satisfactory speech transmission. Tone controls on intercoms are the high-cut type. A typical circuit consists of a 500K control in series with a .05 mfd capacitor; this network is across the grid of the output tube.

The smal table-top intercoms usually return one side of the power line to the chassis through a .1-mfd capacitor. In the built-in type of intercom, the power line is usually connected to the metal housing. When the electrical contractor wires the house, he connects the ground side of the intercom to the neutral side of the power line. If the intercom has been moved or altered by

the customer, it is always wise to check the polarity of the power line. A ten-watt lamp connected between the metal box of the unit and a water pipe will indicate if the chassis is hot. Also, a VOM could be used to determine if a voltage exists between the unit's enclosure and a water line.

Transistor Intercom Units

Many newer installations use solid-state amplifiers. These may be powered by batteries or a small power pack. As the quiesent drain of transistors is very low, batteries will operate the unit for close to their shelf life. Troubles encountered with amplifiers of transistor-type intercoms should be repaired in the service shop, since there are so few easily replaced parts. Battery powered transistor intercoms generally have less talk power than vacuum-tube models, and a loss in volume or an increase in distortion is noticed immediately by the customer. Servicing transistor amplifiers is very similar to repairing transistor radios. Open or shorted capacitors and bad transistors are the main causes of failure.

Intercom Troubles

Speakers in intercoms are used as microphones, and should the voice coil rub or the cone become warped, the talkback sound will be badly distorted. Speakers that are located outdoors and in damp locations are usually the first to go bad. The leads to the voice coil often corrode and make the speaker operate intermittently. An intermittent speaker may check okay on an ohmmeter and work fine on low-volume signals. However, when a strong signal comes along, the cone moves far enough to break the connection to the voice coil. To test speakers with this fault, connect an ohmmeter across the speaker terminals and move the voice coil in and out with your fingers.

When a replacement speaker is installed, make sure it has the same impedance as the one removed. A speaker with a large magnet operates better as a microphone than one with a small magnet.

Intercoms that are located near each other, or in adjacent rooms, often produce feedback. This condi-

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Circle 35 on literature card

tion can be eliminated by reversing the leads to one of the speakers.

There are occasions when the elements in level controls on remote speakers become dirty and develop dead spots. This situation produces an intermittent condition. Usually a good liquid cleaner for controls will repair this trouble. However, there are instances when a new control is the only remedy.

Unshielded three-conductor twisted wire is used to connect remote stations in the single-master intercom system. In the all-master system a cable is used; the number of conductors in the cable depends upon the number of stations in the system. Intercom cables must be kept away from AC circuits and apparatus. Hum from power circuits is troublesome; however, the biggest problem is the noise that travels along power lines. Clicking and buzzing noises created by small office machines are difficult to suppress. This type of interference is filtered best at the source. A .01-mfd, 600-volt capacitor, connected across the contacts or motor brushes of the troublemaking appartus, will usually clear up the trouble.

RF pickup from strong AM stations can be eliminated by placing .001-mfd capacitors across the incoming lines. If the trouble persists, relocation of the connecting cables should be tried.

Intermittence shorts in intercom cables often occur in the walk-over raceway used between walls and desks in offices. The raceway has sharp edges and if accidentally moved out of place can bite through the cable whenever someone walks over it.

Hum in amplifiers is caused by poor filters and tubes with heater-to-cathode shorts or gas. Lead dress is important when replacing filters in intercom amplifiers, since many of the units have ground systems designed to reduce hum.

Loss of gain in intercoms takes place over a long period of time. Gassy output tubes, especially the 35C5 and 50C5 types, are common offenders. Many units operate for 12 hours or more a day, and the heat developed by the tubes contributes to the deterioration of many components.

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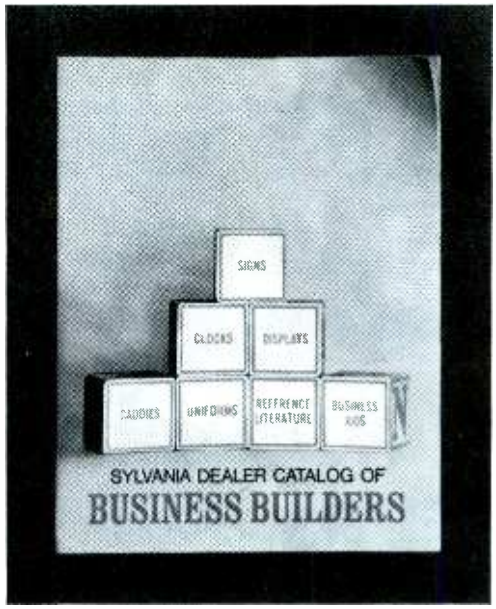

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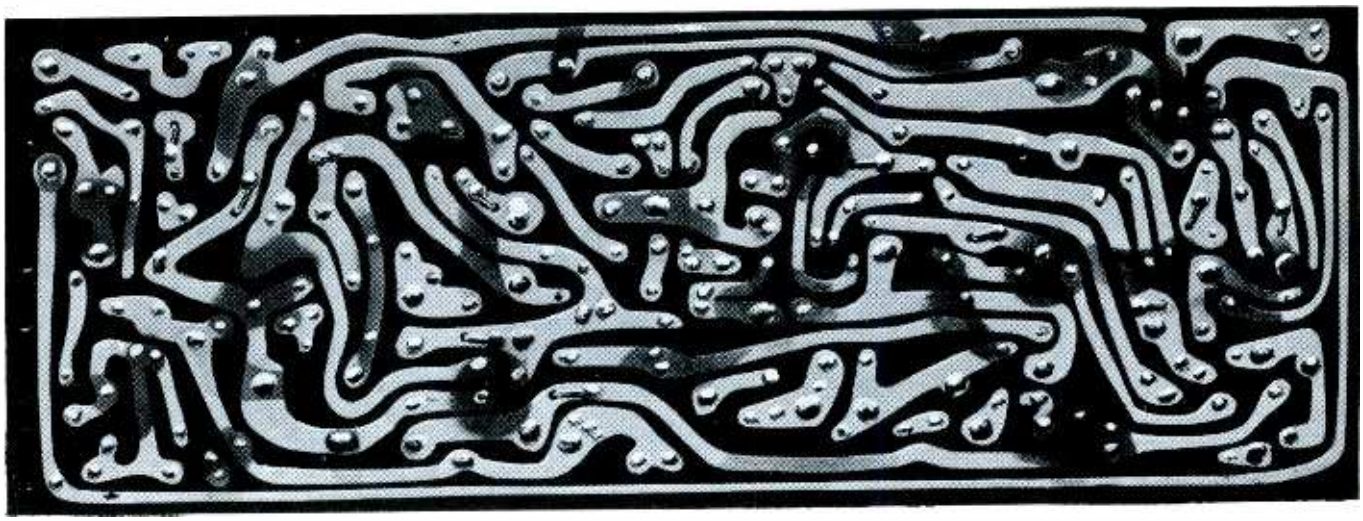
The plate and screen resistors in the first stage of the intercom amplifier should be checked. If a screen resistor has changed value and is replaced, the associated screen-bypass capacitor should also be replaced; chances are the bypass capacitor is leaky.

Intermittent troubles in intercoms are not too difficult to locate. Slide-type switches are used for many functions in intercom systems and often become intermittent. They can be cleaned if you want to take the time to pull them apart. However, a new switch of this type is inexpensive, and a new replacement for one that is found defective or intermittent would be more profitable for the serviceman as well as the customer.

Final Checks

When checking out an intercom after repair, you may use a small transistor radio to do the talking at the remote stations. By using an elastic band to hold the talk/listen key down, one man can check the entire system.

When repairs are completed on a complex system, make sure the customer operates it correctly; this will save needless and time-consuming callbacks. ▲



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Training Systems

Continued from page 32

and some manufacturers and associations offer courses and clinics in business management tailored to the needs of the service shop. This aspect of training a prospective service-shop owner, operator, or manager should not be overlooked; even the service manager of a distributor or manufacturer needs to know practical pricing practices, personnel management, and work-control systems.

Upgrading Courses

These are planned for the already trained technician whose knowledge of a particular field is limited. They cover each of the subjects already mentioned; but they invariably assume that the student thoroughly understands basic electronic fundamentals, and so offer only concentrated doses of specialized knowledge on one specific subject. It is a waste for the untrained technician to attend classes of this type, because he seldom soaks up enough knowledge to make his attendance worthwhile (and he often disrupts the session with unnecessary questions).

Upgrading sessions are sponsored by distributors, associations, set manufacturers, test-equipment makers, and sometimes even by the owner of a large shop. Attendance is usually by invitation only, and the sessions often cover only one specific brand of equipment. They are well worth attending, anyway, because troubleshooting principles that apply to one chassis apply also to other similar ones. The instructors generally know their material inside out and know how to present it quickly and accurately. Sometimes upgrading sessions take the form of slide-tape lectures, which have proven a highly effective means of presentation.

Whether upgrading sessions encompass business practice, advanced color training, transistor servicing, or some other modern technique, every ambitious technician should avail himself of the opportunity to attend. The clinics seldom cost anything, and they offer one of the best ways available to keep up-to-date.

Self-Training

No discussion of training techniques would be complete without examining that time-honored development method among technicians: self-training.

While results prove that self-training is the least efficient of all training methods, some very competent technicians of today have trained themselves. To do a reasonably thorough job requires tremendous initiative and perseverance, incalculable hours of reading, and a lot of time-wasting experimenting with how to apply book knowledge. Self-training frequently leaves yawning gaps—the technician doesn't truly understand his field and never feels really at ease with complex electronic gear. Self-training is to be recommended only as a last resort. Even then, self-training almost requires that the student be employed in the field so he can practice regularly.

The tools of self-training are numerous, but they include basic electronics texts, specialized technical books, math books, technical magazines, and often kits.

Books are the most obvious tool and can take the beginner through the most advanced mathematical circuit analysis. Dozens of basic texts are available, with material presented in every imaginable man-

But books, even those that present the most practical side of servicing, can never provide the guidance and experience gained in formal instruction—whether in residence or by correspondence. Books find their most important place in upgrading the trained technician, teaching better servicing methods, and providing in-depth information on developments in specialized areas.

Magazines serve best in advancing the ability of the trained technician and offering specific information on installing, troubleshooting, and maintaining electronic equipment. They keep the student and practicing technician informed of new developments, but can seldom include more than one or two articles that teach the rank beginner. Technical magazines should inform and upgrade.

Another common, but limited, form of self-training is kit building. The knowledge required is narrow, because the kit is only one in the vast array of electronics instruments the competent technician must master. For the technician who understands electronics, however, or for the student who is depending on books to teach him basic fundamentals, kit building offers a concentrated way to learn the operation and internal construction of specific units.

Conclusion

Whatever system you choose to train your apprentices, upgrade your technicians, or better equip yourself to work in electronics, get the most for your training dollar. Time and money are wasted sending unprepared beginners to courses in advanced servicing; doing this may even keep them from realizing the importance of thorough training in fundamentals.

But once a technician (and this includes yourself) has mastered the basics, don't let him rest on his laurels; the technology of electronics will pass him by, and one day he'll find himself facing only equipment with which he isn't familiar. There are literally dozens of ways to keep up with modern developments. See that everyone in your shop does. They'll be of more use to themselves, to you, and to the industry. ▲

Gray Scale

(Continued from page 34)

4. Advance the BRIGHTNESS control until the raster is just visible.
5. Reduce the G-2 controls of the predominant colors until a gray raster is obtained; leave the G-2 control of the weakest color at maximum.
6. Adjust the MASTER G-1 control until the picture blooms; then adjust the BRIGHTNESS control to eliminate blooming.
7. With a normal BRIGHTNESS setting, touch up the DRIVE controls for a white raster. It may be necessary to go back and forth from low to normal brightness for proper tracking.

It is possible to have *too much* screen voltage in those models which have a "boosted-boost" supply, and this can make tracking difficult or cause weak color. If this should happen, try reducing all the screen controls ¼ turn and raising the CRT bias.

The Admiral 24A2, the General Electric CY, the Magnavox 45, and the RCA CTC17 series chassis all use "boosted-boost" screen supplies and have quite similar tracking procedures:

1. Tune in a b-w picture or a color picture with the COLOR CONTROL set to minimum.
2. Set the SERVICE-NORMAL switch to SERVICE with the Magnavox 45; also set the BRIGHTNESS control to minimum and the CONTRAST control to midrange. (In this particular circuit, the SERVICE position does not disable the BRIGHTNESS control.)
3. Slide the PICTURE-TUBE BIAS switch to the upper position for the General Electric and RCA chassis; for the Admiral and Magnavox chassis turn the PICTURE-TUBE BIAS control fully counterclockwise.
4. Turn the RED, BLUE, and GREEN SCREEN controls fully counterclockwise. Then advance the screen-grid controls until each control produces a barely visible line.
5. If any control fails to produce a line, leave that control ¼ turn below maximum, and return the other controls to minimum. Advance the BIAS control until a barely visible line appears. If a switch is used, move it downward one position, and adjust all three controls for a barely visible line. Set the other two SCREEN controls so each produces a barely visible line.
6. Return the NORMAL-SERVICE switch to NORMAL; and, for the Magnavox 45, return the BRIGHTNESS control to normal.
7. Adjust the BLUE and GREEN DRIVE controls to eliminate coloring in the highlights and the lowlights at all BRIGHTNESS control settings.

Many new color receivers have a switch or variable control ("sepia switch," "color-fidelity control," etc.) so that the set owner can change the screen color to suit himself. Always move this adjustment to the neutral position before making the screen-color and tracking adjustments given here. This is necessary to give adjustment on either side of the correct one.

Conclusion

Screen-color adjustments are more easy and accurate than ever before, but they still should be made in the proper sequence for best results in the least amount of time. ▲

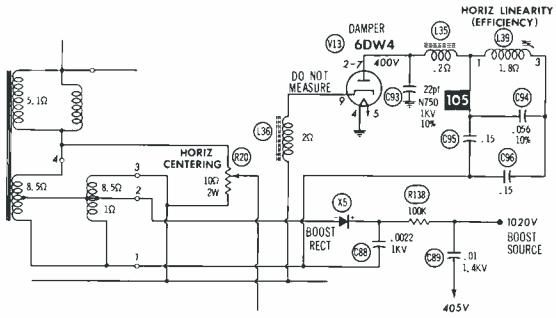
COLOR COUNTERMEASURES

Symptoms and service tips from actual shop experience

Chassis: RCA CTC15, CTC16

Symptoms: Brightness is insufficient even with BRIGHTNESS control set at maximum.

Tip: Use a scope to check for presence of a 500-volt peak-to-peak pulse at the junction of X5 and C88; presence of a pulse indicates that X5 is shorted. Voltage checks will



indicate that the boosted-boost voltage is only 800 volts — equal to the boost voltage. High voltage is approximately 25kv owing to the low screen-grid voltage which causes decreased CRT conduction. Although voltage to the vertical multivibrator is reduced, the change in vertical sweep may not be noticeable.

The boosted-boost voltage is derived by using X5 to rectify the positive portion of the flyback pulse and placing the voltage developed across C88 in series with the 800-volt boost voltage. The result is a 1020-volt DC supply for the CRT screen grids and the vertical multivibrator.

Similar boosted-boost circuits are common in many late-model color television receivers, and identical symptoms will occur if the boosted-boost supply rectifier shorts.

CB 2 WAY SECTION

SOLID STATE

Transistor VHF Front ends are now possible.

Certain transistor characteristics that restrict the high-frequency performance of a transistor have until recently limited the use of solid-state RF circuits at VHF. Chief among these limiting characteristics are three capacitative components. Two of them are *depletion capacitances* at the emitter-base and collector-base junctions are shown in Fig. 1. With the resistive components through which they charge, the depletion capacitances form a time constant that limits the speed with which current change can be transferred from input to output.

The third capacitive effect is a less conventional one called *diffusion capacitance*. In the basic operation of a transistor circuit, the motion of charges through the base is a diffusion-current flow. There is really no difference of potential between the emitter and collector sides of the base. The random motion of charges (electrons, in NPN units) injected through the base-emitter junction, and the mutual repulsion among them, propels the charges to the collector side of the base. Once they reach the collector-base junction, however, they are quickly drawn into the collector and pass on to the external circuit. Since there is a definite transmit time involved in the motion of these charges, signal-current variation cannot be any faster than the speed with which

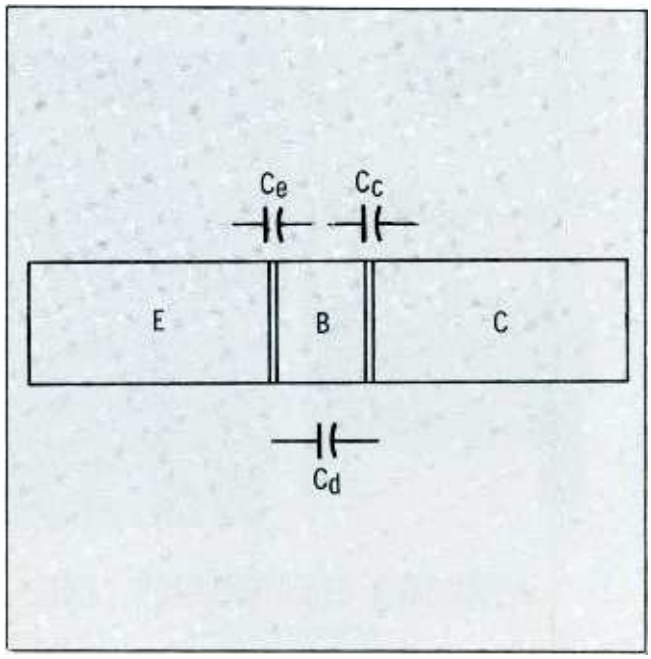
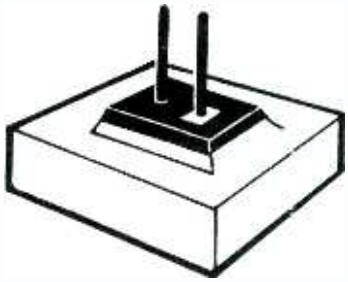


Fig. 1. Capacitances and cross transistor junctions.

RF Circuits

by Edward M. Noll



the charge can move through the base, this is the capacitive effect that restricts frequency.

Recent high-frequency and VHF transistors are designed to minimize these capacitances, and the associated circuits are designed to minimize their effects. An extremely thin base is one approach to the reduction of diffusion capacitance; the travel time of a carrier through the base is thus much reduced. On the other hand, the thinner the base, the higher is the transverse base-spreading resistance in the path of emitter-base current. The higher resistance increases the time constant associated with the depletion capacitance of the transistor junction. Another restriction of a thin base is the voltage limit it imposes on back-biasing of the collector-base junction and therefore on the operating Vcc voltage; this is a serious limitation for an RF power transistor because it reduces the emplifying capability.

The high-frequency limits can also be extended by keeping the areas of the junctions as small as possible, but this imposes both processing and power limitations. Collector depletion capacitance can be reduced by increasing collector resistivity but the resistance it presents to collector-current flow must be considered.

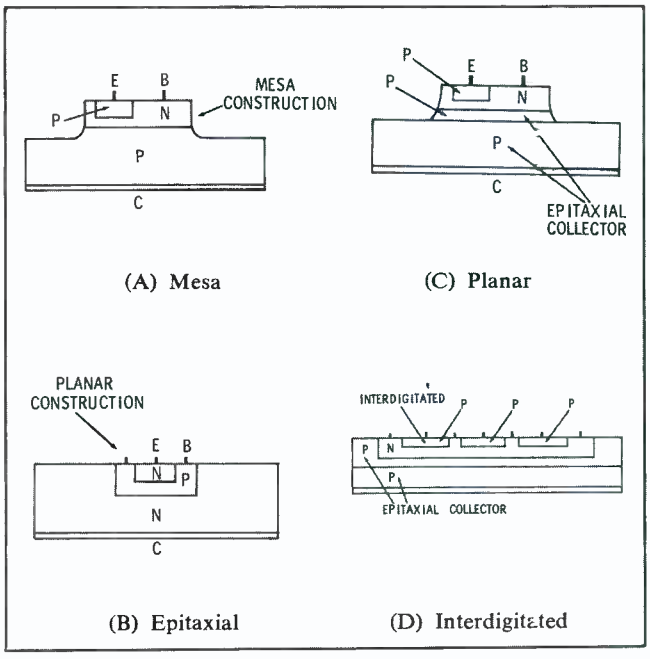


Fig. 2. The construction of high-frequency transistors.

The RF Transistor

It is apparent that transistor design is a complex process of compromise. The successful development of both small-signal and high-power RF transistors can be attributed to three break-throughs: special physical constructions, diffusion process, and epitaxial technique.

A diffused base encourages faster movement of charges through the base and makes possible a compromise base thickness that permits both high-frequency efficiency and a respectable power output. As mentioned previously, electron or hole carriers move through the base from emitter junction to collector junction by the diffusion-current process. There is no difference of potential between the two sides of the base when doping (deliberately introduced impurities) of the base material is uniform. This is not true, though, if doping of the base is not uniform. If doping is stronger at the emitter-base junction and tapers off toward the collector, a gradient is established that affects the velocity of the injected carriers. They move through the base quickly, and the *effective* thickness of the base is reduced.

Some popular constructions for high-frequency transistors are shown in Fig. 2. *Mesa* construction (2A) starts with a semi-conductor wafer, into which the base is diffused. Emitter and base connection stripes are then film-deposited on the top. The wafer is carefully etched in its active area to develop the mesa; a small, low-capacitance active area is thus obtained, while the collector retains a large overall area for effective heat dissipation.

Collector junction resistance must be moderate to hold down capacitance. With the collector doped uniformly, its resistance is considerable —a disadvantage at high frequencies. The problem is reduced with *epitaxial* type of construction (Fig. 2B). In epitaxial transistors, the collector has two degrees of doping. In the vicinity of the base junction, doping is reduced so capacitance is low, even though collector resistance in that area is high. In other areas of the collector, there is higher doping and consequent lower resistance. In the epitaxial arrangement, therefore, lower overall collector

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Sync Complaints

(Continued from page 44)

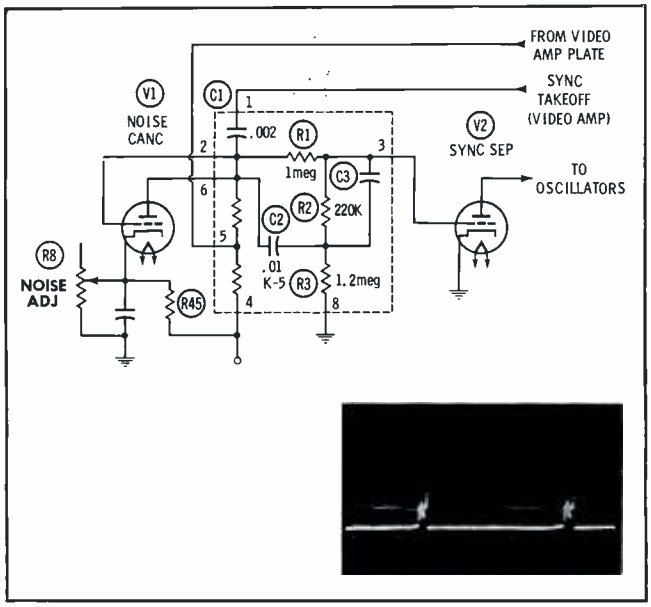

Fig. 11. Noise canceller in common use; how it affects sync.

In one early Philco, the TV-390, which has a similar circuit but without a PC module, VTVM readings were not as conclusive as scoping. Severe sideways tearing (as in Fig. 10) constituted the complaint. Scoping the separator grid revealed the waveform in Fig. 12A, suggesting a leaky sync coupling capacitor. Changing this capacitor (a .001-mfd unit corresponding to C1 in Fig. 11) got rid of the side-slipping, but the picture still had a nasty twist, and the waveform had changed to Fig. 12B. Replacing the capacitor at the noise-canceller plate (a .005-mfd unit corresponding to C2 in Fig. 11) brought the more normal Fig. 12C and restored steady pictures.

While many sets use the basic circut of Fig. 11, or variations thereof, a much simpler circuit (Fig. 13) is also in common use. A 6BE6 was originally used with G1 biased to provide cutoff *during* noise signals. Later, tube types such as the 6BY6 and 6CS6 improved noise cutoff, and the 6BU8 and its offspring provided even better noise cancellation in the separator.

A composite video signal of more than 40 volts is applied to G3 so that, during normal noise-free reception, the tube operates as a high-efficiency separator. G1 is fed by negative-polarized video signal from the video detector; but G1 also has just enough bias to prevent extreme negative video peaks from being amplified. Noise signals normally extend beyond the video-signal peaks; applied to G1, they cut off tube conduction for their duration.

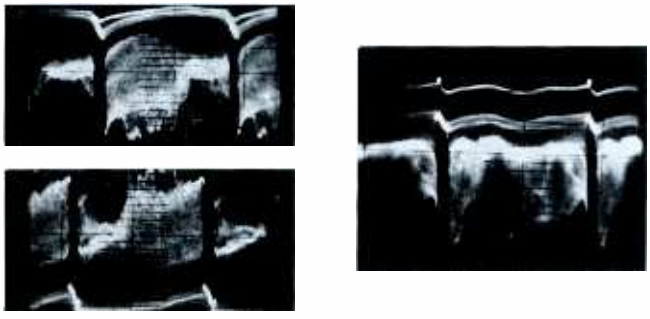

Fig. 12. Steps to repair double fault in sync and noise.

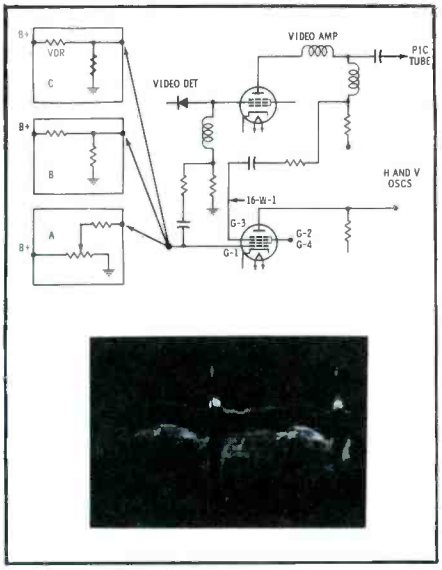

Fig. 13. Three forms of canceller input.

The ways by which the slight positive DC voltage is applied to G1 are shown by alternates A, B, and C in Fig. 13. In A the noise-cancellation level is adjustable by means of a potentiometer; in B the canceling level is fixed; C uses a voltage-dependent resistor. In any of these, if the positive voltage is insufficient, the noise canceller will clip horizontal sync pulses and result in poor horizontal sync. If, on the other hand, G1 is too positive, the circuit will lose its ability to cancel noise. A simple test will indicate if the noise canceller is causing shakes, weave, or twist: Merely short G1 to the cathode; if this corrects the trouble, the G1 components are likely at fault.

Malfunctions cause symptoms similar to these from other noise-canceller circuits—shaky horizontal sync in the form of twisting or weaving, and the same waveform distortion shown in Fig. 11. Defects in the noise-canceller portion will usually affect the separator-grid (G3) signal so it has the distorted appearance of the waveform in Fig. 13.

Conclusion

Since any sync system contains only a limited number of components—two or three tubes, at most, a few capacitors, and six to eight resistors, at most—defects in these components should present little difficulty in troubleshooting. Sync complaints can be pinned down by signal distortions either within the sync system or in associated signals. ▲

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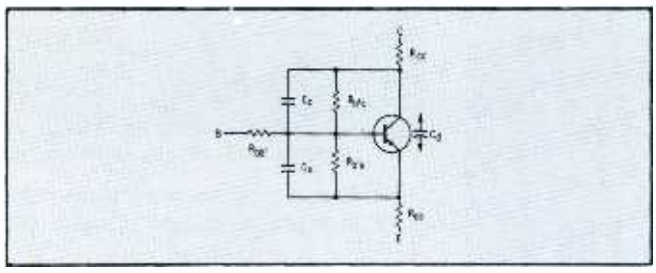


Fig. 3. Equivalent transistor circuit.

Voltages are attainable. The planar type of transistor (Fig. 2C) has the same general characteristics, but the manufacturing process differs because of the different mechanical arrangement. Base and emitter both are diffused into the water using a masking arrangement. To maintain low junction capacitance and resistance, the emitter is in the form of narrow stripes or rings.

If greater current capacity and power-handling capabilities are desired, several stripe or ring sections are paralleled in so-called *interdigitated* structures as shown in Fig. 2D. An epitaxial collector can be used in this arrangement, too.

Equivalent Circuits

The effects of transistor capacitances and resistances are shown in the equivalent circuit of Fig. 3. These parameters determine three very significant limits of high-frequency operation. These frequency limits are:

1. f_{max}—maximum frequency at which the transistor will oscillate.
2. F_{ae}—the current-gain (alpha) cutoff frequency for common-emitter operation. At this frequency, gain is down 3 db relative to low-frequency gain.
3. f_t—frequency at which gain is exactly one (unity). This symbol is also called the gain-band-width factor.

Near f_{max}, a transistor would not provide much useful output; in fact a transistor will not function well as an oscillator for an operating frequency more than $f_{max}/2$. In practical transistor circuits, maximum usable gain (about 40 db) is attainable up to a frequency of approximately $f_{max}/100$.

The gain bandwith product f_t is established by transistor gain, base-emitter resistance, and the net internal base-emitter capacitance (the sum of emitter junction capacitance and diffusion capacitance).

The 3-db-down frequency f_{ae} is determined by base-emitter resistance, base-emitter capacitance, and a feedback capacitance. In practice, the load resistance is also of significance.

Maximum power gain is obtained when the impedances are matched as shown in Fig. 4. However, the collector, supply voltage and power output needs are

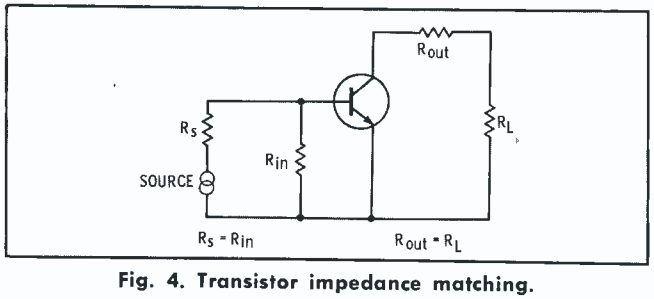


Fig. 4. Transistor impedance matching.

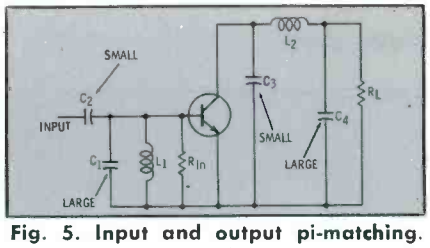


Fig. 5. Input and output pi-matching.

such that design for maximum power gain is not practical. Actually, the concern is maximum power transfer to the load rather than maximum power gain from input to output.

Inasmuch as resonant circuits are concerned, reactive components must also be considered. The input network in an RF stage must not only match the signal-source impedance to the input resistance, but must include a reactive component that resonates with the transistor's input capacitance. The coupling network on the output side must also be designed to tune out the transistor's output reactance.

A representative equivalent circuit is shown in Fig. 5. An L-network is used to match a 50-ohm signal source to the transistor's input resistance. The values of C1, C2, and L1 have been selected for "Q" and for matching. The input capacitance is a part of C1; but, in a practical L-network input, the value of capacitor C1 is normally so high that the input component can often be neglected.

A pi-network arrangement is shown at the output, matching the transistor's output resistance to a 50-ohm load. The true input capacitance of the pi-network is the sum of the output collector capacitance and that of network capacitor C3.

Typical Circuits

The RF sections of a Citizens-band unit are shown in Figs. 6 and

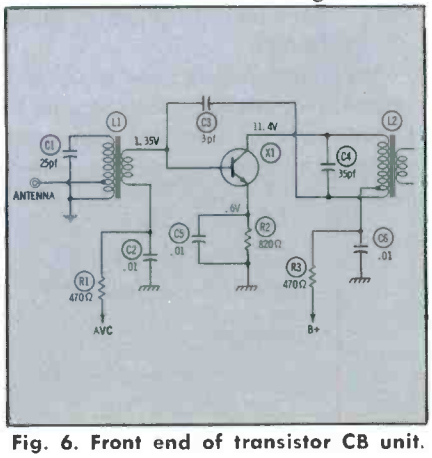


Fig. 6. Front end of transistor CB unit.

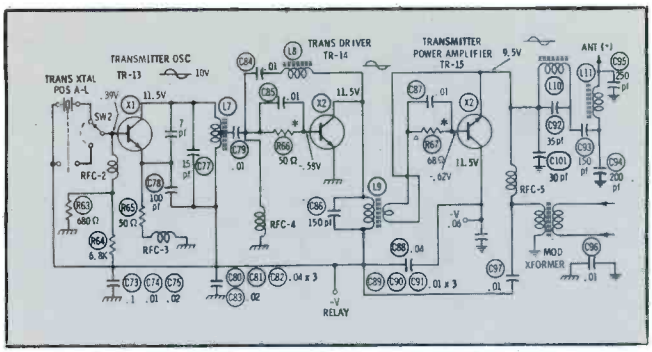


Fig. 7. Transistorized transmitter is okay for low power.

7. A silicon-mesa transistor is used in the RF section of the receiver, in a common-emitter stage. Such a stage has low input impedance and a substantially higher output impedance. The antenna impedance for Citizens-band frequencies is usually in the 50-ohm range. However, the antenna system is not matched directly to the transistor input; rather, it is connected into a low-impedance tap on a high-Z, resonant-tank circuit—this improves selectivity. A low-impedance secondary is then used for matching to the base circuit of the RF transistor. AVC bias current is also introduced through the L1 secondary winding, into the base circuit, decoupled by R1-C2.

This high-gain RF stage is neutralized (prevented from self-oscillating) by a signal from a tap in collector tank circuit; feedback path is by way of capacitor C3. A low-impedance secondary is again used as a link to match the input of the next transistor.

The RF section of the transmitter, Fig. 7, uses silicon epitaxial mesa transistors in three NPN stages—oscillator, driver, and power amplifier. The oscillator is crystal controlled, using some collector-emitter feedback via a small 7-pf capacitor.

The oscillator-tank circuit is tapped to provide low-impedance drive to the second transistor stage, which is neutralized from collector to base via inductor L8. The final stage operates in a common-collector configuration and does not require neutralization; at the same time it has a low-impedance output and is capable of good power gain.

The pi-network following the PA stage is in two segments, providing a high order of harmonic rejection and a match to the low impedance of the antenna system. The double network also provides high "Q" for the impedance transformation.

The emitter of the PA stage is returned through an RF choke to the secondary of the modulation transformer. Since the secondary is grounded, the emitter operates at ground potential. Emitter modulation is used

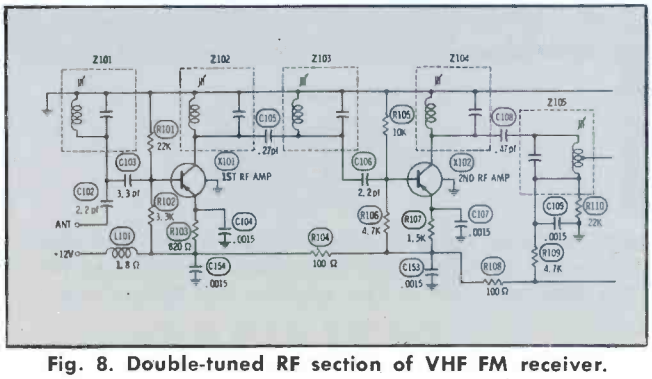


Fig. 8. Double-tuned RF section of VHF FM receiver.

Circle 58 on literature card

Circle 57 on literature card

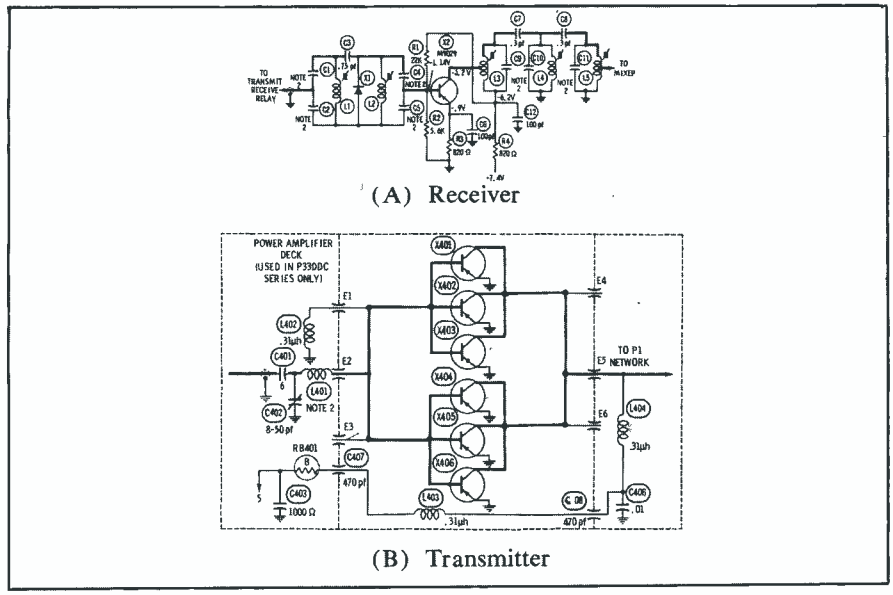


Fig. 9. Portable high-band VHF transmitter and receiver.

because of the low impedance of any emitter-input configuration.

FM Transceiver

In the 145- to 175-mc FM receiver shown partially in Fig. 8, two RF stages are employed that use double-tuned interstage coils with a capacitor for coupling. A tap on the secondary of one coil, the last of the cascaded group, provides proper matching into the base circuit of the mixer. The local oscillator is a crystal-controlled overtone type, operating in the 45- to 50-mc range.

The transmitter (not shown) starts with a fundamental crystal oscillator in the 12- to 15-mc range. A phase modulator, consisting mainly of a *varicap* diode, is inserted in the coupling circuit between the crystal oscillator and the first buffer amplifier. A transistor buffer amplifier and a doubler follow. The output of the doubler drives the first of three tube amplifiers, since no RF transistor yet available can be used practically at the VHF power level required in this transmitter.

Portable

An example of a portable FM transceiver is shown in Fig. 9. Typical all-transistor models have transmitter outputs up to 3 watts.

In the receiver's RF system, triple-tuned resonant circuits are used to obtain a steep-skirted response; transistors are low-impedance devices and spurious signals leak through when adequate selectivity is not provided. In the antenna circuit, capacitive impedance dividers are used to match primary and secondary to the low impedances of antenna and transistor.

The transmitter's RF section is a nine-stage affair using a crystal oscillator, a phase modulator, and a series of multipliers (18x) and amplifiers. The final RF-amplifier schematic (9B) shows a method of using low-power RF transistors to obtain substantial RF output—six transistors are used in parallel, in a common-emitter circuit. ▲

Circle 56 on literature card

The Troubleshooter

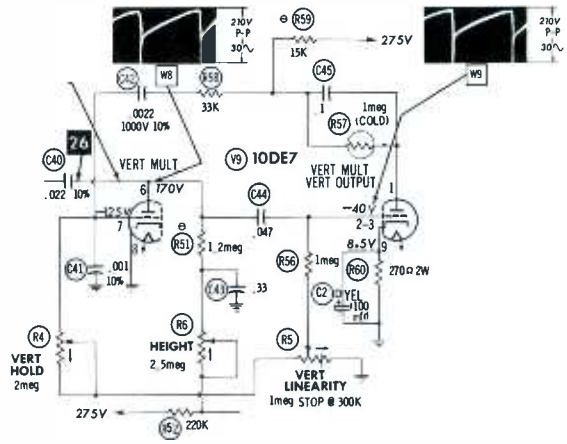
answers your servicing problems

Vertical Shrink and Roll

I have a Sylvania Model 1712303S TV receiver (covered in PHOTOFACT Folder 447-3). The vertical-oscillator/output tube (V9) lasts for only one or two months; then the picture starts to shrink vertically and sometimes rolls. I have checked all voltages on V9, and they are correct.

MATTHEW AVAGLIANO

Ridgewood, N. J.



The raster is shrinking in height because of deterioration of the right-hand triode of tube V9. The picture is then starting to roll because the right-hand triode is actually part of the vertical multivibrator. A possible cause of deterioration of V9 is a leaky coupling capacitor to the control grid, pin 2. Check capacitor C44. Also check capacitors C45, C42, and C40.

No AGC

I have AGC trouble in an RCA Chassis KCS81A (covered in PHOTOFACT: Folder 208-8). The set will run okay for 5 to 10 minutes, then overload in the IF section. When I apply a negative bias to the AGC line, the set operates normally. Sound is good all the time. I have changed and/or checked all components through the AGC keying section. Capacitor C50 has been replaced. Waveform W4 is 200 volts p-p, and waveform W3 is 6 volts p-p. Both remain when the trouble occurs. Voltage on pin 2 of V10 is 65 volts. Voltage on the cathode of V18 is 155 volts. The AGC voltage slowly drops, and the set blacks out. A bias supply of about 2 volts makes the set work fine.

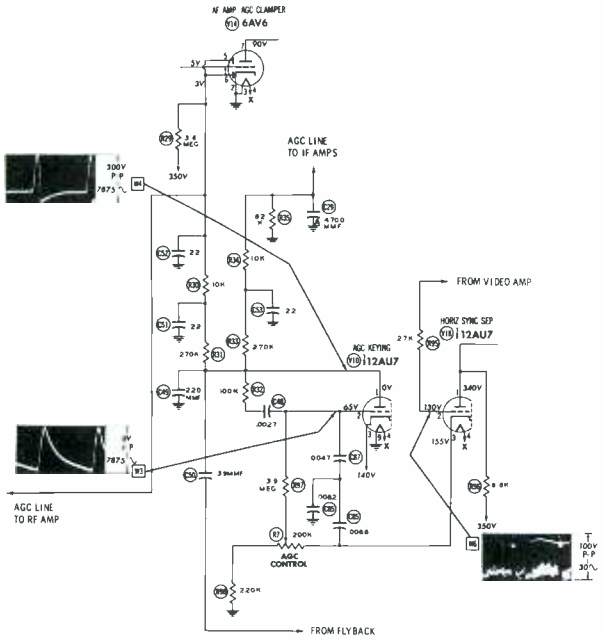
Please explain how the AGC voltage is developed, as I find no B+ going to the AGC circuitry.

LOUIS MIEDEMA

Moline, Mich.

You stated that the AGC voltage overloads the IF section. Be sure also to check the AGC voltage going to the tuner section. Try checking tubes V10 and V18. Check resistors on the AGC line, such as R33 and R34. Other resistors will be found along the line, since the AGC line

has a path to each of the controlled tubes. The "B+" for the AGC section is actually the pulse supplied by the horizontal-deflection circuitry to capacitor C50. C50 charges during times of pulse arrival by conduction of V10, the AGC keying tube. The top side of C50 then



has a negative potential. When the AGC keying tube is not keyed on, during times between flyback periods, the negative potential at the top of C50 is discharging through the AGC line and developing the negative potential to the grids of the controlled tubes.

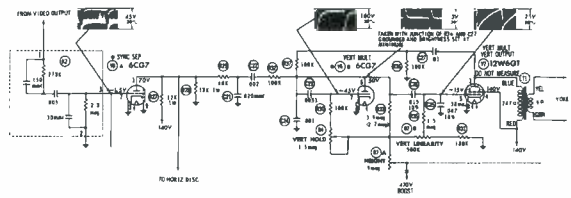
Slow Roll

I have a Bradford TX Model 91199A (covered in PHOTOFACT Folder 621-1) with a very slow vertical roll after warmup. I have made all voltage and scope checks as suggested in *SYMFACT* for November and December 1962 with no results. A running sync pulse can be observed at pin 7 of V6B.

LEO PETRUCCI

San Jose, California

First be sure that the picture is normal (has sufficient contrast and resolution). Using a scope, check the waveform at pin 2 of V6. If the waveform is not normal, try replacing printed-circuit component K2. If necessary,



make additional scope checks, progressing toward the vertical multivibrator, for loss in amplitude of the sync pulse. Even though the sync pulse is present, it apparently is too low in amplitude to produce synchronization of the vertical multivibrator. Also check the shape of the waveform at pin 7 of V6. A poor waveform here might create a condition in the vertical multivibrator whereby the oscillator does not respond readily to sync pulses. Also check the supply voltages going to the sync-separator and vertical-multivibrator circuitry.

Degausing

(continued from page 50)

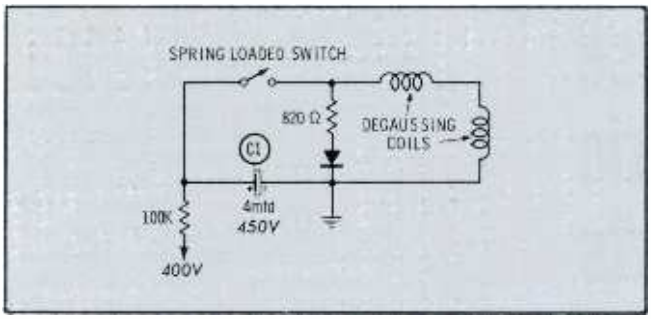


Fig. 5. ADG started when spring-loaded switch is pressed.

A check of this circuit may be made in the same manner as with the other—by connecting a temporary jumper (clip-lead) across the thermistor (R1) while the receiver is turned off.

Should the check of ADG action prove the circuit defective, the jumper may be left in place or the circuit disconnected—if your customer approves. Operation of the receiver is not affected by removal or by-passing of the ADG circuit. In this case, and pending repair of the ADG circuit manual degaussing may be performed as necessary.

Early versions of the Packard Bell 98C8 color chassis did not have the automatic degaussing feature, but production runs incorporated a circuit that is automatic, although manually initiated. Differing from RCA and Zenith, degaussing doesn't occur every time the receiver is turned on; this version may be degaussed at will by pressing the decaussing switch button located at the rear of the receiver.

Operation of the Packard Bell circuit (Fig. 5) is as follows: Switch S1 is of the momentary contact type; depressing and releasing this switch allows a "slug" of current to flow through degaussing coils L1 and L2. The AC magnetic field built up around these coils demagnetizes the CRT tube and surrounding area. The magnetic field is prevented from suddenly collapsing by resistor R2, and diode D1, and a gradual return to zero potential is effected. Due to the retarding action of R2 and D1, the degaussing switch must not be depressed again for a minimum of 30 seconds, or impurity will result. A degaussing kit, part number 1CPK11, is available for installation on early production runs of the 98C8 chassis.

Summary

As we stated, it doesn't seem that ADG circuits will produce any tough-dog servicing jobs—at the present time anyway. Only a very few components are associated with the circuit. The thermistor isn't new to many of the color receivers—it has been used previously in many sets. The usual fault this component developed was an open connection. The degaussing coils shouldn't present much of a problem, unless they are mishandled or damaged by rough contact. The VDR may turn out to be the weak link (only a guess), so you might keep an extra on your stock shelf . . . and a few R1's, too! ▲

BOOK REVIEW

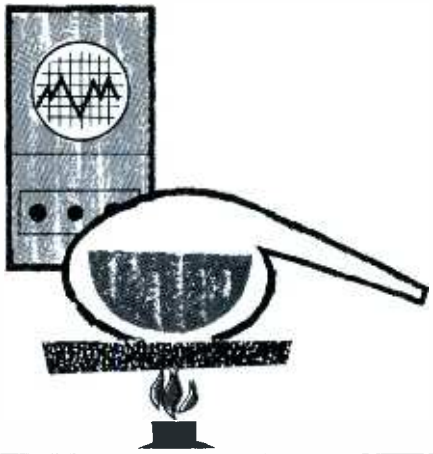
Modern Electronic Voltmeters; Sol D. Prensky; John F. Rider, Inc., New York, New York, 1964; 232 pages, 8½" × 5½", paperback; $4.95.

The author has written an informative text which ranges from a review of vacuum tubes and semiconductors —through the measuring of DC, audio, and RF energy—to microammeters and digital voltmeters. The chapters are divided into sections with references provided where pertinent. Drawings and photos are used throughout. Not only are the basics covered, some real "meat" is provided with which to get a clearer understanding of electronic measuring instruments.

The test covers many types of voltmeters—average-sensing diode; peak-sensing diode; diode-rectifier, triode-amplifier arrangement; two-triode balanced-bridge; AC-DC tube multimeter; AC-DC transistor multimeter; high sensitivity AC and DC voltmeters; microammeters and galvanometers; femtoammeter; recording voltmeters; digital display voltmeters; and voltmeters used in medical and nuclear applications. The text is closed with a bibliography, a list of manufacturers, and an index.

If he studies this book thoroughly, the reader should be rewarded with a good understanding of electronic voltmeters. ▲

PFR Bench Report



CB Transceiver Tester

An instrument to assist the CB technician in the installation and servicing of CB transceivers (and other transceivers in the CB frequency range) is the multipurpose transceiver tester manufactured by **Hallmark Instruments** of Dallas, Texas. The purpose of an economy-priced tester of this type is to facilitate making peaking adjustments or relative measurements, rather than for making absolute power or signal-strength measurements.

This tester will indicate the following quantities:

RF power (0-5 watts)
percentage of modulation (0-120%)
standing-wave ratio
relative field strength

In addition, the instrument has a built-in crystal-controlled signal generator that may be modulated with a 1000-cps tone. The carrier power of this test signal is about 100 mw. A socket is provided on the front panel for the insertion of crystals. A built-in telescoping antenna is provided for the relative-field-strength and signal-generator functions. Included with the transceiver tester are a 2' cable fitted with connectors, and an instruction manual.

Operating power in the first four positions of the function switch is derived from the RF signal itself. In the last three positions, an internal battery is used to power the transistor amplifier for field-strength readings and the transistors oscillators for the signal-generator function.

The list price of the instrument is $49.50.

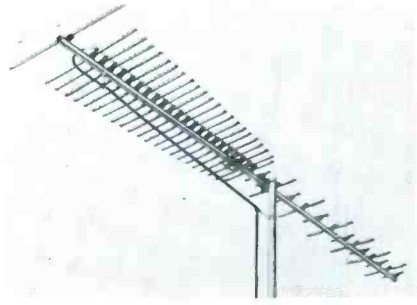
H.E.L.P. Transceiver

(136)

A two-way radio that uses less than half the electrical current required by an automobile tail light has been introduced by **Raytheon** as an aid to motorists requiring assistance on the highway. The completely transistorized Citizens-band radio will operate even when a car's battery is so depleted that it can no longer start the engine, light the headlights, or blow the horn.

In addition to H.E.L.P. Channel 9, the Ray-Tel TWR-7 two-way radio also has four other channels for direct communication with home or office. The design uses silicon transistors exclusively.

Developed especially for automobile and truck use, the radio will be distributed through franchised dealers of Ford Motor Co. and International Harvester Co. as well as electronic parts distributors for $129.95.



UHF Antenna

(137)

The "Planar-Grid UHF Yagi' antenna uses both the full wave planar-grid and the progressive gain accumulation principles. **Winegard's** planar-grid antennas include such features as a built-in UHF-VHF coupler, to allow installation with a single downlead, and weather-resistant Gold Vinylized finish. The Planar-Grid UHF Yagi is available in five models priced from $5.95 to $29.95 list.

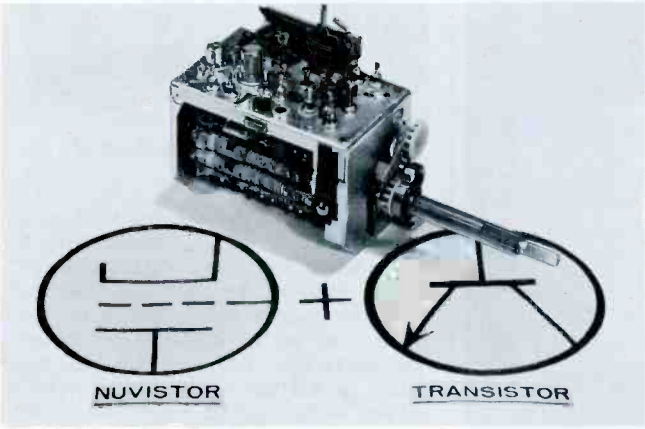
Contact Cleaner

(138)

A tuner cleaner — "KLEEN-IT' — that is not flammable, contains no carbon tet and has a low toxicity rating is manufactured by **Colman Electronic Products.** The formula, containing protective silicon lubricants, is harmless to plastics used in TV tuners yet clears all types of contact materials. Tne caddy-sized container comes packed with a free, shock-proof flexible extension.

Product Report

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



Hybrid VHF TV Tuner

(139)

A compact hybrid VHF turret tuner, called the "Transvistor," combining the excellent cross-modulation characteristics of the Nuvisor electron tube and the long life, low voltage drain characteristics of transistors, has been developed by the Tuner Division of **Standard Kollsman Industries, Inc.**

The Transvistor also can be easily combined with UHF tuners made by Standard Kollsman. Further, the unit, designed primarily for critical high performance color TV set circuitry can be provided with Automatic Frequency Control (AFC) and gold contacts. Its weight and compactness made it suitable for portable TV set designs and requirements.

Tape-Splicing Kit

(140)

The "EDITall' is a tape splicing block that can be fastened to any tape machine with or without the use of screws. It enables an operator to splice standard ¼" tape, including small sections, professionally and accurately.

The KP-2 editing kit contains an TDIT all block for splicing and editing tape, 3 sheets of 10 EDItabs tape splices, a marking pencil, a specially treated demagnitized razor blade, and complete instructions. The complete kit, manufactured by the **Tall Company,** retails for $3.50. Additional EDItabs are $1.50 for a package of 50.

Portable Tube Tester

(140)

A new model of the "Mighty-Mite' series tube testers is being manufactured by **SENCORE,** Inc. The "Mighty-Mile IV" has a specially designed hinge so that the cover may be either left on the tester or removed, whichever is desired during operation. Also a socket has been added to test the Amperex and Mullard 10-pin tubes used in many 1965 color receivers, and a plastic holder has been installed to hold the pages of the set-up booklet open. The unit sells for $74.50.

Power Transistor

(141)

Up to 100 watts rms power in class AB audio power output applications can be obtained from a pair of the DTG-110B transistors now available from **Delco Radio Division** Linear gain (typically, 125 at IC of 5 amperes) and transconductance characteristics provide for very low amplifier distortion. The DTG-110B is enclosed in the standard, copper-based TO-3 package. Price is $2.95, and it is available at all Delco Radio semiconductor distributors.

Oops!

In the August Product Report, the wrong photo was shown with the report on the Ungar Model 7800 desoldering tool (Key No. 128, page 72). The correct photo appears above.

INDEX TO ADVERTISERS

SEPTEMBER 1965

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

Please allow 60 to 90 days for delivery.

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73. *ALLIANCE* — Colorful 4-page brochure describing in detail all the features of *Tenna-Rotors.**
74. *ANTENNACRAFT*—Literature featuring 3 new 75-ohm, all-channel TV antennas available in factory-built or kit form.
75. *FINNEY*—Catalog 20-337 covering U-Vert series UHF converters and catalog 20-338 on Model 65-1 distribution amplifier.*
76. *JFD*—Literature on complete line of log-periodic antennas for VHF, UHF, FM, and FM stereo. Brochure showing converters, amplifiers, and accessories; also complete '64-'65 dealer catalog plus dealer wall chart of antenna selection by area.
77. *MOSLEY ELECTRONICS* — Illustrated catalog giving specifications and features on large line of antennas for Citizens band, amateur, and TV applications.*
78. *MULTITRON* — Illustrated literature on FM-stereo antenna No. MA-44, multi tuner Model M-11, and Minitenna No. MINI-4T.
79. *NEW-TRONICS*—Catalog describing line of Citizens band antennas and accessories, including models for mobile and base station use.
80. *PARKER*—Flyer giving specifications of 4 VHF outdoor antennas recently added to company line.
81. *STANDARD KOLLSMAN* — Catalog sheet on Model TA transistorized UHF converter and transistor converter kit.*
82. *TRIO*—Brochure on installation and materials for improving UHF transistor reception.
83. *WINEGARD* — Brochure explaining requirements for FM stereo reception and illustrating *Stereotron* FM antennas and preamplifiers, *Colortron* VHF TV antenna, and Planar-Grid Yagi UHF TV antenna.*
84. *ZENITH* — Information bulletins on antennas, rotors, batteries, tubes, loudspeakers, record changers, and wire and cable.*

AUDIO & HI-FI

85. *ADMIRAL* — Folders describing line of '65 equipment; includes black-and-white TV, color TV, radio, and stereo hi-fi.
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87. *BRITISH INDUSTRIES* — Literature covering Garrard line of record changers, Wharfedale speaker systems, and Ersin Multicore solder.
88. *GC ELECTRONICS* — New up-to-date phono wall chart, No. FR-250-G, including new drives and hundreds of newly cross-referenced models.
89. *JENSEN* — 24-page catalog, No. 165-K, illustrates and describes speakers and speaker system kits.
90. *NUTONE*—Two full-color booklets illustrating built-in stereo music systems and intercom-radio systems. Includes specifications, installation ideas, and prizes.
91. *OAKTRON* — "The Blueprint to Better Sound," an 8-page catalog of loudspeakers and baffles giving detailed specifications and list prices.
92. *OXFORD TRANSDUCER*—4-page catalog describing three lines of automobile rear-seat speaker kits.*
93. *PERMA-POWER* — Literature describing Model S-2000 *The Diplomat* transistorized attache-case public address system which operates on flashlight batteries.
94. *QUAM-NICHOLS* — Catalog 65 listing replacement speakers for public address systems, hi-fi, auto radio, and radio-TV applications.*
95. *SAMPSON*—4-color catalog page featuring full line of transistor radios.
96. *SETCHELL-CARLSON* — Illustrated booklet supplying information on company's 1966 line and explaining *UNITIZED* construction.

COMMUNICATIONS

97. *FANON*—Folder C-2 describing eight CB walkie-talkies. Brochure No. 9 covering entire line of electronic megaphones, and catalog 10-C supplying information on complete product line.
98. *GENERAL RADIOTELEPHONE* — Literature on Models BB-30 business radio, MC-8 and VS-6 CB transceiver, CG-3 frequency counter, and 615-B CB wattpress method of shipping with rates and meter.
99. *PEARCE-SIMPSON* — Specification brochure on IBC 301 business-band two-way radio, *Companion* 11, *Escort*, and *Guardian* 23 Citizens-band transceivers. "The Modern Approach to Business Communications," a booklet supplying information to businessmen concerning land mobile radio service.

COMPONENTS

100. *BUSSMAN*—Bulletin SHF-12 introducing shielded fuseholder designed to prevent radiation and reception of RF energy via the fuseholder.*
101. *CORNELL-DUBILIER* — Vibrator cross-reference literature.
102. *E-Z HOOK* — Catalog listing complete line of test connectors.
103. *J-B-T INSTRUMENTS*—General catalog 565; bulletins on reed relays, oscillator controls, toggle switches, and subminiature rotary-lever switches.
104. *MERIT*—Form 850, 1965-66 general catalog and replacement guide for coils and transformers.
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106. *SONOTONE*—Brochure titled "This Is Sonotone" illustrating production and uses of rechargeable batteries.*
107. *SWITCHCRAFT*—New product bulletin No. 152 describes: series H-100 and H-200 "HI-D" switch, and series DA *"DATA-SWITCH."*
108. *WALDOM*—Latest catalog No. 6F5 covering solderless terminals and connectors, hardware, tube sockets, terminal strips, knobs, dials, and service replacement parts. Includes index and prices.

SERVICE AIDS

109. *CASTLE*—How to get fast overhaul service on all makes and models of television tuners is described in leaflets. Shipping instructions, labels, and tags are also included.*
110. *ELECTRONIC CHEMICAL* — Catalog sheet describing aerosol cleaner for electrical contacts.
111. *LUBRA CLEAN* — Information on new tuner contacts.
112. *PRECISION TUNER*—Literature supplying information on complete, low-cost repair and alignment services for any TV tuner.*
113. *WALLIN-KNIGHT* — Folder on Reflect-O-Scope, an effective tool for static convergence of color TV receivers.
114. *YEATS*—The new "back-saving" appliance dolly Model 7 is featured in a four-page booklet describing feather-weight-aluminum construction.*

SPECIAL EQUIPMENT

115. *ATR* — Descriptive literature on selling new, all-transistor *Karadio* Model 707, having retail price of $29.95. Other literature on complete line of DC-AC inverters for operating 117-volt PA systems and other electronics gear.*
116. *GREYHOUND* — The complete story of the speed, convenience, and special service provided by the Greyhound Package Express routes.
117. *SPRAGUE* — Circular M-853 describes SK-1, SK-10, SK-20, and SK-30 *Suppressikits* for vehicles with alternators or DC generators.*
118. *WINDSOR ELECTRONICS*—"The Open Door to TV Profits" booklet describing a process by which TV servicemen can rebuild regular and bonded CRT's.

TECHNICAL PUBLICATIONS

119. *CLEVELAND INSTITUTE OF ELECTRONICS*—Free illustrated brochure describes electronic slide rule with four lesson Instruction Course and grading service.*
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121. *HOWARD W. SAMS* — Literature describing popular and informative publications on radio and TV servicing, communications, audio, hi-fi, and industrial electronics, including special new 1965 catalog of technical books on every phase of electronics.*

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123. *HICKOK*—Specification sheets on Model 662 installer's color generator, Model 677 wideband scope, Model 470A uni-scale VTVM, and Model 799 *Mustang* tube tester.*
124. *JACKSON* — Complete catalog describing all types of electronic test equipment for servicing and other applications.*
125. *LECTROTECH* — Bulletins on *Metergards, Lectrocells,* Models V-6 and V-7 color-bar generators, and Model T-100 horizontal-deflection circuit meter and, Model U-75 UHF translator. *
126. *MERCURY*—Catalog describing full line of electronic test equipment.*
127. *SECO*—New colorful folder describing 20 test instruments including tube testers.*
128. *SENCORE*—Information on new TC136 tube tester and SS 137 sweep circuit analyzer.*
129. *SIMPSON* — Complete 16-page brochure on entire line of electronic test equipment; also, catalog on line of panel meters.
130. *TRIPLETT* — New catalog No. 47-T covering the company's entire line of test equipment.*

TOOLS

131. *ARROW* — Literature outlining "How, When, and Where" to use 3 staple gun tackers.
132. *ENTERPRISE DEVELOPMENT*—Time-saving techniques in brochure from Endeco demonstrate improved desoldering and resoldering techniques for speeding up and simplifying operations on PC boards.
133. *SWING-O-LITE* — Flyer showing high-intensity fluorescent utility lamp.
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135. *WORKMAN*—Cross-reference list for entertainment-type transistor replacements.

RCA all-new, rare-earth Hi-Lite Color Picture Tubes are being stocked by smart dealers who are ready for the replacement color picture tube business.

why?

Hi-Lite's rare-earth phosphors provide picture brightness unsurpassed in the color TV industry. Natural color reproduction. Great black-and-white pictures, too! RCA's Hi-Lite Color Picture Tube Line is here. Now! Available in 19-inch and 25-inch rectangulars and 21-inch round tube types.

What about you? Are you ready for color?

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

The Most Trusted Name in Electronics

EXACT REPLACEMENT direct from factory to you

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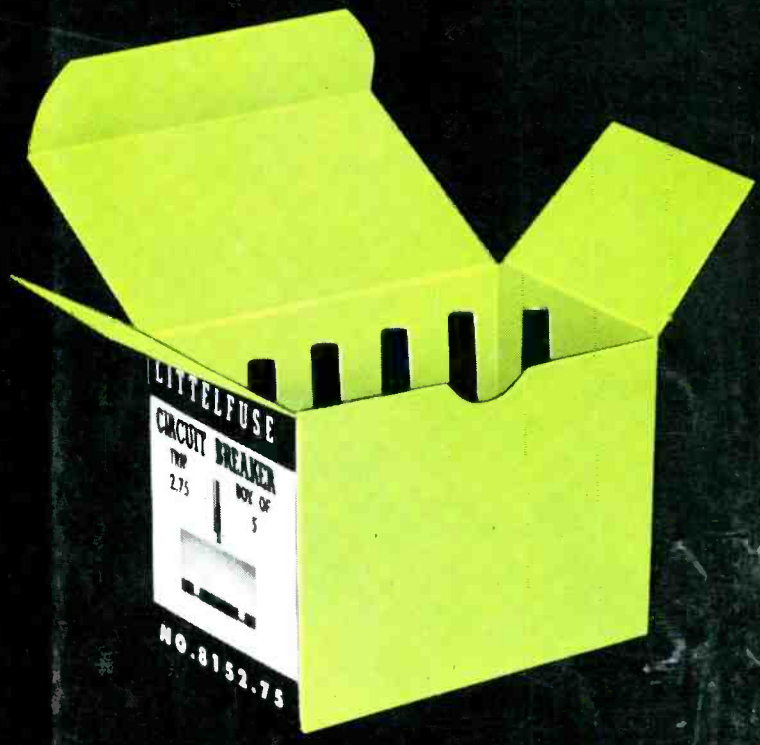

Complete range of high quality circuit breakers to cover every replacement need, packaged for your convenience individually on a display card or 5 per box.

Also, available in 10 card assortment (9 separate ratings) or 10 breakers per unit box (9 separate ratings).

LITTELFUSE DES PLAINES, ILLINOIS

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