

ELECTRONIC TECHNICIAN

WORLD'S LARGEST ELECTRONIC TRADE CIRCULATION



621

58

DECEMBER 1966



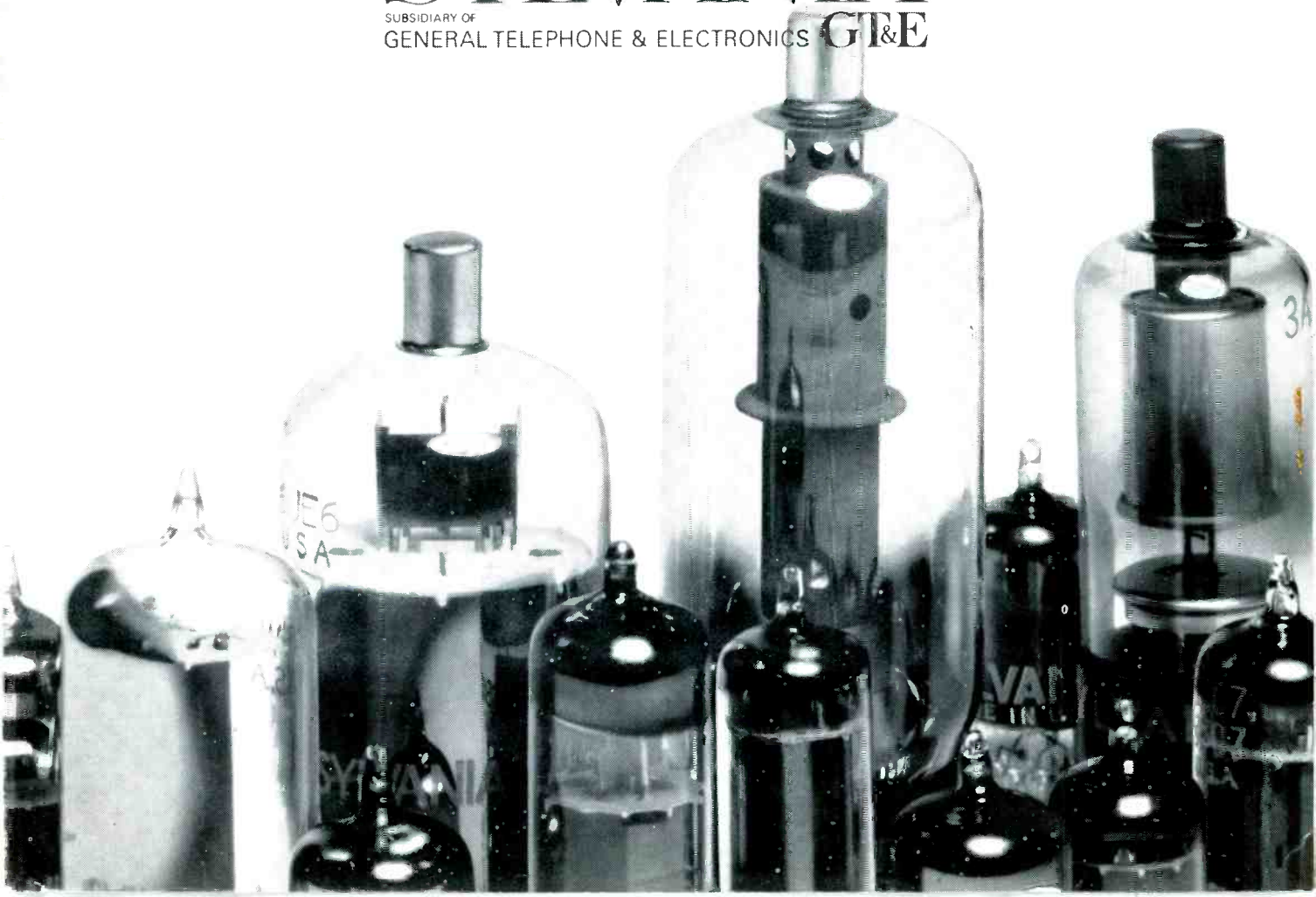
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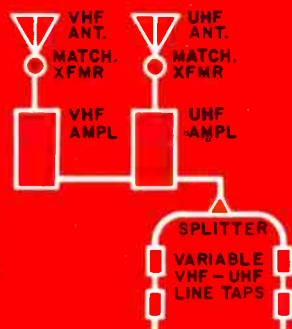
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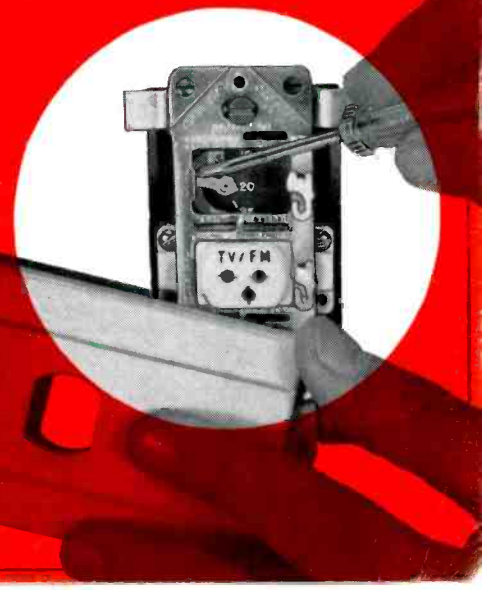
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ELECTRONIC TECHNICIAN

DECEMBER 1966

VOL 84 NO. 6

ELECTRONIC TECHNICIAN

WORLD'S LARGEST ELECTRONIC TRADE CIRCULATION

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Cover

Between nine and ten million color TV sets will be in U.S. homes at the end of 1966. This will put at least one color TV in approximately 16 percent of the TV homes in this country.

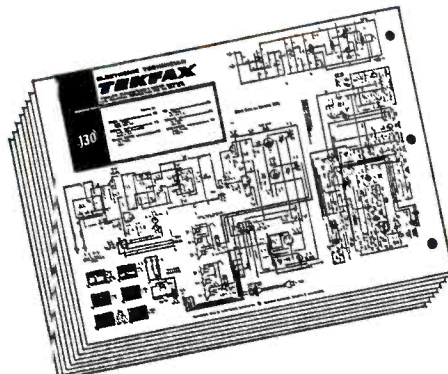
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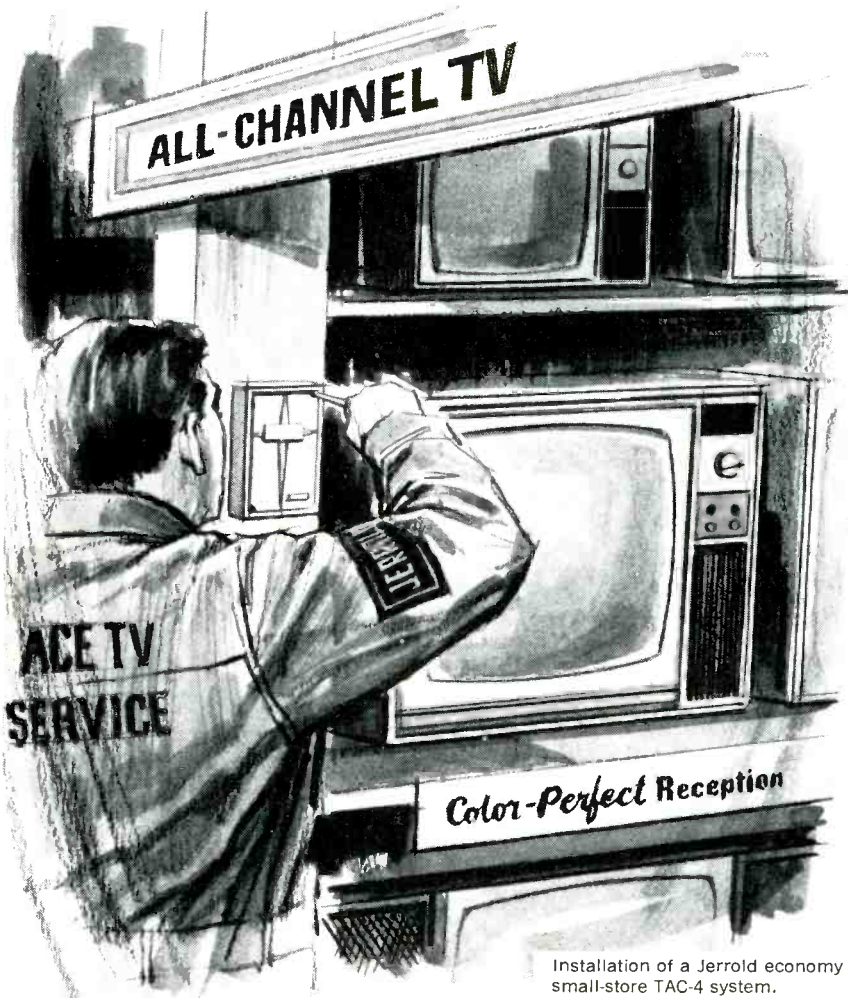


Group 172 December • 1966

GENERAL ELECTRIC: TV Chassis TC
 PHILCO: TV Chassis 17N35
 RCA VICTOR: TV Chassis KCS 164
 SYLVANIA: TV Chassis A04-1, -2
 TRUETONE: Model No. 2DC3731
 WESTINGHOUSE: TV Chassis V-2483-1
 ZENITH: TV Chassis 14M21

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Installation of a Jerrold economy small-store TAC-4 system.

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All-channel systems are here—*now*. Profit from installing them—if UHF isn't yet in your area, it soon will be. Talk with your Jerrold distributor or write *Jerrold Electronics, Systems Products, Distributor Sales Division, 4th & Walnut Sts., Philadelphia, Pa. 19105.*

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EDITOR'S MEMO

Man of Vision

Some time ago we were invited to attend a memorable event which was sponsored jointly by the Electronic Industries Association (EIA), the Institute of Electrical and Electronics Engineers (IEEE) and the National Association of Broadcasters (NAB). Only urgent pressure of work and the distance prevented our attendance.

The "Salute to David Sarnoff" dinner in New York celebrated his 60th year in electronics. The affair was attended by some 1500 leaders and representatives from the electronics industry. A few of the people who paid tribute to David Sarnoff included General Dwight D. Eisenhower, The Honorable Hubert H. Humphrey, vice president of the United States, Dr. Jerome H. Wiesner, Provost of the School of Science at the Massachusetts Institute of Technology, the Rev. Dr. Daniel M. Potter, Director, Protestant Council of the City of New York, Rt. Rev. Msgr. Joseph T. O'Keefe, coordinator of instructional TV for the Archdiocese of New York and the Rev. Dr. Nathan A. Perilman of Congregation Emanu-El.

As everyone must know by this time, David Sarnoff came to this country from Russia at age 9. He worked as a messenger boy, a newspaper delivery boy and an office boy. He rose, step by step, over a long period of time, to head the largest electronics corporation in the world.

He was a pioneer in electronic communications. And he has been, and probably still is, one of the most outstanding men of vision in this nation today. But he has proven to be more than a visionary. He has had the faith and practical sense to do whatever was necessary to make his visions come true.

As everyone recognizes, his visions and leadership have gone a long way in shaping a new age of progress.

Ten years ago, on his 50th anniversary in electronics, Mr. Sarnoff made a speech in which he once again proved his unique powers of vision. He predicted coming events in many areas.

Excerpts from that speech were published in ET (December 1956, page 39).

Although his 1956 visions were projected to 1976, we have just read that speech once again and can easily confirm that David Sarnoff is, indeed, a man of vision.

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AMPHENOL

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LETTERS TO THE EDITOR

Servicing Transistor TVs

I have some difficulty understanding certain AGC functions as explained in the article "Servicing Transistorized TVs," which appeared in the June 1966 issue of ELECTRONIC TECHNICIAN.

My difficulty begins with the words in column 2, page 53, "The amount of current drawn from the AGC

amplifier base etc.," and extending through the two paragraphs following.

ROBERT L. SMITH

New Hyde Park, N.Y.

• This part of the article indicated that the charge becomes more positive when the sync pulse amplitude decreases. This is incorrect. As the sync pulse amplitude decreases, the charge becomes less negative. . . . When the AGC keyer transistor ceases to conduct current, the negative charge in the capacitor cannot return to the AGC keyer transistor since the capacitor has a more negative potential

than the transistor. The keyer diode has become reverse biased, ceasing to conduct current. . . . As the sync signal decreases, the AGC keyer supplies a smaller negative charge to the AGC amplifier and it conducts less current. The reverse voltage differential on the amplifier diode then decreases.—Ed.

Help!

Can any ET reader give me some idea where I may find a replacement horizontal output transformer for a CBS Columbia 19in. TV, model 205C1? I have not been able to find a flyback that will work in this set.

ROBERT F. LAWTON

Winona Lake, Ind.

NEED A GOOD \$125 CARDIOID MICROPHONE?

HERE'S ONE FOR \$59.50

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The Turner 600 cardioid . . . the mike that's setting new quality standards for popularly-priced cardioids. It's available from your nearest Parts Jobber or Audio Distributor. Write for free literature.



Corrections

Enclosed is a copy of the first two pages of an article from the October issue of ELECTRONIC TECHNICIAN. There were several errors which I feel you should be informed of. The corrections are included on the copies.

DONALD E. FISCHER
Phillips Laboratories

Briarcliff Manor, N.Y.

• The equivalents of alpha and beta had been switched in two paragraphs. They should have read: "If we wish to know a transistor's small-signal emitter-current gain (h_{fe}), when the small-signal base-current gain (h_{fb}) is 0.98, we must make the following calculations:

$$h_{fe} = \frac{h_{fb}}{1 - h_{fb}} = \frac{0.98}{1 - 0.98} = \frac{0.98}{0.02} = \frac{98}{2} = 49."$$

"To find the dc base-current gain (H_{FB}) when the dc emitter-current gain (H_{FE}) is 24, we must make the following calculations:

$$H_{FB} = \frac{H_{FE}}{H_{FE} + 1} = \frac{24}{24 + 1} = \frac{24}{25} = 0.96."$$

At one point in the article the source voltage was inadvertently shown as V_{EE} rather than V_{CC} . Although the article had made reference to two points on the load line, a description of the second point, developed in an earlier portion of the article, had been omitted. It should have read: "The collector current can be determined by the equation:

$$I_C = \frac{V_{CC}}{R_1} = \frac{6V}{750} = 8ma."—Ed.$$

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LETTERS TO THE EDITOR

NPN/PNP Again

An article in the August issue of *ELECTRONIC TECHNICIAN*, page 52, mentions the proper method of making transistor resistance measurements with VOM or VTVM. The simple schematic showed a PNP transistor with VTVM. How do you make these measurements in NPN transistor circuits? Your magazine is very helpful

and I recommend it for every technician.

DALE EXCELL

Onondaga, Mich.

• PNP and NPN transistors are basically the same except for their arrangement of semiconductor materials. Similar PNP and NPN transistors may have identical internal resistances when each is properly biased. By reversing the VOM or VTVM leads, the positive lead of the meter is connected to the NPN transistor where the negative lead had been connected to the PNP transistor

and a similar set of measurements are obtained from the two transistor types.—Ed.

Service-Dealer/Technicians Organizations

In your October issue of "Letters to the Editor" I note two national Electronic Technician organizations and state organizations referred to. Would you give me the names and addresses of those organizations, both national and state? Also would you send me the complete address of the reader who sent in that question?

FRANK SZPIECH

Newark, N.J.

... You mentioned two national organizations for technicians. I know of only one, ASCET. What is the other one.

LAWRENCE BOSLER

Warminster, Pa.

• The two national trade organizations of service-dealers and technicians are: NATESA (National Alliance of Television & Electronic Service Associations) Frank Moch, director, 5908 South Troy Street, Chicago, Ill. 60629; NEA (National Electronics Association, Inc.) Dick Glass, president, 5302 10th Street, Indianapolis, Ind. 46224. There are a group of state organizations, like CSEA (California State Electronics Association) for example, and many local (generally city-wide) organizations. We do not have a complete and up-to-date list of these organizations. ASCET (American Society for the Certification of Electronics Technicians) is not a similar type organization. ET does not divulge reader addresses—Ed.

German/American Electronics Translations

Please send a copy of the translations for electronic parts and abbreviations which appeared in *ELECTRONIC TECHNICIAN* some time ago.

EBERHARD SIEKMAN

Saugerties, N.Y.

• This article appeared in the November 1963 issue of ET. We do not have spare copies available.—Ed.

Comments from our readers are always welcome. Address

your letters to:

The Editor

ELECTRONIC TECHNICIAN

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TECHNICAL DIGEST

RCA VICTOR

TV Chassis CTC21 AFC Circuits—Circuit Description

Solid state components are used throughout this UHF/VHF tuner's AFC circuit. If the fine tuning is misadjusted, the IF frequency response is normally incorrect—producing a poor picture. The AFC circuit functions to sample the incoming signal, using the 45.75MHz picture carrier as a reference—keeping the local oscillator on the correct frequency at all times.

The manufacturer's service data shows basic AFC stages associated with oscillator frequency correction. From the output of the 3rd video IF amplifier the 45.75MHz carrier is coupled to the AFC buffer amplifier. The buffer amplifier's output feeds a discriminator which is followed by a dc voltage which controls voltage-dependent-capacitance circuits connected in parallel with the local oscillators in the VHF and UHF tuners. Capacitance of these circuits change with applied voltage — varying the capacitance — which varies the local oscillator's frequency.

The buffer amplifier, discriminator, dc amplifier and their associated components are located on a separate chassis mounted outboard on the main TV chassis front. A single, shielded, circuit board contains all the components.

A simplified schematic also indicates major components in the AFC circuit. The 45.75MHz carrier is coupled to the buffer amplifier input from the 3rd IF plate circuit. Both the base input and the collector output circuits are tuned for maximum transfer of the 45.75MHz carrier.

A 46.50MHz trap limits the high frequency pull-in range of the system to prevent the AFC system from functioning on a wrong higher frequency carrier: the 47.25MHz adjacent channel sound, for example. This could result in a condition called "lock-up" or "lock-out" in the receiver. The system is, therefore, designed to have a narrow pull-in range of from ± 0.75 to ± 1.25 MHz.

The frequency of the carrier at the buffer amplifier's output is applied to a discriminator circuit tuned to 45.75MHz also. If any difference exists between the sampled carrier frequency and the reference frequency of the tuned discriminator circuit, it causes a dc voltage change at the dc amplifier's collector.

The main 10v B+ supply for the system is regulated by a zener diode. A reference adjustment resistor reduces this voltage so the reference voltage from the discriminator circuit equals +5v.

The dc voltage change at the dc amplifier's collector results in a voltage that differs from the +5v reference. When the tuner's frequency is too high, the reference potential is less than +5v. But when the frequency is too low, the potential is greater than +5v.

Both the reference voltage and the correction voltage are fed to the VHF variable capacitance control circuit. Here the 0.1 μ f capacitor—connected to the control voltage input of this circuit—acts as a filter or "anti-hunt" network designed to prevent noise or other interference from affecting the automatic tuning.

When the tuner frequency is set too high, the reference potential is less than +5v and the frequency control

transistor then becomes forward biased. This increases the transistor's junction capacitance—in turn lowering the oscillator frequency. Conversely, if the tuner frequency is set too low, the reference potential will be greater than +5v, the transistor's junction capacitance would be reduced and the oscillator frequency increases. The control potential in the UHF tuner affects a varicap diode, which is part of a variable capacitance circuit having a ground return. This circuit also contains a 0.1 μ f capacitor designed to eliminate interference effects.

The temporary AFC DEFEAT switch is actuated by the fine tuning control. When the VHF or UHF fine tuning control knob is pushed in to preset the oscillator, the AFC circuit is removed from the oscillator circuit. A manual AFC ON/OFF switch is located on the rear of the dial light dimmer control. Pulling the knob outward permanently defeats the AFC circuit.

A better understanding of the AFC function can be had by following the chain of events that occur throughout the closed-loop system when the channel is selected and fine tuned.

A particular channel is selected and the fine tuning is adjusted to the correct frequency—causing the picture carrier to appear at 45.75MHz. The discriminator output at this time is zero and the output at the collector of the dc amplifier is approximately +5v. This voltage appears on one side of the capacitance control circuit in the VHF tuner while the other side of the control circuit is connected to the fixed +5v reference supply developed in the bleeder network. With both voltages equal a 0v difference appears across the variable capacitance circuit and the local oscillator frequency remains unchanged.

If the fine tuning is mis-adjusted, causing the local oscillator to produce an incorrect frequency, the discriminator output is no longer 0v, but instead a voltage dependent on the degree of mis-tuning of the oscillator. This voltage in turn affects the voltage of the dc amplifier—the voltage dependent capacitance and the tuning of the local oscillator—which is returned to the proper frequency.

GENERAL ELECTRIC

AC Chassis—Tube Type Change

The vertical multivibrator V8 has been changed in the AC chassis from a 6FY7 to a 6FM7. To accommodate this change, the copper pattern that grounds pin 8 of the vertical compactron socket had to be removed, allowing pin 8 to "float." This change was necessary since pin 8 and 3 of the 6FM7 are internally connected to the control grid of the amplifier triode, while there had been so internal connection to pin 8 in the 6FY7 tube.

No other circuit modifications are necessary for the change-over from a 6FY7 to a 6FM7. Therefore, on receivers that are originally equipped with a 6FM7, a 6FY7 may be used as a substitute replacement. A 6FM7 tube may not be used as a substitute replacement, however, in a receiver that was originally equipped to function with a 6FY7 tube — unless the pin 8 ground return is removed.

Ed Leahy doesn't work for us. We work for him.

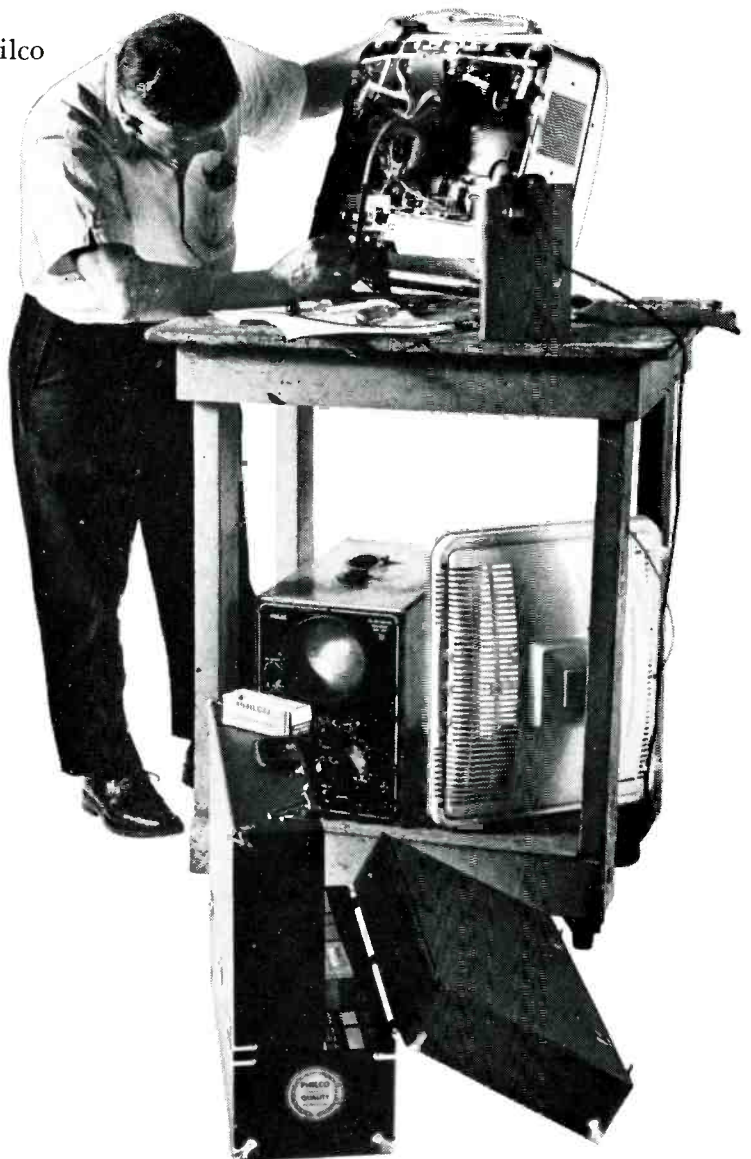
Ed Leahy believes in being his own boss. Which is what Ed likes about running his own Philco Qualified Service Center. It means that, with no strings attached, he gets better training, better service and more benefits than any other manufacturer offers.

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Ed keeps up on new products with Philco Tech Data Service. He tried other services and found out that he gets the facts sooner, better and at lower cost from Philco.

Ed likes Philco's "fringe benefits," too. A complete accident insurance program for himself and his men. Advice on business management, found in Philco's popular "Service Businessman" magazine. He gets extra business, too, when his name appears under a Philco listing in the Yellow Pages.

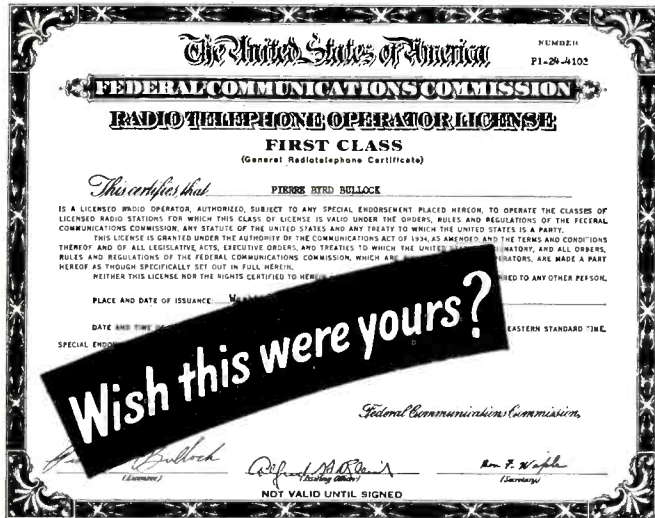
Ed Leahy has it good. You can, too. Talk to your Philco Parts Distributor or contact Parts & Service Department, Philco-Ford Corporation, "C" and Tioga Streets, Philadelphia, Pa. 19134.



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TECHNICAL DIGEST

ADMIRAL

Current Record Changers—Improper Push-Off Operation

If current record changers, particularly portables, have an improper push-off operation, the centerpost should be checked.

The 8-32 Allen set-screw in the centerpost base under the changer pan must be tightened to 24in./lb (to the point where you wonder if the wrench will break) in order to hold the post securely during shipment. Considerably less force is required to hold the centerpost in a console once it is installed in the customer's home. Then a force of 8in./lb is sufficient.

Model Y1009A All-World Portable—Diode Replacement

A replacement kit is available to insure proper operation of the output circuit in the "All-World" portable radio when one of its transistors or diodes is replaced.

Admiral will automatically substitute this kit (57B3-13) on any orders for a 57C6-16, -17, -18 or 93B51-1. The complete kit should be installed when any of these components fail.

If you should require the 93B51-1 diode for any reason other than replacement in the 1301 chassis, be sure to mark your order "do not sub kit."

H2-1A Chassis Portable TV-Tube Substitution

Current 15in. portable TV models with H2-1A chassis use a 17BF11A sound detector/output tube. The new electron tube is electrically identical to the 17BF11, but is housed in a smaller glass envelope.

Although the old 17BF11 can be used for replacement in the 13in. set using the H1-1A chassis and in earlier sets, it would sit too close to the picture tube in the current 15in. models.

Since the 17BF11A can be used for replacement in all current and previous models, the manufacturer will stock only the new tubes and will substitute it on all orders for the 17BF11.

Model YK8418 Stereo Tape Recorder Console—Warranty

This stereo console contains a model TD103 tape recorder made by Ampex. The tape recorder is covered by an Ampex warranty on parts and service for one year. Admiral will not stock parts for this recorder, and the warranty will be handled only through the Ampex field service stations. Their address can be obtained from the Admiral distributor.

Current UHF Tuners—New Mixer Diode

The part number for this tuner diode is incorrectly identified in the parts list of many recent TV manuals. If your schematic shows a 1N82AG, change the part number in your parts list to 93A59-1. This diode is used in place of the common 1N82A (57D1-65).

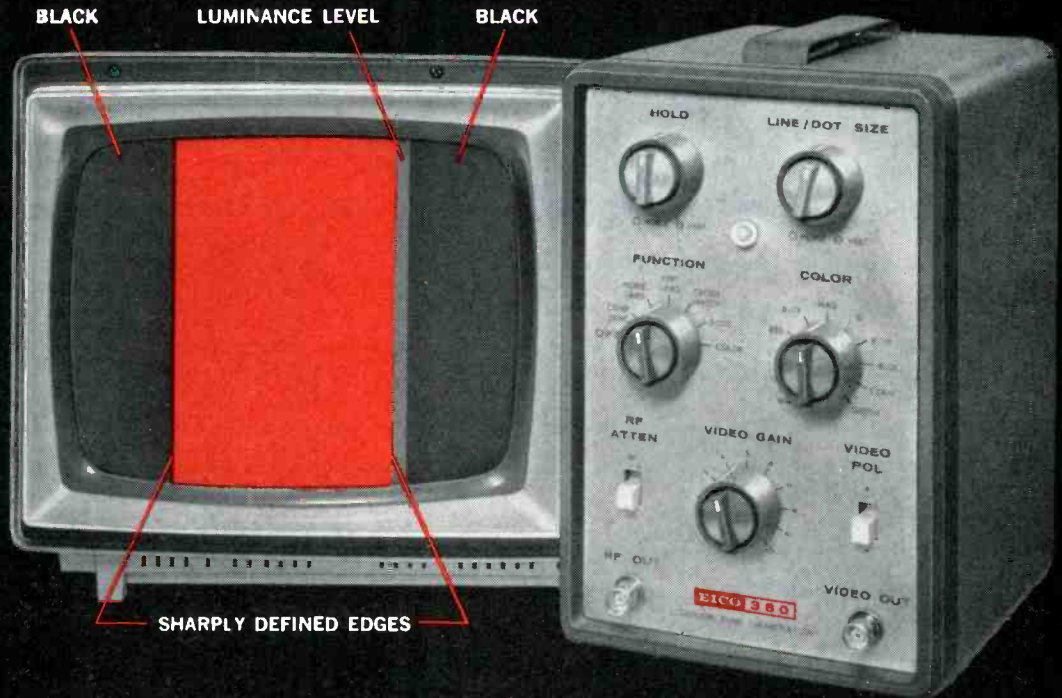
Although both diodes perform the same function, the 1N82AG is smaller and is soldered in place. The following precautions should be observed when replacing this part:

- Replace the diode with the same type originally used.
- Use a heat sink on the lead between the body of

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ELECTRONIC TECHNICIAN

EICO 380's color signals (3 primaries, 3 complementaries) cover fully 60% of the screen: thus tell you MORE about the set's response — enable EXACT alignment.



Now you can afford a True NTSC* Color Generator

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The 380 takes the risky guesswork out of color servicing — because it gives you all test signals *exactly* like the Color TV station. So now you can be *certain* of exact results — faster, easier, for more profits per day. You'll also quickly become known as the pro who makes sets "*come alive*" with brilliant *correct* color response!

Only EICO provides you with all these advanced engineering features at so low a cost: ■ **100% true NTSC* full-field color signals**, including both chrominance and luminance exactly as specified for a Color TV station transmission. ■ **No "Gun Killers"** — Faster, easier use by feeding to the RF stage. You don't need to go inside the TV set to feed the color signal. ■ **Each true NTSC* color signal covers fully 60% of the entire TV screen** (as compared to 1-inch from a rainbow generator) — this tells you a full, true picture of what's going on inside the set — all the way from the RF to the screen. ■ **100% solid state** (33 transistors). ■ **5 individual switch-selected alignment patterns** for monochrome and color. ■ **Individual, switch-selected full-field color display.** ■ **Generates I, Q, R-Y, and B-Y signals** for demodulator adjustment, plus 7 standard color signals (3 primaries, 3 complementaries, plus black and white). ■ **Adjustable bar width and dot size** down to just visible for exact convergence. ■ **3 crystal-controlled oscillators** for true 3.58 MC color signal generation, pattern timing, and RF output. ■ **Drift-free RF output** (crystal-controlled Channel 3) and video output. ■ Conveniently compact: 8" high x 5" wide x 6" long. ■ Portable and light weight (only 4 lbs.) for easier field use. ■ Instant-on operation: time-saving, accurate, drift-free. ■ Excellent for field or shop. And **will not** become obsolete!

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EICO EICO Electronic Instrument Co., Inc.
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ET-12

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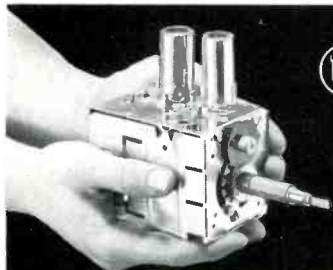
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For complete tuner overhaul we still charge only \$9.95. This includes all labor and parts; except tubes and transistors, which are charged extra at low net prices.

Simply send us the defective tuner complete; include tubes, shield cover and any damaged parts with model number and complaint. Your tuner will be expertly overhauled and returned promptly, performance restored, aligned to original standards and warranted for 90 days.

UV combination tuner must be single chassis type; dismantle tandem UHF and VHF tuners and send in the defective unit only.

Exact Replacements are available for tuners unfit for overhaul. As low as \$12.95 exchange. (Replacements are new or rebuilt.)

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*Major parts are charged extra in Canada.

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TECHNICAL DIGEST

the diode and the soldering iron. The iron should have a small tip and be rated at 35 to 50w.

- The new part must be soldered in place and have the same lead length, lead shape and physical location as the original. Note: Some diodes have a loop in one lead that acts as an oscillator injection loop. Be sure to duplicate this loop in the replacement diode's lead.

- The replacement diode must be wired for the same polarity as the original for best results.

- The tuner shields must be replaced exactly as they had been before.

MAGNAVOX

T911/T918/T919/T920 Color Chassis—Production Changes

It was noted in service literature that some color sync problems arose in the T911/T918/T919/T920 chassis that could be caused by a defective diode in either the color killer detector or color phase detector circuits. Further checks have shown that arcing in the picture tube may be an indirect cause of the diode failure. Spark gaps are provided on the chroma board for the CRT grid leads. In the case of the blue grid, the spark gap ground was connected at the ground lead for the V706. The spark gap is now being relocated in production to return more directly to chassis ground—from the ground lug on the terminal strip used to mount R147 and R146 in current production. In earlier production, the ground lead could be extended and connected to the same ground point as the spark gap for the red grid.

It is suggested that this change be made when replacing a defective killer phase detector diode. It should be remembered that these diodes are matched and should only be replaced in matched pairs.

When the focus rectifier on the T911 chassis was changed in production from a 2AV2 to a 1V2, a 3.6Ω resistor was connected in series with the 1V2 filament. Some cases were reported indicating that the CRT screens on these sets could not be extinguished, during the white balance adjustment, by setting the brightness control. This problem was corrected by adding an 18Ω resistor across the 3.6Ω resistor in the 1V2 filament circuit. In future production this resistor will be changed to 3Ω.

GENERAL ELECTRIC

Model 11R61 Radio—Incorrect Printing on Cabinet Back

Some model 11R61 radios have been shipped from the factory with an incorrect tube chart on the cabinet back.

The set is equipped with a 50C5 tube; on some sets, the tube chart shows a 35C5.

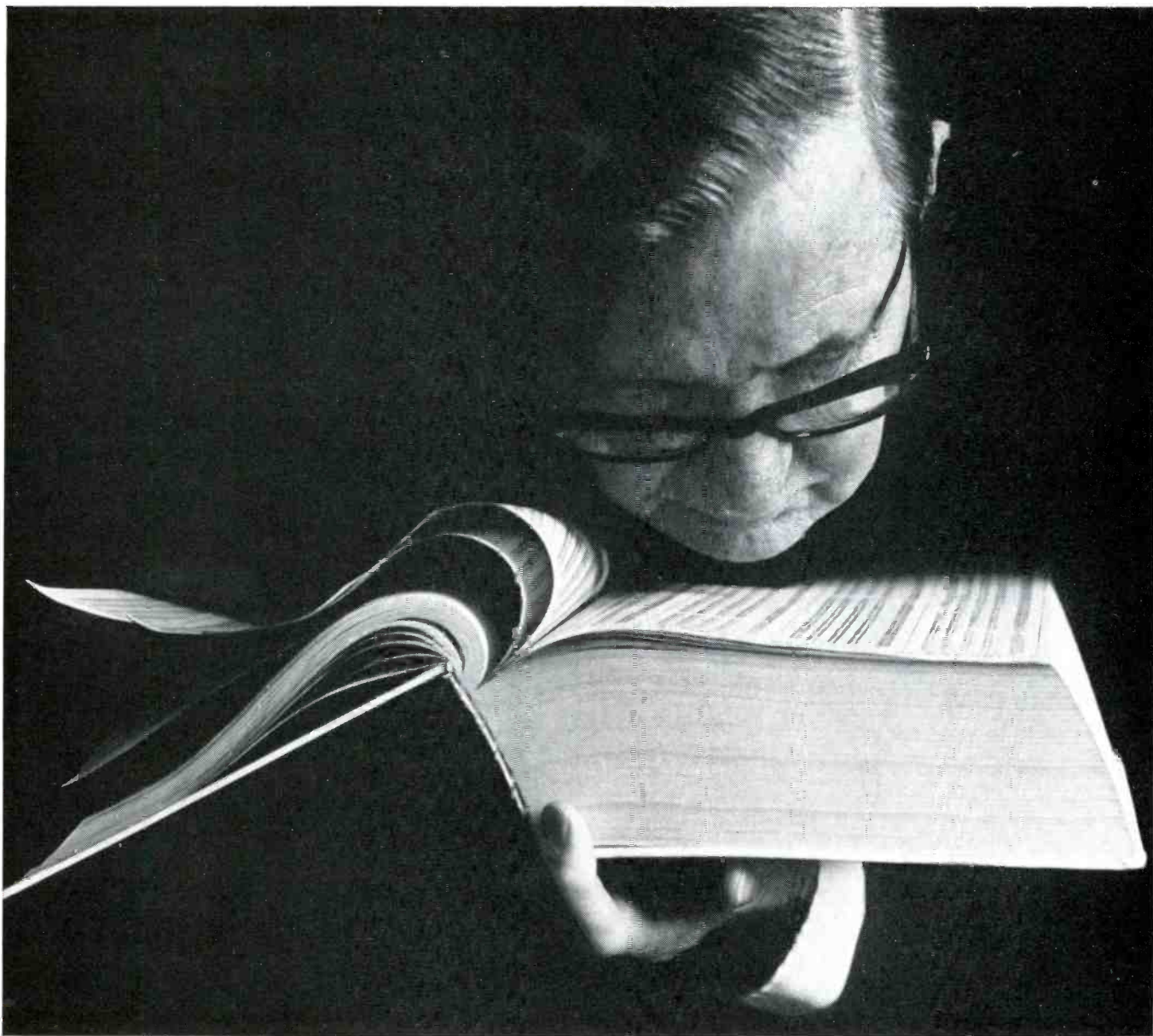
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Frequencies to 250 MC may be measured with auxiliary Diode Probe, \$8.00 extra. DC voltages to 50 KV may be measured with auxiliary High Voltage Probe. \$23.00 extra.

TRIPLET ELECTRICAL INSTRUMENT COMPANY, BLUFFTON, OHIO

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Portable RFI System Covers Wide Frequency Spectrum

Designed for lab or
portable mobile use

■ A hand-portable RFI system covers the full frequency spectrum from 10kHz in the low-frequency range to 10GHz into the super-high-frequency (SHF) range.

Designated the LF-SHF-2T, the system performs essentially the same instrument functions as systems occupying six or more drawers of a standard rack weighing hundreds of pounds. The instrument is only 17x17x11in. and weighs 15 lb. It can be mounted in trucks and vans for mobile operation and may be rack mounted for laboratory use.

Among the many applications claimed are determination of the source and characteristics of radio interference, radar-site selection surveys, antenna-pattern measurements, specification testing, laboratory determination of filter effectiveness, verification of electronic systems compatibility, telemetry studies and satellite communications monitoring.

The controls have been simplified and arranged in functional order so that the operation is reduced to a series of easy-to-perform steps. Less frequently used controls and the output connectors are located on the rear panel.

The instrument has provision for four tuner units. These cover an area of the very low-frequency range (VLF) from 10kHz into the low-frequency (LF) range to 160kHz; from 150kHz to 32MHz through LF and the entire medium-frequency (MF) range into the very high-frequency (VHF) range; from 31MHz and 1GHz through the VHF range into the ultra-high frequency (UHF) range; and from 950MHz in the UHF range to 10GHz into the super-high-frequency (SHF) range. Depending on measurement requirements the user may start with one or more tuner units and expand the system for full frequency coverage. The specific tuner used in a given application is selected with a four-position tuner control.

The instrument's two functional modes are average signal measurement and peak measurement. To facilitate calibration and permit substitution measurements, an impulse generator is an integral part of the instrument.

The sensitivities are said to range from -146dbm at 10kHz to -81dbm at 10GHz. For portability the instrument contains an integral, rechargeable battery pack, providing 100ma at 14.4vdc. The unit may also be operated from 115/230vac, 50-400Hz power supply.

The design includes miniature low-loss microwave circuitry, solid-state etched circuit modules, thin film modules and integrated circuits. The instrument is reportedly equivalent to equipment meeting the most stringent military specifications and carries a full two-year service warranty. It is manufactured by Stoddard Electro Systems Div., Tamar Electronics. ■

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In fact, we're so deep in color antennas there's no color problem we can't solve for you.

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Are ghosts driving Doc Peterson crazy? One of our two famous Crossfire Colorays, ghost-chasers extraordinary, will run them right out of Doc's house. (Our unique Power Equalizer actually provides up to 30 to 1 back-to-front ratios.)

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Remember! Channel Master—and only Channel Master—sells more color antennas than any other antenna manufacturer in the world. Anyone else is second best... at best.

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UHF
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CHANNEL MASTER® new **Color Crossfire** **TV/FM**

MADE IN U.S.A. **COLORAY** **OUTPERFORMS 28 ELEMENT 36006**

Color Crossfire **TV/FM ANTENNA**

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...with Channel Master Accessories

New-Design Colorotor Tenn-A-Liner Rotator... brings in extra color stations. And kills color ghosts (the worst kind). The only rotator that can aim an antenna within one degree of precise transmitter location. Shown, the Crestwood, Deluxe Automatic with solid walnut cabinet, Model 9516.

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Plus a complete line of other needed accessories such as standouts, screw-eyes, guy wire, guy rings, etc.



...and here's something new from the **HOUSE OF COLOR!**

Announcing...

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Educational Radio Design

■ An FM radio receiver, designed and manufactured for Educasting Systems by the Commercial Electronics Div., of Sylvania Electronics Products, has been tested for some time by Radio station WFIL-FM, Philadelphia, Pa.

The testing began last summer with a single 30-hour course in modern management. The broadcast went to 100 students. It covered subjects like management planning, organizing and controlling, motivation and selection of personnel, the manager's role in employee relations, how to train, how to control costs and communications skills. The course was developed by International Correspondence Schools which is located in Scranton, Pa.

While taking the course over radio, students are able to be active participants in the learning process and "talk back" to their teacher. Four response buttons on a special radio receiver permit active and frequent participation from the pupil at home or in his office. Each lesson runs for about an hour and is broadcast several times during the day for students' convenience. Review and make-up lessons are also broadcast. Supplemental information is provided. At the end of a given course, all student can obtain a certificate from ICS, but only after completing a final examination.

Prior to this public test, two private tests were successfully conducted by ICS. Central High School in Scranton, Pa., explored the effectiveness of "educasting" by teaching an 11th grade physics class with students 16 and 17 years old. In Brooklyn, N.Y., an adult mathematics class ranged from 17 to 54. In both cases, a significant improvement in grades was recorded, along with almost unanimous student approval for the techniques.

Without interfering with regular programming on FM broadcast stations, the system is adaptable to any FM station or community antenna television system (CATV), according to the announcement. The program source is a four-track teaching tape. This tape feeds the signals to a four-channel modulator which is connected to the FM transmitter or the FM strip of a CATV head-end amplifier. The FM carrier is multiplexed with four special channels which cannot be intercepted by anyone who is using an ordinary AM or frequency modulated receiver.

The system's FM receivers are equipped with four tuning buttons which control the filter circuits and which may be alternately incorporated in the broad-band of the FM detector circuits. By pressing one of the four response buttons, one of the four supersonic transmitted signals is selected by the receiver's filter circuits.

A broad spectrum of learning opportunities are believed to be possible with the system, including adult education units, industrial and government training, home improvement and hobby enrichment, staff study pools within offices, invalids and geographically isolated persons, military bases and as a supplement to in-school undergraduate study classes. It is believed the system will find wide use in the future.



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"And I could kick myself for not getting it sooner. I'm pulling in all kinds of mobile, marine and CB business that I couldn't touch before; have even had some calls to work on closed-circuit television. I've hired two new men to help out and even with them, I'm two weeks behind."

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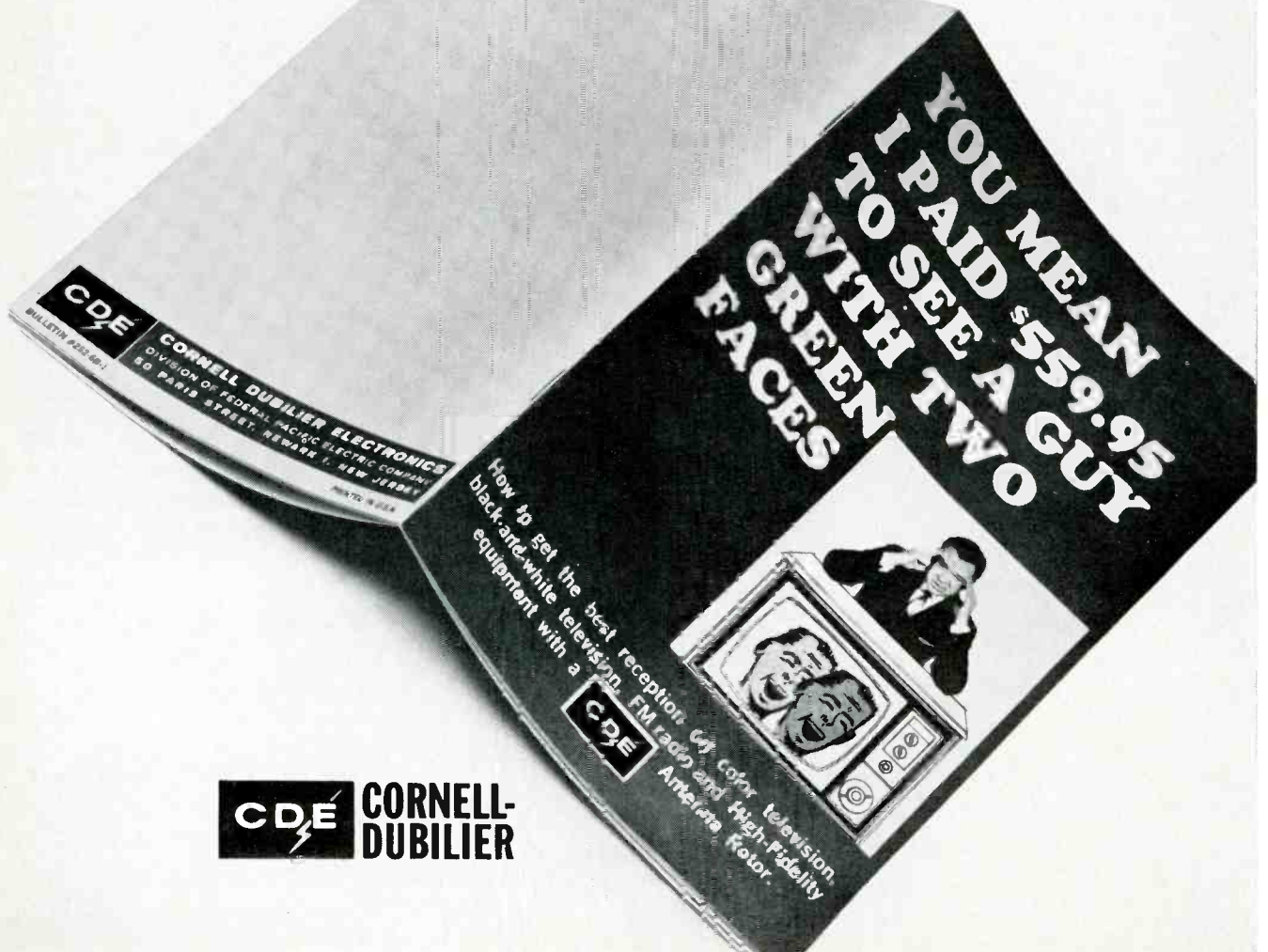
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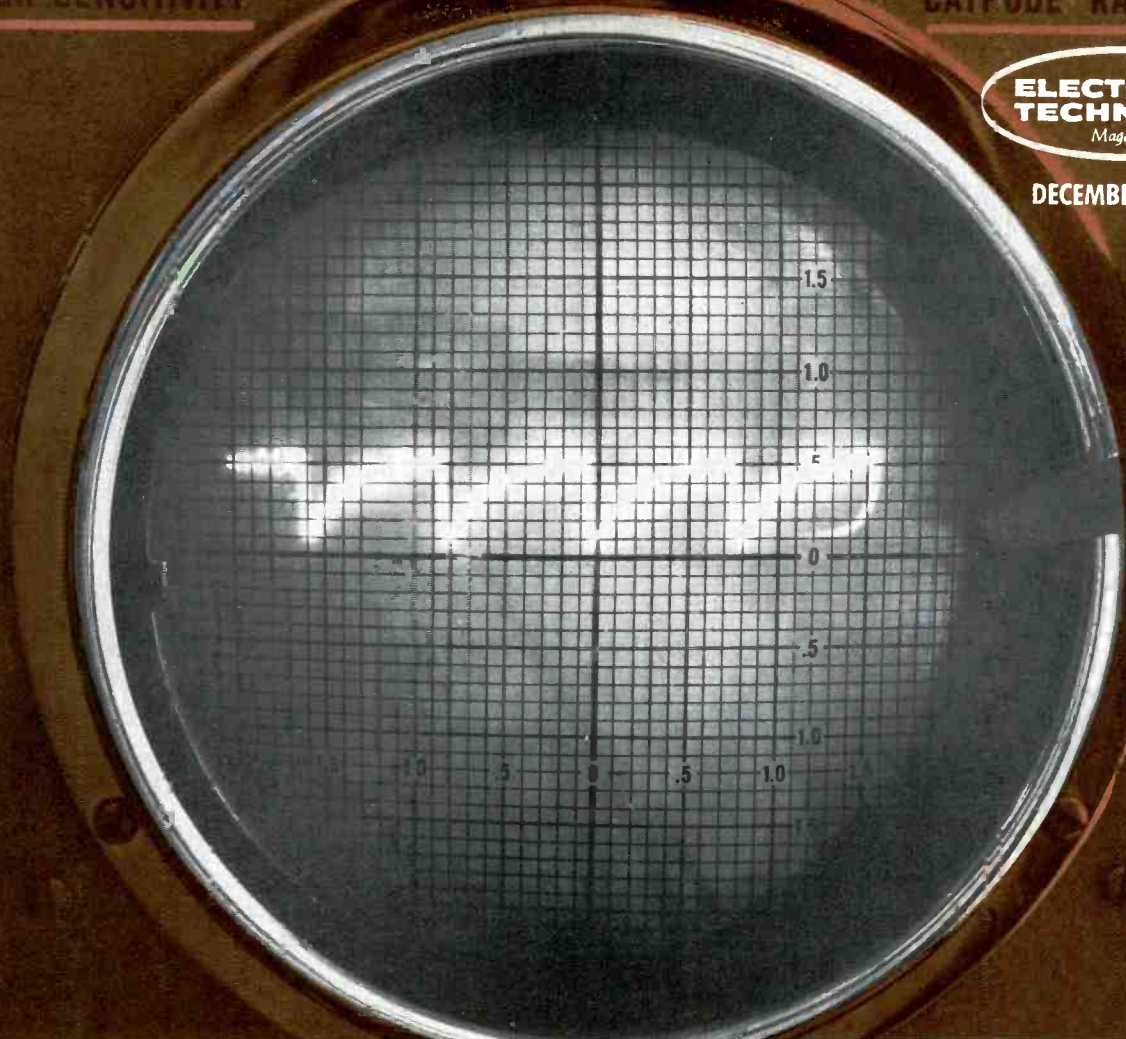


Fig. 1—Drive voltage waveform at the grid of the horizontal output tube.

SOLVING COLOR TV HIGH VOLTAGE PROBLEMS

Know your HV, how to measure it and what procedures to use in troubleshooting horizontal sweep and voltage regulator circuits

■ Quite a few technicians say that most of their color TV problems develop in the high voltage section. This section in color sets is no different than it is in B/W receivers but a few features are added—and the requirements are more demanding.

To produce a high ultor voltage for the color CRT, a horizontal output tube with higher driving power is needed. A voltage regulator circuit—tube or solid-state—is one added feature.

A focus rectifier tube is used to focus the raster in early sets and also in some late models. Many newer color receivers have a fixed focus rectifier, eliminating the focus rectifier tube. This also eliminates a focus heater winding from the flyback transformer.

The horizontal oscillator is practically the same circuit as used in B/W receivers. This horizontal oscillator circuit provides a drive voltage to the grid of the horizontal output tube. Of course, the horizontal output tube draws more current than in B/W receivers—from 150 to 210ma. The 25kv CRT voltage is taken from the HV rectifier and shunt, or voltage regulator.

A separate heater winding is used on the power transformer for the shunt regulator tube.

Most pictures on a color TV receiver are shifted horizontally with a low-ohm rheostat connected between two identical windings of the flyback transformer. The center arm of the horizontal centering control connects directly to the horizontal deflection yoke. When the arm is in the center position, the current is balanced—with no current flow in the deflection yoke. Likewise, when the center arm is rotated from the balanced position, current will flow through this circuit—shifting the picture to the right or left.

Voltage Regulator Operation

The voltage regulator tube in most color HV sections is a 6BK4, high voltage triode. This voltage regulator tube and its corresponding circuits are connected between the ultor voltage circuit and ground. The purpose of the voltage regulator tube is to keep the 25kv ultor voltage constant at all times. Service technicians should set the high voltage adjustment control so that 25kv is applied to the color CRT.

When an all-white picture is fed to the color CRT, the beam current is very high. But when an all-black picture is fed to the color CRT, the beam current is low and the voltage regulator tube conducts heavily. Then, when the beam current increases in the CRT, the 25kv starts to decrease because of the heavy load. Likewise, the boost voltage will drop and lower the grid voltage of the 6BK4 regulator tube. The bias on the voltage regulator tube increases, allowing the current through the regulator tube to decrease. The difference between the voltage on the grid and cathode of the voltage regulator tube is the bias voltage. When this bias voltage increases, less current will flow through the voltage regulator tube—thus maintaining ultor voltage at 25kv.

Quick Isolation

Most HV trouble symptoms are: insufficient width, horizontal stripes, poor focus, picture blooming, poor convergence and no

brightness, or raster. Since the aim of all color TV technicians is to save time and do a good job, too, it is best to develop methods to quickly isolate troubles in this section. In practically all cases, when there's no brightness or raster on the color TV screen, the trouble is in the HV section or in the CRT.

If we have a bright raster with horizontal lines, for example, the trouble is in the horizontal oscillator circuits. If the picture is pulled in on the sides—indicating insufficient width—the trouble could be caused by the horizontal output tube, damper, high voltage rectifier tube, shunt regulator tube or other circuit components in these areas. The horizontal oscillator tube may also cause insufficient width if the driving pulse amplitude is inadequate.

If the CRT raster is blurry or out of focus, first replace the focus rectifier tube. Then readjust the focus control. Nine times out of ten, raster blooming will be caused by a defective HV rectifier tube. On some older models, extreme brightness control settings will also cause excessive blooming.

Checking Voltage, Resistance and Current

Together with a color dot/bar generator and scope, the VTVM is a color TV technician's most prized test instrument. By adding a HV probe to the VTVM, the ultor voltage can be checked accurately. Remember, the 25kv ultor voltage is dangerous and when working on any high voltage color circuit, one must exercise extreme caution.

If there's no raster on the color CRT screen and the fuse or circuit breaker is OK; if all tubes have been checked and substituted, pull the chassis from the cabinet. Connect the chassis to a colortube mockup or use longer cables to extend to the CRT remaining in the cabinet.

Go directly to the ultor voltage and check it with the VTVM HV probe. Be sure the VTVM is set to the proper scale for the probe used. Most color ultor voltage will be between 24 and 27kv. If not, measure the drive voltage on the horizontal output tube.

By measuring the drive voltage you will know if the horizontal oscillator is performing correctly.

For instance, if the drive voltage is very low, you know the trouble is in the horizontal oscillator circuit. Of course, this drive voltage may be low because of heavy currents in the horizontal output tube from a short or high leakage in the flyback circuits. Remove the plate cap from the horizontal output tube and see if the drive voltage returns to normal. If this is the case, the

SOLVING HIGH VOLTAGE PROBLEMS

troubles lies beyond the horizontal output tube.

Suppose the drive voltage is very low, then make voltage and resistance measurements in the horizontal oscillator section. Horizontal striped lines are caused by loss of horizontal sync in the horizontal oscillator circuit. A defective dual diode horizontal phase rectifier will cause a loss of horizontal sync and unstable horizontal pictures. Drifting and shifting of the horizontal hold control can also be caused by this same horizontal phase detector. A pulling and unstable horizontal picture can be caused by poor filtering.

It is best to remove the dual-diode rectified from the circuit and check the resistance both ways. In other words, you should have a high resistance measurement one way and when the ohmmeter leads are reversed the resistance should read infinity. If your ohmmeter shows resistance both ways on a dual-diode rectifier, discard it and install a new one.

Resetting the horizontal sinewave coil may be necessary when the horizontal control is way off to one side. Only horizontal stripes or bars are seen. Jagged horizontal lines can also be eliminated by adjusting the

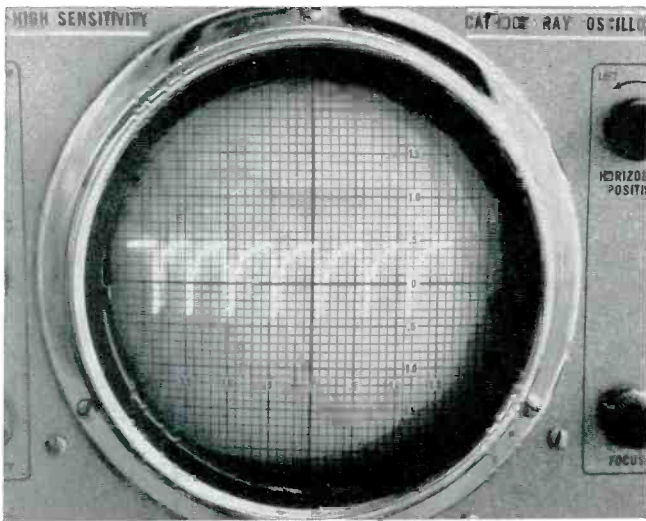


Fig. 2—Horizontal oscillator waveform taken from the plate of the 6FQ7 horizontal oscillator tube.

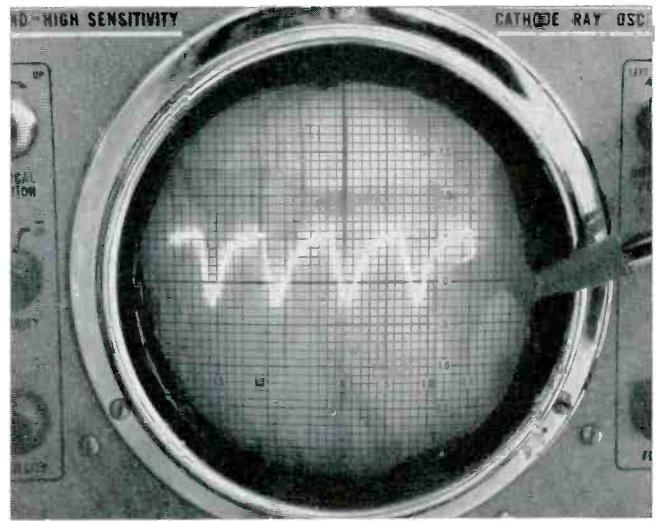
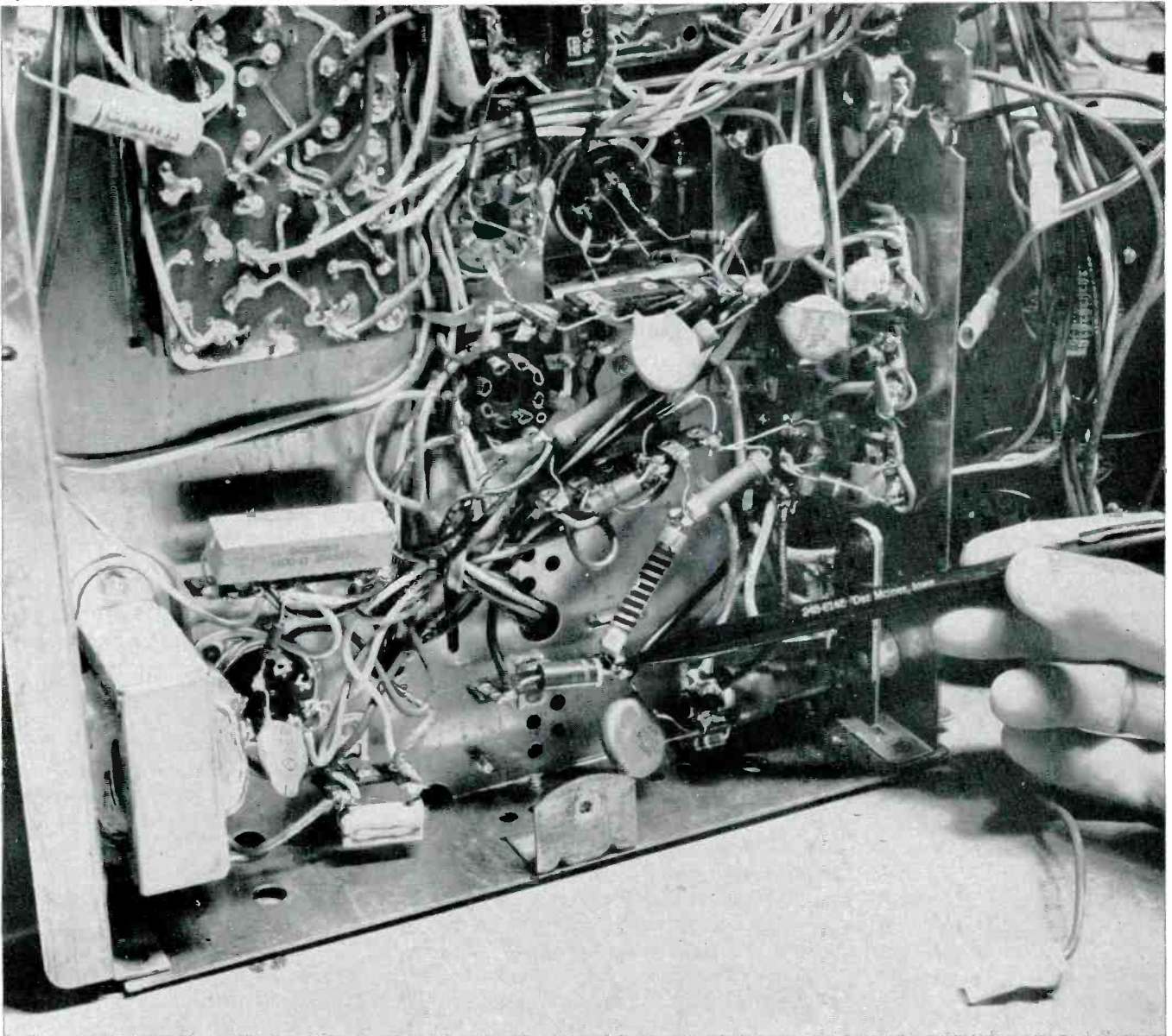


Fig. 3—Output waveform of the dual diode phase detector.

Fig. 4—This 66M film-type resistor changed value and caused trouble in the focus rectifier circuit.



SOLVING HIGH VOLTAGE PROBLEMS

sinewave coil. This condition generally arises with wide fluctuations in weather conditions or after the receiver has become old.

When the horizontal drive voltage seems quite normal but there's still no HV, insert a milliammeter in the cathode circuit of the horizontal output tube. Set the milliammeter to the 500ma scale and observe correct lead polarity. If this cathode current is too high, a high leakage in the damper circuit, shorted flyback transformer or a shorted turn in the deflection yoke may indicate the high voltage trouble. Most flyback transformers run cool and a warm or hot one indicates trouble. A shorted turn in a winding of the horizontal deflection yoke will show signs of low boost voltage.

If the current in the horizontal output tube is very low, suspect low B+ voltage, low horizontal output tube screen voltage, an open flyback or an open deflection yoke. The current drawn by a color horizontal output tube will range from 150 to 220ma. The current should never be higher than 220ma. Resistance measurements of the flyback and yoke may uncover shorted or open windings. A single shorted turn in a yoke and flyback transformer cannot be measured with a VTVM. In this case either substitute the part or check with a flyback or yoke tester. Today, the deflection yoke and flyback transformer cause the least trouble in the high voltage section. See manufacturer's service data for exact adjustments of the horizontal deflection.

Scope Checks

You can see the drive and horizontal waveforms of the horizontal circuits with your scope. Place the scope probe on the grid of the horizontal output tube and compare the waveforms with those on the manufacturers' schematic or those shown in Fig. 1. Check the output waveforms at the plate of the oscillator tube and also the input waveforms (see Fig. 2). The waveforms at the output of the horizontal phase dual-diode detector should match those shown in Fig. 3.

Pulse type waveforms and complex horizontal waveforms can best be measured with a scope. A good horizontal sinewave adjustment is almost impossible to make without observing the waveform. A low-capacitance probe should be used in this check. You can make a quick scope check of the horizontal output circuit by clipping the scope lead to the insulation of the horizontal output plate lead. A large pulse will be seen on the scope screen if the horizontal output circuit is working properly.

Focus Troubles

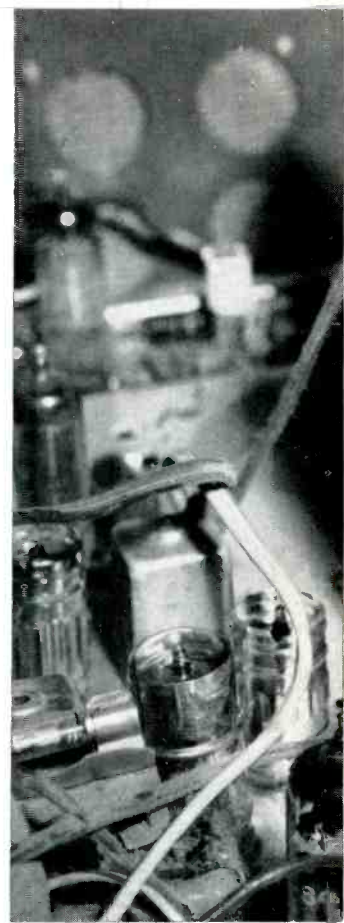
There are many reasons why a color receiver will go out of focus. In an Admiral G12 chassis, for example, the focus was good and then became intermittent. All of the tubes were pulled and substituted but by jarring the cabinet the focus would change. The chassis was pulled since the symptoms were a loose or poor connection somewhere in the focus section.

After checking a number of small

component connections, the symptom pointed to a defective CR105—the focus rectifier. This rectifier is made up of a spring tension type holder and one end of the small rectifier was making intermittent contact.

Poor focus can also be caused by a defective resistor dividing network in the focus rectifier section. In an RCA CTC16 chassis, resistor R111 had changed value. This resistor is in the ground circuit of the focus rectifier tube (see Fig. 4). If the focus coil doesn't show any signs of changing the focus on the picture tube raster, replace it. In the older color receivers the focus rheostats burn easily and should be replaced.

Defective capacitors in the shunt regulator circuit, can also affect focus and cause lower than normal ultor voltage. Capacitor C107, in an RCA CTC9 color chassis had a leakage of 79 Ω and caused this same trouble. This capacitor is located between pin 1 and 5 of the 6BK4, shunt regulator tube. A voltage check will not show up this trouble as only a few volts separate the two pin readings.



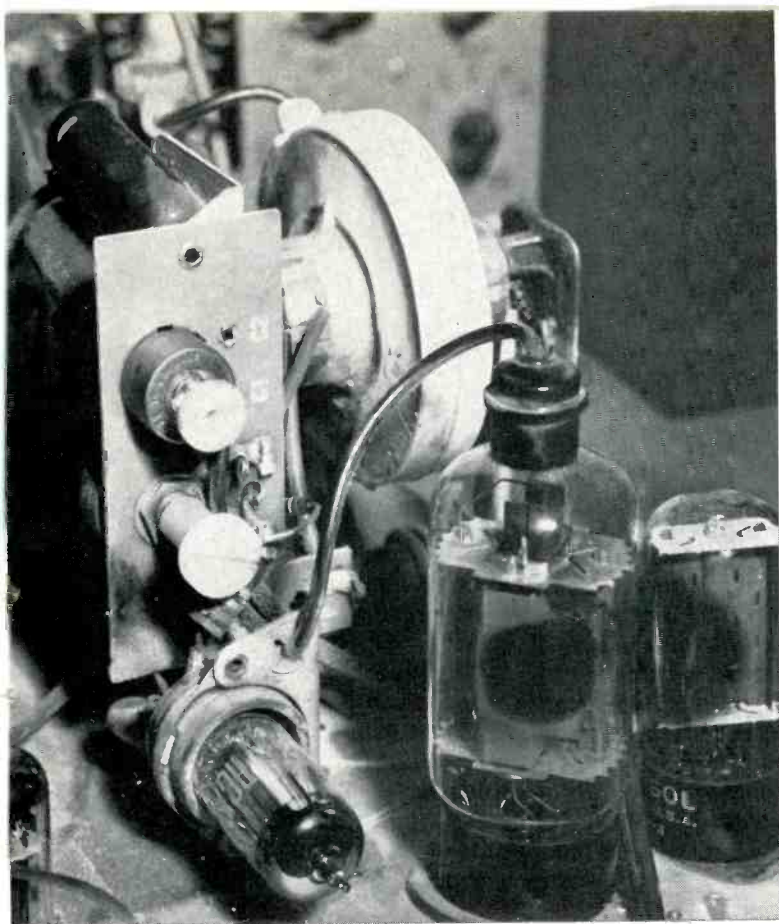
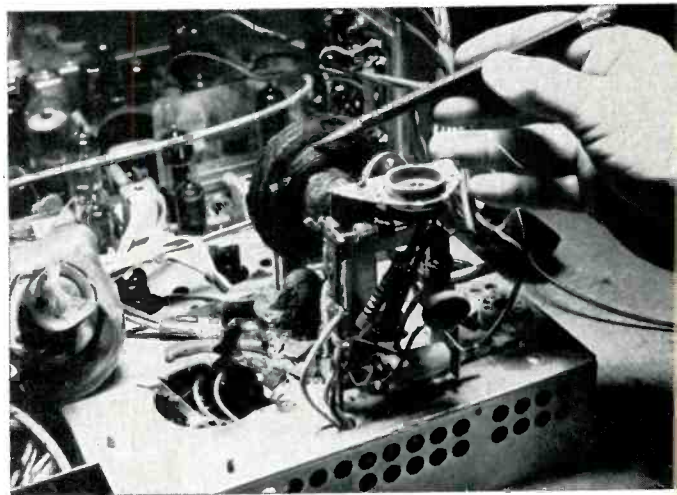


Fig. 5—Burned focus control (top) at left of flyback. Horizontal centering control, just below focus control, was also burned.

Fig. 6—"Firing" in this defective high voltage transformer caused it to char, melted the plastic cup, socket and cracked the 3A3 HV rectifier tube.



In another CTC9 RCA chassis the raster would not center horizontally or focus properly. A burned horizontal centering control was the trouble (see Fig. 5).

Poor Width Problems

Insufficient width is caused by weak tubes, leaky capacitors, low drive voltage and low high voltage. A burned resistor in the HOT screen grid circuit can cause poor width. Check the bypass capacitor off this same screen grid resistor for a short or high leakage.

Check for high leakage in horizontal efficiency coil circuit capacitors if you have insufficient width or low brightness. If the horizontal efficiency coil adjustment does not change the width of the raster, check the capacitor across it and also check the internal resistance of this coil. Insufficient width in another RCA CTC9 chassis was caused by a leaky shunt regulator capacitor.

A quick way to set the horizontal efficiency coil or horizontal linearity coil is to place a 239 pilot lamp in series with the plate cap of the horizontal output tube.

Adjust the coil for minimum lamp brightness. Two alligator clips, with short leads, can be soldered to the lamp to make easy hookup connections.

High Voltage Arc-over and Lines

After color receivers grow older, high voltage arc-over may develop. In many old RCA CTC5's to CTC11's, the ultor high voltage lead may begin to arc and hiss. This is especially true in damp, rainy, humid weather conditions. Sometimes the hissing of the high voltage can only be seen in the dark but the high voltage cable should be replaced. Replace the ultor lead with an original cable part or make one from a roll of 25kv cable.

Snapping and "firing" sometimes occurs in 25in. color receiver high voltage rectifier circuits. In some 23in. color chassis the high voltage plastic insulation cap has fired through to the metal chassis. Simply cut two or three plastic washers from the tip of a plastic polyethylene coffee can and insert them inside of the plastic cap.

High voltage firing and arc-over can be caused by firing inside of

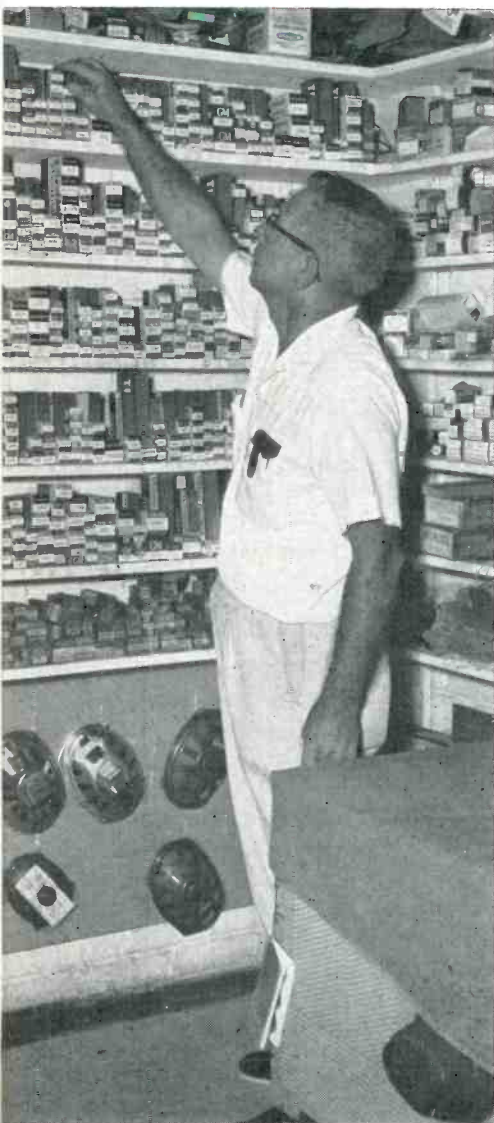
the high voltage cap of the CRT. This rubber cap may have a lot of corona burns that one can't readily see but it will still hiss and arc over. Replace the rubber cap and ultor cable. Clean the HV socket and around it with methol-chloride obtainable at most drug stores.

Arc-over in the high voltage flyback transformer may destroy the entire flyback (see Fig. 6). Several sets with completely destroyed flybacks have been brought in for repair but still no explanation has been found for this. Snivets or Barkhausen lines are generally caused by the horizontal output tube. Replacing the tube or changing the horizontal output circuit will eliminate them. The suppressor grid of the horizontal output tube is wired to B+ instead of to ground. Snivet and Barkhausen lines are found to exist mostly when sets are tuned to UHF channels.

In some early 1966 RCA chassis several vertical lines appear on the left side of the screen resembling Barkhausen lines. This trouble has been eliminated in most cases by simply replacing the 3CA3 high voltage rectifier. ■

SERVICE-DEALER MINES BOTH ENDS OF COLOR TV RAINBOW

Strong service base pushes color sales ahead of B/W by 9 to 1



Tubes and parts are arranged so technicians can find them easily.

■ Color is outselling B/W by 9 to 1 at Hampton Radio and TV Service in St. Louis, Mo. Owner Byron Napper is digging successfully at both ends of the color TV rainbow — the sales end and the service end — with special education and service for customers: priority on color calls, special education and 15 percent incentives for service-technicians who promote sales.

Selling color is the best way for this service-based business to thrive, Mr. Napper decided two years ago. "Don't get me wrong, I realize that the biggest profit dollar for us is in the service end," this veteran 36-year shopowner observes. "But the big swing to color sales increases your chances of making more regular service customers."

Although sales oriented, the operation is service based. Service accounts for 60 percent of the \$100,000 annual volume. The staff consists of Mr. Napper, three service technicians (one outside and two in the shop), one combination antenna/deliveryman and two part-time evening salesmen.

Customer Relations and Sales Promotion

Here's how Mr. Napper makes satisfied color customers. A color TV is delivered and installed by one of his best technicians. This is the regular full-time outside service-technician who is not only highly skilled in servicing, but is also an

excellent customer relations man. B/W sets are delivered by the full-time antenna/delivery man.

While installing a color set, a technician gives a full explanation, in layman's language, of the color set's operation. Then the technician goes through the operator's manual with the customer. A color program is then tuned in. Hampton delivers color sets only when color programs are on the air. Demonstrating the fine tuning, the technician then flips the set off color and asks the customer to tune in the program.

"Two steps in this procedure are very important," Mr. Napper says. "They include explaining the operator's manual and encouraging the owner to use the controls. Even if he later forgets what the technician has explained, the customer will refer to the manual as explained to him when the set was delivered."

Despite the pains taken at delivery to educate the color TV owner, Hampton still gets many calls from customers who are afraid to use the color TV controls. This is somewhat reminiscent of the late 40's and early 50's when TV was relatively new and owners were afraid to touch the horizontal and vertical controls on their B/W sets.

"We continue to educate our color owners over the telephone and whenever they drop in," Mr. Napper smiles. "We handle most color set calls over the phone just by urging customers to use the controls and



Sixty percent of Hampton Radio & TV's \$100,000 gross comes from service. But the emphasis is on sales—to create more service.

This color TV monitor, reportedly first of its type in St. Louis, is used in the home to permit diagnosing color troubles without having to pull the set to the shop.



by assuring them again that they can't possibly harm the set. When a new color set owner comes in, perhaps to look at a stereo, we always ask how the set is performing and continue the educational process."

Fast, priority service also keeps Hampton color TV owners happy. "Color always gets priority over B/W service here," Mr. Napper informed us. "We make every effort to get the ailing set in proper operation the same day, even if the customer has a second B/W set."

Same-day color service is made possible by using a recently acquired color monitor, reportedly the only one of its kind in the St. Louis area. This permits in-home diagnosing and repair — eliminating the need of sending out two men to bring the set in for two-day service.

Another key to Hampton's success is a sales educated and inspired service technician staff. This is based on a special color emphasis which Byron Napper began two years ago.

"Back in 1964, I figured, as many other service-dealers did, that the color tide was finally coming in," Mr. Napper says, "and I decided to do something about it." He gambled and ordered heavily in color sets. And he switched his service technicians to a 15 percent commission on sales.

"We really started pushing color," Mr. Napper emphasizes. "We hon-



Byron Napper shows the daytime viewing booth for color TV which he built with a simple drape arrangement in one corner of his sales floor.

estly informed our customers that color was almost bug-free and we offered them an excellent service policy. Our technicians were encouraged to sell color by the commission and we had a sales floor full of color sets and an excellent service policy to match."

A technician gets the 15 percent commission on any sale he makes whether in the home or on the sales floor. The two in-shop technicians and Mr. Napper double as sales force during the day. Two part-time salesmen are on the floor in the evening. Hampton is open until 9 p.m. every night except Saturday during October, November and December

and on Monday, Thursday and Friday the remainder of the year.

Hampton's service policy is an excellent sales tool for color. All service for the first 90 days is free, and payment of \$35 takes care of the remaining nine months of the first year of ownership.

By now the average color set customer at Hampton is so well sold on the merchandise that three out of five don't take advantage of the \$35 nine-month service program. Instead, they prefer to take their chances when they realize that a service call isn't as expensive as they thought. The regular color service program is \$8.50 per call and extra

COLOR TV RAINBOW



There's plenty of color on the Hampton floor with 10 color models and a choice of 7 styles.

for extended time or bench labor.

The average color set sale at Hampton tops \$500. This is true because the demand for quality in this area of St. Louis is high. "But we always begin by showing the bottom of the line first," Mr. Napper says, "and even our technicians follow this technique when they are on the floor. You can always trade-up, of course, and you don't want to scare off the prospect who came in because he read that color TV has dropped below the \$400 level."

How about the customer who wants a set for under \$400? Mr. Napper replies, "Sure, here's one for \$399.95 but it's 'take-along-with-you' and no installation or free service." Then he proceeds to sell the minimum add-ons — \$8.50 for delivery and installation and \$16.95 for 90-day service, bringing the total to a respectable sum. "No one dares take a color set home for do-it-yourself installation," Mr. Napper observes. So, the prospect is readily sold on paying more than \$400. Then the trade-up starts to a better model.

"We've never had a customer walk out with the \$399.95 deal yet," Mr. Napper recalls, "and I don't believe we've ever lost a customer just on price. We manage to get \$10 to \$15 more per set just because we make the point that we service the set ourselves and the customer knows the mass merchandiser usually farms out his service."

Sales and Inventory

Hampton has a color-oriented

sales floor. Mr. Napper built a daytime-viewing booth for color TV. Located in a dramatic spot at a corner of the salesroom facing the entrance, this is simply constructed of colorful drapes and a small platform on which the set is placed. When open, as it usually is, the booth spotlights the color set. When closed simply by a tug on the drapes, it shuts out almost all light — to provide good viewing.

Hampton is in a fairly good color sales position despite the current set shortage. There are 10 color sets on the floor with a choice of 7 models. Mr. Napper has partially overcome the shortage problem by long ago becoming a good customer of his supplier. He has carried one line and nothing else for his entire 36 years in business and he got aboard the color wagon early, so his distributor regards him as a top account.

Another Hampton solution to the color shortage problem is cooperation with other dealers. "With a few dealers handling the same line, all out of my territory and all doing their own service, I have an exchange agreement," Mr. Napper says. "If any one of us has a sale for a particular model but it's not on hand, we just get on the phone and call the others. We usually find it."

Mr. Napper established the exchange policy with other service-dealers of the same line because he knows that every satisfied customer of his brand is an excellent salesman.

Hampton enjoys four advantages of being a one-line dealer: (1) Better treatment from the supplier by not spreading your buying; (2) no misery of choice for the customer; (3) preventing a salesman from leaning to one of the brands on the floor; (4) opportunity for the sales force to become expert on everything on the floor.

"With a part-time selling force, such as our evening sales force or our service technicians, it's important for them to have very few items to become knowledgeable about," Mr. Napper says "All of us know how to sell our line because every one attends the twice-a-year open houses of our distributor when the new lines are revealed and explained, sales and servicewise."

Advertising

The advertising budget of Hampton is heavily influenced by the emphasis on color. Amount and type of advertising is decided by the color situation. Right now Hampton spends an average of 2½ percent of sales on advertising, most of which is manufacturer coop, drawing a like amount from the supplier for a total of 5 percent of sales. This goes mainly to newspaper and direct mail.

But in 1964, Hampton spent almost twice as much on advertising, just because that was the year of a successful forecast of a big swing to color. "We bought five billboard spaces, had a grand opening for color sets with helium balloons, etc." Mr. Napper recalls, "and we

started giving a handsome crystal bud vase to every customer buying a color set." For the first time, in 1964, color sales led B/W at Hampton — a situation which increased quickly to a 9 to 1 ratio.

Servicing

How about color service problems? "We have no more trouble than we do with B/W," Mr. Napper says. "We have several sets out that were bought two years ago and they have never required a service call. In a few of the cases, we have the owner's permission to refer prospective customers to them if they are leery about any bugs in color sets."

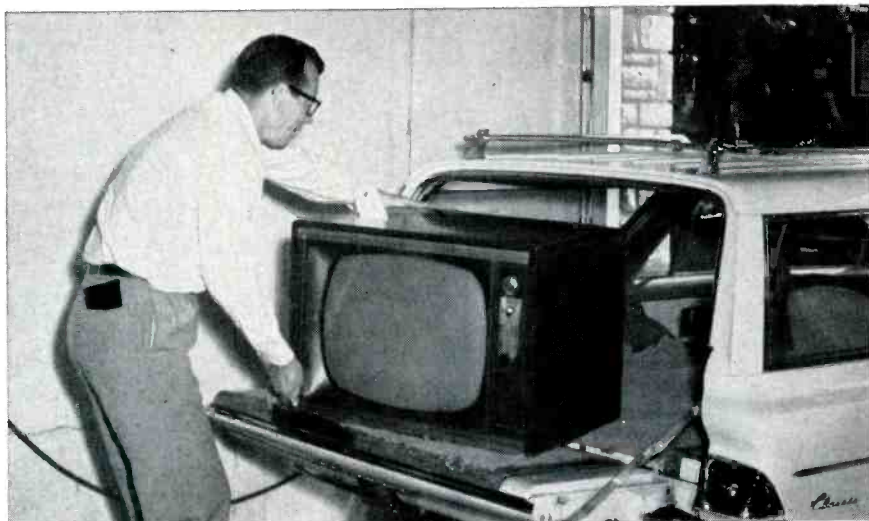
Hampton's minimum rates are \$8.50 for a color call, \$6.95 for B/W, \$3.50 minimum in-shop, and \$1.50 minimum for a radio brought in by a customer.

Profitable policies at Hampton include: (1) Keeping well instrumented and trained technicians to tackle just about any electronic job; (2) avoiding the patch-up job; (3) concentrating on a smooth work flow with deliveries as promised; and (4) keeping a clean shop.

The clean shop policy is as important as any. Here's how it works: "We compartmentalize in-shop work by model type," Mr. Napper points out. "All auto radios (and we do quite a few) are kept at one corner because they are dirty. We have a carpeted bench set aside for portable TV and home radios. This carpet is vacuumed regularly. Then we keep the console jobs on a Masonite bench.

"Old parts from each job are kept in a small cardboard box to avoid the cluttered look. This also prevents having a set scratched by a loose part. Even the owner of a 'clunker' doesn't want it marred."

The smooth work flow at Hampton is assisted by the policy of having a clean shop. Also helping is an excellent parts layout. Tubes are kept in a rack in numerical order. There's another rack for capacitors and other parts. All parts are filed by number or size to save time. The shop men are now so familiar with the arrangement that they no longer have to look for a part — they just grab blindly — sure to hit the one they want.



Two drive-in service bays work fine for out-of-weather unloading of TV sets and for working on auto radios.



Owner Bryron Napper believes in keeping a clean shop. Sets are vacuumed and carpeting covering the bench is kept clean.

Mr. Napper is a strong believer in well-instrumented and well-trained personnel. "We take advantage of every opportunity for additional training and just last week had a factory man in to demonstrate his company's newest service instruments."

Besides the three service technicians, Mr. Napper lends a hand whenever needed. He tackles the toughest jobs. For instance, he recently took on repair of the electronic number flasher units behind a butcher counter at a supermarket. The market had three units (which cost about \$500 apiece) all idle because a technician couldn't be found. Then the owner contacted Mr. Napper who is game for anything electronic. He made the repairs himself and since has become unofficial repair headquarters for all such units.

Another example of how Hamp-

ton's reputation for excellent service grows, involved electronic welders for cabinet shops. "This started a few years ago when a cabinet shop approached us rather than send the welding unit back to the factory for repairs. We did the job and word has spread so that now we get jobs in from as far away as Chicago."

Adjoining the shop in the rear is a two-bay drive-in area. Here, under roof, car radios can be checked or removed or the drive-in TV customer can carry his set in out of the weather.

Mr. Napper reports that 60 percent of all Hampton work is done in the shop, because there is such a large percentage of drive-in work. The firm does a lot of auto radio work.

"When TV came on, many firms got out of the auto radio repair business, but we hung on," he says.

continued on page 68



The 1/4 in. tape on AKAI Electric's longitudinal video tape recorder passes the recording head at 30ips.



Pictures can be recorded on-location with a portable TV recording camera. Courtesy of Westel.

ANOTHER LOOK

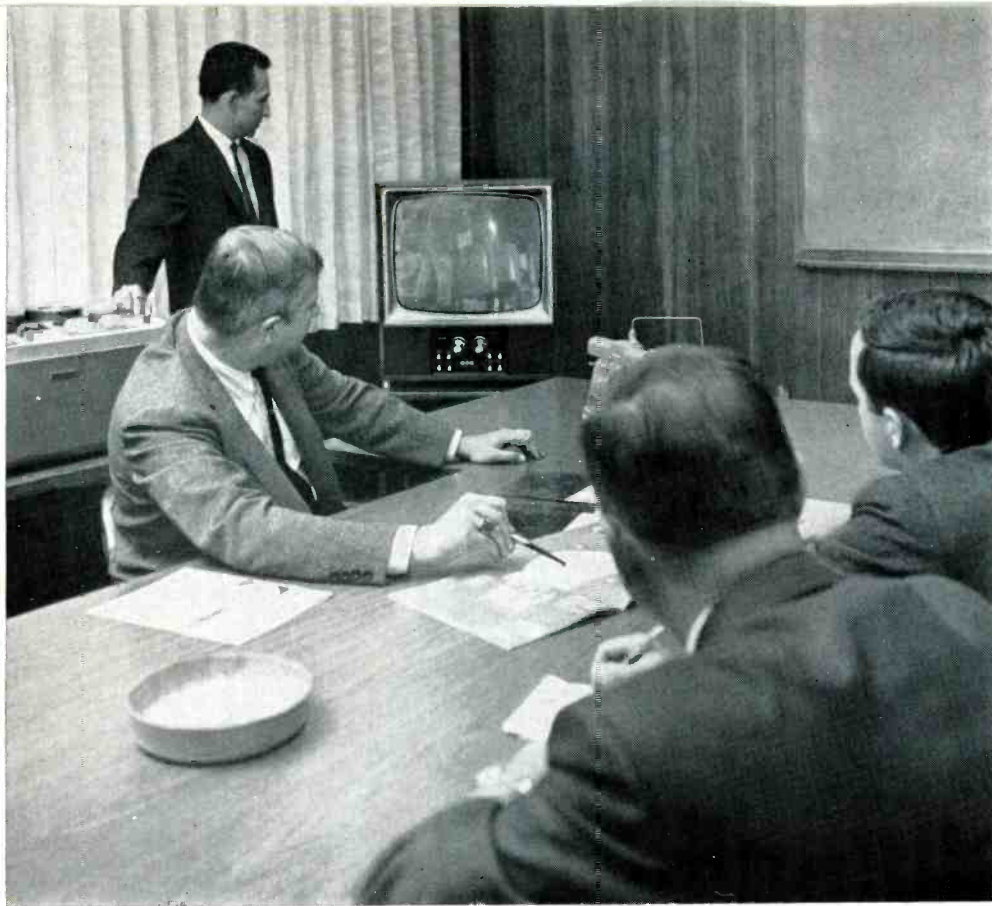
Prepare yourself for service and sales in an expanding area of educational and home entertainment electronics

■ Video tape recorders first came to our attention about 10 years ago when the nation's TV networks switched from motion picture film to video tape recordings. The equipment used to record these network programs weighed close to a ton and cost up to \$50,000 or more. Such video tape recorders were of little interest to the average TV-radio technician—except during the few free hours he had to enjoy network programs.

VTRs Are Coming of Age

The situation is now changing and alert technicians are finding it profitable to become familiar with video tape recorders.

But many technicians were not reminded of the existence of this equipment until they received a 1967 parts catalog from one electronics supply house recently. A video tape recorder photo was on the catalog's front cover. At least two other supply houses devoted a full page to video tape recorders.



FAR LEFT

The video camera captures the action as a machinist positions a vertical turret lathe for modification. Courtesy of Ampex.

LEFT

The modification of a turret lathe is shown to representatives of firms seeking to have similar equipment modified. Courtesy of Ampex.

AT VIDEO TAPE RECORDERS

One VTR advertised in these catalogs as a home-type was quoted at \$1495. Although the tape speed of this recorder was indicated as only 10ips, its rotating head provides an effective tape speed of 1000ips to develop a 2.5MHz bandwidth and a 250 line horizontal resolution. The price includes a tuner, which permits the recording of one program while another is being watched on a separate TV set. Although a monitor is not included, the manufacturer claims that the recorder can be connected to any regular TV set within minutes.

A camera outfit, including microphone, can be purchased for an additional \$580. By using this equipment in conjunction with the video tape recorder, anyone can make their own TV shows.

Cost Still Higher Than Movies

We are realistic enough to know that most technicians will not find a customer willing to spend \$1495 to avoid missing a favorite TV show. Neither will many customers be willing to invest \$2075 in electronic equipment, plus \$44.95 per roll of video tape, so they can make home B/W TV programs. Not when the same catalog 16 pages later offers an 11-piece super 8mm movie outfit for only \$139.95, with color movie film costing \$3.15 per cartridge. Although this less

expensive equipment could make only silent movies, the same catalog advertises tape recorders for "on-location recordings to accompany home movies" at less than \$100—which uses tape cartridges costing \$2.65.

No, in the near future, few service-dealers will have calls for this equipment for the home. But do not be discouraged! Prices will be going down—down—down. Like TV did. Besides, even at today's prices, VTRs and accessory equipment offer opportunities to alert technicians to get in at the bottom and build up the business.

VTRs Needed in Many Fields

One aggressive VTR manufacturer is punching hard to get its spurs firmly set in the video tape recorder market. A two-page ad in a recent edition of the WALL STREET JOURNAL pointed out many practical uses for this equipment. Key executives in management are using them to record recruitment interviews. Surgeons are recording delicate operations to preserve them for training and as a study record of new techniques.

Student teachers can record and re-play their sessions for evaluation, while student situations can be

VIDEO TAPE RECORDERS...



Sony's home video tape recorder has a timing device that can be preset to record a TV program at any particular time.

played back for analysis. Beginning salesmen are having the experience of viewing themselves as customers view them.

Police departments and fire departments can use video tape recorders for surveillance or to record interrogations for future study. Key scenes can be still-framed for study of suspects, clues or situations.

The speeches of political candidates can be taped for replay at subsequent meetings or for rehearsals or research.

Creative and production people are kept up-to-the-minute by recording programs and commercials "off-the-air" for study and evaluation. Test commercials can be tried, improved or discarded.

Critical processes can be recorded and re-played, even with adapters for telescope or microscope, rather than repeated.

Merchandising men are pre-recording product and promotion shows for multiple playback in different departments or branch stores.

Video cameras are tracing traffic flow, creating attention-getting displays and recording customer reactions. They can also be used for the detection of shoplifters or other undesirables. Retail sales techniques are being taught, perfected and evaluated.

Golf pros, coaches, drama and music teachers and athletic directors can make on-the-spot recordings of each student's achievements. Tapes can be played back immediately for instantaneous evaluation or correction. In music, drama and public speaking these video recordings aid auditions, rehearsals and promotion.

When immediate playback is wanted for testing and evaluation, video tape equipment is superior to movie equipment. Also, when a large number of recordings

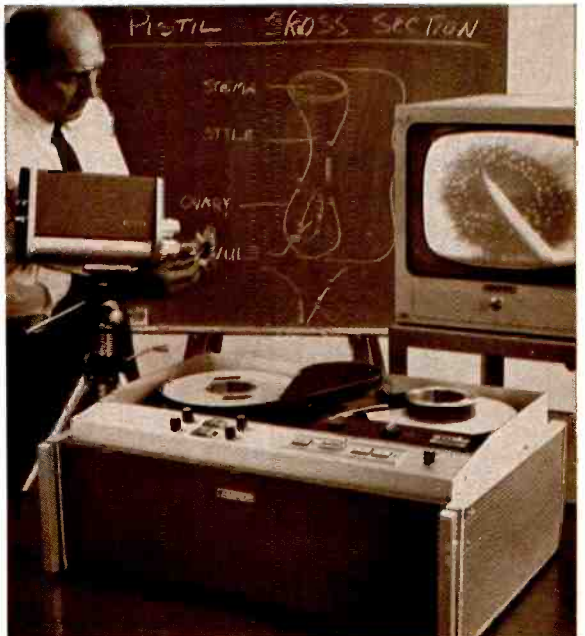


Matushia miniaturized color video tape recording camera was demonstrated daily at a New York department store's Far East Festival.



The Westel color-compatible TV recorder (right) plays back tapes from the TV tape camera.

Classroom demonstrations can be prepared at the convenience of the instructor for viewing by the classes when they meet. Equipment by Ampex.



are made for temporary use, where many programs are recorded on a single tape, the video tape recorder is more economical than movie equipment.

Models Already on the Market

Another model by the same manufacturer reportedly has a 3.5MHz bandwidth and 350 line horizontal resolution. It is currently advertised at \$3150. Still another model by the same manufacturer is advertised at \$5945 and contains a complete system for recording and playback. It is contained in a mobile console and includes not only the TV tuner, but a picture monitor, speaker, microphone with floor stand and a camera having four lenses, tripod and tilt head. This manufacturer has two separate series of VTRs which feature a machined azimuth and zenith which are not adjustable. With this feature, the company guarantees full interchangeability between all recorders of the two series. The company advises that any video tape recorder that is not interchangeable may be unable to play back a tape recorded a year earlier because of minute changes in physical dimensions.

Although only B/W recording can presently be made with these two series, the manufacturer says any current model can be converted for an additional charge in 1967 to record and playback color. Tapes recorded before that date in B/W, reportedly can still be played on the converted models.

Another company is currently developing a home color video tape recorder and indicates that it is not interested in bringing out equipment capable of only B/W recording. An official of the company advised ELECTRONIC TECHNICIAN that, "While our company is very active in research aimed at a home type video recorder we are not at this time in a position to provide any information since we are not that close to the marketing of a commercial product."

Another company is currently selling a 75lb video tape recorder priced at \$15,000 which for color recordings requires an additional module priced at \$10,000. This unit can record and play back standard NTSC color signals plus 2 audio tracks. These recorders reportedly have a 10ips tape speed and a 10Hz to 4.2MHz \pm 2db bandwidth.

An inverted three-piece, flat-top cone on these video tape recorders provides a circular path for the 1in. wide tape. As the tape spirals once around the cone, it overlaps itself. The cone's entire mid-section contains a single magnetic recording head which revolves in a direction opposite that of the tape's motion. As a result of the overlapping tape path, the single head never leaves the tape. Each revolution of the head records or plays back one uninterrupted TV picture field, plus the extra synchronizing information.

This company is also selling a portable system containing a 23lb video tape recorder with rechargeable batteries included and a 7lb cable connected camera. This unit is priced at \$10,500 without camera lenses. With one loading of batteries and tape, it will reportedly record 33 minutes of B/W video and one channel of sound.

The camera head includes an active CRT viewfinder

and all operating controls and indicators for convenient operation. To save on weight and power consumption, there is no playback, rewind or fast forward, and only pre-erased tapes can be used.

One company recently announced a 12v battery-powered portable video tape recorder which uses standard 1/2in. tape at 7 1/2ips across a tape head that rotates at 1800rpm. This unit can be used only for recording. The 9 1/2lb recorder, along with a 5lb rechargeable battery pack and a 7lb TV camera, is expected to be on the market in about a year, with a retail price of about \$1000.

This company makes a home type recorder capable of using tapes recorded by the portable unit. This solid-state unit contains a video monitor and tuner plus a timing device that can be preset to record a TV program at a particular time. The equipment is priced at \$1150, while the camera ensemble sells for about \$350 extra.

Another video tape recorder which is offered by the same manufacturer is sold without a viewer or timer for \$995.

About the same time that this company releases the portable video tape recorder it is expected to release another designed to operate on color which is expected to sell for about \$2000.

Another well known manufacturer expects to have a B/W home video tape recorder on the market at any time now with a suggested retail price ranging between \$850 and \$4000, depending on the bandwidth. The recorder can reportedly record a 1 1/2 hour program on a 7in. tape.

The same company expects to market a color video tape recorder early next year. A home unit, including color receiver, may sell for a price somewhat above the \$2000 mark.

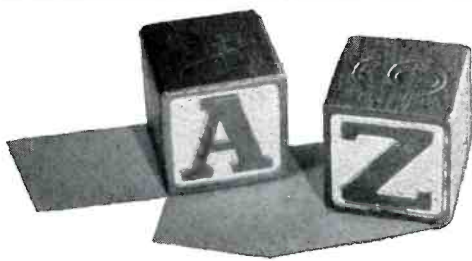
A miniaturized color camera for video tape recording has been developed by a Japanese manufacturer. This camera, measuring 5 3/4 x 7 1/2 x 13in. and weighing 19lb, was demonstrated by a well-known New York department store during its Far East Festival.

Another Japanese manufacturer has developed a video tape recorder that uses 1/2in. tape at 7 1/2ips across a dual-rotary-head system. It is reported that the unit has a 3MHz bandwidth and a 300 line resolution.

A longitudinal video tape recorder, also from Japan, uses 1/4in. audio-quality magnetic tape at 30ips. The manufacturer indicates that the 45lb unit has a 60Hz to 1MHz \pm 6db video bandwidth and a 50Hz to 10kHz audio frequency response.

IIT Research Institute (Illinois Institute of Technology) has announced the development of a 20lb color video tape recorder for the home and educational market.

The \$500 unit employs a direct, longitudinal, single, fixed-head assembly for recording and playback. Four separate channels are recorded at 120ips on a 1/4in. tape during four passes. Although IIT's present recorder has been licensed to three firms for commercial development, they have not announced when such units will be available. ■



SEMICONDUCTORS FROM A TO Z

Know how field effect transistors differ from regular transistors before you attempt to service 'FET' circuits

■ Previous articles in this series have discussed the function of regular transistors. We have seen that they are low-impedance components controlled by forward biasing their bases with respect to their emitters. Their particular P and N structure determines the polarity of all applied voltages.

Although junction field effect transistors are also made of P- and N-type material, their design permits an entirely different set of characteristics.

Controlling The Drain's Current

The FET shown in Fig. 1 contains a rod of P-type material capable of conducting current in either direction. The chemistry in portions of the rod has been changed and made into N-type material. The resulting junctions of P and N materials are like the junction in a diode. Since current cannot flow through these junctions when the N-type material is more positive than the P-type material, the current traveling through the rod must pass around them.

The larger the positive voltage applied to the N-type material in junction FETs, the larger the effective size of the junctions, and the smaller the rod's remaining cross-sectional area capable of current flow. As the area permitting current flow diminishes, the resistance of the rod increases and less current is able to flow through the rod.

The portion of the junction FET that controls current flow is called the gate. Voltage is applied to the gate to "pinch-off" the current passing through the rod. Since the gate of a junction FET is biased to reduce current flow through the junc-

tion and therefore through the rod, we say that it is reverse biased. This is quite unlike the regular transistor, which has a forward biased base to encourage current flow through the junction and transistor.

Current flows from one end of the P-type rod to the other. The source is where the current enters the rod while the drain is where the current leaves the rod. Since the lead connected to the source is attached in the same manner as the lead connected to the drain, no difference exists between the two ends. If the source and drain leads of a junction FET are interchanged in a circuit, current will flow through the rod in the opposite direction — the drain has become the source while the source has become the drain. Hence, the source and drain of a junction FET are interchangeable. This characteristic also differs from a regular transistor, which has an emitter and collector not normally interchangeable.

Biasing The Gate

A simplified circuit for a P-channel FET is shown in Fig. 2. Since the gate is made of N-type material, a positive potential must be applied to it to regulate the semiconductor device. Because currents flow from negatively to positively charged potentials, the little gate current that does exist flows from the voltage source (V_{GG}) into the gate. The direction of the arrow used to represent the gate points in a direction opposite that of current flow. (The arrow points in the direction of "conventional" current flow.)

The P-N junctions bordering the gate of a FET are reverse biased to reduce current flow through the

junctions and the rod. Since the junctions are reverse biased, their resistance is high and very little current flows through the gate lead. In silicon junction FETs the gate resistance can be 10M or higher.

This FET characteristic differs sharply from that of a regular transistor, which has a forward biased base-to-emitter junction to encourage current flow. The regular transistor discussed in a previous article had a base resistance that varied from 230K to $\frac{2}{3}$ K — depending on the base-to-emitter voltage.

The effective size of the FET's P-N junctions can be partially reduced when the gate is forward biased, and even more current can then flow from source to drain. Silicon junction FETs have a high gate resistance even when the gate is forward biased up to about 0.5v.

It is practical to use a junction FET with this characteristic to operate small-signal amplifiers with a zero-biased gate, if the peak input signal levels off at about 0.5v. Above this forward bias voltage the P-N junction current increases exponentially. Gate signal peaks are clipped with the sudden drop in gate resistance at higher forward bias voltages. To eliminate this effect, the signal's forward bias must either be reduced by lowering the circuit's input impedance, or shifted by modifying the circuit so that it contains a dc reverse bias to counteract the signal's forward bias.

"Pinch-Off" Voltages

Measurements show that when the gate-to-source (V_G) is held constant and an increasing drain-to-source voltage (V_{DS}) is applied to a FET (Fig. 3), there will be a cor-

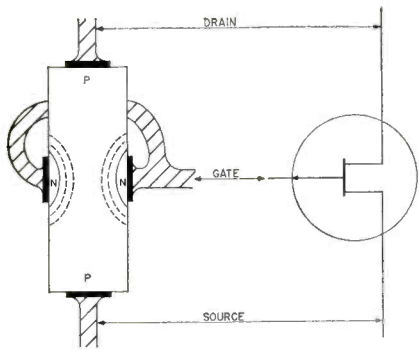


Fig. 1—The structure of a junction field effect transistor.

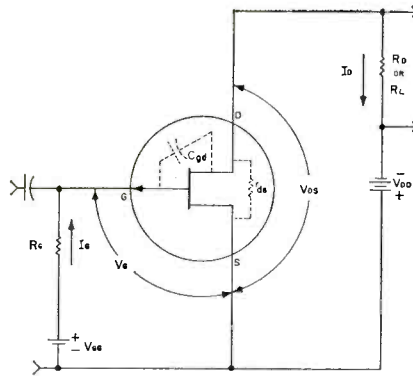


Fig. 2—A simplified junction FET circuit.

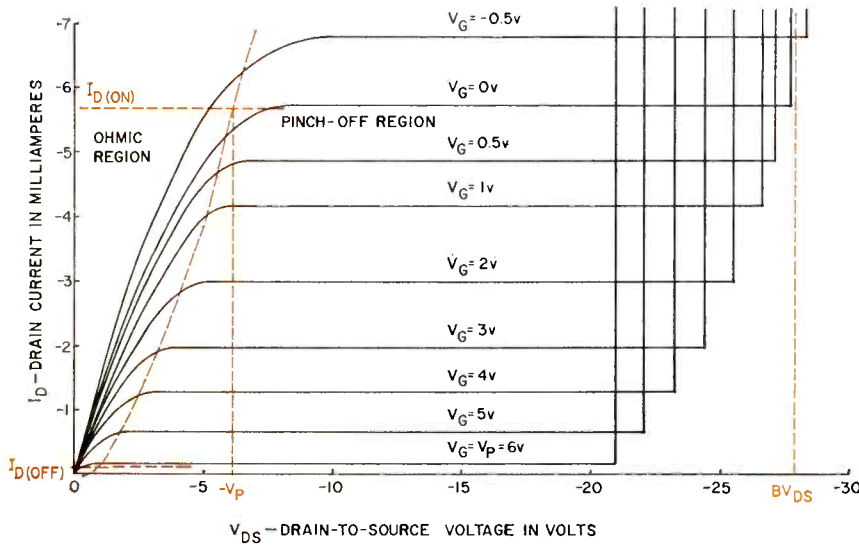


Fig. 3—Junction FET characteristic curves.

responding increase in drain current (I_D) until a certain voltage is reached. Further increases in drain-to-source voltage will not result in any significant increase in drain current until the semiconductor's breakdown voltage (BV_{DS}) is reached. The drain-to-source voltage, at which there is no corresponding increase in drain current, is dependent on the gate-to-source voltage. The pinch-off voltage (V_P) has been defined as approximately the negative of the drain-to-source voltage (V_{DS}) for maximum current, when there is no gate-to-source voltage ($V_G = 0$). ($V_P \approx -V_{DS}$ when $V_G = 0$, and I_D first becomes independent of V_{DS} .)

The range of drain-to-source voltages (V_{DS}) between the negative of the pinch-off voltage ($-V_P$) and the breakdown voltage (BV_{DS}) is called the pinch-off region. (Pinch-off region is where $-V_P < V_{DS} < BV_{DS}$.)

The drain on-current ($I_{D(ON)}$) is defined as the drain current (I_D) that occurs when there is zero gate-to-source voltage ($V_G = 0$) and the drain-to-source voltage (V_{DS}) is in the pinch-off region. ($I_{D(ON)} = I_D$ when $V_G = 0$, and $-V_P < V_{DS} < BV_{DS}$.)

As the gate-to-source voltage (V_G) in a junction FET increases, the drain current (I_D) decreases (Fig. 3). The pinch-off voltage (V_P) has also been defined as approximately the gate-to-source voltage (V_G) reverse bias for minimum drain current ($I_{D(OFF)}$). At this gate-to-source voltage the reduced drain current is nearly independent of the drain-to-source voltage. ($V_P \approx V_G$ when $I_D = I_{D(OFF)}$, and I_D is nearly independent of V_{DS} .)

The characteristic drain-to-source pinch-off voltage at which nearly maximum drain current occurs is nearly equal in magnitude to the

characteristic gate-to-source pinch-off voltage at which nearly minimum drain current occurs. Almost the only difference between the two voltages is their polarity.

Junction FET Amplification

One of the specifications for the gain in a regular transistor refers to the ratio of collector and base current signals when the transistor is connected directly to a constant voltage source. This ratio of signal currents, frequently expressed as β or h_{fe} , is not an appropriate measure for describing junction FETs. Since a junction FET has a very high gate resistance, the input signal's current at the gate is so small that a ratio of gate signal current to drain signal current would not be a practical unit of measure.

Junction FET specifications compare the drain current signal (ΔI_D), when the source and drain are directly connected to a constant voltage source, with the gate-to-source signal voltage (ΔV_G). This ratio ($\frac{\Delta I_D}{\Delta V_G}$) is called transconductance or mutual-conductance, represented as g_m , and has a value generally ranging from 500 to 10,000 μmhos . (The unit "mho," as we know, is the inverse of resistance, and is ohm spelled backward.)

If the drain-to-source resistance (r_{ds}) of the FET, shown in Fig. 2, is much greater than the load resistance (R_L), the approximate value of the circuit's voltage gain (A_v) can be easily calculated ($A_v \approx g_m R_L$).

Small signal junction FET amplifiers have a maximum voltage gain (A_v) with a zero gate-to-source bias voltage (V_G) and a drain-to-source voltage (V_{DS}) slightly above the pinch-off voltage (V_P). ($A_v = \text{maximum}$ when $V_G = 0$, and $V_{DS} > -V_P$.)

Determining A Load Line

A load line can be drawn (Fig. 4) on the FET's characteristic curve (Fig. 3) in the same manner as the one drawn for a regular transistor in an earlier article. The load line should be drawn so it crosses the " $V_G = 0$ " line near the lower end of the pinch-off region. In this case, we have selected a 20v source (V_{DD}) and a 1.8K load resistor (R_L). The

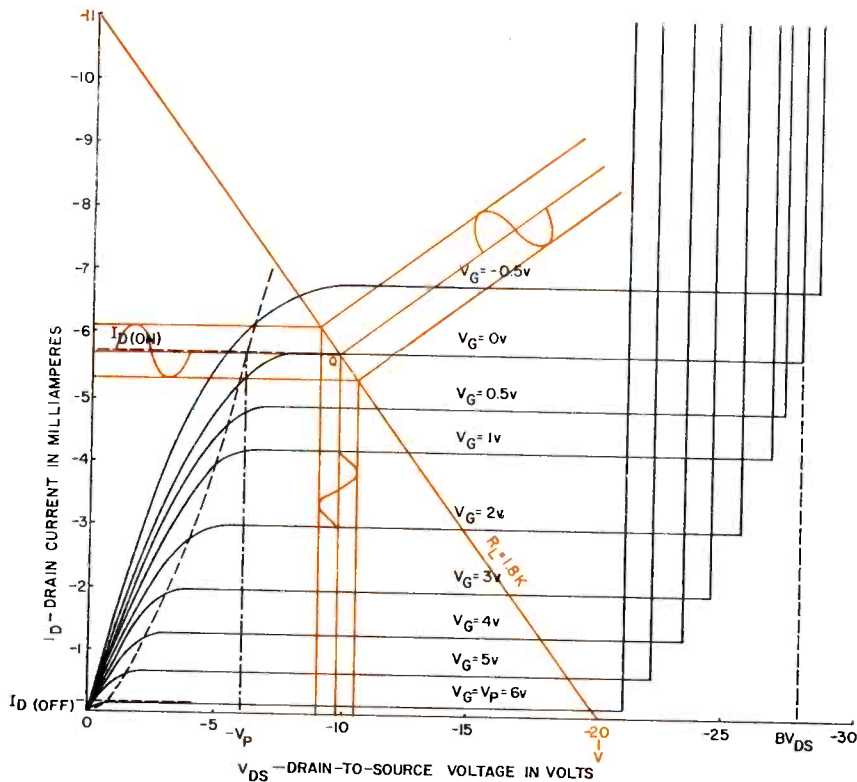


Fig. 4—The load line of a junction FET circuit.

Q point for best amplification falls where the gate-to-source voltage is zero ($V_G = 0$).

From the load line we note that under these conditions a 1v gate signal (ΔV_G) develops a 0.8ma drain current signal (ΔI_D) and a 1.5v drain-to-source voltage signal (ΔV_{DS}).

With this information we can calculate the junction FET's transconductance (g_m). ($g_m = \frac{\Delta I_D}{\Delta V_G} = \frac{0.8 \times 10^{-3}a}{1v} = \frac{1v}{800 \times 10^{-6}a} = 800\mu mho$.)

A previous article indicated that a circuit's voltage gain (A_v) equals the output signal voltage (ΔV_{DS}) divided by the input signal voltage (ΔV_G). ($A_v = \frac{\Delta V_{DS}}{\Delta V_G} = \frac{1.5v}{1v} = 1.5$.)

We can use the other voltage gain equation to verify our calculations. $A_v = 1.5 \approx g_m R_L = 800\mu mho \times 1.8K = 800 \times 10^{-6} mho \times 1.8 \times 10^3 \Omega = 1.44$. The slight discrepancy in this case results from a small error in reading the load line and because the load resistance is not exactly 1.8K.

Although the circuit has developed very little voltage gain (A_v), it has served a practical function. Since the input resistance at the gate measures about 10M or higher, while the circuit's load resistance is only 1.8K, the high impedance input signal results in a low impedance output signal. The signal can now be amplified further with low impedance regular transistors, which may have loaded down the original input signal if they had been connected directly to it.

Frequency Response

Low power junction FETs have a gate-to-drain capacitance (C_{gd}) ranging from 1 to 100pf. This capacitance increases as the drain-to-source voltage is reduced and approaches the pinch-off voltage. As a result of this capacitance (C_{gd}), the "Miller effect," discussed in an earlier article, also occurs in junction FETs.

A regular transistor's low impedance base input tends to shunt a large portion of the transistor's high impedance internal feedback to the emitter. The Miller effect in regular transistors is, therefore, not as

great as in FETs where the input signal at the gate, like the internal feedback signal, is usually also of high impedance.

The Miller effect in FETs can be reduced by increasing the drain-to-source voltage, reducing the circuit's input impedance or with a feedback circuit opposing the semiconductor's internal feedback. (Such feedback circuits were discussed in an earlier article.)

When the voltage gain of a FET circuit is limited to unity, the semiconductor's internal capacitance is large enough to limit the circuit's input impedance to between 1 and 50M. With higher gain the Miller effect still further limits either the upper frequency or the input impedance.

Theoretically, junction FETs should be able to handle frequencies up to 1GHz. Although manufacturing difficulties limit them to 100-MHz, junction FET amplifiers should be useful up to 1MHz, if they can be driven by a low impedance signal source.

The principal noise generated in junction FETs is thermonoise produced in the rod. This noise, however, is less than that produced in regular transistors or even in most electron tubes.

Temperature Effects

Junction FETs, like regular transistors, are normally affected by changes in temperature. Measurements indicate that their pinch-off voltage (V_P) usually increases at about 0.2 percent per $^{\circ}C$.

Although FET N-P junctions are affected by temperatures, the gate current stability of junction, silicon FETs approaches the base current stability of regular, silicon transistors when the circuit's gate-to-source resistance (R_G) lies between 1 and 10M.

Two opposing effects of temperature change in junction FETs result in a linear decrease in drain on-current ($I_{D(ON)}$) with increasing temperature, causing the current to decrease about 0.6 percent per $^{\circ}C$. This drift can be reduced by operating the FET at very low Q-point currents.

The use of junction FETs with

continued on page 68



A color CRT faceplate goes through one of a series of inspection steps at the Muncie, Ind., plant of Owens-Illinois, Inc.

WHAT'S NEW IN CRTS?

Know all about picture tubes and keep your customers happy

■ It is not uncommon to find two, three or more TV sets in many homes today. But we seldom pause to realize that advancements in many phases of electronics—in circuitry and styling—have made TV receivers bigger and better, yet they cost the consumer less than ever before.

And CRTs, the “eyes” of TV receivers, have evolved to higher levels — with increased reliability and higher performance. Additionally, because tubes have increased in size and in deflection angle, they have become more difficult to produce.

The most popular sizes in currently produced sets are 19 in.—114deg deflection, 23 in.—92, 110 and 114deg deflection. About ten years ago the over-all length was 24 in.—but today's CRTs are only half as long, 13 in. or so.

The wide angle types have had their neck cross-sectional areas reduced by 40 percent to lower the sweep power requirements.

Recently the Federal Trade Commission issued a new Trade Regulation Rule relating to the advertising of screen sizes. This Trade Regulation Rule, which takes effect on January 1, 1967, states in part:

“... the Commission hereby promulgates, as a Trade Regulation Rule, its conclusion and determination that in connection with the sale of television receiving sets in commerce, as “commerce” as defined in the Federal Trade Commission Act, it is an unfair method of competition and an unfair and deceptive act or practice to use any figure or size designation to refer to the size of the picture shown by a television receiving set or the picture tube contained therein unless such indicated size is the actual size of the viewable picture area measured on a single plane basis. If the indicated size is other than the horizontal dimension of the actual viewable picture area such size designation shall be accom-

WHAT'S NEW ...

panied by a statement, in close connection and conjunction therewith, clearly and conspicuously showing the manner of measurement.

FTC Specifications

Examples of proper size descriptions when a television receiving set shows a 20in. picture measured diagonally, a 19in. picture measured horizontally, a 15in. picture measured vertically, and a picture area of 262 square inches include:

- "262 square in. picture" or
- "20in. picture measured diagonally" or
- "19in. x 15in. picture" or
- "19in. picture" or
- "19in."

Examples of improper size descriptions of a television set showing a picture of the size described above include:

- "21in. set" or
- "21in. diagonal set" or
- "21in. over-all diagonal—262 square in. picture" or
- "Brand Name 21. . . ."

Table I shows currently used designations for several common tube sizes as they appear, and two of the picture size designations for the same tubes approved by the new Federal Trade Commission rule. Measurements are based on the latest information available from the EIA (Electronic Industries Association).

Recent Developments

RCA recently announced a new development in rectangular color CRTs which provides, according to the company, optimum color reception almost instantly after the set is switched on.

This advancement has been achieved by a temperature-compensated-shadow-mask assembly which overcomes the problems of heat expansion during the warm up period.

General Electric's 11SP22 is constructed so the three electron guns are in line on a horizontal plane. The phosphor dot pattern on the tube's screen is arranged in the same general manner as other tri-gun tubes. The guns of this tube scan the horizontal in-line rows of phosphor dots rather than the triad groups. This deflection arrangement, along with over-all system considerations (including a toroidal deflection yoke) lead to a simplified setup or convergence procedure. The deflection angle is 70deg.

Sylvania says it has developed an improved "rare earth" CRT which is 16 percent brighter than its previous tube.

Owens-Illinois, plans a multi-million dollar expansion at its TV bulb plants at Columbus, Ohio and Muncie to meet the growing demand. The expansion will increase the company's production capacity for glass CRT envelopes by 25 percent. The TV industry is expected to produce more than 4.5 million color sets this year, compared with 2.5 million in 1965. Black and white set production is expected to decrease only slightly from the total of 8.1 million produced in 1965. Owens-Illinois supplies color bulbs to all major domestic tube makers and also a substantial part of the B/W CRT bulbs used by the industry.

RCA announces that construction of its \$26 million plant is progressing on schedule in Keystone Industrial Park, and manufacturing operations are expected to begin during December of this year. The plant will produce color CRTs.

Admiral has announced a daily output average of 1800 color CRTs, after completion of phase two of its Chicago CRT plant. Full production capacity of 600,000 color CRTs will be reached at the end of the year. Construction of phase three expansion started at the beginning of July and when completed in July, 1967, will give Admiral a total annual production capability of 900,000 color CRTs. ■


Table I
CRT size designations

COLOR

Current Designation to Jan. 1, 1967: Over-All Tube Diagonal (inches)	New Designation after Jan. 1, 1967: Viewable Picture Diagonal (inches)	Viewable Picture Area (Square inches)
15	14	102
19	18	180
21 (round)	19	267
22	20	226
23	22	268
25	23	295

BLACK & WHITE

Current Designation to Jan. 1, 1967: Over-All Tube Diagonal (inches)	New Designation after Jan. 1, 1967: Viewable Picture Diagonal (inches)	Viewable Picture Area (Square inches)
9 (9WP4)	1.3	38
12	12	74
16	15	125
19	18	172
21	20	212
23	22	282



With the time it ^{*}saves in set-up, you can take a breather, make a few more calls and still have time to play with the kids.

*RCA's new Hi-Lite Color Tube with Perma-Chrome

If you've been waiting half an hour for the picture tube to warm up every time you repair or install a set, here's good news. RCA's new rectangular Hi-Lite Color Tubes with Perma-Chrome lock colors in place instantly, eliminate distorted color as the set warms up. Colors are true and unchanging

from turn-on to turn-off. Saves hours of set-up time. New Hi-Lite Color Tubes with Perma-Chrome now in RCA Victor consoles. **New service switch in all 1967 color chassis.** Three-position for Normal, Service and Raster. When Raster is selected, all video and noise is removed from

the color picture tube, leaving a noise-free Raster. Purity is adjustable without removing an IF tube or using other means to remove noise and/or interference from the screen.



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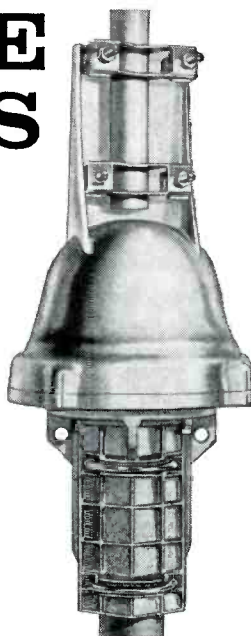
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ZENITH QUALITY WIRE, CABLE AND ROTORS

Zenith's new heavy-duty rotor

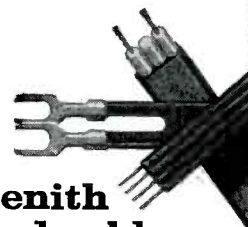
can turn a 150-lb. antenna in a complete circle in only 45 seconds! Rugged, dependable Zenith quality throughout.

You can couple it quickly to a mast or tower without using an adapter. Choose from two control units; one stops rotor automatically at preset position, the other is directly controlled by the operator.



New Zenith wire and cable

assures exceptionally low loss and longer life. Designed to Zenith's exacting specifications for UHF and VHF reception, antenna rotors and other electronic uses. You'll find convenient lengths—from 50-foot coils to 1000-foot spools.

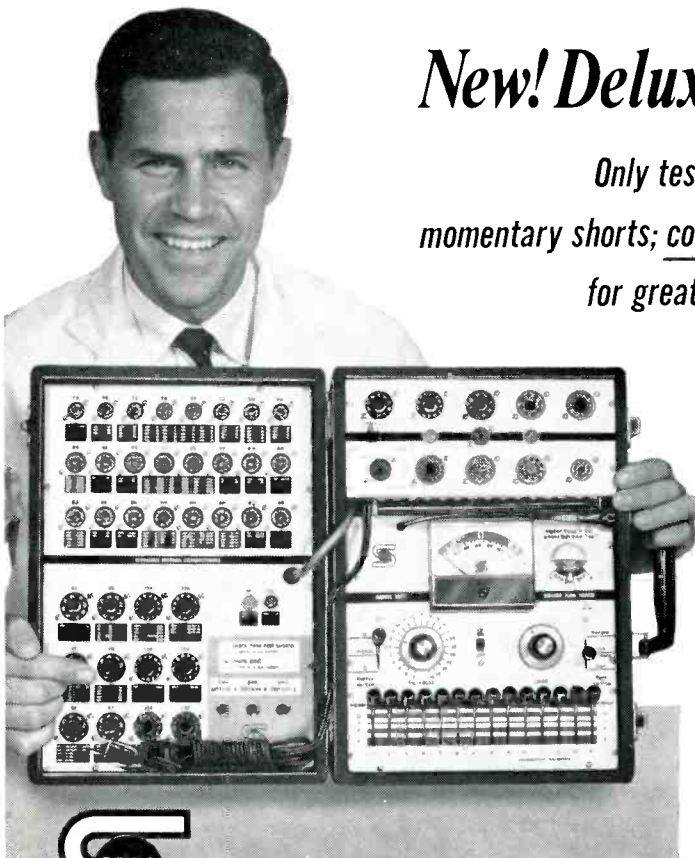


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MOTOROLA		TV Chassis KCS153—Sync Separator & Noise Cancellation—Circuit Description	7/66-32
Color TV Chassis TS-914—Low Brightness	11/66-38	TV Chassis KCS153X Integrated Audio Circuit—Servicing	9/66-30
TV Chassis TS-454A—Production Changes	3/66-36	TV Chassis CTC21 AFC Circuits—Circuit Description	12/66-28
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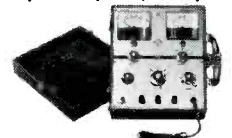
New! Deluxe 107C Tester!

Only tester with "eye" tube to spot momentary shorts; constant voltage transformer for greatest stability and accuracy!

Now, Seco brings you a compact, portable tube tester unmatched in speed, sensitivity and reliability! "Eye" tube spots momentary shorts missed by normal meter lag—constant voltage transformer eliminates need for "line-adjust", provides proper filament and test voltages for **superior accuracy**. Patented Grid Circuit Test; Dynamic Mutual Conductance and Cathode Emission Tests. 38-socket, pre-wired panel accepts 80 base arrangements to test more than 1000 tubes without setup. Replaceable, 10-socket plug-in panel for complete test on all modern TV, Radio, Hi-Fi, Industrial and Foreign tubes. Model 107C

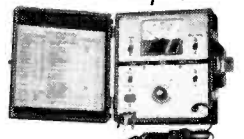
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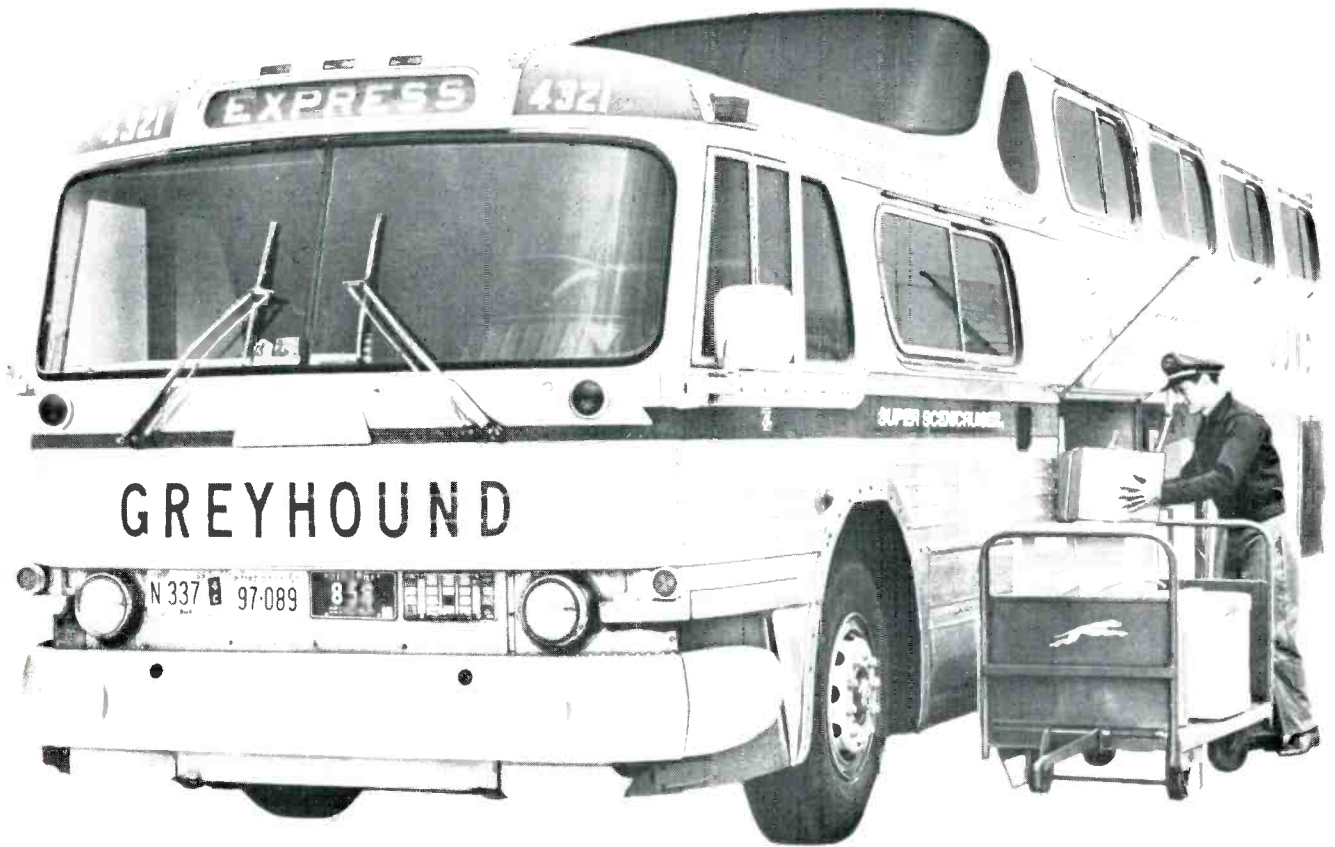
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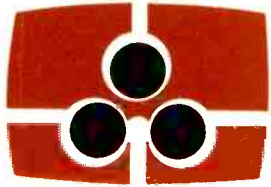
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One of a series of messages depicting another growing service of The Greyhound Corporation.

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COLORFAX

New RCA Vertical-Output Tube For Color

A new developmental beam power tube, which is said to offer the first practical solution to one of the most difficult problem areas in color TV receivers—the vertical-output amplifier—is announced by RCA. “The new developmental type beam power tube with integral diode, when used in recommended vertical-deflection circuits for color TV receivers, provides a number of outstanding benefits,” according to G. J. Janoff, manager, marketing. “These benefits include true height control, exceptionally good linearity, a minimum of interaction between the height and linearity controls, greater independence from variations in tube characteristics, and fewer components than conventional circuits,” he said. Two vertical deflection circuits have been developed by RCA for high B+ and low B+ operation of the new tube, RCA A40607C. Basically, these circuits operate in the same manner as conventional vertical-deflection circuits.

Their difference lies in the use of feedback stabilization provided by the integral diode which is connected internally to grid 3 of the tube. Both circuits are said to be insensitive to changes in tube characteristics and interelectrode leakage current.

The integral diode is used to develop bias and a drive waveform for grid 1. During retrace, capacitor C1 charges negatively through the diode. Potentiometer R1 controls the amount

of charging current and in effect sets the start of scan on grid 1.

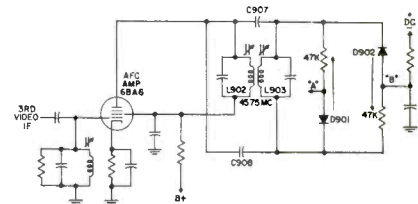
During scan, capacitor C1 discharges through the resistance path of R4, R1, R5 and R2 back to the B+ voltage. Capacitor C1 provides negative feedback voltage into the circuit which makes the circuit practically independent of tube characteristics. Potentiometer R2 is used to control the rate of discharge.

Because this independent path is provided for the partial development of the drive waveform and bias, the height and linearity controls have little effect on the vertical frequency.

Magnavox Automatic Color Control

In a number of versions of the 45 Series chassis, the T904 and the new color chassis, automatic frequency control circuitry has been added to make tuning less critical and to compensate for oscillator drift. The TV signal from the VHF or UHF tuner is amplified by the three IF stages and coupled to the AFC amplifier. The output circuit of the AFC amp is tuned to 45.75MHz which is the frequency of the IF video carrier. The video carrier is then applied to the AFC discriminator. Any frequency variations between the video carrier and the resonant frequency of the discriminator transformer results in a plus or minus dc correction voltage in the output circuit. The correction voltage is then fed back to an AFC diode in the oscillator circuit of the tuner

which causes the oscillator frequency to shift to the correct tuning point. As shown below, the signal from the

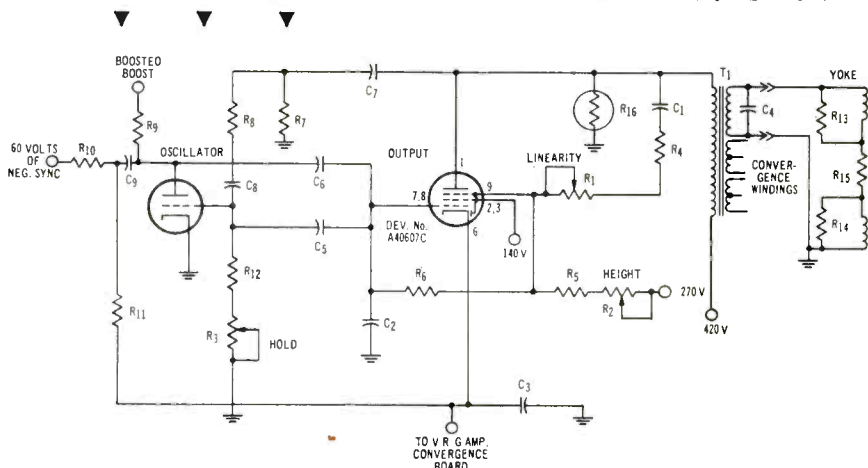


3rd IF stage is amplified by the AFC amplifier and coupled through C907 and C908 to the discriminator diodes, D901 and D902.

The IF signal is also coupled to the discriminator transformer. Actually, L902 and L903 are separate coils, but they are spaced close enough to each other to provide transformer action. These coils are tuned to 45.75MHz, the IF frequency of the video carrier. While passing through the transformer, the IF signal is delayed 90deg. out of phase. This delayed signal adds to the *direct* signal coupled through C907 and C908. As a result, the ac voltage applied to D901 is 90deg. out of phase with the voltage applied to D902. The diodes conduct equally through their respective load resistors and produce zero voltage between points “A” and “B”.

If the oscillator drifts off frequency or if it has been mistuned slightly, the IF video carrier frequency will be shifted above or below 45.75MHz. The secondary tuned circuit will appear to be an inductance or a capacitance, depending on the direction of frequency shift. The phase shift introduced by the transformer will now be *more* or *less* than 90deg. The resultant ac voltage applied to the diodes will then cause one diode to conduct more while the other diode will conduct less.

If diode D901 conducts less, then the heavier current flow through D902 will cause point “B” to become negative with respect to point “A”. This negative voltage is filtered and coupled to the tuner to correct the oscillator frequency. When diode D901 conducts heavily, point “B” becomes positive with respect to point “A”. The positive voltage “B” then corrects the oscillator frequency in the opposite direction.



FEEDBACK STABILIZED VERTICAL OUTPUT CIRCUIT FOR HIGH B+ COLOR-TV RECEIVERS

RCA ANNOUNCES NEW ANTENNA ACCESSORIES ENGINEERED FOR COLOR TV

New catalog tells the full-line story.
Get it from your RCA Distributor.



5

RCA Deluxe Transistorized Antenna Amplifiers

... a full line of dual purpose units with the most advanced silicon transistors in high-gain, low-noise circuits. They are masterfully designed to bring in the sharpest picture on color or black and white TV. Or they can drive multiple receivers from a single antenna using RCA multi-set couplers as a small distribution system. Five types include: 300 ohm UHF type 10P223; 300 ohm VHF/FM type 10P213; 75 ohm coaxial VHF/UHF type 10P215 and 10P235; and 300 ohm VHF/UHF type 10P233—all with remote, A.C. operated power supplies.



4

RCA Deluxe Multi-Set Couplers

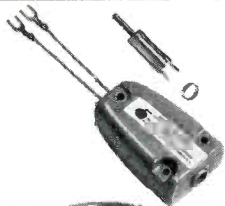
... UHF/VHF/FM 300 ohms, couple two or four sets to one antenna or amplifier. Channels 2 to 83, types 10P302 and 10P304. Also VHF/FM 75 ohm coaxial types 10P752 2-set coupler; 10P754 4-set coupler.



3

RCA Deluxe Band Splitters

... Separate UHF, VHF and FM signals from a single transmission line or combine separate antennas. 300 ohms. Three types include: 10P311 couples VHF/UHF signals to one line; 10A135 separates UHF and VHF at set; 10P312 separates UHF, VHF and FM.



3

RCA Deluxe Coaxial-to-twin lead Transformers

... streamlined for fast installation. Coax plugs in using solderless connector. Terminals for twin lead connections. Models: 10P723 and 10P753 for indoor use and 10P375 for outdoor use.



2

RCA Deluxe Lightning Arrestors

... Positive contact with all varieties of twin-lead (flat, round, and oval). Eliminate lead stripping, insert line in slot, screw on cap for fast installation. Low insertion loss, does not increase VSWR of a good antenna even at critical UHF frequencies. Screw mount type 10A118; and strap-mount type 10A119.

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COLORFAX

The AFC diode, or varicap, shown in Fig. 2, acts as a voltage variable

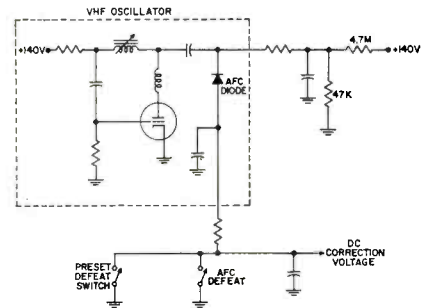


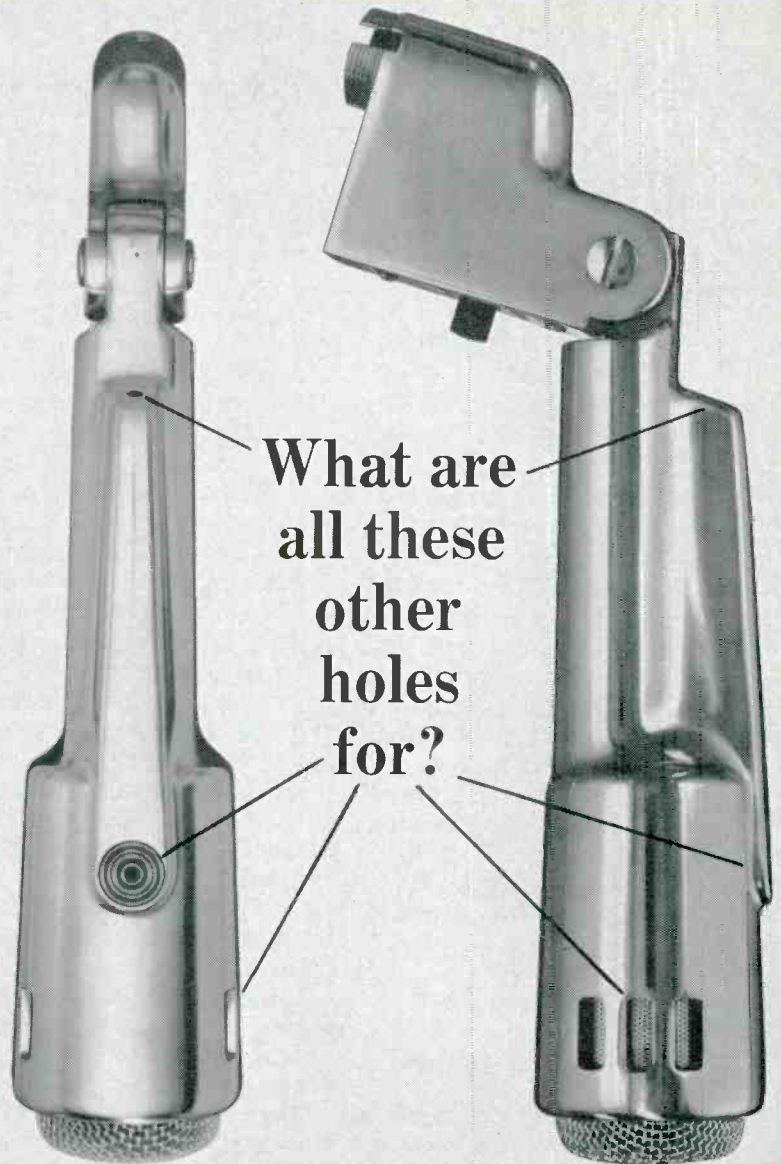
Fig. 2—Magnavox VHF oscillator and DEFEAT switch circuitry.

capacitor. As the dc voltage across the diode increases, the capacity decreases; and as the dc voltage decreases, capacity increases. Any change in dc voltage across the diode changes the diode capacity which, in turn, alters the oscillator frequency. The AFC diode must be operated in a reverse-biased condition. This is done by placing a fixed positive voltage on the cathode and then using the correction voltage from the discriminator to vary the anode voltage. The plus or minus correction voltage adds to or reduces the total voltage across the diode, decreasing or increasing the capacity across the tank circuit. A positive correction voltage reduces the total voltage across the diode, increases capacity, and lowers the oscillator frequency. A negative correction voltage produces the opposite effect.

The dc correction voltage is shorted to ground by the pre-set DEFEAT switch when the VHF fine tuning control is adjusted. This allows the customer to tune the receiver to approximately the correct point. When the fine tuning control is released, the pre-set DEFEAT switch opens and the AFC circuit takes control.

A second AFC DEFEAT switch on the BRIGHTNESS control may be used to disable the AFC if desired. This switch might be used in weak signal areas where snow is excessive. With AFC defeated, the picture can be detuned to minimize snow. This procedure would be suitable only for B/W reception, however, since very much detuning of a color program would result in loss of color. This DEFEAT switch would also be used when tuning in a UHF station. To maintain the advantages of the AFC to eliminate oscillator drift, be sure to press the switch IN after tuning.

If the
Electro-Voice
Model 664
 picks up
 sound here...



What are
 all these
 other
 holes
 for?

E.V. The holes in the top, sides and rear of the Electro-Voice Model 664 make it one of the finest dynamic cardioid microphones you can buy. These holes reduce sound pickup at the sides, and practically cancel sound arriving from the rear. Only an Electro-Voice Variable-D[®] microphone has them.

Behind the slots on each side is a tiny acoustic "window" that leads directly to the back of the 664 Acoustalloy[®] diaphragm. The route is short, small, and designed to let only highs get through. The path is so arranged that when highs from the back of the 664 arrive, they are cut in loudness by almost 20 db. Highs arriving from the front aren't affected. Why two "windows"? So that sound rejection is uniform and symmetrical regardless of microphone placement.

The hole on top is for the mid-range. It works the same, but with a longer path and added filters to affect only the mid-frequencies. And near the rear is another hole for the lows,

with an even longer path and more filtering that delays only the bass sounds, again providing almost 20 db of cancellation of sounds arriving from the rear. This "three-way" system of ports insures that the cancellation of sound from the back is just as uniform as the pickup of sound from the front—without any loss of sensitivity. The result is uniform cardioid effectiveness at every frequency for outstanding noise and feedback control.

Most other cardioid-type microphones have a single cancellation port for all frequencies. At best, this is a compromise, and indeed, many of these "single-hole" cardioids are actually omnidirectional at one frequency or another!

In addition to high sensitivity to shock and wind noises, single-port cardioid microphones also suffer from proximity effect. As you get ultra-close, bass response rises. There's nothing you can do about this varying bass response — except use a Variable-D

microphone with multi-port design* that eliminates this problem completely.

Because it works better, the E-V 664 Dynamic Cardioid is one of the most popular directional microphones on the market. It has both high and low impedance outputs available at the plug. Frequency range is peak-free from 40 to 15,000 Hz (cps). Output is —58 db. To learn more about Variable-D microphones, write for our free booklet, "The Directional Microphone Story." Then see and try the E-V 664 at your nearby Electro-Voice microphone headquarters. Just \$85.00 in satin chrome or non-reflecting gray, or \$90.00 in gold finish (list prices less normal trade discounts).

*Pat. No. 3,115,207

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SEMICONDUCTORS . . .

continued from page 56

lower pinch-off voltages also reduces drain current drift. Measurements show that FETs having a 0.63v pinch-off voltage experience no temperature drift when operating at their normal drain on-current ($I_{D(ON)}$) and their normal transconductance (g_m).

Junction FET Standardization

A previous article had indicated that few of the regular transistors with the same code number have exactly the same characteristics, and that by using negative feedback circuits the circuit's gain was sacrificed for the economy of being able to exchange transistors. The same problem exists with junction FETs for many FETs with the same code number had drain on-currents ($I_{D(ON)}$) and transconductances (g_m) that vary by as much as 2-to-1.

The characteristics of two other types of field effect transistors differ greatly from those of junction field effect transistors. Those semiconductors will be discussed in a forthcoming article. ■

RAINBOW . . .

continued from page 49

"Now we are one of the largest in St. Louis and we do the car radio and car tape installations for Sears." Although the bulk of the volume is in-shop, this is not primarily TV sets brought in by Hampton's staff.

"We try to complete the TV repair on location and do so on about 95 percent of all service calls," Mr. Napper says. "We will not change a CRT in the home, however. For major work we like to bring it in because: (1) a soldering iron shouldn't be used around carpeting; (2) our men will do a better job in the shop; and (3) here we can give the set a 24-hour shakedown play-test."

Apparently Hampton's repair procedure is almost perfection. Mr. Napper reports that call-backs are few — only averaging about one a month. "In the last three months we had three and one of those was just because the customer was unfamiliar with color."

The outside Hampton technician

is an excellent customer relations man. He keeps tabs on work flow in the shop and tells any customer when to expect delivery on a set which is in the shop for repair. Usually his promise is 1 to 2 days, but if it's a big job, he says, "We'll call you." Hampton religiously follows a policy of never promising what it can't deliver.

Regular shop procedure is to devote all day Saturday to finishing up major repair jobs so that Monday begins with a clean slate. The only really long delays on a repair at Hampton's involve a wait for an imported part.

"We do everything we can to get parts quickly, often going directly to the manufacturer rather than the wholesaler for auto radio parts," Mr. Napper says. Sometimes, however, there's quite a wait as when we have to send to West Germany (we are in a German-descent neighborhood) for a stereo part. We prefer not to substitute and usually talk our customers into waiting for the exact part — even though this sometimes means just a break-even deal for us."

Mr. Napper, from his 36 years of experience, has some urgent advice for other small shops like his. "It's a life and death matter to keep a close eye on your overhead," he says. "Overhead eats up many small shops, they get behind and then don't discount their bills which means a big loss of 2 percent net. They pay too much for rent or they take too much of one kind of advertising media. Advertising display ad costs should be figured on how much *extra* business they will bring in."

"I have an auditor go over our books every three months and then he tells me exactly where I should make adjustments in our management," Mr. Napper says. "Every business should always keep in mind exactly how much it costs to open the door each day. Every additional expenditure being considered (and we believe in spending for test instruments and training) should be measured in terms of how much extra it will cost per day and what it will produce in extra business or time saved."

But Mr. Napper isn't all conservative businessman. Instead, he's downright expansive when he thinks about the future of color TV. ■

CATALOGS AND BULLETINS

Stereo Components & Systems 400

An eight-page, multi-color catalog is available that lists a line of stereo components and systems ranging from a solid-state FM receiver to enclosed speaker systems. Altec Lansing.

Semiconductor Guide 401

A 20-page booklet, entitled ENTERTAINMENT SEMICONDUCTOR ALMANAC, is available. It is divided into three sections: "Entertainment Semiconductor Components," "Replacement Guides" and "Experimenter/Hobbyist Components." Included is a table that lists 16 types of semiconductors by name, circuit symbol and commonly used junction schematic. Consumer Electronics Div., G-E.

Tape Sample Chart 402

Typical properties of 41 different electrical tapes are listed in an electrical tape data and sample chart. The chart includes sample strips of treated paper, plastic, cotton cloth, aluminum, acetate, polyester and TFE tapes and includes descriptions, thickness, tensile strength, elongation adhesion, electric strength, temperature class, insulation resistance, electrolytic corrosion factor, military specification and cost. 3M Co.

Steel Shelving 403

Steel shelving is discussed in a 24-page catalog. Practical layouts for steel shelving and related equipment are suggested. Mezzanine shelving, designed to make efficient use of available storage space, is illustrated along with a number of business installations. Penco Products.

Epoxy System 404

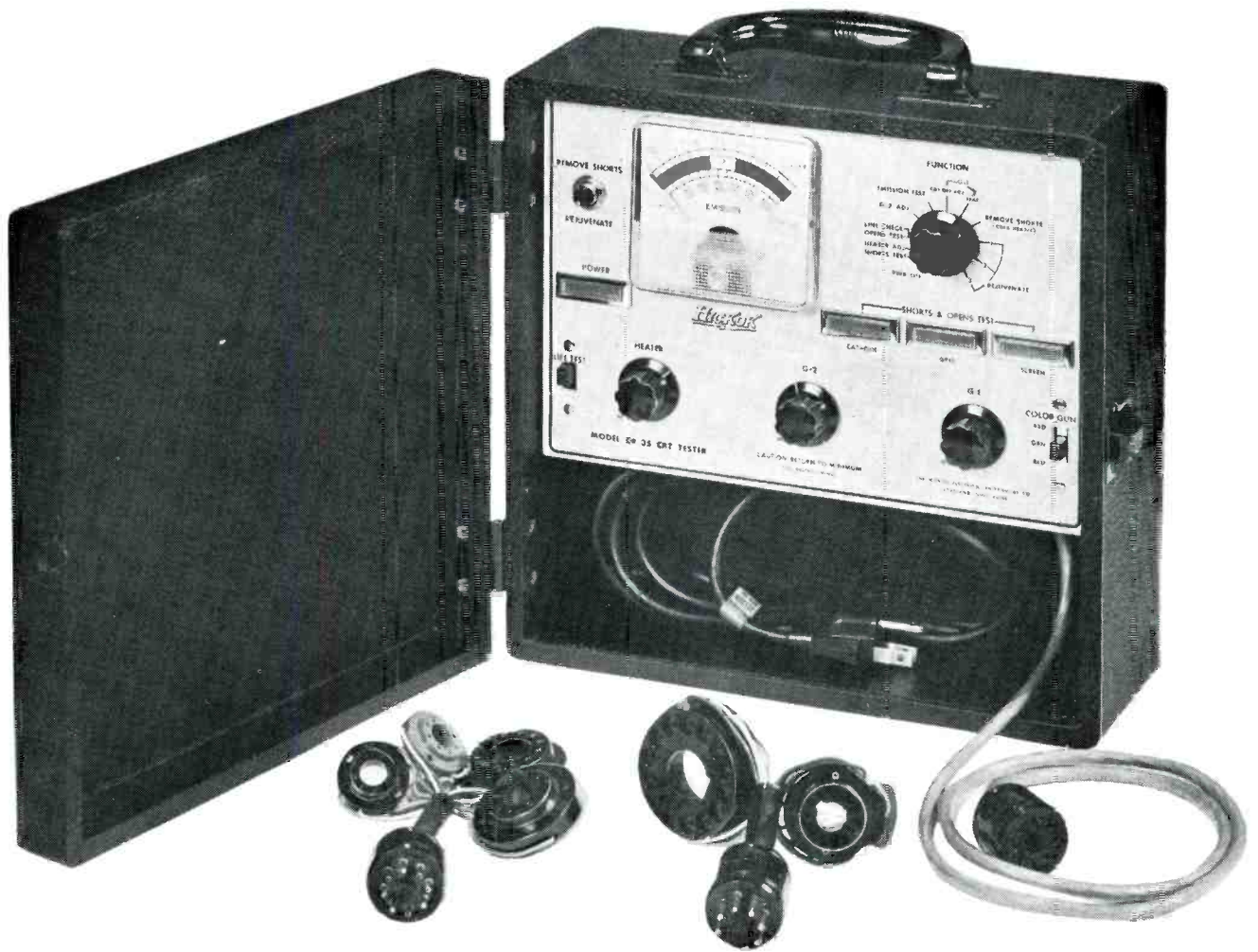
A technical product bulletin is available, which describes a transparent casting epoxy system, TRACAST 3051. The bulletin lists the properties of the epoxy and describes the mixing dispenser that contains the epoxy. Tra-Con.

Appliance Manual 405

A 32-page booklet on electrical appliance servicing has been published. Entitled, SIMPLIFIED ELECTRICAL APPLIANCE SERVICING, the booklet is a source of "how to do it" information on appliance troubleshooting with test instruments. Photos of equipment being checked and circuit diagrams are included. Price 50 cents. Simpson Electric.

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Here is a quality test instrument designed for the complete job of testing, rejuvenating and repairing all types of black and white and color picture tubes—including the latest 11", 16", and 19" color types. *Obsolescence protection* is assured through test potentials that are variable over an infinite range of voltages; exclusive SCR circuit assures exact heater test voltage. Rejuvenation and repair of opens and shorts are controlled for maximum safety and effectiveness. This is an instrument you can use with confidence—now, and in the future . . . see it at your Hickok distributor.

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NEW PRODUCTS

For additional information on any products in this section, circle the numbers on Reader Service Card. Requests will be handled promptly.

Lubricating Aerosol 700

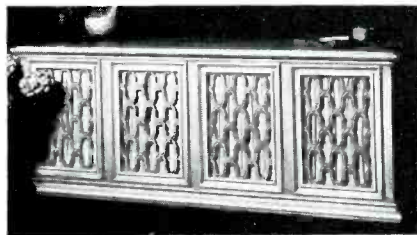
A low temperature oil in an aerosol container is introduced. According to the manufacturer it is a light-



weight, non-evaporative oil with good penetrating properties. They indicate that corrosion inhibitors and rust preventatives have been added to increase its usefulness. Colman.

Color-Adaptable Consoles 701

A line of stereo consoles features snap-out grille panels that permit console purchasers to substitute fab-



rics of their own choice to match or contrast with room decor. Wood finishes are available in fruitwood, walnut, pecan, oak, maple and cherry—plus antique white and gold, antique blue, teak, antique red and gold and Polynesian walnut. H. H. Scott.

Electronic Counter 702

An electronic counter, model 5246L, designed for a maximum counting rate of 50MHz, can reportedly measure frequencies up to 12.4GHz with 1Hz resolution, when



used in conjunction with a plug-in heterodyne frequency converter. Specifications indicate a full complement of gate times available from 1 μ sec to 1sec. Price \$1800. Hewlett-Packard.

Transceiver Holster 703

A leather holster for handheld transceivers is introduced. It is constructed of black natural leather and



fastens to the user's belt for carrying when not in use. When the user is ready to transmit he merely unsnaps the transceiver from its holster and talks. E. F. Johnson Co.

Hypodermic Grease Gun 704

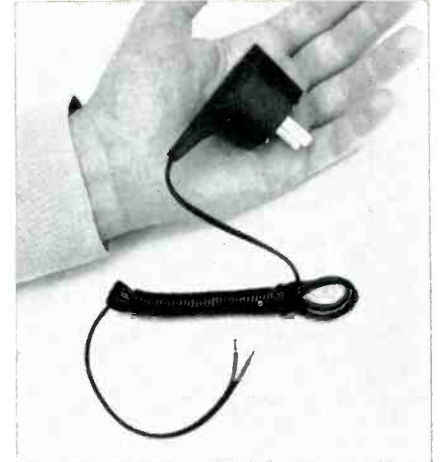
Announced is an all metal constructed, hypodermic type, grease gun that is about the size of a fountain



pen. It has a 1in. long stainless steel needle (0.049in. x 0.033in. od) for reaching nearly inaccessible places without fear of damage or smearing. The needle is protected by a dust proof cap when not used. Price \$1.25. Gaunt Industries.

Converter-Charger Plug 705

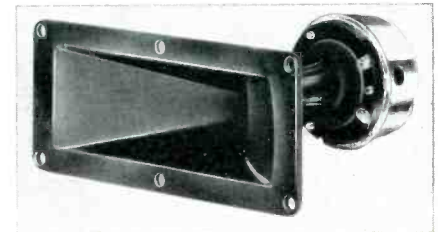
A plug and cord set, designed to convert ordinary household current to the low voltage required by tran-



sistorized products is announced. It can reportedly also be used to recharge batteries. Dynamic.

Horn Tweeters 706

Two tweeters are designed for 20w capacity. According to the announcement, model CH26SQ08 measures 2



x 6in. while model CH39SQ08 measures 3 x 9 in. They have a rated frequency response of 1.5 to 20kHz and 0.9 to 20kHz, respectively. Oxford Transducer.

Zener Diodes 707

A series of 1w glass zener voltage regulators is designed for regulator and commercial applications where



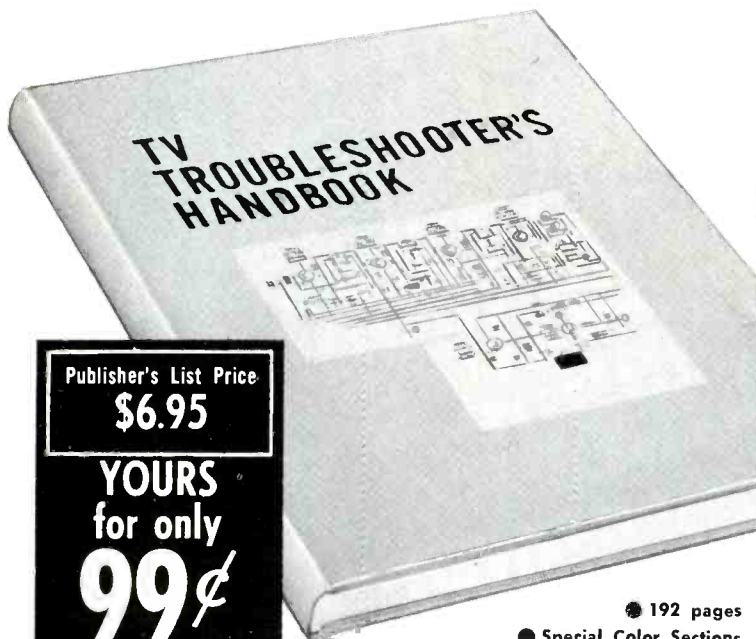
stable long-term operation is required. They reportedly have a voltage range from 3.0 to 12v and voltage tolerances of $\pm 20\%$, $\pm 10\%$ or $\pm 5\%$. International Rectifier.

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Partial List of Contents TV TROUBLESHOOTER'S HANDBOOK contains over 350 proven servicing items describing "tough dog" problems and their solutions. For ease of use, these helpful trouble cures are arranged by manufacturer & model number. And, a special section concentrates on color set servicing. These tried and tested troubleshooting aids constitute a vital reference source of servicing techniques and will help make your own work easier and more effective. Circuit faults and solutions are included for these manufacturers:	B&W SETS RCA VICTOR GEN. ELECTRIC PHILCO SYLVANIA WESTINGHOUSE MAGNAVOX MOTOROLA ZENITH ADMIRAL EMERSON CURTIS-MATHES HALLI- CRAFTERS CORONADO TRUETONE SYMPHONIC SILVERTONE	EMERSON-DUMONT GAMBLE SKOGMO COLOR SETS RCA VICTOR SYLVANIA GEN. ELECTRIC ZENITH PHILCO MAGNAVOX MOTOROLA OLYMPIC SETCHELL- CARLSON WESTINGHOUSE ADMIRAL
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This detailed compilation of practical help is the answer to the need for an organized gathering of proven troubles and cures, new and unusual circuits and descriptions of how they work, field and factory changes, recurring defects, etc., that will help you locate and correct the most elusive TV circuit faults. This practical information will help you solve your daily servicing problems . . . will save you hours of time and effort. These accurate and clear servicing descriptions are supplemented by over 175 easy-to-follow schematic diagrams and illustrations. For ease of use, all troubles have been logically organized by manufacturer and model number.

A Special Section on color TV describes recurring defects and cures, and includes service hints for troubleshooting chroma circuits, short cuts for making convergence adjustments, etc.

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NEW PRODUCTS

Frequency Response Meter 708

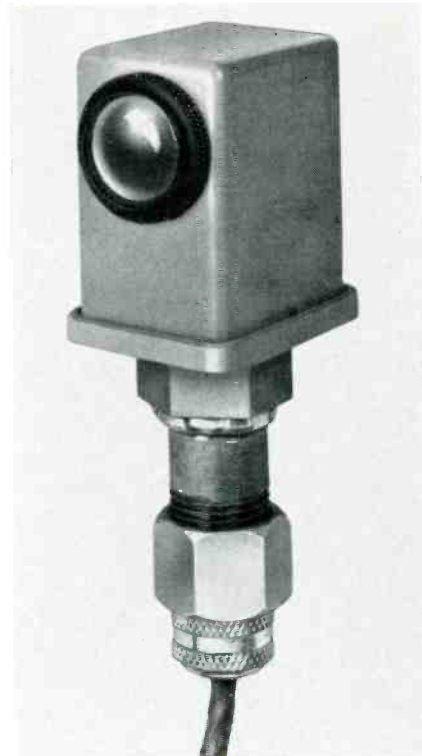
An audio frequency response meter is announced that is both a logarithmic frequency meter and a logarithmic voltmeter in one package. Specifications indicate that the voltage and frequency of any signal can be measured 0.01v and 100v, and between 20Hz and 20kHz. Analog dc voltages representing both signal frequency and voltage are brought to



front panel connectors and may be used as X and Y drives on X-Y recorders and scopes. Log/log frequency response curves can then be drawn automatically. Price \$600. Waveforms.

Photoelectric Scanner 709

A retro-reflective scanner is announced, which contains both a light source and photocell in a single hous-



ing. The photocell is a high-speed cadmium selenide, low resistance type, using a number 15 lamp. Farmer.

Color Service Aid 710

Announced is a service aid designed to permit technicians to observe an enlarged view of the TV screen while working on controls in the back of the set. It consists of a 2 1/4 in. mirror attached to one end of a



6in. stainless steel rod, with a suction cup at the other end. Mounted on the rod in the middle, is a 1 1/2 in. three power magnifying lens. The unit attaches to a TV screen with the suction cup and the mirror and lens are adjusted from the back of the set. Price \$7.95. B & K.

Brand New and Exclusive!

Discriminates Between Desired Signal and Unwanted Noise!

3-Way Combination
FREE SPACE
STANDING WAVE
MAGNETIC
ANTENNA
 (UHF-VHF-FM-COLOR)

Here for the first time, is an antenna with the unique ability to discriminate between the desired signal and unwanted noise! A complete absence of minor lobes and an extremely high front to back ratio are characteristics of these antennas. This is made possible by the development of the Free Space Standing Wave Magnetic Drive Antenna system (F.S.M.). The outstanding electrical qualities, combined with the simplified mechanical construction of this system yields a total performance package unparalleled in today's market. 4 models, 60-inch to 180-inch boom, all modestly priced.

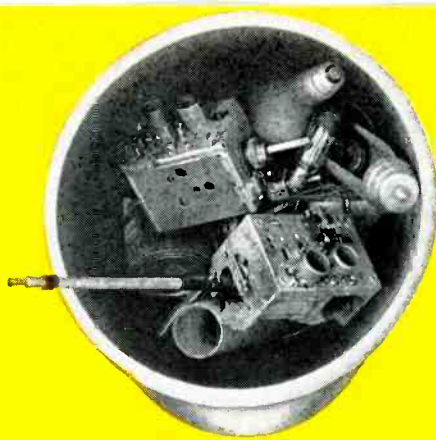
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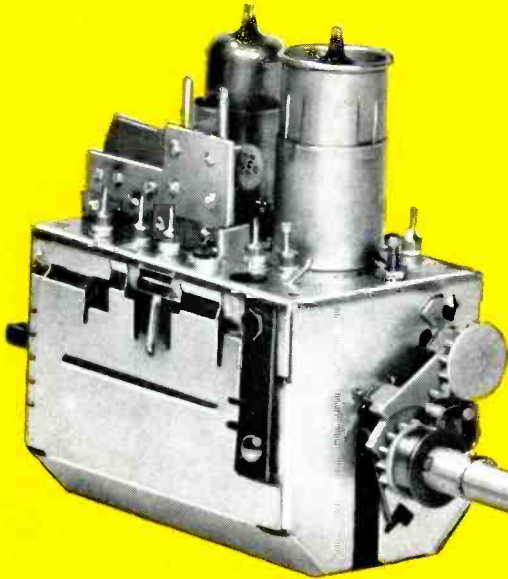
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Repairing broken tuners is trouble. You pack it, mail it, wait for it, get it back, unpack it, install it . . . it's wait, wait, wait—and for what? A second-hand tuner.

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Standard Kollsman Replacement Tuners offer the latest in design and the maximum in performance. Simply check your mounting space: SK Preset Height 4.58" max. to top of tubes; length 3.61" max.; Width 2.50" max. Shafts have extended "flats" . . . simply cut to proper length.

13 Position Switch	AR-250 (Parallel)	ARS-252 (Series)	AR4S-251 (Series AC-DC)
Antenna Input	300 ohms balanced to ground		
Intermediate Frequency	41.25 mc sound 45.75 mc video		
RF Amplifier Tube	6HQ5	2HQ5	3HQ5
Oscillator-Mixer Tube	6GX7	4GX7	5GX7
Heater	6.3 volts	600 ma	450 ma
B Plus	125-145 volts dc		

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MODEL 8C10PA

For top quality public address. This 8" speaker has a 10 oz. ceramic magnet, frequency response of 55-13000 Hz., easily handles 12 watts. One of 34 Quam speakers for sound system applications.

Men who specify loudspeakers in enormous volume have to be particular about quality and performance. That's why more and more sound system installers are developing the habit of specifying Quam.

It's a good habit to acquire, because Quam makes good speakers for public address, background music and other sound system needs, as well as for radio-tv-automotive replacements.

Whatever kind of speaker you need, look for Quam, the Quality line, in the red, white, and blue package at your distributor.

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NEW PRODUCTS

AM/FM Receiver 711

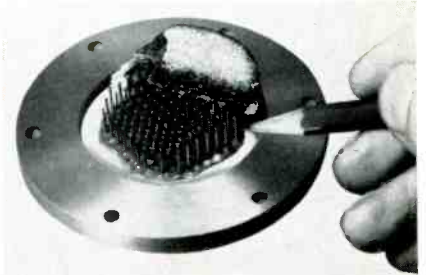
Announced is an AM/FM receiver designed for either 110 or 220v operation. It contains a tuned RF stage followed by four tuned IF amplifiers. A double cascade limiter



preceding the ratio detector has been designed for minimum noise. The manufacturer's specifications indicate that less than 1% harmonic distortion is present at full rated output, and that the frequency response is essentially flat from 20Hz to 20kHz. Price \$210. Pioneer.

Reactive Solvent 712

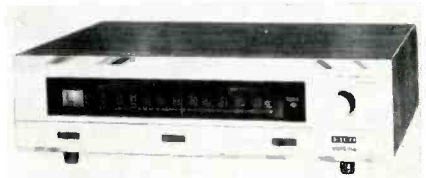
A reactive solvent designed to remove cured urethane resins from electronic components is introduced. The product will reportedly com-



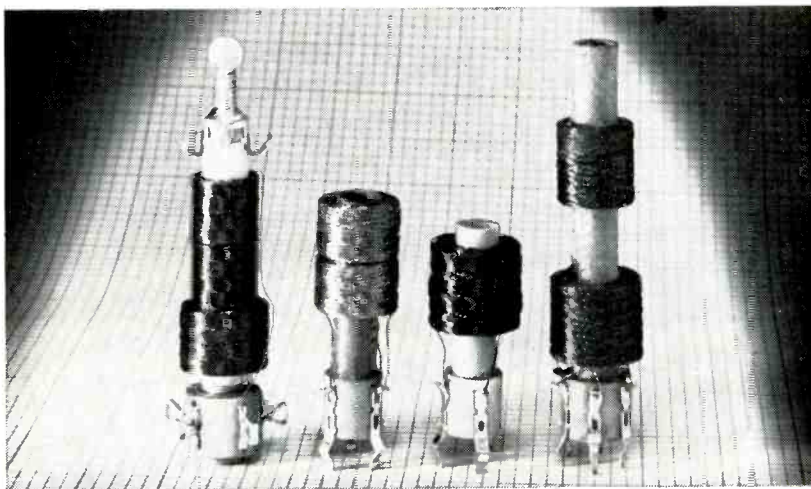
pletely dissolve cured urethanes without harming or attacking other plastic materials or metals used in electronic packaging. Price \$10 per quart. Dynaloy.

FM Tuner 713

An FM tuner is announced that has two tuned RF stages coupled to a four-stage double-tuned IF circuit. This model 3200 tuner reportedly



has a 2.4 μ v sensitivity for 30db quieting and a 40db channel separation at 1kHz. The audio frequency response is rated at 20Hz to 15kHz \pm 1db. Price of kit \$89.95, wired \$119.95. EICO.



Exact Replacement Linearity Coils for More than 25 Color TV Manufacturers

Exact replacement Models 6347 and 6348 Red/Green Convergence... Model 6349 Horizontal Oscillator and Waveform... and Model 6350 Focus coils are for Color TV sets by manufacturers such as RCA • Admiral • GE • Silvertone • Emerson.



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NOW SPEED-REPAIR 1500 POPULAR PRINTED CIRCUIT TV RECEIVERS FOR LESS THAN 1½¢ EACH . . .

it's serviceman proven—it's speed servicing with COLOR CODED TV COLORGRAMS

It's the most money-saving, money-making deal ever offered to Professional Servicemen. We deliberately made it that way so you'd remember us.

If you've heard of TV COLORGRAMS, if some of your friends have been using them, then you know what a bargain they were at their original total price of \$102.50.

now get the entire kit of 50 for \$19.95 and each kit is your key to approx 30 or more sets

What are TV COLORGRAMS? They're amazing new color-coded charts that help you isolate printed circuit TV receiver difficulties and with less effort than you ever dreamed possible. Each COLORGRAM chart is clearly color-coded to show signal-flow, continuity, test points, and voltages. The entire ground conductor is shown in its own distinctive color. Every component in the circuit is clearly identified, and its relationship to other components made readily recognizable. COLORGRAM charts let you concentrate on that small portion of the set most likely to be the cause of the trouble. There's no time wasted working back and forth between schematic and set looking for test points . . . wading through superfluous information . . . identifying components incorrectly. With COLORGRAMS, everything is there, before your eyes, and very often looking just as it does in the set.

What does a TV COLORGRAM Service-Pak include? Everything you need to service a whole series of TV sets!

First of all, the Pak includes COLORGRAM charts for IF, Video, Audio, Vertical and Horizontal (showing sync and sweep circuits), B+ distribution and AGC circuits. You use the Video chart if you have a Video problem, the Audio chart if you have an Audio problem, and so on.

Second, the Pak includes a color keyed master schematic providing an overall view of the receiver circuit. It shows the Tuner, IF, Video, Audio, Vertical and Horizontal sections, color-keyed to the colors used in individual COLORGRAM charts. It also shows test points, waveforms, voltage, resistance, capacitance, practical alignment data, etc.

Third, the Pak includes a Rapid Repair Manual that is an effective guide to the use of the COLORGRAM System. It contains original manufacturer's service notes, special instructions, circuit modifications, parts list, and parts numbers. Other practical service data in the Guide are a Pictorial Tube and Component Location Chart and a Tube Failure Guide.

WHAT ELSE DO I GET? The 148-page MASTER-INDEX and Cross Reference Replacement Parts Guide which lists all 1500 TV sets you can quickly repair with TV COLORGRAMS. It describes the black-&-white receivers Admiral, Emerson, General Electric, Magnavox, Motorola, Philco, RCA and Westinghouse. These receivers are cross referenced to nine replacement parts manufacturers . . . Aero-vox, Centralab, Clarostat, G.C., Merit, Stancor, Thordassan, Triad, and TVD, covering over 25,000 parts listings.

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Compare these features:

- Ten standard RCA licensed color bars plus all patterns found on more expensive generators.
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- All solid state. Battery powered by long life "C" cells.
- HI in performance — LO in price. . . . (Less than the cost of a kit)

only \$89.50

SENCORE CG138 LO-BOY—Just like CG10 except AC operated, 4.5 mc crystal controlled signal; recommended for troubleshooting. . . .

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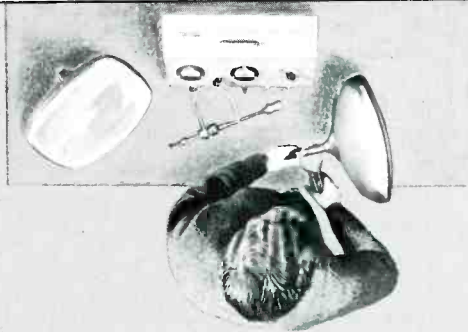


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NEW PRODUCTS

PA Speakers 714

Three woofers and a tweeter are contained in a columnar speaker system. They are rated for a frequency range of 50Hz to 18kHz, contain a



built-in transformer for 16 to 500Ω adjustable impedances and reportedly have a 50w power capacity. American Geloso.

Control Cleaner/Lubricant 715

Announced is an aerosol spray designed for lubricating and cleaning



controls. The manufacturer indicates it is a heavy white lubricant that can be used safely on plastic as well as metal controls. Colman.

For more information on these

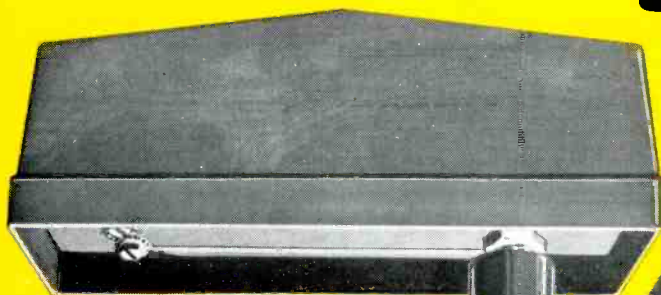
NEW PRODUCTS

See pages 89 and 90

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High performance Indoor and Outdoor Matching Transformers convert old-fashioned and inefficient 300 ohm hook-ups to the new Finco-Axial 75 ohm color reception system.

List price for complete kit . . .
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7512-A Mast mounted matching transformer . . . list \$5.40

7512-B TV Set mounted matching transformer . . . list \$4.15

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Highest quality, 75 ohm swept coaxial cable (RG 59/U) complete with Type F fittings, weather boot ready for installation.

Available in 25, 50, 75 and 100 foot lengths. List price . . . \$5.55, \$8.65, \$11.50 and \$14.20.

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For the best color TV picture

*eliminates color-fade, ghosting and smearing!
Improves FM and Stereo, too!*

QUICK, EASY INSTALLATION

ENJOY brilliant "TV-Studio" color reception today by changing over to the new Finco-Axial Color Reception System. NOW, color fade, ghosts and smears are a thing of the past. Finco-Axial shields color sets against signal loss . . . eliminates outside interference and mismatch problems.

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NEW PRODUCTS

VTVM

716

A VTVM is announced which features a 6½ in., two-color scale and seven ranges for each of the following

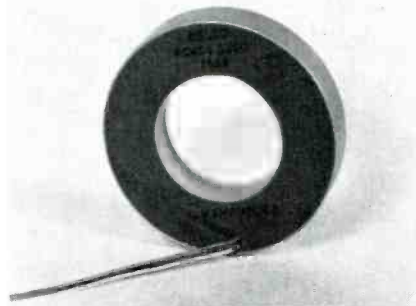


measurements: ac rms volts, ac P-P volts, dc volts, resistance and decibels. The meter measures 7¼ x 6½ x 3¾ in. and operates on 110 to 120vac, 50/60Hz. Price \$39.98. Olson Electronics.

Beam Centering Coils

717

A coil, used to position the undeflected beam in the center of a CRT face, is announced. The coil report-

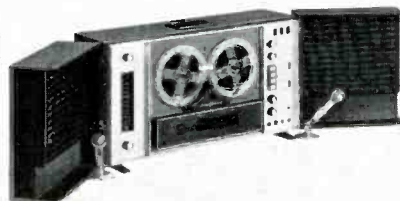


edly eliminates the need for permanent magnets and reduces fringing fields in high resolution systems. Special deflection systems are available which combine the centering coil with focus and deflection components in a single housing. CELCO.

Portable Tape Recorder

718

A three-speed, four-track stereo tape recorder contains a rechargeable nickel-cadmium battery for up to four hours of cordless operation. The battery charges on either house cur-



rent or 12v car current. With the integral AM/FM tuner, the unit can be used to make off-the-air recordings. It has inputs for phono, microphone and auxiliary. Price with walnut veneer \$469.95, with black vinyl \$439.95. V-M

In-Converter

719

Announced is an in-converter designed for those who desire to install a two-way radio system, car radio or other electric appliance in a foreign car with a 6v electrical system or



in a vehicle that uses a positive ground electrical system. The in-converter, rated at 14w, has an input of 6 or 12v dc and an output of 6 or 12v of the polarity desired or an output of 18 or 24v of the same polarity as the input. E. F. Johnson Co.

Cleaning Instrument

720

A portable laboratory clean gas for dusting, without abrasion, blind interior areas not accessible to surface cleaning agents is available. The blowing action reportedly removes grit and dust without abrading or



scratching sensitive areas. The manufacturer indicates that there are over 600 one sec cleanings in each can of gas. Refills are packaged 12 cans to a carton. Price of duster pack, \$17. Price of refills, \$22 per carton. The Texwipe Co.



Mr. Lynn A. Townsend (left) accepts the Chairmanship of the U. S. Industrial Payroll Savings Committee from Secretary of the Treasury Henry Fowler.

Won't you get on the 1966 business bondwagon for payroll savings?

"Important as the Payroll Savings Program has been in other years, it will be even more important in the year ahead. During the present period, every American is aware of the increasing pressures on the economy as the result of our long-sustained prosperity. And every American has reason to know about the added burdens on the country occasioned by the stepped-up military operations in Vietnam.

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These words by Mr. Lynn A. Townsend, President of Chrysler Corporation and this year's Chairman of the U. S. Industrial Payroll Savings Committee, kick off the 1966 drive for payroll savers. The goal is 1,200,000 new

savers by the end of this year. *You can help*—by setting up and encouraging Payroll Savings participation in your plant. Write U. S. Treasury Department, Savings Bonds Division, Washington, D. C. 20226—today.



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IN SECONDS
in circuit**

TR139
\$89⁵⁰



Also check all transistors, diodes, and rectifiers out of circuit for true AC beta and I_{cb0} leakage.

Your best answer for solid state servicing, production line testing, quality control and design.

Sencore has developed a new, dynamic in-circuit transistor tester that really works—the TR139—that lets you check any transistor or diode in-circuit without disconnecting a single lead. Nothing could be simpler, quicker or more accurate. Also checks all transistors, diodes and rectifiers out of circuit.

BETA MEASUREMENTS—Beta is the all-important gain factor of a transistor; compares to the gm of a tube. The Sencore TR139 actually measures the ratio of signal on the base to that on the collector. This ratio of signal in to signal out is true AC beta.

ICBO MEASUREMENTS—The TR139 also gives you the leakage current (I_{cb0}) of any transistor in microamps directly on the meter.

DIODE TESTS—Checks both rectifiers and diodes either in or out of the circuit. Measures the actual front to back conduction in micro-amps.

COMPLETE PROTECTION—A special circuit protects even the most delicate transistors and diodes, even if the leads are accidentally hooked up to the wrong terminals.

NO SET-UP BOOK—Just hook up any unknown transistor to the TR139 and it will read true AC beta and I_{cb0} leakage. Determines PNP or NPN types at the flick of a switch.

Compare to laboratory testers costing much more. . . \$89.50

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Skill — Not Manpower

Secretary of Labor Wirtz states that "There is no shortage of men and women willing and able to work. There is a shortage of some skills and an incomplete matching of people with jobs." This statement was made before the Select SubCommittee on Labor, House Education and Labor Committee, in testimony supporting the various amendments to sharpen and strengthen the Manpower, Development and Training Act. He indicated that approximately 75 percent of those completing the courses sponsored by MDTA have obtained jobs.

The Labor Dept's policy in the next fiscal year will focus on two problems: the emergency of selected skill shortages that accompany declining unemployment and the residual pockets of hard-core unemployment among fairly well defined disadvantaged groups even at low unemployment levels. Secretary Wirtz said the "major training effort will be directed toward the disadvantaged worker, reflecting our determination to give greater service to youth groups, older workers, minority groups, persons with low academic achievement, the long-term unemployed and the rural poor." He recommended, however, that welfare recipients selected for training under MDTA not receive training allowances.

Secretary Wirtz has sent Robert Fodor to Indianapolis to help find jobs for some 2500 workers expected to be laid off in the shutdown of a Hygrade Foods Products Corp. plant. Mr. Fodor will determine if special Federal measures are required to find new employment or retraining for the workers who face job losses over the next three to four months. Indianapolis currently has a 3.0 unemployment rate which is half the national rate.

African Students Complete Workshop

Sixteen African engineering students have successfully completed a pilot project in New York designed to provide them with a deeper understanding of the relationship of their fields of study with the broad spectrum of electronics and telecommunications.

The 10-week Summer Communications Workshop was conducted at RCA Institutes, under the sponsorship of the African-American Institute, and included laboratory experiments, demonstrations, discussions and other activities to familiarize participants with technical devices and methods that should prove valuable when they return to Africa.

J. K. Koinange, Attache, Educational Advisor of the Permanent Mission of Kenya to the United Nations, presented Summer Communications Workshop graduation certificates on behalf of the African-American Institute. Students also received certificates from RCA Institutes.

Much emphasis was placed on instruments, over-all systems and various facets of communications equipment with which the participants had little or no previous familiarity. All of this supported the theory of the project that an engineer who can design a radio, for example, must also be able to repair it in areas where skilled know-how is not readily available.

Students who were graduated from the workshop are presently enrolled as civil, electrical, mechanical and aeronautical engineering majors at American colleges and universities in various parts of the country.

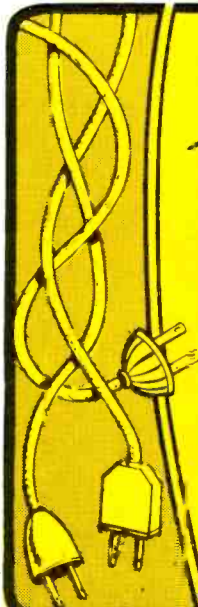
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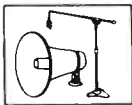
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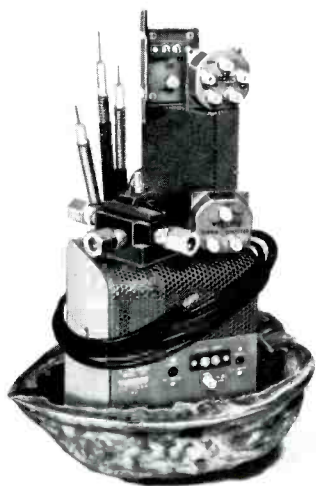
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NEWS OF THE INDUSTRY

Electronic Equipment Production

Records are still being broken in electronic equipment. Color TV sales last August showed an increase of 88.4 percent over the comparable 1965 period, while the B/W distributor movement was only 4.3 percent below 1965.

The year-to-date figures on January /August unit sales are as follows:

B/W TV Sets 4,693,381 4,491,065
Color TV Sets 1,320,080 2,487,037

Home Table,

Clock and

Portable

Radios 7,304,564 7,930,104

Home FM

Radios 1,557,562 2,164,482

Auto Radios 6,511,333 5,648,449

Portable &

Table Phono-

graphs 1,866,897 1,782,007

Console Phono-

graphs 888,996 1,051,343

The United States Dept. of Commerce reports that tabulations for the first quarter of this year indicate production of electronic components has soared to a new high. Estimates for intra-plant and inter-plant transfers of electronic components for the first quarter were as follows:

Capacitors	824,490,000
Resistors	1,383,752,000
Color Picture Tubes	926,000
B/W Picture Tubes	2,976,000
Receiving Tubes	94,621,000
Power and Special Purpose Tubes	3,759,300
Transistors	205,175,000
Integrated Circuits	33,305,000
Transformers and Reactors	26,833,000
Connectors	53,618,000
Quartz Crystals	5,100,000
Relays (For electronic Applications)	169,000

Philco's Parts & Service Dept. Receive NATESA's Award

The Parts and Service Dept. of Philco sales and distribution div. has been given the Friends of Service Management Award for the fourth consecutive year by the National Alliance of Television & Electronic Service Assn. (NATESA).

The award, a bronze plate mounted on hardwood, was presented to Hobart Ballou, Philco's national parts and service manager, by Howard Wiggs, NATESA's West Control secretary.

The award notes Philco's efforts to improve customer relations for inde-

pendent service businessmen through three comprehensive service plans offered to service-dealers by the company.

They include the Philco Tech-Data and Business Management Service; the Philco Qualified Service Center program, and Philco Central Service, a warranty service plan implemented by independent service technicians.

Sencore Increases Facilities

Sencore, manufacturers of electronic test instruments, has moved its labs, office and service department into new air conditioned facilities. The 16,000 square ft addition brings the factory total to 35,000 square ft, according to Herb Bowden, president. Mr. Bowden stated that the new building permitted tripling of office, lab and quality control departments. New engineers have been hired to keep up with the increased market in the test instrument field.

National Science Foundation Grant to Pratt Institute

A National Science Foundation grant of \$18,800 has been awarded to the Pratt Institute School of Engineering and Science for use in the

dept. of Electrical Engineering. The grant is to be matched with institute funds and will be used to purchase scientific educational equipment in the field of automatic control systems. The equipment will be used to advance undergraduate education at the institute and provide an opportunity to further graduate study in the field of automation.

The grant will enable the department to add to its feedback laboratories the latest in automatic control systems equipment. Of particular interest will be the addition of a correlator for experimental studies of statistical control systems, a field of current and vital interest.

BWI TVs

A subsidiary has been established by General Telephone & Electronics International Inc. to manufacture the first TV sets to be produced in Jamaica, West Indies, William F. Bennett, President of GT&E International, announced today.

Mr. Bennett said the new wholly-owned company, General Telephone & Electronics Jamaica Ltd., will market the TV sets under the Sylvania brand name. Both Sylvania Electric Products Inc. and GT&E International

are subsidiaries of General Telephone & Electronics Corp.

Increased Warranty Protection

Both technicians and customers will benefit from increased warranty protection, according to a number of manufacturers. For the technician, Mercury Electronics Corp. has announced a one year warrantee policy. This warranty covers all parts and workmanship for the instrument, used under normal conditions.

Customers will also benefit from G-E's new product service program. This program includes a 30-day "over-the-counter" exchange of defective radios. Under the "over-the-counter" exchange program, a dealer may exchange a new radio from his stock for one that a customer returns within 30 days of the purchase date, provided the radio is defective under the terms of the warranty. G-E radio distributors are, in turn, authorized to supply dealers with new radios for the defective models returned under the plan. Radios must be returned in the original carton or a carton from the replacement radio. The regular 90-day parts and labor warranty also continues in effect as the foundation of the over-all service program.

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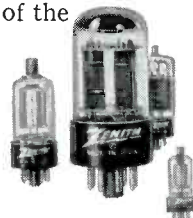
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NEWS OF THE INDUSTRY

Satellite Communications Criticized

Descending views have been expressed regarding present and future satellite communications programs. Howard R. Hawkins, president of RCA Communications, Inc., warned that the neglect of the nation's international cable and radio services in favor of satellite communications alone could impair or destroy "a necessary national resource" and perform "a major disservice to all concerned."

In a statement to the Military Operations Subcommittee of the House Committee on Government Operations, Mr. Hawkins stressed the importance to the nation of a "multi-media" system incorporating satellite, cable and high-frequency radio facilities in a total international communications network.

As a means of developing satellite technology, without at the same time impairing or destroying the international cable and radio services and the carriers that provide them, Mr. Hawkins supported the concept of establishing substantially the same rates for comparable service through each medium.

"In the glamor that frequently surrounds satellites and space technology, we are apt to overlook the remarkable and continued improvement in both performance and economy achieved in cable and radio communications as a result of continuing research, development and investment in new facilities," he said. "Coaxial cables, for example, promise to rival satellites for some time to come in both capacity and economy in providing voice and record communications."

He added that the same process of technological advancement that leads to better satellite service will also lead to further advances in cable and radio techniques, and that the neglect of cable and radio in favor of satellites would therefore "perform a major disservice to all who need rapid and efficient international communications."

A similar view was expressed by Vincent T. Wasilewski, president of the National Assn. of Broadcasters in an address before the International Conference of the Radio-Television News Directors Assn. He noted that the anticipated "saving" of money by networks and stations using satellite transmission is based "on estimates." If these estimates are off, he said, savings may be "radically lower than anticipated."

"The history of cost-estimates for buildings, bombers, missiles, and nearly everything else, suggests that almost inevitably costs prove to be considerably higher than they were expected to be," Mr. Wasilewski said.

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Michigan Magnetics to Double Productive Capacity

Ground has been broken at Vermontville, Mich. for a 7180 sq ft addition to the Michigan Magnetics plant. This new plant will be used primarily to mass-produce tape recorder heads for cartridge tape players. The new plant will be automated as near as possible, and according to Wayne Cole, general manager, "This new building demonstrates our faith in continued growth of the cartridge tape player for both passenger cars and home entertainment use."

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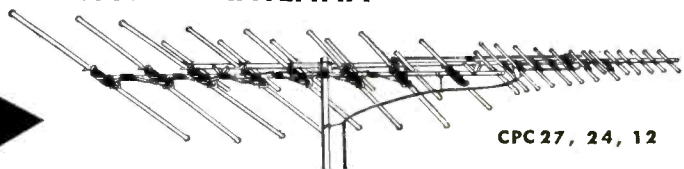
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ELECTRONIC TECHNICIAN

SEMICONDUCTOR CIRCUITS HANDBOOK, VOL. 1. *Written and published by Techpress, Inc., 192 pages, soft cover. \$2.95.*

This handbook contains working diagrams, operating descriptions and frequency evaluations of practical transistor circuits. The circuits include 7 direct-coupled amplifiers for differential and dc amplification, modulating and chopping; 16 audio-frequency amplifiers for crystal, ceramic, transducer and low-level preamplification, plus amplifiers for high-fidelity and servo use; 10 high-frequency amplifiers for IF, narrow band, wide band and video; 14 AF and RF oscillators for high stability, constant amplitude, phase shift and Wien Bridge use and 20 switching circuits for flip flop, multivibrator, trigger, blocking oscillator, dual and buffer inverter, pulse shaper and astable functions. The book may be of value to anyone looking for a circuit performing some specific function or for those working on similar circuits.

HANDBOOK OF STROBOCOPY. *By Fredrick Van Veen. Published by General Radio Co. 116, pages, soft cover. \$1.*

This handbook begins with a discussion of the principles and history of stroboscopes. The major portion of the book explains various types of strobes, their circuitry and numerous setups for measuring velocities, checking machinery and high speed photography. Many high speed photographs are included along with illustrations showing how the equipment was arranged for taking pictures. Charts are included to help obtain the quantitative values needed for strobe work. This handbook may prove valuable to anyone who uses any brand of strobe.

ERRATUM

A portion of the review on the book **PRINCIPLES OF ELECTRONIC OSCILLATORS**, which appeared on page 94 in the October issue of **ELECTRONIC TECHNICIAN**, was inadvertently left out. It should have read: *Although some theory would apply to transistor circuits, the reader should remember that transistor circuits, unlike tube circuits, are generally low impedance and are forward biased.*

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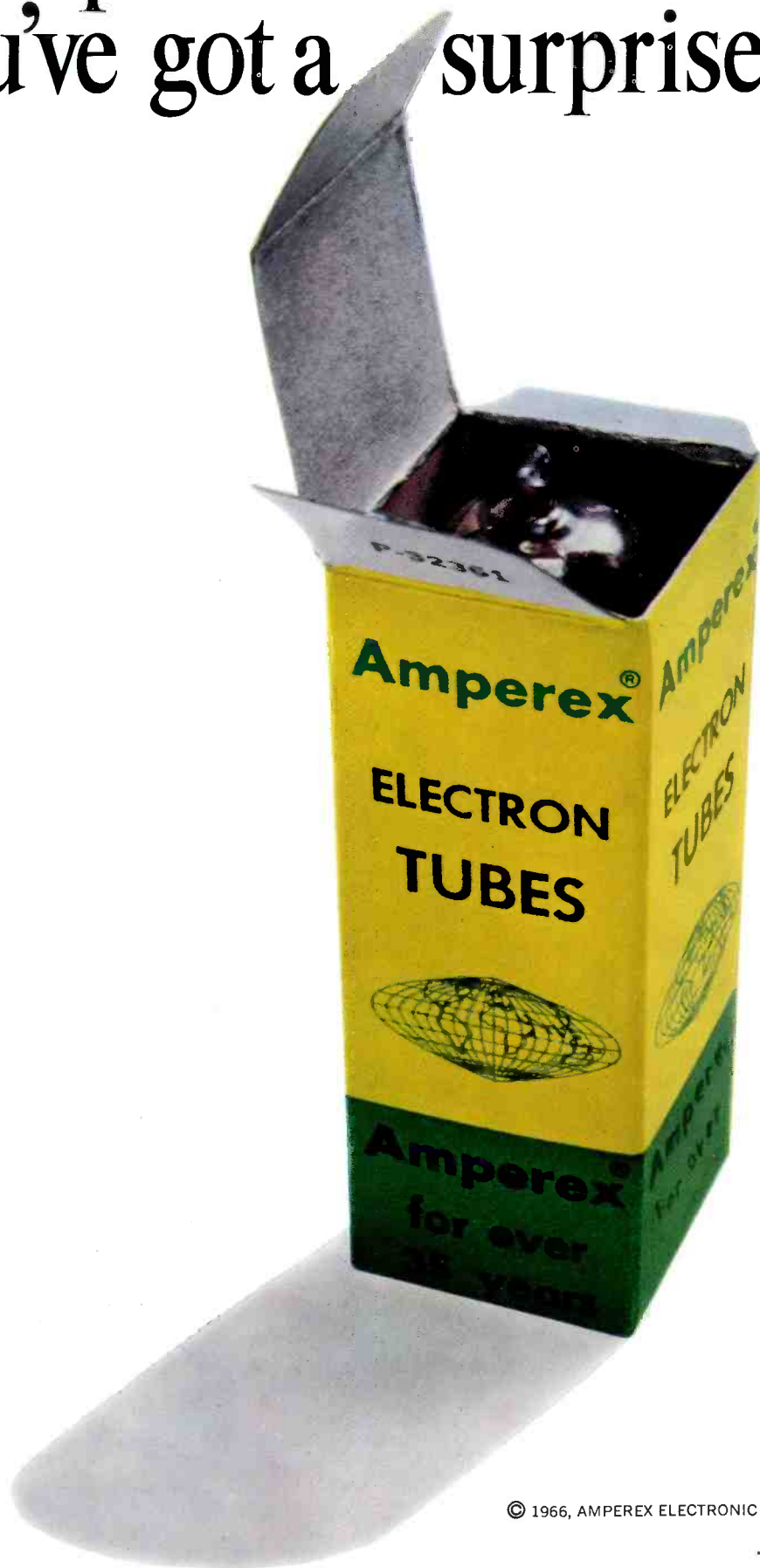
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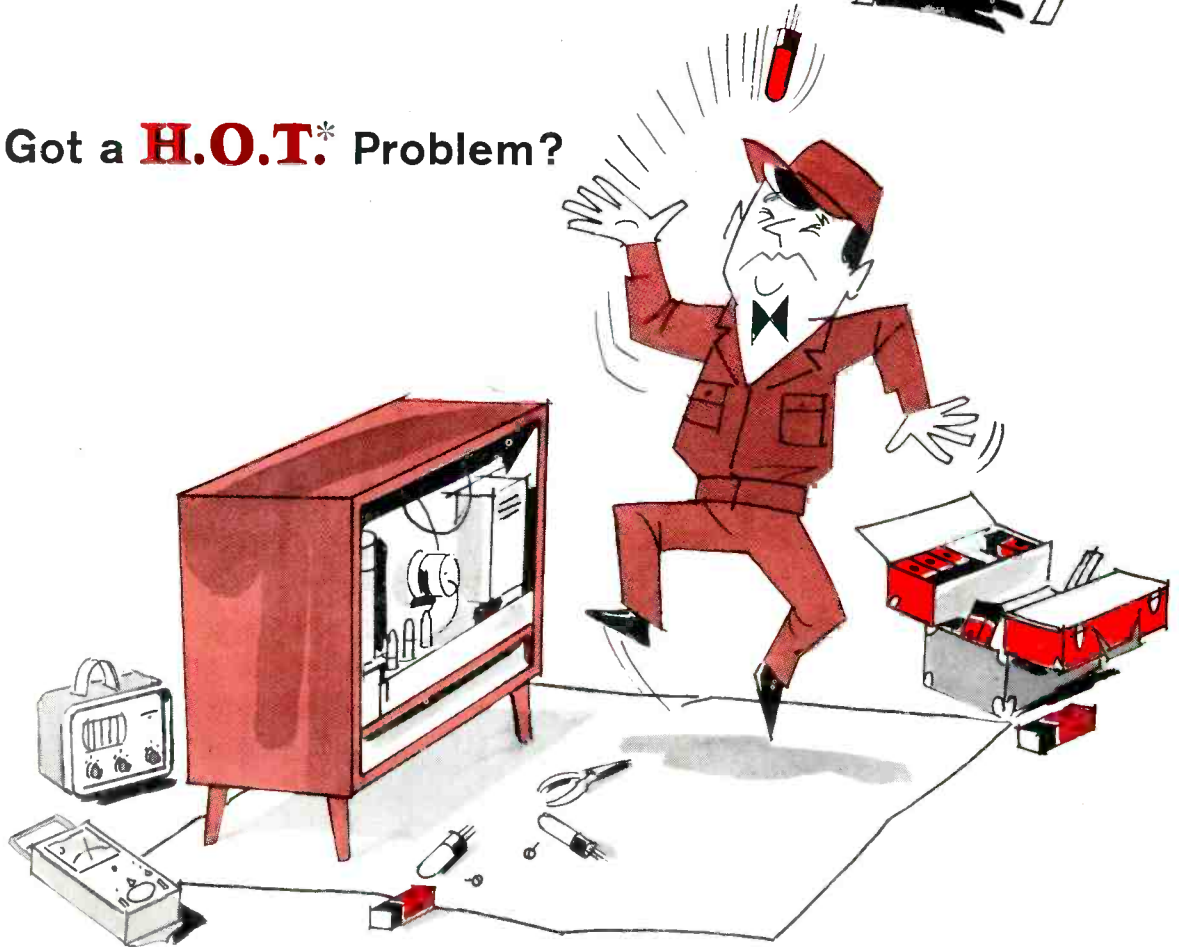
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2. **Don't** apply power to a "warm" set if the oscillator tube is cold. Wait a few minutes, or heat the oscillator tube in a tube tester.
3. **Don't** risk H.O.T. damage by shorting out overload devices.
4. **Don't** disconnect the H.O.T. plate cap to kill high voltage. Use the method recommended by the set manufacturer.
5. **Don't** replace an H.O.T. without adjusting the horizontal-efficiency coil for correct cathode current.

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