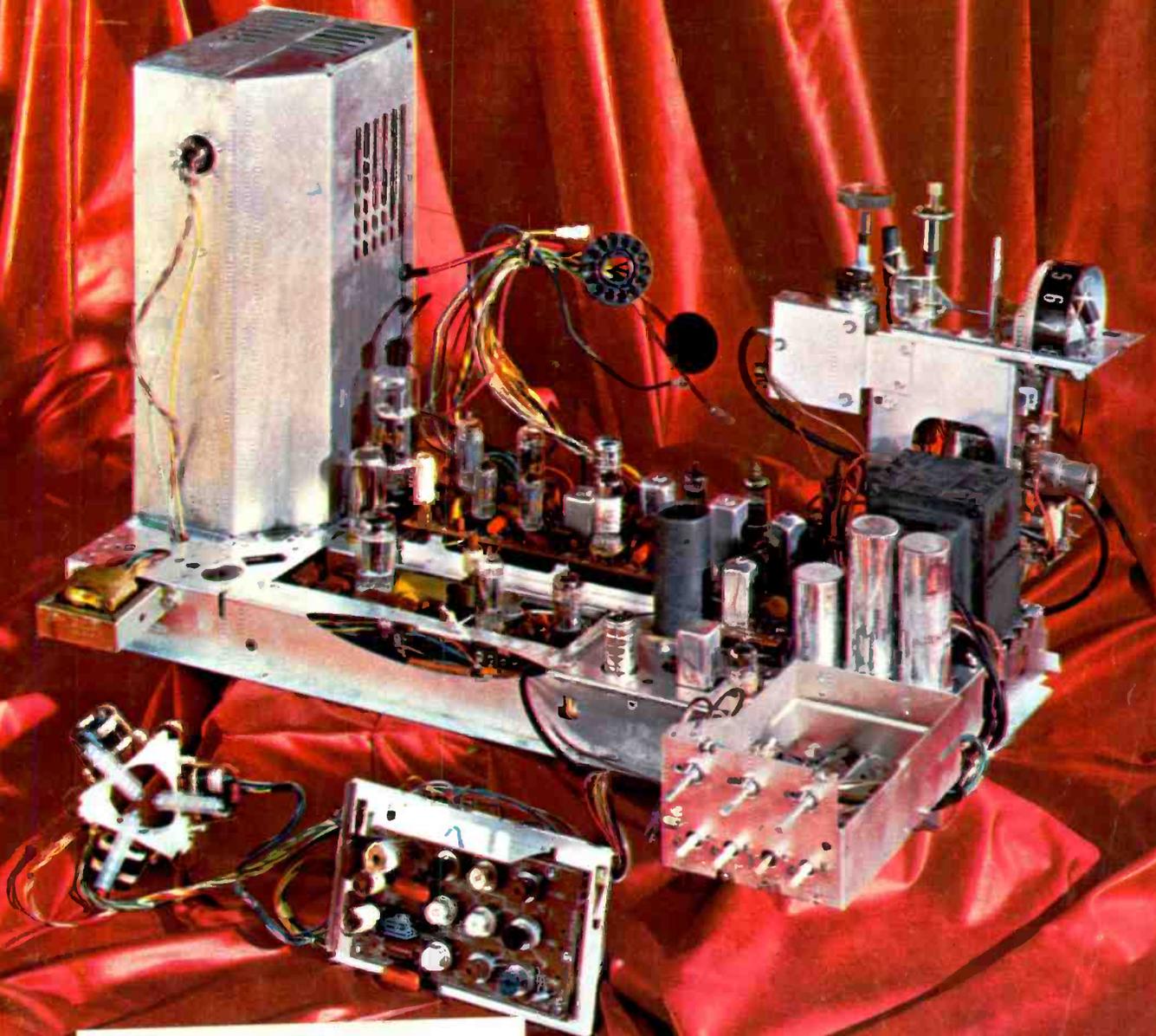


ELECTRONIC TECHNICIAN



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AUGUST 1963

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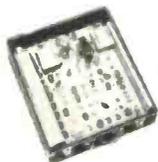
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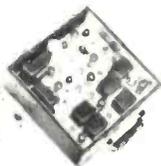
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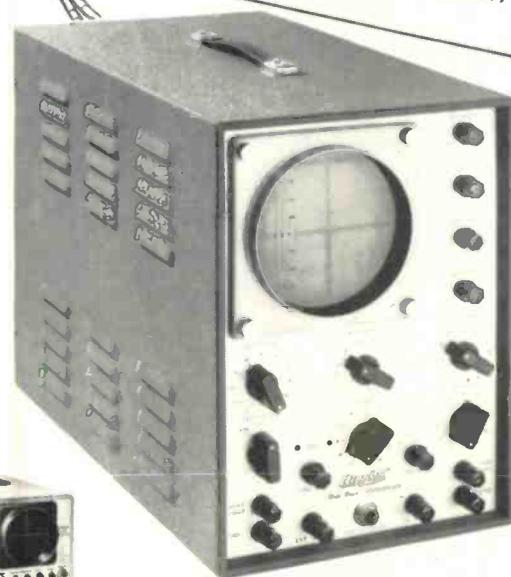
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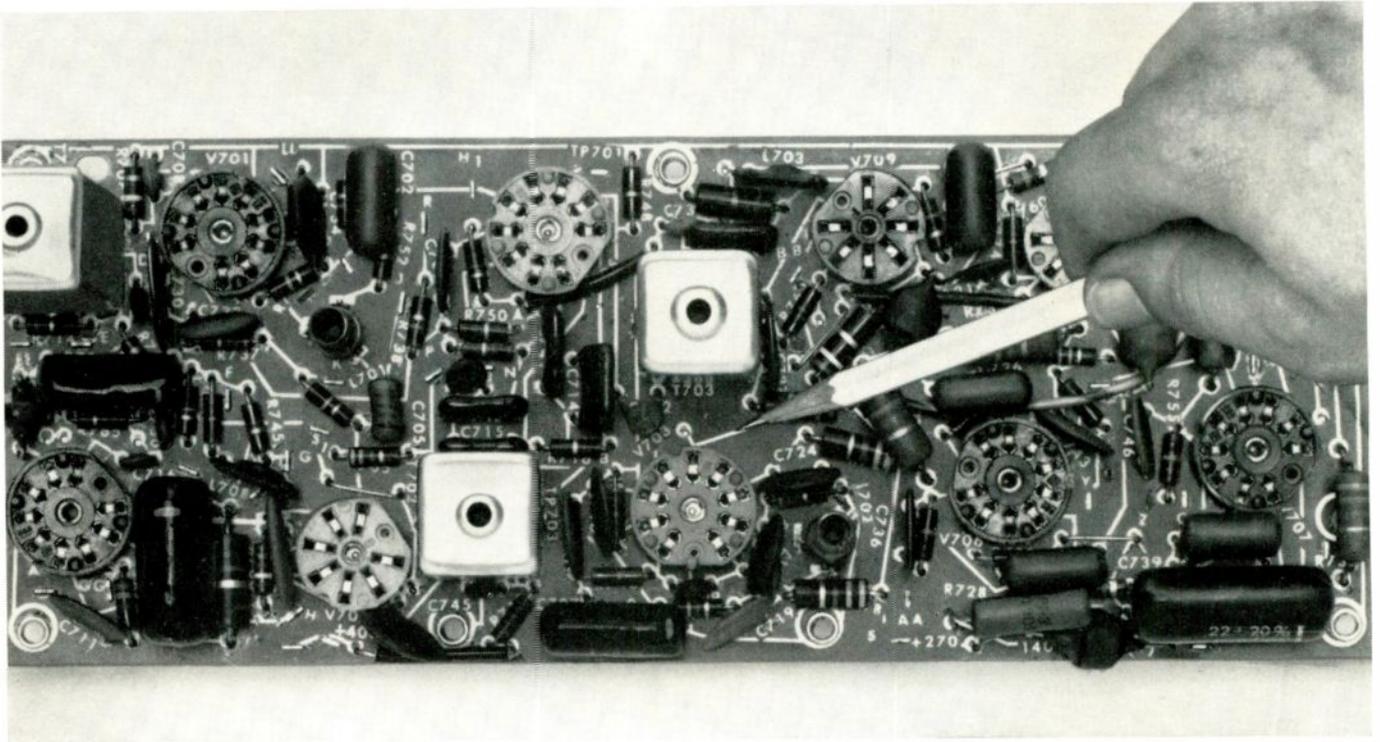
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From RCA Victor—another big advance in Space-Age Sealed Circuitry



RCA Victor Color TV Chroma Circuitry

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

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

This new schematic diagram “road-mapping” consists of *straight white lines* that run *directly from point-to-point*. No confusion, no difficult paths. And the extra space gained has been used

to make the label markings larger. You can see and trace the circuits at a glance.

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

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AUGUST • 1963

Vol. 78 • No. 2

COVER: The cover photograph this month was made by RCA. The subject is their newest chassis, the CTC 15 which features a cooler Novar horizontal output tube, dark heater design in all tubes and a Nuvisor tuner. New designs in color TVs from most manufacturers make this a year to watch for the start of the color boom. To help technicians prepare for sets they will be selling and servicing ET is focusing on color information in this issue.

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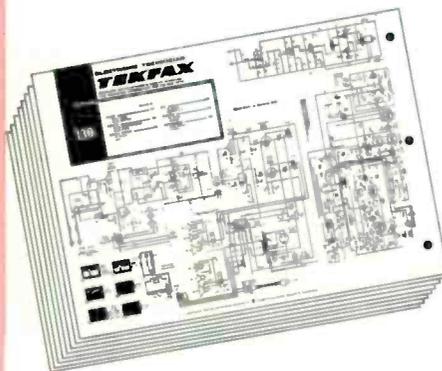
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TEKFAX 16 PAGES OF LATEST SCHEMATICS



AIRLINE: Reverberation Unit, Model GVC-9019A

DELCO: Reverberation Unit, Oldsmobile and Pontiac Models 7284742 and 7284893

DUMONT: TV Chassis, 120622-A, 23-B, 44-A and 88-A

RCA: Record Player, Series 4VC6 and 4VC8

TELECTRO: Tape Recorder, Model MM-214

UTICA: CB Transceiver, Model T & C II

WESTERN AUTO: Tape Recorder, 4DC7465

ZENITH: Remote Control, Chassis S-60804, 44, 1204 and Hand Control S-54344

make extra dollars with your scope

An oscilloscope gives a visual picture of what is happening in a circuit, something no other test instrument can do. This very feature makes a good scope a money maker for your shop. It saves you time, analyzes those intermittent faults, and makes routine servicing easier than ever. Once you start using a scope regularly you'll never be without one.

You've pulled a set with a buzz in the sound. Is it 60-cycle hum or 60-cycle buzz? A quick look with the scope and you'll know. You'll either see a 60-cycle sine wave caused by heater-cathode leakage or there'll be a vertical deflection sawtooth probably resulting from a defective bypass capacitor.

I.f. alignment required? A scope is a must. Set it up along with your EICO post injection sweep generator, and you have only to adjust transformer and sound trap slugs to finish the job. Same thing for setting up the 4.5-mc sound takeoff network.

Losing the signal somewhere in the video circuits? Hook up the scope and see where it's going astray. There's a good chance you'll spot the bad component at the same time.

But when you go to buy a scope, what do you look for? Large screen, high sensitivity, frequency response, attenuators, synchronization, calibrator? All of these are important and are included in the design of any professional scope intended for the service technician.

Large screen: You can get by with 3 inches, but take the 5-inch screen of the EICO 460. Get a close look at what's happening. It's got an edge lit calibrated bezel too. **High sensitivity:** The 460's vertical amplifier delivers 25 mv per cm. All you'll ever need and more. **Frequency response:** EICO makes it flat from dc to 4.5 mc

in the 460. Ideal for color and black and white as well as industrial production and research, audio testing and experimenting. **Attenuators:** The vertical attenuator in the EICO 460 is a 4-step frequency compensated network. Can't beat this kind of design. **Sync:** Any signal reaching the screen is fully synced — automatically. And for special purposes you can inject your own external sync signal. **Calibration:** Accurate peak-to-peak voltage calibrator is built right into the 460.

All this adds up to the top scope for TV service. You can get it as a kit for \$89.95 or completely wired for \$129.50.

If you don't need so elaborate an instrument, take a careful look at the 427 dc to 1 mc scope or the new 3" General Purpose scope, the EICO 430 (kit, \$65.95; wired, \$99.95). The new 430 does everything bigger and more expensive scopes do. Vert amp/flat from 2 c to 500 kc, —6 db at 1 mc. Sensitivity 25 mv/cm. Horiz amp. flat from 2 c to 300 kc. Sensitivity .25 V/cm. Flat face 3" tube; mu-metal shield eliminates effects of external fields.

There are plenty of accessories for EICO scopes too. An Electronic Switch to put two different signals on the scope screen at the same time (EICO 488; kit, \$23.95; wired, \$39.95). Voltage Calibrator for the less expensive 427 and 430 (EICO 495; kit, \$12.95; wired, \$17.95). Three accessory probes-demodulator, direct and low capacitance types.

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LETTERS TO THE EDITOR

Wants Styli-Record Article

I enjoy your magazine a great deal. Your articles are both informative and helpful.

However, there is one article I would like to see which has not appeared. This is an article on phonograph records. A few of the questions I have are as follows: What causes the surface noise found on even the most expensive records? Can it be avoided through care of the records or must it be filtered out along with parts of the music? Is there some preparation on the market with which a record may be treated to lessen the static? Does the type of needle or needle wear have any effect on this problem?

Thank you very much for your attention. Keep up the good work.

JOHN R. FINK

Roanoke, Va.

● We have an article on styli and phonograph record wear scheduled for the September Stereo Annual issue of ELECTRONIC TECHNICIAN. — Ed.

March Article

In your March issue, an article by Mr. Faler was illustrated with two antenna pictures. These two products are not made by the General Electric Co., nor does the General Electric Co., either directly or indirectly, recommend the use of these products. When this article was submitted by Mr. Faler, there was no mention of the use of such illustrations, and it is of serious concern to our company that the use of such illustrations in conjunction with the article may be wrongfully construed as a possible company endorsement of the products.

J. S. KELLY,
General Electric Co.

Syracuse, N. Y.

● The article in question was illustrated by the editors. These pictures were intended simply to show examples of FM only antennas. — Ed.

May Viewpoint

I just finished reading "Editor's Viewpoint" in the May, 1963 issue

the HIDDEN 600*



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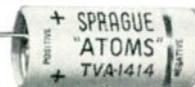
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NET

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LETTERS

TO THE EDITOR

of ELECTRONIC TECHNICIAN.

May I extend my personal appreciation, that you would print this article to vindicate to some extent the many, many intelligent, hard working, honest technicians who must never cease study, must put up with non-understanding customers; who must not only be genius's at servicing, but also diplomats, businessmen, philosophers, lawyers and, yes, even politicians.

After spending 18 years as an electronic wholesale salesman and store manager, I feel more qualified to pass judgement on the technicians than Canby.

It has been my pleasure to have called upon and know practically every technician in Iowa at one time or another in the past 18 years.

No doubt that we do have some rum-dums and chowder heads that should rightfully be in some other occupation. There is a constant turn over and it has been my experience that time or nature has a way of taking care of all of this.

I wonder if Edward Tatnal Canby has even had the grievous experience of being "had" by some one supposedly a mechanic, a plumber, a carpenter, a painter or even our highly educated professional men such as doctor or lawyer? I imagine he has.

It would appear to me that many of our good citizens ask to be "had"—primarily by looking for the *cheapest* not the *best* in service and also merchandise.

It was indeed a pleasure to read your article.

DAVID G. KING

Des Moines, Iowa

Directory Omission

In your May Annual Directory and Parts issue, we note that the 1963 MANUFACTURERS' DIRECTORY LISTING (omits) . . . Philco Parts & Service Operations, C and Westmoreland Sts., Philadelphia 34, Pa.

R. G. SUTTON

Bala Cynwyd, Pa.

● *Our apologies. Technicians should insert this important address in their May issues. — Ed.*

don't sell half a television set!



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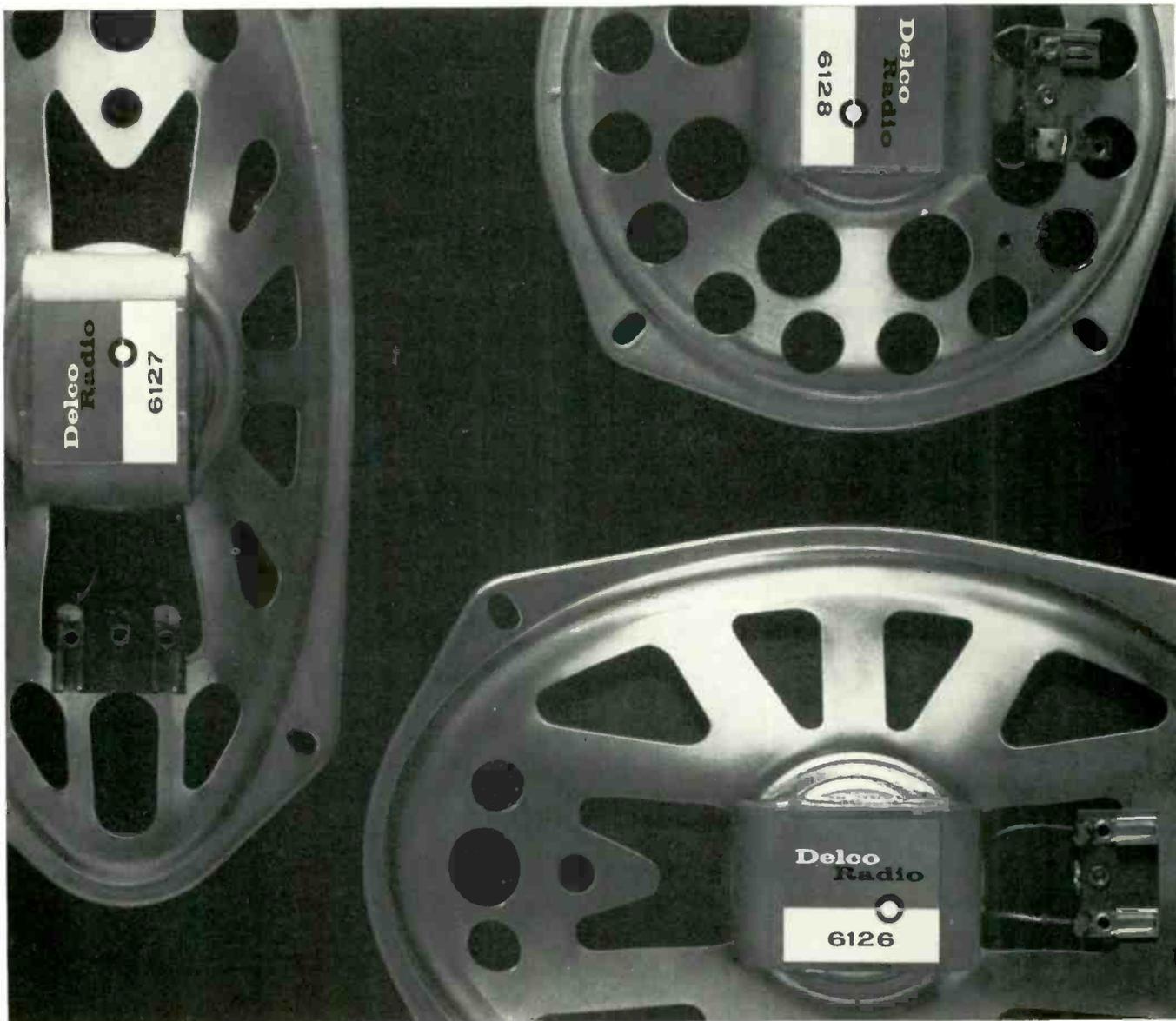
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ELECTRONIC TECHNICIAN

TECHNICAL DIGEST

GENERAL ELECTRIC

Radio — P870 Dial Slippage

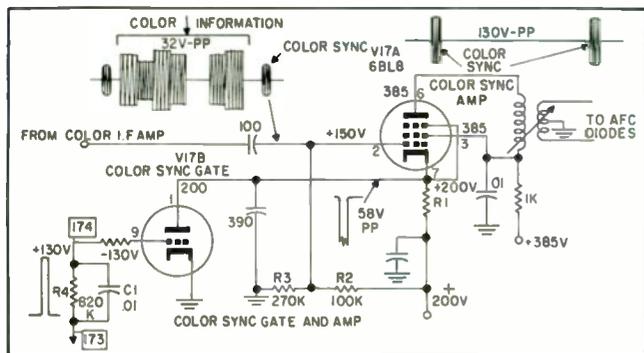
Some model P870's may be returned to you where the complaint is dial pointer sticking at either end.

This condition is usually caused by excessive tension in the dial spring used in the bead chain that drives the dial pointer. Correct this by either substituting a replacement spring or by reducing the tension on the dial bead chain by stretching the spring slightly.

MOTOROLA

Color Sync, Gate and Amplifier — Operation

The gate and color sync amplifier circuitry passes and amplifies the color sync signal and rejects all other information. A composite color signal from the



Color sync and gate amplifier circuitry in Motorola's new set.

plate of the first color IF amplifier is fed to the gate-color sync amplifier circuitry. The gate tube is a switch to turn the color sync amplifier on when the color sync is present at its grid and allows the stage to be turned off at all other times. The basic circuitry is shown in the accompanying drawing.

The color sync amplifier plate is fed from a +385 v source and the cathode from a 200 v source. R2 and R3 form a voltage divider from the 200 v source to ground. This causes the V-17A grid to be +150 v. Since the cathode is +200 v, the tube has -50 v bias and is cut off.

The gate tube plate is connected directly to the color sync amplifier cathode. A positive pulse from the horizontal transformer is fed to the gate tube grid. When the pulse is present, V-17B draws heavy plate

current causing V-17A's cathode to become less positive and thus, turn the sync amplifier on. This same pulse causes V-19A to draw current which charges C1 providing bias for this tube.

The color sync signal and the pulse from the horizontal transformer both occur during horizontal retrace so that the color sync amplifier tube is turned on during the time the burst of color sync is present, and off during the remaining portion of each scan line.

If the sync amplifier and gate circuitry should become completely inoperative for some reason, there would be a complete loss of color sync if a color program was being viewed; color would be present on the screen but would be out of sync (scattered through the picture). A partially inoperative color amplifier-gate circuit may cause the color sync to be unstable or the hue range to be incorrect.

These circuits can best be checked for normal operation by removing the chassis and observing the waveforms with a wide band oscilloscope. The set should be connected to the color pattern generator or tuned to a color program. The color signal amplitude in the sync amplifier control grid will depend to a degree on the signal strength but the sync signal amplitude on the plate of the stage should be approximately 13 times greater than that on the grid. The area between the plate circuit color sync bursts should be clean. Any evidence of color information in this area would indicate that the amplifier stage is biased incorrectly. A dc voltage check on the tube elements should disclose this.

The gating pulse amplitude should be checked at V-17A's cathode to insure that the sync amplifier is turned on completely when sync is present. The sync signal should be centered in the gating pulse measured at V-17A's cathode when the horizontal hold control is adjusted at its most stable point. This insures correct timing for the gating pulse to turn the sync amplifier on at the instant the color sync is present on the control grid. If these two signals do not coincide, an undesired sync signal phase shift results, causing a hue change on the screen. Incorrect timing could be caused by incorrect R and C values in V-17A's grid circuit.

The gate tube, V-17B, is biased by grid current caused by a pulse from the horizontal transformer. In servicing this chassis, the set should not be operated with the horizontal sweep system inoperative for an appreciable period of time without removing V-17 or connecting sufficient negative voltage to its grid to prevent tube damage.

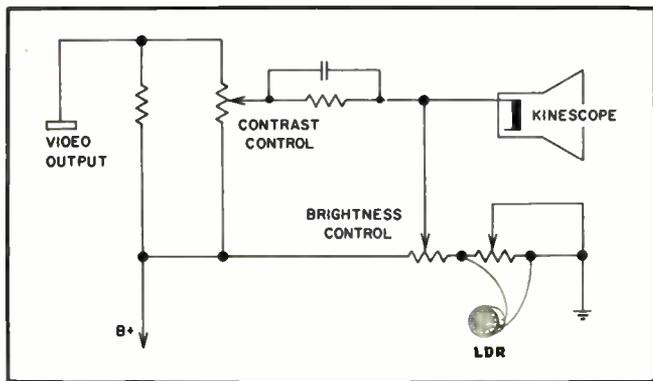
TECHNICAL DIGEST

When servicing the color sync system, the defective stage must be located before the preceding checks can be applied. If color sync is poor or non-existent, the AFC circuit should be checked first. Determine if color sync is received at the detector tube by measuring the dc voltage at pin #1 of the 6AL5 (color oscillator tube removed). This should be near +18 v. Determine if the AFC diode is receiving a local oscillator reference signal by measuring the dc voltage at pin #1 of the 6AL5 (color sync amplifier tube removed). This should be approximately +7.5 vdc.

If the AFC will pass these two tests, the defect is probably in the reactance or oscillator stages. If sync is not present at the AFC diode, the defect is likely in the sync gate-sync amplifier or color IF circuitry.

Chassis 136Z — Automatic Brightness Control Circuit

The ABC circuit operates as follows: After optimum brightness has been set, any change in room lighting acts on the light dependent resistor. An increase in overall room light causes the LDR to decrease in value. This places the low side of the brightness control nearer to ground potential, decreasing B+ on the kinescope cathode. Lower potential at



Automatic brightness control using light dependent resistor in RCA receivers.

the cathode decreases grid-cathode bias and causes the kinescope to conduct more heavily thus increasing raster brightness. A decrease in room brightness has the opposite effect.

RCA

Record Player Chassis R5-202A — Critical Lead Dress

1. Dress signal cable around transformer T2 on that side between transformer and "Sing-Along" jack to keep it from coming into contact with V3.
2. To keep hum to a minimum, the portion of the power cable under the circuit board should be free of slack so that it dresses toward the interlock.
3. The red and blue leads of T2 should be dressed away from V3 to prevent damage to the wire insulation.

ZENITH

Color TV Chassis 25LC20 — CRT Drive Connections

The red cathode is connected to receive maximum fixed output from the Y amplifier. The blue and green cathodes go to two gain adjustments providing Y signal variable coupling. Connections are made through a slip connector and terminal lugs arrangement from the three separate gun cathodes. This particular arrangement *may not* be the same on every receiver, however. This is determined at the factory and the arrangement depends on which CRT phosphor is least efficient. The least efficient phosphor gun cathode (usually red) is connected to receive Y amplifier maximum fixed output. If a new CRT is installed, the least efficient phosphor gun cathode should be connected to receive maximum Y signal. Generally, if a new CRT tube is installed, the red cathode gun lead should be first connected to the terminal marked R. All cathode leads go to a terminal strip near the chassis rear-center. These terminals are indicated R (maximum Y signal), B and G. If a black and white picture cannot be obtained during the tracking procedure, it will be necessary to interchange the connection, placing the least efficient phosphor gun lead on the terminal indicated R. The other two cathode leads should be connected to the remaining terminals.

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LOOK!

SAVE!



All crystal controlled

A STANDARD COLOR BAR GENERATOR

at **1/2**
THE COST OF OTHERS

only **\$99⁵⁰**

the all new **SENCORE** CG126 STANDARD COLOR BAR GENERATOR

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

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

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

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

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

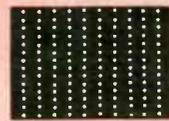
Pretuned RF output to Channel 4. Other low channels can be selected if Channel 4 is being used in your area by simple slug adjustment. Patterns are injected directly into antenna terminals, simplifying operation and saving servicing time.

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

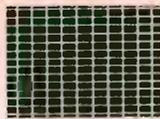
Smaller and more portable. With color receivers weighing much more than black and white TV, portable equipment becomes essential for home servicing. The CG126 weighs less than 10 pounds and measures only 11" x 8" x 6".



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



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



Stabilized crosshatch pattern for simplifying convergence adjustments.



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



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

March into your local parts distributor and demand the CG126 Sencore color generator that sells at 1/2 the price of others. Don't let him switch you.

SENCORE

426 SO. WESTGATE DRIVE • ADDISON, ILL.



Compactrons take the heat off service dealers



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

1. Long waits for repair will be a thing of the past. Simple compactron circuits mean you can locate trouble faster, repair it easier, get sets back to your customers quicker. Fast, effi-

cient service builds repeat business and gets you free word-of-mouth advertising.

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

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

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

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

Remember, you'll be seeing more compactrons in the future . . . They'll mean easier servicing and happier customers for you.

Progress Is Our Most Important Product

GENERAL  ELECTRIC

DISTRIBUTOR SALES

--- for more details circle 19 on post card
ELECTRONIC TECHNICIAN

EDITOR'S VIEWPOINT



Now or Never

For some technicians this will be a year of reckoning. Color TV has arrived. I must say, however, that many of you put up a good fight — you retarded color TV for several years.

Most of you have customers that ask you about the merits of color TV daily. And in the past (some still do) you've said "It's not perfected yet . . . too many bugs. Wait another year."

You've stymied the growth of an area which could reap greater profits than any other in the home entertainment equipment field. Why? Because you haven't seen a good color picture yet? Because you don't understand how it works? Because you have enough B/W service work?

Well, if you are still preaching non-perfection and have enough ambition to try to reverse that trend, you still have a chance to stay in the service business. Don't worry about saving your face — you're the authority; you have the prerogative to change your mind.

You see, while you were busy in your own little world, the manufacturers have been telling the public another story. And it's starting to get through in spite

of your insistence that color is still a toy. I've had a color set for five years. It's been moved all over the midwest and gets played hours and hours every day. It still has the original picture tube and produces pictures with quality nearly equal to sets now being manufactured. I'm glad I didn't listen to the local TV technician. I might have believed him.

It's high time you wake up and see which side of the bread is buttered. Color TV sales involve a larger money transaction and consequently, a greater profit is realized. Service is somewhat more frequent since a larger number of parts are involved in each set. Service charges can justifiably be higher since special equipment, additional training and more time is required to service color TV.

Every industry needs an occasional "shot-in-the-arm." The electronic service business has had its share in the form of TV (let's say radio was the beginning); the phonograph boom, Hi Fi, and stereo. But the additional shot that up until now hasn't been received is color TV. It's not a sleeper any longer, however. You're either going to get into it or get out of the business.

Lesson from the Past

The other day I was looking through some old magazines and came across an editorial that had a great deal of significance 10 years ago. It is unfortunate, however, that many of you took the writer's advice: Charge 15 or 20 cents each to test tubes. Don't give your services away. The article said that your time would cost you several dollars a week to test tubes for "nothing."

He failed to point out that a lot of tubes would be sold through this service — and he failed to point out the consequences to the service shops all over the country: People look for what is apparently the cheapest way out; they will not be victims of crude treatment. Now drug stores, hardware stores, grocery stores and filling stations sell tubes.

And look who's screaming. You've lost a lot of tube sales over the past few years and there's no one to blame but yourself.

You're faced today with many similar problems; your response to each situation should be based on a prediction of your customers' reactions formed from your experience. Of course, thinking about your costs and rewards are foremost. But don't let this be the only criteria you use.

Vic Beale

MANUFACTURER'S COLOR TV REVIEW

■ The TV-consuming public has become more color-conscious during the past year. A number of factors have contributed to this change, including: increased and improved color telecasting, better sets, lower-cost service and brighter color CRTs.

Manufacturers who wouldn't touch color with a "ten-foot-pole" only a few years ago have scented profit-tracks on the frontier and are now in hot pursuit on a cold trail. Difficulties encountered in most cases — especially in color CRT production — are being hurdled in stride.

Predictions for 1963 production range from 450,000 to one million sets. More realistic crystal-ballers visualize between 500,000 and 700,000 sets. One thing is certain — there's more color activity this year than last. And many technicians are making money right now by selling and installing color TV sets and appropriate antenna equipment.

What Manufacturers Are Doing

Admiral Corp. — has hit the market with its Sheldon (T1000) table model color set at \$399.95 list. The complete color line has 16 models — the largest ever shown by the company. All the sets are available with the full-function Sonar wireless remote control for an additional \$30 list. All contain provisions for UHF reception — with a continuous tuner or with UHF strips. Admiral says it is tooled-up to make 100,000 or more sets.

Radio Corp. of America — has increased its color TV line also. Included in the 21-model color line, which ranges in price from \$495 to \$1700, is a 66-in. credenza-styled AM/FM stereo phono, 21-in. color set, at top price. RCA executives predicted that 750,000 to one million color sets *could* be sold this year — depending on the industry's ability to produce color CRTs. It is estimated that the company made between 260,000 and 290,000 sets last year. RCA has stuck to its colors from the beginning — splashing an estimated \$130,000,000 on the palette. Its president, Elmer W. Engstrom, announced some time ago that "color TV receivers and

color picture tubes were the greatest profit contributor of any RCA product in 1962."

General Electric — has a number of new color models. It has also recently announced a \$5 million contract with National General Corp., a 220-movie-theater chain, for Talaria — a large screen projector. The movie chain expects to project Broadway shows, symphonies, boxing matches, etc. on regular-size movie screens.

Emerson Radio and Phonograph-DuMont combine, Olympic Radio & TV, Magnavox Corp., Packard-Bell and some others are showing increased activity. It was reported that Magnavox is building a \$5 million plant in Greenville, Tenn.

Sylvania, a subsidiary of General Telephone & Electronics, is working to increase its share of the color TV market and has its own color-tube plant in operation.

Motorola — has contracted with National Video to produce its 21-in., 90 degree rectangular CRT, which the company believes will give color TV a significant shot-in-the-arm, by making 'thin-line' type color sets feasible. In the meantime, Motorola is using round tubes in present beefed-up-production models.

Zenith, a hard-hitting color-TV set manufacturer, predicts sales of about 600,000 sets for the industry in 1963. It estimates that one-third of the sets will be manufactured by Zenith. Production facilities have been expanded throughout — including the Corporation's Rauland color TV tube plant. Zenith is now producing 18 basic models ranging from a compact console to complete "home theatre" units. The company has its own patented two-tube color demodulation system and has recently added a focus voltage adjustment circuit and "clover-leaf" convergence assembly. An automatic "Fringe-Lock" circuit is incorporated in all 1964 color TV receivers.

Consensus indicates a bright future for color. No one predicts a sudden boom. The process will probably be a steady increase in sales, dependent on overall economic conditions, and more money in the pockets of alert and aggressive service-dealers. ■

UNDERSTAND COLOR TV SIGNALS

*Knowledge of
fundamental concepts
essential in adjustment,
troubleshooting and repair*

by Andrew Murnick, Jr.

■ Since color and black-and-white TV signals are compatible, color is supplementary information included with normal black-and-white signals. These color signals are fitted into the TV transmitter's 6 Mc bandwidth. Because previously established TV bandwidths were narrow, it was necessary to design a color system to give low color information detail. Thus, only the larger areas of the scene are reproduced in color. The remainder is reproduced in black and white. This does not prevent production of a pleasing picture because the human eye cannot detect fine detail in color, though the eye *can* perceive fine black-and-white detail.

It should always be kept in mind that two signal-types are required to produce a complete picture — color signals for the low detail color portion and black-and-white signals for the higher detail portions.

Producing Basic Color Voltages

All signal information in color transmission originates in a color-camera which is essentially three cameras in one — since a separate tube is used for each primary color — red, blue and green. Selective filter's are placed in front of the camera tubes to allow correspon-

ding-color light to enter its respective camera tube and charge the mosaic surface.

As the mosaics of the three tubes are simultaneously scanned with individual electron beams, instantaneous voltages are produced in each tube. These three voltages are designated R, B and G and form the basis for all picture signals in color TV.

It is important to remember that the color signals will eventually be placed in the three guns of a tri-color picture tube. These guns must reproduce the *color* portions of the picture — as a speaker reproduces a microphone's action in audio. To explain further: red, blue and green light enters the camera and is resolved into R, B, and G voltage. In the tri-color picture tube only the corresponding R, B and G voltages remain to control current flow in their respective guns and the voltages are resolved into red, blue and green light. See Figure 1.

Monochrome Signals

The human eye notices an apparent difference in brightness in the three primary colors. By combining a certain portion of the three camera outputs — actually 30 percent of the red, 11 percent of the blue and

59 percent of the green — it was found that an instantaneous brightness signal voltage could be produced. This signal is designated as "Y" and is used to reproduce the higher detail black-and-white portions of a TV color picture and reproduce black-and-white pictures on sets tuned to the color program.

R-Y and B-Y Signals

A block diagram (Fig. 2) shows how low detail color portions of the picture are created. The procedure is as follows: First, the Y brightness signal is passed through a 180 degree phase inverter to produce a -Y signal. The output voltage of the red camera (R) is then electronically added to the -Y to produce one color signal, R-Y. The blue camera tube output (B) is added electronically to the -Y signal to produce the second color signal, B-Y.

The R-Y and B-Y signals (often called color difference signals) carry all the color information through the system from program to the TV receiver. These signals are further processed by passing through a filtering system to limit their frequency components effectively to 0.5 Mc. Hence, the R-Y and B-Y signals are able to reproduce only

Color TV Signals

Continued

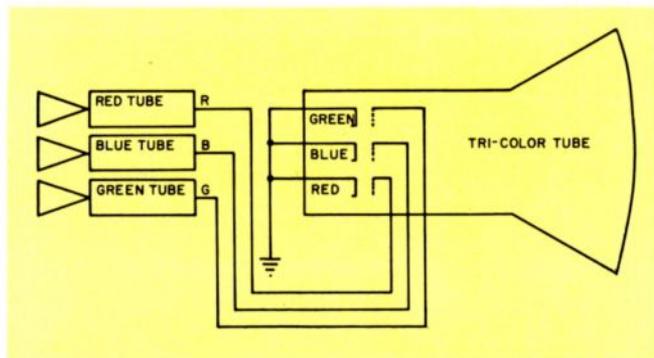


Fig. 1 — Reversing camera action in tri-color CRT.

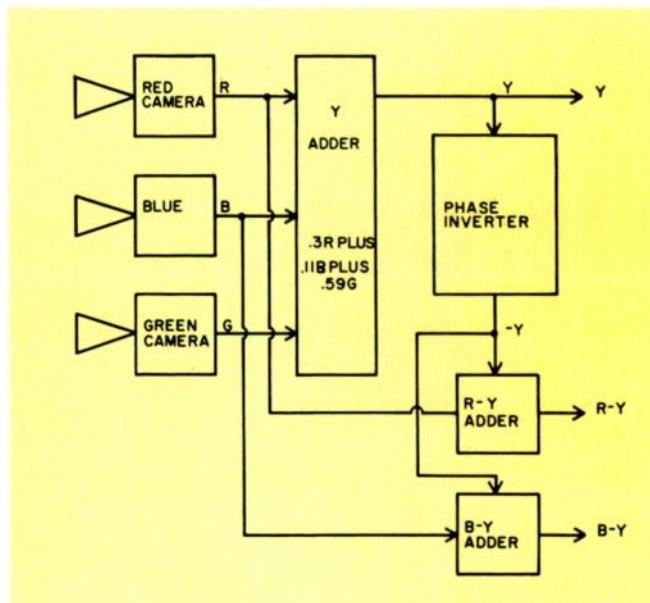


Fig. 2 — Producing color and brightness signals.

low detail color information — up to a maximum of 500,000 changes in color per-second-of-time.

It is noted here, by FCC standards, that R-Y is converted to an "I" signal (frequency components as high as 1.5 Mc); and B-Y is converted to a "Q" signal (frequency components of 0.5 Mc). However, since most present-day receivers do not use the extra detail carried in the "I" signals and demodulate directly for R-Y and B-Y, the "I" and "Q" signals can be ignored in arriving at an understanding of color signals.

A graphical analysis of how R-Y and B-Y are able to reproduce all the color hues in their various saturation levels (amount of white mixed with the basic hue) can be made by comparing a land area, a Chicago city map, for example, and a color wheel. (Fig. 3.)

It will be noted that locations of only the primary and secondary colors are indicated on the color wheel although all colors that can be reproduced in color TV appear on it. The colors on the outer area of the circle are fully saturated (no white mixed with them) toward the center of the circle. The circle's center represents white.

A study of Fig. 3 shows that *any location* in the city of Chicago can be represented by a direction (N-S-E or W) and a distance along two perpendicular coordinates — Mad-

ison and State Streets. Likewise, in the color wheel, *any hue of color in any saturation level* is represented by a direction (here positive or negative), and an amplitude of the perpendicular coordinates, R-Y and B-Y. For example in the illustration, point "A", the intersection of Irving Pard Rd. and Kedzie Ave., can be described as 3200 West and 4000 North as, indeed, many Chicagoans describe it. Similarly, a pale red color which contains about half white, point "B" on the color wheel, is represented by a certain amount of positive R-Y (up from the intersection of the coordinates) and negative B-Y (to the left of the intersection of the coordinates). In either case, the exact location; on the city map or on the color wheel, is at the intersection of two lines extended the proper distance and direction from the intersection of the coordinates as illustrated by "a" and "b" in Fig. 3.

Coordinates on the map are actually streets. In the color wheel too, R-Y and B-Y coordinates are actually colors. Colors of R-Y and B-Y differ when they have positive instead of negative values. When B-Y is positive, for example, it is near blue but when negative, it is near yellow.

"Packaging" Color Signals

The Y brightness signals, in a video range from about 30 cps to

4.2 Mc are passed through the system without further packaging in order to preserve compatibility. These are high-detail signals because they are able to reproduce up to a maximum of approximately 8,400,000 changes in brightness per-second-of-time (each cycle represents two changes — positive and negative). The R-Y and B-Y color signals, however, must be packaged so that they will not, during transmission, combine with one another or with the Y signals in a manner to make separation impossible in the receiver. This is accomplished through a scheme of amplitude modulating a 3.58 Mc sub-carrier with the R-Y signals to produce an upper and low sideband. The 3.58 Mc sub-carrier phase is then shifted 90° before it is modulated by the B-Y color signal. Thus, a second set of upper and lower sidebands is produced. In each case, the 3.58 Mc carrier is eliminated through a suppressed carrier modulation system. This is necessary because of power requirements and to prevent interference beats. Since the R-Y and B-Y sidebands will now always remain 90° apart, they will maintain individual identities.

The color sub-carrier's frequency is 3.579545 Mc and has been chosen to provide frequency interleaving of the color sub-carrier information in between the video information energy groups which form

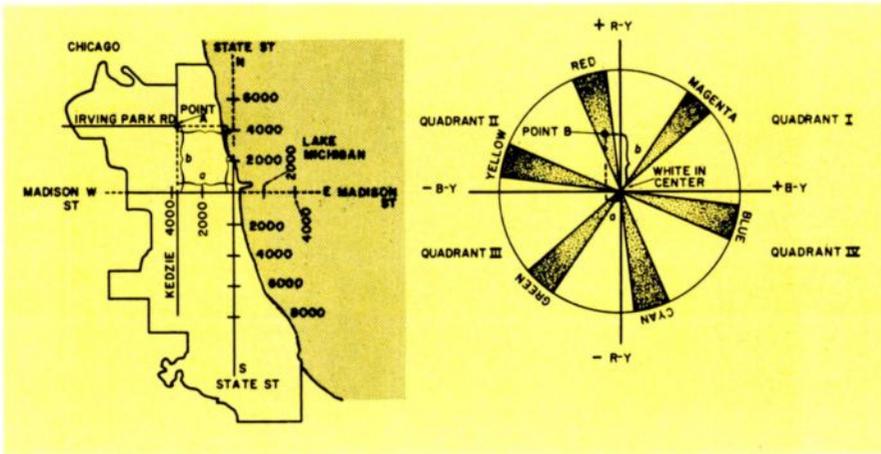


Fig. 3 — Comparing two streets with R-Y and B-Y as coordinates in terms of which any point in an area is identified.

as a result of the scanning method used in TV. The video signal components group about the harmonics leaving a void or space between these energy groupings. It is in this unoccupied region that the color sub-carrier is placed.

One other signal is required in the system. In the receiver, the modulated sidebands will have to be de-packaged or demodulated; but this cannot be accomplished unless the original sub-carrier is present at the same frequency and phase as it was in the modulator. Since the 3.58 Mc sub-carrier was eliminated when producing the R-Y and B-Y sidebands, it must be re-created with an oscillator in the receiver. A sample of the 3.58 Mc sub-carrier as used in the modulator is therefore transmitted. It is used in the control of the 3.58 Mc oscillator in the receiver. This sample is called the "color burst" and is sent during horizontal retrace time when R-Y and B-Y signals are not present.

It should be noted that the R-Y and B-Y sidebands will occupy the frequency area from 3.08 to 4.08 Mc when assuming that the maximum 0.5 frequency components are present in the color signals. This happens because the upper sideband in amplitude modulation is created by adding the modulating frequency components (here up to 0.5 Mc) to the 3.58 Mc sub-carrier

and the lower sideband is created by subtracting the modulation frequency components from the sub-carrier.

Receiving Color Signals

After amplification of the R-Y and B-Y sidebands, Y signals and color burst in the RF and IF sections of the receiver, detection is performed. Further amplification occurs in the first video amplifier.

At this point, the color burst is separated by merely allowing an amplifier tube — called the burst amplifier — to conduct on video signals but only during horizontal retrace time. The burst is then used in the oscillator control circuitry to insure proper phase and frequency insertion of the 3.58 Mc sub-carrier to the demodulators.

The R-Y and B-Y sidebands are also applied to the demodulators after being removed from the video amplifier through stages having a bandpass essentially from 3.08 to 4.08 Mc in most receivers. After the R-Y and B-Y sidebands are demodulated and the 3.58 Mc component has been removed, the color difference signals are again in a video range. A G-Y signal is now produced by combining the proper proportion of $-(R-Y)$ and $-(B-Y)$.

After the Y signals are further amplified through a video amplifier, we are ready to apply them to the picture tube.

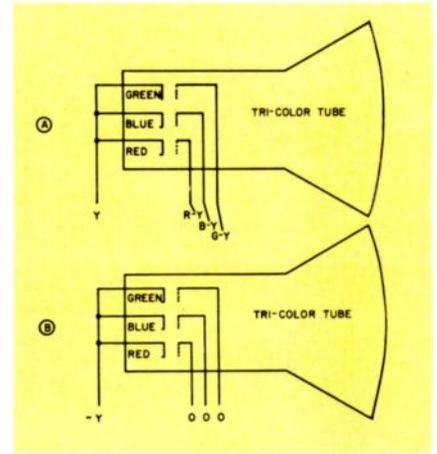


Fig. 4 (A) — Signals applied to tri-color CRT to produce color portion of picture. The $-Y$ components cancel out leaving only R, B and G on grids. (B) — Signals applied to pre-produce b/w portions of the color TV picture program.

Applying Signals to CRT

As shown in Fig. 4A, the R-Y signal is placed on the grid of the red gun, B-Y on the grid of the blue gun and G-Y on the grid of the green gun. The Y signals are applied to the cathodes of all three CRT guns in a negative or $-Y$ polarity.

For reproducing the low detail color portions of the picture, when R-Y, B-Y and G-Y are present; the factor " $-Y$ " appears both as a part of the color signals (placed on the grids of the guns) and as the brightness signal (placed on the cathodes of all three guns). Since any tube can change ac conduction only if there is a signal *difference* between grid and cathode, the $-Y$ components, appearing on both the grid and the cathode, cannot change gun conduction and thus effectively cancel one another out; leaving only the R, B, and G voltages in the respective guns.

Thus we have accomplished what we set out to do — the tri-color picture tube has reversed the action of the cameras to reproduce the color portions of the picture in full color by virtue of the fact that only R, B, and G voltages (which were the camera outputs) remain to control beam current in the respective guns.

For higher detail (about 0.5 Mc)

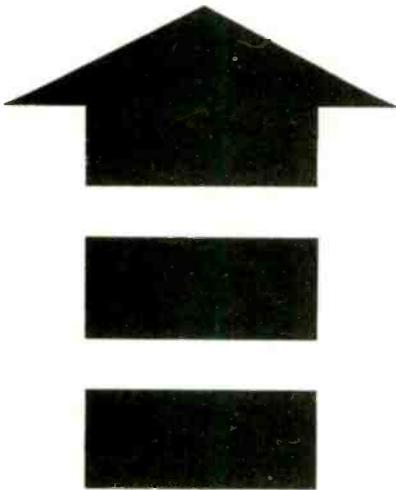
Continued on page 82



Aperture masks are removed from conveyor after annealing in lehr shown in background....



Aperture masks are lowered in a steam tank for blackening. Process increases thermal radiation properties....



EVOLUTION OF A COLOR CRT AT SYLVANIA



Applications engineer adjusts test equipment to evaluate color CRTs.



Color patterns are produced on the color CRT by an external alternating magnetic field. Pure colors of red, green and blue are bordered by combinations of these primary colors....



Masks are then shaped properly ('domed') on this press....

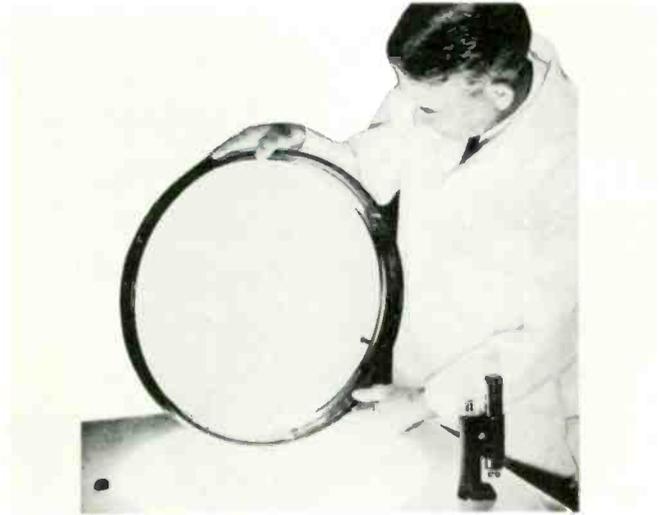


Control panel monitors tests to determine if mask contours are properly formed....

After mask is inserted in CRT facepanel and photosensitive screen is deposited, facepanel is exposed on exposure table....



Beading machine is used to produce electron guns — three for each CRT....



When dots are on faceplate panel, screen is inspected for dot size, structure and density. Inspection is made with aid of a powerful microscope.

The B&K model 850 analyst conceals all cables in a rear compartment. This unit features a special deconvergence unit built-in.

New test instruments are an absolute necessity to service color

by Ken R. Basil



PACO'S color generator features only three operating controls. Available in kit form.



The Simpson color bar generator utilizes only three main controls with four separate output jacks for video, RF, and horizontal and burst frequencies.

Test Equipment

■ The advent of color TV has changed test equipment requirements nearly as much as the advent of TV itself. Absolute test equipment requirements since the early days of B/W TV have been a scope, meter, and some sort of a generator.

True, other test devices served a legitimate purpose by aiding the technician in preventing call-backs and speeding his work. But the absolute requirements did not change until color TV became a service problem. Now, in order to do a proper job at least one new multi-function unit is needed: The Color Bar Dot/Crosshatch generator. Several units are available from an increasing number of test equipment manufacturers. Prices range from less than \$100 to more than \$500.

To stay in business the TV technician will have to include color service in his service repertory. And to service color, he must obtain the proper equipment.

Why Special Equipment?

Special equipment for color servicing is necessary for several reasons. Special circuits, never before used in B/W receivers, heads the list. Color demodulators which operate at precise frequencies in the megacycle range leave no room for error in chroma circuit alignments.

Aside from the color alignment there are other uses for the Bar/Dot and Crosshatch generator. The prime use, of course, convergence.



The Heath color bar and dot generator has standard outputs plus one for shading bars. The unit is available in kit form.

for COLOR TV

Although there are several "gimmicks" available which claim to be just the thing for convergence alignment, the full-fledged crystal controlled test sets are the only ones recommended.

Another group of items found in the TV caddy or the shop are also necessary for servicing: The CRT extension cable along with necessary cables for the yoke and high voltage leads. Working on the color chassis can be a real challenge without these aids. Most of the time it's not necessary to bring the picture tube along when it becomes necessary to pull the chassis — in fact, most of the time it is more desirable to leave the CRT in place. The tri-gun CRT costs too much to cart it around for no good reason.

The CRT tester and rejuvenator used with B/W TVs can no longer be used with color CRTs — some technicians have hay-wired their old testers to the color tubes but with less than desirable results. Color tube testers are specially designed to handle the heavy current demands placed on them; more than twice that of most testers. When the old testers are wired to the color tube, test voltages and rejuvenation voltages are decreased causing erroneous readings and poor rejuvenation.

The scope you have used up to color will also be less than desirable in the color channels of the color set. The burst frequency, for ex-

ample, is 3.58 Mc; in order to see the burst — as is often necessary — a scope with high frequency capabilities is a must. Most service scopes which were built several years ago cannot handle these frequencies.

What to Look for in New Equipment

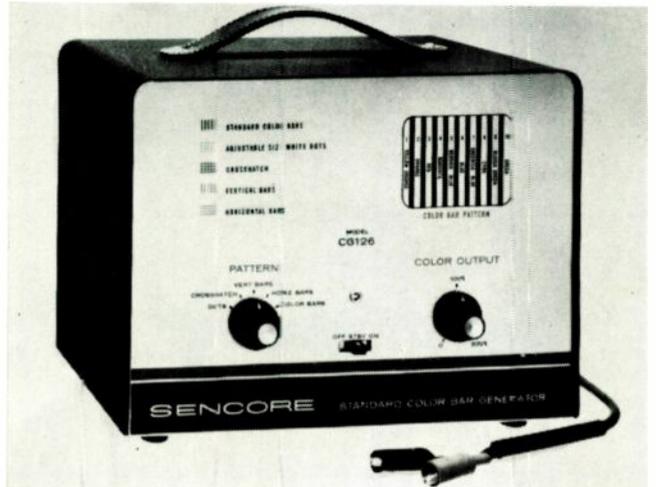
As with buying any equipment, you must set up standards with which to measure your purchase. Since the bar generator, the dot generator and the crosshatch generator all have the same output frequency, it is wise to select a unit which combines all these functions. Buying a one-function unit with the idea of buying another unit later is not wise for several reasons: Different sync levels are invariably required for each piece of equipment; connecting one instrument to a set and then another can be very time consuming and not least, the multi-unit approach is far more expensive than equivalent single-function generators.

Whether you buy a generator with an RF output, video strip output, CRT output or combinations of all will depend on your budget. The more outputs these instruments

have, the better opportunity you will have to pinpoint a particular area when troubleshooting a set. Don't jump at the first deal offered you unless you've carefully considered the drawbacks and advantages. Also, some sets now being built have sync taken ahead of the chroma sections which negates the possibility of troubleshooting in the chroma section without externally available sync. Whether or not this will be a feature you will require is a decision you must make.

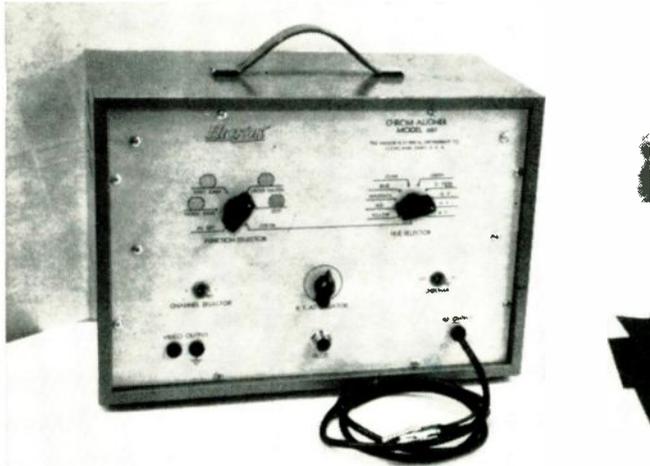
Even something as apparently simple as test extension cables can be full of surprises if care is not used in their selection. Some of you who have made home-brew models will probably be aware of the smear that develops with what were perfect dots without the cables or perhaps the variations in the relative position of each of the color patterns. Obviously this is not the type of equipment necessary to do the professional job expected of a color expert.

When intermixing different equipment makes, it is often found that considerable outlay of cash was spent for function duplications too. Again, this can be avoided by a



Sencore's newest color generator is a compact version of their more expensive CA-122.

Test Equipment *Continued*



Hickok's newest color generator does not have an NTSC output. The older Hickok generators which are still available have NTSC output.



Kine-Color circuit analyzer is an extension for CRT cables and allows convenient tests for all elements in the color CRT. Any or all guns can also be killed with switches.

careful analysis of the equipment which best suits your needs before making a selection. Even if you plan on buying only one piece of equipment now and the rest later, you should decide what type of equipment you will need from every standpoint now to spend your money most wisely and to get the most out of your new instruments.

If you feel a new scope is in order you may want to consider keeping the old one for the radio bench or as a spare. The controls on a wide band scope used for color work are identical to those found on its older counterpart. The specifications are widely divergent, however. The vertical amplifier response is the prime consideration

in what you will see of a 3.58 Mc burst. It is best to purchase a scope which is flat within 3 db up to about 4.5 Mc.

The horizontal or sweep frequency should not be overlooked either. The maximum horizontal scan frequency will determine the number of bursts you will see on the screen. The higher the sweep frequency, the better. For even though the vertical amplifier is capable of following the changes, the signal must be broad enough so you can view it on the screen.

NTSC and Other Considerations

NTSC colors are standard colors which have been set up by the National Television System Committee.

The question in many technicians' minds is "do we really need NTSC colors?" This question is not as easy to answer as it may seem. Although there are certain advantages to NTSC color, a good alignment can be performed without actually using NTSC signals.

Most rainbow patterns are generated by delaying the chroma signal (operating at the same frequency as the burst oscillator) so that a constant and varying difference exists between the burst and the input signal. This generates a changing color pattern which is called the rainbow pattern. As long as the input is kept at the same frequency as the burst, but one frame out of phase, this condition will generate an identical color pattern on each succeeding line.

Another major difference is that NTSC color bar generators available produce a saturated color pattern. This is not always true in other available instruments.

Portability should also be considered when buying any piece of equipment. In color equipment this is particularly important since it is usually required that the final adjustments for the TV be made in the home if optimum performance is to be obtained.

Additionally, you should consider the equipment's set up ease. Does the unit require difficult to read charts? Is any guess work involved in setting up? Are the results difficult to determine? If you get a yes in answer to any of these questions you should consider very strongly looking at another unit.

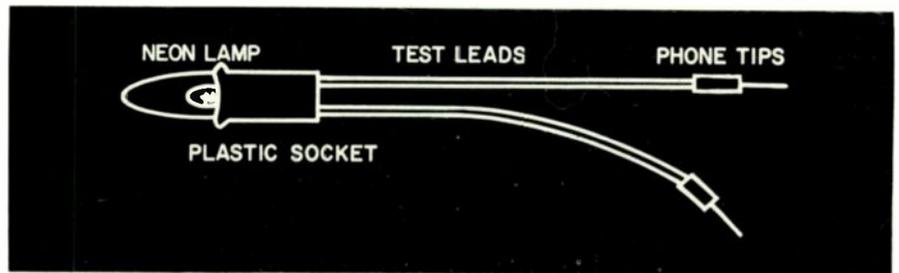
Special features are also included in many late models which aid in setting up color receivers though they aren't necessary. Examples of this are shading bars which are used to adjust tracking and deconvergence methods to aid in CRT convergence. Most all units available have a 4.5 Mc sound output which can be switched off and on to make tuning the set possible. If the fine tuning is not set properly, the entire choma alignment will prove fruitless.

Be alert to these features and get in the color business now by getting the color equipment you need. ■

Rapid short-cut checking techniques
reduce troubleshooting time

The Versatile Neon Tester

by Joe E. Sport



Quick-check neon tester can help technicians isolate many circuit faults.

■ One of the most useful test instruments is the neon lamp tester. This device is no more than a neon lamp, similar to the NE-51, mounted in a plastic base with two test leads having phone tips on their ends.

Many technicians have already discovered that this little instrument has varied uses when servicing TV receivers and other electrical equipment. In servicing TVs, quick checks with the neon tester can help technicians analyze faulty receivers.

Dead Receiver

In the "dead" receiver with no filaments — the neon tester can be used first to check the AC outlet for voltage by inserting the two phone tips into the outlet. If AC is present, the neon lamp will glow; if it is not present, the lamp will not light. Second, the "cheater" cord can be tested similarly by inserting the phone tips into the female end of the cord. Again, if the lamp glows, AC is present, and if it does not glow, (assuming voltage is present at the AC outlet), the cheater cord is bad.

If both outlet and cheater cord check good, the fuse in the set's AC line can be checked by shunting

the fuse with the tester. If the fuse is open, the neon lamp will glow, and if the fuse is good, it will not glow.

An alternate method of checking the fuse with the tester is to put one tip at either end of the fuse and the other to ground. If the fuse is good, the lamp will glow when connected to either end of the fuse, and if the fuse is bad, the lamp will only glow on the voltage-source side and will not glow on the side away from the voltage source.

Fusible resistors and filament dropping resistors in series filament receivers may be checked by the same methods for checking fuses. The off/on switch may also be checked from either side of the switch to the other side of the AC line. If the switch is good, the lamp will glow when connected to either side of the switch, and if the switch is open, the lamp will glow only on the side toward the voltage source and will not glow on the other side.

Sound But No Raster

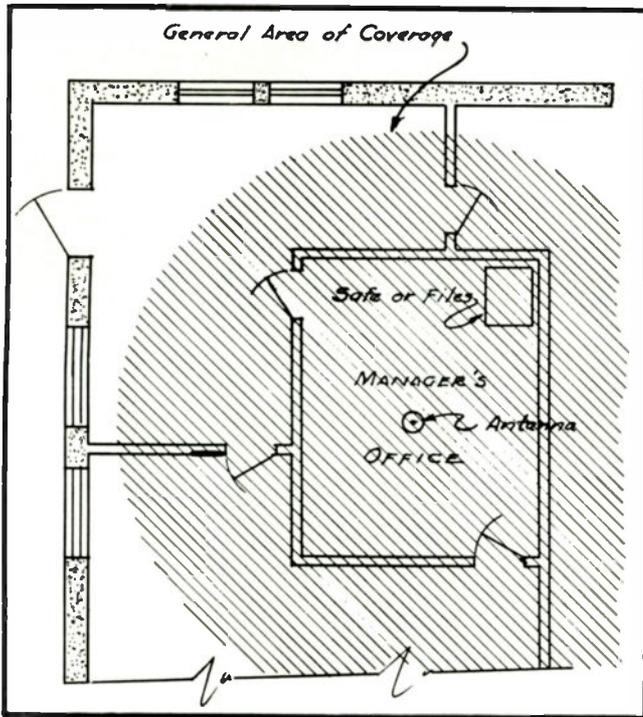
When no raster is present, the tester can be used for a quick high-voltage test. The tester is attached to one end of a plastic slug-adjust-

ing tool with a rubber band and the lamp is held inside the HV cage. If the horizontal output and associated flyback circuits are working, the neon lamp will glow. In fact, the lamp should light as soon as it begins to enter the cage if the circuit is working properly. Note, also, that no physical contact is made between the lamp and any point in the cage. The lamp is ionized by the RF generated by and radiated from the HV circuit.

If RF is present in the cage, as indicated by the neon tester glowing, a defective HV rectifier would be suspected. If no RF is present, a defective horizontal output tube or associated parts might be checked along with damper tube and flyback transformer. However, if RF is present and a check proves the HV rectifier tube is good — but no high voltage is present at the CRT anode — then a check for a bad HV rectifier tube socket, filament resistor, or limiting resistor might be made. If high voltage is present at the picture tube anode, then, of course, the CRT with associated grid and cathode circuits might be checked.

It may be pointed out that the neon tester is not a final analyzer

Continued on page 82



Protection over a 30-ft diameter area is provided for offices by the 'Radar-Eye' alarm system.

Radar ALARM System

■ A low-cost, fully portable radar detection device for stores, homes and offices has been placed on the

market by the Pinkerton Electro-Security Corp., a division of Pinkerton's National Detective Agency.

Called the "Radar-Eye Minuteman," the device is priced within the range of a good television or Hi

Update Your



by Ernest W. Fair

■ The number one advertising medium for many TV-radio shops is frequently the mailing list. Surveys have shown that a properly organized mailing list produces good results at optimum expense.

But no mailing list, large or small, can be effective unless it is kept up-to-date. Converting a run-down list into a business-building tool is well worth the little time, expense and effort spent.

Below is a check list for modernizing your shop's mailing list.

- City directories not more than one year old.
- Classified and regular telephone directories.
- Crisscross telephone directories listed by address and by name

Fi set and the manufacturer feels it will open up a popular new business line for electronics dealers and others in related fields.

The system consists of a detector and alarm unit, both about the size of a table radio, and a match-box-size control unit.

The detector unit plugs into an ordinary 110 v wall socket. After a simple adjustment to provide the range of coverage desired, the unit is "on guard."

The system is activated by turning a key in the control unit, which can be placed anywhere outside the radar field, including a remote location.

An antenna on the detector unit floods the area with high frequency radar waves. If the waves strike a reflecting surface that is stationary, they are bounced back to the antenna at the same frequency on which they were transmitted, and nothing happens. However, if the reflecting surface is in motion, the waves are returned on a different frequency. This trips a relay and sets off an alarm.

The field has a maximum range of 15 ft in all directions and a thickness of 10 ft. Visualized, the pattern has the shape of a doughnut with a 30 ft diameter. When it is necessary to confine the coverage to smaller areas, the installer can control the range by a simple adjustment.

The unit will sound an alarm the instant any motion is detected. When the intruder leaves the scene, the alarm continues to ring for one minute, then automatically re-sets itself for the next intrusion. The device can also be set to sound a continuous alarm until shut off by

the key-switch. The alarm will also sound if power fails, a wire is cut, detector tube fails or covers are tampered with.

While the Minuteman has many applications for large establishments, company officials feel it answers a particular need for low-cost, highly simplified and virtually fool-proof security by those with a relatively small area to protect.

A number of dealerships for the system have already been established and others are being added as quickly as those qualified to install and service the equipment can be found. ■

System can be used to provide home protection. Key is turned at bedside to activate the detector unit before retiring for the night.



- as well as telephone number.
- *Utility companies* such as electricity, water and gas.
- *Commercial and industrial directories* offered by mailing-list firms in one's own community or a nearby large city.
- *An exchange of mailing lists* with other firms. CAUTION: Potential business can be lost if the list received is not up-to-date and "alive."
- *Legal and business newspapers.*
- *Business correspondence.*
- *Customer purchase records.* Businessmen have been surprised to find mailing lists didn't include a number of active customers.
- *Old office records* frequently reveal good prospects.

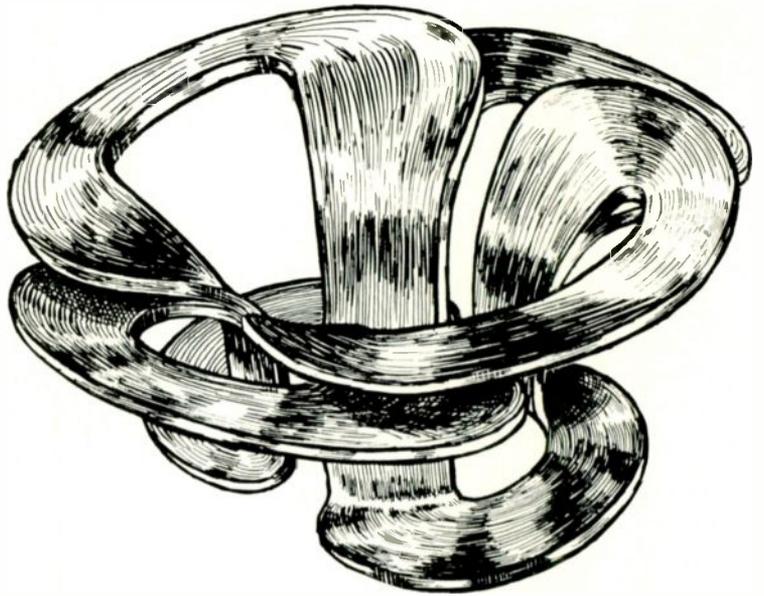
- *Voting list.* The advantage is geographic arrangement for specific business-building in definite areas.
- *Annual homeowner list* from county tax rolls.
- *Building permit lists* published in local newspapers.
- *Social registers* of prominent community people.
- *Annual church membership lists.*
- *Newcomer lists* issued in some cities by the Chamber of Commerce.
- *Club membership rosters* perhaps obtained from a member friend.
- *Contributor lists* from charitable organizations. If your firm is a contributor, it should have no difficulty borrowing the list.

- *Graduate and alumni directories* from educational institutions for a nominal fee.
- *Newspaper "Vital Statistics" listings* appearing almost daily reveal deceased persons who may be removed from the mailing list and new names in marriage license and birth notices.
- *Local automotive owner lists* whether or not the shop offers auto radio service.
- *Contests* modestly promoted for no other purpose.

Weed out the "deadwood" on a regular basis. When new directories come out, check your mailing list against them.

An up-to-date mailing list is a valuable asset. ■

Fig. 1 — Windings of deflection yoke with insulation and housing removed to show approximate placement of vertical and horizontal coils.



by Jay Shane

Substituting Deflection Yokes

■ Next to flybacks, yoke replacement is a confusing aspect of TV servicing. Yoke substitution is not new. It's done every time a standard "replacement" is used. This is proven when you get a yoke, say for DuMont, and find the carton marked, "Exact replacement for RCA," or "Muntz," or "Sylvania." Too many shops hold up repair jobs when an "exact" replacement is not readily available. It takes only a little ingenuity to resolve the problem to everyone's satisfaction — especially the customer. And you won't get inventory-loaded with yokes.

Yoke Categories

Basically, there are four yoke categories, regardless of sweep angle, and they can be broken down impedance-wise as: high-high, high-low, low-low and low-high. To understand this, compare the wire size in the windings. If both windings have, say #24 wire, then the yoke can be called, for all practical purposes, a high-high (Fig. 1). But if the horizontal winding is #24 and the vertical #20 or #22, it is a high-low. Almost any yoke with

comparative windings will substitute for the defective one.

Another factor is millihenry inductance. Here, there is reasonable leeway in many cases. Suppose, for example, a set calls for a yoke rated at 17.8 mh horizontal and 13.5 mh vertical. Good results can frequently be achieved by using one rated at 16 mh to 19 mh, and 12 mh to 15 mh. Make sure its sweep angle is the same.

It may be argued that this approach can only produce negative results. The practical answer to this is, if no visible effect is noted on the screen or in the set's operation, then the sweep system's latitude has not been violated.

Case Histories

Here's an example of how far one can go. Take, for instance, a Motorola PTS 546 chassis. Triad shows a Y-60-2 as replacement. But Triad is not distributed in this area. By using the above procedure, it was determined that a G-E RLD-080 yoke (Fig. 2) was a fair substitute. Its ratings were horiz. 18 Ω , vert. 42 Ω . Motorola called for horiz. 35 Ω , vert. 30 Ω . Nothing available

on the mh ratings, and the G-E yoke's horizontal windings were in parallel. These were changed to series and the damping network installed. Everything was fine — except not enough width. A violation of sweep latitude was evident. But the flyback was "tuned" with a 56 pf/7.5 kv capacitor across the damper plate and cathode which gave an inch-and-a-half wrap-around on both sides of the screen. Good linear picture without loss of brightness resulted.

No replacement was locally available for a Packard Bell 98D8 chassis, with "keystone." An RCA "tapped" yoke was available (Fig. 3A). The problem was resolved by altering the yoke as shown in Fig. 3B. After several months, the set is still doing fine.

In some areas the Philco portable, 10H25 chassis, is a popular small set. Its yoke is #76-10508-9, horiz. 40 Ω , vert. 30 Ω , with no standard replacement available. The regular yoke will substitute in the Seventeen series, from I through III, as well as the 9L35 chassis, along with several Silvertone models. If you run into a crowded sit-

Case histories indicate replacement-yoke inventory can be reduced by knowledgeable approach to problems

uation, remove the side magnet used for horizontal centering.

If a replacement yoke doesn't have centering tabs, or the old cover does not fit, trim the edges off the old cover and cement it to the new one.

01M01, 490-V005M01, 490-V00-H04.

RCA #105632, Stancor DY26A and Merit MDF113 will substitute for RCA 105053, 104408, 104078.

Philco #76-10508-9 will substitute for Philco #76-102823, 76-10-

508-3, 6, 8, 13, 14, 16 and 76-12279-4, 6. Also for Silvertone #80-7-4, 80-10-4, 80-13-4, D80-11-4 and D80-12-4A.

Admiral can be pretty well covered with Stancor's DY13A, DY-16A and DY26A. ■

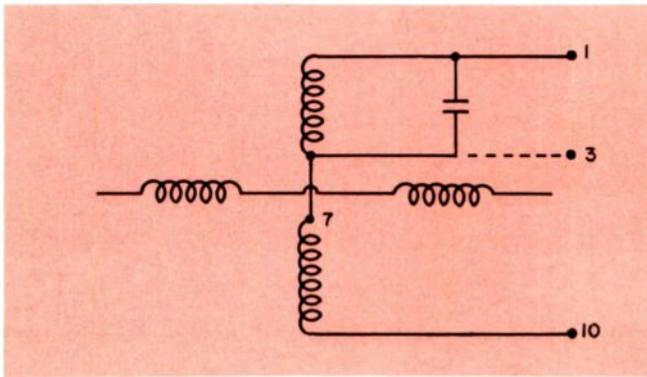


Fig. 2 — G-E yoke schematic modified for Motorola PTS 546 chassis.

Substitutions

Zenith yoke #95-1768 will substitute in any Zenith using the 21C-XP4 picture tube, from 1957 into 1963. If the white or orange leads are not needed, cut and tape them. Zenith's 95-1666 yoke, for small necked 114° tubes, will substitute for Admiral's 15B1 series through Zenith's 1963 portables.

Below is a list of yokes and the makes and numbers for which they will give excellent results:

RCA #235D1, Stancor DY16A, Merit MDF92 and Triad Y-41-1 will replace Hoffman #99810 and 790002; Magnavox #360617-1, #360660-1, 361222-1; Olympic #CL3600, CL3600-1, R-2060; Westinghouse V-15995-1, 490-V0-

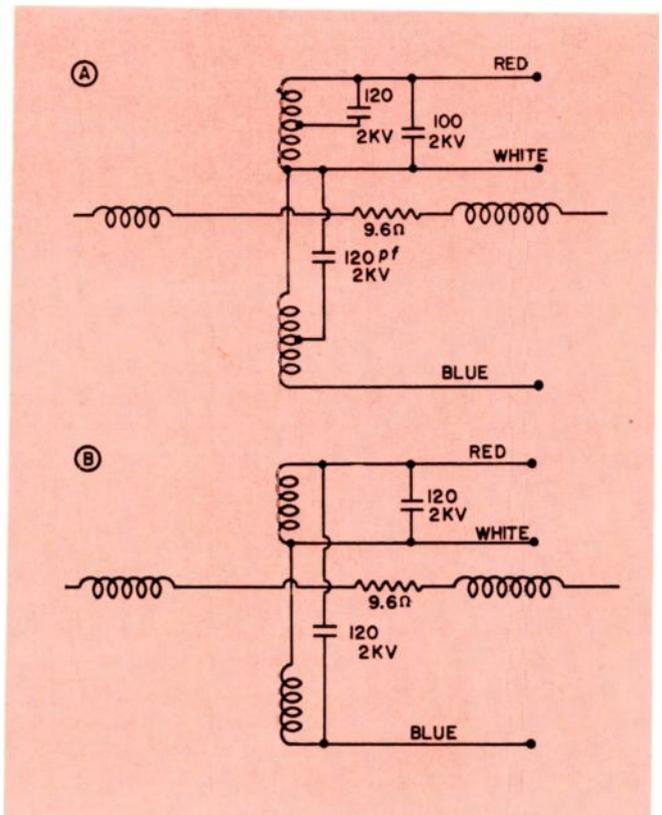


Fig. 3 (A)—Schematic of RCA 'tapped' yoke. (B)—RCA yoke was altered as shown for Packard Bell 98D8 chassis.

PART I



New equipment
pays for itself
when purchased
to speed servicing

The Best

by Art Margolis

■ The best test equipment is not only free but turns a neat profit. Our accountant verified this fact in statistical figures.

Comparison was made with our situation two years ago. At that time I made a careful study in the interest of increasing the gross and at the same time cutting costs. One major way I accomplished this was by establishing a new test equipment budget.

With the budget, I retire old equipment with newer models, increase the number of our garden variety pieces, purchase new units that employ new techniques to speed up solving old problems and buy new equipment to handle new type receivers, we are always being called upon to fix.

As a result of these purchases, our over the counter sales of parts more than doubled, we are turning out, with the same man hours, 40 percent more completed bench jobs and have eliminated all avoidable guesswork.

Tube Tester City

Before our test equipment revolution, I noticed with concern, that our over the counter tube sales dropped off considerably. Since this income has been a sweet rent defrayer I decided to do something about it.

We had two self service tube testers in the store front yet the customers seemed to prefer drugstores, gas stations and bargain shops.

I got into my station wagon and started driving from one tube testing competitor to another. Here are the things I noticed.

The most successful testers were large and gaily colored with festive flashing lights and moving signs. All contained a shelf to hold the batch of tubes while the customer tested them one by one. The tube list and test instructions were mounted on one easy to read poster. Lastly and very important, the number of pulls, twirls, or pushes, on levers, dials, or buttons numbered only three.

Then I examined our own do-it-yourself tube testers as objectively as I could. I was shocked at our deficiency. Our tube testers were compact, colorless and without any sign of any kind. There was no shelf to hold the tubes and I remembered a few loud pops and unhappy customers' faces when they dropped one of their tubes. Instead of easy reading posters we had out of date roll charts; the number of pulls, twirls and pushes came to a staggering eight!

I went shopping. I bought three of the prettiest flashiest tube testing merchandisers you've ever seen. I lined them up like a group of pin-ball machines and put a large fluorescent type sign in the window saying TUBES TESTED BY EXPERTS.

The testers give an excellent emission gas and short test. They check vibrators and batteries. In addition

to placing the tube in the right socket there is only one move. Push one button.

The men call the tube testing area "Tube Tester City" and it does the trick. If the customer is a rugged individualist, and feels he wants to test all his tubes at least he comes to us and we ring the register. Also, we give him advice and best of all, when more often than not, he fails in his repair attempt, we are right there to take over.

Pre-Bench Checkup

Admittedly, a good roadman is not necessarily a good benchman and vice versa. Each has his own specialty. A roadman leans heavier on his personality than his theory. A benchman lives in the circuits and his personality is not important. As a result, and it cannot be feasibly helped, roadmen pull chassis that a benchman might have repaired on the spot.

I have found that I must accept these facts of life and as a result have set up what I call the Pre-Bench Checkup. This procedure weeds out the easy jobs from the rough ones.

An easy job is one that is easy to diagnose and a tough one is when you are having real problems figuring out which part is bad. Any technician can replace a bad part, that's only a mechanical job. The repair skill consists mainly of locating which component has "gone west."

So in our shop a good diagnos-

FREE!

Test Equipment is Free! FREE!

FREE!

tician tests every TV as it arrives off the street. The TV can be on the floor, on a shelf or on the incoming racks. About 25 percent of jobs are by-passed around the bench by locating and replacing bad parts during the pre-bench checkup. Bypassing the bench saves about seven dollars labor.

An extra bonus to the procedure is, if the trouble is diagnosed as flyback, yoke or some other part we might not have in stock. That part can be ordered then, rather than a day or two later when the TV gets its regular rotation on the bench.

The most valuable piece of test equipment during pre-bench is the VOM. Its portability coupled with an assortment of pin socket test adapters permits voltage and resistance checks of most circuits.

Not only is it important to have a VOM during this time but it is important to have a VOM with certain salient features. In fact, it can cost money to use an older VOM instead of one of the latest.

For instance I was training a new benchman to do the pre-bench work. John is a competent workman who prefers using his own tools and meters. I go along with this as long as there is no complication. He was testing a 19L2A Admiral with his own well worn VOM. There was no high voltage.

The chassis was still in the console cabinet and he was lying on his back under the chassis inside

the cabinet. He was making some voltage checks.

His first approach after tube checks was horizontal output control grid drive. He said, "No bias attall." With that he extricated himself from the awkward position, and began filling out the repair card for the bench.

One of the things we do is look up the schematic file number and mark it on the card. If the TV is going to be worked on presently, we pull the schematic too. He pulled the schematic and laid it on top of the cabinet. Then I intervened.

"How come you only made the one bias reading?" I asked.

"Well," he thought as he rubbed his chin, "to tell you the truth," and he did come out with the truth: "The bias is a negative reading. If I would have checked the oscillator plates, I'd have to come out of the

cabinet, shut off, then reverse the probes, then turn the TV back on to make a plus reading. I figured it's easier to do that on the bench with a VTVM — besides, I'm not going to hook this alligator clip on B+ without turning the set off."

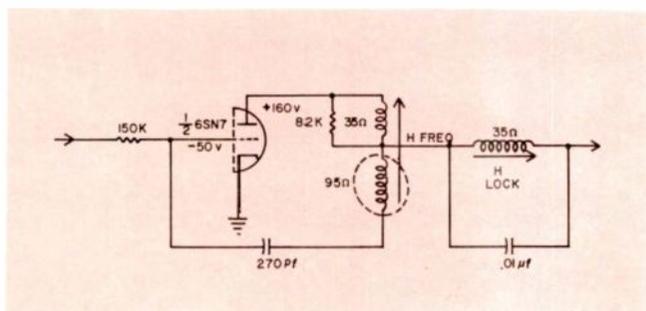
I handed him my new VOM. I pointed to the polarity switch on the brand new model. "This is what you mean," I smiled.

He nodded back and crawled under the chassis again. Quickly he noted no B+ on the oscillator plate. An oscillator coil led onto the plate. There was B+ on the other side of the coil.

A fast look at the schematic sheet revealed no other components nearby to cause complications. Diagnosis — open oscillator coil. A new coil was ordered and I lost the use of my VOM as John adopted it.

Continued on page 78

No. B+ was noted on the oscillator plate. An open coil prevented B+ from reaching the plate. A new coil solved the problem.



Antenna Installations for Color TV

Satisfy your color customers with
a good antenna installation

by John Holmes

■ When a dealer sells a B/W set, he very frequently leaves the installations entirely up to the customer. In most areas, the biggest problem is finding an outlet for the set's power. Color TV, however, poses some problems unlike any encountered in B/W work.

First, the antenna itself must be more precisely designed. It must have a relatively flat frequency range as wide as the channels being received in color. Ghosts are also more annoying on color broadcasts, so care must be taken to select an antenna with good directivity in areas where ghosts are prevalent.

Many antennas now being used for B/W reception will definitely prove inadequate for color reception. Considering that the set owner has paid from \$400 up for his set, you should have no trouble convincing him that he should also have a new antenna installation. Even

customers who have been used to "getting along" with a degraded B/W picture will be among the complainers with color programming. And where degraded B/W pictures were normal with the old set, a new antenna will definitely be in order for color.

Antenna Types

The same antennas which have been used for B/W reception can be employed with color with few exceptions. The old conical, for example, is an excellent antenna for color because of its wide response and its relatively flat response on any one channel. In areas where ghosting may occur with the B/W installation, the conical can't be used; it's simply not directional enough.

The *basic* type best suited for color reception is the *in-line* antenna. Although a simple in-line antenna

will not be sufficient for many installations, several of the "broad-banded yagis" available will fill the bill. These antennas should not be confused with the cut channel yagi which many manufacturers suggest should not be used with color sets. Modified yagi antennas are perfectly satisfactory for color TV.

Certain modified log type antennas are also acceptable for color reception. Remember that the goal in selecting an antenna is to find one with good directivity and uniform broad response.

Installing the antenna also requires greater care than installing a B/W antenna. If at all possible, the final antenna direction and height should be determined by the quality of a color broadcast. This leads to some interesting problems in the final installation which many of you haven't bothered to concern yourself with in B/W installations.

After It's on the Roof

After it's been determined that a particular location is the area of strongest signal and least ghosting, many installations will just be getting under way. When the antenna is rotated, for example, the set may overload and obscure the true picture condition. The AGC controls may be misadjusted, or the signal may be too strong. In the absence of a field strength meter, the only way to determine this is to adjust the set's AGC and signal strength reception controls. If the overload condition disappears, the antenna must be rotated again until an optimum picture is obtained. When the final antenna position is determined, the set controls should, of course, be readjusted.

In the event that the set's controls do not correct the overload condition, attenuation pads should be installed. Simple 6, 12 and 18 db pads are shown in Fig. 1. If a few of these are made up in advance, much time will be saved during the installation of either B/W or color sets in strong signal areas. The pad giving the strongest signal without set overload should be used.

The Lead-in

The most neglected part of a B/W installation becomes one of the most important ones in color TV antenna installations: the lead-in. Many types of lead-in are available and the technician owes it to his customer and himself to install the best lead-in for a given installation.

The difference in price of a sub-standard and a high quality transmission line for a TV installation is very small. And contrary to what you might think, if the antenna or transmission line needs maintenance or repairs within a year or two after the initial installation you probably won't get the business anyway. So select a line that will last four or five years in your locality. Special leads are available for almost every normal environment which will last at least five years.

Many twin leads are on the market which are so poor that the insulation becomes cracked and useless in less than a year. These leads cause fluctuating impedances and

signal losses which result in poor color or not uncommonly, complete loss of color.

Where a distribution system will be used with the antenna system, it may be desirable to use 75 ohm coaxial cable in place of 300 ohm twin lead. This will make the installation easier and at the same time eliminates noise or interfering signals from entering the lead-in. In apartment houses where noise may be more prevalent, this may be the only answer.

If 75 ohm line is used, matching transformers must be employed at the set and at the antenna. Depending on the make, matching transformers may also be necessary at the input, output or both when 75 ohm line is employed.

Any amplifier should be thoroughly checked to be sure that it will handle a color signal. Most of the units perform satisfactorily, but some do not. Don't buy blindly and find out later that it was a bad buy. You're simply wasting your time.

Set Location

Set location will play a part in the antenna installation. When installing a B/W set, the customer usually will tell you to "put it right there." Color TV, however, has some peculiarities that call for more care in selecting the set's location. In order to properly install an antenna, set location must be one of the first decisions.

Applying a few simple rules is all that is required to properly locate the TV.

First, by design, the color set has a picture which has considerably less brightness than the standard B/W TV. Consequently, viewing the set in a bright light is very difficult and sometimes even impossible. Also, colors which are saturated tend to take on a pastel appearance in bright light. To prevent this from happening, the set must be located so any outside light does not fall directly on the TV screen.

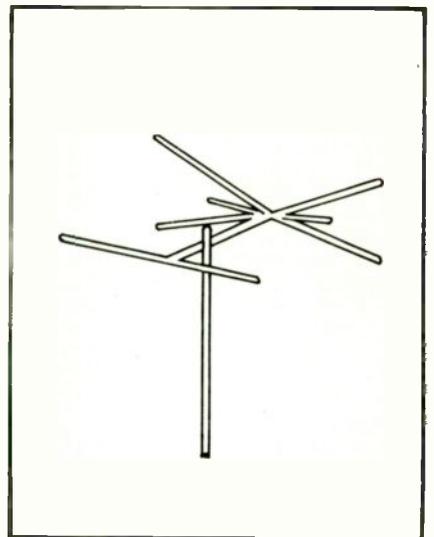
Artificial lighting causes the same problems and is usually easier to cope with since it can be moved or turned out. If artificial lighting is portable, it is best employed to the side or rear of the set.

Where the TV room is so "windowed" that the set cannot be lo-

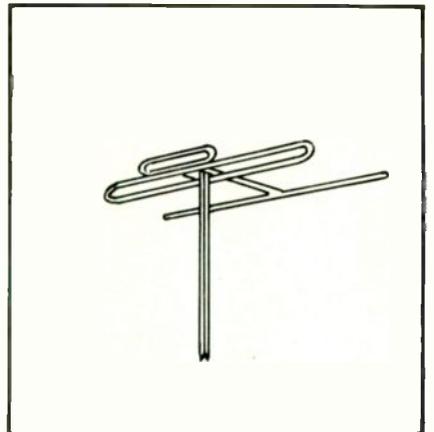
cated out of direct sunlight, generous use of heavy curtains or shades will be required. The customer should be informed of these facts so that he will not move the set across the roof and splice lamp cord to the antenna lead for an extension.

When the set location is determined, the best way to run the TV lead to the set must be considered. Unless it is not practical, the shortest routing should be employed as this will keep losses to a minimum.

After the set and antenna are installed, the line should be checked for standing waves. Most installations will have standing waves pre-



The conical antenna performs very well on strong signals where ghosts are not a problem.



The in-line type antenna is most suitable for color reception where ghosts may be prevalent.

Antenna Installations *Continued*

sent, either from the antenna design, the tuner design or from reflections in the lead-in because of the capacitance between the line and surrounding objects.

To check for standing waves, wrap a piece of aluminum foil around the lead-in and slide it back and forth on the line. If a change in the picture is noted, standing waves are present. The foil should be left where the picture is best.

One final precaution: don't let your customers try to get along with "rabbit ears" or a built-in an-

tenna. These antennas are simply not acceptable for color reception.

Sets employ a built-in antenna as a sales feature — to compete with other manufacturers. In some areas, these are acceptable for B/W reception. In no case, should they be used for color, however.

Color is still new enough that every color installation you make will be viewed by many people. If for no other reason you should make the installation good enough so that the picture speaks for the quality of your work. ■

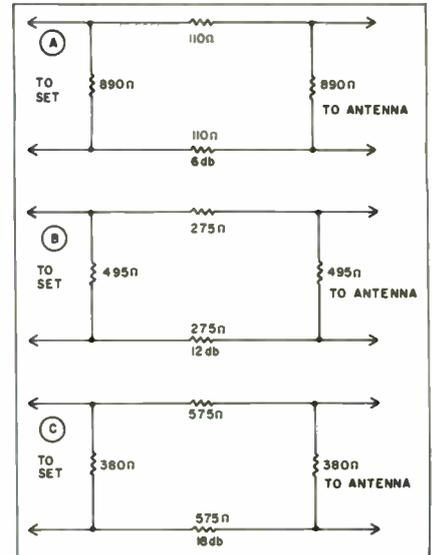


Fig. 1 (A)—A six db attenuator for signals that overload the receiver only slightly. (B)—A 12 db attenuator for strong signal overloads. (C)—An 18 db attenuator for exceptionally heavy overloads. One of these three attenuators should be suitable for any overload condition.

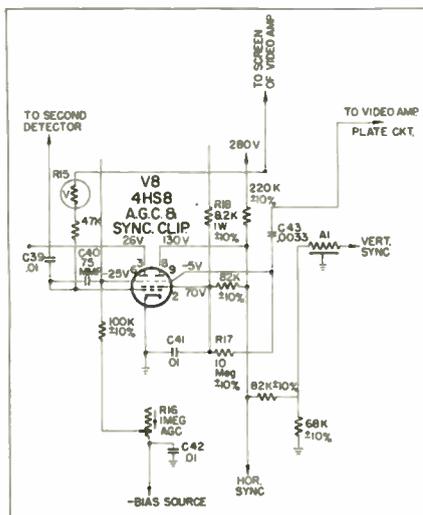


Diagram of Zenith's automatic "Fringe-Lock" circuit.

■ Among the changes in Zenith's new color TVs is the use of a 12-GN7 frame grid video amplifier tube with a G_m of 35,000 μmhos . This makes it possible to obtain a wider video bandwidth and to terminate both ends of the delay line.

Another circuit includes a contrast control of the video amplifier which is said to eliminate bouncing of brightness when the contrast control is rotated.

New Circuits for COLOR SETS

Current color sets also incorporate the automatic "Fringe-Lock" circuit. Before the automatic feature, the degree of noise immunity was determined by the adjustment of a control known as the "Fringe-Lock" control located in the noise gating grid of the AGC and sync clipper tube. This "Fringe-Lock" control was to be set by the serviceman to suit local signal conditions. In some instances, where both strong and weak signals exist, the noise protection of the weak signal needed to be compromised so the "paralysis" or "split phase" condition would not occur when switching to a strong signal channel. An automatic "Fringe-Lock" control system was developed which utilizes a voltage dependent resistor instead of the adjustable control.

As the signal level to the detector decreases, the video screen decreases in potential. Since the VDR

is connected to the video screen, less potential is applied across the VDR increasing its resistance. This action is the same as adjusting the "Fringe-Lock" control. Therefore, the noise protection required by a weak station can be obtained without compromise. Furthermore, each set no longer needs to depend upon correct adjustment by the factory, the television technician or the set owner.

Another change is the use of a potentiometer in the focus control circuit. This potentiometer is insulated above ground and is operated with only dc applied within the ratings of the control. This provides a smoother focus adjustment than the previously used tuned circuit, where the slug in the coil was rotated to vary the focus voltage. This is not to be confused with application of a pulse voltage to the control used in other receivers. ■

FCC's technical requirements for transistorized 'bantam' units must be maintained by repairing technicians

Servicing Hand-Held Citizens Band Transceivers

■ Public response to Citizens Band 2-way radio has been little short of fantastic. Sales doubled in 1962 and may repeat in 1963.

It is difficult to determine how many hand-held units are being used today. Designated to operate with not more than 100 mw input power they do not require licensing. A partial list of CB hand-held transceiver applications appears in 'Table I.

Although no license is needed to use 100 mw CB equipment, certain official requirements must be met:

1. Input power to the transmitter's RF output stage must not exceed 100 mw.
2. The RF carrier must be between 26.975 and 27.225 Mc. This prohibits its use on channel one of the 23-band CB spectrum.
3. Spurious radiations must be at least 20 db below the carrier.
4. Total length of the antenna must be less than 60 in.

Manufacturers, of course, meet the aforementioned requirements at the time the units are produced but it would be embarrassing to technicians if a unit did not maintain these requirements after repair.

Typical Transistorized Unit

The block diagram of a typical battery-operated, fully transistorized CB transceiver for channels 2-23, is shown in Fig. 1. This particular unit can also receive standard broadcast stations. It can be seen that the audio voltage is developed by the speaker, which functions as a microphone. The signal is amplified by the speech amplifier driver before it is used to drive the output modulators. The audio signal is then applied to the final amplifier where it causes the carrier signal to be amplitude modulated. The amplitude modulated RF signal is then radiated by the antenna. Let's have a look at circuit operation. (See complete schematic in the TEKFAK section.)

Since switching plays an important part in a transceiver's performance, operation of the spring loaded, push-to-talk switch, SW1A, is important. The following occurs when the push-to-talk switch is pressed to the transmit position:

The telescoping antenna is connected to the final amplifier output stage B—operating voltages connect to the transmitter oscillator stage, TR8. The speaker voice coil is connected to the driver stage, TR5. The speaker is now used as a micro-

phone. The modulation winding of T6 is connected to the transmitter's final amplifier tank circuit, TR9. It also supplies the dc operating voltages to TR9. The voice coil is connected to SW1C.

Speech Amplifier & Modulator

The speech amplifier is a straight forward transistor voltage amplifier. Its job, whether transmitting or receiving, is to amplify the audio signal applied to it. Whether transmitting or receiving, the output modulators also amplify the audio signal applied to them. They operate as a conventional transistorized pushpull power amplifier. The modulation stages have a biasing diode in the base circuit. This diode adds voltage and temperature stability to the modulator stages.

As shown in the schematic, the plus or cathode end of X3 is connected to R26 which in turn is connected to —11 v. Current flows from the —11 v. line, up through R 26 and X3 to ground. Since the resistance of X3 is small in the conducting direction, only a small voltage will be developed across it. This small negative voltage across the diode is applied through the secondary of T5, to TR6 and TR7 transistors' bases—providing them with a fixed bias.



Hallicrafters CB-4.



Lafayette HE-66L.

Transceivers Continued



Cadre hand-held CB transceiver.



Johnson 'Personal Messenger.'



Heathkit GW-31.

Diode X3 is also a temperature sensitive device, chosen to have heat characteristics similar to transistors TR6 and TR7. If the transceiver's temperature goes up, the resistance of diode X3 goes down and the voltage across it decreases. The forward bias of TR6 and TR7 transistors therefore becomes less. As the current through the transistors increases because of heat, their forward bias becomes less because of the diode action, reducing the current, and the effects of heat are counter-balanced or neutralized.

Another type of stabilization introduced by addition of diode X3 is supply voltage regulation. In the event battery voltage drops, as it

does under normal use, the transistor's emitter and collector voltages decrease, lowering the transistor's gain. But the voltage across diode X3 also decreases, thereby decreasing the transistor's base voltage. Decreasing the base voltage in proportion to the lowered collector and emitter voltages, permits the stage to continue to operate linearly. In short, diode X3 provides an automatic bias control on TR6 and TR7.

Oscillator

Since the transmitter and receiver used to communicate with each other operate on a single frequency, it is important that both are fixed

exactly to that frequency. To obtain this accuracy, crystals are used. Crystal pairs for Channels 2 to 22 are usually available and it is not necessary to make adjustments when crystals are changed.

Final Amplifier Modulation

Since RF carrier modulation actually takes place at the final amplifier, it might more appropriately be called either the modulation stage, or final amplifier. Hence the final amplifier's task is two-fold. One is to amplify the carrier signal generated by the crystal oscillator; the other is to combine this carrier signal with the audio signal to obtain an amplitude modulated carrier.

This is accomplished by what is comparable to conventional plate modulation, where an RF amplifier's plate voltage is varied at an audio rate. In the transceiver, the final amplifier's collector voltage is varied at an audio rate.

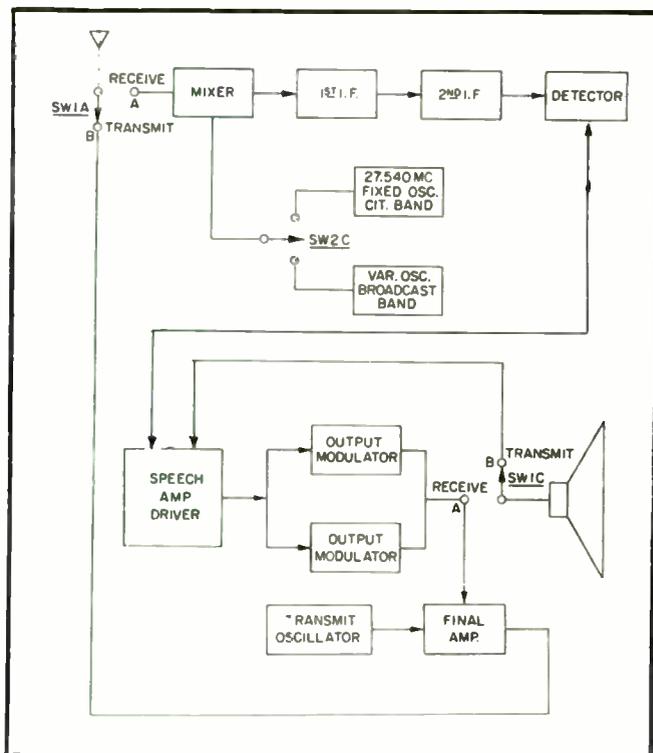
It can be seen on the schematic how modulation is accomplished. With SW1D in the transmit position, -12 v is applied to the final amplifier's collector (TR9) through the 115Ω modulation winding of T6. Assuming the audio voltage induced into this winding is an 8 v sine wave, depending upon its polarity, it would aid and oppose the -12 v supply. So the actual voltage applied to the final amplifier's collector will vary from a maximum of -20 to a minimum of -4 v. Thus the final amplifier's collector voltage is varied at an audio rate, causing the signal to be amplitude modulated before it is radiated by the antenna.

Receiving

Essentially, the receiver operates the same as a regular AM broadcast receiver except it has a fixed receiving frequency.

Let's follow the signal through the receiver. SW1 and SW2 are shown in the CB receive position on the schematic. Two crystals for channel 11 operation are installed—a 27.085 Mc transmitter crystal

Fig. 1 — Block diagram of typical hand-held transistorized citizens band transceiver. This particular unit is designed to receive the regular broadcast band.



and a 27.540 Mc receiver crystal. The 27.085 Mc signal is picked up by the antenna, heterodyned in the mixer with the crystal controlled 27.540 Mc oscillator, producing a 455 kc IF frequency. The IF signal is passed through two amplifier stages detected and fed to the speech amplifier. The audio signal

is then fed to a pair of transistors in push-pull, and then finally to the speaker. To make the receiver capable of tuning the AM broadcast band, a variable oscillator can be switched in by SW2C. When the selector switch is placed in the broadcast position, SW2C switches in the tapped tank circuit oscillator

CHART I

TROUBLE #1

Symptom — Set does not work on citizens band receive only.
Isolation — Switching the selector switch to R shows that the broadcast receiver operates normally.

Conclusion — Entire broadcast section of the receiver is OK, which means the common stages are OK (IF stages to the speaker). Trouble must be in the citizens band receiver oscillator circuit.

Possible Defect — Receive crystal X1 defective.

NOTE: Crystals are delicate devices and cannot be subject to abuse. If set shows signs of rough handling, it's advisable to check crystals thoroughly.

TROUBLE #2

Symptom — Set doesn't receive citizens band or broadcast stations.

Isolation — Check the transmitter by pressing the push-to-talk

button and check against a receiver or field strength meter. Transmitter works OK.

Conclusion — The transmitter working means the audio stages, TR5, TR6 and TR7, are probably OK. Barring a defective switch, the trouble must be in the mixer or IF stages since these stages are common to both CB and BC.

Possible Defect — Open IF can T3.

TROUBLE #3

Symptom — Set doesn't transmit.

Isolation — Checking the unit's other operations, by placing the selector switch, SW2, in either receive positions, shows receive sections OK.

Conclusion — The only stages the receivers don't have in common with the transmitter are the transmitter oscillator and final amp. Trouble is probably there.

Possible Defect — R31 open.

coil, T8, and the local oscillator is a Hartley-type variable oscillator.

Troubleshooting & Repair

When troubleshooting, it is necessary to note that the oscillator transistors, TR2 (receive) and TR8 (transmit) are slightly reverse-biased. With a tube-type oscillator, a quick check calls for measuring the negative voltage on the control grid to determine if the tube is oscillating. There is also a quick check for the transistor oscillator.

As seen on the schematic, the transmit oscillator transistor (TR8) base is one tenth volt less negative than the emitter and is therefore reverse-biased. For a PNP transistor to be forward biased the base must be more negative than the emitter, of course. The quick check of the oscillator stages then, is to see that the base is reverse biased by being slightly less negative than the emitter.

Since TR8 is reverse biased, only the more negative portion of the crystal output signal will cause TR8 to conduct. The crystal is vibrating at 27.085 Mc and supplies energy to the tank circuit, T7, at this rate. The tank circuit, in turn, rings or oscillates at its resonant frequency, in this case the same frequency as the crystal. The same can be said of the receive oscillator transistor, TR2.

Two stages use average gain transistors. One is the transmitter section, TR9, and the other is the receiver section, TR3. When replacing these transistors, only average gain transistors should be used. When TR3 replacement is not an average gain transistor, overall receiver sensitivity may be affected.

If receiver gain increases considerably and the receiver goes into oscillation when TR3 is replaced, the 150 K damping resistor R12, across T3 primary, should be decreased in value. Experimentally select a value between 150 K and 100 K until the receiver becomes stable and sensitivity becomes adequate.

If receiver gain decreases considerably when TR3 is replaced, then R12's value must be increased. Substitute a value between 150 K

and 330 K until receiver sensitivity is satisfactory.

When replacing the final amplifier transistor, TR9, an average gain transistor *must* be used. To insure that final amplifier input power does not exceed 100 mw and also that the input power is adequate, the following check can be made:

1. Remove the shorting bar, CCP2 shown in diagram near the battery symbol.
2. Connect a milliammeter (0-10 ma) in its place, observing polarity.
3. Press the talk button, SW1.
4. The final amplifier current should be 6.5 ma.

Adjustment of the drive control, R30, and the final tank coil, L3, should bring the final current to 6.5 ma.

If TR9 is replaced and the final current is low and can't be adjusted to 6.5 ma by L3, T7 and drive control R30, then resistor R29 must be changed. By experimentation, substitute a value for R29 between 33 and 15 Ω , so that the final current can be adjusted to 6.5 ma.

If the final current is high and can't be brought down to 6.5 ma and by adjusting L3 then R30, R29 must be increased in value. Try values between 33 and 56 Ω until the final current can be adjusted to 6.5 ma.

Some interaction may be noted between the adjustment of R30 and L3. To adjust properly rock both adjustments.

With TR8's collector current set to 6.5 ma, the final amplifier's input power is about 78 mw.

It must be remembered that with the numerous contacts involved in two switches, SW1 and SW2, they should be considered when isolating defective stages.

When the set is completely inoperative, after a quick power supply check, the most logical place to look for a defect is the audio stages. These stages are common to all functions, receive and transmit. This should be regarded as a quick isolation check because it doesn't rule out the possibility of two or more defects in separate sections of the receiver.

Further troubleshooting information would be too repetitive since

the set in the R (broadcast receive) position is a conventional high quality AM broadcast receiver. ■

This article was based on information furnished by Westinghouse's TV-Radio Division.

TABLE I CB APPLICATIONS

1. Plant security patrols
2. Roving supervisory personnel
3. Crane operators in steel industry
4. Materials handling in intra-plant
5. Materials handling to yard & fork-lift trucks
6. Departments to inventory warehouse
7. Inside shipping department
8. Guided tours
9. Dispatcher to loading platform
10. Vest pocket annunciator
11. Plant engineer to maintenance superintendent
12. Emergency backup for regular 2-way communications systems
13. Model shop to tool crib
14. Warning systems, dangerous locations
15. Steel mill control console to workers on floor
16. Quality control to production
17. Plant engineer to boiler room
18. Coordinating testing
19. Lumber mill to field logging
20. Oil field to rig supplies
21. Looms to raw fiber supply
22. Multi-level printing presses
23. Quarry pit to processing machinery
24. Sales office to mobile salesman
25. Lumber stock record to kilns or yards
26. Inventory to purchasing
27. Pipeline maintenance — field to central office
28. Bridge construction
29. Building construction
30. Siding to sugar mill batch feed
31. Dispensary to factory floor
32. Hangar to airfield office
33. Drafting room to drafting storage
34. Drafting room to prototype design
35. Chemical processing to laboratory
36. Dam power inspection to office
37. Rail siding to receiving and shipping
38. Drydock & shipbuilding operations
39. Fire fighting coordination
40. Farmhouse to planting, cultivating and harvesting equipment in field
41. Geological surveys on prospecting
42. Land surveys
43. Road construction operations
44. Power and telephone line maintenance
45. Large building maintenance superintendent-to-personnel
46. Radio interference location operations
47. Antenna orientations and field strength measurement operations
48. Civil defense
49. Campers and hunters
50. Search-party operations in woods



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Difficult Service Jobs Described by Readers

Booster Generates Hum Bar

I recently made a call on a 14-YP3D Admiral portable. The customer complained about a faint hum bar that was creeping its way from the bottom, up and out of the picture. As soon as the bar disappeared another one would start slowly creeping up and out again.

The customer complained that another technician had worked on the set a few weeks before and it was only since then that this trouble became evident. It looked like a simple case of poor filtering to me so I could hardly hold anything he did responsible for this problem. I explained this to the customer; feeling satisfied that this was a brand new condition, the customer agreed to let me take the set to the shop.

I've serviced this type of capacitor before and it has usually turned out to be a leaky filter condenser. The B+ filters and the vertical output tube cathode filter are generally all parts of a multi-section filter can. When the dielectric separating the sections breaks down, a small portion of the high ac pulse voltage makes it way over to the vertical output tube and shows up as a faint hum bar slowly creeping through the picture.

Before I completely dismantled the receiver, I thought I would check my diagnosis by taking a scope check at the vertical output cathode. This receiver is the double-decker chassis variety so I first swung the printed circuit IF chassis down on its hinges, plugged a nine pin test socket into the vertical sweep tube socket. After reinserting the vertical tube, I connected the scope to the cathode terminal. When I finally turned the receiver on, much to my dismay, the hum bar was gone.

I operated the set this way for

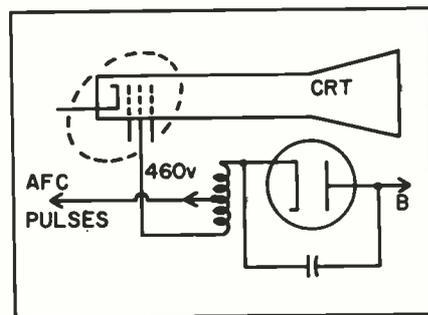
two days hoping the hum bar would reappear, but it didn't. I removed my test setup and screwed the IF chassis back in place and placed the set aside to cook some more. When the switch was turned on again, I was surprised to see that the hum bar was back again.

I swung the set around to face the shop mirror and proceeded to swing the IF chassis down and out of the way once more. Again I noticed that with the chassis swung down, the bar disappeared. The solution suddenly became clear.

The serviceman before me installed a picture tube booster. This being a very tight set with limited room, he tucked the booster right up against the picture tube neck. Being so close to the kine gun, the small transformer inside the booster was modulating the beam with 60 cps filament voltage. When I first lowered the IF chassis, the booster pulled away from the kine explaining why I lost the bar. When I reassembled it, I made the same mistake as the other fellow and tucked the booster up tight again. I relocated the booster a little further away from the kine and the problem was solved. — *Frank A. Salerno, Long Island City, N. Y.*

CRT Causes Reduced B+

I was called on to service a Motorola RTS 525A-03 chassis with "no raster." Close observation of the screen in a dark room revealed a faint picture. The high voltage arc looked good. However, I decided to supply a plate drive pulse from my sweep analyst to the plate lead of the 6BQ6. This failed to produce a raster improvement. Substituting a new 1B3 did not help. A check of B+ showed it to be low, so I replaced the selenium rectifiers.



This brought up the B+ and revived the set.

Thinking my troubles were over, I replaced the chassis in the cabinet. The original trouble had returned with dividends; in addition to a dim raster, the horizontal oscillator was off frequency! After adjustments and a few other checks failed to show any promise, I pulled the chassis and took it back to the shop for more extensive checks.

At the shop, voltage checks revealed that things were OK along these lines. I tried a new yoke, but this did not cure the trouble. I studied the schematic very carefully noting that the boost voltage was also fed to pin ten of the 21YP4. I decided to try my substitute picture tube. The set was back on frequency and a perfect picture appeared. Replacing the 21YP4 picture tube completed the repair. — *P. R. Savage, Jr. Decatur, Ala.*

TOUGH DOGS WANTED

\$10.00 paid for acceptable items. Use drawings to illustrate whenever necessary. A rough sketch will do. Photographs are desirable. Unacceptable items will be returned if accompanied by a stamped envelope. Send your entries to "Tough Dog" Editor, ELECTRONIC TECHNICIAN, 1 East First St., Duluth 2, Minnesota.

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SHOP HINTS

TIPS FOR HOME AND BENCH SERVICE

Eliminating Noise on "Seeker" Tuner

On some auto radios with touch-tuners objectionable noise develops while the searching motor is operating (seeking station). To correct this condition, obtain some three-in-one oil and mix with equal parts an oil additive known as "STP." Carefully apply this oil mixture to both bearings (front and rear) of the search tuner motor, one drop will usually do the trick. This mixture is also great for Generators and other small Motors, Tape Recorder bearings and anything that requires a long lasting lubricant. — *Floyd A. Roberts, Kearney, Nebraska*

Cleaning Tube Pins

I find cleaning tube base pins with contact fluid when I have them out for testing improves performance of many sets; especially the miniature tube pins. — *H. E. Barta, Hepler, Kansas*

Solder Remover

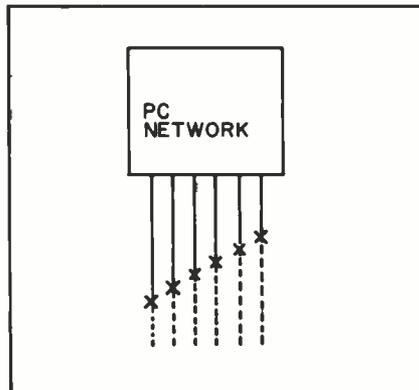
Solder can be cleaned from points with a special tip. The old tip of the iron is removed and replaced with a 1 3/4" length of 3/16" copper tubing, flare one end slightly and thread the other end to fit the heating element. Drill a small vent hole near the threaded end as shown.

To clean a solder connection apply the hot iron tip to the connection and the molten solder is drawn up into the hollow tube by capillary action. When the tube becomes

full it is emptied by merely shaking the iron while hot. — *Robert L. Howell, Berlin Heights, Ohio Sarasota, Fla.*

Network Replacement

To replace transistors, or resistors — capacitor networks with long wire leads — cut the leads in a



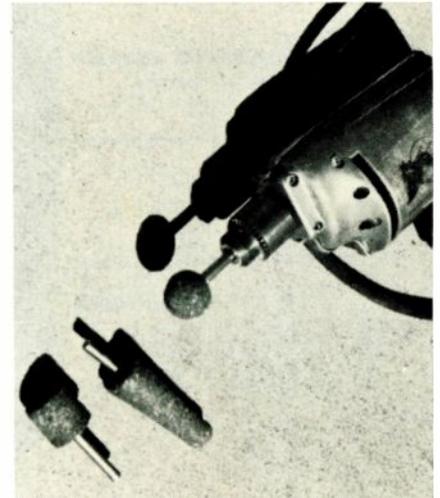
Multiple wire PC networks can be installed easily if leads are stagger-cut.

"step" fashion. Then by heating the back side of the printed board each wire can be pushed through separately.

— *Ivan Ruggles, Lubbock, Texas*

Rivet Remover

One of the best time savers we have in the shop is a set of three vari-shaped grinding bits for our electric drill. There's no faster way of getting off riveted components like interlocks, than by touching the whirling burr to the heads of the rivets. They come off in no time and avoid damage trying to remove



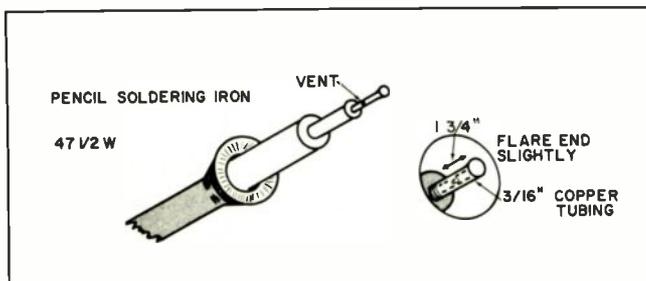
Grinding bits speed removal of rivets.

them by drilling, etc, especially in close-in work. The burrs are inexpensive, last a long time and are obtainable in hardware stores and hobby shops. — *Harry J. Miller, Sarasota, Florida*

Liquid Lock Washer

When assembling components destined for a mobile rig in a jouncing vehicle, we've found it very useful in preventing premature breakdown, to dip the threads of mounting screws, nuts and bolts in a bit of ordinary shellac.

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Modified soldering iron tip for printed circuit work.

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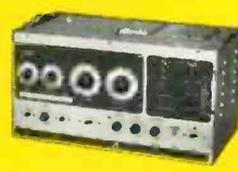
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Automatic VOM



Model 375 Dynamatic
Automatic VTVM



Model 1076
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NEW PRODUCTS

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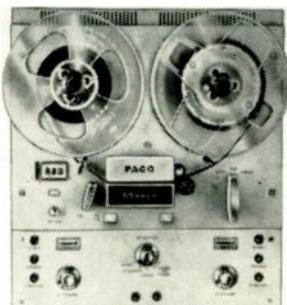
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STEREO TAPE DECK 201

A 3-speed stereophonic tape deck and preamp combination is claimed to offer utmost versatility and be ideal for rack mounting or custom installation. Featuring an integrated dual preamplifier, it permits 4-track stereo and mono record/play; 2-track stereo and mono playback; and facilities for sound with sound



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SPEAKER KIT 202

A pre-finished loudspeaker kit reportedly can be constructed by the novice in less than twenty-minutes — without tools. Christened the Coronet, the system combines an 8 in. extended-range loudspeaker with a ducted-port acoustic phase-inverter enclosure. Three versions are available: the Coronet I, which includes the enclosure kit and

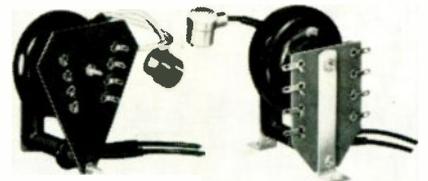


an 8 in. MC8 Michigan loudspeaker; the Coronet II, including enclosure kit and a Wolverine LS8 loudspeaker; and the Coronet III, which includes enclosure materials and an SP8B. The Coronet I will sell to audiophiles for \$39; the Coronet II, for \$43.50; and the Coronet III, for \$54. (Prices, west of the Rockies, are slightly higher.) All systems feature exterior surfaces of select hardwood veneers, pre-finished in oiled walnut. The design which makes possible "the industry's first tool-less loudspeaker system kit," is said to be the system of interlocking tongue-and-groove joints, further secured by four threaded rods which extend vertically through the unit, fastened by wing-nuts which are recessed into wells in the bottom. Strips of adhesive-backed gasket tape, of polyurethane foam,

are used to line the joints, assuring tight, rattle-free construction. Electro-Voice, Inc.

FLYBACK TRANSFORMER 203

Four exact replacement flyback transformers are now available. When used in the following applica-



tions, no circuit or chassis alterations are required. HO-345 replaces Philco 32-8855-1, -2, -5, and -8 in 76 models and chassis. HO-349 replaces Philco 32-8993-3 in 47 models and chassis. The HO-350 replaces Admiral 79D83-4, -5, -7, -8 and -10 in 32 models and chassis. The HO-351 replaces Admiral 79E77-11, -14, and -15 in 36 models and chassis. All these units are now being stocked by distributors. Stancor Electronics, Inc.

RADIO CONTROL 204

A complete radio control system for automatic remote operation of doors, lights, signals, motors, etc., the Model RT-400, has a suggested user price of \$99.50. Operating is up to 500 ft. when used outdoors in unobstructed areas. Indoors, distance will vary from 50 ft to several hundred ft, depending upon the structure of the building and the



DESIGNED FOR COLOR TV

WINEGARD COLORTRON ANTENNAS

4 gold anodized models from \$24⁹⁵

*Pat. Nos. U.S. 2,700,105; 2,955,289 • Canada 511,984 • Others Pending.



**NUVISTOR
AMPLIFIER**
\$39⁹⁵

AVAILABLE WITH REVOLUTIONARY NUVISTOR COLORTRON AMPLIFIER...

Now, through continuous Winegard research, a new, improved Electro-Lens yagi has been developed—the NEW WINEGARD COLORTRON—PERFECT ANTENNA FOR COLOR TV!

Colortrons have a flat frequency response (plus or minus 1/2 DB across any 6 MC channel), no “suck-outs” or “roll-off” on end of bands . . . accurate 300 ohm match (VSWR 1.5 to 1 or better) . . . unilobe directivity for maximum ghost and interference rejection. They deliver today’s finest color reception, give a new picture quality to black and white. Colortrons are the only outside antennas that carry a WRITTEN FACTORY GUARANTEE OF PERFORMANCE.

And Colortrons are built to last. High tensile aluminum tubing for rigidity and stability, insulators with triple moisture barrier, GOLD ANODIZED for complete corrosion-proofing.

There are 4 Colortron models to cover every reception need, from suburbs to distant fringe areas . . . \$24.95 to \$64.95 list.

New Winegard Colortron twin-nuvistor amplifier perfectly matches Colortron antennas. Gives added gain and sensitivity on both color and black and white. Ultra-low noise, high

gain Colortron Nuvistor Amplifier can easily drive 6 or more TV sets.

With revolutionary twin-nuvistor circuit, Colortron amplifiers can handle up to 400,000 micro-volts of signal without overloading. *This is 20 times better than any single transistor amplifier.* The Colortron Amplifier will bring the weakest signals up out of the snow, yet strong local TV & FM signals will not overload it. A special life saver circuit gives the two nuvistors a life of 5 to 8 years.

This amplifier is completely trouble free and the finest performing antenna amplifier you can own.

Completely weather sealed, nothing is exposed to corrode and cause trouble . . . has all AC power supply with 2 set coupler. (Model No. AP-220N, \$39.95 list). Twin transistor model also available up to 80,000 micro-volts input. *New type circuit protects transistor from static electricity built up in lightning flashes.* (Model No. AP-220T, \$39.95 list).

Colortron Amplifier can be added to any good TV antenna for sharper, clearer TV reception.

Ask your distributor or write for technical bulletin.

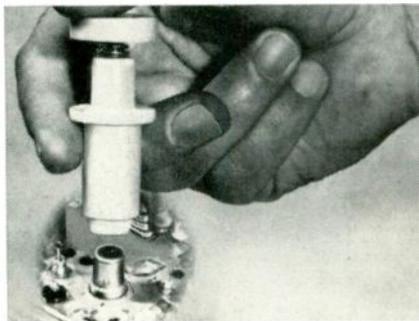


NEW PRODUCTS

presence of metal obstructions, such as wiring conduits piping, duct work, columns, etc. The system consists of a portable pocket sized transmitter with self contained antenna and battery, and a receiver contained in a metal enclosure with flanges for wall mounting. Perma-Power Co.

TUBE PULLER 205

The TP-1 tube puller was designed for removing nuvistor tubes, too small to be removed with conventional tube pullers. It is

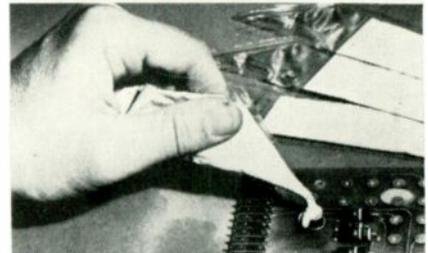
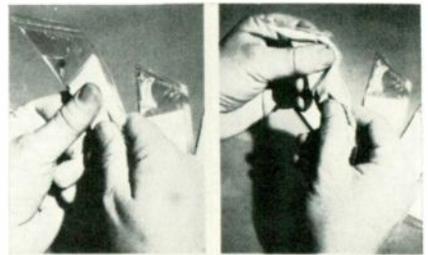


designed with an internal spring mechanism that firmly grips the tube without danger of denting, scratching, or other damage, the manufacturer says.

Cinch Manufacturing Co.

SQUEEZE PACKS 206

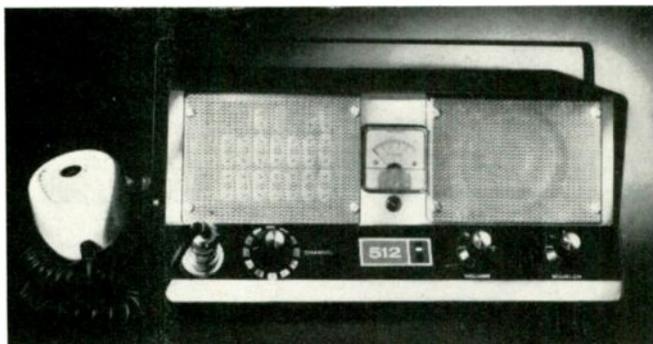
Instant squeeze packages of silicone are available for the encapsulation of electronic components. The unit packages contain precisely measured amounts of silicone RTV resin and catalyst. The two components are kept separate by a heat-seal barrier until ready for use. Intermixing is accomplished by squeezing the resin compartment to break the seal. The components are then mixed by massaging the package for approximately one minute. A funnel tip is provided for dispensing the catalysed resin, which cures into a solid rubber at room temperature in five minutes or less. The Instant Rubber packages are claimed to eliminate any chance of error in measuring and mixing the components, thereby simplifying quality-control procedures. Standard packages of Instant Rubber



contains 1/2 oz of resin and catalyst. Price for a box of 10 units is \$5.25. Laguna Labs.

AUTO/HOME STEREO 207

An auto/home stereo set may also be installed in pleasure boats, trailers, and airplanes. The in-car installation includes the basic Model 100 set having 4-in. speakers, two in back and two in front. The set nestles beneath the dash or other convenient location. It has 10 tran-



List Price \$149.50

HALLMARK 512

UNEXCELLED IN PERFORMANCE, STYLING AND RUGGED RELIABILITY!

Today's best selling CB from Hallmark features dual-power. 12 channel crystal-controlled, push to talk operation. Sensitivity better than 0.3µv for 10 db S N ratio. Selectivity better than 30db. RF power over 3.2 watts. Audio power 3 watts. Top-quality components in rugged hand-wired chassis. 26.965 to 27.255 mc. High-level modulation, improved low-noise front end. "S" meter and neon modulation indicator standard.

NOW FROM HALLMARK! NEWEST ADVANCE IN IMPROVED MULTI-PURPOSE TRANSCEIVER TESTERS!

Price \$ 49.50



A precision instrument designed to assist the technician in installation and servicing of low power transceivers. Measures: RF power (absolute) 0-5 w.; 0-120% amplitude modulation; VSWR; Produces a 100mw carrier (with or without amplitude modulation of a 1000 cps tone) for checking receivers; Use as a field strength meter.



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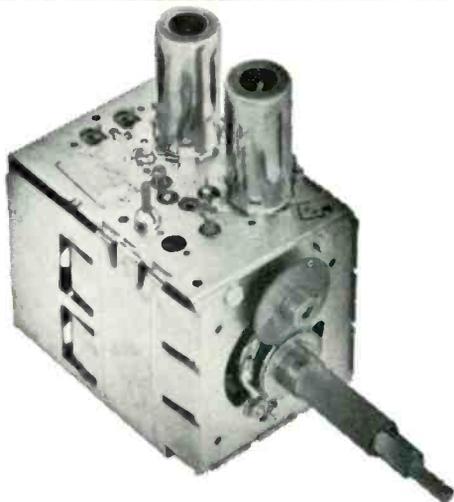
Company Name

Street Address

CityZone.....State.....

Prices effective January 1, 1963

Tarzian offers
**FAST, DEPENDABLE
TUNER REPAIR
SERVICE (ALL
MAKES)**



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

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

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

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

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

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Bloomington, Indiana

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

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ALL PARTS
(except tubes)
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ALL TAPE HEADS WEAR OUT! HERE'S HOW AND WHY!



Magnetic tape itself is the real cause of head wear!

The abrasive action of tape as it passes over the head face gradually wears away the *depth of metal* left on a new head after final polishing (see above). Because wear is nearly always uneven, craters or ripples are also formed on the face as wear progresses, thus making it impossible to achieve good contact between the head gap and the all-important signal recorded on the tape. The severe high frequency losses and erratic output resulting from poor tape-to-gap contact are very annoying to the ear. Head wear should NOT be permitted to reach this point — much less go beyond it to the limit where the gap actually begins to open up.

By replacing the worn head with a new Nortronics professional type of laminated tape head you will obtain improved high frequency response over the original head, plus the added feature of longer life since laminated heads have 50% more depth of metal at the gap. Nortronics manufactures both laminated and solid-core heads, but recommends the use of the laminated types for up-grading of your customer's recorder.

CHECK into the profit-packed Nortronics Tape Head Replacement Program NOW!

This new program offers you the opportunity to get in on the ground floor. Replacement of worn tape heads is profitable — is easy — is ever-growing in demand. If your local representatives can't help you — write Thor Johnson, Distributor Sales Manager.

*"Music sounds best on Tape —
Tape Sounds Best
with Nortronics Heads"*

Nortronics 

8133 10th Ave., N.
Minneapolis 27, Minn.

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NEW PRODUCTS



sisters, a 12-v system that will operate on 9 to 14 v, drawing less than 1 amp. Cost of the set including installation approximates \$150. The standard home adapter includes a converter element which houses the auto/home stereo and transforms 110-120 v, 60-cps ac to 12 v plus/minus 2 vdc; plus two walnut speaker housings that sit on table or hang on wall. Cost of this optional home adapter assembly is about \$70. Diamond Electronics, Inc.

CAR RADIOS 208

A line of custom auto radios includes 24 exact-fit, custom-look models. Features include a built-in



fader control for push-button models. In addition to the custom models, the company also offers three Universal model auto radios for installation in sports cars, foreign cars, trucks and boats. Tenna Corp.

FM STEREO TUNER 209

Equipped for stereo reception, the new 310E FM tuner utilizes



time-switching multiplex circuitry for achieving optimum stereo separation. Features claimed for the 310E include: sensitive, illuminated tuning meter for optimum orientation and station selection; convenient front-panel recorder output jack; laboratory-type precision vernier tuning control; auto-sensor circuitry for fully automatic operation; and mode control with FM monophonic, FM stereo, and FM stereo automatic positions. The 310E carries a net price of \$279.95. H. H. Scott Inc.

SOLDER REMOVER 210

Soldapullit is a portable hand tool for component rework. It is said to be a convenient method of de-



soldering radio and television components on printed circuit boards. It features a high impulse of 25 in. of Hg vacuum and a self cleaning tip. It reduces solder splash and overheating of solder connections and simplifies removal of multi-component terminal connections, expediting component replacement, claims the manufacturer. Edsyn Engineering.

CB TRANSCEIVER 211

A 10-channel citizens band transceiver employs a solid state frequency synthesizer so that the same



crystal can be used for transmitting as well as receiving. Supplementing the 10 crystal-controlled channels, the unit is equipped with a tunable receiver covering all frequencies

within the 27 Mc citizens band. This enables users to monitor any channel and to pinpoint clear channels. In addition to the frequency synthesizer said to cut crystal costs, the TWR 3 features a sensitive RF stage. This coupled with exceptionally low internal noise levels is said to make unit particularly effective for receiving distant and weak signals. High electrical efficiencies produce 3.2 w output from the maximum input permitted by the FCC. The suggested list price is \$219.95. Raytheon Co.

COMM SYSTEM 212

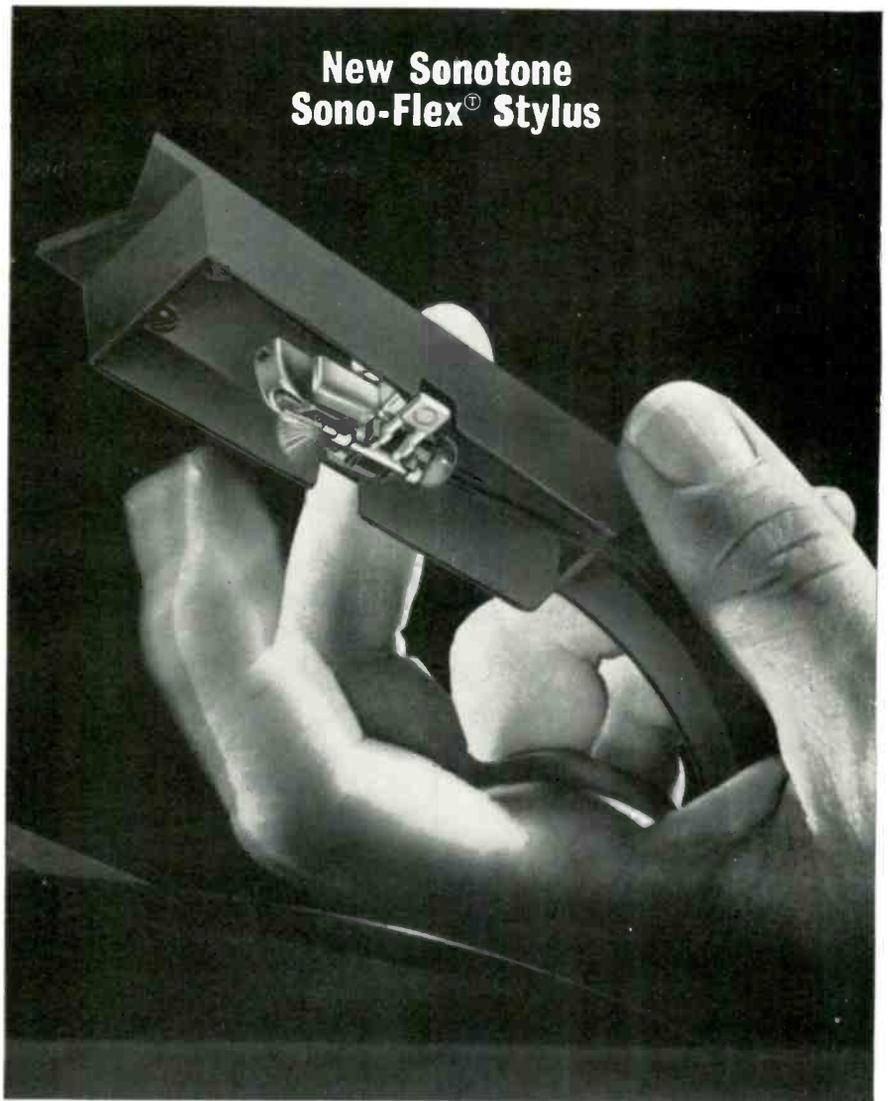
A transistorized two-way communications system aimed at home or business use, the Interphone, has been introduced. Designated as Model 6555, the transistorized interphone is battery-operated. Light and compact, it can even be hung on a wall. Either unit, master or slave, can initiate calls. The master unit can be set to insure privacy, yet can



be buzzed at any time. A volume control feature is included. List price is \$34.95. Channel Master Corp.

FUSE PACKAGING 213

The Visual-Pak, a package of glass tube fuses, has a clear plastic bottom with a metal slide top. This combination is said to make the top firmly grip the bottom and securely lock, thus eliminating the danger of the top coming off and spilling the fuses. The new type metal top has a flat end so that the type and size of fuses can be shown in large clear letters. Bussman Mfg.



New Sonotone Sono-Flex[®] Stylus

try this with any other cartridge
(at your own risk)

No way to treat a cartridge, for sure—That is, any cartridge except the Sonotone models featuring the new Sono-Flex[®] needle. No more bent or broken needle shanks caused by flicking off some lint, dropping the arm, or scraping it across the record.

The newly developed Sonotone Sono-Flex[®] needle to the rescue! Gripped in a resilient butyl rubber mount, you can flex this needle shank in a 360-degree orbit without breaking. Pluck it—flick it—bend it—bump it—it will continue to perform as good as new.

Moreover, the Sono-Flex brings advantages in performance never before offered by any replacement cartridge: Higher compliance, wider and flatter frequency response, lower IM distortion, and longer needle and record life.

Sonotone Sono-Flex[®] increases your profits two ways

Sonotone cartridges are better than ever, easier to sell, because they're better performers. Further, you eliminate callbacks because of broken needle shanks. Sono-Flex needles are standard right now in these Sonotone cartridges models: 9TAF, 16TAF, 916TAF and the Velocitone Mark III.

Sono-Flex opens up lucrative needle replacement business for upgrading these Sonotone cartridges models: 9T, 9TA, 9TV, 9TAV, 16T, 16TA, 16TAF and 916TA, original equipment in over a million phonographs. Replacement is fast, simple—requires no tools—assembly snaps into position easily, and gives immediate proof of better performance plus abuse-proof, longer needle life.

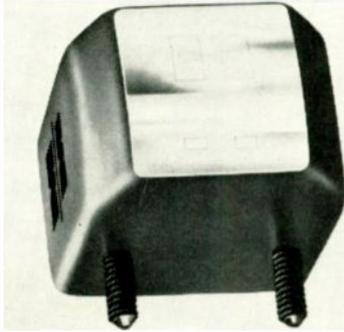
See your distributor today and ask for Sonotone cartridges with the Sono-Flex[®] needle.

SONOTONE CORPORATION Electronic Applications Division Elmsford, New York
In Canada: Atlas Radio Corp., Ltd., Toronto • cartridges • speakers • batteries • microphones • electron tubes • tape heads • hearing aids • headphones

NEW PRODUCTS

TAPE RECORDING HEAD 214

A triple-action, one component tape recorder head that records, plays and erases has been marketed.



The all-metal faced head can erase one track at a time or both tracks simultaneously. Its tapered design is said to prevent incorrect insertion of reels or tapes. Michigan Magnetics Inc.

PLAYBACK SYSTEM 215

A longer-play Symphonair Music System is offered with playback



The happiest customers are serviced by repairmen who use Quietrole... the amazing lubricant that so effectively silences pesky, noisy controls and switches on radios, TV sets and electronic instruments. If you want to leave your customers smiling, you'll do what good servicemen do everywhere... **USE QUIETROLE!**



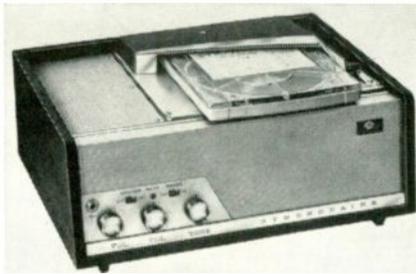
manufactured by



COMPANY

Spartanburg, South Carolina
In Canada: CROSS CANADA ELECTRONICS
12 Laurel Street, Waterloo, Ontario

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equipment which provides four hours of continuous general background, mellow moods, show tunes, dinner music, industrial and special selections by leading musical groups, without repeating. To support the 4-hour service feature, a new direct drive repeatable tape transport has been designed. National Sound System.

ANTENNA SYSTEMS 216

Three indoor antenna systems have been introduced. The Twin shown consists of two separate an-



tennas coupled to a common feed line. The Color Master may be used as a color television antenna, a black and white television antenna, an FM monaural and stereo antenna, and a master distribution television and FM amplifier system, the manufacturer says. The Discovered, for broadcast and short wave frequencies, has a built-in, fully transistorized preamplifier, which increased the strength of the signal at the receiver. Gallo Electronics Corp.

MONITOR RECEIVER 217

A crystal-controlled VHF-AM monitor receiver for the 100-150 Mc/s range, the AMR52-X can, according to the manufacturer, be equipped for receiving on any frequency in the following bands: 108:

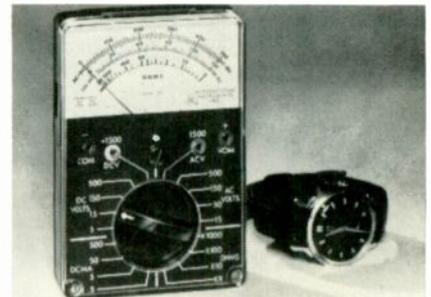
135 Mc/s aeronautical band; 136-137 Mc/s earth-space band; 143.91 Mc/s and 148.41 Mc/s Civil Air Patrol land and mobile channels; and the 144-148 Mc/s (2-meter) amateur band. The AM receiver is available in single and multi-chan-



nel types. Hammarlund Manufacturing Co.

MULTI-TESTER 218

The VOM-22 is a miniature multi-tester said to have a sensitivity of 20,000 ohms/v dc and 15,500 ohms/v ac and 18 different measurement ranges. Equipped with thumb-operated ohms adjust, external zero adjust and detachable leads, the multi-tester has five different ranges for ac voltage, five for dc voltage, four for dc milliamperes and four for resistance. Complete



with leads and batteries, it is priced at \$36.90 International Instruments, Inc.

INDOOR ANTENNA 219

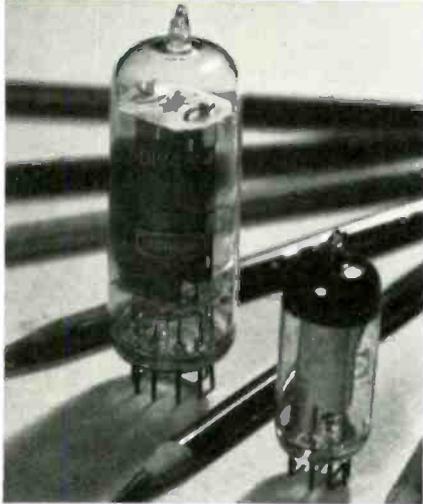
The FM 1000 Indoor antenna is said to have been engineered and



perfected exclusively for FM multiplex, stereo and Hi Fi. It features a combination of matched components, special noise filtering circuit, and 12-position direction finding switch. The unit is fair traded at \$6.95 retail. All Channel Products Corp.

COLOR TV TUBES 220

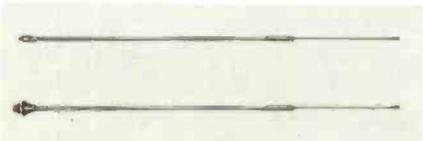
Two tubes for use in color television circuits have been introduced. Designed particularly to



handle the higher dissipations and voltages of color TV receivers, the nine-pin 6DW4A is a heater-type diode for use as a horizontal frequency damper. A filamentary diode designed as a high voltage focus rectifier in color TV receivers, the 1AU2 is directly replaceable for the 1V2. The tubes have a suggested unit list price of \$2.10 for the 1AU2 and \$3.70 for the 6DW4A. Raytheon Co.

CB ANTENNA 221

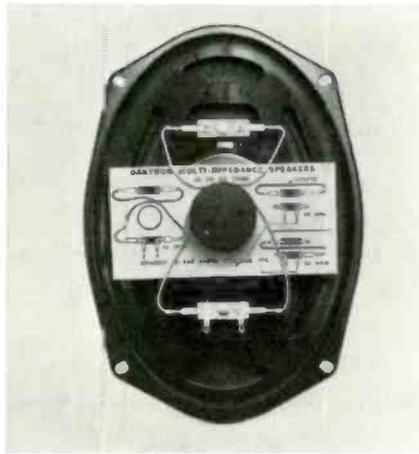
This tuneable mobile CB antenna is a copper-sheathed fiber-



glass rod encapsulated in a waterproof plastic sheath. It is 48" high. New-Tronics Corp.

SPEAKER LINE 222

A multi-impedance replacement speaker line utilizes multiple-winding voice coils. The multi-impedance speaker line boasts the alum-



inum voice coil plus extra-heavy windings claimed to handle maximum power without overheating or loss of efficiency. Oaktron Industries.

MICROPHONE HOLDER 223

The No. 65-525 magnetic microphone holder need not, the company says, be permanently mounted, but relocated time and again on any metal surface to suit the desired availability of the user. The magnet is said to have a holding

INSTALL and SERVICE COLOR TV in the HOME



**FAST-SIMPLE
COLOR and
Black & White
SERVICING**

ONLY

5950



TEST PATTERN GENERATOR

Designed for low cost color servicing . . . on location! Light-weight, compact, GC's new Color Test Pattern Generator eliminates lugging heavy, bulky equipment into the customer's home—allows Color set-up, final convergence and purity checks to be made quickly, easily . . . economically!

Simple to operate . . . easily connected, the generator produces 3 different patterns, each with a specific function, including individual switching for any combination of three color guns . . . for fast purity or convergence checks without upsetting color controls.

PLUS . . . many more features! Complete specifications are available from your GC distributor or by writing GC.

No. 36-610 Complete in rugged, handsome carrying case. . . . Net \$59.50

GENERATES THESE PATTERNS



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Write for the all new GC 340 page Master catalog . . . with the complete Test Equipment line and over 12,000 other products.



GC ELECTRONICS CO.

DIVISION OF TEXTRON ELECTRONICS, INC., 400 S. WYMAN STREET, ROCKFORD, ILLINOIS, USA

for more details circle 18 on post card

NEW PRODUCTS



capacity up to 12 lb. It has a net price of \$.99. G. C. Electronics Co.

OSCILLOSCOPE 224

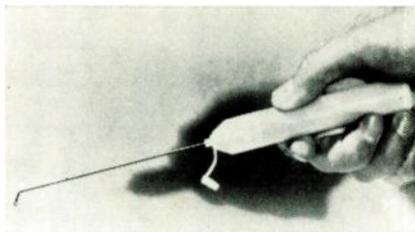
This compact and lightweight general-purpose oscilloscope has a 3 in. flat face CRT and mu-metal



neck shield. It features direct connection to vertical deflection plates without need of removing and replacing shorting links or wires. Test leads are simply plugged into rear jacks and the switch is turned from amplifier to direct plates. The list price for the kit is \$65.95. Wired it is \$99.95 Eico Electronic Instrument Co.

PEN OILER 225

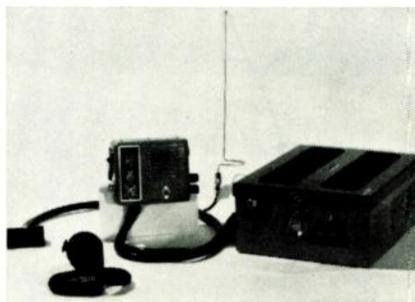
The plastic Oil-Mite pen oiler has an extending retracting "needle-thin" stainless steel tube. With finger tip control, the special instrument oil is easily dispensed through the tube a drop or fraction of a



drop at a time, the manufacturer says. The over-all reach is over 9". Armitte Laboratories.

UHF-FM EQUIPMENT 226

The Model 684 Ultra Basecom and the Ultra Fleetcom (shown) mobile units are said to provide a UHF radio system featuring high transmitter powers for extended range. The Model 684 Portacom is available in a hand-carried case with self contained speaker and controls for installations requiring frequent



moving of the radio equipment from vehicle to vehicle, or vehicle to base. Communications Co.

CATHODE TUBE 227

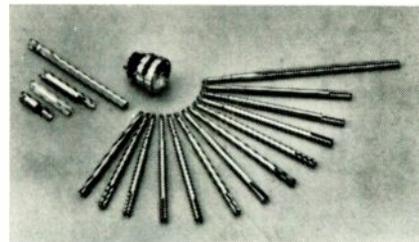
The 8408 harp cathode tube utilizes a frame grid. It features a power output of 6w at 500 Mc with an instant heating warm-up time of less than 0.5 sec, the firm claims. The tube is a push-pull tetrode designed for use as an RF amplifier or frequency multiplier in transistor-



ized vehicular transmitters. Amperex Electronic Corp.

PUSH-PULL CONTROL 228

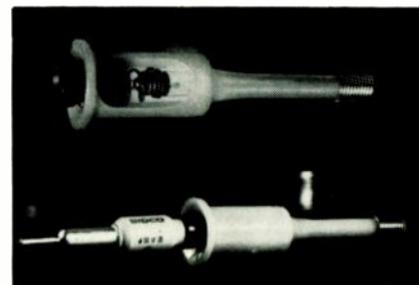
Fourteen new items have been added to the Fastatch II replacement control system for use in the construction of push-pull controls. Among the items are a KR-8 push-



pull line switch which snaps onto the rear of any dual concentric Fastatch II control; a universal push-pull, snap-in shaft and 12 exact replacement push-pull shafts in various sizes for use with KR-8. Centralab

SOLDERING IRON 229

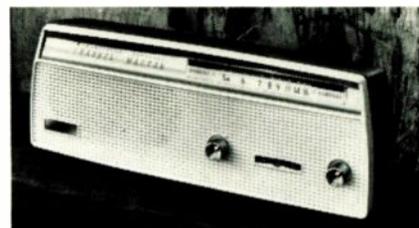
A tiny lamp, built into the handle of the Sentry Model KC 1200B soldering iron gages tip temperature and wattage. The lamp burns brightly on 50 w and dimly on 40



w. The iron is hot when the lamp is lit. It lists for \$2.50. Electronic Ideas, Inc.

TABLE RADIOS 230

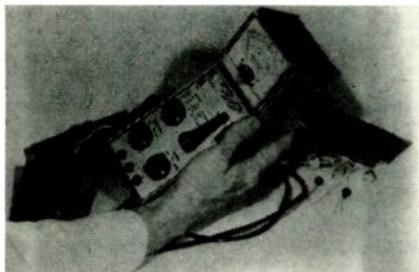
Model 6500 is a 6-transistor table portable radio that retails at \$19.95. Model 6520 shown is an 8-transistor cordless AM table portable that features an RF amplification stage. It has a list price of \$49.95. Model



6536 is an FM/AM clock alarm radio. List price is \$99.95. Channel Master Corp.

TRANSISTOR TESTER 231

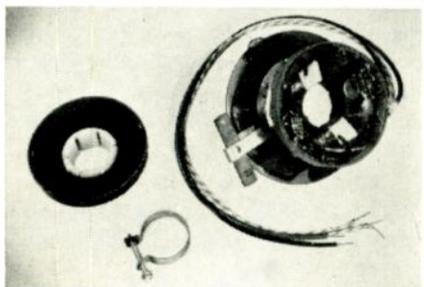
The Model 4 in-circuit transistor tester tests semiconductors installed in circuits. Circuit resistances down to 20 ohms may be balanced for evaluating low medium and high power transistors and diodes, the firm reports. It is said to measure saturation voltage and forward resistance in-circuit with 5% accuracy



at 5, 50 or 500 ma by a simple 2-step sequence. Test Equipment Corp.

THREE YOKES 232

Three yokes have been announced. They are Part No. #Y-54A, which replaces 7 Philco yokes in 5 chassis and 32 models; DY-56A, a replacement for 4 Zenith yokes in 7 chassis and 58 models; and DY-51A, which replaces 2 Packard Bell part numbers in 21



chassis and 45 models. Stancor Electronics, Inc.

AM/FM PORTABLE 233

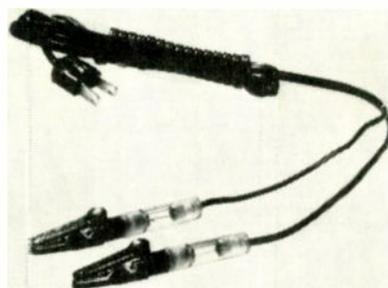
A new Toshiba AM/FM portable has been introduced by Transistor World Corp. to retail at \$59.95 complete with batteries and earphone. The Model 10TL-655F AM/FM portable is said to incorporate advanced circuitry using 10 high frequency transistors, 6 diodes and a 3½-in speaker. The set is powered by 4 C-cells held in a side-

POWER LINE CORD 234

A power line cord, Model 1480 consists of two insulated Safe-T-Klips, each incorporating a type AGX-5 fuse. Connected to these



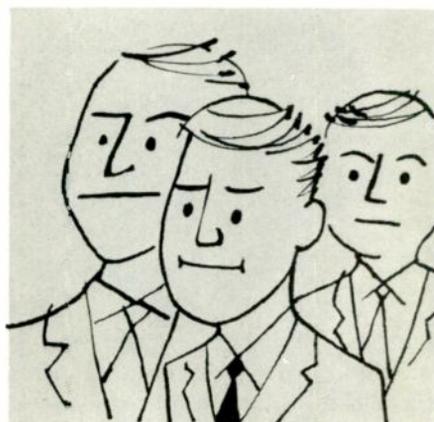
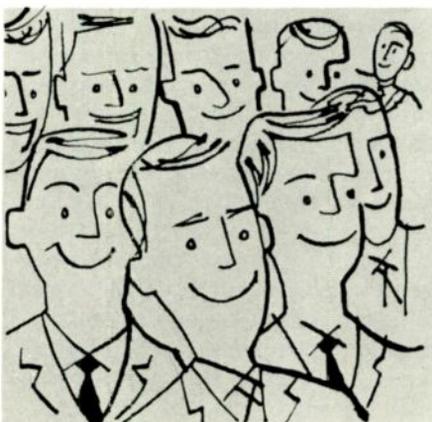
opening battery compartment. It retails at \$59.95. Transistor World Corp.



There are 2 Kinds of Radio-TV Servicemen-

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QUAM
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Those who use
other brands of
replacement loudspeakers



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* According to the findings of Brand Name Surveys, Chicago, Illinois in March and April 1963, more servicemen prefer Quam speakers than all other replacement brands combined. Major reasons stated for the preference: Quality! Availability! Performance!

QUAM-NICHOLS COMPANY

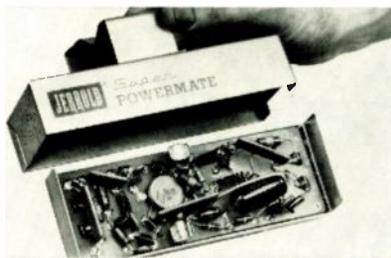
226H E. Marquette Road, Chicago 37, Illinois

NEW PRODUCTS

fused clips is a 6-foot length of No. 18 SPT-1 black line cord complete with strain relief and molded plug. Industrial Devices, Inc.

PREAMPLIFIER 235

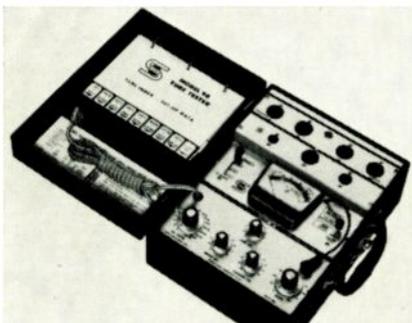
The Model SPM-102 Super-Powermate 2-transistor preamplifier is said to handle up to 700,000 μv



output. Super-Powermate works with any antenna, the company claims. The list price is \$44.95. Jerrold Electronics Corp.

TUBE TESTER 236

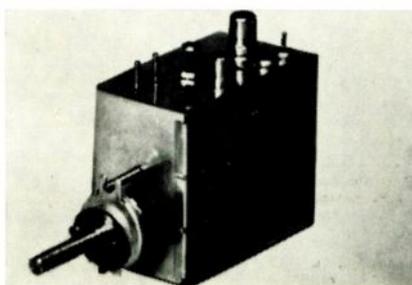
The Model 98 tube tester is designed for analysis of TV and radio tubes and filament rectifiers. It



includes a replaceable socket chassis. The replaceable socket chassis is available with special sockets upon request. Seco Electronics, Inc.

UHF TUNER 237

Model 100 UHF tuner is furn-



ished with a direct drive shaft. Model 100-V is supplied with a 6:1 planetary ball reduction drive attached. The Oscillator tube type

is a 6CW4 nvistor. The mixer-diode is a specially selected low-noise component. Gavin Instruments, Inc.

Transmission Lead-ins For Color TV

by Roland Miracle and Robert Spode

Electronic Product Engineers
Belden Manufacturing Co.

■ For years snow, smearing and ghosts which were merely annoying in black and white, have been ignored. But these defects are intolerable in color.

Obtaining crisp picture detail in all types of weather requires that maximum signal be transferred from the antenna to the tuner without picture smearing reflections. An all weather transmission line must have features not found in the "fair weather" flat ribbon twin-lead.

Little difference exists in attenuation characteristics of different types of twin-lead when clean and dry. The important difference occurs when the lines are wet as shown in the accompanying chart.

When dirt and moisture accumulates on the surface of a flat line or when the line is routed near metallic or lossy objects (such as masts, gutters, downspouts, roofing or wet lumber,) part of the electro-magnetic field surrounding the lead-in extends into these objects, creating eddy currents and increasing attenuation losses. These conditions also lower the characteristic impedance of the line resulting in losses due to mismatch and signal reflections.

The most annoying defect in color TV reception is ghosts which can be caused by the transmission line system as well as by reflection from large objects. Energy is reflected from the receiver back to the antenna and then again back to the receiver if the characteristic impedance of the lead-in has been lowered because of surface deposits. This reflected signal produces

a ghost image which appears on the screen as a multiple image or as smearing.

A solution to the problem of loss creating deposits and lowered impedance is transmission line with the critical field zone occupied by a low-loss insulating material. Now that transmission lines specifically designed for color TV are available you cannot justify downgrading the performance of an expensive color TV set by installing an inferior ribbon-type lead-in.

The best designed lead-in will not function properly unless it is installed correctly. We should visualize the transmission line as having a diameter of twelve inches (the twin-lead plus the surrounding electro-magnetic field). Then we can appreciate the need to keep the twin-lead at least six inches away from all objects.

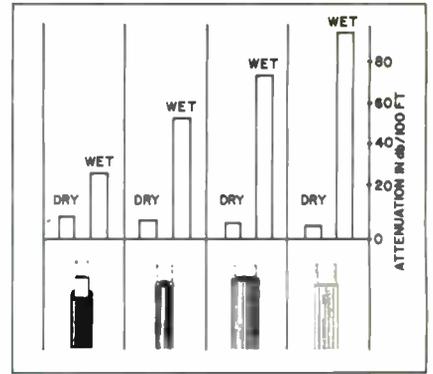
This twelve-inch pipe concept will keep us from making the following errors:

1. Taping the line to gutters, downspouts, masts, towers, etc.
2. Entering the building thru holes drilled in metal window frames or jamming the lead between the window and frame. A better method of entering the building is thru an insulating feed-thru tube installed to prevent entry of rain water. Another good approach is to install a plexi-glass panel in a window frame and route the lead-in through the panel center.

3. Bending the lead-in sharply. Sharp bends in the line produce impedance discontinuities due to distortion of the field surrounding the lead-in thereby creating ghost images.

The lead-in should be routed in the shortest way possible using stand-off insulators which are at least six inches long. Stand offs which encircle the lead-in with a metal ring should not be used. Select stand offs which have been constructed to keep metal parts as far from the transmission line and as-

sociated electro magnetic fields as possible. The proper line balance should be maintained by twisting the lead-in at least one complete revolution every two feet insuring that both conductors are equally exposed to outside influences. Horizontal runs should be avoided where possible. The signal from the transmitting antenna is horizontally polarized and is therefore easily picked up by the horizontal portions of the lead-in, which results in ghost images and also picture smearing.



Attenuation of various transmission lines when wet and dry.



"That wasn't what I meant when I said I hadn't got all the bugs out of it yet."

MOVING?

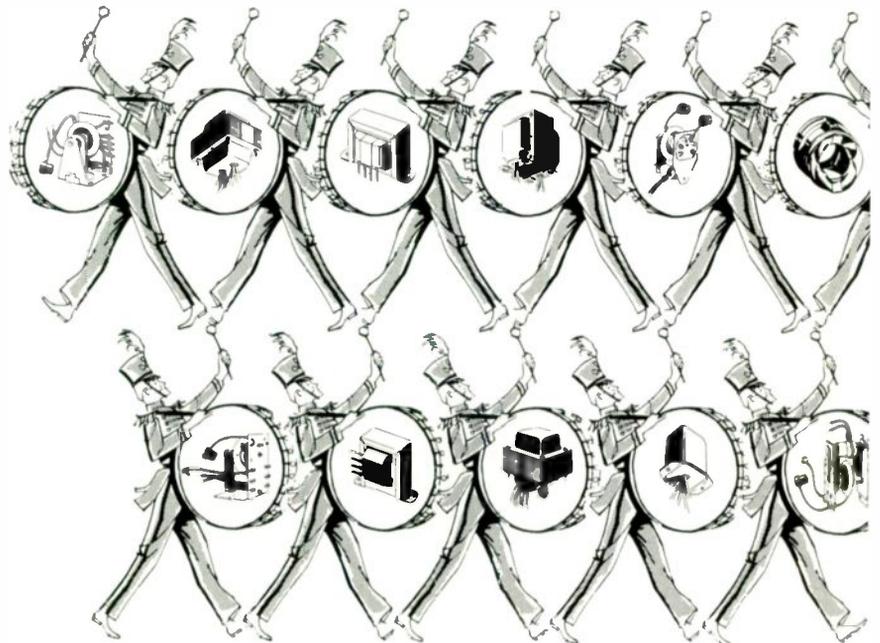
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ELECTRONIC TECHNICIAN

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1962-63

TV Replacements Lead Stancor's



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Transistors Require

by Max Alth

■ Do you still find transistor circuits too hard to repair? It may be because you are using the wrong meters. If this seems as obvious an error as using a screw driver in place of a nut driver, better take another look.

The use of the wrong meter or rather a meter with an unsuited range is due to several wrong conceptions many service technicians have in regard to transistor circuits, and in regard to meter accuracy ratings.

The voltages involved in transistor circuits are usually low. The collector voltage ranges from say 3 to 12 v and the bias may be on the order of 0.1 v. Some technicians feel that because the voltage is small it is not particularly important. This impression is substantiated when they make a voltage test on a functioning circuit with the wrong meter and find that the voltage indicated is far from what the circuit may call for.

How does this happen? Read on. Assume that the voltage under test is exactly 0.10 v. The meter used is a voltmeter with a range from 1 to 10 v. The needle, if it moves at all, is in that portion of the total scale that is least accurate. (Fig. 1) In addition, because of the position of the needle, and because of the width of the needle in relation to the scale markings, it would be physically difficult to read the pointer with accuracy. Add to this the basic error of the meter itself.

Many bench test meters have a basic accuracy of plus or minus 5 percent or less. This is a far greater

accuracy than that demanded for most bias circuits. It would seem then that the meter is entirely adequate for its task. Actually, this meter is just a mite better than worthless for this measurement.

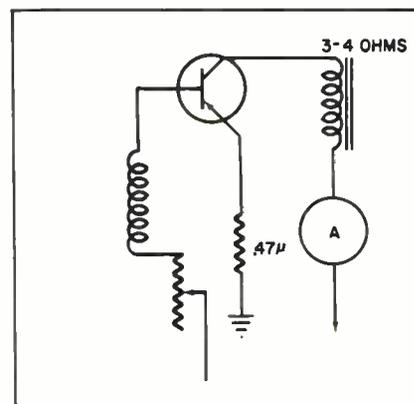
All service grade instruments, as distinguished from laboratory instruments, are calibrated to an accuracy that is a percentage of full scale deflection. This is usually expressed in a plus or minus percentage figure. When a meter with a ± 5 percent accuracy is operated on its 0 to 10 v scale, the statement means that the pointer may be 0.5 v away from the actual voltage under test. We are assuming the average accuracy. When the meter is operated at its low end, the error is greater; and in our example that is where it is being used.

When we endeavor to measure 0.1 v with a meter having a scale of 0 to 10 v, and having an accuracy of ± 5 percent, the *minimum* error that we can expect will be *five times* the figure that we seek to measure. It now becomes quite obvious why transistor servicing can be so difficult. It also becomes obvious why many technicians who have troubled to analyze circuits that operate satisfactorily with the wrong instruments have come to the erroneous conclusion that transistor bias is not too important.

A better grade instrument is not the solution. If the meter were accurate to ± 2 percent, the minimum error we could expect would be 0.2 v, or twice the figure we are seeking to measure. We could, of course, buy a meter with a log scale, but

there is a cheaper solution. Use an instrument with a scale that is more than two or three times the voltage you want to measure. Since there are few service instruments having a voltage range of 0 to 0.2 or 0.3 vdc, we have to make-do with what is available — meters with a 0 to 1.0 or 1.5 v range. A 5 percent error on a 1 v scale amounts to 0.05 or 0.075 v. This could change 0.1 v to appear as 0.15 v, or 0.05 v, and should be kept in mind. At least our instrument error is now less than the voltage we are measuring.

Along the same line of thought is using the wrong milliammeter for measuring emitter current in a transistor output stage (Fig. 2). The meter that should be used must not have an internal resistance higher than 0.5 Ω . If it does, the result is that when the meter is removed from the emitter circuit after the



A high resistance milliammeter in the emitter circuit will establish an incorrect bias.

Proper Meters

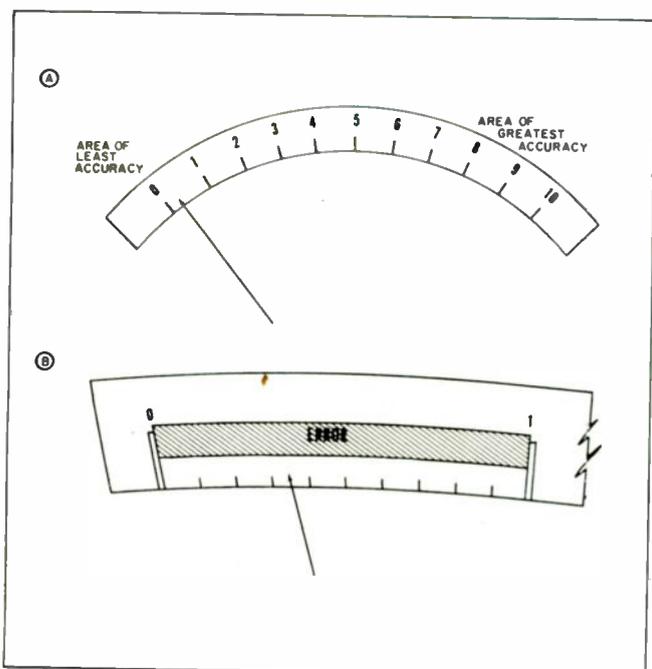
Transistor radios are a standard item now and transistor TVs are finding their way onto the bench. Still some technicians have trouble because they can't get voltage readings to check out

bias on the output stage has been adjusted, the bias will be incorrect. The emitter circuit resistance of an audio output stage is usually on the order of a few ohms. The resistor in the emitter lead is frequently under one ohm in value, and the output transformer has a resistance of three or four ohms. If a 5 Ω milliammeter, for example, is placed here, the total resistance is more than doubled. When the bias is adjusted with the meter in the circuit, it goes off when the meter is removed.

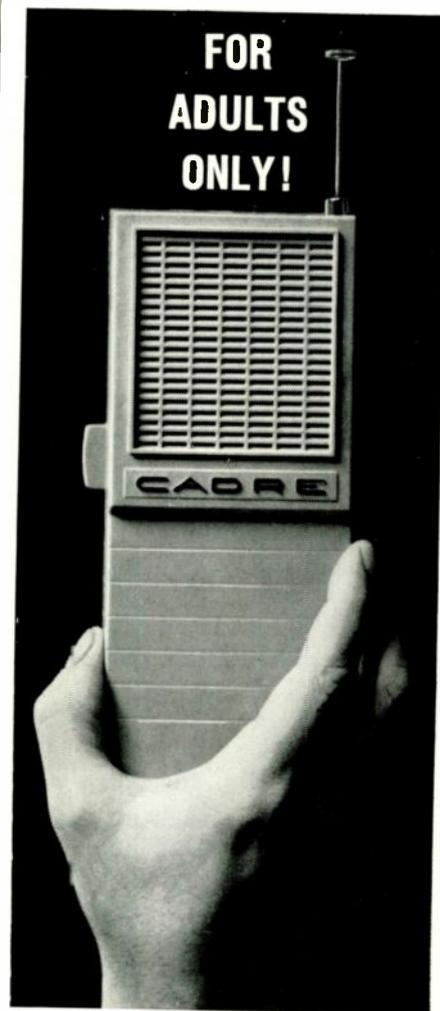
Ohmmeters can also generate trouble for the unwary technician. Most of us are aware of the necessity of removing the transistor when attempting to make circuit resistance

measurements; what is often overlooked is the fact that some portions of the circuit place the transistors in parallel, so that when an ohmmeter having an internal 22½ v battery is used, care must be exercised to make certain that all the transistors in the circuit are disconnected. By the same measurement, we may say, the electrolytics can also be ruined.

A VTVM can also cause similar damage. On occasion they develop transient voltages that are high enough to cause transistor damage. This is rare, it is true, but without precautions, how can you use these instruments and know for a certainty that you are making a repair and not damaging the receiver? ■



The hatched zone is a visual representation of the area ± 5 percent accuracy would cover. There would be no way of knowing whether the actual voltage was 5 percent above the pointer, or 5 percent below the pointer, or anywhere in-between.



NEW CADRE C-75 CB TRANSCEIVER

The new Cadre C-75 1.5-watt, 2-channel transceiver is 15 times too powerful for youngsters (under 18 years of age) to operate, according to FCC regulations. Clearly, it's not a toy. It's designed for serious CBers who need 'big set' performance that can be used anywhere.

The new C-75, weighing less than 2 lbs; provides clear, reliable 2-way communications up to 5 miles and more. All solid state design creates an extremely rugged transceiver to absorb rough handling, stays on frequency. Two crystal-controlled channels spell perfect communications contact everytime. Sensitive superhet receiver (1 μ v for 10 db S/N ratio) brings in signals in poor reception areas. Powerful transmitter has one watt output to the antenna. Adjustable squelch silences receiver during standby. AGC assures proper listening level. In a word, the C-75 has all the features you'd look for in a quality full size CB unit.

The C-75 has all the portable conveniences you'd want, too: operates on alkaline or mercury penlite cells (8-hour rechargeable nickel-cadmium battery available); earphone and antenna jacks; built-in retractable antenna; jack for base operation while recharging.

Use the Cadre C-75 anywhere in the field, for vehicle, office, boat or plane. Use it constantly too, because its all-transistor modular circuit (11 transistors and 2 diodes) is virtually maintenance free. \$109.95. Recharger and 2 nickel-cadmium batteries \$31.85.

Cadre also offers a complete line of 5-watt all transistor transceivers and accessories.

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Servicing Transistor Amplifiers in Hybrid Auto Radios

Don't let a blown fuse-resistor throw you

by Jack Brayton

■ If you see a technician, who is normally mild mannered, cussing softly to himself over the car radio he has on the bench, you can be sure that the transistorized output stage is the cause. Even though the hybrid, with its customary transistorized output, has been widely used since 1958, it is still misunderstood and troublesome. Why is this? To find the answer let's take a closer look at a typical circuit, examine the common troubles and the methods used to locate them.

We all know that the transistor is a current rather than a voltage amplifying device. What is not always fully understood is how service procedure must be changed because of this.

A schematic of the output stage in the Chevrolet car radio model 987727 is shown in Fig. 1. This circuit uses a Delco 2N278 transistor as the final audio amplifier. This transistor is capable of handling a peak power collector dissipation of 55 w. As used here, however, the collector power dissipation is about 1.5 w.

As with any electronic device which technicians service, it is important to understand "exactly" how it works. In other words, we must understand circuit theory if we are to quickly and efficiently locate defects.

The audio signal is still primarily a function of voltage at the 2nd audio amplifier plate — the 12K5.

If we connect a scope to this point we see an audio signal of about 1v P-P.

The signal is fed to the plate load — the primary of the impedance matching transformer T1. Note that T1 is a step-down transformer with a turns ratio of fifty to one.

Remember we have stepped our original 1 v signal down in the ratio of fifty to one, plus losses. When we connect the scope to the emitter of the transistor, we will not be surprised to find either a very small signal or none at all — if you use an expensive scope. If you cannot pick up the audio signal at the emitter and doubt that the audio signal is being passed by the matching transformer, lift the transformer lead from the emitter. This done the signal will again be strong enough to display on the scope. Transformer T1 matches the impedances but it should be noted that it also changes the audio signal from a voltage to a current function. Of course, the audio current is now part of the base emitter current.

Moving our scope from the emitter to the collector we find that the audio signal is about 1.5 v P-P. Note that there is very little voltage gain between the 12K5 plate and the transistor collector — about 1.5 possibly 2.

From the collector the audio signal is loaded across the audio output transformer T2. The audio

signal taken from the tap on T2 goes to the speaker.

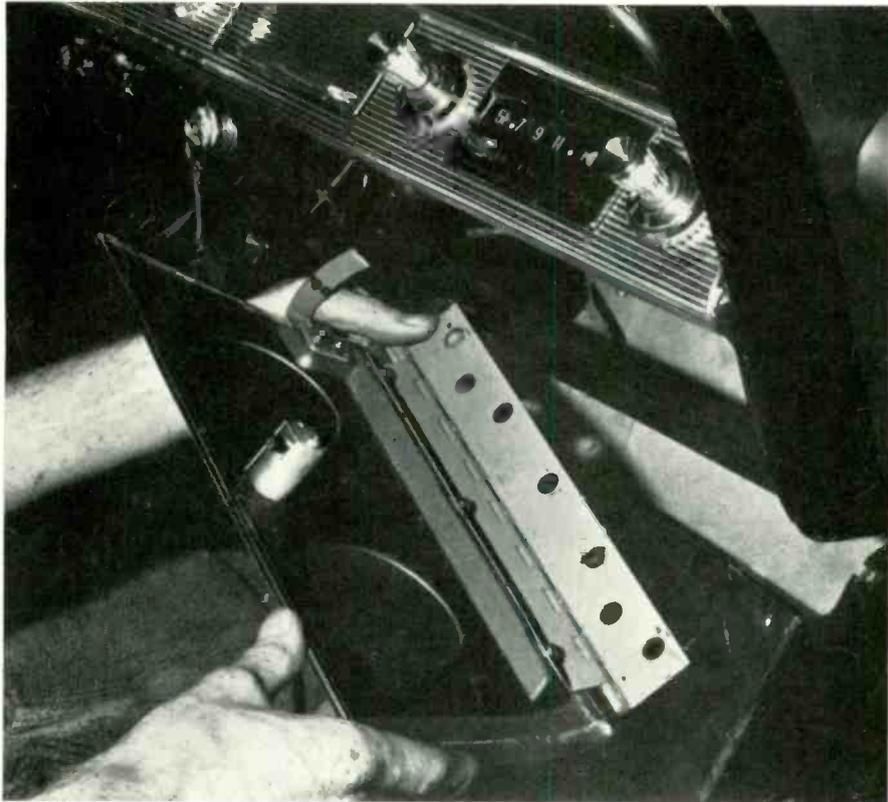
We have carefully traced the audio signal through a typical transistorized audio output stage of the large signal type but we have said nothing about how the dc voltages are developed at the transistor terminals. This is very important as considerable difficulty is often encountered because of mis-interpretation on this point.

Watch That Fuse-Resistor

According to the schematic (Fig 1) a positive 11.3 v is on the emitter. If we trace the emitter circuit back, we can see that the voltage comes from the on/off switch, SW1, through the choke, L10, continuing through the fuse resistor, R22, to the emitter. But here is where the difficulty comes in, suppose the fuse resistor, R22, burns out. At first glance it would seem that the emitter voltage would be reduced to zero. It's simple logic, since the emitter voltage flows through the fuse resistor, and R22 is now blown, of course, the emitter must now have zero volts on it.

The "logic," however, is a bit too simple. With a blown fuse resistor we find that instead of having the expected zero volts the emitter now has a little over 12 v on it. There are two reasons for this.

When the fuse resistor blows, it does not open completely, but changes its resistance from a frac-



tion of an ohm (.27, .33, .47) to a much larger value which may be as small as two or three hundred ohms to five or six thousand ohms. When the fuse resistor burns, the core on which it's wound also burns — turning the core material into carbon much the same as partially burned wood has a layer of carbon on it. Carbon, of course, conducts electricity.

Suppose the fuse resistor burns and changes its value to 1500 ohms. Under these circumstances, the emitter would have the 12 v on it that we measured earlier. But the 1200 ohm resistor in the emitter circuit stops the transistor from drawing any appreciable amount of current.

Even if the fuse resistor does open completely or if you disconnect the emitter from the circuit, we find that we still measure about 12 v at the emitter because the meter itself completes the circuit.

With the emitter disconnected we have a circuit equivalent to that shown in Fig. 2. If transistors were perfect, we could not measure a voltage difference between emitter and ground while in this circuit — the transistor base-to-emitter circuit is back biased. But transistors are not perfect and they have some leakage current. The dc resistance

of this particular transistor, under the conditions shown in Fig 2, is approximately 5000 ohms and is the reason why the emitter still reads slightly over 12 v even disconnected.

The 1.7 collector voltage is the only terminal voltage left for consideration. The emitter collector current flows from the on/off switch, SW1, through the choke, L10 through the fuse resistor, R22, through the transistor, and through the output transformer, T2, to ground thus completing the circuit. Transformer, T2, with the emitter-collector current flowing through it, of course, develops a voltage across it in proportion to its dc resistance — in this case 1.7 v.

Use The Milliammeter

It's obvious from the foregoing that servicing a transistorized output stage with a VTVM can become very confusing. If the transistor in this particular circuit is not conducting, no voltage will appear at the collector. But many transistorized output circuits are used that have grounded collectors — hence no voltage appears on them — even when working. As a result, the best initial instrument to use when servicing these output stages is a milliammeter. A milliammeter in conjunction with a scope or a good

FOR THE NATIONAL ELECTRONIC CONFERENCE IN CHICAGO

(OCT. 28-30)

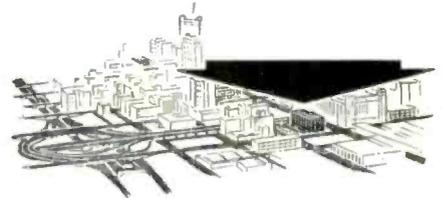


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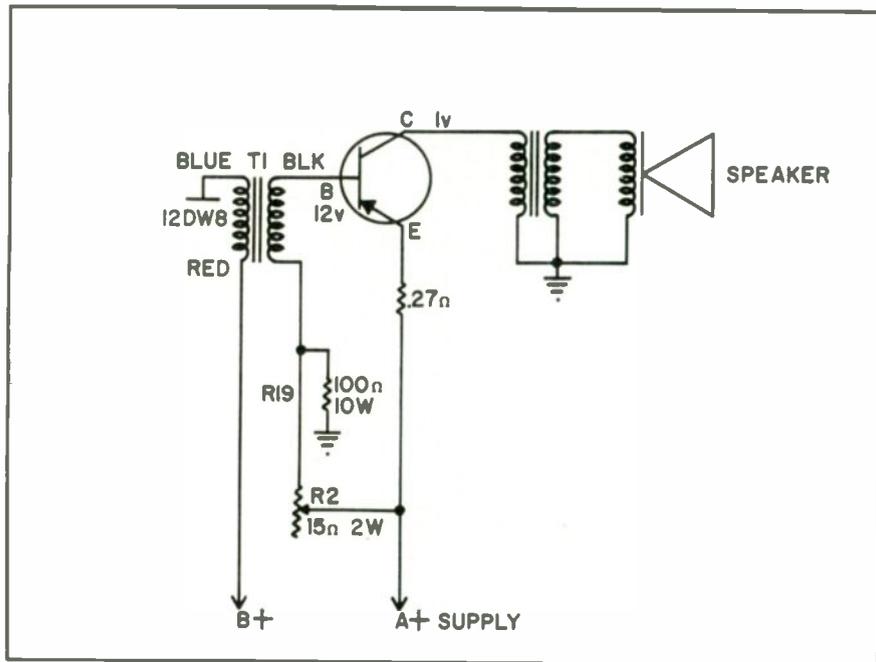


Fig. 3—Schematic of Mopar model 848 transistor output stage.

Olympic Radio & TV Division of Lear Siegler announces a stereo-phono/color-TV combination for \$449.95.

Curtis Mathes brings out a table model color set for \$399.95—meeting Admiral's price.

Motorola is using its new 23-in. rectangular CRT in eight of its 1964-line sets.

RCA is working on a 25-in. 90° rectangular color CRT — expected to be ready in about a year.

A report from Buffalo, New York, says that Sears, Roebuck and Company is selling a color TV set in that area for \$369. It was said that the set has a 21-in. round CRT.

RCA group executive vice president. W. W. Watts, says color TV sales for June 1963 were 170 per cent above the same month in 1962.

By the time you read this a Japanese color set, by Toshiba, with a 16-in. round CRT, will probably be on the US market.

COLOR VIEWS-

At Press Time

John K. West, a vice president of RCA, believes 750,000 color sets will be sold in 1963 — doubling 1962 sales. RCA announces a \$11.6-million expansion program for its Lancaster, Pa., tube plant for color TV CRT engineering and conversion tube operations.



"Please don't send this serviceman again, ... he screams."

AUGUST 1963

Exact Replacements

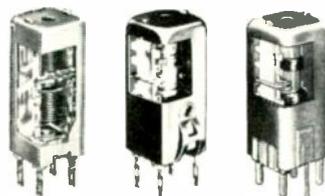
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6504	262 kc I.F.	2090237-4
6505	262 kc I.F.	2090237-5
6506	262 kc I.F.	2090239-1
6507	262 kc I.F.	2090239-2
6508	262 kc I.F.	2090239-3
6509	262 kc I.F.	2090907-2
6510	262 kc I.F.	2090908-3
6511	262 kc I.F.	2090907-3
6513	262 kc I.F.	2090908-4
6514	262 kc I.F.	2090907-5
6515	262 kc I.F.	2090908-5
Delco		
6540	262 kc I.F.	1221253
6541	262 kc I.F.	1221255
Motorola		
6550	455 kc I.F.	24C485553
6551	455 kc I.F.	24C485554
6552	455 kc I.F.	24C485555
6553	262 kc I.F.	24D563300 (Mopar)
General Replacement		
6581	455 kc I.F. Output with Diode Filter	
6582	455 kc I.F. Input	
6583	455 kc I.F. Output	
6584	262 kc I.F. Input	
6585	262 kc I.F. Output with Diode Filter	



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J. W. MILLER COMPANY
5917 S. Main St., Los Angeles 3, Calif.

... for more details circle 24 on post card

Auto Radio Reverberation

■ TV-radio shops who do auto radio work are now being called upon to install and service reverberation units. It may prove helpful if the technical characteristics and installation techniques are known for a typical system.

Reverb Unit

This system employs two electro-mechanical transducers with dual spring assembly. The original program received on the auto radio is fed into the "transmitting" transducer which vibrates the sound into the springs, in a torque fashion, so that the vibrations travel the full length of the springs. The "receiving" transducers pick up the delayed sound and amplify it to a second speaker (rear seat). Spring assemblies are slightly different in length to allow for a smooth transition of delayed sound and are wound in

different directions to cancel out foreign vibrations — bumps on rough roads, for example.

A capacitor couples a portion of the original sound to the rear speaker. An under-dash fader control allows switching reverberation off the rear speaker, if desired. A schematic of the system is shown here.

Because of the various types of plug assemblies used on car radios, the manufacturer of this unit has removed the plugs shown on original installation guide diagram. Cables should be connected as follows:

1. Cut lead going from radio to front speaker.
2. Select two wire cable labeled "front speaker."
3. Connect the green and the black leads to the front speaker.
4. If either one of the voice coil terminals is grounded to the speaker,

this connection must be insulated from the ground.

5. Select the other green and black cable.

6. Connect the green lead marked *radio output* to the ungrounded lead going to the radio.

7. Connect the black lead marked *ground* to other lead going to the radio or to ground.

According to the manufacturer the system will operate through a battery supply range of 10.5 to 16.0 v. Amplifier sensitivity is rated at 2 w output at 400, 1000 and 3000 cps with .070 v applied to the amplifier input through a 2 μ f capacitor.

The speaker is reported to be 6 x 9 in. with a 1.73 oz capped magnet. Speaker impedance is 8 Ω . Distortion at the 2 w output level does not exceed 12 percent at 400, 1000 and 3000 cps, according to the manufacturer.

Installation Tips

System should be installed in cars with negative ground only. Lugs must not touch metal parts of car or other electrical wiring. Transistor must not touch metal of car. Unit must be mounted so that its side, with transistor, is vertical or it will not operate satisfactorily. Unit uses one 2N1379 and one 2N250 transistor. Current drain is 0.7 amp.

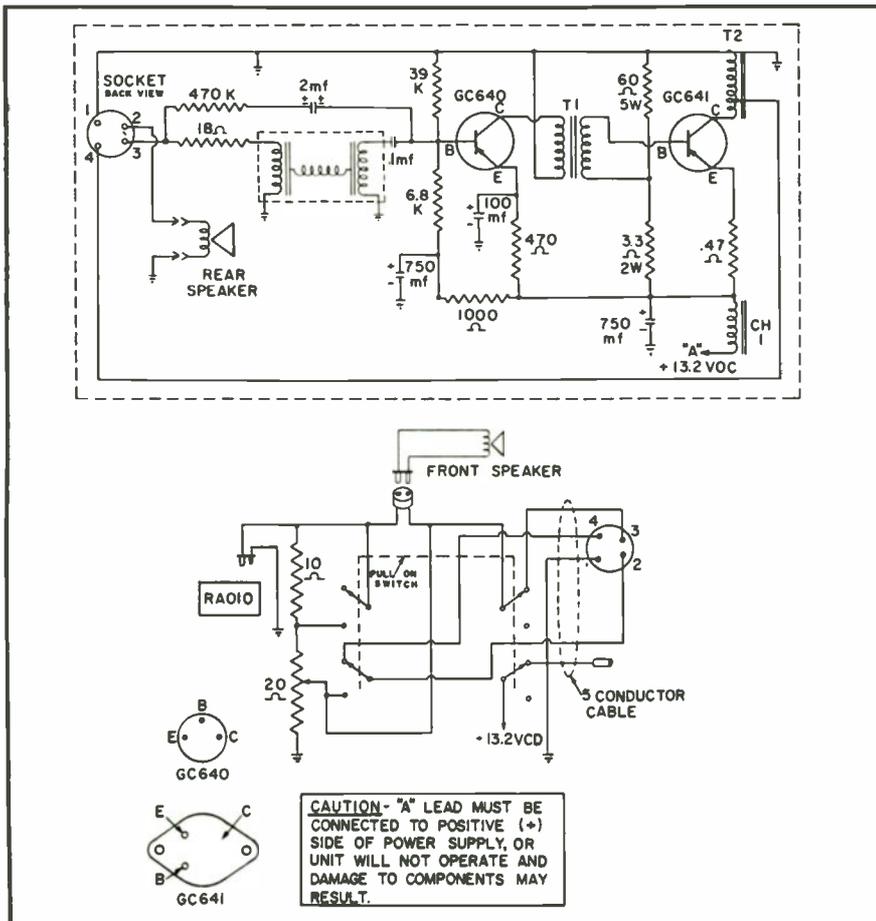
... TEST EQUIPMENT

Continued from page 47

Bench Production

We consider bench production as completed chassis per day. Our shop payroll, overhead, etc. remains fixed. If we turn out a lot of chassis in one day our cost per chassis is low. If we turn out a low number during a dog day the sets are expensive. Naturally we strive to turn out the TVs as quickly as possible without sacrificing our quality.

The right test equipment keeps



Schematic of Tenna Corporation's Model RU-101T auto radio reverberation unit.

production high. I can't stress how important this is. The point was brought startlingly home to me once again a few weeks ago.

I was working on the bench on a squashed in thin line portable. There was not enough high voltage. My normal approach to this problem is roll the centered table that my flying spot scanner is mounted on up to the TV and begin substituting circuits. My signal sub unit permits me to substitute for the tuner, IF strip, video amps, sync circuits, vertical circuits and horizontal circuits. It has rolled many miles around the shop.

This particular day the sub machine was sitting idle. It had opened up a width coil and we were awaiting delivery of the part.

Without the use of my electronic right arm I was back using antiquated techniques. Warily I checked the screen grid of the horizontal output tube. It was +145 as it should be. I checked the control grid and it read -20 which was about 5 v low. I went into the oscillator. Voltages were near normal. I checked the damper. The plate was normal and the cathode a bit low. My conclusion, trouble could be anywhere from the horizontal oscillator grid to the CRT well. Approach: Start testing components one by one.

I decided to quit the hassle and wait for my sub machine to get back into action.

The next day the width coil arrived. Before all else I dropped it into the signal substitution generator.

After awhile I was back to the thin line portable. I plugged the sub's probe into the control grid pin of the horizontal output tube's sock-

et. There was a whine and the bristling of high voltage in the picture tube shell. I looked in the screen. The repair was almost complete. A perfect keystone shone brightly. A new yoke replacement cleared all.

One Step Beyond Equipment

A must reason to purchase new test equipment, is when new TVs and radios appear on the scene with components and circuits that just won't be tested with existing apparatus. You must buy spanking new gear designed expressly for a particular purpose. Among such new test units are pieces for color troubleshooting, transistor testing and instruments to analyze all the picture tubes that are installed in the new TVs.

No matter what you purchase you cannot cover one hundred percent of all eventualities per set, but if you do keep yourself in up-to-date equipment, you can wiggle out a repair in a pinch if you add one more thing to the test gear: Your own ingenuity.

Like this emergency nine inch Hotpoint that belonged to a local motel account of ours. He had to have the TV for the weekend. It was Saturday late afternoon. All distributors were closed. The trouble was no raster.

I tested the high voltage. It was supposed to be 5.5KV and that was exactly what my VTVM equipped with high voltage probe read.

I suspected the picture tube. It was a strange little job. A 9QP4. The high voltage was injected not into a well, like ordinary tubes but in through pin number six, normally a focus anode.

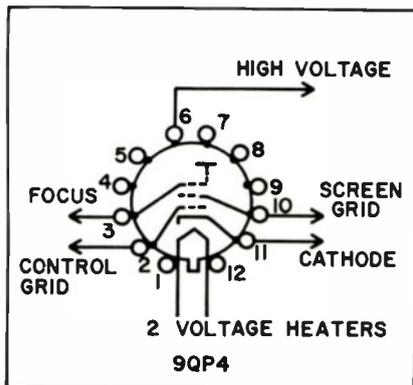
I pulled out my latest CRT testing machine. I looked up 9QP4. No listing. I pulled out some other picture info that I keep.

No Listing

After searching around, the only information I had was on the schematic sheet, but there was no filament voltage listed. At least I had the pin numbers.

Fortunately the filaments, cathode, control grid and screen grid were identical to regular tubes although there was another addition, pin three evidently was focus anode.

I installed the CRT tester, careful to keep the filament voltage of



Base diagram for 9QP4.

IT PAYS TO USE AEROVOX!

Let's face it...this radio-TV-electronics servicing business is a highly demanding business. Your customers demand good service at a fair price. Your work at the bench or on service calls requires skill and efficiency. The rapid pace of new circuits and equipment demands time to keep up with the industry. And how well you know that time means money! That's why you can't afford costly callbacks or customer complaints due to premature component failures. When it comes to capacitors, you know you can depend on Aerovox. You see, at Aerovox there's absolutely no compromise with quality. Since the early days of radio, Aerovox engineers have pioneered capacitor improvements. Take electrolytics, for example. Your Aerovox distributor stocks the most dependable and complete line of exact replacement types in every rating you need...a few of the most popular types are shown here. Get all the facts...ask him for a free copy of the new Aerovox TV Electrolytic Capacitor Replacement Guide AFG-462. ▶



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the machine at its lowest setting around 2 v. Good thing I did for at that voltage the tube lit normally. The emission was zero.

I contacted the set owner and broke the bad news. He was nice, but explained he had to have it for the weekend. We could have it back on Monday to install a new replacement.

I hung up the phone and went back to the TV. I attempted rejuvenation measures since I now know the correct dial setting. (The filament voltage should have been 4.68 v, though the emission was still very low.) Between my research and the capabilities of the new tester I was out of a tight spot. The resurrection took beautifully.

He picked up the TV. The only thing that happened is the TV is still playing merrily and this incident took place four months ago.

Anyway, test equipment does very well for us. We do not skimp or cut costs in that direction. Rather we are constantly examining and purchasing the gear we feel will increase our efficiency and sales.

It is not an expense but in actuality is part of your profit making. You actually earn money by studying your needs and satisfying them.

That doesn't mean buy everything that shows itself in the marketplace. It does mean buy everything you feel will help you properly operate on the receivers you are commissioned to repair.

New Test Equipment Survey

New test equipment to a technician has tremendous appeal. Given an unlimited budget we would buy everything we saw.

However, from a practical standpoint we must buy not one more item than we need. Here is a list of questions I ask myself before each major purchase.

1. Do I need it?
2. What are its features in comparison to other brands?
3. In my labor time saved, how long will it take me to get my money back? (Figuring time at \$5.00 an hour.)
4. Will this apparatus obsolete any existing equipment? (If so is it advisable to trade in the old equipment?)
5. How fast can I depreciate it?
6. Can my business afford the investment. ■

NEW BOOKS

BASIC MATHEMATICS. By Norman H. Crowhurst. Published by John F. Rider Publisher, Inc. 556 pages, hard cover. \$14.50.

This is a one-volume binding of previously published paperback volumes 1 through 4. It is a four-part course that makes it easier to learn mathematics. Since most people find it difficult to learn mathematics, the author worked out this system after his teaching experiences at two leading technical colleges. The text embraces a new concept in teaching arithmetic, algebra, geometry, trigonometry and calculus. The complete course proceeds step-by-step, in easy stages, from simple arithmetic on to calculus.

NEWS

OF THE INDUSTRY

FM-Stereo Gets Boost

FM-stereo reception capability was contained in just a shade under 50 percent of all radio-television combinations and radio-phonograph combinations produced during the first quarter of this year.

During the first quarter of 1963, production of radio-TV and radio-phonograph combinations totaled 411,252, of which 205,217 had FM-stereo capability. A total of 24,465 radio-TV combinations out of the 62,816 produced could receive FM-stereo broadcasts. Of 348,436 radio-phonos produced, 180,752 were equipped to receive the signals.

As previously reported by the Electronic Industries Association, nearly 46 percent (767,539) of the 1,677,385 combinations produced during the entire year of 1962 were capable of receiving FM-stereo transmissions.

Speed All-Channel TV Production

The country's TV set manufacturers are stepping up the tempo of their changeover to full production of all-channel TV receivers, al-

though the effective date of a new law requiring that new sets receive the complete range of 82 channels is still 8 months away, according to an EIA report.

G-E Lowers Color-Set Price

A color TV receiver has been introduced by General Electric which will sell for about \$450, or about \$45 below the lowest priced set in its line. The price partly meets Admiral's previously established price of \$400.

Hallicrafters Enters 2-Way FM Field

Hallicrafters Co. announces plans to enter the FM two-way radio market with a complete line of units for business and industrial applications. Units are designed to operate in the Business Radio Service or in any of the other available land-mobile services.

Parts Distributor Sales Rise

The national Credit Office reports an increase of 9.9 percent in total volume of electronic parts distributors during 1962 over 1961. Sales exceeded \$1-billion for the first time.

Zenith Reports Record Orders

L. C. Truesdell, president of Zenith Sales Corporation, announced that orders for new products placed by distributors at the company's sales convention were the highest in history. Truesdell said that the record-breaking orders for new 1964 Zenith instruments were substantially ahead of orders for the same period last year and more than 28 percent ahead of orders for the same months in 1961. He said that the company's entire production of color TV was sold out through August and initial production schedules have been increased, substantially through September.

CRT Implosion Protection

Corning Glass Works announces a low-cost implosion protection system for YV picture tubes. The new system, approved by Underwriters Laboratories, eliminates the need for a glass safety plate by surrounding the tube face with a steel shell.

The lightweight shell fits like a rim around the tube faceplate edges. A strip of pliable gasket material and an alcohol-base bonding resin are also used.

Sylvania's Acheson Retires

Marcus A. Acheson, chief engineer of Sylvania Electric Products radio tube division, retires after 40 years of work in electronic development. He was responsible for the redesign of many tube types and increased tube reliability.

Harmon Resigns from Jerrold

Sidney Harman, president and chief executive officer of the Jerrold Corp, has resigned. It was understood that policy differences between Mr. Harman and Milton J. Shapp, chairman of the board, led to the resignation.

Stancor Increases Yoke Line

Stancor Electronics announces the addition of three new yokes to its "Parade of Parts," program. Part No. DY-54A replaces seven Philco yokes in five chassis and 32 models; DY-56A replaces four Zenith yokes in seven chassis and 58 models, and DY-51A replaces two Packard Bell yokes in 21 chassis and 45 models.

Stark Merges With Hickok

Stark Electronic Instruments, Ltd., of Ontario is merged with Hickok Electrical Instrument Co. of Cleveland. Terms were not announced. Hickok purchased all outstanding stock of Stark.

April Phono Sales Dip

Phonograph sales in April dipped under March totals by nearly 100,000 units at the distributor level and better than 88,500 at the factory, according to the Electronic Industries Association. The EIA said the declines failed to offset cumulative gains over last year's sales, however. April sales were 246,730 units compared to 346,152 recorded for March. A year ago in April, 201,192 phonos were sold. Cumulative sales for 1963 stood at 1,239,379 at the end of April, an appreciable increase over last year's 959,597.

AUGUST 1963

FREE LITERATURE

TAPE RECORDERS 300

This color brochure contains detailed specifications of the Model 801-A battery powered portable tape recorder. In addition it pictures five Model 801-A accessories. Superscope Inc.

TOOLS CATALOG 301

A 24-page catalog, No. 10, covers a line of special pliers and tweezers designed for aerospace requirements. Also included is a selection of clean-room hand coverings and white-room accessories. Techni-Tool, Inc.

RESISTOR LITERATURE 302

Bulletin 104 announces a line of wire-wound, vitreous enameled resistors. The bulletin is arranged to simplify ordering, and is said to constitute a technical aid to those concerned with naval equipment. Ohmite Manufacturing Co.

TRANSFORMERS CATALOG 303

A 48-page catalog lists 1500 replacement transformers and coils for television, radio, high fidelity, and stereo applications. The book contains specifications and additional information to aid the technician in the selection of the proper unit for his application. Stancor Electronics, Inc.

RESISTOR INFORMATION 304

A short catalog covers three styles of deposited carbon, fixed film resistors and one wire wound series. Published in the form of 3-hole punched data sheets printed in two colors, the 8-page short catalog provides information on dimensions, design and construction, electrical characteristics, derating curves, performance and environmental characteristics where pertinent. Penn Resistor Corp.

CAPACITOR CHART 305

The Ceramics Selector, a 17" x 22" wall chart was designed to aid engineers select ceramic capacitors. Twenty different ceramic capacitor types are listed with line drawings and dimensions showing form factors and actual sizes. Cornell-Du-bilier Electronics

HEATHKIT COLOR BAR & DOT GENERATOR . . . YOUR BEST BUY IN A COLOR TV SERVICE INSTRUMENT! . . . ONLY \$64.95

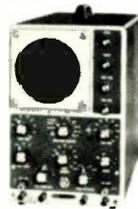


- Crystal-controlled accuracy & stability
- Produces six different patterns for picture adjustments
- 10 vertical color bars—special shading bar pattern
- Perfect for color or B & W TV servicing

Another outstanding value from the world's largest kit manufacturer! The Heathkit IG-62 Color Bar & Dot Generator at only \$64.95 is unmatched in the industry for performance, quality and value! Provides choice of six different patterns for color or B & W TV picture adjustments . . . all with crystal-controlled accuracy and stability. No sync leads required, internal sync pulses lock the patterns firmly on the TV screen, without jitter or crawl for fast, easy servicing. One simple connection to the antenna terminals of the TV set is all that is required. Output is on Channels 2 through 6. Color bars produced by the offset-carrier method allow AFC, phase and matrix alignment of color sets and adjustable video output permits checks of color hue and sync at different signal levels. Crosshatch, vertical & horizontal bars, dots, and special shading bar patterns simplify convergence, linearity and background picture adjustments. Order this fine instrument for your test bench now! Save with Heathkit!

Kit IG-62 . . . 13 lbs. . . no money down, \$7 mo. **\$64.95**

WIDE BAND 5" OSCILLOSCOPE 10-12 \$76.95



- Professional styling & features at low cost • Full 5 mc bandwidth for color TV servicing • Heath patented sweep circuit—10 cps to 500 kc • Push-pull vertical & horizontal amplifiers

TV SWEEP GENERATOR IG-52 \$67.95



- Complete FM & TV coverage—3.6 to 200 mc. • Stable all-electronic sweep circuit • Built-in crystal & variable marker oscillators • Versatile, easy to operate, reliable.



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... COLOR TV SIGNALS

Continued from page 35

portions of the picture, there are no R-Y, B-Y and G-Y color signals because they were *not* transmitted. The -Y signals, up to 4.2 Mc, still appear on the cathodes of the CRT guns, however, and merely cause *in unison* gun conduction to produce white when they are at saturation, the gray scale when they are between cut-off and saturation, and black when they are at cut-off. Refer to Fig. 4B.

On the black-and-white programming; there are no R-Y, B-Y or G-Y color signals. The full frequency range of the Y signals will therefore cause in unison conduction of the guns reproducing the picture in black-and-white.

It should be noted that on a blank raster, in the absence of any signals, all guns are conducting in unison with no change in electron flow; on monochrome programming or to reproduce the higher detail black-and-white portions of a color program, the guns are conducting in unison but the electron flow is changing in accordance with the in-

stantaneous brightness values of the Y signals; and finally, to reproduce the color portions of a scene, the guns are changing conduction with respect to one another in accordance with the actual instantaneous color present. ■

... THE NEON TESTER

Continued from page 41

but serves only as a quick and easy short-cut tester to help technicians analyze the trouble. For example, in checking for RF in the HV cage, much time used in checking or substituting tubes can be saved. At the same time, the presence or absence of RF will indicate what further checks need to be made.

B-plus Checks

It is a simple matter to use the neon tester to determine if B+ is present at any point in the supply. Place one test lead from the supply point and the other to ground or B-. If B+ is present, the neon lamp will glow, and if absent, the lamp will not glow. (The tester will indicate either ac or dc from approximately 50 to 600 v.)

The B+ check is useful in locating open resistors in B+ circuits by checking from either side to ground. Also, primary windings of audio output transformers, IF transformers, vertical output transformers, blocking oscillator transformers — and RF chokes in the B+ circuits — may be checked in the same manner. B+ fuses may also be checked the same as ac line fuses. ac line capacitors used in selenium, silicon, or germanium power supplies may also be checked to determine if ac is passing through them in the same manner used to check resistors. Rectifier output may also be checked from output point to ground. Plate and screen supplies in excess of 50 or 60 v dc may also be checked in a like manner.

The neon tester does not measure voltages, but only indicates their presence. To determine the *amount* present, a voltmeter must be used. Also, the neon tester in no way replaces the voltmeter as this would not be feasible; it is used, as pointed out before, to provide quick preliminary checks in helping to analyze troubles.

Technicians servicing two-way radio communications transmitters will

also find the tester is a useful instrument in checking antenna loading, resonating various stages, etc. For example, if RF is present in the antenna, the neon lamp will glow (it might be necessary to touch the test leads to the antenna ionization and then remove them). The amount of load or maximum load is indicated by maximum brilliance of the neon lamp when at a fixed position near the antenna base while the transmitter output and coupling are being tuned. RF in the "tank" circuit of a transmitter can also be determined by holding the neon tester lamp near the coil. Maximum RF is indicated by maximum brilliance of the lamp.

Many other uses for the neon tester can be found in servicing electrical appliances and circuits. ■

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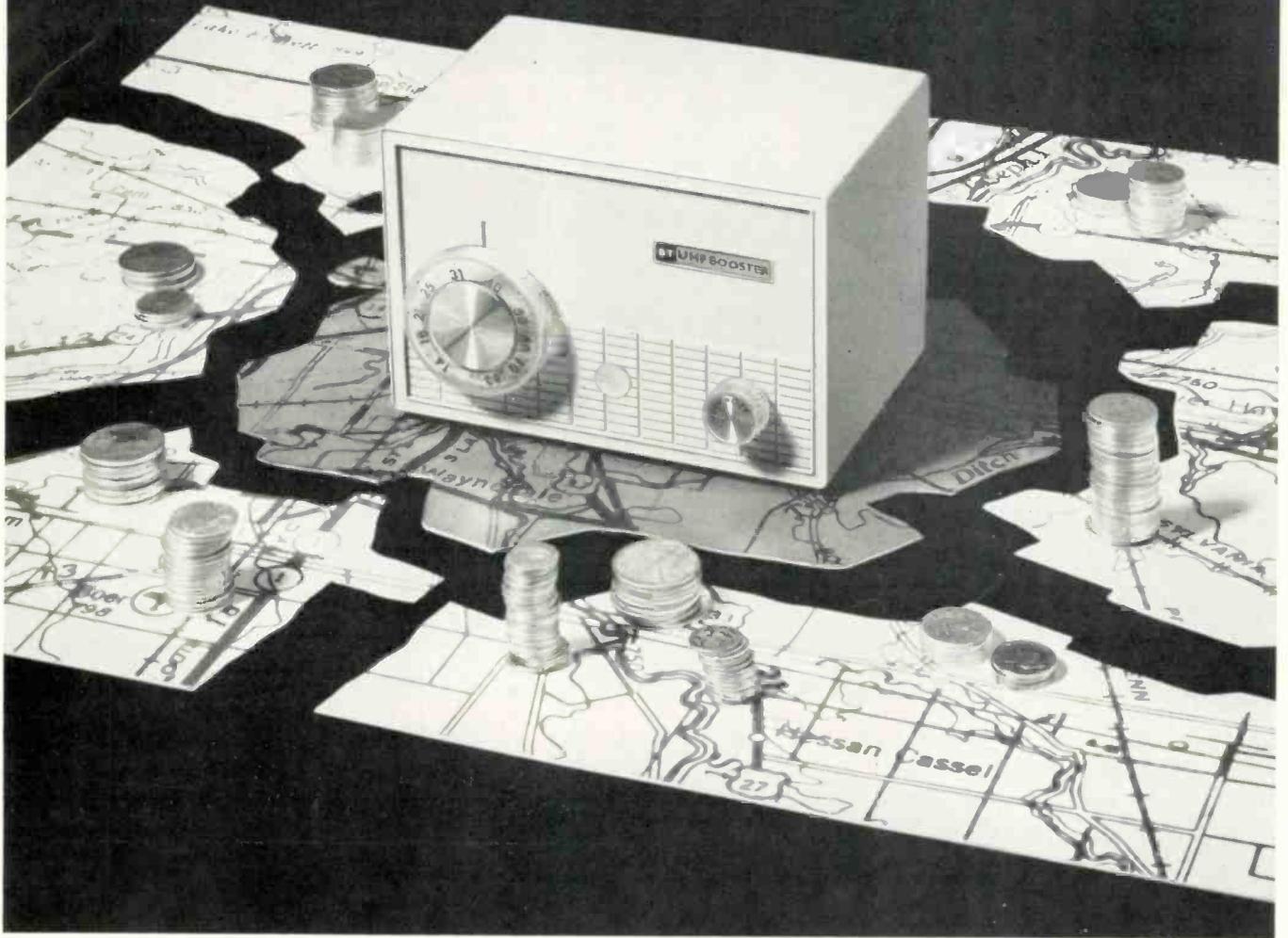


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Blonder-Tongue increases the UHF profit zone



First all-channel UHF Booster—the U-BOOST

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

The U-Boost (gain 10 db)—triples the antenna signal voltage. Teamed up with a UHF converter, or added to an all-channel receiver, the U-Boost improves picture contrast on all but the "hottest" TV sets or with deluxe converters. Just a turn of the dial pinpoints any desired channel from 14 to 83 and brings it in sharp and clear. TV picture quality is always excellent with the U-Boost because it has a lower noise figure than most existing TV sets or UHF converters. This means a better signal-to-noise ratio, resulting in less snow

The U-Boost is easy to install: convenience AC receptacle;

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patented 300 ohm stripless twinlead terminals. And finally, the modern U-Boost styling matches the new Blonder-Tongue UHF converters — making combination sales easy. Sell a Blonder-Tongue converter and a U-Boost together. They're "profit-mates".

U-Boost, List \$39.95.

BLONDER-TONGUE TOTAL SALES POWER SPELLS BIGGEST UHF PROFITS
1. World's finest UHF converters performance tested in 2,000,000 homes.

Model 99-S for prime signal areas. List \$27.95.

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

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Look to the leader in UHF.

Contact the Blonder-Tongue distributor in your area now.



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ALL YOU
NEED FOR

COLOR-TV SERVICING



WR-64A



WO-91A



WR-69A



WR-70A



WR-99A

RCA Color-Bar/Dot/ Crosshatch Generator

Low-cost, lightweight, portable instrument that provides all essential Color-TV test patterns. Simple to operate: only 3 controls. RF output leads connect directly to antenna terminals of receiver; no external sync leads required. Crystal-controlled signals assure rock-steady patterns, free from "jitter" and "crawl." Extra-wide-range chroma control. Generates:

- **Color-bar pattern:** ten bars of color, including R-Y, B-Y, G-Y, I and Q signals spaced at 30° phase intervals for checking phase and matrixing, and for automatic frequency and phase alignment. Permits accurate alignment of the "X" and "Z" demodulators which are used extensively in RCA Victor and many other makes of color TV receivers
 - **Crosshatch pattern:** a grid-like pattern of thin sharp lines for adjusting vertical and horizontal linearity, raster size, and overscan
 - **Dot pattern:** a pattern of small sized dots facilitating accurate color convergence adjustments
- \$189.50* with output cables.

RCA 5-Inch Oscilloscope for Color-TV

A wideband scope excellent for checking colorburst signals and general troubleshooting of wideband color circuits and other electronic equipment. Mult-scale calibrated graph screen makes measurement of peak-to-peak voltage as easy as with a VTVM.

- New 2-stage sync separator assures stable horizontal sweep lock-in on composite TV signals
 - Dual bandwidth: 4.5 Mc at 0.053 volt rms/in. sensitivity. 1.5 Mc at 0.018 volt rms/in. sensitivity
 - Continuously adjustable sweep frequency range: 10 cps to 100 Kc
 - 3-to-1 voltage-calibrated, frequency-compensated step attenuator for "V" amplifier
 - Simplified, semi-automatic voltage calibration for simultaneous voltage measurement and wave-shape display
 - Vertical-polarity reversal switch for "upright" or "inverted" trace display
- \$249.50*, including direct/low capacitance probe and cable, ground cable, and insulated clip.

RCA Television FM Sweep Generator

Specifically designed for visual alignment and troubleshooting of color and black-and-white TV receivers, and FM receivers. The RCA WR-69A has pre-set switch positions for all VHF TV channels, FM broadcast band, and TV video, chrominance, and IF frequencies. The WR-69A has these important features:

- IF/Video output frequency continuously tunable from 50 Kc to 50 Mc
 - Sweep-frequency bandwidth continuously adjustable from 50 Kc to 20 Mc on IF/Video and FM; 12 Mc on TV channels
 - Output level—0.1 volt or more
 - Attenuation range: TV channels, 60 db IF/Video, 70 db FM, 60 db
 - Return-trace blanking
 - Two adjustable bias voltages on front panel
- \$295.00* including all necessary cables.

RCA RF/VF/IF Marker Adder

Designed for use with a marker generator (such as RCA's WR-99A) and a sweep generator (such as RCA's WR-69A), this instrument is used for RF, IF, and VF sweep alignment in both color and black-and-white TV receivers. In visual alignment techniques, it eliminates distortion of sweep response pattern. Important features:

- Choice of four different marker shapes provided by front panel switch for different types of sweep-response curves and for positive and negative sweep traces
 - Provides very high-Q markers of high-amplitude and narrow bandwidth
 - Complete front panel control of marker shape, marker amplitude, marker polarity, sweep amplitude, and sweep-trace polarity
- \$74.50* complete with cables.

RCA Crystal-Calibrated Marker Generator

Supplies a fundamental frequency RF carrier of crystal accuracy for aligning and troubleshooting color and B&W TV receivers, FM receivers and other electronic equipment in the 19-260 Mc range. Combines functions of multiple-marker generator, re-broadcast transmitter, and heterodyne frequency meter.

- Highly stable output
 - May be calibrated at 240 separate crystal check points—accurate calibration provided at 1-Mc and 10-Mc intervals
 - Matched-impedance pad-type attenuator and double shielding of the oscillator provide effective attenuation of all frequencies
 - Most-used IF and RF frequencies are specially indicated on the dial scale
 - Sound and picture carrier markers available simultaneously
- \$242.50* complete with output cable and phone tip.

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



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