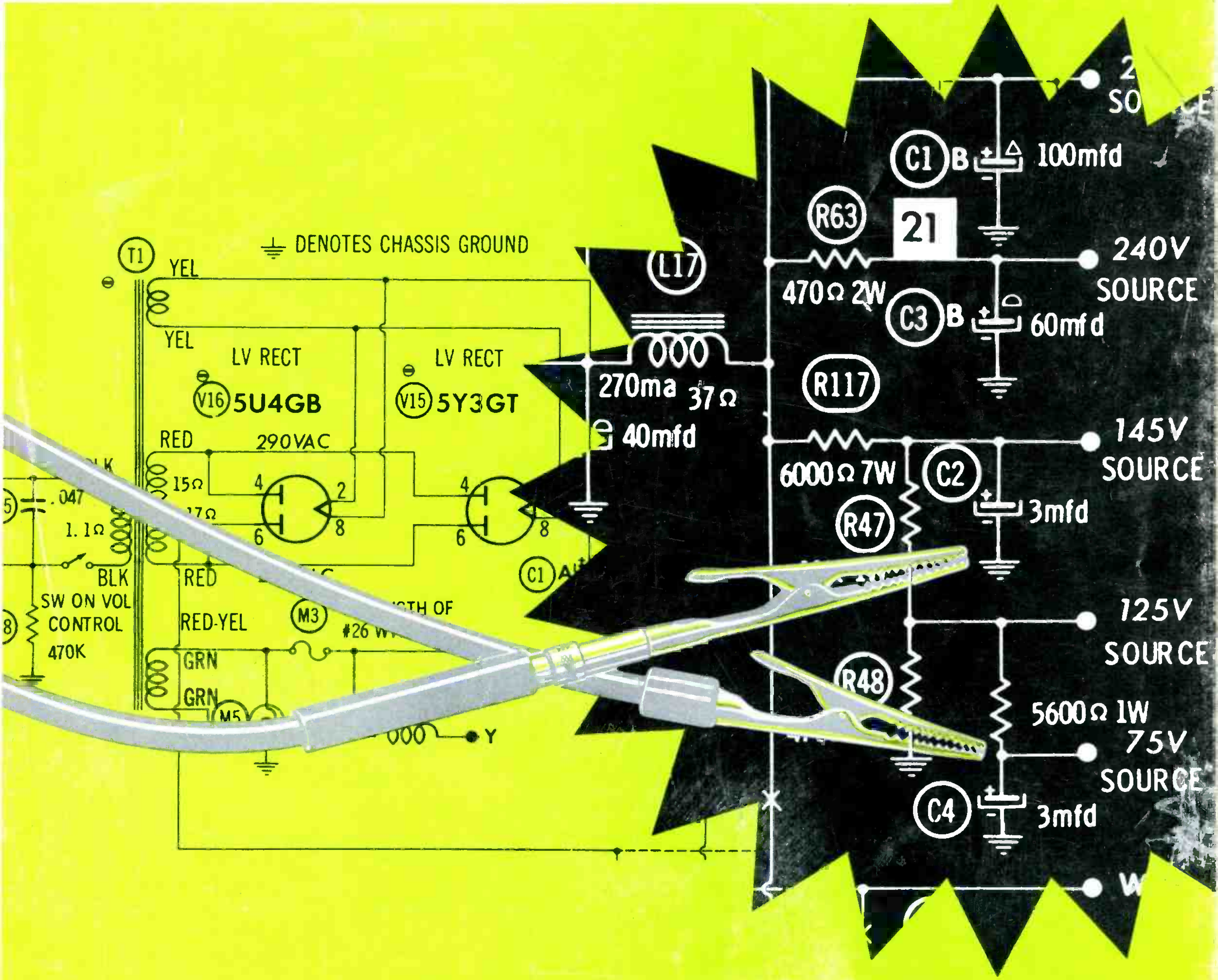
SEPTEMBER, 1962 35 CENTS

PF REPORTER

PHOTOFACT

including **Electronic Servicing**



Debugging B+

Transformer Tactics

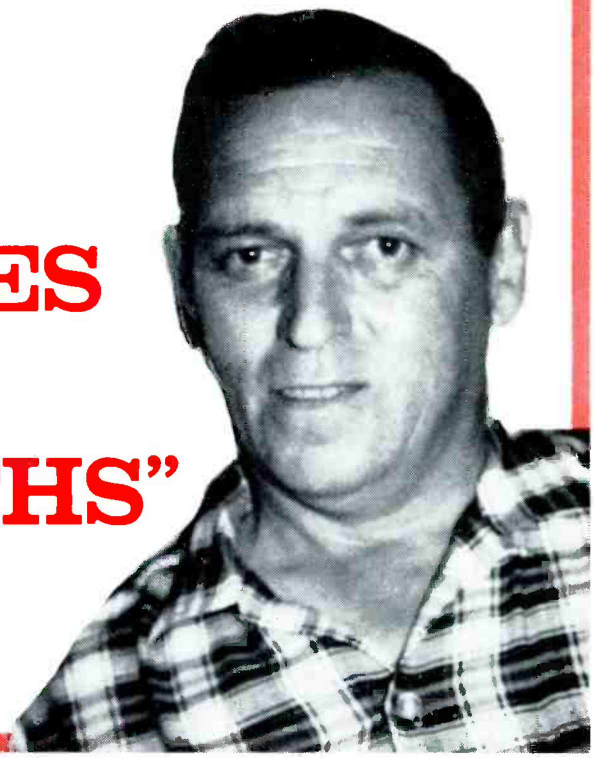
A Good Generator Sweeps Clean

Colors Adrift? Check Color Sync

Calibrate Your Own Voltmeters

"Symfact" Charts

"WE SOLD $3000 WORTH OF POWERMATES DURING THE 'SLOW' MONTHS"



CHRIS MARCOTTE
Capeway TV Service Co., Harwich Port, Mass.

POWERMATE's unexcelled performance plus Jerrold's powerful LOCAL promotions achieved this for Chris...

Chris Marcotte worked closely with his Jerrold distributor on a powerful promotion program that appealed *directly* to his Cape Cod customers. Jerrold newspaper mats pre-sold the POWERMATE where it would do the most good—in Chris's service area. Jerrold also supplied store banners, counter displays, envelope stuffers—in short, a complete package that helped Chris tell the POWERMATE story most effectively to his neighbor-customers. This well-planned LOCAL promotion, plus an unbeatable product, turned the trick for Chris.

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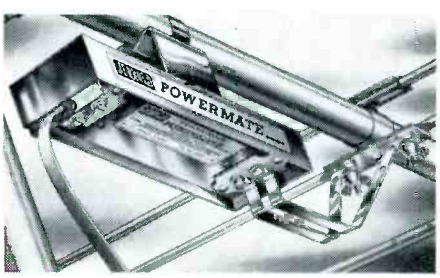
Chris Marcotte's success story is being repeated over and over throughout the country. So get on the POWERMATE bandwagon now! Let Jerrold set up your LOCAL promotion. Write now for the name of your nearest Jerrold distributor.



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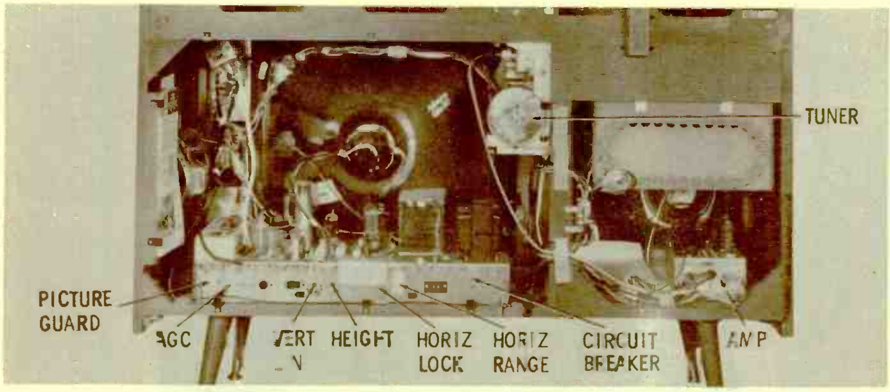
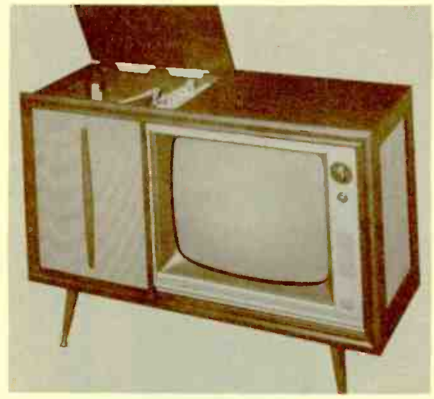
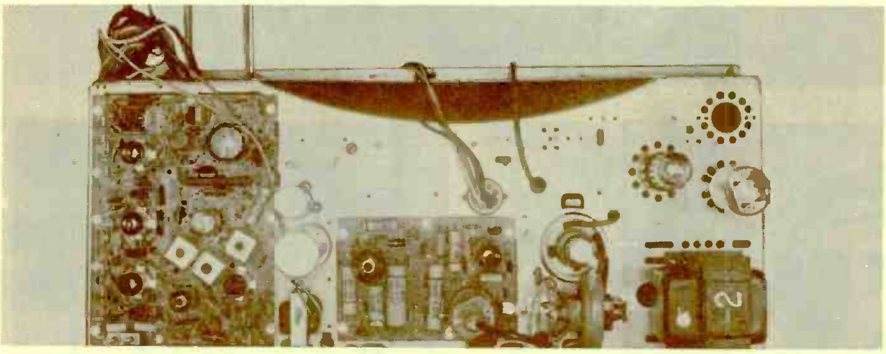
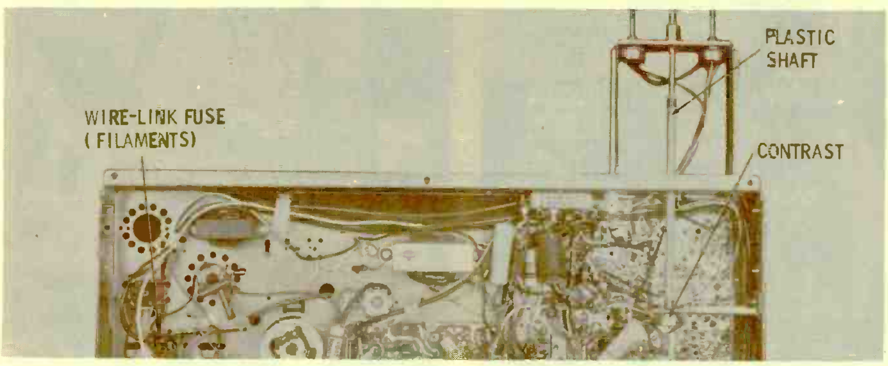
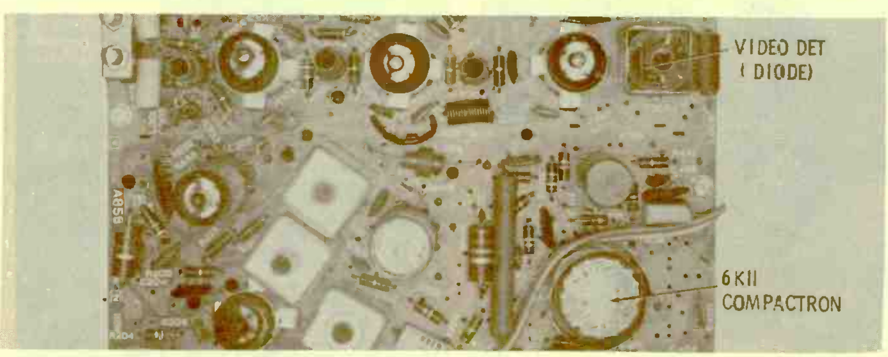








PRINTED BOARD FOR VERT AND HORIZ SWEEP COMPONENTS



Admiral Model STF351
TV Chassis 19C8B
FM-AM Chassis 6S3C
Amplifier Chassis 2PA5

This combination model makes use of an FM-AM tuner, a stereo amplifier, and a 23" TV chassis. All operating voltages for the tuner are furnished by the power supply (5U4GB rectifier) on the TV chassis. The amplifier obtains B+ from the TV, but has its own filament supply. The B+ rectifier circuit is protected by a circuit-breaker mounted on the rear of the chassis, while the TV filament circuit includes a wire-link fuse (note physical location shown in the photo).

Plugs and sockets are plentiful in this set, and you should take note of where they are connected, before you start unplugging. The TV chassis can be operated independently of the tuner or amplifier, but if trouble develops in either of these latter chassis, operational checks will require that they be connected to the TV chassis.

Like the other TV sets in Admiral's '62 line, this receiver uses a 6K11 compactron as the AGC keying tube, sync separator, and noise limiter. A 6EW7 (a 9-pin miniature tube with an oversized glass envelope) is used in the vertical multivibrator-output stage, and the horizontal multivibrator is a 6CG7 (alternate 6FQ7). AFC voltage for the horizontal stage is developed by a selenium dual diode. Replacement of this unit is quick and easy; the diode (see photo) plugs into a socket mounted on one of the two printed circuit boards used in this set. A 1G3GT high-voltage rectifier and a 6AX4GTB damper round out the tube complement of the horizontal sweep section. (Some chassis may come equipped with a 6DE4 in the damper stage, rather than a 6AX4.)

Controls for on-off-volume, channel selection, fine tuning, brightness, and vertical hold are all mounted on the front. The contrast control is mounted on the underside of the chassis, but connects to a front operating knob via a plastic extension shaft. Controls mounted on the rear include PICTURE GUARD (noise), AGC, vertical linearity, height, horizontal lock (frequency coil), and horizontal range. The width is controlled by a metal sleeve placed between the yoke and the CRT.

The picture tube (a 92° 23AUP4) and the chassis can be removed, as a single assembly, from the front of the cabinet.

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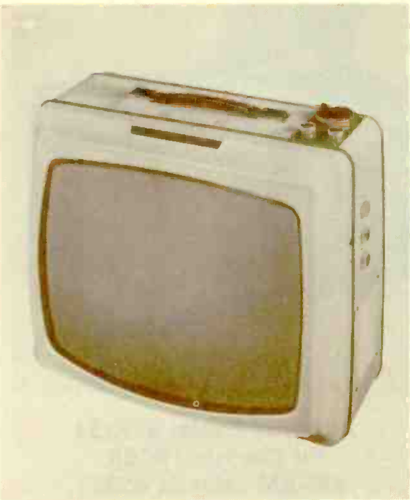
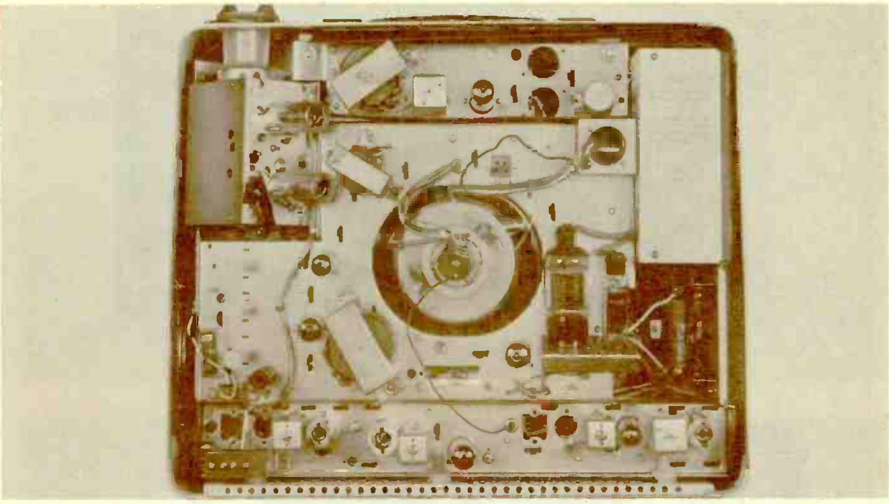




Delmonico Model PTV-M3U

One of the newest portable TV's introduced by Delmonico, this 19" receiver uses a 19YP4 114° picture tube and is equipped with a monopole antenna. If you elect to use an external antenna instead, loosen the thumb screws on the antenna terminal board (located on the rear cover), and remove the shorting bars from the upper terminals. Then, connect the external antenna leads to these upper two terminals. The connection from this terminal board to the tuner input proper is made via a plug and socket. The tuner, by the way, is a switch type that uses a 4BQ7A as the RF amplifier and a 5EA8 in the oscillator-mixer stage.

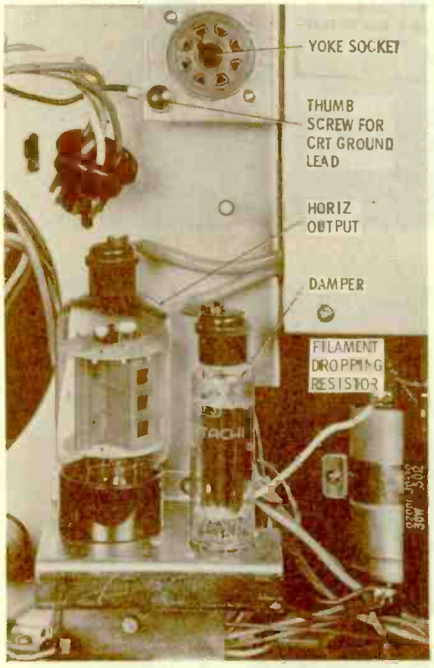
The tubes used in this receiver are 600-ma types, wired in a series string. The horizontal multivibrator is a 12BH7A—unusual for this application. The 50-ohm, 10-watt filament-dropping resistor may be replaced without pulling the chassis.

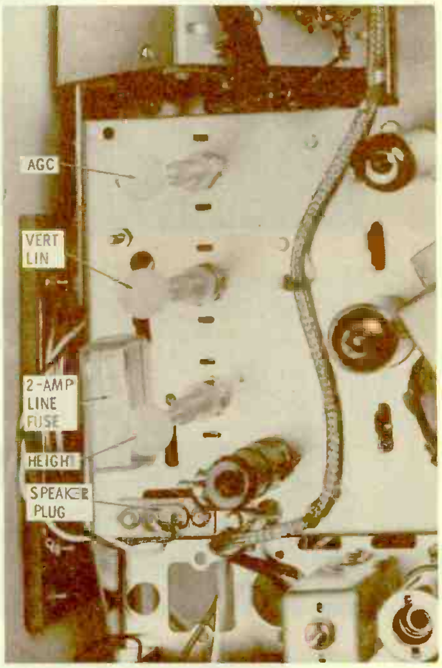
A 2-amp fuse, mounted under a plastic cover on the rear side of the chassis, protects the entire receiver from overload. Electrically, this fuse is wired between one side of the AC input line and chassis. Make sure you use normal *hot-chassis* servicing procedures when working on this set.

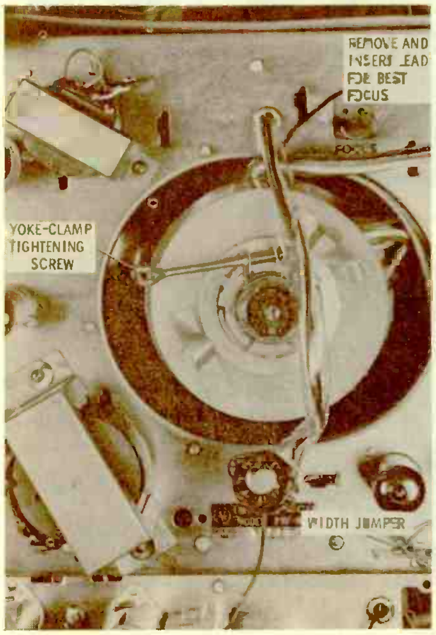
Two silicon rectifiers, wired to double the input voltage, develop the B+ in this set. To replace either of these units, you must first pull the chassis.

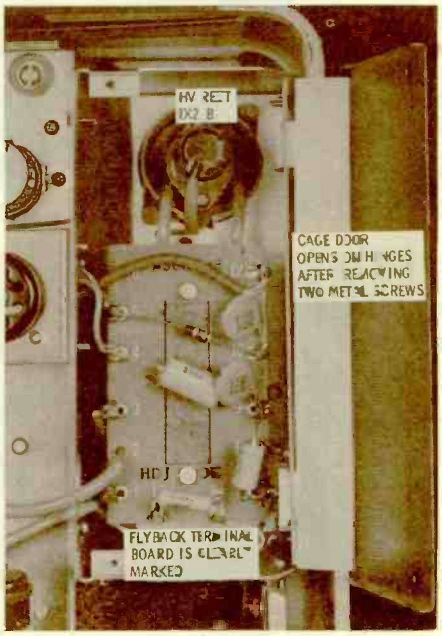
Operating controls for brightness, vertical hold, and horizontal hold are all mounted on the right side of the cabinet; those for channel selection, fine tuning, contrast, and on-off-volume are located on the top. Service-adjustment controls (AGC, vertical linearity and height) have plastic extension shafts and are adjustable through holes in the rear cover. Other servicing adjustments in this set include one for width (a jumper wire in the screen circuit of the horizontal output stage), and one for focus. Any of three focus voltages may be selected with the plug and socket arrangement shown in the photo.

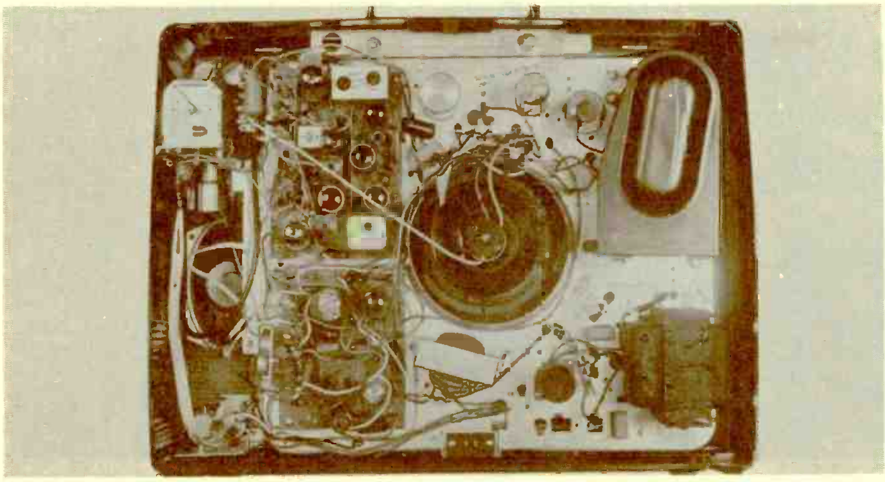
Safety-window removal is fairly simple: Take out the five metal screws located on the front mask assembly, and lift this unit from the cabinet. Clean the window with mild soap and water only.

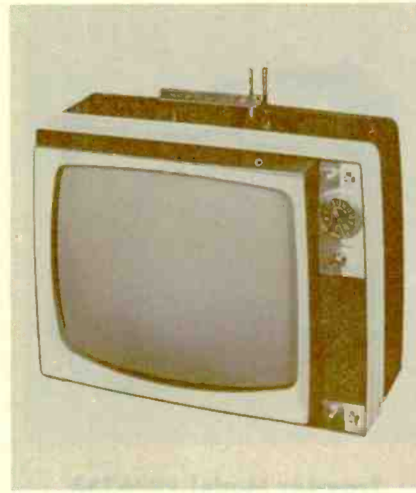


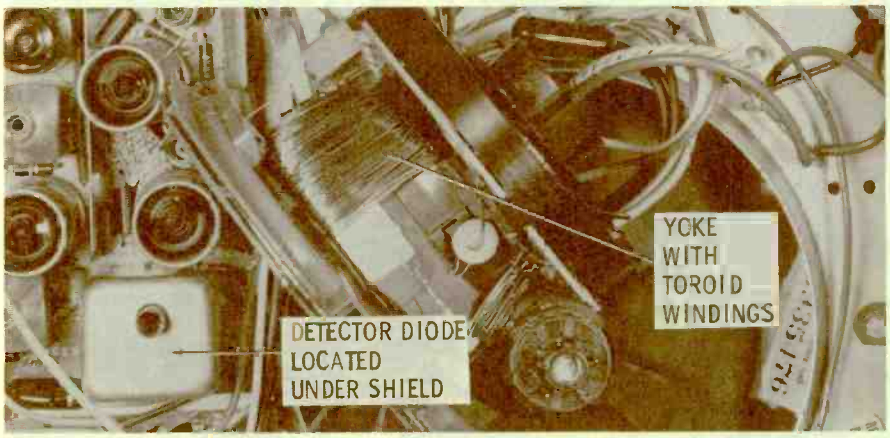


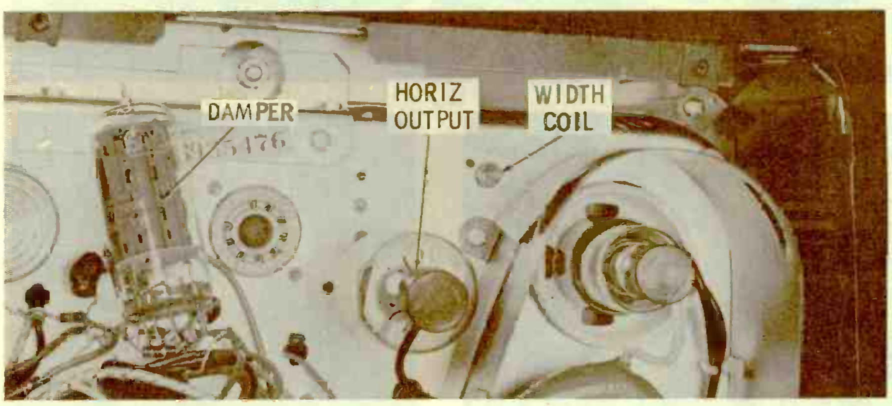


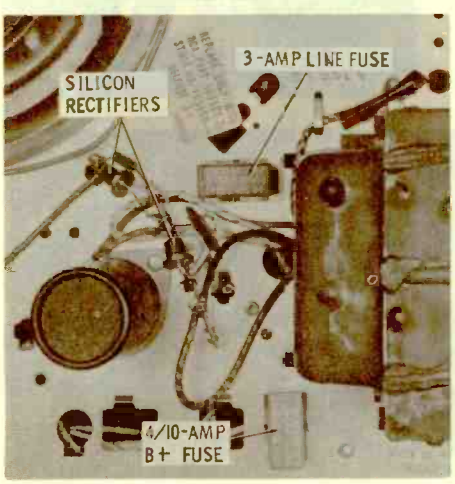












RCA Model 193-A-542-MV Chassis KCS140A

Pictured here is RCA's newest entry in its *Sportabout* line. Designated as the *Stylist*, this receiver uses a 114° picture tube (a 19AYP4), and has a built-in rabbit-ear antenna.

The RF amplifier in this set is the now-familiar 6CW4 nuvistor. A 6EA8 is used as the mixer-oscillator. This model is equipped to receive VHF channels only, but other models in this line, containing both a UHF and a VHF tuner, are available.

The deflection yoke (shown in the close-up) is wound in an unconventional manner. In place of the usual saddle-shaped windings, it has pairs of separate coils which are wound around the core in a *toroid* pattern.

Two plug-in *chemical* fuses are located near the power transformer. One is a 3-amp line fuse in the primary winding of the transformer; the other is a 4/10-amp fuse protecting the B+ circuit. The low-voltage supply uses two 1N1763 silicon rectifiers, wired in a voltage-doubler circuit. The 6.3-volt filament supply is split into two branches, with a #28 wire-link fuse protecting each branch.

Two *novar* tubes, the first to be employed in this company's portable-TV line, are used in this set. A 6GJ5 functions as the horizontal output tube, while a 6AY3 (removed from the socket to show its profile in the photo) is found in the damper slot. Other tubes in the receiver include a 6HF8 video output-sync separator and a 6GY6 used for keyed AGC.

The AGC, noise stability, height, and vertical linearity controls are adjustable through holes in the left side of the rear cover. To change the setting of the width coil, you must first remove the rear cover. To replace the video detector (crystal diode), remove the snap-on shield from the final IF can.

The safety window, which should be cleaned with mild soap and water only, is held in place by three bottom screws outside the cabinet and two additional screws located on the inside. These inside screws can be reached by removing the rear cover. After removing those five screws and the front operating knobs, you can snap off the mask and safety window as a single unit.

Trav-Ler Model 19P6233
Chassis 1180-12

Shown here is one of the 19" portable TV's available from Trav-Ler, using a 19XP4 aluminized 114° picture tube. Focusing is adjustable by changing the connection between pin 4 of the CRT socket and the focus terminal board on the chassis. Two of the plugs on this board are connected to different DC-voltage sources, and the third plug is grounded. Connect the lead to the plug which gives the best over-all focus on the screen.

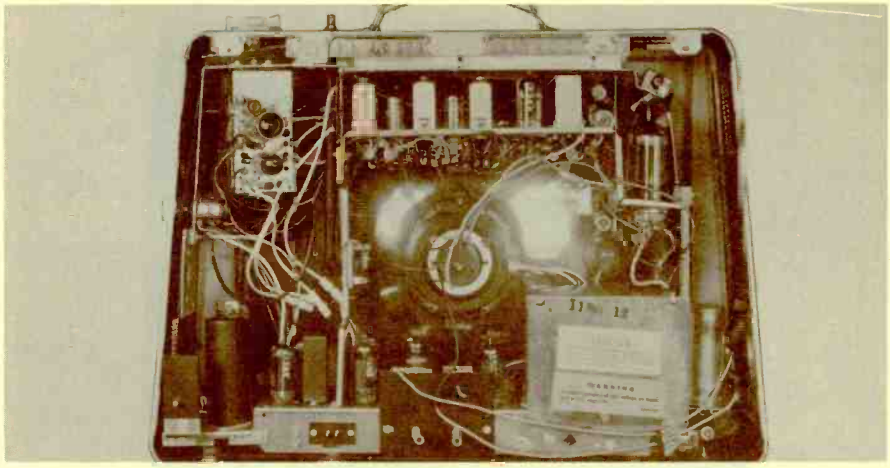
The low-voltage circuit, a half-wave doubler using two silicon rectifiers, is protected by a circuit breaker and an 8-ohm, 10-watt surge resistor. As shown in the photos, all these components are located on top of the chassis and are easily accessible for replacement without removing the chassis from the cabinet. A 35-ohm, 10-watt resistor wired in series with the tube-heater string is similarly easy to replace.

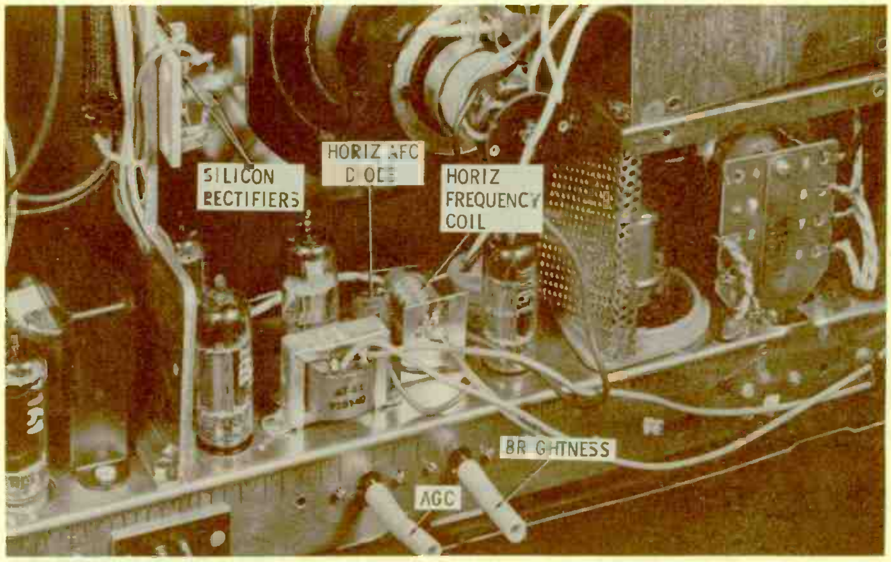
Two semiconductors are used in this set: a 1N87 germanium diode as the video detector and a dual selenium diode in the horizontal AFC stage. The AFC diode (shown in the photo) plugs in, making replacement easy. The 1N87 is not replaced quite so simply; it's located inside the third IF can, and before it can be changed, the can must be unsoldered and removed from the chassis.

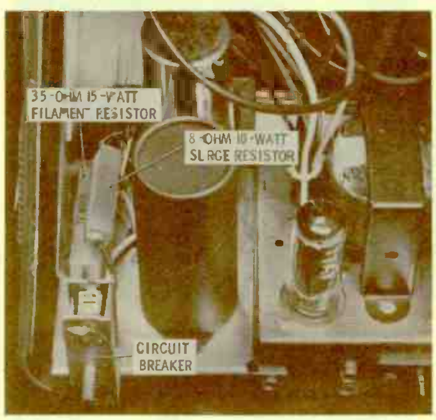
Some of the tubes used in this receiver are: a 6AW8 for the video output and sound-IF amplifier circuits; a 12CU5 for audio output (serving also as a B+ voltage divider); and a 3BU8 for the three functions of AGC keying, noise limiting, and sync separation.

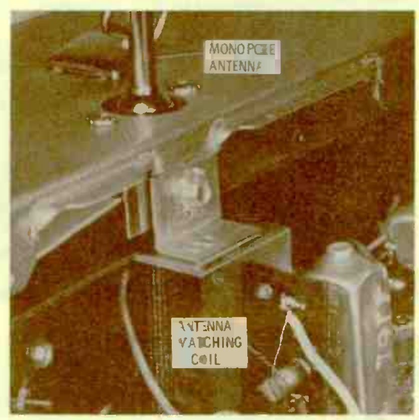
The operating controls for on-off-volume, contrast, and vertical hold are mounted on the side of the cabinet. The vertical linearity control is attached to the rear of the contrast pot, and can be adjused through the hollow shaft of the latter unit. In a similar manner, the height control is located directly behind the vertical hold. Controls for AGC, brightness, and horizontal hold are mounted on the rear apron of the chassis, and all are adjustable without removing the rear cover.

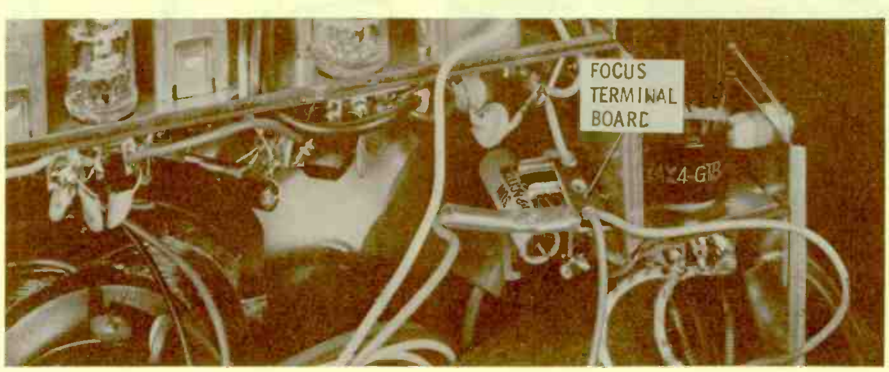
The safety glass can be removed for cleaning after you remove the seven metal screws from around the front of the cabinet (three on the bottom and two on each side).











See PHOTOFACT Set 515, Folder 1

See PHOTOFACT Set 515, Folder 1

Mfr: Motorola **Chassis No.** TS-568

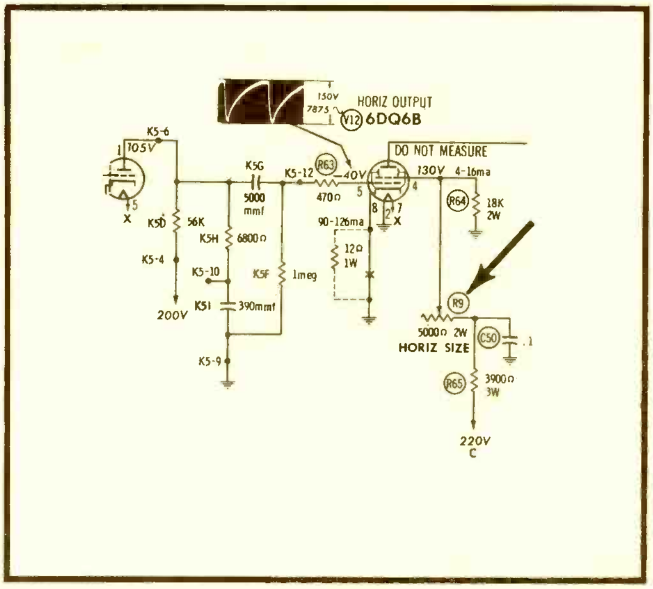
Card No: MO 568-1

Section Affected: Raster.

Symptoms: Flashes and streaks in raster; fluctuating voltage at screen grid (pin 4) of V12 (6DQ6).

Cause: Defective horizontal size control.

What To Do: Replace R9 (5000 ohms—2W).



Mfr: Motorola **Chassis No.** TS-568

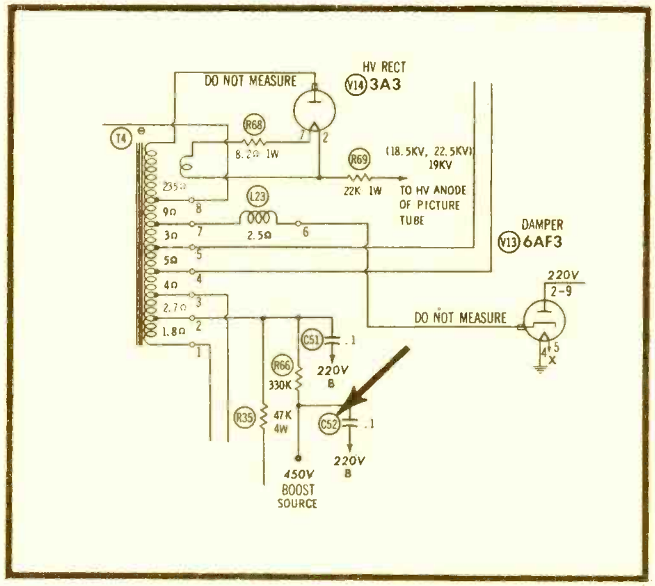
Card No: MO 568-2

Section Affected: Raster.

Symptoms: Insufficient vertical sweep; low boost voltage.

Cause: Leaky filter capacitor on boost line.

What To Do: Replace C52 (.1 mfd).



Mfr: Motorola **Chassis No.** TS-568

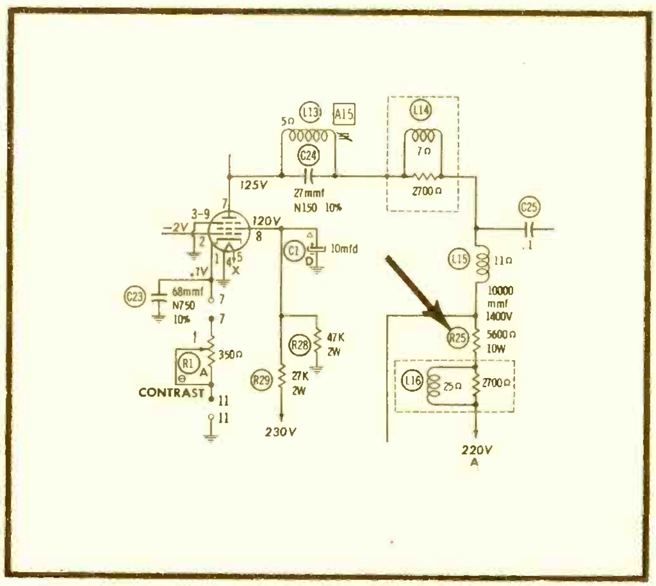
Card No: MO 568-3

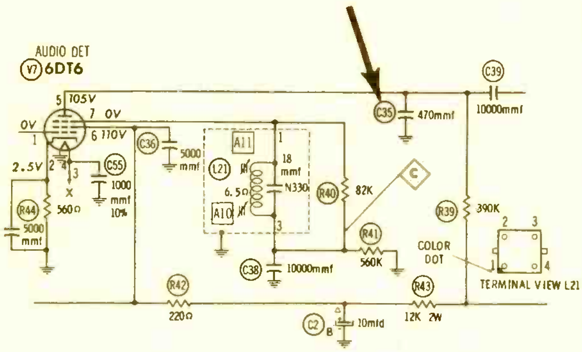
Section Affected: Pix.

Symptoms: Smeared, weak picture.

Cause: Plate-load resistor in video output stage has decreased in value.

What To Do: Replace R25 (5600 ohms—10W). Check V4 (6GK6) for shorts.





See PHOTOFACT Set 515, Folder 1

Mfr: Motorola **Chassis No.** TS-568

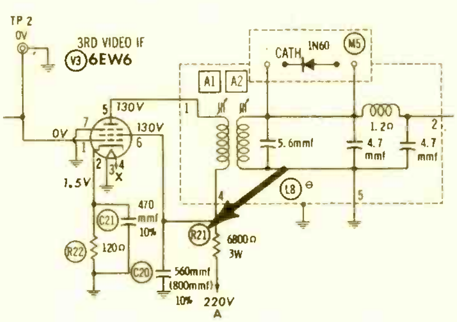
Card No: MO 568-4

Section Affected: Sound.

Symptoms: No sound. Zero voltage at plate (pin 5) of V7 (6DT6).

Cause: Shorted plate-bypass capacitor.

What To Do: Replace C35 (470 mmf).



Mfr: Motorola **Chassis No.** TS-568

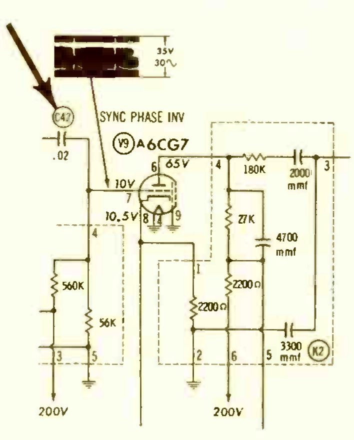
Card No: MO 568-5

Section Affected: Pix and sound.

Symptoms: Video and sound fade intermittently; when trouble occurs, voltage disappears at plate (pin 5) of V3 (6EW6).

Cause: Plate-decoupling resistor opens intermittently.

What To Do: Replace R21 (6800 ohms — 3W).



Mfr: Motorola **Chassis No.** TS-568

Card No: MO 568-6

Section Affected: Sync.

Symptoms: Poor vertical and horizontal hold; voltage is too positive at grid (pin 7) of V9A (6CG7).

Cause: Shorted coupling capacitor between sync separator and sync phase inverter.

What To Do: Replace C42 (.02 mfd).

See PHOTOFACT Folder 539-2; PCB 588-3

See PHOTOFACT Folder 539-2; PCB 588-3

Mfr: Sylvania **Chassis No.** 546-1

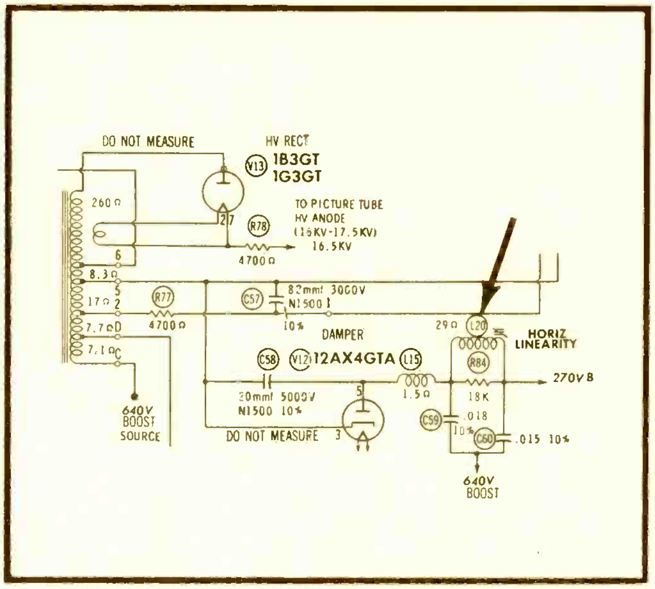
Card No: SY 546-1-1

Section Affected: Raster.

Symptoms: No raster; R84 overheats; low voltage at plate (pin 5) of V12 (12AX4GTA).

Cause: Open horizontal linearity coil.

What To Do: Replace L20.



Mfr: Sylvania **Chassis No.** 546-1

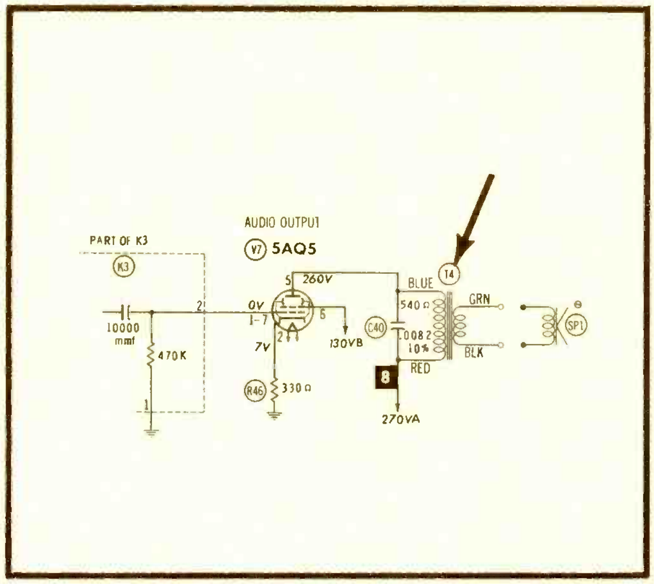
Card No: SY 546-1-2

Section Affected: Sound.

Symptoms: Insufficient volume.

Cause: Shorted turns in audio output transformer.

What To Do: Replace T4.



Mfr: Sylvania **Chassis No.** 546-1

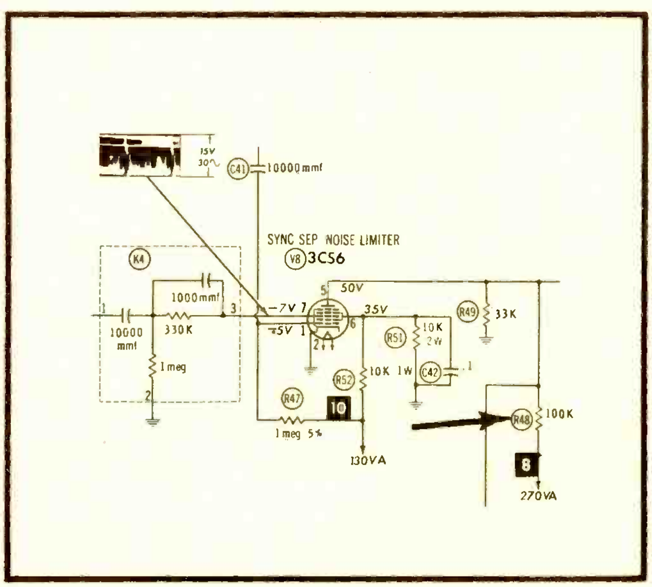
Card No: SY 546-1-3

Section Affected: Sync.

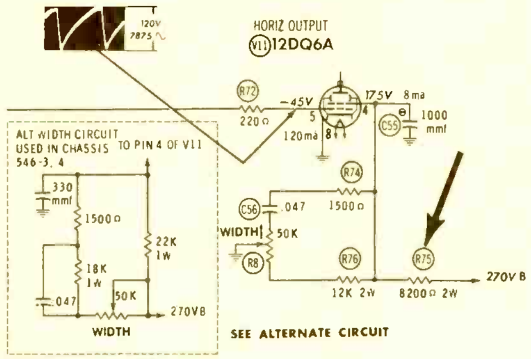
Symptoms: Horizontal tearing and vertical rolling. Low voltage at plate (pin 5) of V8 (3CS6).

Cause: Plate-load resistor has increased in value.

What To Do: Replace R48 (100K).



See PHOTOFACT Folder 539-2; PCB 588-3



See PHOTOFACT Folder 539-2; PCB 588-3

Mfr: Sylvania **Chassis No.** 546-1

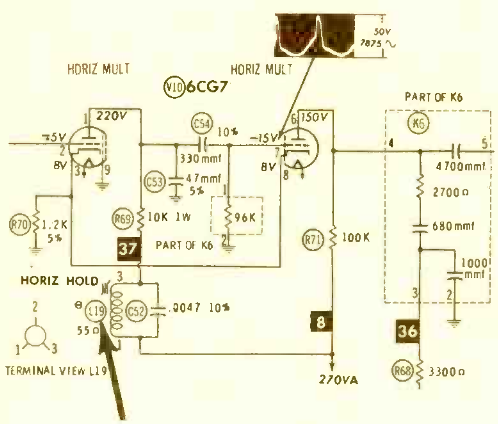
Card No: SY 546-1-4

Section Affected: Raster.

Symptoms: Insufficient width.

Cause: Resistor in screen-grid circuit of horizontal output stage has increased in value.

What To Do: Replace R75 (8200 ohms — 2W).



Mfr: Sylvania **Chassis No.** 546-1

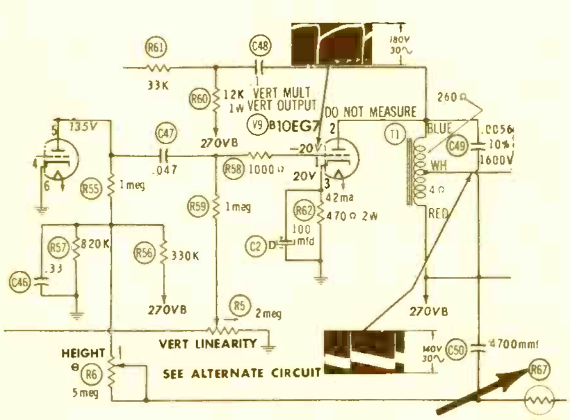
Card No: SY 546-1-5

Section Affected: Sync.

Symptoms: Poor horizontal hold.

Cause: Horizontal ringing coil has developed shorted turns.

What To Do: Replace L19, and check V10 (6CG7) for shorts.



Mfr: Sylvania **Chassis No.** 546-1

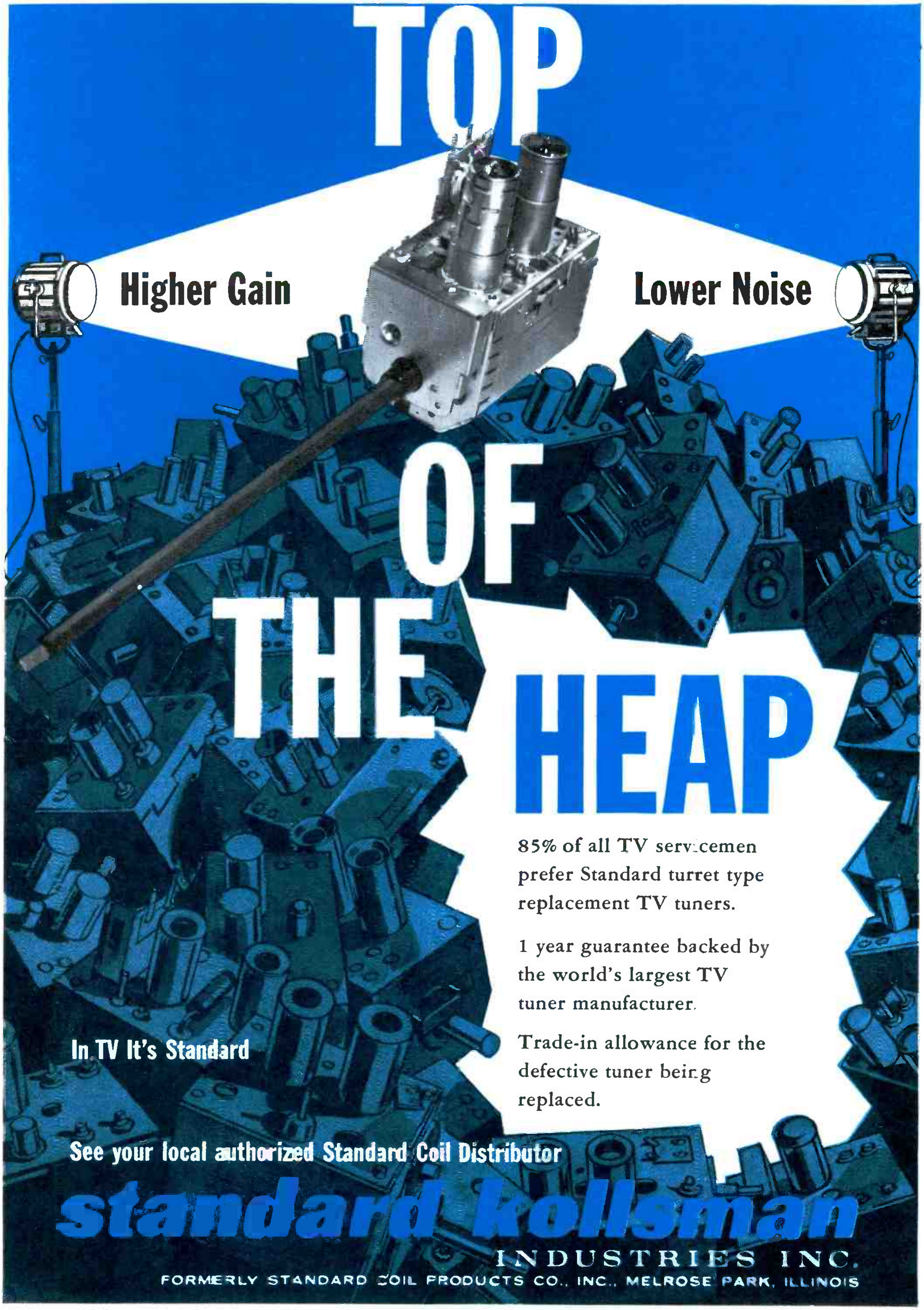
Card No: SY 546-1-6

Section Affected: Raster.

Symptoms: Insufficient vertical sweep; low voltage at grid (pin 1) of V9A (10EG7).

Cause: Defect in thermistor wired between height control and boost source.

What To Do: Replace R67 (Sylvania part no. 189-0081).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New Heavy Duty RFI Suppression Kit For Mobile Radio

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Sprague's new Type SK-1 SUPPRESSIKIT provides effective R-F Interference suppression—at moderate cost—up through 400 megacycles. Designed for easy installation on automobile, truck, or boat engines with either 6-volt or 12-volt generators, the Suppressikit makes possible high frequency interference control by means of Sprague's new, extended range, Thru-pass® capacitors.

The components in the SK-1 Suppressikit are neatly marked and packaged, complete with easy-to-follow installation instructions. All capacitors are especially designed for quick, simple installation.

The generator capacitor is a heavy-duty unit rated at 60 amperes, and will operate at temperatures to 125°C (257°F). This means you'll have no trouble with an SK-1 installation in the terrific temperatures found "under the hood" on a hot summer's day. There's no chance of generator failures from capacitor "short outs," as with general purpose capacitors. The Thru-pass capacitors for use on voltage regulators are also rated at a full 60 amperes.

The Deluxe Suppressikit is furnished complete with an 8-foot shielded lead on the generator capacitor which can be trimmed to necessary length for any car or small truck, preventing R-F radiation from armature and field leads.

Containing only 5 easy-to-install capacitors, the Deluxe Suppressikit is a well-engineered kit. The net price is a little higher than that of many thrown-together kits, but it saves you so much time and aggravation it's well worth the slight extra cost.

For additional information on the Type SK-1 Suppressikit, see your Sprague Electronic Parts Distributor.

PF REPORTER

including **Electronic Servicing**

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ABOUT THE COVER

One of the things that "bug" TV service technicians is the job of tracing through the multiple branches of a B+ system to locate a short. This problem can be simplified, and wasted effort cut to a minimum, by means of the "thinking man's" approach outlined on page 24.

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LETTERS TO THE EDITOR

Dear Editor:

My curiosity is on the rampage, wondering what you mean in the August issue by the "new kind of aid for troubleshooting." Are you talking about an improvement in VSS? It very definitely is an aid to troubleshooting. Or will something completely new start in September? I can hardly wait to find out!

V. T. GARAMONDI

Boston, Mass.

You can relax, Mr. Garamondi, the time has come to reveal the new PF REPORTER "Symfact" *feature. It will consist of facts about trouble symptoms in specific TV circuits. A complete explanation of the circuit is accompanied by tips on how to troubleshoot it. Then four common symptoms are analyzed in detail, and the components which cause trouble are pinpointed. But why take our word for it? See for yourself—it's on page 34! By the way, let us know how you like it.—Ed.*

Dear Editor:

Fire the proofreader! ! I guess he's already heard—there are a couple of mistakes in "Binary Numbers" (July PF REPORTER). The article was great, but don't add confusion to an already confusing subject. On page 28, Table II, Example B, the third binary digit (the 2^4 position) should be 1 instead of 0. Then, on page 63, Rule 6 should be restated; where it says 1 x 1 = 0, it should say 0 x 1 = 0. I'm in favor of more articles like you've been printing. Yours is one of the best magazines on the market today, but not if mistakes keep popping up.

JOHN B. PERKINS

Niles, Mich.

Do we dare point out just one more error, John? Table V on page 62 had a goof, too; in example D, the third decimal equivalent is 25 instead of 22. As for our proofreader, we've given him a light to read by, and I'm sur nohting like thsi will hapen agian.—Ed.

Dear Editor:

I'd like to pass along an idea I use for convincing customers that shop work on TV sets is worth the cost. Before I pull the chassis, I take a photo of the TV picture with my *Polaroid* camera, and give the snapshot to the customer for comparison with the improved performance after the repairs are finished.

T. J. WHITLEY

Dallas, Texas

You must get some interesting photos on symptoms such as no raster, garbled sounds, or no picture. Only kidding, T. J. It sounds like a pretty good (and inexpensive) convincer, when you can use it.—Ed.

Dear Editor:

I think you're overlooking a good possibility by not running a series of articles on servicing electronic flash guns. Evidently, you're not in touch with enough fellows who have gotten their feet a bit wet in this line of work. This week, 55% of my total business was from repairing these units. They are shipped to me from six states, apparently because so many fellows don't quite see what a profitable service item this is. There must be a void somewhere.

M. G. GOLDBERG

St. Paul, Minn.

Got their feet wet, servicing flash guns? Must be a strange business! Anyone who'd like to find out more about this line of servicing? By the way, we're preparing a servicing article on darkroom equipment that is run and controlled by electronics; this is in somewhat the same field.—Ed.

Dear Editor:

On page 58 of your July issue, the Troubleshooter advised Mr. Leo Fruit of Macks Creek, Missouri, regarding a flyback replacement. If Mr. Fruit followed the diagram which accompanied the advice, he's probably still having trouble—the primary terminals are reversed! You'd better let him know, quick, before he burns up another flyback.

NAME WITHHELD

New Orleans, La.

Thanks, Mr. Withheld, and let's hope he reads this in time. Our apologies to both you and Mr. Fruit.—Ed.

Dear Editor:

A television dealer who services the sets he sells has one commodity with which to beat the discounter and price cutter . . . it is his service! We have competitors who don't care much for servicing; they take little responsibility for a set once it is sold, and don't mind "upping" a trade-in allowance several dollars above what is fair. When our customers say they've been approached with one of these "better offers," we agree to meet that price provided the customer will forego our usual full-year service warranty. This generally swings the deal our way, for few people want you to wash your hands of them after a sale.

JOHN A DEFREES

Durhamville, N. Y.

"Shay . . . can anybody shpare a dime?"

• Please turn to page 18

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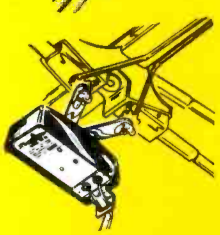

- **JFD amplifier is mounted directly on antenna terminals**—the point of highest signal-to-noise ratio—the one and only right place. Result more clean signal on every VHF channel to each set in use—plus brilliant STEREO FM.

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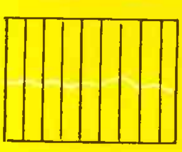

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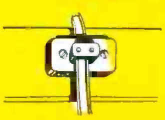

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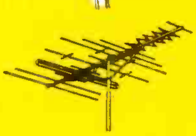

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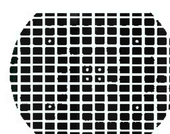

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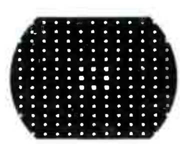

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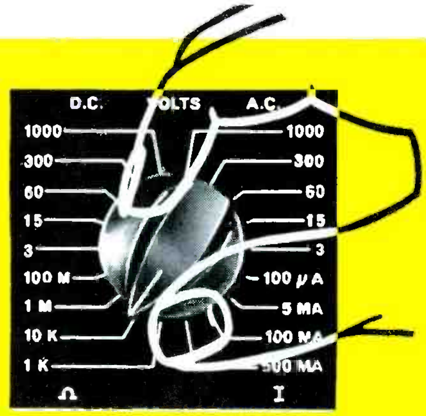

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That's undercutting the undercutters! But what do you do with the customer who buys on credit, and then dares you to refuse him service?—Ed.

Dear Editor:

I would like to know why some brands of small receiving tubes test much higher than others in a mutual conductance type of tube tester. Do you have any comments on this?

WALTER J. WILLIAMS
St. Clair, Mich.

In the usual emission tester, all elements except the cathode and heater are connected together for the test, and the instrument measures the ability of the cathode to emit electrons. In a mutual conductance tester, however, a signal is applied and the tester indicates how much control the grid has on the plate current. Since the effectiveness of the grid is somewhat dependent on the spacing between it and the cathode, slight differences in manufacturing tolerances may cause varied spacings among various brands—leading to different Gm readings, even in tubes of the same type. This does not necessarily mean they differ widely in performance, for the spacing of other elements within the tube also contributes to the overall performance.—Ed.

Dear Editor:

In the July issue, your VSS card WE 2378-1-11 describes a symptom I've encountered often. My remedy consists of hooking a voltmeter to the plate (pin 5) of the 6DT6 and tuning L21 (A9) for maximum DC voltage. This always clears up my problem. Another thing: I'd like to see another issue like November, 1961—nothing but color.

HUGH O. BUTTS
Des Moines, Iowa

Your wish is our command. Presto—and the November issue will be piled high with color-TV servicing goodies. Thanks, Hugh, for the service tip, although I doubt that tuning L21 will compensate for the defective resistor indicated on the VSS card. And if tuning did cure the symptom in such a case, the trouble would be likely to recur as the resistor further changed in value.—Ed.

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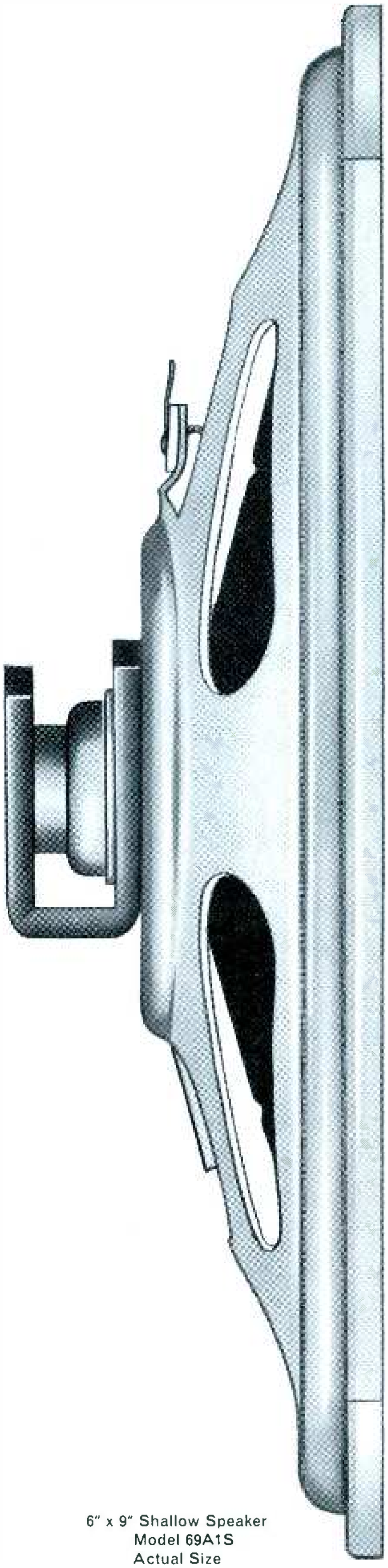

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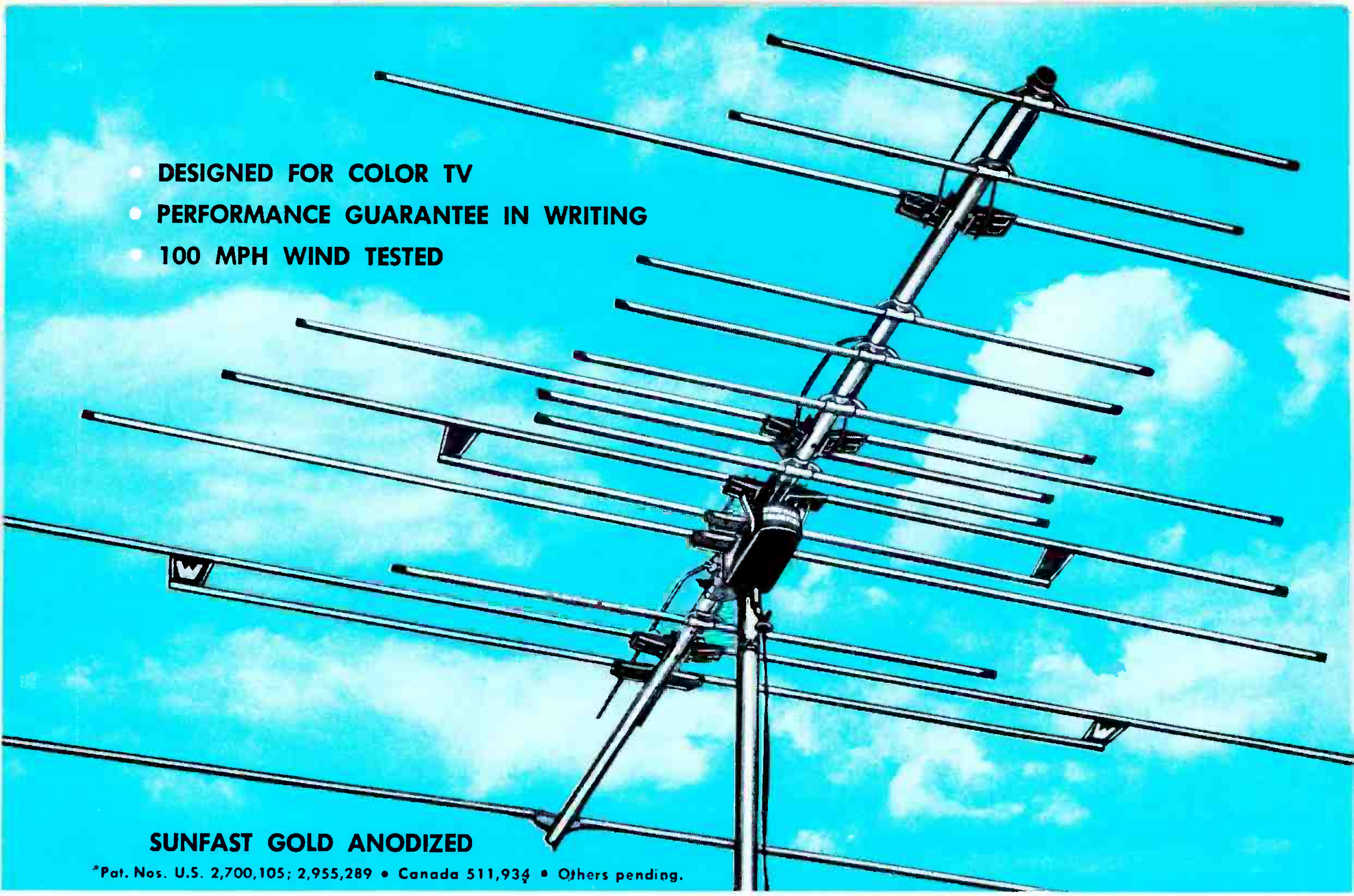

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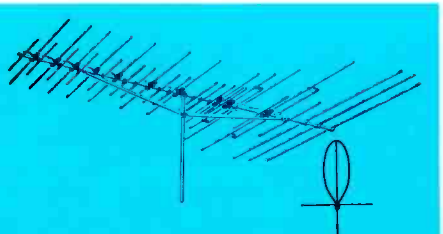

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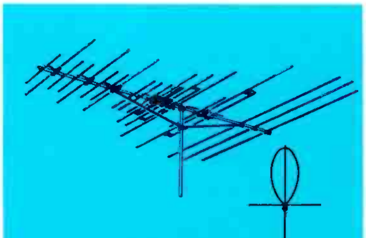

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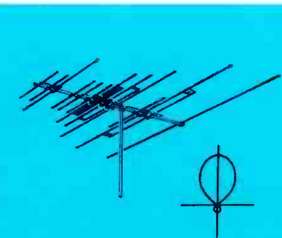

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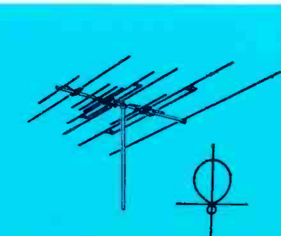

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FOR TV—2 Transistor (Mod. No. AT-220, $39.95) also available. Will take up to 80,000 microvolts of signal input without overload. This is 3 times the input of other transistor antenna amplifiers.

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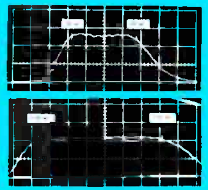

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ANTENNA SYSTEMS

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RADIO-TV Substitution STOCK GUIDE

Keeping this inventory of major parts on hand will help you service faster and better

What is the surest way to find out if a specific part is causing trouble? By substituting a known-good equivalent in its place. To do this, every radio-TV service shop needs a basic stock of replacement components. Naturally, you'll stock such small items as tubes, resistors, capacitors, fuses, fusible resistors, dial lamps, connectors, and other inexpensive parts. Suitable assortments of these components are readily available—often in kit form—but what about major components?

You have three alternatives when it comes to more expensive replacements: 1. Run down to the distributor and buy a part every time you want a substitute, 2. equip your shop with a complete assortment of component-substitution test equipment, or 3. maintain a basic stock of replacement items. A mixture of the last two is the most-favored choice. However, if you have limited finances, patient customers, and lots of time, the first alternative is okay. Even so, there is a definite disadvantage to this practice. If you guess wrong about the part, and the replacement didn't solve the problem, it means another trip. Also, you'll have to replace the original substitute instead of leaving the new part in the set and charging the customer for it—unnecessary billing is unethical and should be avoided.

To point out the most-often-needed major components, we've compiled the accompanying list. Notice the vertical integrator listed under the heading "Component Combination;" although this unit is an inexpensive part, it has been listed because it is difficult to test or substitute for in any other way.

The list doesn't show flybacks, picture tubes, power transformers, and other specialized components. Flybacks demand "exact replacement" types for substitution, and other parts are so easy to check that there is no need for substitution. The parts shown in bold type are the "must" items for all shops, and those in light-face type are "nice to have." Obviously, larger shops will want to stock one or more of all the items to have a readily available stock of replacements. However, you must be able to sell an item at least four times a year to make it profitable to stock more than the one test component. Therefore, watch the turnover of your stock to see exactly what you need. ▲

Coils

Linearity—2-18 mh
Width—.05-3 mh
Width—4-30 mh and 2-8 mh
Ratio Detector—4.5 mc
Quadrature—4.5 mc
Horiz. Ring—15,750 cps
"Synchroguide"—15,750 cps
Motorola, RCA (modified), and Zenith Horiz. Osc.
Universal Osc.—BC Band
Ferrite Loop Antenna

Component Combinations

Vertical Integrator
2200 mmf, two 4700 mmf, two 8200 ohm, 22K
AC Isolation
470 mmf, .3-1 meg

Electrolytics

4/10/50/100/200 mfd @ 450V for test—assorted voltages and combinations for stock

Speakers

4" square—3-4 ohms
6" x 9"—3-4 ohms
Assorted sizes

Transformers

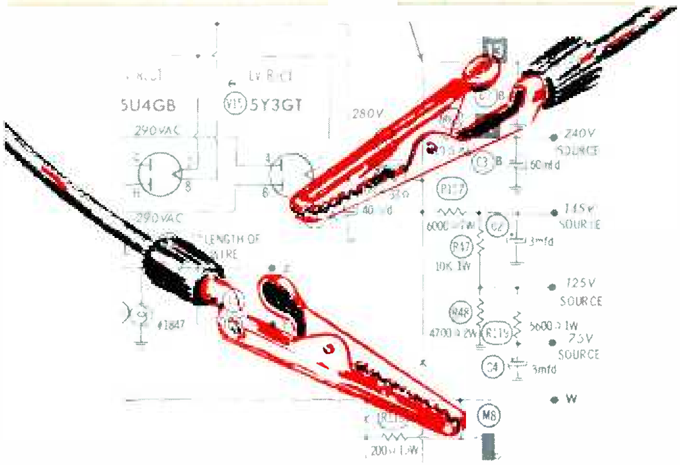
Audio Output—3-4 ohm sec.
5000 ohms, 50 ma
2500 ohms, 50 ma
7500 ohms, 50 ma
10K ohms CT, 30 ma
Vert. Osc.—1:4.2 (turns ratio)
Vert. Output—70°-90°
Universal 5:1 - 50:1
Vert. Output—110°
12-13:1

Yokes

Degree	H	V	Degree	H	V
110°	**18 mh**	**12 mh**	90°	12 mh	33 mh
90°	**20 mh**	**40 mh**	70°	10 mh	45 mh

Previous Articles About Stock

CRT's—May, 1961
Tubes—May, 1961
Diodes, Rectifiers—July, 1961
Transistors—Aug., 1961
Tuners—see article in this issue



DEBUGGING B+

by Wayne Lemons

Here's a logical way to troubleshoot low-votage supply networks . . .

Since troubles in B+ supplies can affect any TV circuit—sound, picture, sync, sweep or AGC—it's little wonder so many real "dogs" result from faults in the B+. Maybe we can refine our approach to B+ troubleshooting by analyzing a few power supplies and their load circuits.

The Voltage Doubler

A circuit often used in transformerless sets—and occasionally in transformer-powered sets—is the voltage doubler, with either selenium or silicon rectifiers. A representative circuit is shown in Fig. 1.

While silicon rectifiers are now used almost exclusively, for many years the selenium was the only type available. The silicon unit has certain advantages in its generally small physical size; and because it has a low forward resistance, it develops from 5 to 10% more output voltage than the selenium. Silicon rectifiers almost never cause low B+ voltage from increased internal resistance—a common occurrence with seleniums. Silicons are, on the other hand, more susceptible to internal short circuits—their most common defect.

Fig. 2 will help you understand just how this circuit actually doubles the input voltage. M1 and M2 each act as a simple half-wave rectifier during one-half of the input-voltage cycle. On the negative half-cycle, M1 conducts as shown in Fig. 2A, charging C1 to almost the peak value of the input voltage; M2 cannot conduct, since it is connected in the opposite polarity. However, during the positive excursion of the input voltage, M2 does conduct as shown in Fig. 2B, charging C2; during this half-cycle, M1 has no effect in the circuit.

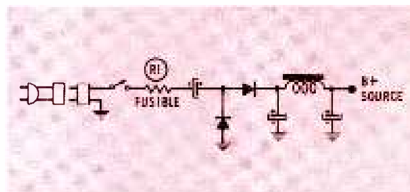


Fig. 1. Silicon rectifiers are commonly used in half-wave doubler circuit.

As the positive half of the input voltage is applied to C2 through M2, you will notice it is in series with the voltage charge already held by C1. This potential, then, combines with the input voltage and charges C2 to a level equal to the sum of both. Thus, the circuit effectively doubles the input voltage value.

The charge time of C1 and C2, the discharge time of the B+ load, and the internal resistance of the rectifiers, combine to prevent the DC output voltage from reaching twice the *peak* input voltage; however, the output level is well over two times the *rms* input voltage.

Doubler Troubles

The most common trouble in this circuit is either low voltage or none at all. Low voltage can be caused by an open or partially open C1 or C2, or by a defective rectifier. (Low voltage is seldom a problem with silicons, for the reason explained above.) The simplest and quickest way to check either of these parts is by shunting the suspected part with a known good one of the same general type.

In a case of no voltage at all, we naturally suspect the fusible resistor (R1) first. This resistor will open if a selenium or silicon shorts, or if a short develops on the B+ line. (Occasionally, one opens just to be an aggravation — see "What To Do When the Fuse Blows" in the July issue.)

If the customer complains of having no picture—and perhaps little or no sound — until after the set has been on for 30 minutes or so, you will be justified in suspecting either C1 or C2. Causing this symptom is a favorite trick of input filters. In radios, we notice it readily because of the excessive hum when the set is turned on; with TV, however,

• Please turn to page 88

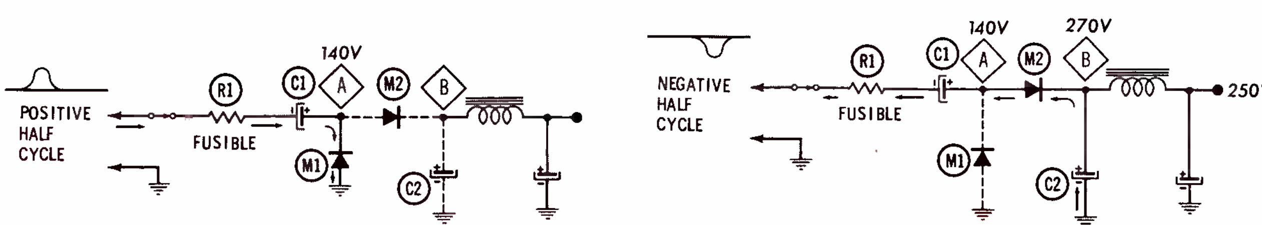


Fig. 2. DC output voltage of half-wave doubler is over twice the *rms* input.

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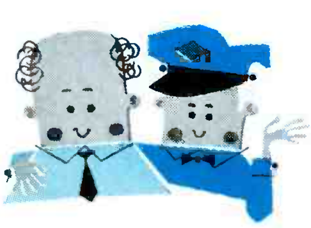

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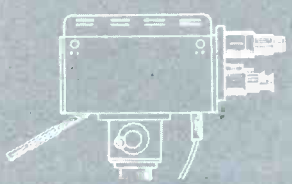

The Electronic Scanner

Microphone Given "Torture" Test

A newly developed Model 551 Industrial Microphone was recently subjected to a punishing torture test by **Astatic.** In an effort to prove the unit's durability, a company sales team attached the microphone to an auto bumper and dragged it 450 miles along the highway. The Model 551 worked perfectly at the end of the trip; the only damage was a missing front grill and some scuffed corners.

To Change Company Name

Stockholders of Jerrold Electronics Corp., at their annual meeting, approved a proposal to reorganize the corporate structure of the company and to change its name to **The Jerrold Corporation.** "The new organization plan more fully reflects the diversified character of the company," according to president Sidney Harman. He further pointed out that, through recent acquisitions, Jerrold is now engaged in many phases of electronic communications, control, and display.

Color Meeting At Channel Radio

A group of progressive dealers and technicians recently attended a color-TV meeting at **Channel Radio Supply,** Santa Barbara, California. The complete **Howard W. Sams** color-TV slide series was shown, providing those in attendance with a review of color principles as well as bringing them up to date on recent developments.

Chicago-Area Firms Merge

B & K Manufacturing Company, Mark Mobile, Inc., and all subsidiaries of both companies, recently merged to form **Dynascan Corporation.** Carl Korn, former head of B & K, is president of the new concern. Dynascan Corp. will continue with the former activities of both companies—developing, designing, manufacturing, and selling electronic test apparatus, antennas, and microwave equipment.

Cartridge Replacement Manual

A new manual released by **Sonotone** lists 1,200 models of phono cartridges made by 33 leading manufacturers. All are cross-referenced so the proper Sonotone replacement can be located easily. The "Phonograph Cartridge Replacement Manual" can be obtained by writing Electronics Application Div., Sonotone Corp., Elmsford, N. Y.

CRT Data Offered

Three technical-aid publications on picture tubes and industrial CRT's are being offered by **Sylvania Electric Products, Inc.,** 1100 Main St., Buffalo 9, New York. The "Picture Tube Comparison Chart" and "Tube Selector Guide" are ten cents each, while "Characteristics of Cathode Ray Tubes" sells for 15 cents.

Replacement Transistor Program Announced

The "Transistor Replacement Assistance Program" devised by **Semitronics** was planned to provide the products and sales aids necessary for high-volume transistor sales. More important, the program seeks to overcome the technician's too-prevalent fear of making incorrect replacement substitutions. Semitronics has assembled an assortment of 35 transistors that will replace 2000 original types.

calibrate your own VOLT

by Len Buckwalter

Few things in a serviceman's daily experience bring the assurance that comes from smoothly-operating, accurately-calibrated test equipment. Working with a meter of questionable accuracy is as futile as trying to build a foundation on quicksand—the results are inconclusive and time-consuming. The price of accuracy does not run high; it merely involves periodic checks against standards that are easily acquired or already available in the shop.

Among the easy-to-obtain calibration standards are mercury batteries, 1% precision resistors, FM or AM broadcast stations, 60-cps line voltage, and certain crystals. Also, reasonable accuracy can be accomplished by first calibrating one piece of test gear, and then using it as a standard for setting up another. If, for example, a VOM is known to provide accurate voltage readings, this knowledge can be used in checking the milliammeter section. Lastly, there are commercially made instruments for calibration purposes, in case extremely close tolerances are desired.

Why The Need

Over a period of time, a variety of factors tend to upset the accuracy originally built into test equipment by the manufacturer. Instruments undergo the same upsetting forces as the equipment they help troubleshoot—and sometimes more. Components age, internal heating alters values, and wear affects mechanical linkages. These add up to a condition which is often worse than outright failure—a progressive, almost imperceptible deterioration of precious accuracy. How far this shift in performance is permitted to go shows up in the service work.

The best way to keep instruments accurate is to follow a regular schedule of calibration. This can often expose a defect before it becomes serious enough to cause trouble during routine measurements. A general rule of thumb for a calibration schedule could be: The more accurate the instrument, the more frequently it should be calibrated. A 1% instrument should be checked about once every three months. In the service shop, most test gear falls into the 1% to 5% category, and a checkup at least once every six months is advisable. Less accurate instruments, including such passive, nonpowered units as substitution boxes, may be checked on a yearly basis. The schedule should be accelerated for any instrument which is subjected to rough handling away from the shop. A chart, notebook, or other method of record-keeping should be used to record the date of calibration for future reference.

Some instruments cannot be calibrated very easily; a VOM, for example, seldom has internal calibrating controls. In cases like this, one workable solution is to find how inaccurate the unit is, and note the amount it deviates from the standard on a small chart which can be pasted directly on the case of the instrument. Then, when readings are taken, the chart can be consulted for corrections.

While it is possible to troubleshoot and repair minor inaccuracies in a VOM, this may be tricky unless one or two components have radically changed value. More often the problem develops from an accumulation of small errors which would require a major overhaul to correct.

Before considering specific calibration techniques, let's review some preliminary considerations applicable to most equipment:

1. *Physical Position* — Gravity affects the mechanical portions of any instrument, including the meter movement; therefore, it's a good idea to perform any calibrating adjustments with the unit in the same position used during routine operation. If your VOM or VTVM ordinarily sits vertically on a bench or shelf, don't lay it flat on the workbench during calibration.
2. *Mechanical Zero* — To compensate for small deviations, most meters have a screw slot just below the face for mechanically zeroing the pointer. This is adjusted with no power applied. The adjustment is most accurate if you gently tap the meter face with a fingertip to offset friction in the meter movement.
3. *Electrostatic Charge* — An accumulated electrical charge on a plastic meter face can affect accuracy. You can neutralize this during calibration, with a cloth wetted in household detergent. A few swipes across the meter face will remove the "static."
4. *Tube Aging*—If a new tube is being replaced at the time of calibration, it should be

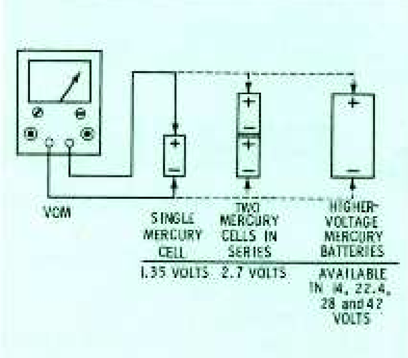

Fig. 1. Mercury cells are reliable as standards for DC voltage calibration.

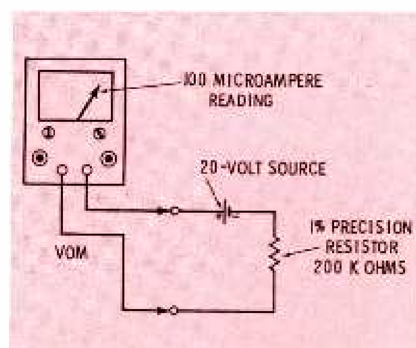

Fig. 2. Current through precision resistor is measured in milliammeter test.

METERS

Keep instruments accurate by checking against readily-available standards.

"cooked" for at least 48 hours to prevent serious changes in instrument accuracy after a period of use—since new tubes initially display high emission which soon tapers down to stable levels. This aging can be done in the instrument itself, or in a tube checker.

5. *Operating Temperature* — If the unit contains tubes, permit them to warm up for at least an hour before attempting calibration.
6. *Mechanical Parts* — Tighten all set screws, knobs, and other mechanical parts which might have loosened during previous use.

VOM Procedures

Probably the best reference source for calibrating the voltage scales of the VOM (or VTVM) is the mercury cell. (These batteries, nominally rated at 1.35 volts, can age for many months and still retain their original voltage characteristics.) However, the usefulness of zinc-carbon flashlight cells should not be disregarded completely. Although their voltage tends to drop off over a period of time, a fresh, unused dry cell may be expected to measure 1.55 volts.

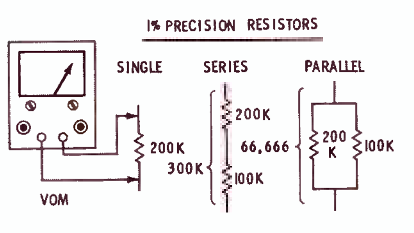

Fig. 3. Combination of precision resistors check accuracy of an ohmmeter.

Single cells of any type offer direct calibration points for low scales only. Yet this limitation is not severe, since any error in the instrument is likely to be uniform throughout all its ranges. Once the error on the lowest scale is known, the same deviation factor is generally applicable to higher scales, too. Direct calibration of the higher ranges is possible by placing cells in series, or by using batteries with higher voltage ratings (cells already placed in series by the manufacturer).

As you compare the voltmeter readings with the known voltage of the calibrating battery, it is important to interpret the results carefully. Manufacturers rate the accuracy of an instrument in a percentage of the *full-scale* reading. If you select a calibrating voltage which is less than full scale, you will have to calculate the permissible voltage error for that particular scale and note whether the reading falls within this limit.

As an example, assume that a 1.35-volt battery is connected to a 3% meter which is set to its 1.5-volt range. The pointer can be "off" by as much as ±.045 volts (3% of 1.5) and still be within tolerance. However, on the 15-volt scale, the permissible error is far greater; ±.45 volts (3% of 15). Even a significant error wouldn't show up if only a low-voltage calibrating battery were used.

Some typical voltage calibration setups are illustrated in Fig. 1. Once the voltage scales of a VOM are known to be accurate (or its calibration error has been noted), the milliammeter function can be checked by the use of Ohm's law and some precision resistors. The test setup for this is shown in Fig. 2.

The choice of the resistor hinges on two key factors. First, it must be of known accuracy — easily solved by securing a 1% precision resistor. These are both inexpensive and readily available. The other factor is the value in ohms. The internal resistance of the meter, which will vary slightly from one VOM to the next, ultimately affects the amount of current through the meter. However, this factor can be eliminated by choosing a calibrating resistor of rather high value. If calibration is to be checked on the lowest current scale, the resistor value should be at least 200,000 ohms. On higher scales, the internal resistance is less significant and lower resistance values are usable.

Fig. 2 shows a typical setup for checking out the 100-microampere scale of a VOM. With 20 volts applied, the current through the resistor will be 100 microamperes.

Other current ranges are checked by using other applied voltages and/or resistance values. Ohm's law calculations can be worked out for the precision resistors on hand and the information noted for future reference.

Determining the accuracy of the resistance scales is the simplest of all the procedures, since you need only the precision resistors. The meter is first zeroed by touching the ohmmeter probes together and adjusting the ZERO knob. (Inability to zero the needle calls for battery replacement.) Readings are taken across suitable resistors and the results recorded. The total number of resistors needed to calibrate all ranges can be reduced by using series and parallel arrangements. Fig. 3 suggests some test setups for checking ohmmeter accuracy.

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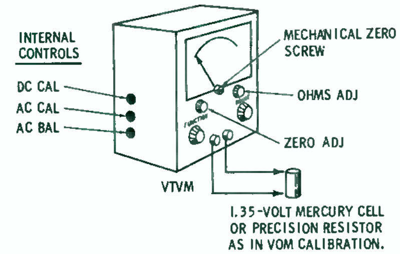

Fig. 4. These are the most important calibration points for typical VTVM.

A GOOD GENERATOR SWEEPS

Alec was fiddling with the knobs on his sweep generator when Gene walked in, so he didn't realize at once that he had company. As he reached over to adjust his scope, he turned a little, and spotted the younger fellow. "Hi, Gene," he called. "The parts your boss sent you for are right over there on the counter. Tell him not to pay me; I'd rather he just replace them sometime soon. My stock sheet shows me they're running low."

Gene picked up the package. "The chief appreciates this," he said. Then, turning toward Alec's bench, he added, "I see you're wrestling with a dog there."

Alec looked surprised. "What makes you think so? As a matter of fact, this job was an easy one, and it's all but wrapped up. The customer complained about interference on all channels. He had an oscillating IF stage, but a new screen-bypass capacitor took care of that. I'm just giving it a final check."

"I wouldn't call an oscillating IF an easy job," Gene offered. "But the reason I thought it was a real brainbuster is the fact that you're using a sweep generator. We have one at our place, but I've never gotten into the habit of using it. I figure a bench man might hook one up if he has tried everything else and is still stuck."

"Too bad," Alec told the young technician. "A lot of other service people have the same false notion about sweepers. Matter of fact, they're easy to use and can save you time on a lot of jobs. We automatically make a sweep check on many sets that come in with certain symptoms. An acquaintance of mine on the east side faithfully makes a sweep check of every completed job before it leaves the bench. What have you got against the instrument?"

"Lots of things," Gene began. "The sweep setup wastes a lot of time. I've seen ridiculous-looking response curves taken from sets that were working very well. On the other hand, I've seen others aligned to produce gorgeous curves, and yet they wouldn't deliver a decent picture until they were realigned with an ordinary RF generator and meter, or even by eye and ear! Besides, everyone knows that modern TV receivers seldom need alignment unless a component in a tuned circuit conks out. I've been warned about being alignment-happy."

Alec scratched his chin, and then said, "You know, that point about sets seldom needing alignment has real merit. But even so, the need for realignment is far from being the only reason for using a sweep generator. It's one of the fastest ways of giving tuned circuits and RF sections an over-all check. As a troubleshooting instrument, it can put the finger right on certain faults that are hard to pin down with other methods. A darned good example is the oscillation I found in this set right here."

He continued, "What is it that bugs you about using a sweep generator? Have you really tried? Did you carefully follow instructions in the manual, and check the recommendations in the service notes for the set?"

Gene nodded positively to each of these questions. "After all that," he said, "I still get distorted curves that change shape every time I sneeze; markers will either get so big they wreck the curve or else will disappear even when I beef them up. It's just about impossible to work with multiple markers—and the whole business is far too time-consuming."

Seeing Is Believing

Instead of answering immediately, Alec busied himself with firing up the equipment on the bench and making an adjustment or two. The IF response curve of the set soon stretched across the face of the scope (Fig. 1). Gene looked surprised. "You told me you were all finished with that one," he said, "and I just saw it putting out a sharp picture. How could it be, if the response really looks like that?"

Alec took one of the jumpers from the wall hook over his bench and, without a word, clipped one end to a ground post on the sweep generator, and the other to the receiver chassis. The curve on the scope flicked and assumed a shape (Fig. 2) similar to that shown in the service data spread out on the bench.

"What happened?" Gene queried. "One side of the sweep cable was already grounded to the TV set . . . oh, I get it! The manuals always talk about good grounds at these higher frequencies. In fact, some tell

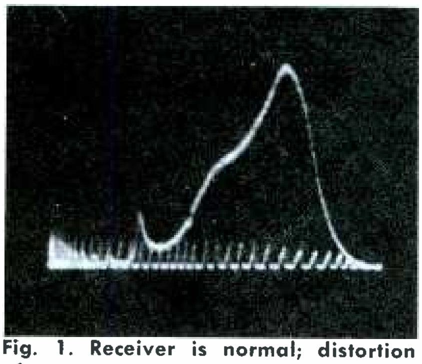

Fig. 1. Receiver is normal; distortion of curve is due to poor test setup.

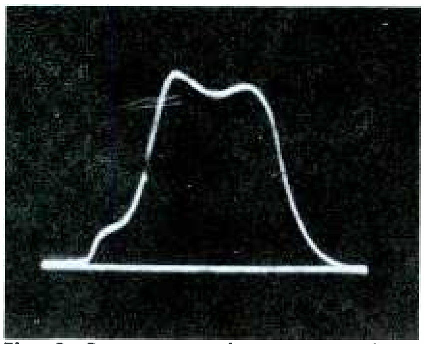

Fig. 2. Better ground connection from generator to receiver cured distortion.

CLEAN

Response curves *can* be as neat as those shown in service data . . .

by Denis A. Gentry

you, that you should have a metal sheet across the top of your bench to insure good bonding and grounding during sweep alignment. And that's another nuisance. I wouldn't go to the trouble and expense of rearranging a good working setup to play with a new toy."

Alec finally spoke: "You don't need a metal top. First of all, try to clip the ground side of your sweep-generator cable as close to the injection point as possible. Then simply add another grounding jumper or two. That's all it should take to get an honest curve that won't be changed in shape by additional grounding or by grasping the output cable. I pulled off that jumper a moment ago when you weren't looking, to prove a point.

"Here's another thing to watch out for, as far as curve distortion is concerned." Alec pointed to the output-amplitude control on the sweep generator, which was set nearly to its minimum position. He cranked it up only slightly, and the curve changed (Fig. 3).

"That last curve was fine," Gene said, "but this one's a beauty. I didn't know they make sets like that. Look at that flat-topped response!"

"I'm looking," Alec countered. "What I did was to overload the set with too much signal. It's clipping. This is one of those cases where it's hard to get anything but a good curve, no matter what you do. But it'll never show up in performance."

"Why should the generator have so much output available, then?" Gene asked. "You had to turn it all the way down to get an honest display."

"Remember," Alec answered, "I'm going through three full stages of IF with good gain. You'll need lots more output when you're feeding the signal through a single, low-gain stage. But you should never use more than you need. Start turning your control up from its minimum position. If you want a bigger display, use your scope's gain controls. Let me show you a few other things that can wreck a curve."

First he nudged the phasing control on the generator. This cut off a portion of the curve, making it unrecognizable. He explained that the sweep generator he was using had automatic blanking, which was now out of phase with the displayed signal. Before Gene could express his disapproval of this feature, Alec reminded him, "The blanking gives you the important zero-reference base line you need in many cases. Besides, it's extremely simple to get the phase adjusted right. The generator's instruction manual details a brief procedure for displaying the generator output without blanking, and for making the proper phase adjustment. Once you've done this, you use the same setting all the time; in fact, I've marked this spot on the front panel so I won't lose my place. Furthermore, I take the horizontal sweep from the binding posts provided on the generator to feed into my scope, not even using the internal scope sweep."

Alec then removed a jumper he'd been using to disable the tuner oscillator, and the curve changed shape immediately. Operating the fine-tuning control or the channel switch produced other alterations. Killing that oscillator obviously avoided a lot of trouble.

Finally, he turned on his RF signal generator, which was connected to the sweep generator, and made a few adjustments. Soon he had a neat marker pip (Fig. 4) cleanly spotting his curve.

"I guess I should applaud," Gene grinned. "I know I'm not the only poor devil who has unsuccessfully struggled to get a clean marker, let alone getting one right away."

Alec reached over to his scope's vertical-input terminals and pulled away a small tubular capacitor. "Is this the sort of junk you get?" he wanted to know, pointing to the scope screen (Fig. 5).

"That's it, but what happened?" asked Gene.

Alec restored the capacitor—and the neat marker—then expanded the vertical and horizontal gain on the scope to show just the region near the marker on the curve (Fig. 6). "Let's consider what a marker is. You're sweeping a whole band of frequencies. The fixed generator is set to only one frequency—the one you want to mark. As the sweep passes through this particular frequency, its output zero-beats with that from the single-frequency generator. The wiggles you see are heterodyne products on each side of exact zero-beat. It's these low-frequency heterodyne signals that show up so well.

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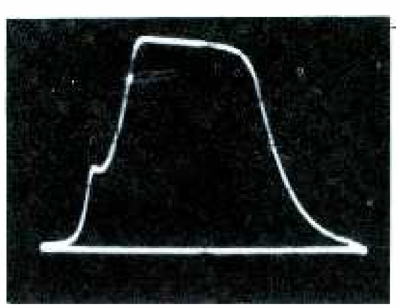


Fig. 3. Flat top on curve is too good to be true; the receiver is overloaded.

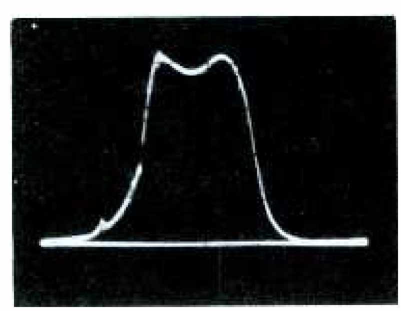


Fig. 4. The marker pip should be small and neat for best visibility on curve.

QUICKER SERVICING
by George F. Corne, Jr.

COLORS ADRIFT?
check color sync!

In my own experience, and that of other technicians I know, color-sync defects have been few and far between. However, those we did encounter were tough ones. Now that we're receiving more frequent calls to service color receivers, we've decided we had better acquaint ourselves more thoroughly with color-sync functions and adopt a workable technique for locating defects in these stages.

What's Color Sync?

The color-sync signal transmitted during color telecasts is a short burst (approximately eight cycles) of a 3.58-mc subcarrier reference signal. The main purpose of this burst signal is to synchronize the local 3.58-mc oscillator within the receiver so it will operate in step (in phase and on frequency) with the subcarrier oscillator at the transmitter. Don't confuse the color-sync signal with the deflection sync signals; color sync is used by the chroma stages only and has no effect on the vertical or horizontal circuits.

The operational theory of color sync circuits was explained in the article "Understanding Color Sync" in the November, 1961 PF REPORTER. You may want to review that article in conjunction with studying the servicing procedures given here.

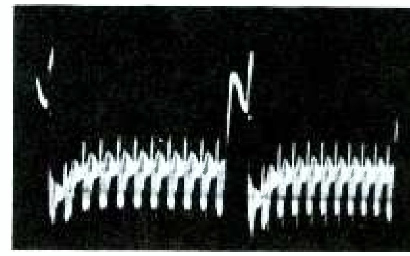
The circuits shown in the schematic diagram are typical of the color-sync stages found in late-model color receivers—the burst amplifier, sync-phase detector, reference oscillator, and oscillator-control circuit. They are found in nearly all color receivers, with occasionally a few variations, such as an extra burst stage, an automatic color-control stage (ACC), or a different sync-takeoff point. Whatever the circuit arrangement may be, the stages must still perform the same function — keeping the local 3.58-mc oscillator exactly on frequency, so the proper colors are reproduced on the screen.

Waveform Checks

Signal tracing the color-sync signals with a scope is perhaps the fastest method to locate a defective stage—provided you know what to expect. The waveforms which illustrate this article were taken using the color-bar output of a keyed-rainbow generator. The RF-type generator was connected to the antenna terminals of the receiver, while the scope was connected through a direct probe to the points indicated on the diagram. Connecting the scope in this manner may cause a slight shift in the hue of the color bars on the receiver screen, but this will not affect your troubleshooting. If you use a low-capacitance probe, it will minimize the loading effect of the scope—just be sure you take the attenuation factor (usually 10:1) of the probe into account when you measure the amplitude of the signal.

Let's explore the color-sync circuits according to the numbered points circled on the schematic, and see what signals should appear at each point. Also, we can discuss some symptoms which might occur when a signal is missing or weak.

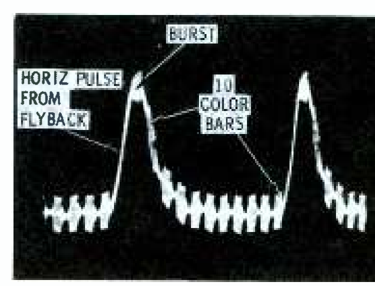
Point 1



The output of the video amplifier stage is fed from this point to the chroma-bandpass and burst-amplifier stages. The waveform here shows us that the color signal is passing through the front-end stages in good shape. Loss of this signal, of course, would result in a "no-color" condition.

The keyed-rainbow signal at Point 1 contains the horizontal sync pulse, the burst signal (which can be seen as a high peak sitting on the back porch of the horizontal pulse), and ten wide pips, representing the color bars. The dark areas between each of the pips correspond to the spacing bars in the keyed-rainbow pattern.

Point 2



Look here for the presence of an incoming burst-and-color-bar signal combined with a keying pulse from a winding on the flyback. The burst signal can be seen sitting on the peak of the positive-going horizontal pulse, right where it belongs. The ten color bars produced by the generator are also well-defined.

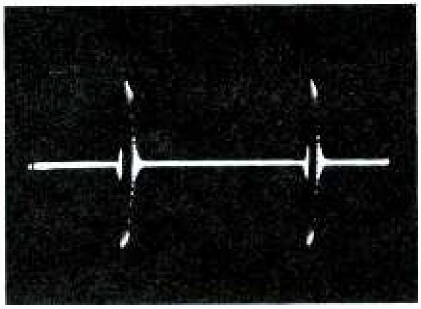
If the horizontal keying pulse is absent at this point, the picture may be out of color sync, with the colors actually drifting around the screen; or perhaps it is in sync but with colors of the wrong hue.

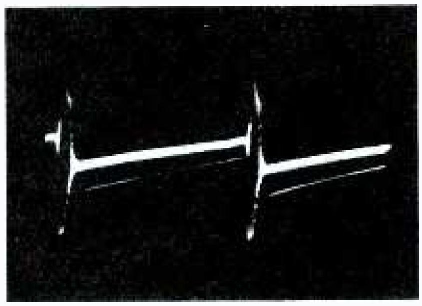
Chances are that the burst signal will pass through the amplifier, even with the keying pulse missing, but the output signal will not be the good, clean burst waveform we need.

Points 3, 4, 5, and 6

What you're checking for at these points is the *presence* of a clean *burst* signal. As mentioned before: At the grid of the burst amplifier the burst signal rides on the peak of the flyback pulse. This pulse appears during horizontal retrace time, and keys the burst amplifier into conduction. Since the burst signal arrives at the same time, it will appear in the output of the tube. On the other hand, the color bars arrive during active horizontal scanning time, and will not be developed in the output because the tube is cut off during that time.

Check for a good, clean burst signal at both ends of the burst-transformer secondary windings (Points 3 and 4), and be sure it





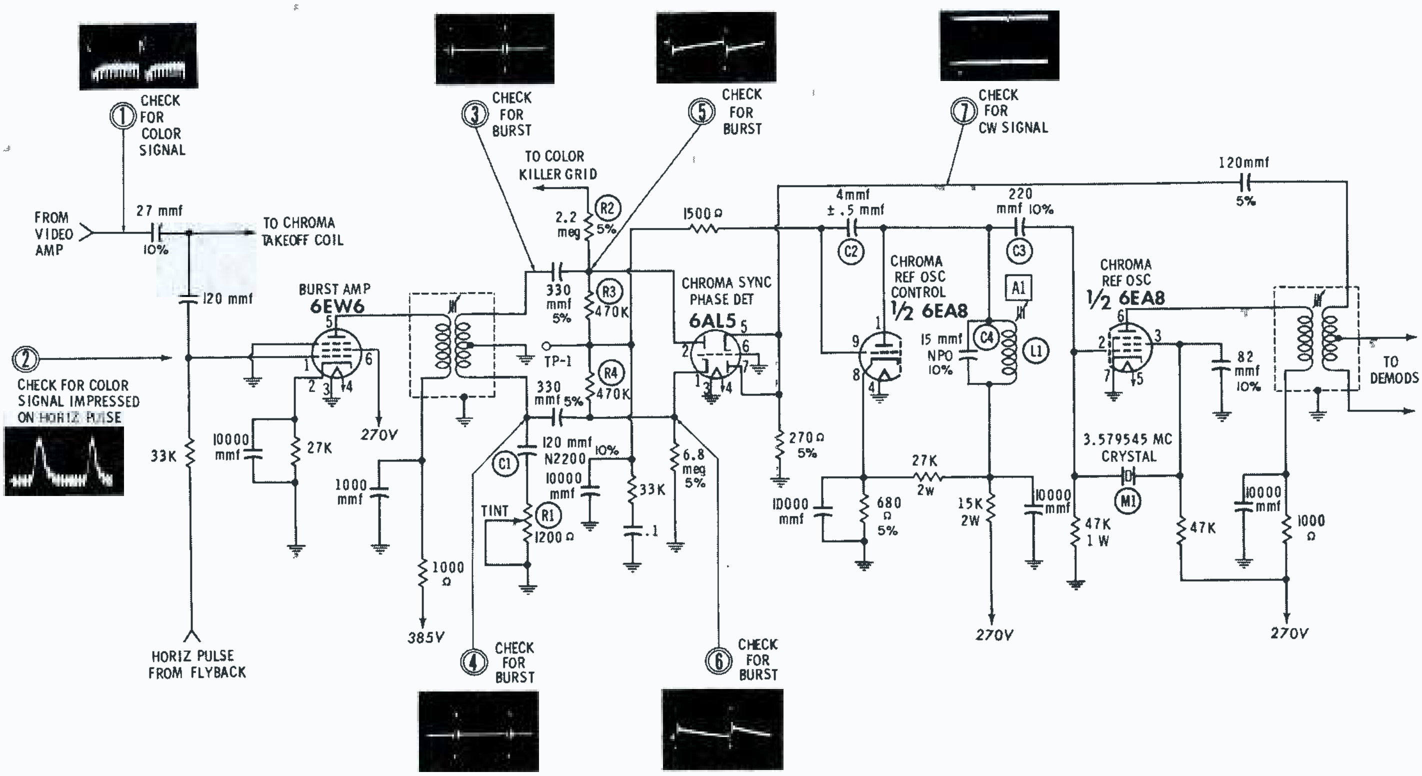
is getting through the coupling capacitors (Points 5 and 6). If trouble develops anywhere in this secondary circuit, it can cause a complete loss of color, wrong colors, or a loss of color sync.

The reason complete loss of color can occur is that the burst-takeoff point for the color-killer stage is in this circuit. Remember, the chroma bandpass stage is biased into cutoff by the color-killer stage *unless* the burst signal is present to disable the killer. With the killer tube operating, due to the lack of a burst signal (or for any other reason), no color can appear on the screen.

When you have a loss of color sync (color bars display a "barber-pole" effect, with different colors floating horizontally or vertically), try rotating the TINT control through its range while watching the CRT screen. This control affects the phase of the burst signal fed into the phase detector. If the color bars sync into place during this test, the trouble is probably in the balance or filter networks of the phase-detector circuit.

If the output of the burst amplifier is good, you obviously have a defect in either the phase detector, the oscillator control circuit, or the oscillator itself. The

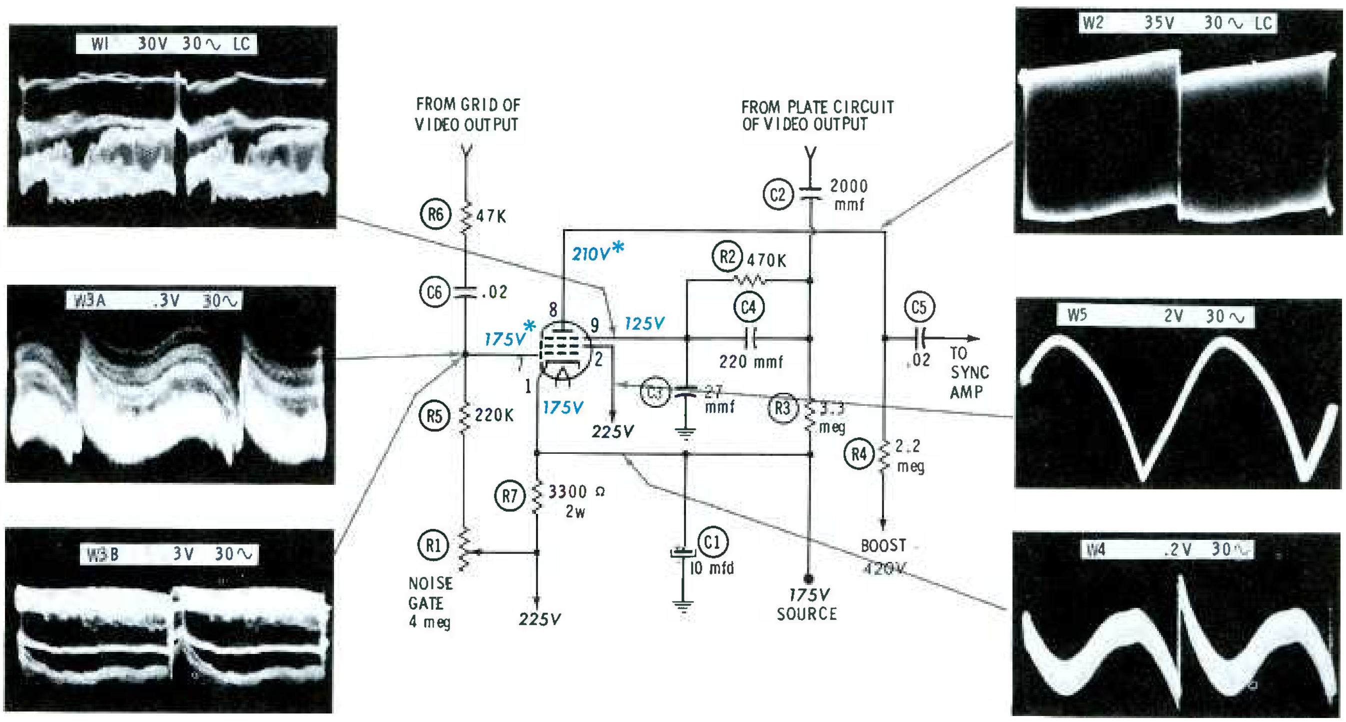
• *Please turn to page 84*



The transmitted color-TV signal contains a *color burst* (a sample of the chroma subcarrier) in addition to video, chroma, and deflection-sync modulation. In the receiver stages shown, the burst is amplified and compared with the 3.58-mc reference-oscillator signal. Any frequency error causes the chroma sync phase detector to apply a correction voltage to the grid of the oscillator-control tube, and the change in conduction of this tube makes the needed oscillator-frequency adjustment.

PF REPORTER Symfact

6BU8 Sync Separator



DC VOLTAGES taken with VTVM, on inactive channel, with antenna terminals shorted. *means voltage will vary when signal is applied or control is adjusted. See "Variations."

WAVEFORMS taken with wide-band scope; receiver controls set for 50-volt p-p video to CRT. Low-cap probe (LC) used where direct probe might distort waveshape or amplitude.

Normal Operation

Half of a 3-, 4- or 6BU8 tube operates as sync separator with built-in noise-limiting feature. Composite video input (W1) is fed to pin 9, and only sync pulses (W2) appear in output at pin 8. A much weaker composite-video signal, with polarity opposite to that of W1, is applied to pin 7. Normally, it has little effect on 'BU8 conduction; however, strong negative pulses of noise interference in video signal can momentarily increase bias at pin 7 enough to cut off the 'BU8 and clip noise out of W2. Noise-limiting action also affects AGC-keying section of tube (pins 1, 7, and 2, plus a separate grid—pin 6—and plate—pin 3). Circuit shown here, used in Motorola Chassis TS-570, typifies BU8 sync-stage designs in most major respects.

General Troubleshooting

Usually, the first sign of trouble developing in a 'BU8 sync circuit is critical vertical hold. Slight horizontal instability appears in some cases. If scope checks of the sync separator indicate a distorted output signal and reasonably normal input, check voltages *with* and *without* signal to help to localize the fault.

Operating Variations

PIN 9 DC voltage almost constant under all signal conditions—unlike triode sync separators. Waveform amplitude will change greatly with contrast adjustment, but only slightly with RF signal variations. This high-impedance circuit will be loaded even by low-capacitance probe, so rough, jittery appearance of W1 is normal. Use of direct probe decreases over-all signal amplitude and attenuates horizontal pulses.

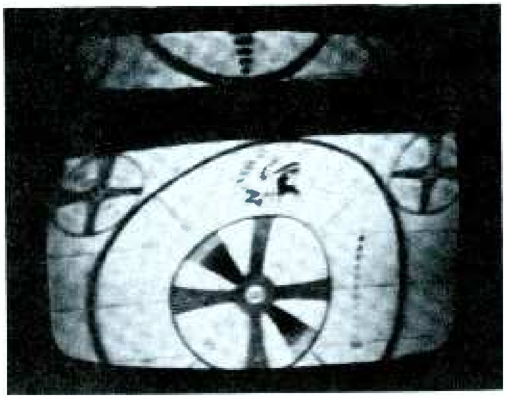
PIN 8 DC voltage should rise to about 225 volts when strong station signal is applied. W2 maintains nearly constant amplitude. Direct probe distorts waveshape only slightly, but reduces amplitude.

PIN 7 At minimum-resistance setting of R1, positive voltage maintains zero bias between pins 1 and 7, swamping out waveform (see W3A). This setting is correct unless noise interference is a problem; then R1 should be adjusted to allow a few (not more than 10) volts of bias at pin 7. Waveform then appears as in W3B, and noise peaks in signal can cut off tube. With too much bias, negative sync tips in W3B can produce cutoff.

Vertical Sync Critical

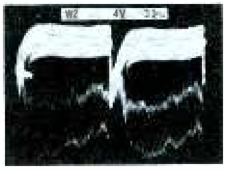
Slight Horizontal Bend at Top of Picture

C5 Slightly Leaky

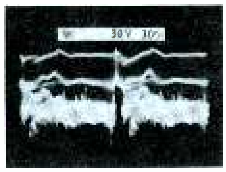


Symptom Analysis

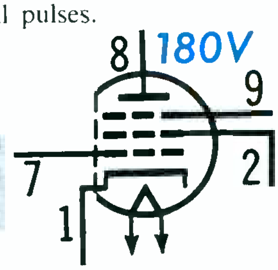
Picture can be made to roll either up or down with vertical hold control, but shows only feeble attempt to lock in; apparently, little or no sync signal is reaching vertical multivibrator. Fairly stable horizontal hold, except for "flag-waving" at top, indicates relatively slight effect on horizontal pulses.



Waveform Analysis



Voltage and Component Analysis



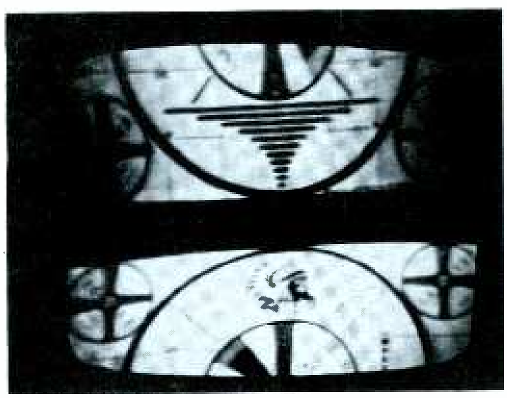
Only abnormal waveform is W2. Most important discrepancy here is low amplitude of only 4 volts p-p—too weak for solid vertical lock-in. Also note distortion in signal for short interval just after each vertical sync pulse—base line pulled down from top, and horizontal sync pulses practically lost. This accounts for bending at top of picture. During rest of time, horizontal sync-pulse amplitude is sufficiently constant for reasonably good synchronization of stable horizontal oscillator used in this receiver. W1 is normal; two jagged pips at top, which travel through waveform as picture rolls, are simply due to stray pickup of vertical retrace pulses.

All DC voltages are okay except on plate, where reading is 15% below normal. Slight leakage through C5 increases DC voltage drop across R4, thus reducing plate voltage of 'BU8. With plate at a DC level only a few volts higher than cathode, 'BU8 passes very little current, and only a weak signal voltage is developed across R4. Since there are no other discrepancies in DC or signal voltages, abnormal reading at pin 8 definitely indicates trouble in plate circuit. Similar symptoms and test indications would have been observed if R4 had greatly increased in value (to over 10 megohms). Leakage in C5 showed up in test with 200 volts applied.

Vertical Sync Critical

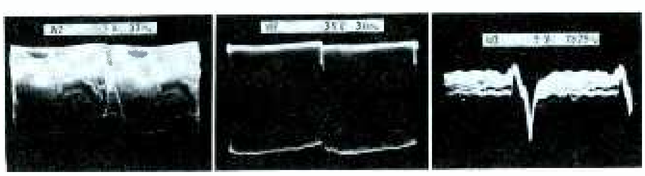
Horizontal Sync Appears Normal

C6 Moderately Leaky



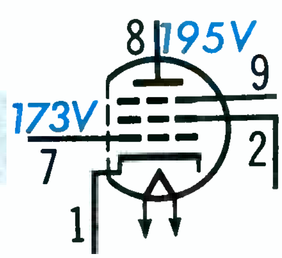
Symptom Analysis

Picture will not "snap" into vertical sync, indicating deficient sync-pulse amplitude. Check of horizontal-hold action indicates good stability, so trouble is evidently affecting only vertical sync. NOISE GATE control must be set at minimum-resistance position to prevent losing all sync, indicating noise-limiter trouble.



Waveform Analysis

Voltage and Component Analysis



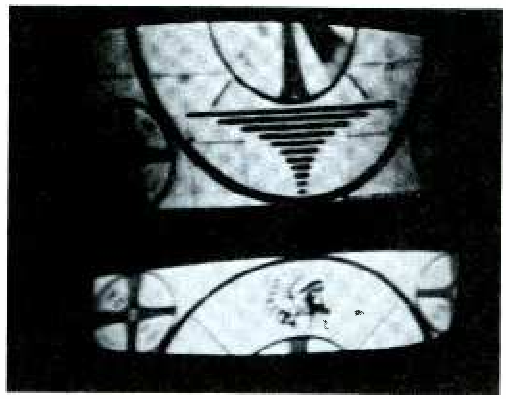
W3 looks clean, but amplitude is 5V p-p—far greater than normal. Output waveform W2 contains normal horizontal pulses; but note virtual absence of vertical pulses (white dots near bottom of normal waveform). No wonder vertical sync is poor! Another look at W3, at scope sweep frequency of 7875 cps, gives clue to why horizontal hold seems unaffected. Horizontal sync pulses build up only gradually to negative peak, and limiter grid is driven into cutoff too late to prevent horizontal pulses in W1 from passing through 'BU8.

With NOISE GATE at minimum, 2-volt bias exists between pins 1 and 7; normal condition is zero bias. Even though this error seems small, it is strong evidence of trouble at pin 7. Plate voltage is low, but not significantly so; with signal applied, it rises to 225 volts, the same as in normal operation. More severe leakage in C6 would have been diagnosed as AGC trouble, but sync disturbance would be noticed first if defect developed gradually. Another fault that would cause similar symptoms is loss of capacitance in cathode bypass C1.

Vertical Sync Critical

Horizontal Sync Critical With Slight Phasing Error

R3 Open



Symptom Analysis

Vertical multivibrator almost free-running; can barely be synchronized for few seconds at a time. Horizontal hold can be maintained for several minutes, but is critical, with noticeable jitter. Oscillator tends to lock in slightly out of phase, with picture shifted to right and horizontal blanking bar visible.

Waveform Analysis

Amplitude of W1 is normal, except vertical sync pulses rise higher than horizontal pulses even when low-cap probe is used. W2 is virtually absent, consisting only of video and hash with amplitude of less than 1 volt p-p. At scope-sweep rate of 30 cps, slight notches along bottom edge of waveform mark remnant of vertical pulses. Different view of W2, at 7875 cps, shows stubs of horizontal pulses. These waveforms might seem to indicate plate-circuit trouble, but it would be wise to check DC voltages before jumping to this conclusion.

Voltage and Component Analysis

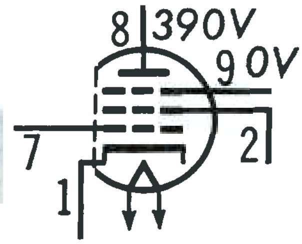
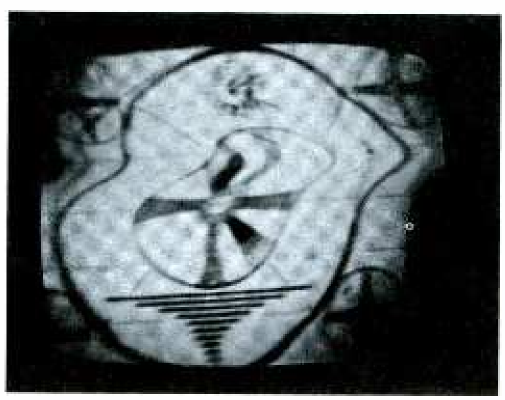


Plate voltage rises to 390 volts—almost the full value of boost. This drastic reduction in voltage drop across R4 is due to almost complete loss of plate current in sync section of 'BU8. Reason for cutoff is apparent when pin 9 is checked; DC voltage is missing, and resultant bias between this grid and cathode is 175 volts! Since connection to pin 1 via R3 is only DC path through which normal operating potential can be applied to pin 9, this connection is obviously broken. Defect does not prevent input signal from reaching grid.

Horizontal Sync Extremely Unstable

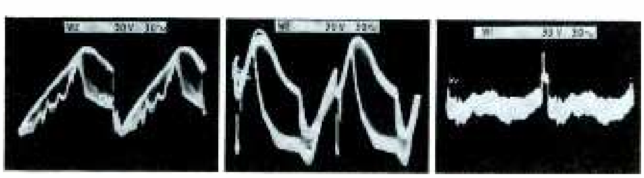
Vertical Sync Normal

C4 Open



Symptom Analysis

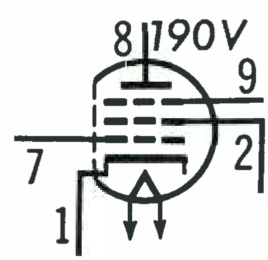
Horizontal hold is very critical. varying amounts of picture bending or pulling are noted, and sync is usually lost when station signal is interrupted. Either horizontal-AFC or sync circuits could be at fault. Checks of operating controls are inconclusive; bench testing is necessary to localize trouble.



Waveform Analysis

Steep "cliff" in W2 is formed by leading edge of vertical sync pulse, which has normal amplitude. However, base line along top of waveform is distorted into hump-back shape, and amplitude of horizontal pulses varies erratically from zero to slightly over one-half of normal. (Note "scalloped" appearance of line traced by pulse tips.) W2 is shown twice to demonstrate changes in shape and amplitude caused by fluctuations in video program material. In W1, vertical sync pulses look okay, but horizontal sync pulses appear to be missing.

Voltage and Component Analysis



DC voltage readings give very meager clues to this trouble, and can even be misleading. Although plate voltage is slightly reduced, it is still "within tolerance," so change can easily be overlooked. If a technician *did* spot this abnormality, he would waste time looking for plate-circuit trouble. Condition of C4 has very little effect on DC grid voltage; its functions are merely to help stabilize grid voltage against momentary signal fluctuations, and to bypass high-frequency signal components (including horizontal pulses) around R2.

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You can, now! You can carry the identical tubes that you find in most of the quality TV sets you're servicing. Chances are, you were not aware that these sets were designed around special "Ampliframe" tubes originated by Amperex.

For some time now, designers have been using many Ampliframe tubes in their quality TV receivers and we can tell you now that even more Amperex tubes are being designed into the sets you'll be handling in the future.

Compare, if you will, the performance of Amperex Ampliframes with conventional IF tubes: They provide 55% higher gain-bandwidth, increase TV set reliability by simplifying circuits and they make your servicing easier, faster and more profitable because their extraordinary uniformity virtually eliminates time-consuming realignment when you replace tubes.

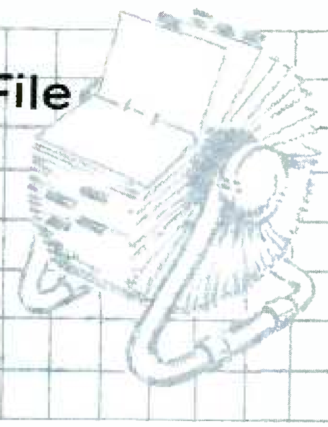
About the only way, then, that you can be sure of optimum satisfaction for your customers and maximum profit operation for yourself is to make room in your caddy right now for the identical, matchless-quality tubes that are being designed into the original sets... now available to you from your local distributor with the brand of the originator — the Amperex brand.

Next time you visit your distributor, look for the green and yellow box and ask about Ampliframe tubes for TV and other entertainment replacement applications. Amperex Electronic Corporation, 230 Duffy Avenue, Hicksville, L. I., N. Y.

In Canada: Philips Electron Devices Ltd., 116 Vanderhoof Ave., Toronto 17.

by Art Margolis

does your Customer Record File COST OR PAY?



About ten years ago an old-timer in my area bought a lot in Florida and decided to retire from servicing. He wanted to sell me his business.

He wouldn't part with his vehicles, parts, or test equipment; he figured he'd supplement his retirement income by doing a few jobs here and there. I couldn't use his shop, which was located in his garage. But he still had something valuable to sell.

Over a period of 25 years he had developed a hard core of customers who swore by him; and he had them listed in a complete, up-to-date customer file. All we had to do was make up a mimeographed letter bidding his customers a fond farewell and telling them I would continue the servicing. It took him about two hours to sign the letters by hand. I paid him a nice price and acquired a fine addition to my customer list.

If he had simply been writing his calls on odd slips of paper all those years, he would have missed out on a chunk of money. This final bonus topped off the many other valuable dividends his customer record file had been paying him all along. For any service-shop owner, a good record file can mean the difference between survival and failure. However, you must put the file into active use to make it pay. To keep the file working takes some time and money — I'd say at least ten to twenty hours a month on somebody's part (maybe yours, your wife's, or part of an office worker's week). But you can make a good profit on this investment, as there are several ways to show a return on it. Here are some of the benefits we reap from our own customer file:

History On Recalls

Recalls are admittedly a pain. The customer is unhappy, you are unhappy, and the risk of customer loss is great. The sooner you track down the reason why a customer called you back to straighten out a repair that went sour, the better off you are.

Even if the recall occurs a month after the original repair, the customer "clearly" remembers your previous call. Unfortunately, though, you do a lot of other work in the meantime, and you may forget what you did before. This dulls your memory of the particular trouble.

For instance, take the 17" Admiral that Jack (one of the boys in our shop) repaired. On the initial call, it had insufficient width. A new 6BQ6 horizontal output tube and a 5U4 rectifier spread the raster out nicely.

About a month later, there was another call from this house. This time there was no raster. Bob went out on the job this time and turned in a warranty slip instead of money. The 6BQ6 had failed, and our 90-day guarantee protected the set owner.

After another month had gone by, the same customer put in still another request for service. I drew the call this time. Before I went, my dispatcher read me the history of the set. At the home, I found a loss of width again. I tried another 6BQ6, and, sure enough, it spread the picture out. I looked closely at the new tube. Its plate was just barely showing a reddish tinge — not enough to notice unless you were looking for it. However, I *was* looking for it, since the dispatcher had given me the recent history of this set.

I pulled the chassis into the shop. Before applying power, I measured the screen and cathode resistors. They were right on the button. I turned on the TV. As the 6BQ6 plate started to redden, I pulled the plug and quickly read the resistors again. Under load, the screen resistor had gone down from 10K to

(Sample)

CUSTOMER FILE CARD

Date ____
Name ____ Address ____
Tel. No. ____ Make ____ Model ____ Serial ____
Cabinet
Antenna ____ CRT ____ Color & Composition ____
Front Glass
Comes Off ____ Portable ____ Table Model ____ Console ____ 3-Way ____
Other, Specify ____
Comments ____

History

Date	Technician	Parts	Total Bill	Comments

This customer form can be made from 3 x 5 file cards, 5 x 8 file cards, or 8½ x 11 heavy manila stock. It should be durable to withstand continual use. It can also be adapted easily for almost any type of service shop.


ANOTHER PRECISION SERVICE TIP FOR YOU.
PRECISION PETE
"CHECKING OUT AT A HOTEL"
SECRETARIES' CONVENTION JUST ARRIVED, PETE. NEED EVERY TV AND RADIO SET IN TIP-TOP CONDITION RIGHT AWAY.
AT LEAST 80% OF ALL SERVICE PROBLEMS ORIGINATE WITH THE TUBES. AND THE FASTEST WAY TO TEST ALL YOUR SETS IS WITH MY PRECISION 650 TUBE TESTER. LET'S START CHECKING "SHORTS," MAX.
I'M 'WAY AHEAD OF YOU, PETE!
RITZ HOTEL WELCOMES SECRETARIES of AMERICA
I MEAN "SHORTS" IN RECEIVING TUBES—LIKE THE MINIATURES, COMPACTRONS, NUVISTORS, NOVARS AND OCTALS THAT CAN BE TESTED WITH THIS 650. IT ALSO ANALYZES CONTROL GRIDS FOR LEAKAGE, EMISSION AND GAS CONTENT.
YES, AND, WITH THIS AD-65 ADAPTER, YOU CAN EVEN TEST PICTURE TUBES FOR SHORTS AND CATHODE EMISSION.
THERE'S NO CATHODE SHORT OR LEAKAGE IN THIS TUBE. I'LL ROTATE THE "D" SWITCH THROUGH ITS TWELVE POSITIONS AND CHECK THE OTHER ELEMENTS.
BETTER CHECK CATHODE EMISSION. I'LL JUST PRESS THIS BUTTON AND SEE.
THERE, THAT'S THE LAST ONE. TWENTY-FOUR SETS CHECKED OUT IN JUST THREE HOURS, THANKS TO MY PRECISION 650 GRID ANALYZER TUBE TESTER.
WITH ALL THE NEW BUSINESS WE'VE BEEN GETTING SINCE WE SIGNED AS REGISTERED PRECISION SERVICEMEN, DON'T YOU THINK WE NEED MORE HELP...LIKE A SECRETARY FOR INSTANCE?
MMMM. THIS SET JUST CAME OUT LAST MONTH. DO WE HAVE A DATA CARD ON IT, MAX?
SURE DO, PETE. PRECISION'S DATA SERVICE KEEPS THE 650 FROM BECOMING OBSOLETE. LOOK HERE.
WHEN IT COMES TO SECRETARIES, I DON'T NEED ANY HELP.
FREE SERVICE BULLETIN
SERVICEMEN: THE PRECISION 650 (DEALER NET: $69.95; AD-65: $5.95) LETS YOU FULLY TEST ALL POPULAR RADIO, TV AND COMMUNICATIONS TUBES FAST. WANT TO KNOW MORE? WRITE FOR FREE BULLETIN #102.
PRECISION APPARATUS CO. INC.
70-31 84 ST. GLENDALE 27, NEW YORK
ALL PRECISION TEST EQUIPMENT IS GUARANTEED FOR ONE FULL YEAR.

about 1000 ohms. I replaced the resistor, and the 6BQ6 plate stayed black this time. Since the shop repair, the set has operated normally for over a year with the same 6BQ6. Without checking the record file, we might have been changing 6BQ6's ad infinitum.

Another handy use for case histories on file is to help us settle recall disputes diplomatically with customers.

It's either difficult for people to remember, or easy for them *not* to remember, what you did on the previous call — especially within 90 days afterward. There was one freeloader who barged into our shop with a portable TV. I was working the counter. He blurted, "Had the TV here a few weeks ago. You fixed it, but it still ain't right."

Instead of playing it by ear, I pulled his file card and laid it alongside his TV. Then I turned it on. There was snow in the picture. I jiggled the built-in antenna, and the picture changed from clear to snowy, coinciding with my jiggling. I said, "You need a new built-in antenna."

"So," he snorted, "put it in, but I'm not paying for it. It should have been done when I had it here about ten days ago."

I picked up his file card and, scanning it, politely said, "According to our files, Mr. Jones, the last service call on your TV was about four months ago."

"Well," he bluffed, "time goes fast."

"It says here we repaired a vertical sweep trouble. There was too much vertical sweep, and a capacitor in the plate circuit of the vertical oscillator had opened up."

He tried to bluff a bit more: "Well, the antenna was supposed to be changed, too."

Then I clinched it: "It says here we told you about the antenna and you told us not to do the job. Here's your signature verifying it."

He smiled weakly, "Funny thing how a guy forgets. Yeh, I remember now. Fix it up, will ya?"

"Yessir," I answered, and installed a new built-in antenna.

Perpetual Mailing List

Your customer mailing list is a vital organ of your TV service business. Without it, you are helpless when business falls off due to a seasonal slump or when your competitors get aggressive.

With it, you can spark up business and compete more successfully. The uses of the mailing list are almost limitless. Besides giving free rein to your own imagination, you can read up on promotions (see "Summer Service Promotions" in July PF REPORTER) or get someone to help you think up ideas. As an aid, most of the manufacturers and publishers have professional advertising programs you can adopt.

The main thing is to have a completely up-to-date file. There are many ways to compile the list and to keep it up to date. The best way is to work on it regularly; a half hour a day is enough. Either you or your appointed assistant must take your completed service-call forms and convert the information into file-card form. If you do it daily, the effort is small and the list is always fresh. If you let it pile up for weeks or months, you have a massive project on your hands, and your file is partly out of date most of the time.

A well-maintained file is ready to use as soon as business slacks off. You can sift through it and compile lists of customers who would be particularly interested in various special offers. To the people who use rabbit ears, you can sell outdoor antennas. To the customers with outdoor antennas, you can suggest rotators and high-gain replacements. To set owners who have more than one TV, the installation of a two-set coupler is easy to sell.

The customers whose TV's have removable safety glass can be tempted with an inexpensive cleanup special. When you're able to make a good buy on a particular type of CRT, you can send out a

"Congratulations . . ."

NEW, MODERN, PORTABLE . . . FOR THE MAN ON THE GO . . .

as easy to use as a voltmeter

3.58 COLOR BURST

- **A new 3 inch Extended View Portable Scope with New Features and Performance Unmatched by even the most Costly 5 inch Oscilloscopes**

NEW

SENCORE PS120 PROFESSIONAL WIDE BAND OSCILLOSCOPE

Lowest priced Wide Band 3 inch Scope anywhere. All hand wired.

Only 124.50 net

Here it is, the scope that technicians, engineers and servicemen from coast to coast have been demanding. A portable wide band scope that can be used on the job anywhere, yet has the highest laboratory specifications for shop or lab. Cumbersome color TV sets, remote audio and organ installations and computers are just a few of the jobs that make owning a scope of this type so essential. Why consider a narrow band scope, when for only a few dollars more, this professional wide band sensitive scope equips you for any job.

• The PS120 provides features never before offered. Only two major controls make the PS120 as easy to use as a voltmeter. Even its smart good looks were designed for functional efficiency. New forward thrust design, creating its own shadow mask, and full width calibrated graph increase sharpness of wave form patterns. A permanent chromed steel carrying handle instead of untidy leather strap and a concealed compartment under panel for leads, jacks and AC line cord make the PS120 the first truly portable scope combining neatness with top efficiency.

• Electrical specifications and operational ease will surpass your fondest expectations. Imagine a wide band scope that accurately reproduces any waveform from 20 cycles to 12 megacycles. And the PS120 is as sensitive as narrow band scopes . . all the way. Vertical amplifier sensitivity is .035 volts RMS. The PS120 has no narrow band positions which cause other scopes to register erroneous waveforms unexpectedly. Another Sencore first is the Automatic Range Indication on Vertical Input Control which enables the direct reading of peak-to-peak voltages. Simply adjust to one inch height and read P-to-P volts present. Standby position on power switch, another first, adds hours of life to CRT and other tubes. A sensitive wide band oscilloscope like the PS120 has become an absolute necessity for trouble shooting Color TV and other modern circuits and no other scope is as fast or easy to use.

SPECIFICATIONS

WIDE FREQUENCY RESPONSE:
Vertical Amplifier—flat within ½ DB from 20 cycles to 5.5 MC, down —3 DB at 7.5 MC, usable up to 12 MC.
Horizontal Amplifier—flat within —3 DB from 45 cycles to 330 KC, flat within —6 DB from 20 cycles to 500 KC.

HIGH DEFLECTION SENSITIVITY:

		RMS	P/P
Vertical Amplifier—	Vert. input cable	.035V/IN.	0.1V/IN.
	Aux. vert. jack	.035V/IN.	0.1V/IN.
	Through Lo-Cap probe	.35V/IN.	1.0V/IN.
Horizontal Amplifier—		.51V/IN.	1.44V/IN.

HIGH INPUT RESISTANCE AND LOW CAPACITY:

Vert. input cable	2.7 Meg. shunted by approx. 85 MMF
Aux. vert. input jack	2.7 Meg. shunted by approx. 20 MMF
Through Lo-Cap probe	27 Meg. shunted by 8.6 MMF
Horiz. input jack	330 K to 4 Meg.

HORIZONTAL SWEEP OSCILLATOR:

Frequency range—	4 ranges, 15 cycles—150 KC
Sync Range—	15 cycles to 8 MC—usable to 12 MC

MAXIMUM AC INPUT VOLTAGE:

Vertical input cable— / Aux. vert. jack— / Lo-Cap probe—	1000 VPP (in presence of 600 VDC)
Horiz. input jack—	approx. 15 VPP (in presence of 400 VDC)

POWER REQUIREMENTS:

Voltage—	105-125 volts, 50-60 cycle
Power consumption—	On pos. 82 watts Stby. pos. 10 watts

SIZE: 7″ wide x 9″ high x 11¼″ deep—weight 12 lbs.

The PS120 is a must for color TV servicing. For example, with its extended vertical amplifier frequency response, 3.58 MC signals can be seen individually.

SENCORE

ADDISON 2, ILLINOIS

mailing to people whose sets use that type, quoting a special replacement price. For the portable-TV owners, a "bring-in" deal can be arranged. Word of radio or record-player repair specials can be sent directly to owners of three-way combos. The things you can do are infinite as long as you own a good customer list.

I'll never forget one popular TV model that was built with a remote-control motor and attachments on the tuner — the only accessory not included was a simple plug-in control box. Yet, when these sets were sold, there was no mention of any remote attachments; so the people didn't know their TV's were set up for remote control! All they needed was the external attachment and hand grip. However, these were not available from dealers handling this brand.

One day, on my rounds, I ran into about 50 of these external units. I bought them for a few pennies each. Then I had the girl go through our file and address a letter to all those people who owned that model. (There were about 75 of them.) Yes, I turned a nice profit and made fifty customers happy by converting their TV's to remotes for a ridiculously low price. This doesn't happen often, but you will run into similar situations you can turn to your advantage if you have a good customer file.

Surveys

No matter what size your business may be, you must appraise its growth periodically. Then you can adjust your policies accordingly, to keep its growth healthy. If you don't do this, you can't stay in business for long.

With a good customer file you can tell approximately how many customers you're losing, how many you're gaining, in what areas you're losing, and in what areas you're gaining. This permits you to delve into losses and gains to take remedial action.

To illustrate this point, there's a gigantic apartment house where we have many service calls. During a periodic file-card survey, I noticed our volume there was dropping off. Since there are a thousand apartments in the building, I didn't like the idea of losing out in that spot. I went around and spoke to the superintendent, who's a friend of mine, to find the reason for the drop off. He told me the general manager forbade him to recommend us as he had been doing. There was nothing he could do — it was policy. The remedial action was easy. I obtained a list of the tenants from an advertising company, listed them in a special file, and bombarded the tenants with a few TV-service mail specials. As it turned out, we did service work for the general manager, who also was a tenant, and he told the super it was okay to recommend us again.

Summary

One last little story about the customer file: I discovered that an area about twelve miles away was becoming harder and harder to serve conveniently, because of increased traffic on the roads in that area. When I first serviced there ten years ago, it was a profitable venture.

By means of my file, I counted the number of calls we received there per week; then I figured the gross income and the cost of doing business. Due to the increased traveling time, the profit margin was no longer worth the effort.

I hated to just give it up, so I dropped over there, and found a young fellow doing service in the area. I sized him up and found he was quite competent; so I asked him whether he'd like to purchase our business in his town. He was receptive, and I accepted his bid. I turned over the files for that district, and made up a mimeographed letter in which I bid farewell to our old customers and told them this excellent young serviceman would take over in our place. He's been doing well there ever since, as I knew he would.

Your customer record file is a strong limb on the body of your TV business. However, it will wither from disuse unless it is treated and used as a living thing. When kept up-to-date, it will give you a good service-call history that will help you stop customer arguments before they start; it will permit you to keep up a constant stream of mail that will keep old customers interested and spark new business; lastly, it will enable you to keep your finger on the pulse of your business so you can swim along with or against the tide. ▲

Wake Up

A new day is dawning in electronics.

Transistors are here to stay . . . they are now being used everywhere; in radio, television, Hi-Fi, intercom, and in nearly all new electronic equipment . . .

Why put off transistor circuit servicing any longer . . . there's gold in them thar hills. But you must be equipped to do the job fast and efficiently. Here are the tools that you will need.

NEW SENCORE TRANSI-MASTER

This Tester will analyze the entire circuit in minutes and test transistors in-circuit or out of circuit. Here is how you can pin point troubles step by step with the TR110.

First, check the batteries with the 0 to 12 volt meter. If the batteries are O.K., check the current drain with the 0 to 50 milliamp meter. A special probe is provided so that you do not need to break the circuit. Excessive current indicates a short; low current indicates an open stage or cracked board. All PF schematics indicate average current.

If trouble is not located by now, isolate the trouble to a specific stage by touching the output of the harmonic generator to the base of each transistor and note spot where sound from speaker (or scope where no speaker is used) stops or becomes weak. The generator becomes a sine wave generator for audio stages to help find distortion.

If trouble points to a transistor, check it in a jiffy with the exclusive in-circuit power oscillator check provided by the TR110. A special probe is also provided for this.

If the transistor checks bad in-circuit, remove it and give it an out of circuit check with the oscillator check or the more accurate DC check. The DC check is provided for comparison reasons, experimental or engineering work and to match transistors in audio output stages. Beta (current gain) is read direct or on a good-bad scale for service work. **DEALER NET. ONLY $59.50**

Tests all transistors in-circuit or out-of-circuit

Model TR110

***It's a* COMPLETE TRANSISTOR TESTER**

- **SIGNAL TRACER** • **VOLTMETER**
- **BATTERY TESTER** • **MILLIAMMETER**

NEW SENCORE TRANSISTOR AND DIODE CHECKER

Here is a low cost tester that has become America's favorite. The TR115 provides the same DC out of circuit checks as the TR110; leakage and current gain. Beta (circuit gain) can also be read direct or as good or bad. Opens or shorts in the transistor are spotted in a minute. The TR115 checks them all from power transistors to the small hearing aid type. Japanese equivalents are listed also. This famous tester is used by such companies as Sears Roebuck, Bell Telephone and Commonwealth Edison. New circuits enable you to make service checks without set-up charts even though charts are provided for critical checks.

Model TR115
Dealer Net
Wired
$24.95
Kit........$15.95

SENCORE BATTERY ELIMINATOR AND TROUBLE SHOOTER

For replacing batteries during repair.

Many servicemen say that they wouldn't service transistor circuits without this power supply. The tried and proven PS103 is a sure fire answer. It can be used to charge the nickel cadmium batteries as well. Dial the desired output from 0 to 24 volts DC and read on meter. Low ripple insures no hum or feedback. Total current drawn can also be read on the PS103 by merely flicking the function switch to milliamps. The PS103 is the only supply that will operate radios with tapped battery supplies such as Philco, Sylvania and Motorola. No other supply has a third lead.

Model PS103
Dealer Net
$24.95

Now in stock at your Authorized Sencore Distributor

ALL PARTS
SENCORE
MADE IN AMERICA

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Transformer Tactics

by Jim Galloway

When you can find an exact replacement—what then?

Transformer replacement can be very easy or it can be difficult. If you find that a set has a defective transformer and you can obtain an exact replacement, it is a simple matter to unsolder the leads, swap the units, and connect the new one. However, if the chassis happens to be out of date or an unfamiliar imported type, you may not always be able to locate an exact replacement.

In the case of most iron-core transformers—such as seen in Fig. 1—lack of a suitable replacement can create difficult problems indeed. Information about electrical ratings is not often marked on the defective unit; so, in addition to solving mechanical mounting problems, you must determine what operating characteristics a new transformer should have.

Sometimes, too, you will be working on a piece of equipment for which you cannot obtain part numbers; or perhaps your distributor doesn't have the correct part in stock. This latter situation is much less of a problem than not having the servicing information, since you can usually take the part number to your distributor and he will help you find a near-equivalent transformer which will work in the equipment.

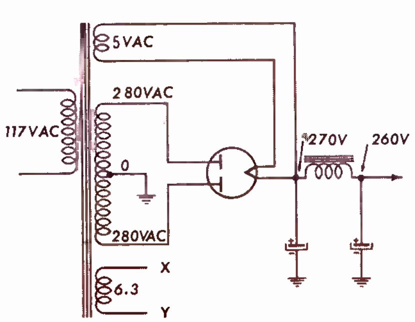

Fig. 1. Typical iron-core transformers.

Choosing a Replacement

Let's say you have an old radio-phonograph in the shop of such a vintage that you can't find service data for it. After picking your way through dirt accumulated over a period of years, you discover that the power transformer has given up. There are no identification numbers of any kind on the transformer and the customer is in a hurry to have the unit back. How can you find out what the proper replacement for the transformer should be?

The most logical method for attacking this problem is to make a few simple calculations which will allow you to choose a replacement with an adequate safety factor, but still not too large for convenient mounting.

Power transformers are usually given two ratings: The voltage of the secondaries and the maximum current that can be safely drawn from each. Of course, there are other considerations such as operating temperature and case insulation, but these factors are of concern only in certain special equipment.

The problem reduces to a matter of figuring out the voltage and current requirements of the set and finding a replacement that will safely meet them. One way to find the needs of a particular set is to locate service data for a piece of similar equipment. In the case of the radio-phonograph mentioned before, we could use the schematic and parts list for any radio-phonograph which used approximately the same types of tubes. Chances are good that a transformer which fits one would fit the other, even though holes might have to be drilled in the chassis to accommodate the replacement unit.

If this method is impractical because you can't find data for a similar unit, the alternative is to figure approximately how much current and voltage is necessary to power the set. Then you can purchase a replacement on the basis of these calculations, made as follows:

1. List all the tubes in the unit and determine the operating requirements for each. A tube manual will give a lot of help, and you can also draw on your servicing experience for this information.
2. Using the "Typical Operation" data in your tube manual, find and list the plate and screen voltage for each tube. Next, note the plate and screen currents. Also write in the filament voltage and current ratings.
3. Add the plate and screen currents obtained in step 2; this will be a close approximation of the total B+ current requirements.
4. Trace the B+ line from the rectifier to see if there are any dropping resistors in series. If there are, calculate the voltage drop across them ($E = I \times R$). Determine the value of I by figuring what portion of the total cur-

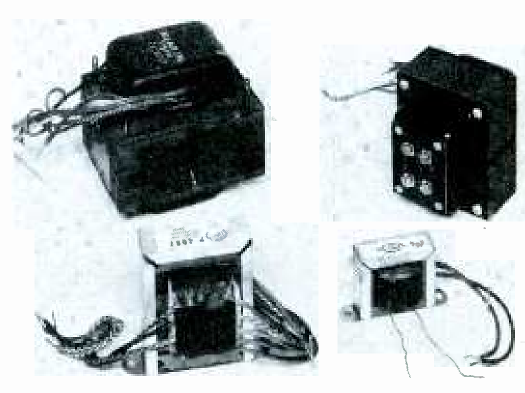

Fig. 2. DC output voltages are usually only slightly less than the rms values.

Can you afford to guess

AT SWEEP, SYNC OR HIGH VOLTAGE TROUBLES?

WHEN IT'S SO EASY TO WALK THE TROUBLE RIGHT OUT OF THESE TIME CONSUMING CIRCUITS..... STEP BY STEP.....

SYNC. CIR. & H. SYNC. DISCRIM.	VERT. OSC.	VERT. OUTPUT	VERT. OUTPUT XFORMER	VERT. DEFLEC. YOKE
HORIZ. OSC.	HORIZ. OUTPUT	HORIZ. FLYBACK XFORMER	2nd ANODE VOLTAGE CIRCUIT	HORIZ. DEFLEC. YOKE

NEW, IMPROVED SENCORE

SWEEP CIRCUIT ANALYZER

MODEL SS117

PUSH BUTTON TESTING . . . for Color and Black and White

How many times do you ask, "Why do I take so long finding that sweep trouble?" How often have you wondered whether weak horizontal sync was caused by defective sync circuit, horizontal oscillator, or sync discriminator? Can you quickly isolate inadequate width or low 2nd anode voltage to the oscillator, output, flyback transformer, or yoke? How many times have you changed a good yoke by mistake?

The SS117 will pinpoint troubles like these in minutes with tried and proven signal injection, plus yoke substitution for dynamic in-circuit tests. Error proof push button testing enables you to make all tests from the top of the chassis without removal from cabinet for maximum speed and profit on every job.

Here are the checks the SS117 makes . . .

- Horizontal Oscillator: Checked by substituting 15,750 variable output universal oscillator from SS117. Signal can be injected at any spot from horizontal output grid to horizontal oscillator to determine defective component.
- Horizontal Output Stage: Checked by reliable cathode current and screen voltage checks made with adapter socket and two push buttons,
- Horizontal Output Transformer: Checked for power transfer in circuit and read as good or bad on meter.
- Horizontal Deflection Yoke: Checked by direct substitution with adjustable universal yoke on SS117.
- Vertical Oscillator: Checked by substituting 60 cycle synchronized oscillator.
- Vertical Output Transformer: By simple signal injection for full height on picture tube.
- Vertical Deflection Yoke: By signal substitution for full height on picture tube.
- Sync Stages: Checked by synchronizing triggered horizontal SS117 oscillator from any stage. If oscillator synchronizes, sync is O.K.
- 2nd Anode Voltage: A new dynamic check using simulated picture tube load. C.R.T. does not need to be operating for current tests. No interpretations—read direct from 0 to 30 KV.
- External Circuit Measurements: By applying from 0 to 1000 volts AC or DC to external meter jacks. Meter will read DC or peak-to-peak volts. 0 to 300 milliamp scale also provided for measuring horizontal fuse current.
- New features include: Large 0 to 300 microamp meter for minimum circuit loading; all-steel carrying case with full mirror in adjustable cover; two 115 volt AC outlets in cable compartment.

Size: 10¼" x 9¼" x 3½". Wt. 10 lbs.

Model SS117 Dealer Net $89.50

SEE YOUR AUTHORIZED SENCORE DISTRIBUTOR

Sencore Sam says . . . How can you miss . . .

EACH PACKAGED UNIT CONTAINS:

- An Easy to Follow Instruction Book Especially Prepared and Edited by H. W. Sams.
- A complete 33 RPM, 10 inch Permanent Record on "How to Simplify Sweep Circuit Trouble Shooting."

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rent (step 3) flows through the resistor in question.

5. Use the highest typical plate (or screen) voltage in the set as a standard, and add to it whatever voltage drops were found in step 4. The result should be the voltage required for B+ in this set. (If the equipment contains an audio-output tube, you can check your figures by comparing the value you obtained with the voltage expected at the screen of this tube; usually, the audio-output screen grid is run at full B+ voltage.)
6. Add all the filament currents to obtain the total filament current required from the transformer.

Now, you can take the data you have accumulated and turn it into some useful transformer ratings. Transformer voltage ratings are always in rms values; when this voltage is rectified and filtered, the resulting DC will be slightly more than the rms value of the secondary AC voltage. Therefore, if the radio-phonograph in our example were found to require approximately 270 volts of B+, a power transformer with a secondary rating of 250-0-250 volts rms would give approximately the required value of B+. In the secondary, it is best to allow about a 50% safety margin. If, from your calculations, you decide the B+ current will be 70 ma, choose a transformer that will supply at least 100 ma. Fig. 2 shows some of the input-output relationships in a typical transformer power supply.

Filament windings should also be protected by a safety factor. If the total drain on the filament supply is calculated to be 2 amps, at least a 2.5-amp filament winding should be used.

Typical Transformer Ratings

Type of Equip.	B+ Current	B+ Voltage
10 watt Hi-Fi Amp	100 ma	260
TV Set	270 ma	260
25 watt Hi-Fi Amp	200 ma	350
Tape Recorder	100 ma	250
AM-FM Receiver	140 ma	115
Two-Way Base Station	250 ma	200
(two windings)	250 ma	200

Note: Each rating includes a safety factor.

Fig. 3. Chart showing *approximate* B+ voltage and current requirements.

The procedure outlined above may seem complicated at first, but with a little practice you will be able to estimate the power requirements for a particular piece of equipment with satisfactory accuracy. In order to save you time, we have included a chart (Fig. 3) listing *typical* current and voltage requirements for various types of equipment you might be called on to service. Bear in mind that individual items differ, and this chart should be used only as a guide and not as an absolute authority.

Output Transformers

The procedure for choosing replacements for audio-output transformers is no more difficult than for power transformers. The steps are:

1. Note the type of tube employed in the output stage.
2. Locate this tube in the tube manual and find its plate current and impedance. Remember, these characteristics vary according to the class of operation, so be sure to find the correct figures. Most single-ended output stages are operated as class A, while push-pull circuits are AB1, AB2, or class B — the tube manual tells which.

15,000,000 MULTIPLE-SET OWNERS NEED

TRANSCEPTOR®

THE HOUSEHOLD SET COUPLER

ANYONE CAN INSTALL IN SECONDS

improves reception for additional TV, color TV, FM, stereo FM
provides most efficient signal delivery
automatically matches impedance
proved in more than 50,000 installations
snaps on without tools
eliminates extra antennas, rabbit ears
packaged and designed for consumer appeal
more than 2 million new customers annually

Foolproof, simple, rugged TRANSCEPTOR was designed especially for the fifteen million multiple-set owners in this country. Now, with easy-to-install TRANSCEPTOR, they can run any combination of TV and FM sets—two or more, one at a time or all at once—*off one antenna* without amplification in normal signal areas. And, because TRANSCEPTOR uses electro-magnetic pick-up instead of resistance splitting of the signal, the line is not cut, there is minimum signal loss, and better set-to-set isolation.

Result: More customer satisfaction. More sales. More profits.

* * * INDIVIDUALLY PACKAGED ON SELF-MERCHANDISING COUNTER DISPLAY CARDS. AVAILABLE FROM YOUR LOCAL DISTRIBUTOR

$2.98 RETAIL

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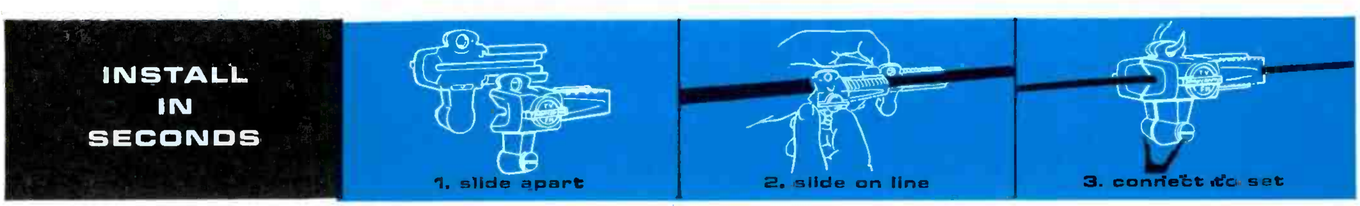


STEP ONE FOR COLOR TV SERVICING:
THE NEW PRECISION E-450 COLOR BAR/WHITE DOT GENERATOR.

Simple to use, crystal controlled and voltage regulated, the PRECISION E-450 is a must for the busy serviceman. It combines the facilities to test and adjust the phasing, matrixing, linearity and convergence circuits in all color receivers. Three front panel controls and one simple antenna cable connection to the receiver under test afford a new high in ease of operation. The PRECISION E-450 is furnished complete with output cable and technical manual for only $189.95 net. For complete details on this and other models, see your jobber or write today.

PRECISION APPARATUS CO., INC., GLENDALE 27, NEW YORK

Patterns: Color bars, White dots, Crosshatch, V bars, H bars. **RF Output and Sound Carrier:** Available on channel 3 or 4; field adjustable. RF output 50 mv max. Sound 10% of picture carrier. **Simple 300-Ohm Connection** to antenna input terminals of receiver. **No External Sync. Signals** required to lock in test patterns. **Master Voltage-Regulated, Crystal-Controlled Oscillator** operating on 189 kc assures stability of displayed patterns. **Easier Convergence Set-Ups:** Separate vertical and horizontal bar patterns. **Optimum Convergence Adjustments:** Extremely fine, well-defined dot pattern. **Color Bars:** A reference test signal, precisely controlled, produces 10 equally spaced color bars across face of TV receiver under test. Included are the color bars corresponding to R-Y, G-Y, E-Y, I and Q signals.

PRECISION SUBSIDIARY OF PACOTRONICS

All Precision Test Equipment is Guaranteed For One Full Year

3. Determine the output impedance from the type of speaker used. If you are unable to find this information, use a transformer with a "universal" secondary and choose a tap that results in the greatest measurable output power.
4. From the data obtained in step 2, your distributor should be able to help you choose a replacement that will work in the circuit.

Vertical-output transformer replacements are seldom as difficult to locate. However, when the need arises, similar principles will help you choose a suitable unit. The information which will help you is the tube type, the output configuration (autoformer, isolated secondary, etc.), and the yoke characteristics. Transformer catalogs are usually very complete in the matter of describing the operating conditions for the replacement units they list.

Replacement Hints

Normal replacement of transformers gives no trouble; however, there are instances when problems arise. Here are a few tips that may help you when you have to troubleshoot and replace transformers.

If ohmmeter checks and visual inspections have not shown why a transformer failed, and you have to check the circuit under operating conditions, a fuse should be employed to protect the new transformer. Most sets have power-line fuses, but if the set you're servicing hasn't, it is a good practice to install one. The owner will seldom object to the cost when it is compared to the repair bill for transformer replacement. Whenever you install a fuse in the primary circuit, place it between the off-on switch and the power line, so *all* portions of the circuit are protected.

Be particularly careful when installing a power transformer—other than an exact replacement—on hi-fi equipment. If the new unit is not adequately shielded or properly placed, it could cause objectionable hum due to its magnetic field interacting with some other transformer. Hook it up without bolting it to the chassis and, with the power on, try orienting the transformer to a position that results in the least hum.

Next, check to see that the

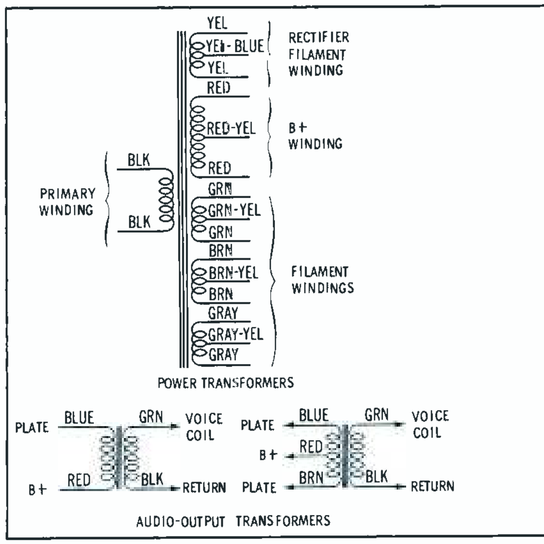


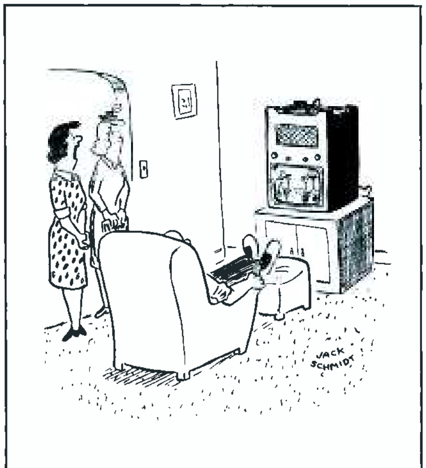
Fig. 4. EIA standard color codes for power and audio-output transformers.

equipment operates properly. If it does, let it cook for a while, placing your hand on the transformer occasionally to see if it is getting too hot. After 15 minutes of operation, it should be quite warm to the touch, but not hot enough to cause a burn.

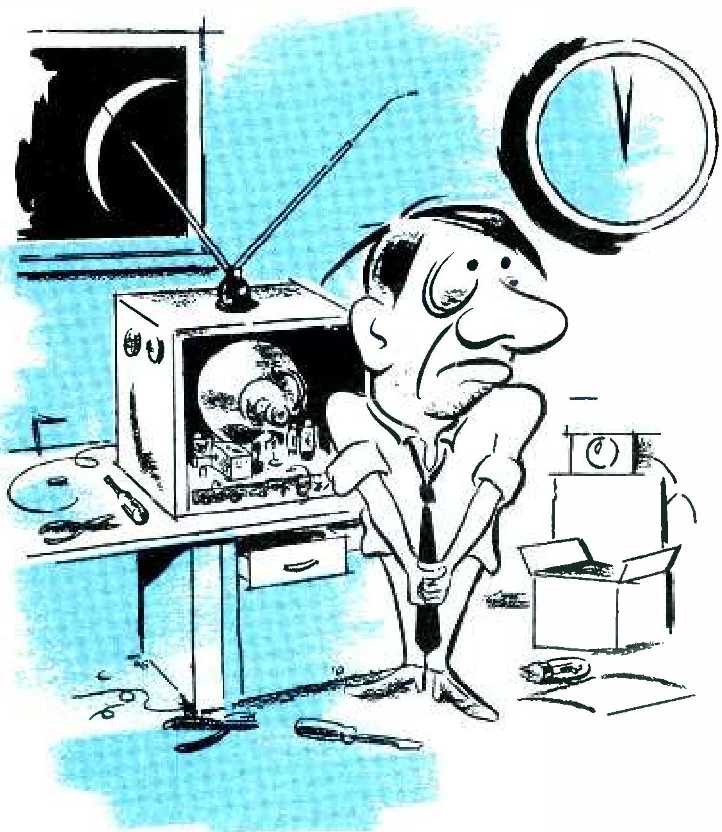
Fig. 4 shows the EIA transformer color code. If you should happen to lose the wiring data which comes with a transformer, this chart will help you identify the leads.

Summary

Most transformer replacements are extremely simple. Occasionally, however, you will have to call on your ingenuity to either guess or calculate what characteristics a replacement unit should have. You don't have to shoot in the dark, though, for the aids in this article will help you choose the correct one. ▲



"He installed the yoke upside down, but is too lazy to change it."



and they say SERVICING is FUN?

"It works better than it ever has!"

These words are almost as much music to the ears of a TV technician as the words, "I've come to pay my bill."

Like other servicemen, I get a great deal of satisfaction from working over some rundown set, finding the causes of its aches and pains, and curing them. It's a real thrill to attempt what appears to be a difficult job and, after studying the symptoms, come up with a diagnosis of the trouble. Then, after taking a few scope checks to localize the trouble and a few voltage or resistance measurements to pin down the defective part, I enjoy verifying the diagnosis and effecting the proper cure.

I replace the defective parts, touch up the alignment, and finish with a set so perfect the waveforms on the service data seem distorted by comparison. The picture looks like a photograph and the audio section is so good that both the deep tones of a foghorn and the high-pitched hiss of a disgruntled studio audience come through perfectly. No king could feel better than a serviceman who has just turned out such a job!

Unfortunately, there are days (about six a week) when my jobs turn out something less than perfect —if I get anything done at all. Take yesterday, for instance, or the day before. I received a call from a new customer who, like my other customers, wanted his set repaired immediately, or even sooner. Quickly winding up the job I was working on, I loaded my caddy and testers in the truck and drove to his home.

Inside, he led the way to the living room where, partly hidden behind a large chair, the TV set stood —nearly buried under an odd-shaped TV lamp, several photos, and a pile of magazines. Knowing from experience that quizzing a customer about the symptoms often gives valuable clues to the cause of the trouble, I tried to do so immediately. After we had discussed war experiences and the world situation for half an hour, he said the first trouble that had shown up was a vertical failure. "There was just a bright line across the middle of it."

He had played the set that way for a few days, just listening to it. Then the sound failed, and he spent an evening or two just watching the little line and hoping something would happen. It did—the bright line went out. As a last resort, he finally called me.

From these answers to my probing questions I surmised the set now had three trouble spots: the vertical stages, the audio section and a high-voltage failure. Taking the last one first, I found I was wrong on one count—the high voltage was fine, but the picture-tube filament had burned out. The owner was quite shaken when I informed him he needed a new CRT, but when I assured him it wouldn't cost much more to fix the set than to buy a new one, he consented to let me do the job.

Back at the shop, I was eager to get started on the set since it looked like money in the cash register. I shoveled out the dirt (plus two bobby pins, a cheap ball-point pen, and a nickel) and pulled the chassis. Then I set it up on the bench, using my small test CRT in place of the bad picture tube. I turned it on and, after a few minutes, the vertical output tube started showing a purple glow. "Either a gassy tube or too much current—shorted maybe," I mused. I shut the set off, grabbed the tube to pull it, and heard something sizzle—the skin on my fingers. As I fished in the tool tray for a tube puller, I wondered if I'd ever remember that tubes get hot so quickly.

I replaced the vertical output tube, and another in the sound section. Turning on the set again, I got a roar of sound, but still only a thin bright line. There was still trouble in the vertical section, so I fired up the scope; did a good job, too, for it started smoking! Having no alternative but to fix it first, I hauled it out on the bench and started taking it out of the case.

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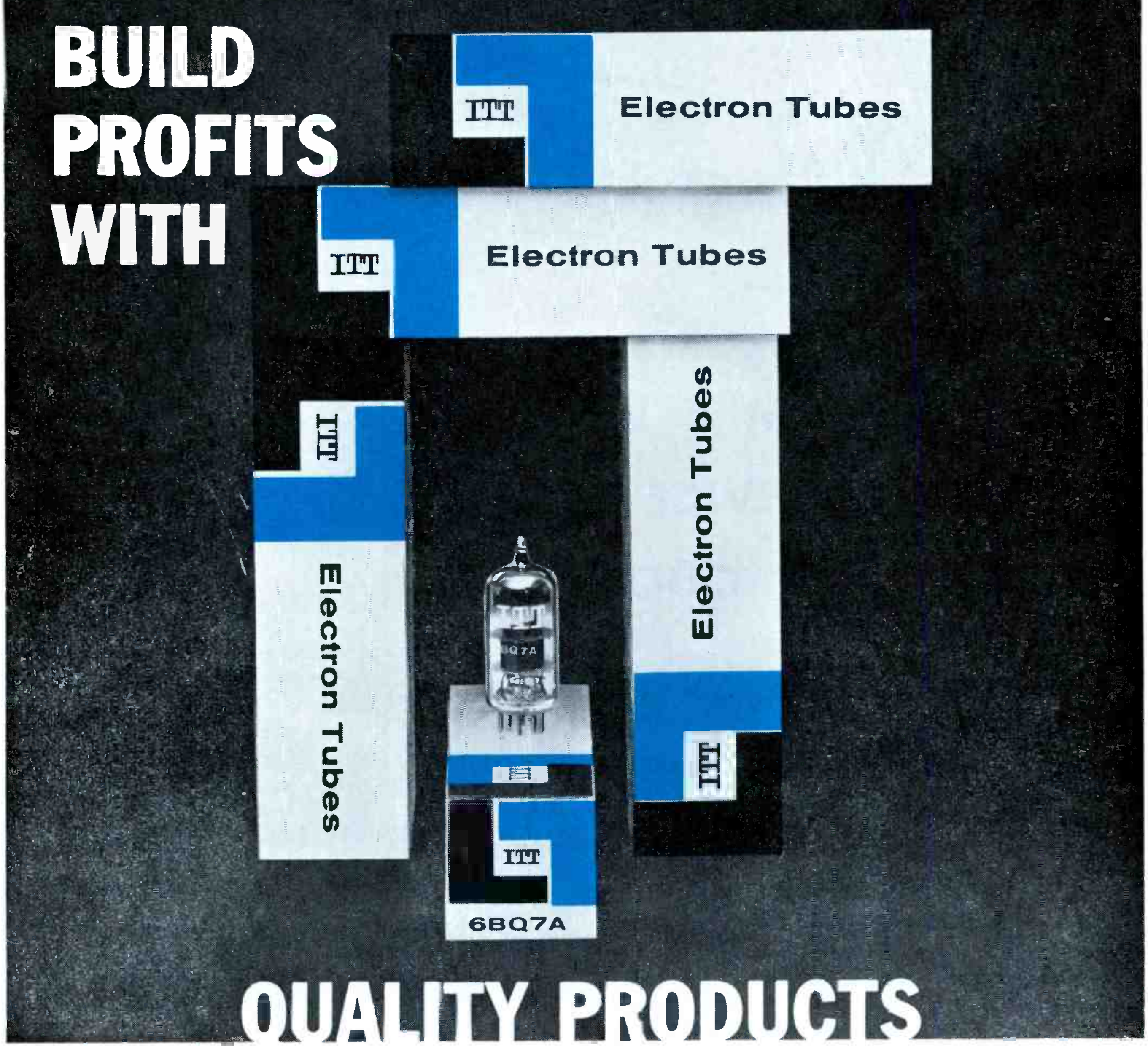

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At that point, a teen-age boy came in and set a paper sack on the counter, so I walked over.

"Do you think you can fix this?" he asked, hopefully. He reached into the sack and carefully pulled out the tangled wreckage of a transistor radio.

"I dropped it," he explained.

"From an airplane or a space ship?" I couldn't help asking.

My remark didn't get a laugh, but he did manage a sickly grin as I started pawing over the parts. The case was broken into several pieces, the antenna was damaged and the printed board was cracked in several places. I didn't know quite what to say, since most youngsters don't have a lot of money. (I often wonder if they ever will, considering the way they can swiftly make junk out of brand-new products.)

I finally told him I could probably patch it up at a reasonable cost but couldn't make it like new for much less than a new one would cost. He went for the patch job.

After he left, I turned back to my repair job on the TV, then remembered the scope had to be fixed. I upended it and a well-cooked resistor glared out at me like a black eye. I followed one lead to a tube-socket terminal; when I tested the tube, I found it shorted.

Just then the phone rang. As I lifted the receiver, the door opened and two ladies walked in. I nodded a greeting to them, then announced into the phone, "Cheerful Charlie's TV Repair Shop."

A girl's voice asked, "Do you fix TV's?"

One of the ladies in the shop said, "I want a tube for my radio."

"I try to," I answered into the phone.

"Have you a number?" I asked the woman.

"Fairview 2-3254," said the voice on the phone. "But I'm not home now, I'm at a friend's house. Her number is —"

"I'm sorry," I interrupted, " I was talking to another person." The phone clicked, and the dial tone came on.

"I just wanted one tube," answered the lady in the shop; "this one wouldn't light up." She produced a tube, which I checked, and

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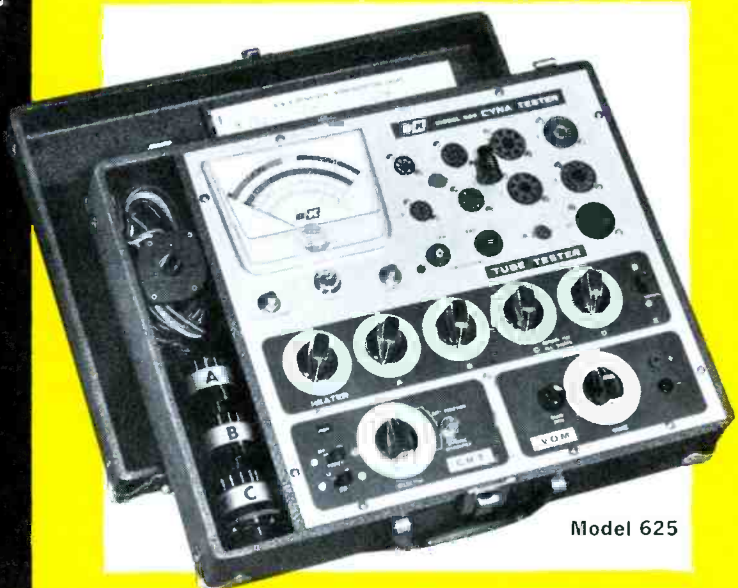
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—wonder of wonders—found to be bad. I sold her a new one, then turned to the other lady who had been waiting patiently.

She showed me a transistor radio from which a small piece near a corner of the case had been chipped.

"Our cat knocked it off the table and made this hole in it," she explained. "After that, it got weaker and weaker until we could just barely hear it. My husband read someplace that the electrons in transistors go through holes and he thinks they've all leaked out of our radio. Can you do anything about that?"

I explained that transistors were only a part of the radio. Also, that they were made so the electrons could go only where they were supposed to. Then I put in a new battery, which restored the radio to life, and the lady departed, happy.

I decided to check the scope more thoroughly while I had it apart, and was busily engaged in this task when the phone rang. The woman's voice sounded familiar. When she asked if I was coming home for supper, I realized it was my wife. I also discovered it was past closing time—the day was done. Now I could go home and, after a satisfying meal, relax and enjoy myself—for about half an hour. I still had that TV on my bench; it wasn't fixed and more would come in tomorrow, so back to the shop I went for an evening session.

As most servicemen (particularly those with small shops) have found out, evenings are the only times one can work without interruption. Therefore, I was not-too-pleasantly surprised to find a man standing at my shop door with a portable television set in his hand.

He greeted me with, "Figured if you didn't show up pretty soon, I'd come on up to your house."

In the course of my business, I always present a smiling and cheerful face to my customers—that is, until closing time. I gave this one the sour look of a man who is not at all pleased. It didn't seem to affect him, so I unlocked the door and let him in.

His set was a series-string rig, and dead. Since I have found it quicker to test the tubes in these sets than to trace with an ohmmeter, I started on them. The job paid off; I found one tube burned out and another shorted. Two tubes restored the set to working order and, evidently anxious to spend the rest of the evening watching it, my customer paid up and hurried out. Locking the door and pulling the blinds, I sealed myself in for the evening.

Once more I turned to the TV on the bench. The bright line was still there. I turned the brightness down and studied it while I got my thinking back on the track. Then I remembered I hadn't yet put the scope back together. Muttering under my breath, I left the TV set long enough to reassemble the scope, without bothering to "check it more thoroughly."

I turned it on, and it seemed okay; so, for the umpteenth time, I fixed my attention on the TV set. I made a few scope checks which showed me that the vertical section wasn't working. This revelation didn't raise my eyebrows any; I'd figured that out already.

Using a low-capacity probe to keep from upsetting the circuit, I touched one scope lead to the grid of the vertical output tube. Getting

no indication on the scope face, I decided the first stage of the multivibrator probably wasn't "vibrating."

I mentally listed the things that might keep it from operating, such as a bad tube (or a tube left out of the socket), little or no voltage (due to trouble on the B+ line), an open coupling capacitor (or one that had been cut out for checking and not resoldered), cold solder joints, solder slopped all over the socket terminals, or right wires connected to wrong terminals (or vice versa).

Since I hadn't started testing parts yet, I could rule out any mistakes I might have made, so I decided to take a few voltage readings. The plate voltage was higher than normal and the grid bias was next to nothing. Since this stage used plate feedback from the output tube, I checked components in the feedback loop and found an open capacitor. A new one brought the stage to life and a full picture to the face of the CRT.

I breathed a short sigh of relief; now all I had to do was install a new picture tube, put the set back together, clean the safety glass, and polish the cabinet. With a little luck I could get home early! . . . I left the shop at midnight.

The next day, as I rang the doorbell of my new customer's home, I could visualize his delight at seeing his set in such good condition. He helped me carry it in, and we quickly set it up and turned it on. My customer studied it thoughtfully for a few minutes, and then said, "Works pretty good, but the people look funny. Their legs are longer than usual and their bodies aren't tall enough. Before the set went bad, the actors' legs were short and their heads were long. Somehow, you've changed them."

I gave him a short explanation about vertical height and linearity controls and how they were used. I also told him I had adjusted his set for equal linearity, top and bottom, but he was still dubious. I asked him if the chorus girls had short legs and long heads at any musical show he had ever seen. That did it. "Gosh, no!" he exclaimed, looking at his TV with new understanding. "Yes, I guess it looks okay after all. I'll come over and pay the bill, in a week or so. . . ." ▲

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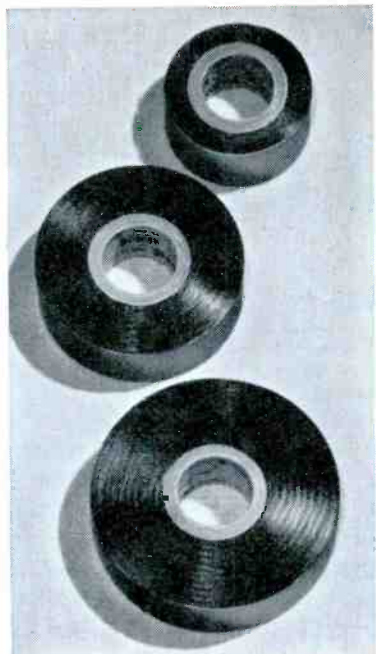

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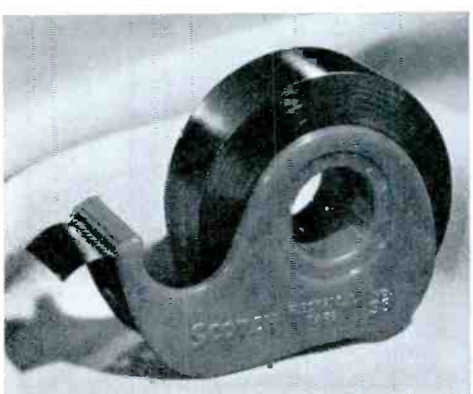

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by Patrick M. Craney

SERVICING tone-coded SQUELCH

In the early days of radiocommunications, two-way radio users had relative privacy. When a frequency was assigned, little thought was given to sharing the channel, for there generally was no need to do so. In fact, a person could just pick up his microphone and transmit without worry of interfering with any other radio system.

However, as more commercial two-way radio stations were placed on the air, it became necessary for several systems to share an individual channel. Needless to say, this was quite annoying—all stations were forced to listen to the chatter from other stations on the channel, and when one was on the air the others could not transmit. The Federal Communications Commission (FCC) tried to help by decreasing the width of each channel, making room for more stations in the same frequency space. However, this solution was only temporary; an ever-increasing number of new users intensified the old problem, until today there are many channels on which more than one licensed station must operate.

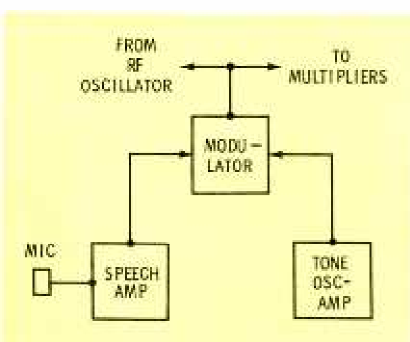


Fig. 1. Audio-frequency tone is applied to modulator stage in transmitter.

The Push For Privacy

Naturally, many stations in the business services don't desire to be bothered by "chatter" from stations with which they share a channel, so they have sought a means by which they might hear only those messages intended for themselves—and no others. Commercial two-way-radio manufacturers have met this need with devices known variously as *Quiet Channel, Quiet Line, Private Line,* and *Channel Guard.* Since these all achieve the same purpose by essentially the same method, we can accurately describe them all as *tone-coded squelch systems.*

How It Works

In a tone-coded squelch system, the receiver audio stages are blocked, or "squelched," much the same as with a carrier-squelch system (see "The Imperfect Squelch" in the June, 1962 PF REPORTER). The transmitter (Fig. 1) applies a low-frequency audio tone to the carrier during modulation. In the receiver (Fig. 2), the tone is taken from the discriminator output, amplified, and fed to a reed relay which opens the squelch circuit of the receiver so the message can be heard. If the receiver picks up a signal which *doesn't* contain this specific audio tone, the audio stays squelched, and the message isn't heard.

In order to understand more clearly, suppose that on a particular channel (say 155.25 mc) there are three systems operating in a single area—each system having one base and several mobiles. The stations whose receivers aren't tone-actuated will have to listen to messages not only from their own units, but also from those of both their "neighbors." However, if one of the systems has tone-coded facilities, the only messages received by that system will be its own. If all three are tone-equipped, each can operate in relative privacy.

A Transistorized Unit

In keeping with today's trend towards use of transistorized circuits, we will first analyze a typical transistorized system. All systems use an audio tone, and except for their manner of generating the tone at the transmitter and utilizing it at the receiver, the systems are basically the same. For example, if the tones are the same, a *Quiet Channel* transmitter can actuate a *Private Line* receiver (or vice versa).

Since the purpose of the continuous audio tone is to operate the squelch circuit in the receiver, the transmitter must produce a tone of very exact frequency. The transmitter in Fig. 1 uses a mechanical resonant-reed device to generate the tone. The reed is located in the electrical field of a coil, through which the transistor base current flows (see Fig. 3). While the vibrating reed itself is not shown in the schematic, it is a functional part of the oscillator circuit because it controls the frequency. The initial flow of base current flowing in the coil energizes the reed, causing it to vibrate at its natural frequency (in the low audio range). The vibrating reed induces an audio voltage

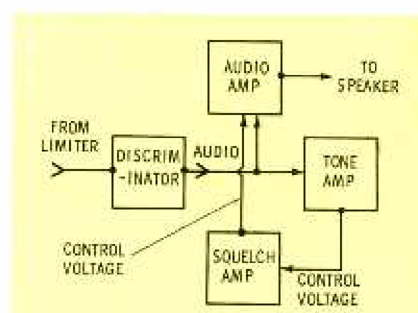
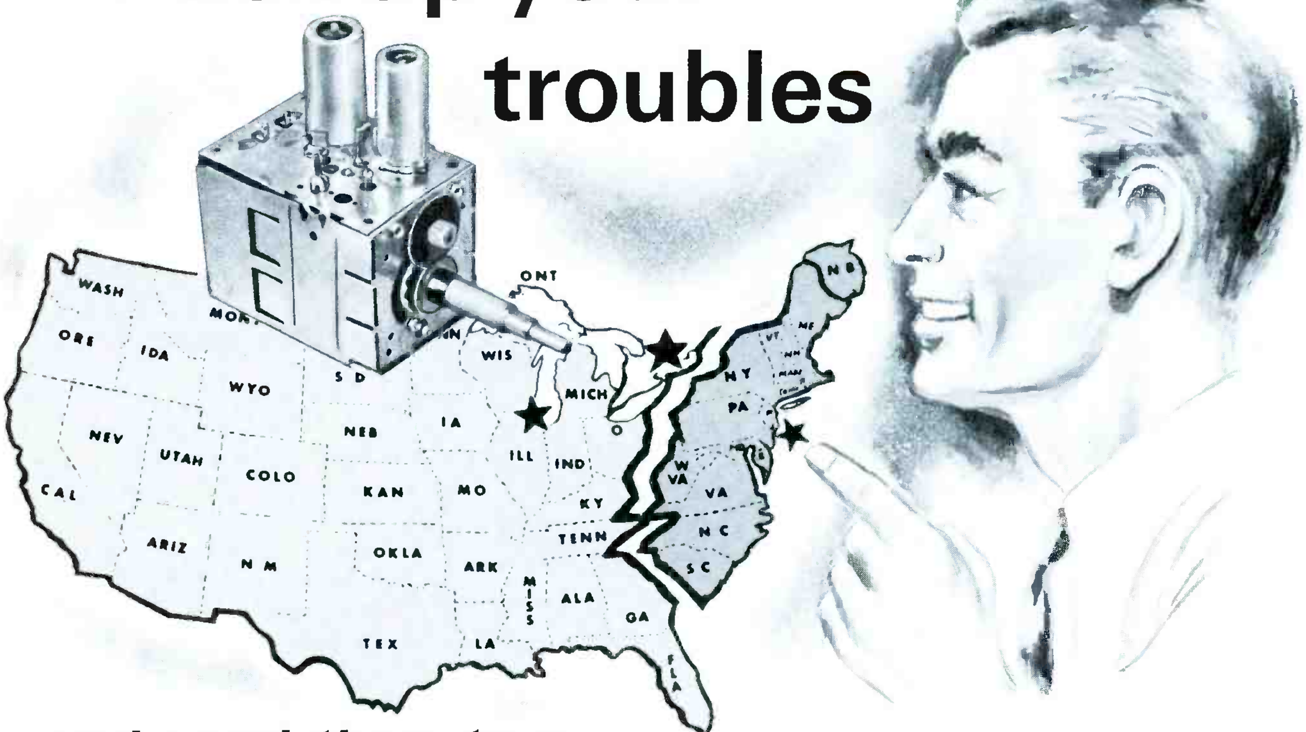


Fig. 2. In receiver, the tone circuit obtains its input from discriminator.

Pack up your troubles



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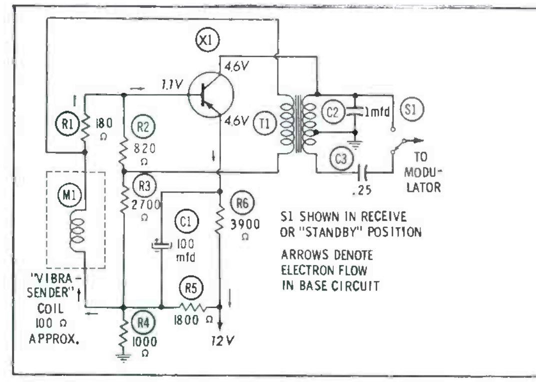

Fig. 3. This transistorized oscillator drives a resonant-reed tone generator.

in the coil and thereby controls the operating frequency of the oscillator.

The reed is a very high-Q device, with a frequency stability of .15% over a temperature range of —20° to +80° C. Because of its high Q, the reed is slow in starting; thus, after the transmitter carrier is keyed, there might be considerable delay before the amplitude of the tone is sufficient to modulate it. To prevent this lag, the tone oscillator is kept operating continuously, and the tone is applied to the modulator circuit by relay contacts when the microphone push-to-talk button is depressed. There is no delay in coding the carrier with this arrangement; therefore, the receiver for which the message is intended will be instantly actuated and none of the message spoken into the mike will be lost.

The oscillator in Fig. 3 is of the common-emitter type, with collector-to-base feedback through transformer T1. The voltage-divider network consisting of R1, R2, and R3 maintains just the right amount of feedback voltage on the base to sustain oscillations. For the sake of illustration, arrows are drawn in the base-to-emitter circuit to indicate the main electron flow. As you can see from the component values, the path of least resistance is through the *Vibrasender* coil rather than the feedback divider network. This current, of course, starts and sustains the vibrations of the resonant reed.

When the transmitter is keyed, the oscillator tone is injected via S1 into the modulator along with voice information from the speech amplifier. Together, they fre-

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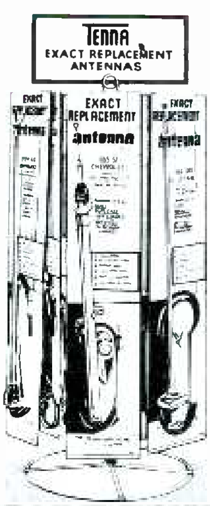

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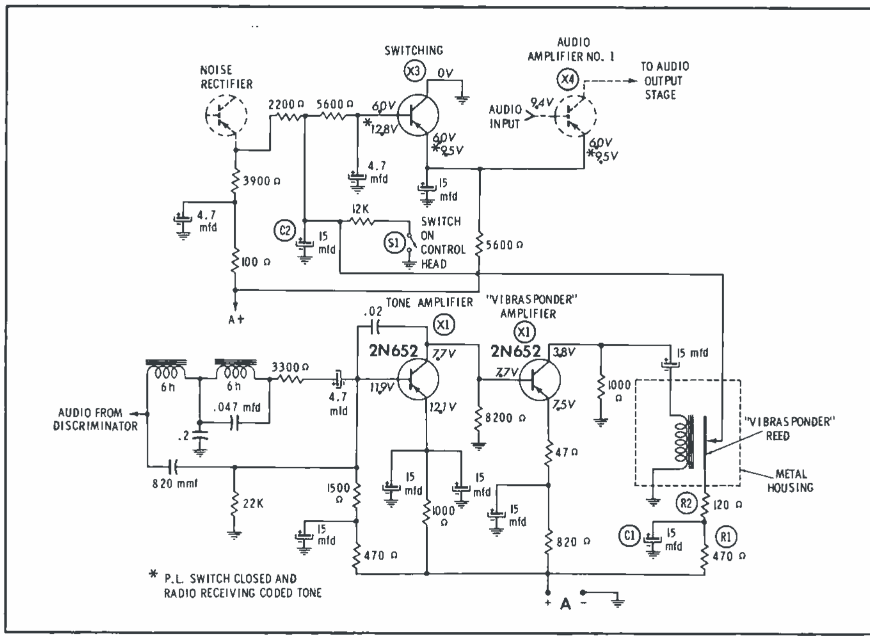

Fig. 4. Tone-operated reed alters bias on X3 to control the conduction of X4.

quency-modulate the RF carrier, which is then transmitted as usual.

When the receiver processes the RF carrier, it recovers the audio signals at the discriminator, resulting in an output containing both the voice components and the tone signal. Just as in a conventional two-way radio, the discriminator output is usually sent along two separate paths—one going to the audio amplifier and the other going to the squelch circuit. The audio amplifier would normally handle the voice message, except that the squelch circuit has it cut off.

In the receiver equipped with tone-coded squelch, the discriminator output also goes to the tone-amplifier circuit, as shown in Fig. 2. The tone amplifier (see Fig. 4) drives the *Vibrasponder* amplifier, which in turn drives the *Vibrasponder* coil itself. The tone sets up an audio field around the coil, causing the extremely high-Q reed to vibrate and complete the alternate A+ circuit to switching transistor X3. This reed does not maintain continuous contact with the switching-transistor circuit; rather, it makes and breaks the A+ circuit at its vibrating rate—

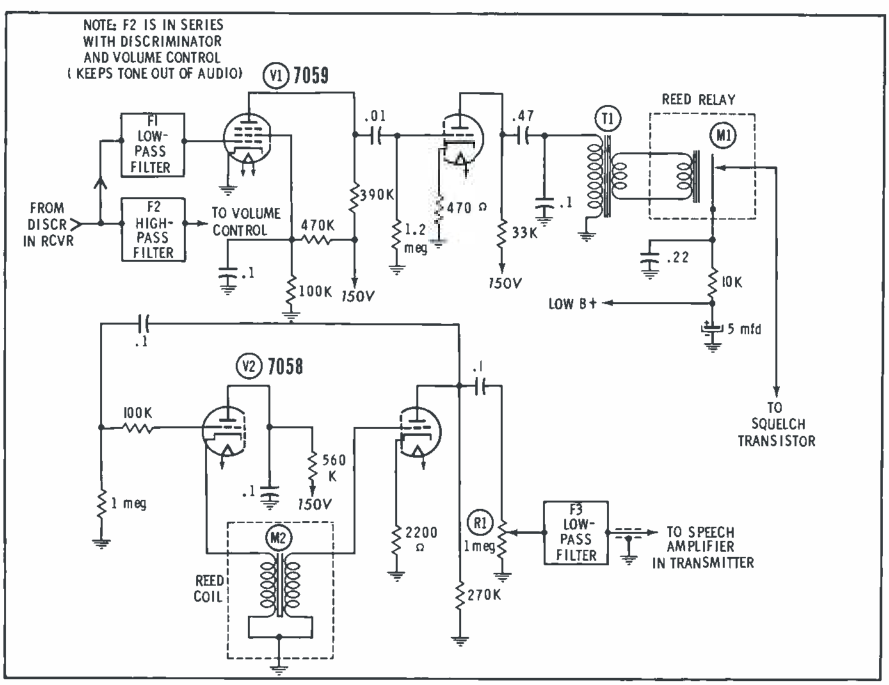

Fig. 5. Tone-coded squelch unit designed to be added to existing radios.

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Tips for Technicians

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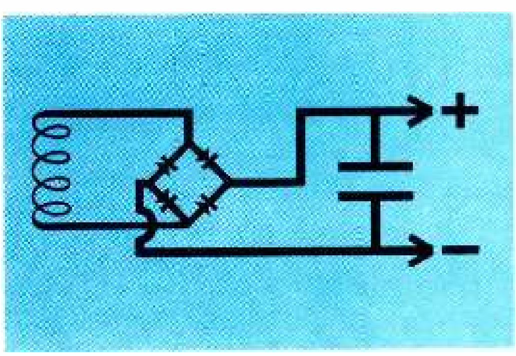
Hints on Reducing Hum . . .

In high fidelity sound systems . . . and in many kinds of commercial and industrial electronic equipment . . . reduction of 60-cycle hum is one of the toughest problems that a technician has to tackle. Most hum comes from 60-cycle voltage sneaking into the signal circuit. There are, of course, many well-known precautions that should be observed . . . using shielded or coax cable between major components, keeping cables short especially in the low-level portion of the system, making sure connectors are tight. Here are some other thoughts that may be useful.



Power supplies in sound systems . . . hi-fi or commercial . . . generally operate at higher temperatures than those encountered in radio or TV. So it pays to be particular about filter capacitors. It pays to use electrolytics rated at 85° C. Those rated at only 65° C start to run into trouble. Then too, because of the added heat, the vent construction is important. In other words, "How good is the seal?" Our tip is to always use Mallory FP-WP electrolytics . . . voltage ratings are conservative and dependable . . . they have excellent stability at high temperature . . . and they all have *etched cathode* construction. This latter is extremely important in avoiding hum. We covered the reasons in a previous TIP (remember?).

Here's another source of hum . . . filament circuits. Many of the highest quality sound systems use a DC filament supply in the preamplifier. It's easy to add this refinement to any system. All you'll need is a Mallory FW-50 "packaged" silicon rectifier circuit. It's encapsulated in a tiny plastic block and takes up very little space. Simply connect the FW-50 to the circuit, add a WP-042 electrolytic and filament hum disappears permanently. If you want more specific information, write and ask us.

Another tip: call on your Mallory Franchised Distributor for prompt service, at sensible prices, on Mallory capacitors, switches, silicon rectifiers, controls, and batteries . . . and for any other parts you may need.

which is almost always below 300 cps. The combination of R1, R2, C1, and C2 presents a sufficiently long time constant to keep the voltage applied to the base of X3 fairly steady.

When switch S1 is closed, the voltage-divider network in the base circuit of X3 is complete. In this condition, audio amplifier X4 is directly controlled by X3, since the emitters of these two transistors are tied together. Normally, 6 volts DC is developed at the base of X3; at this value of base-bias voltage, X3 conducts, holding the voltage on its emitter to a value low enough to keep X4 cut off.

When the *Vibrasponder* reed is actuated by the incoming tone, the base voltage of X3 is raised to 12.8 volts. This causes PNP transistor X3 to cut off, increasing the emitter voltage from 6 volts to approximately 9.5 volts. The result is an increased emitter voltage on X4, which allows that transistor to conduct and permits the incoming message to be heard.

As previously explained, the tone squelch system prevents the radio operator from hearing stations other than his own. However, when he desires to transmit, he must first be sure the channel is not occupied; otherwise, he may interfere with someone's conversation. To provide for monitoring, a toggle switch (S1) is included in the control panel. When open, this switch disables X4, which in turn allows the audio amplifier to conduct. Any message on the channel can then be heard in the speaker, even if no tone is present.

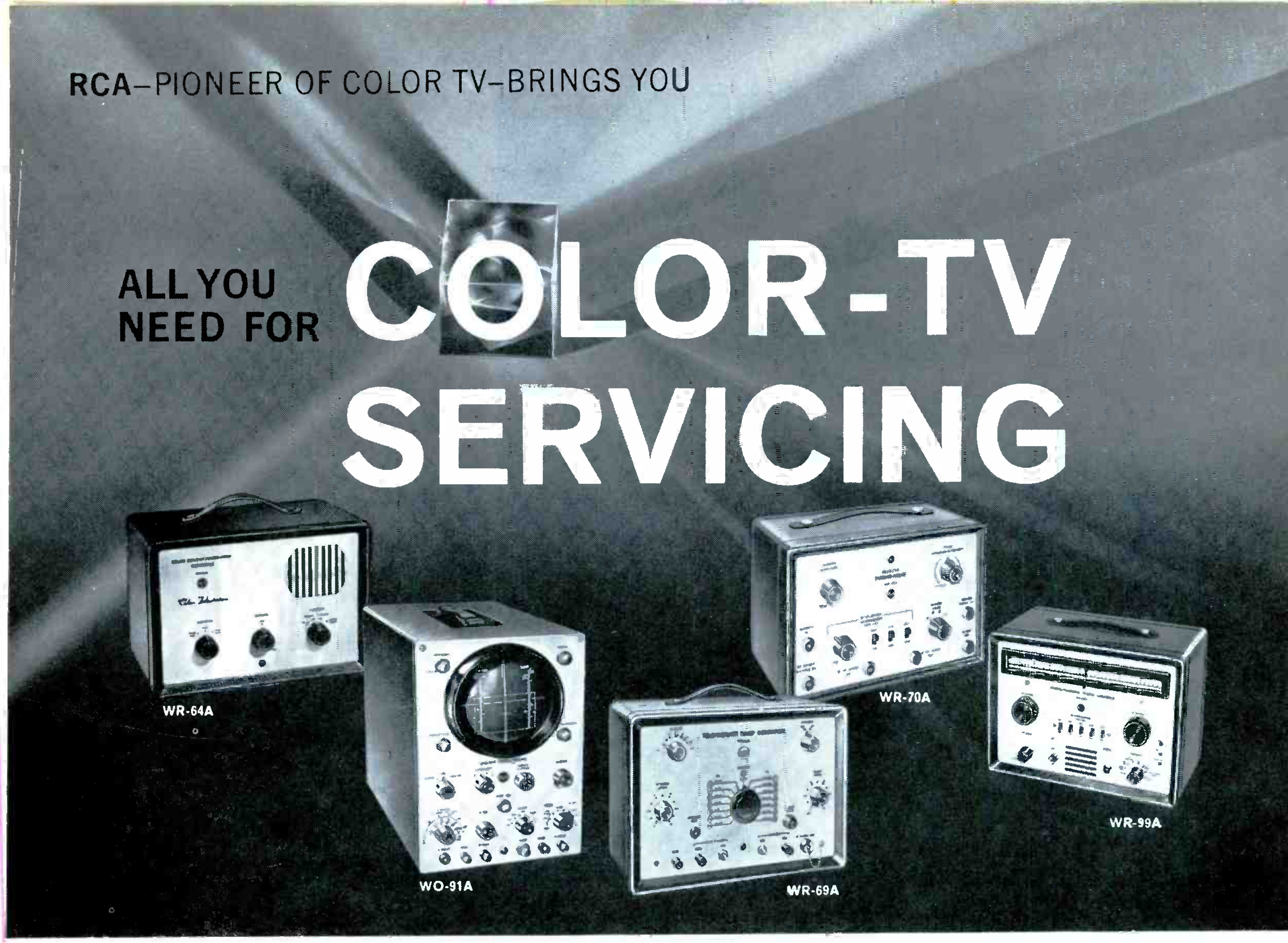
An Add-On System

The tone-coded squelch system shown in Fig. 5 is similar in most ways to the one just discussed; they both work on the principle of a resonant-reed relay. There are differences in the circuitry of various systems, but they all produce and receive a tone—the common denominator of them all. Therefore, if you understand the transistorized system just presented, you will have no trouble understanding any other system, even the few which do not use resonant reeds.

The unit shown in Fig. 5 is an "add-on" device, consisting of the tone-squelch control circuit (V1), a filter (F2) which extracts the tone from the receiver audio and removes voice components, and an audio oscillator (V2) which supplies the tone for the transmitter. A unit such as this can be added to almost any existing equipment.

The squelch-control circuit consists of low-pass filter F1, audio amplifier V1, and resonant-reed relay M1. The output of the discriminator is fed to the input of filter F1. This filter rejects frequencies in the voice range and allows only the signalling tone to reach the two-stage tone amplifier, V1. The output of V1 is fed through transformer T1 to the coil of relay M1. The relay operates only if the tone frequency is the same as the resonant frequency of the reed.

The action of the squelch circuit (not shown) can be described as follows: Normally, the squelch gate tube in the receiver is cut off by a negative bias applied to its grid. When a signal containing the required tone is received, relay M1 operates and applies a posi-



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. Muilt-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
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- 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

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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, rebroadcast 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
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tive voltage to the gate tube, thus causing it to conduct, and permitting the message to be heard in the speaker.

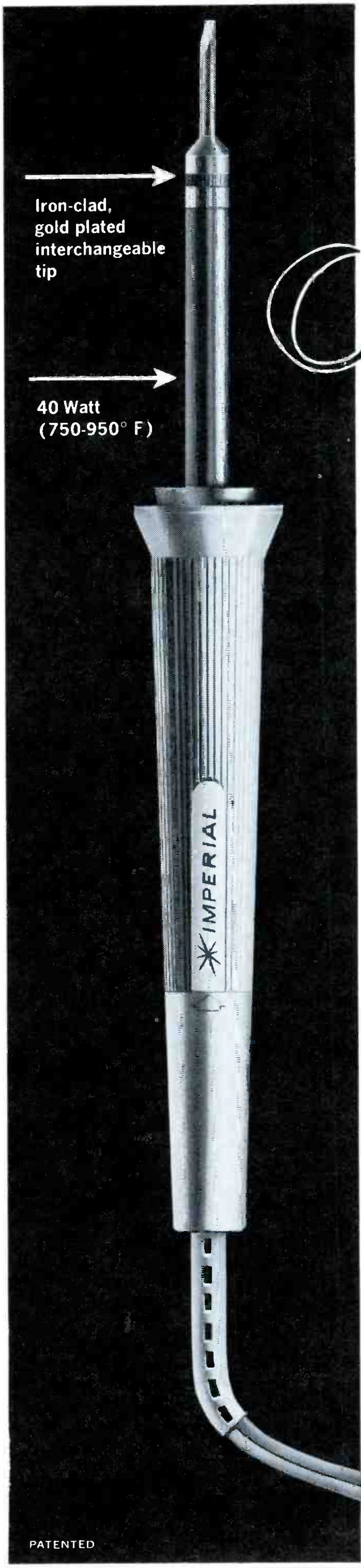
To provide for monitoring the channel before transmitting, a microphone hang-up switch is wired so that, when the microphone is lifted, the receiver audio section is restored to regular (carrier-actuated) squelch operation. Any signal strong enough to actuate the regular squelch circuit will then be audible even though it may not contain the required tone.

Like the audio-oscillator transistor in the other unit, this audio oscillator (V2) uses a resonant-reed drive-and-control coil to set the frequency of oscillation. The output of V2 is fed, through a modulation control and a low-pass filter (F3) which attenuates harmonics, to the second stage of the speech amplifier in the transmitter. Here, it is mixed with any voice modulation from the mic, and both signals go directly to the modulator.

Maintenance And Service

The tone-coded squelch portion of any transmitter or receiver seldom gives trouble. When it does occur, however, a malfunction in these circuits can be a real "dog." Sometimes, just replacing the resonant-reed relay (which is a plug-in unit) will cure the trouble. This, and changing the tubes (or the transistors) is about the easiest and quickest method of arriving at a decision as to the extent of trouble.

The wise serviceman will take voltmeter and scope readings in a couple of units he knows to be working, just to have a good reference in case of trouble. When readings are taken with a scope, it is not so important to obtain a perfect sine wave as it is to find the correct amount of amplification. Distortion of the waveform can become most severe before it will adversely affect the system, just as long as the frequency remains constant and the amplitude sufficient. In fact, when comparing the waveforms of units in the same system, you may find quite a variation from set to set. Ignore it!



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The shape of the signal is of little importance.

In the unit of Fig. 3, relay switch S1 gives trouble. Also, the disabling switch (S1 in Fig. 4) occasionally goes bad. More common is trouble in the resonant-reed devices in transmitters and receivers.

In some units there are no adjustments to be made. In Fig. 5, modulation control R1 is set at the factory and will require adjustment only when the oscillator tube or reed relay has been replaced—in which case the following adjustments must be made:

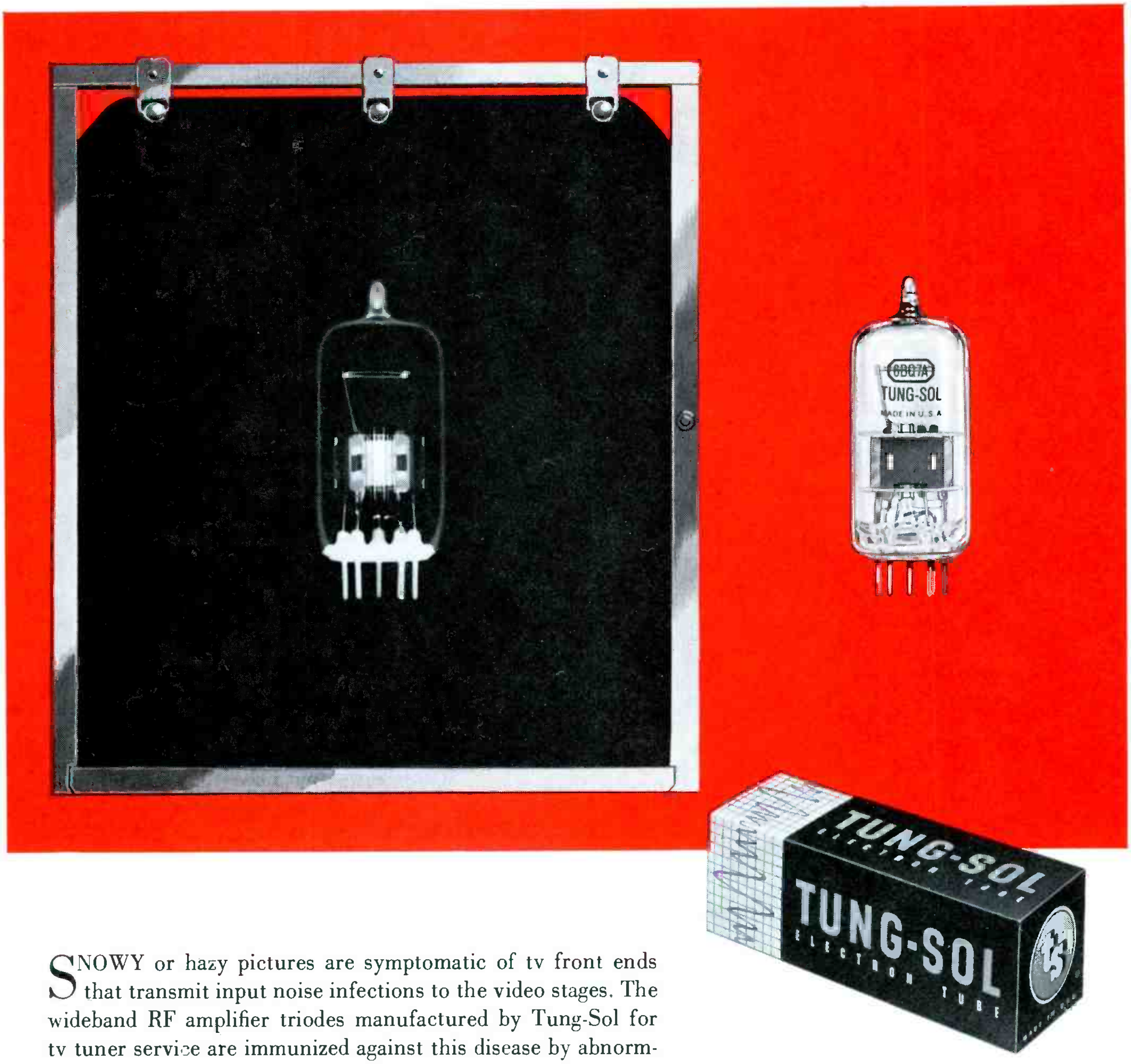
1. Disconnect the output cable of the tone unit from the jack on the transmitter.
2. Connect a signal generator (adjusted to provide a 1-volt, 1000-cps tone) to the mic-input terminals.
3. While observing a frequency-deviation meter, key the transmitter on and adjust the transmitter modulation control for 80% of maximum deviation (±4 kc deviation for narrow-band or ±12 kc for wide-band stations).
4. Reconnect the oscillator output cable to the transmitter. Leave the signal generator connected, also.
5. Adjust modulation control R1 in Fig. 5 until the modulation meter indicates 100% modulation (±5 kc for narrow-band or ±15 kc for wide-band stations). The modulation now produced by the tone will not evceed ±1 kc on narrow-band or ±3 kc on wide-band units.

Conclusion

The user can't have 100% privacy on a particular channel anymore, but a tone-coded squelch system can provide relief from incessant channel chatter. Whether the tone unit is an add-on type such as in Fig. 5, or a built-in unit, servicing consists simply of being sure the correct tone is being generated, and the received tone is properly actuating the squelch-control circuits. With a working knowledge of these circuits, you will find no problem in troubleshooting them. ▲

HIGH GAIN AND LOW CAPACITANCE OF FRONT END TRIODES

EXPLAIN ABSENCE OF SNOW ON PICTURE TUBES



SNOWY or hazy pictures are symptomatic of tv front ends that transmit input noise infections to the video stages. The wideband RF amplifier triodes manufactured by Tung-Sol for tv tuner service are immunized against this disease by abnormally close spacing of grids and cathodes, boosting power gain and allowing transconductance to increase faster than input capacitance. Isolation of tube elements is maintained by three-part formula: clear mica spacers and rigidized construction to prevent thermal warping and microphonics; high-purity materials prevent gas generation and the formation of leakage paths; extreme cleanliness during every step of manufacture avoids contaminants. Shot noise caused by uneven cathode emission is prevented by using finely dispersed cathode materials.

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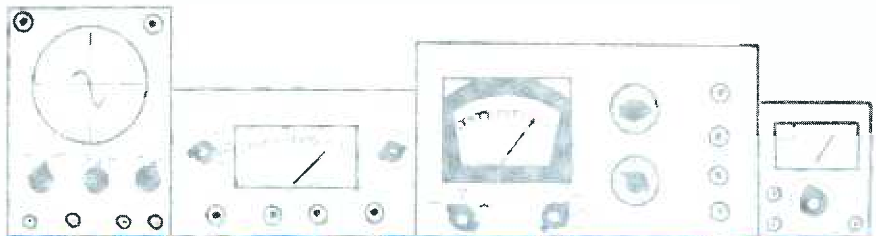

NOTES ON TEST EQUIPMENT

by Forest H. Belt

Unlimited Scope

The Model WO-91A Oscilloscope (Fig. 1), manufactured by RCA, is a wide-band, high-sensitivity instrument which is capable of handling color-TV trouble-shooting requirements as well as the day-to-day needs of regular radio and TV servicing. In addition, it has many industrial uses.

Its specifications are:

1. *Power Required—105-125 volts; 50-60 cps; 70 watts.*
2. *Vertical Amplifier — Frequency response, within ±1 db from 3 cps to .5 mc (high sensitivity), within ±1 db from 3 cps to 4.5 mc (wide band); sensitivity, 150 mv peak to peak for 1" deflection (wide band), 50 mv peak to peak for 1" deflection (high sensitivity); input loading 1 megohm shunted by 40 mmf (57 mmf with direct probe attached); maximum input voltage, 600 volts peak to peak (in presence of not more than 400 volts DC).*
3. *Horizontal Amplifier—Frequency response, within –6 db from 3 cps to .5 mc; sensitivity, 180 mv rms for 1" deflection; input loading, 2.2 megohms shunted by 30 mmf; phase-control range from 0° to 160°.*
4. *Z-Axis Input — Frequency response, within –6 db from 3 cps to .5 mc; sensitivity, 12 volts rms for blanking.*
5. *Sweep Ranges — Continuously adjustable from 10 cps to 100 kc; preset positions, 30 cps (TV vertical) and 7875 cps (TV horizontal).*
6. *Controls and Terminals—Nine potentiometers:* INTENSITY *(ganged with* ON-OFF *switch),* FOCUS, V CENTERING, H CENTERING, SWEEP VERNIER, H GAIN, SYNC ADJ, V CAL *and* PHASE; *five rotary switches:* 4.5 MC-CAL-1.5 MC, V POLARITY, V RANGE, SWEEP, *and* SYNC-H SEL; *four combination-type terminals:* GND, Z-AXIS, SYNC, *and* H INPUT; *one coaxial* V INPUT *connector; pilot lamp.*
7. *Size, Weight, Price—13½" x 9" x 16½"; 30 lbs; $239.50.*

Fig. 1. New version of an old standby.

The Model WO-91A is a successor to the well-known Model WO-91 and incorporates a number of the features which made the earlier instrument popular. But the WO-91A has characteristics which are a definite forward step in scope design.

The WO-91A incorporates a green-trace, 5" CRT—the 5UP1. A calibrated graticule, combined with internal compensation of the vertical attenuator, permits exact measurement of peak-to-peak voltages as they appear on the CRT screen. The high sensitivity of the instrument makes it useful for tracing voltages and signals in almost any type of entertainment-electronics equipment, from transistor radios to color television sets. By the turning of a switch, the unit can be changed to a wide-band scope, enabling the service technician to see highly accurate presentations of such complex waveforms as horizontal sync pulses, color bursts in a composite video waveform, and high-frequency square waves.

A special multipurpose probe — the Model WG-300B—is included with the scope. This probe is a combination direct-reading and low-capacitance unit, enabling the user to choose either function at the flick of a self-contained switch. The attenuation ratio of the low-cap probe is 10:1—standard with most such probes. This merely means that, when using the probe, you must multiply any signal measurement by 10 to find its true value, since the waveform will be reduced on the scope screen by a factor of 10.

Probably the most unusual feature of the WO-91A is its choice of bandwidths for the vertical amplifier. This is accomplished by switching alternate values of certain components into the vertical amplifier circuits and adding or removing extra decoupling components. The result is a choice of either narrow bandpass with high sensitivity (.018 volts rms/inch) or wide bandpass with lowered sensitivity (.053 volts rms/inch). The practical high-frequency limit is 500 kc for the narrow-band position, and 4.5 mc for the wide-band position; the lower limit for both modes of operation is 3 cps—low, indeed.

The vertical input circuit incorporates a calibrated, frequency-compensated attenuator. The component values are chosen to control an input signal according to marked values, so the scope graticule can be used to measure the peak-to-peak value of an applied signal.

To use this measuring function of the WO-91A, first switch the bandwidth selector to CAL; this automatically switches the vertical attenuator to the 5-volt scale and applies a 3-volt peak-to-peak 60-cps signal to the vertical input. Then, adjust the V CAL control so the waveform on the screen fits between the "Cal" lines on the graticule. (We found this to be easiest when we used a SWEEP-control setting between 1000 and 10K, and adjusted the H GAIN for a scope trace about 2" wide.)

Having thus calibrated the vertical attenuator, you can use the V RANGE switch and graticule the same as the range switch and meter of any VTVM. For example, if a video waveform of unknown value were applied to the scope vertical input—using the *direct* probe— and the V RANGE switch had to be set to 15 (on the wide-band setting) to keep the pattern "on screen," the graticule marking would represent 15 volts, full scale. If the waveform filled only ⅔ of the vertical space in the graticule, its value would be 10 volts. To make readings more accurate, the graticule divisions are marked in volts; by use of these markings, very accurate peak-to-peak voltage measurements can be made.

Keeping the WO-91A in good operating shape is no problem. The only adjustment which may need to be made periodically—the *astigmatism* control—is accessible through a hole in the left side of the cabinet, as shown in Fig. 2. To adjust it, set the SYNC-H SEL switch to LINE and set the bandwidth control to CAL. Adjust the PHASE, V CAL, and H GAIN controls for a perfectly circular trace on the CRT. Set the FOCUS control for best focus around the entire circle. If the trace line is exactly the same thickness all the way around the circle, the astigmatism control is already set properly; however, if the thickness of the line varies, adjust the control with a screwdriver. It may be necessary to readjust the FOCUS control each time a slight adjustment is made to the astigmatism potentiometer; alternate

Where you gonna get it?

From the distributor that stocks the "exact replacement" line? Too bad. Chances are 8 to 1 he can't fill your order. (This really shouldn't surprise you. There are more than 10,000 different values of electrolytics used in electronic equipment today. How can any line of 1600 exact ratings possibly include the exact replacement every time?)

Or maybe you hope to get it from the distributor who stocks the "service-designed 300." Pity. By the manufacturer's own admission, you'll be out of luck 3 times out of 10. You then have to "double up" (assuming you have the space, the time, the patience and the customer's consent) or you high-tail it to another distributor who has the right value (made by somebody else, probably us).

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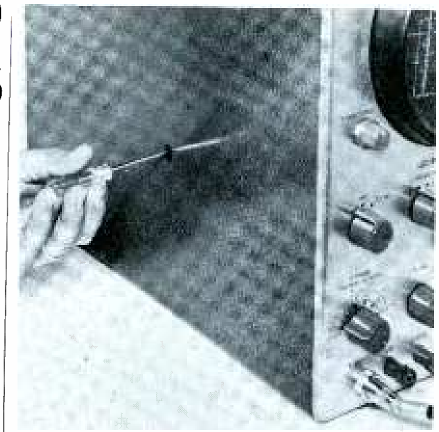


Fig. 2. Simple astigmatism adjustment.

between adjusting and refocusing until the trace forms a perfectly even, well-focused circle.

Other maintenance adjustments, which are best made with the proper test equipment, are fully described in the comprehensive manual which accompanies the WO-91A. These adjustments include vertical-amplifier alignment (which, incidentally, will very seldom be needed), plus compensation and calibration of the sweep oscillator.

We used the WO-91A scope in our lab for quite some time. The only annoyance we found with the instrument was a "bounce" of the trace (sometimes clear off-screen) when we connected the probe into a DC-carrying circuit. This is most noticable when you're using the low-cap probe, and is caused by the large input capacitor used. This large-value component takes a bit of time to charge through the resistors in the vertical attenuator, and since the remainder of the vertical amplifier is DC coupled, the charging lag results in displacement of the trace. The large resistor in the low-cap probe makes the charging time even longer than when a direct probe is used, and the trace is much slower in returning to the center of the scope screen. We found we could hasten this "return time" by momentarily flipping the V RANGE switch to its highest position; this caused the capacitor to charge faster, and the trace returned more rapidly.

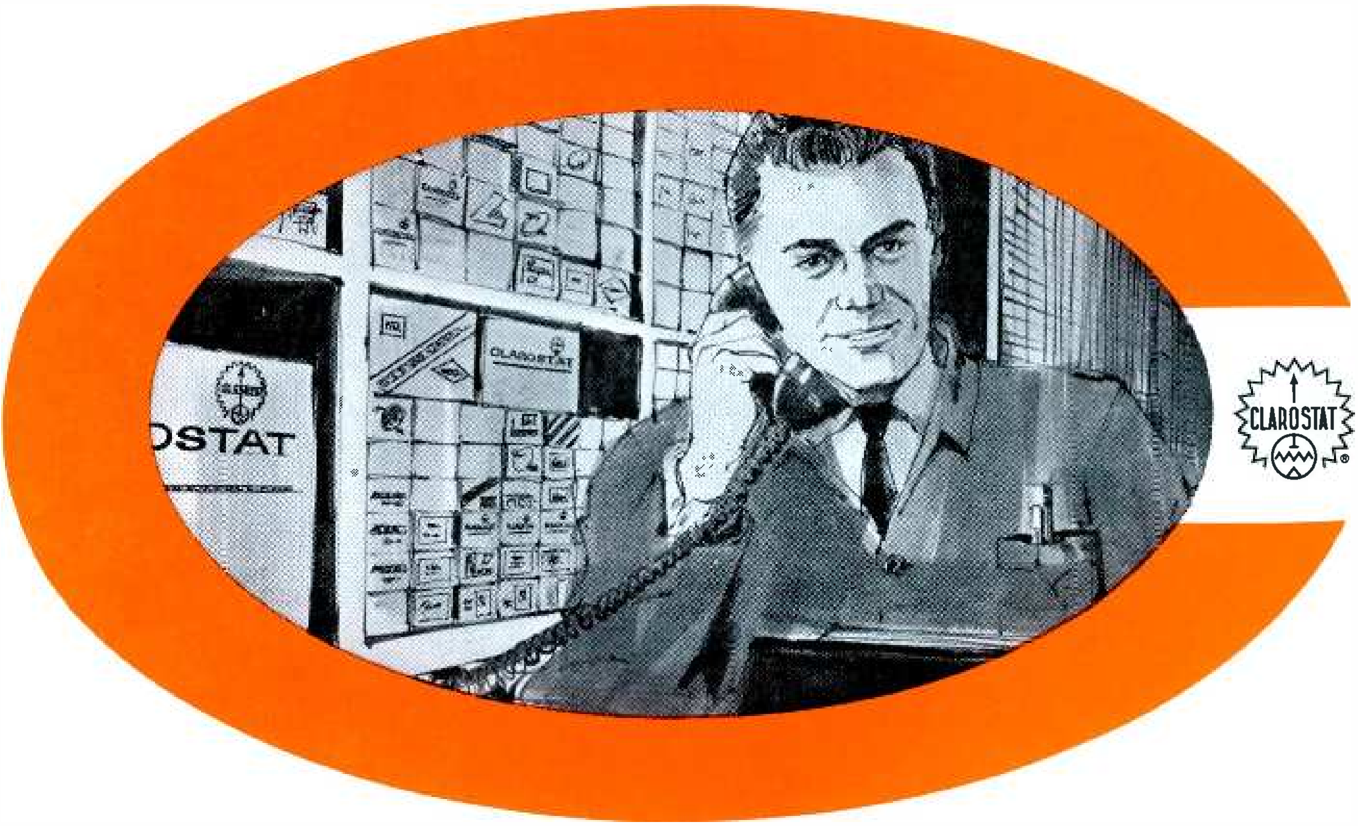
With its wide-band, high-sensitivity characteristics, Z-axis modulation capability, quick-change probe, line-phase control, external-sync facilities, and easy-reading calibration, the Model WO-91A is a very useful instrument for industrial applications, communications trouble-shooting, and, of course, radio-television servicing. It is one of the better servicing scopes available today.

Behind The Bars

A newly announced item of color-TV test equipment is shown in Fig. 3—the Model E-450 Color Generator introduced by Precision Apparatus Co., Inc.

Its specifications are:

1. *Power Required—105-125 volts AC; 60 cps; 60 watts.*



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2. *RF Output—Pretuned to Channel 3; video carrier, 20,000 uv; 4.5-mc sound carrier, 2000 uv; 300 ohms, balanced.*
3. *Video Patterns—Horizontal bars, vertical bars, crosshatch, dots, keyed color bars.*
4. *Controls and Terminals—Rotary* DISPLAY *switch for choice of video pattern; rotary* SELECTOR *switch, controlling output functions and AC power;* CHROMA *potentiometer, controlling percentage of saturation in color-bar display; coaxial RF output jack; pilot lamp.*
5. *Size, Weight, Price—13" x 12" x 8"; 14 lbs; $189.95.*

The Model E-450 is a keyed-rainbow type of color-bar generator. Its operating panel is especially designed for simplicity of operation, having only three controls—one to choose the type of RF output, one to select the video display, and a saturation control for the color bars. In addition to the color display, the Model E-450 also supplies the signals needed for other color-set adjustments, such as convergence and deflection linearity.

The rainbow signal is produced in the generator by a crystal-controlled 3.563795-mc signal. Notice this signal is displaced from the 3.579545-mc reference oscillator in color receivers by 15,750 cps—a difference which represents a 360° phase shift during each horizontal scanning line. This precise phase variation will create a continuous color change during each scanning line, resulting in a complete color spectrum or *rainbow* display on the CRT screen.

To furnish a reference for the various portions of the rainbow pattern, the signal is "broken up" into sections, or bars, by keying the 3.563795-mc rainbow signal on and off. The periodic interruptions of the signal cause the display on the CRT screen to appear as *bars* of color. This "on-off" characteristic of the color signal gives rise to the name *keyed-rainbow*.

A series of oscillators and dividers initiate the various video patterns, as diagrammed in Fig. 4. The main timing action is controlled by a 189-kc crystal oscillator—a Pierce circuit which uses one section of a 12AU7. The frequency dividers are actually triggered blocking oscillators (a very stable arrangement)

Fig. 3. Newly developed keyed-rainbow signal generator for color servicing.

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Jensen Manufacturing Co., 6601 S. Laramie Ave., Chicago 38, Ill. / Canada: Radio Speakers of Canada, Ltd., Toronto each of which is controlled by the stage preceding it. Looking at Fig. 4—the 31.5-kc divider is a blocking oscillator which is triggered by every sixth positive-going pulse from the 189-kc master oscillator. A shaping stage gives the 189-kc output signal the correct characteristic to perform this triggering action properly.

The various black-and-white video pattern displays are developed by the chain of divider stages. For example, to create vertical bars, the 189-kc signal is used directly. It is fed to a keyer stage, turning that stage on and off some 12 times during each horizontal-scanning period. This keyed signal is fed through switch S1 to a vertical-bar shaping circuit which forms the pulse into a peaked waveshape; this vertical-bar signal is then applied to the video stage, where it can be passed on to the output circuits of the generator. Only 10 vertical lines appear on the CRT because two of the pulses are "lost" during horizontal blanking and retrace.

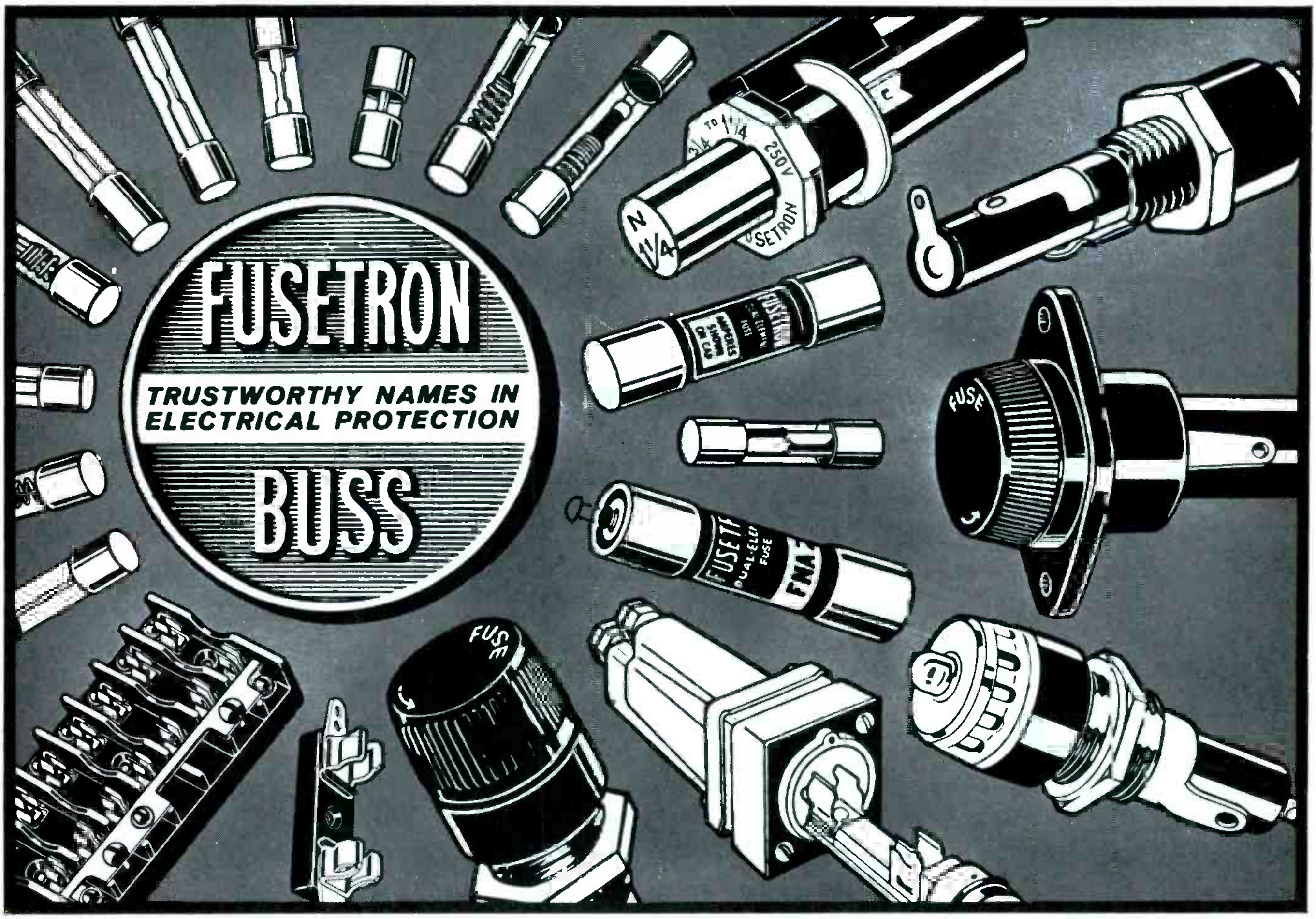
The horizontal-bar pattern is created by feeding a 900-cps signal into the video mixer. This signal is derived from the chain consisting of the 31.5-kc, 4500-cps, and 900-cps dividers. The 900-cps output is shaped into sharp pulses which occur 15 times during each vertical scan period; thus, on the CRT of a TV set, 15 horizontal lines will appear.

The crosshatch pattern is developed by simultaneously feeding the outputs of the vertical-bar shaper and the horizontal-bar shaper into the video mixer. This creates both vertical and horizontal bars on the CRT screen at the same time. A dot pattern is formed by incorporating a diode to eliminate the crosshatch lines, except at their junctions; the result is a presentation about 15 dots high by 10 dots wide on the CRT screen.

So the video display will be in synchronization with the sweep circuits in the set, the Model E-450 furnishes horizontal and vertical sync pulses along with the signal to the color receiver. The horizontal pulses are developed by a frequency-divider chain beginning with the 189-kc oscillator, and progressing through two other stages—the 31.5-kc and 15,750-cps dividers. The output of the 15,750-cps divider is formed into the correct shape for horizontal sync purposes, and is fed to the video-signal mixer.

The vertical sync signal follows a longer chain of dividers, progressing from the 189-kc oscillator through the 31.5-kc divider, then through the 4500-cps, 900-cps, 300-cps, and 60-cps divider stages. Each of these 6CG7 blocking oscillators is controlled by the preceding stage in the chain. The 60-cps output of the last divider is shaped into a vertical sync pulse and fed to the video mixer.

For color-bar signals, the 3.56-mc oscillator is used. The shaped output from the 189-kc oscillator is mixed with the 3.56-mc chroma signal in the keyer stage. The keyer alternately turns the 3.56-mc signal on and off, causing *bursts* of the chroma signal to be fed—via S1—to the video mixer. Each burst contains ap-



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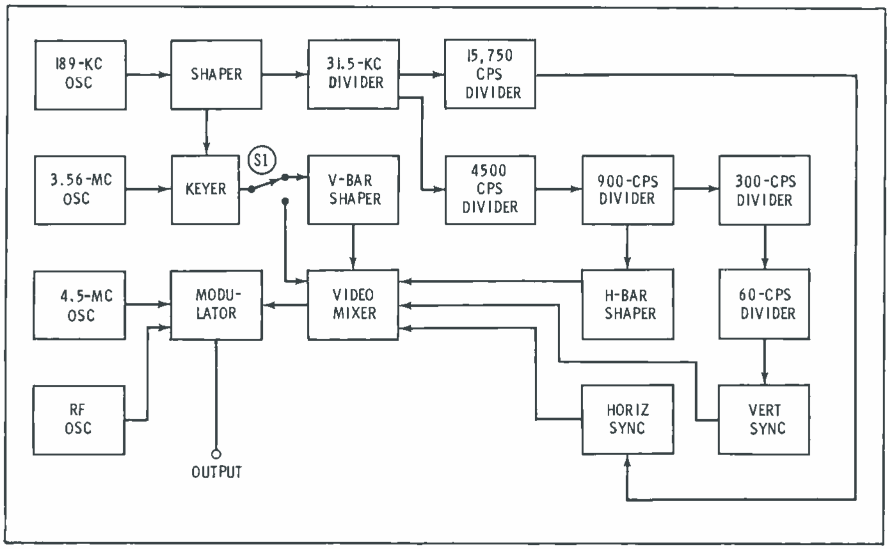

Fig. 4. Video pattern signals developed by a series of divider circuits.

proximately 8 cycles of the chroma signal.

In the video mixer, quite a variety of signals can exist, depending on the setting of the generator controls. If the DISPLAY switch is set for vertical bars, a 189-kc signal is mixed with the horizontal and vertical sync pulses in the video mixer. For horizontal bars, only the 900-cps pulses are combined with the sync signal. With dot or crosshatch patterns, all four signals appear in the video mixer stage. To produce color bars, the "ingredients" are the horizontal and vertical sync pulses, as well as the 8-cycle bursts of 3.56-mc chroma signal. In short, the video mixer combines various signals to create the pattern selected by the DISPLAY switch.

The pattern signal is fed from the video mixer into a modulator stage. The output of an RF oscillator—a Colpitts type using one half of a 6BQ7—is fed into the modulator and mixed with the video signal. The RF oscillator is tuned to either channel 3 or 4 (at the option of the user), and the result is a video-modulated RF signal which can be fed into the antenna terminals of a color receiver.

The other half of the 6BQ7 is utilized as a crystal-controlled 4.5-mc oscillator to generate a sound-carrier signal. This 4.5-mc output is mixed with the RF signal in the modulator to create a VHF sound-carrier signal exactly 4.5 mc away from the video carrier. This signal can be used to align sound circuits in a color receiver, as well as to check for 4.5-mc beat signals reaching the CRT circuits.

The Model E-450 was given a trial run in our lab, and was found to be extremely stable. When convergence procedures and chroma adjustments were attempted with the Model E-450 as the signal source, the results were very satisfactory. The stability of the blocking oscillator-divider arrangement in the unit made adjustments easy, since we were not bothered by "bounce" of the patterns; video displays stayed firmly in place on the CRT screen. The Model E-450 Color Generator easily qualifies as a stable, readily-usable color-servicing instrument. ▲

now in our lab . . .

We're analyzing these test instruments for future "Notes" columns.

EICO Model 955 Capacitor Checker
Hickok Model 656XC Color Generator
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Paco Model G-34 Sine-Square Gen.
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THE TROUBLESHOOTER

answers your service problems

Depth Sounders

It appears I am going to become more and more involved in servicing depth finders in this small-lake area. The circuitry will not cause me much concern, but I don't understand how to test the transducers. How can I check these devices? Can I use an ohmmeter?

F & F TV & Radio Service
Bullhead City, Ariz.

Yes, crystal-type transducers (most commonly used) can be checked with an ohmmeter. Any reading less than 2 megohms indicates leakage or a short in either the cable or the unit. If a good high reading is obtained, reverse the ohmmeter leads; you should notice a "kick" of the meter needle as the connection is made. If this deflection is absent, the cable or the transducer is open.

You can check operation of the entire system—transmitter, receiver, and transducer—by immersing the transducer in a water-filled tank of some sort. Some shops which do a volume of transducer work dig a hole with an auger (six feet deep will do), line it with pipe, and fill it with water. Others build a long, shallow testing tank; the suspect transducer is placed at one end, facing the other.

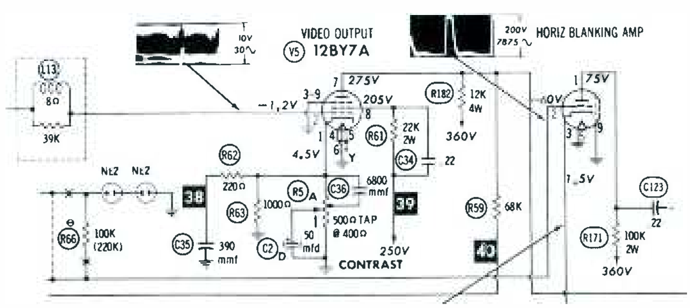
If it is absolutely necessary to test the unit without water, it can be done: Merely point the transducer at a nearby wall and note the indicator. The reflection will appear at a calibration point about four times the actual distance, because sound is much slower in air than in water—1100 fps in air, as opposed to 4800 fps in water. Also, the sensitivity of the unit will be reduced when the transducer is not submerged.

Noisy Church

We are having trouble with a sound system in a local church—the amplifier is picking up noise. The church is heated with a thermostatically controlled hot-water system. The thermostats (in various parts of the building) control electric valves, and each time one of these valves closes or opens, a noise pops through the sound system like a gun going off. When we turn on light switches anywhere in the building, we have the same noise problem. We've tried grounding the amplifier, placing large capacitors across the AC line inside the amplifier, and installing a special AC filter at the power outlet; none of these have had any effect on the noise. The only way we can stop it is to turn down the gain on the amplifier, which makes it too weak to use. Do you have any suggestions?

Clyde Wilson Ray
Lancaster, Ky.

The noises you describe are not uncom-



COLOR COUNTERMEASURES

Chassis: RCA CTC10
Symptoms: Picture intermittently loses contrast. It may jump rapidly back and forth from a weak, washed-out condition to normal operation, with lines or streaks appearing in the raster each time a change occurs. In some cases, the trouble may remain for several hours at a time.
Tip: Look for a defect in C2D, a 50-mfd electrolytic wired from the arm of the contrast control to chassis. The best way to check the capacitor for this particular trouble is to tap it with a screwdriver or other tool while watching the screen. If C2D is bad, the tapping will usually produce the symptoms.

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mon in high-gain amplifier systems and must usually be suppressed at their source. For example, in the case of the thermostats, a .05-mfd, 600-volt capacitor across the points of each unit will usually eliminate the spark which causes noise in the amplifier system. The same thing is often needed across particularly noisy light switches.

However, the fact that the noise is so common, with almost every switch in the building affecting the problem, leads me to wonder about a couple of other possibilities: Is the building old? If so, perhaps a series of new switches (and thermostats) would solve the problem. Also, are you very sure the building electrical system is properly grounded? This last trouble can give rise to some very unusual effects, and the symptom you describe is one of them. Have a competent electrician check to make sure both sides of the service are properly returned to ground, and that the ground rod is correctly installed and effective.

Also, you can check a few points about the sound system itself. In areas where electrical noise is a problem, low-impedance microphones are best. Be sure the microphone is located as near the amplifier as possible, and properly shielded low-impedance mic cable is used. An improper impedance match between the mic and its cable, or between the cable and amplifier, can make the system unusually susceptible to noise.

Width to Spare

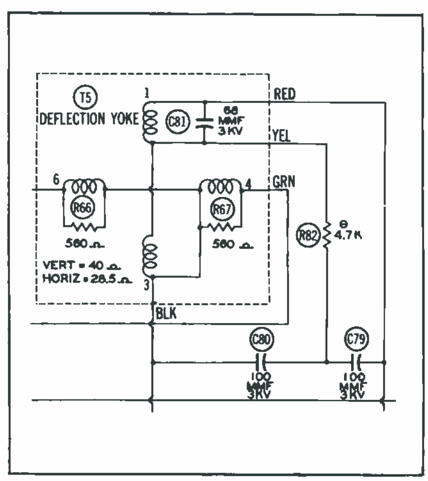
A Hallicrafters Model 24T430B (covered in PHOTOFACT Folder 306-9) produces too much horizontal sweep, and the chassis has no width control. Voltages on the horizontal output tube check within tolerances. What can I do to reduce the width to normal?

J. E. CHAMBERS

Evanston, Ill.

If the screen voltage of the horizontal output tube is definitely not too high, and the drive waveform has the correct shape and amplitude, your best bet is to concentrate on the yoke.

You might try reducing the value of C79 and C80 in the yoke circuit, but keep their values equal so as not to upset the ringing balance set by C81.



Colors Adrift

(Continued from page 33)

oscillator stage may be cleared of suspicion very easily; color on the screen, even though it may be out of sync, proves the 3.58 mc oscillator is running. But is it operating at the correct frequency?

One quick way to find out is to connect a clip lead from TP-1 to chassis. This just removes the phase-detector correction voltage from the control tube. (You've made this test before in horizontal-AFC circuits.) Now, try adjusting coil A1 in the control-tube plate circuit; if the shifting of hues in the color-bar pattern can be almost stopped, you may assume the oscillator to be working properly. If it is, you should concentrate your servicing efforts in the phase-detector circuit. Voltage and resistance checks should indicate the defective component.

If the color bars cannot be slowed to a "floating" condition (or even to a couple of slanted multicolor bars) by adjustment of A1, the reference oscillator and its control circuits are most likely the culprits. In this case, crystal M1 is a prime suspect; try a new one in its place. If this fails to correct the fault, the most expedient troubleshooting procedure is simply to replace L1, C2, C3, and C4 with exact-replacement components.

Here's a hint to keep in mind at this point:

If, after adjusting A1 and removing the clip lead from TP-1, you find that color-sync action has returned to normal, it's possible that aging components merely caused the oscillator to drift a slight amount. To check this, turn the receiver off and let it cool awhile; then, with the color-bar generator connected, turn the set back on and check for proper color sync. If it's good, let the set cook for a few hours, and then recheck for proper sync action—before you pronounce it cured.

Point 7

A waveform check here shows the reference signal which the phase detector is receiving from the demodulator transformer. It is a 3.58-mc CW signal, with only a slight trace of horizontal-sync pulse voltage mixed in. The phase of

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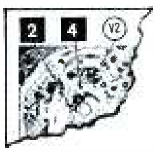

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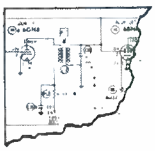
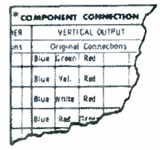
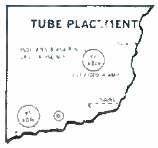


Famous Standard Notation Schematic saves valuable hours—always uniform, accurate, complete for every model.

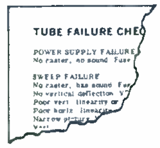


Exact Terminal Connections are indicated—no need for trial-and-error methods—a real time-saving feature.

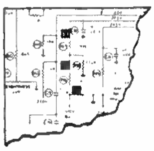
Field Servicing Notes spell out locations of adjustments for speedy "in home" servicing. Saves time spent in hunting for hidden adjustments.



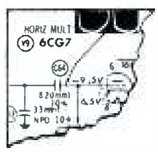
Tube Location Guide enables you to locate and replace proper tubes in seconds—a big time-saver on most repair jobs.



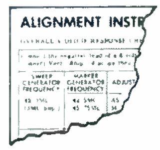
Tube Failure Check Charts spell out probable tubes responsible for failure—no need to waste time studying circuitry.



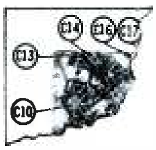
Clear Parts Symbols with values and associated information are shown plainly on the schematic—no time wasted in cross-reference "look-up."



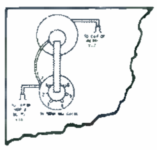
Waveform actual photos are shown on schematic for quick comparison of patterns on your scope. No time wasted in guesswork.



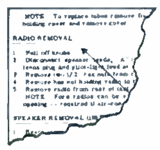
Unique Alignment System eliminates guessing; you get complete instructions with response curves, how to connect test equipment, proper adjustment sequence.



Full Photo Coverage of the actual equipment makes identification of all components and wiring easy—you can *see* everything.

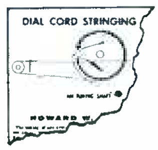


Terminal Identification saves you time; transformer and coil terminals quickly identified by color code or basing diagram shown on schematic.

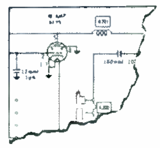


Auto Radio Removal instructions show you step-by-step procedure for removal of even the most complicated models—a big time-saver.

Disassembly Instructions, step-by-step, help you remove difficult chassis, sub-chassis, and assemblies in minutes.



Dial Cord Stringing instructions save you up to an hour or more of time and headaches on a single job.



Alternate Tuner Data—separate schematics, alignment data and parts lists are provided—no time wasted interpreting various tuner versions.

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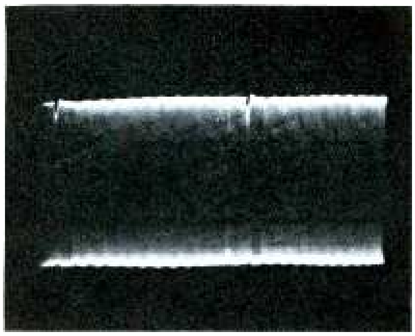


this CW signal is determined by the oscillator, and the relationship between it and the incoming burst signal sets the conduction of the phase detector. Loss of this feedback signal could result in wrong colors or out-of-sync color bars.

Summary

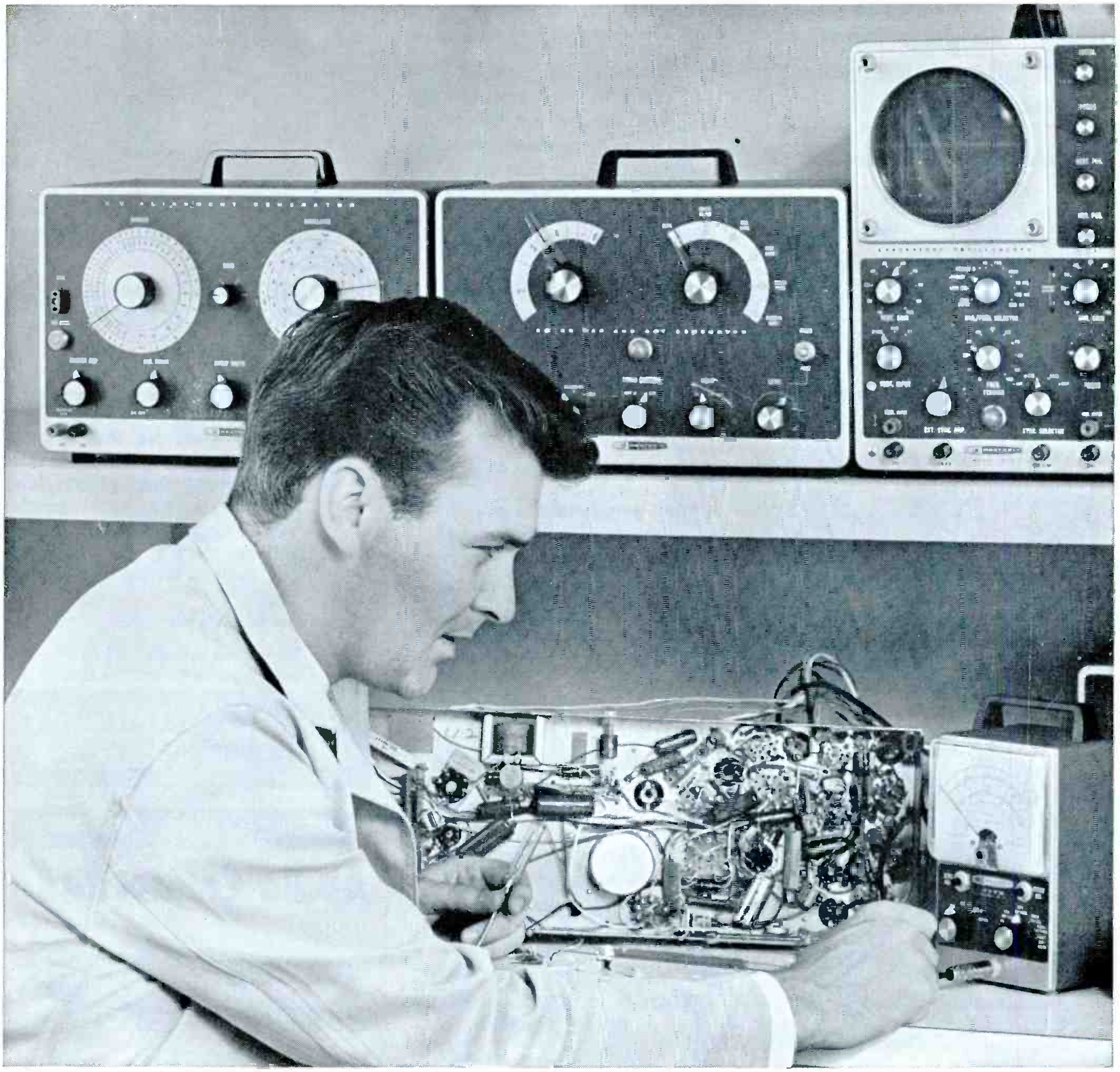
Color-sync servicing is no push-over, because the circuits contain close-tolerance components, and the operation of one circuit depends directly on the correct operation of another. However, you can be one step ahead if you will take a normally operating color receiver and run through the procedure outlined here, so you'll know exactly what the signals should look like. This way, you'll be more able to locate and repair trouble in a defective color-sync stage, and you'll show more clear profit for your time. Don't wait until you *have* to fix one.

"Spiked" Troubleshooter

The instrument pictured here — GC Electronics' Model 36-564 — is a simplified signal generator for troubleshooting transistor or tube radios. It is entirely portable, being powered by a small 6-volt battery contained within the unit.

The test signal is supplied by a two-transistor noise generator which develops a spike-shaped output — essentially a square-wave signal with a fundamental frequency in the vicinity of 1200 cps. A switching arrangement permits adding an extra capacitor for greater differentiation of the output waveform, which sharpens the pulse and creates a greater harmonic content in the output signal. A "volume" control on the instrument has a similar effect on the signal — the shape of the pulses is altered, causing more signal to be passed through the stage being tested. The output level is constant, although it is somewhat dependent on the battery voltage; with a new battery, the unit will produce a signal of approximately 6 volts peak to peak.

Due to the choice of low or high harmonic content, the Model 36-564 is useful for signal tracing RF-IF as well as audio stages in small radios. Having no connection to the power line, it can be used on battery-powered, transformer-powered, or AC-DC equipment with equal safety. This device is handy to carry along on service calls, since it is compact, complete, and self-powered. The Model 36-564 sells for $9.95. ▲



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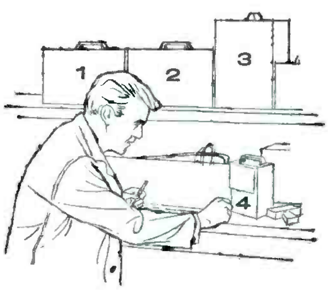

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Debugging B+

(Continued from page 24)

other electrolytics do a pretty good job of keeping the hum voltage down even though an input unit may be open. As a result, there are few telltale signs to lead us to the real trouble. A 100-mfd, 300-volt capacitor is a good size to use for checking the doubler electrolytics by substitution.

Output electrolytic C3 will not affect the DC output voltage even though it opens completely, but it will influence the ripple content and also affect decoupling between circuits on the B+ line.

Transformer Power Supplies

As we mentioned, a few transformer power supplies use semiconductor rectifiers and voltage-doubler circuits; the discussion above applies to these circuits as well. For tube-rectifier circuits, though, we want to consider another point or two.

Look at the circuit in Fig. 3—what would you expect the DC voltage to be at point A in a normally loaded circuit? The answer is: about 330 volts DC. This is a good rule of thumb, in case you can't find the service literature; the DC output voltage will approximate the rms voltage measured from one of the rectifier plates to ground. If the DC voltage is low, we suspect first the tube and then C1; C2, unless it becomes shorted, has no effect on the DC voltage.

Tracing B+ Faults

In any power supply, the output voltage is affected by the load; therefore, the B+ line must be free of leakage or shorts. If a trouble of this sort occurs in a hand-wired circuit, we can disconnect the various branches of the B+ supply line and check each for the component causing the overload. With printed circuits, however, disconnecting B+ lines indiscriminately can lead to a rather rough-looking service job; for these we need a troubleshooting method that doesn't involve too much brute force.

Fig. 4 shows a typical B+ circuit arrangement. We will use this circuit to demonstrate one method of locating the cause of an overloaded B+ line. Resistance readings are

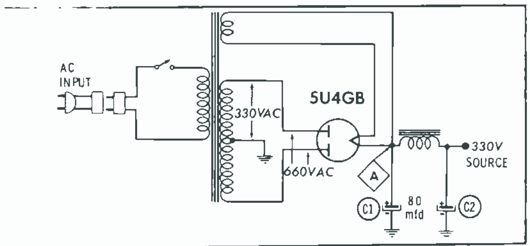


Fig. 3. Output is approximately equal to voltage across half of secondary.

taken at several different points and analyzed to pinpoint the location of the trouble. This system can be used with printed circuits as well as with conventional wiring.

Starting at point A, we find a higher reading than at point B or C. At point C, with a 980-ohm reading, we have reason to suspect the short may be at the other end of the 1000-ohm resistor—point E. (980 ohms is well within the usual tolerance of a 1000-ohm resistor, and a short at point E would cause an ohmmeter connected at point C to read the value of this resistor.) However, a higher reading at point E immediately tells us the short or leakage is in some other direction from point C. By the same logic, it automatically eliminates point D as a possible trouble spot.

Looking at the circuit from where the resistance reading so far is lowest (point C) we can disregard the branch toward F due to the higher reading at point B. At point G, however, we find a lower reading than at C. This means the trouble is in that direction and other legs of the B+ circuit can be ignored.

Possible troubles, then, could be: a defective audio output tube, a partially shorted .002-mfd capacitor (the most likely cause), a leaky tube socket, or leakage from primary to secondary or core in the output transformer. It is now simply a matter of connecting your ohmmeter between point G and ground, and disconnecting each suspected part until the leakage disappears—when it does, you've found the faulty component.

One point you should observe when checking leakage in sets using semiconductor rectifiers: To verify an apparently low resistance to ground from a B+ line, always reverse the ohmmeter leads before making a final analysis; depending on ohmmeter polarity, you may have been reading the forward resistance of the rectifier in your first test. (Not all ohmmeters have sufficient voltage to overcome the "potential hill" of these rectifiers, in which case you won't encounter this possible difficulty.)

Debugging "Stacked" B+

By "stacked" B+ circuits, we mean those in which B+ potentials are developed through voltage drops in normally operating tubes—for example: in stacked IF stages, cascode amplifiers, and circuits which derive B+ from the cathode of the audio output tube.

Fig. 5 shows a B+ circuit of the latter type wherein the tube takes the place of a large dropping resistor. The operation of this sort of circuit depends on the distribution of the various voltages. The grid must remain slightly negative with respect to the voltage expected at the cathode. In this circuit, the grid voltage is obtained at the junction of R1 and R2. Should R1 open or increase in value, the grid bias would become more negative—lowering conduction in the tube. As a result, the "low B+" voltage at the cathode would decrease sharply.

In this type of supply circuit, a defect in the audio stage can often cause a seemingly unrelated symptom. For example, a common trouble in some color sets is a loss of AGC action. This fault has been traced several times to a grid resistor in the audio output circuit having changed value. This, in turn, lowered the B+ to the AGC keyer, causing the AGC voltage to be erratic.

Another typical case is a symptom of snow, caused by low gain in the cascode RF stage of a tuner. Grid bias for one of these "stacked" stages is nearly always developed by two fixed bleeder resistors from B+ to ground. When one of these resistors changes value, it causes one section of the tube to operate at reduced gain.

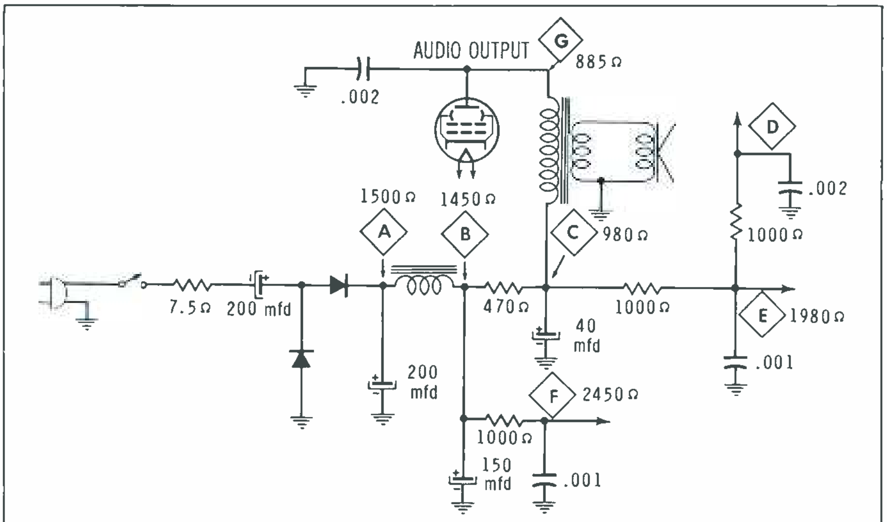


Fig. 4. Resistance method of localizing B+ shorts requires no unsoldering.

B+ Filtering

Inadequate filtering of the B+ line is one of the most common causes of bending, jitter, tearing, and other similar instabilities. When this fault develops, the signal voltages of one circuit may get into another circuit and cause all sorts of weird troubles.

Without doubt, the oscilloscope is the most useful instrument for checking filtering on the B+ line, and its use is certainly not difficult. You don't even have to know the peak-to-peak value of the voltage, although this information is helpful at times.

When the problem is jitter or tearing, you will be most interested in whether or not the waveform you find on the B+ line shows any change as the picture content changes. If it does, there is video on the B+ line—a condition which can't be tolerated!

For "bending" problems that do not change with the content of the picture, you need to measure the peak-to-peak voltage of whatever waveform appears on the B+ line. This signal should not exceed 2 volts peak to peak, except at the input-filter electrolytic.

Now, the question might be asked: Why not just shunt the suspected B+ circuits with a good electrolytic rather than use a scope? The reason is that the sudden surge of charging the test electrolytic often heals the defective capacitor, unless you're using a substitution box which has an "anti-heal" test switch. If the faulty capacitor heals, you cannot really be sure you've found the trouble. And, unfortunately, a healed capacitor usually stays that way for only a limited time. If you accidentally "heal" a capacitor, you may have to keep the set for days or even weeks before the trouble will show up again. Using the scope eliminates this problem.

Parts for B+ Circuits

The values of electrolytics in B+ circuits are not usually too critical. If the voltage rating is ample, you can use a capacitor from 25% below to 100% above the original value with little noticeable difference in set performance.

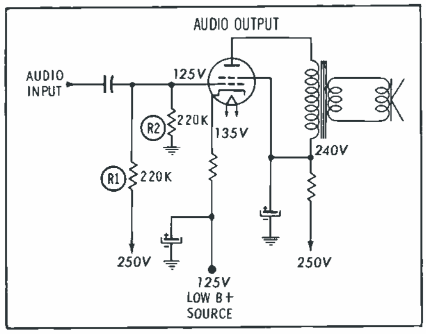


Fig. 5. Audio output tube serves as dropping resistor to develop low B+.

Silicon rectifiers should not be used directly to replace seleniums unless you take into account the increased output voltage and the possible damage that might be done to other circuits in the set. Silicon rectifiers will sometimes "pep up" a set by increasing width, brightness and contrast, but this is somewhat like giving aspirin for fever—it cures the symptoms but not the disease! In addition, silicons require extra surge protection beyond that afforded by the fusible resistor; thus, conversion jobs usually require adding a wire-wound resistor (say, 10 to 22 ohms at 10 watts) in series with the fusible unit. Selenium rectifiers, of course, can't be used to replace silicons, since the B+ voltage would be too low.

The fusible resistor should not be changed in size from the original design; however, if you wish, you may install a slow-blow fuse and a resistor of the appropriate value and wattage in its place. Caution: Do not use only the fuse; the resistor is essential to prevent the surge damage mentioned before.

The information in this article should help you solve most B+ problems. When faced with a tough one, first be sure the supply itself is okay. If it is, then trace down any overload by means of resistance checks along the supply line. Lastly, reason out the probable cause of any abnormal voltage in a "stacked B+" system, taking into account the effects of the series tube or tubes. If you use this procedure, no B+ trouble need turn into a "tough dog" for you. ▲

Voltmeters

(Continued from page 29)

VTVM Calibration

There is a great deal of similarity in techniques for calibrating the VOM and VTVM. The major difference is that the VTVM contains internal controls which can be adjusted to correct calibration errors. Also, the VTVM rarely has current scales. The general approach for setting up VTVM internal controls (which may or may not be accessible from outside the cabinet) can be followed by referring to Fig. 4.

The mechanical-zero set screw on the front panel is adjusted before turning the instrument on. Then, after sufficient warm-up time, the selector switch is rotated to DC+ for DC voltage calibration with a battery. The internal DC CALIBRATE control is turned until the needle reads the exact voltage of the calibrating battery. In Fig. 4, this is a 1.35-volt mercury cell, and the meter range is 1.5 volts. The meter should read accurately throughout its ranges after this step; otherwise, it will be necessary to resort to the technique used with the VOM—a calibration chart.

Next is the ohmmeter check. The calibrating controls for this are the two front-panel knobs for zeroing each end of the ohms scale. These are the same controls which are adjusted each time the meter is used for ohmmeter service. The precision resistors provide a calibration check and the information required to make up a correction chart, if needed.

The remaining internal controls have to do with the AC calibration of the meter. The adjustment procedure involves completely removing the AC test lead from the meter (to avoid stray pickup) and setting the range switch to its lowest scale (usually 1.5 volts, or thereabouts). The function switch is rotated from AC through DC– and DC+. Any tendency of the meter pointer to move off zero should be countered by adjusting the internal AC BALANCE control. After the needle remains stable, the AC test lead is reconnected and the VTVM set to measure some known AC voltage. The internal AC CALIBRATE control is adjusted to bring the needle to read the applied calibrating voltage.

An accurate AC voltage is not easily secured. However, this lack is not necessarily serious, for the intended accuracy of the instrument on AC is usually less than that for DC, due to the characteristics of the rectifiers used. If the meter is rated at 3% for DC, the AC tolerance may be 5%. This lesser accuracy for AC ranges is not a major disadvantage, since tolerances for AC measurements are not critical in most service work. Unless you are willing to invest in special calibrating devices, the AC section of the instrument may be calibrated against the power line for a nominal 117-volt reading. The internal AC CALIBRATE control should bring the meter needle to the correct point on the 150-volt scale.

The above steps are about all that's necessary to keep your VOM or VTVM reliable and accurate. In a later article, we'll consider calibration techniques which can be applied to other basic test instruments—the audio oscillator, oscilloscope, signal generator, and sweep generator. ▲

Generator Sweeps

(Continued from page 31)

"You see, one real trouble is that most of us have wide-band scopes these days, as we should. If you have a scope that can be switched to narrow-band operation, it will not pass higher-frequency heterodyne products, thus leaving only low frequencies grouped neatly around the zero point to give you a neat marker.

"My scope doesn't have a narrow-band position, so I shunt this .01-mfd capacitor across the vertical input to kill unwanted bandwidth when I'm sweeping. Too high a value will make the marker too small to see; too low a value will leave too much smear. Incidentally, this trick will help keep out those spurious markers that sometimes crop up."

More Than One Marker

"That's all right," Gene said, feeling a lot friendlier toward the whole business of sweep alignment. "But your mention of spurious markers brings up another point. They didn't really become a problem for me until I tried to use a simultaneous display of multiple markers. Then everything began beating with everything else, and I didn't know what I had. How do you get around that?"

"By not using multiple markers!" Alec countered. "I'm usually content to use one marker at a time, and tune the CW generator to run the marker over to any point I'm interested in at the moment. I can't imagine when I'd ever want more than two markers at the same time, and getting two is no problem at all—even though one may be invisible."

Before Gene could protest, Alec waved him to silence. He then adjusted the positioning controls so the marker on the curve fell right under the vertical center line on the calibrated grid over the face of the scope CRT. He then turned off the marker generator.

"That center line," he stated, "is now your marker for that frequency. As long as you don't change the sweep-width or phase-control settings on the generator—or the horizontal-gain or positioning controls on the scope—it will stay put. Increasing the sweep-generator amplitude or the scope's vertical gain will not budge it." He then reset the marker generator to produce a pip at another alignment frequency on the curve as recommended by the receiver manufacturer. "You now have two markers. No interaction, no confusion."

"You know," Gene said, "this has all been pretty impressive. It intrigues me enough that I'd like to give a sweep generator another try. I'm not sure the one in our shop will work the same way, but it's something to start on. I have to prove to myself that a sweep setup is worth the time it takes. To isolate troubles in the IF strip, I'd have to make a stage-by-stage check. In that case, I couldn't use the output of the video detector as an input to the scope, so I'd have to add a demodulator probe to the setup. Besides, I'd have a lot of connections to change around after checking every single stage."

"You know," said Alec, "I hate to deflate you, but you're not quite right about that. You *can* keep on using the detector in the set, so at least you won't have to switch the scope connection. That makes things a lot easier. Watch this—I'm going to feed sweep into the grid of the third IF through a capacitor—.001 is fine. Another capacitor, from the grid of the second IF to ground, shorts out stray signals and gives a cleaner curve. The response here depends mostly on the tuning of the last IF can. This double-tuned transformer gives a curve with twin peaks; here's a drawing in the service notes that shows the correct shape. The scope trace looks practically identical to it, and running a marker over the curve tells us the slopes occur at the right frequencies. So far, so good.

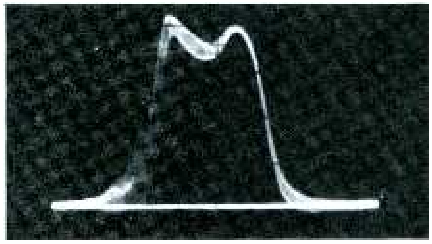


Fig. 5. Without capacitor, markers on wide-band scope may spread out.

"Now I remove my bypass capacitor and move it to the grid of the first IF; this allows me to feed the sweep signal into the grid of the second stage. Starting with this step, I'm also going to clamp the AGC line with a bias box, so I can control the effect of the grid bias on the curve. With the detector output now being influenced by the tuning of the second IF can, I can now set the marker to the resonant frequency of this single-tuned coil and peak the curve at this frequency. The scope shows me how the over-all curve is shaping up, too. If I need to touch up the previous adjustments, I can do this as I go along. By the time I've worked back to the input of the IF strip, the curve is all set. I don't know of any other method that's quicker or more reliable.

"If anything is interfering with proper tuning, it shows up right away. On this job I just finished, the curve broke up into wild oscillations as soon as I injected the signal ahead of the guilty stage. Sometimes the trouble won't be so obvious; perhaps you'll see just one high peak at a spot on the curve where it doesn't belong, or maybe one slug

Fig. 6. Pip is produced by heterodyning between the sweep and marker signals.

will fail to affect the curve. At other times, you'll have to back off on the AGC bias to make the trouble appear.

"Even so, you can sure save trouble by checking the IF curve. The other day, I had a case where a do-it-yourself whiz kid had knocked out one IF can, producing oscillation. He was too embarrassed to tell me what he had done. A turn of the alignment adjustment for that one stage took care of the problem. Later, I got a full confession from the owner.

"And that isn't all. I can show you a lot of other tricks. You can do a lot on an ordinary broadcast radio with a sweep generator if it sweeps down low enough, as this one does. But the main thing is that you're ready to reconsider the sweep method. We'll get together on this some other time. Right now, you'd better get back to your own shop before your boss thinks you've quit."

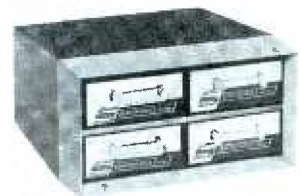
"Gee, that's right," Gene said, startled. He grabbed the package he had come for and took off, saying, "In the meantime, I'm going to try some of the stuff you showed me and let you know how I make out." Alec waved. ▲

"He's about got it. Start the fire."

PRODUCT report

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

Replacement Diodes (43R)



300 diodes are contained in an assortment released by **Semitronics Corp.** More than 125 popular diodes can be replaced by the assortment, which is grouped into four basic types. A replacement chart is included with each display, listing the most popular diodes used in television and FM/AM radio. The complete assortment, packed in a 6½" wide x 6½" deep x 4" high plastic display-storage case, sells for $48.00.

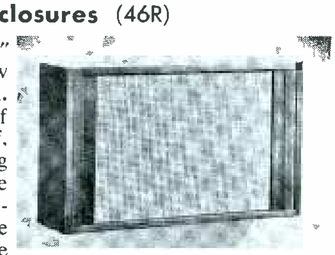
Tape Recorder (44R)

NuTone's new stereo tape recorder Model 2405 is built into the wall and matches the company's other built-in hi-fi components. Easily removed if a portable tape recorder is desired, the unit features two VU meters for accurate setting of recording levels and individual control of both record and playback channels. List price of the recorder, which will copy stereo tapes, is $349.50.

Inverter (45R)

A large-capacity unit has been added to **Terado's** line of power inverters. The "Dual Continental" Model 50-202 has a capacity of 550 to 600 watts, and allows operation of such equipment as drill presses, cash registers, and large appliances from a 12-volt car or truck battery. A remote control unit contains a variable-AC output switch and a signal light. The dealer net price of this transistorized inverter is $232.68.

Bookshelf Enclosures (46R)



An 8" woofer and a 3½" tweeter are contained in a new bookshelf system from **Utah.** Thinner than most rows of books, it can be used on a shelf, mantle, or table, or even hung on a wall. Keyhole slots in the back cover permit either vertical or horizontal mounting. The walnut-veneer surfaces of the "Sorcerer" Model SH4-W have a low-gloss oiled finish. An unfinished hardwood version is also available. Overall size of the unit, which will handle 12 watts of audio power, is 12" x 20" x 5".

Loading Coils (47R)

A new line of epoxy-encapsulated loading coils for Citizens-band use is available from **Creative Products.** The LCF series permits owners of CB equipment to use shorter antennas and obtain increased efficiency. LCF-3 is used for antennas 96" and 102" in length, while Model LCF-4 is for those 92" long. The coils measure 1 15/16" in length by 1 3/16" in diameter and have 3/8-24 threads. A 3/4"-long mounting stud is also supplied.

Transistorized CB (48R)

Receiver fine-tuning is provided for in the "Commaire" ED-276 transistorized Citizens-band transceiver manufactured by **Vocaline**. Other features of the unit include a signal-control squelch and RF gain, double-conversion receiver, and a three-stage AGC circuit. The ED-276 uses 22 transistors, 8 diodes, and 3 tubes, and measures 5⅜" high by 9⅜" deep.

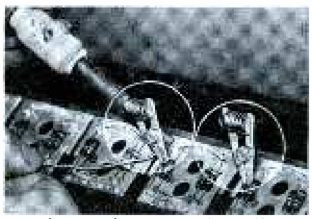
Tube Tester (49R)

Two significant changes have been incorporated in all new **Sencore** Model TC114 "Mighty Mite" tube testers. An improved D'Arsonval meter is designed to provide increased reliability and damping. A large quick-setup chart, cemented inside the removable cover, eliminates the need to refer to the regular set-up booklet for most-often-used tube types. Price of the Model TC114 is $74.50 net.

Stereo Attenuators (50R)

10 watts of audio can be handled by a new line of wire-wound stereo attenuators by **Centralab.** The units, designed for installation in standard junction or switch boxes, are approximately half the depth of conventional four-section stereo L-pads. Measuring 1⅝" in diameter and 1 5/32" deep, these attenuators feature anti-backlash construction and come with a gold anodized dial plate and a black set-screw knob.

Heat-Sink Clips (51R)



Intended to protect semiconductors during soldering, **Avtron's** heat-sink clips (Part No. A1942) are made of aluminum. These clips fit around the lead between the semiconductor and the joint to be soldered, to absorb and dissipate the heat. Designed for use on any electronic equipment, the clips are spring-loaded, and are easily attached and detached. Price is $19.80 per 100.

TV/FM Couplers (52R)

No stripping, splicing, or soldering is necessary to install the "Transceptor" manufactured by **Aerogap Corp.** This two-set coupler snaps around the line and electromagnetically couples the signal from the main antenna line to the tap line. Insertion loss is only ½ db for low and ¼ db for high channels. Useful for black-and-white TV, FM, and/or stereo FM, the device sells for $2.98.

Tab Twister 53R)

Quick twisting of tabs on electrolytic capacitors is easy with a new service aid from **General Electric.** Called a "Capacitor Tab Adjuster," the tool looks like a screwdriver, but has a slotted end instead of a blade. The slot fits over the capacitor mounting tabs, and a quick twist makes an easy job of removing and installing can-type capacitors. Price of the tool is $1.00.

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ANTENNAS & ACCESSORIES

1R. *COMMUNICATORS, INC.* — 16-page guide containing information on master-antenna system installations for homes, showrooms, apartment houses, and motels.

2R. *CUSH CRAFT*—8-page catalog (No. 62) describing complete line of amateur communications antennas; both UHF and VHF types included.

3R. *GAM* — Catalog sheet giving specifications on miniaturized TG-2-R VHF mobile antenna designed to mount on top of vehicle or in other restricted spaces.

4R. *JFD*—Descriptive and promotional literature plus sales aids for new *Transis-Tennas;* also complete set of specifications for outdoor and indoor TV antennas and accessories, including exact-replacement antenna data. *See ad page 15.*

5R. *WINEGARD* — New Factfinder bulletins on FM antennas, UHF antennas, and yagi couplers. *See ads pages 20-21.*

AUDIO & HI-FI

6R. *ATLAS SOUND*—Catalog No. 562 listing specifications on microphones and loudspeakers for public address, commercial and industrial use. *See ad page 78.*

7R. *CINE-SONIC* — Brochure describing background-music tapes available (hundreds of listings). *See ad page 46.*

8R. *EICO*—New 32-page catalog of kits and wired equipment for stereo and monophonic hi-fi, test equipment, Citizens-band transceivers, ham gear, and transistor radios. Also "Stereo Hi-Fi Guide" and "Short Course for Novice License." *See ad page 60.*

9R. *HARMAN-KARDON* — Revised catalogs on PA lines including *Commander, Troubador,* and *Galaxy* series.

10R. *NORELCO*—Catalog NAP 1251 describing line of *Continental* tape recorders and other hi-fi components.

11R. *QUAM-NICHOLS*—Catalog sheet listing specifications and prices on complete line of wall baffles. *See ad page 19.*

12R. *SWITCHCRAFT*—Catalog E-508 illustrating and describing new series of 3-contact audio connectors. *See ad page 88.*

COMMUNICATIONS

13R. *AMECO*—Information describing Model SWB Standing Wave Ratio Bridge, for in-line use, and Model BIU Bridge Indicator Unit, for reading SWR, % power, and % voltage.

14R. *CREATIVE PRODUCTS* — Catalog sheets describing Citizens-band antennas for mobile use; also booklet listing antenna loading coils and discussing applications.

15R. *DU MONT LABS* — Information on *Fairco* Mark III Frequency Meter used to reduce WWV frequency standards to 5 kc for use throughout the amateur and Citizens bands.

COMPONENTS

16R. *BUSSMANN* — 24-page booklet (SFB) giving detailed information on complete line of BUSS and FUSETRON Small Dimension fuses and fuseholders used for protecting electronic equipment. *See ad page 77.*

17R. *LITTELFUSE*—Fuse Guide No. FG-62, giving up-to-date information and cross-reference data for auto-radio fuses. *See ad 4th cover.*

18R. *PERMA-POWER*—Latest *Britener* selector guide, showing the correct brightener to use with every type of picture tube in general use.

19R. *SPRAGUE*—Chart C-457 (designed to hang on wall) showing all popular TV-radio-hi-fi replacement components. *See ad page 12.*

SERVICE AIDS

20R. *BERNS*—Data on 3-in-1 picture-tube repair tools, on Audio Pin-Plug Crimper that lets you make pin-plug and ground connections for shielded cable without soldering, and on ION adjustable beam bender. *See ad page 95.*

21R. *CASTLE*—Leaflet describing fast overhaul service on television tuners of all makes and models; also illustrated lists describing universal and original-equipment tuners. *See ad page 59.*

22R. *RCA (PARTS & ACCESSORIES DIV.)* —Forms TK-306 describing Color Test Jig, and TK-310 describing Color Accessories and Color Parts Rack.

23R. *SYLVANIA* — Dealer shop equipment folder illustrating and describing workbenches, tube racks, and display counters. *See ad page 55.*

24R. *YEATS*—Literature describing the new Model 14 appliance dolly, featuring all-aluminum I-beam construction. *See ad page 94.*

SPECIAL EQUIPMENT & SERVICES

25R. *EMCEE*—12-page brochure describing complete line of TV rebroadcast translators and discussing their uses.

26R. *ROTRON*—Data sheet on *Whisper* fans for use in tape recorders, electronic instrumentation, and TV cameras.

27R. *TERADO*—Catalog sheet describing line of converters, battery chargers, and relays. *See ad page 88.*

28R. *VOLKSWAGEN* — 60-page illustrated booklet, "The Owner's Viewpoint," describing how various business enterprises use VW trucks in their operations; also booklet giving complete specifications on VW truck line.

29R. *WABER* — Sheet giving specifications and prices on various multiple-outlet boxes for use in service shop or home.

30R. *WORKMAN* — Catalog sheet describing fuse adapters used to adapt regular fuses for use in C and N type fuse holders; also information on 125-watt *Transverter* that allows 117-volt, 60-cps equipment to be operated in autos.

TECHNICAL PUBLICATIONS

31R. *HOWARD W. SAMS* — Literature describing all current publications on radio, TV, communications, audio and hi-fi, and industrial electronics, including brand-new Fall 1962 Book Catalog and descriptive flyer on 1962 Test Equipment Annual. *See ads pages 46, 85, 88.*

TEST EQUIPMENT

32R. *B & K* — Catalog AP20-R, giving data and information on Model 850 *Color Analyst,* Model 960 *Transistor Radio Analyst,* Model 1076 *Television Analyst, Dynamatic 375* VTVM, *V O Matic* 360, new Model 625 3-in-1 *Dyna-Tester,* Models 600 and 700 *Dyna-Quik* tube testers, Models 440 and 420 CRT Tester-Reactivators, and Model 1070 *Dyna-Sweep* Circuit Analyzer. *See ads pages 16-17, 53.*

33R. *ELECTRO PRODUCTS*—Specifications on EC-3, a 20-volt, 150-ma power supply for servicing transistor radios; also list of special types that can be serviced. *See ad page 96.*

34R. *MERCURY*—New master catalog showing complete line of test equipment and service aids.

35R. *PRECISION* — 20-page catalog giving specifications and details on complete line of electronic test equipment; includes illustrations and prices. *See ads pages 39, 48-49.*

36R. *RCA*—Pocket catalog covering complete line of test equipment; includes all color-TV instruments. *See ad page 65.*

37R. *SECO* — Catalog sheet and instruction manual detailing specifications and operational procedure of Model 520 Antenna Analyzer. *See ad page 68.*

38R. *SENCORE*—New booklet, "How to Use the SS117 Sweep Circuit Troubleshooter," plus brochure on complete line of *Time-saver* instruments. *See ads pages 41, 43, 45, 93.*

39R. *TRIPLETT*—Circular on Model 310-C hand-size VOM featuring enclosed selector switch and 15K ohms/volt AC sensitivity.

TOOLS

40R. *EVERSOLE INDUSTRIES* — Sheets describing and listing prices on *DeSod* desoldering tools for removing and replacing parts on printed-circuit boards.

41R. *XCELITE* — Bulletin N762 describing new compact Nut Driver set that contains 10 sizes with torque-amplifier handle.

TRANSISTORS

42R. *GENERAL ELECTRIC* — Wall-chart reference guide (ETR-3345) listing replacements for 1,213 commonly-used transistors.

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