A HOWARD W. SAMS PUBLICATION

FEBRUARY 1965/50¢

PF Reporter™

PHOTOFACT

the magazine of electronic servicing

- Radar Maintenance is Easy
- Finding and Keeping CB Customers
- Linear Sweep for Flat CRT's
- Voltage Division and How It Works
- Plus many more

How to replace top quality tubes with identical top quality tubes

Most of the quality TV sets you are presently servicing were designed around special Frame Grid tubes originated by Amperex. More and more tube types originated by Amperex are going into the sets you'll be handling in the future. Amperex Frame Grid tubes provide 55% higher gain-bandwidth, simplify TV circuitry and speed up your servicing because their extraordinary uniformity virtually eliminates need for realignment when you replace tubes.

Amperex Frame Grid Tubes currently used by the major TV set makers include:

2ER5	2GK5	2HA5	3EH7	3GK5	3HA5	4EH7	4EJ7	4ES8	4GK5	4HA5	5GJ7
	6EH7	6EJ7	6ER5	6ES8	6FY5	6GJ7	6GK5	6HA5	6HG8	7HG8	8GJ7

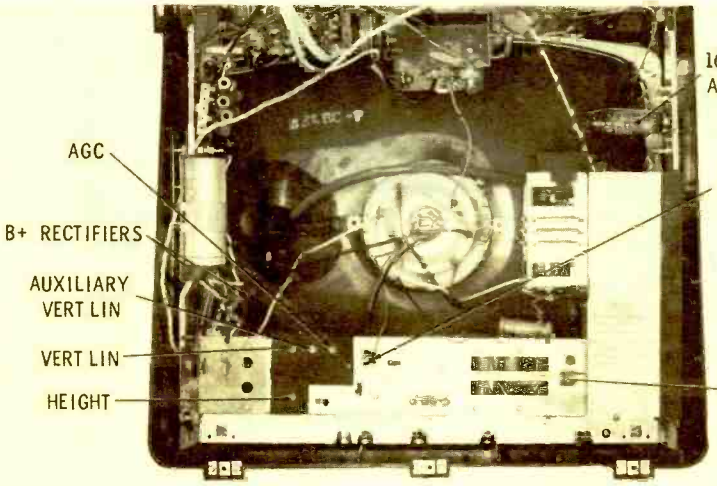
If your distributor does not yet have all the Amperex types you need, please be patient—in some areas the demand keeps gaining on the supply.

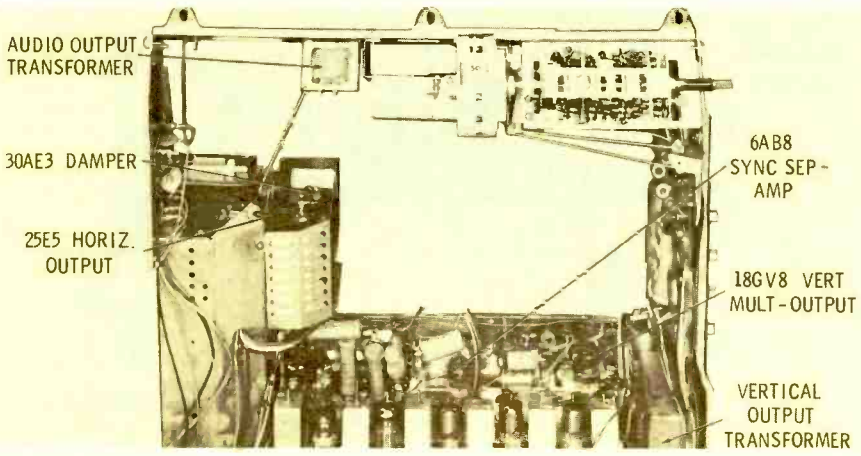
Amperex Electronic Corporation, Hicksville, Long Island, New York 11802.

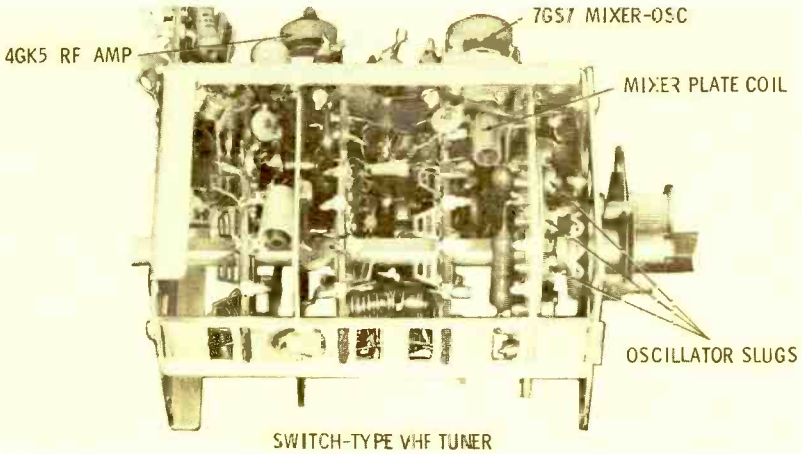
Circle 1 on literature card

.....PREVIEWS of new sets

Delmonico

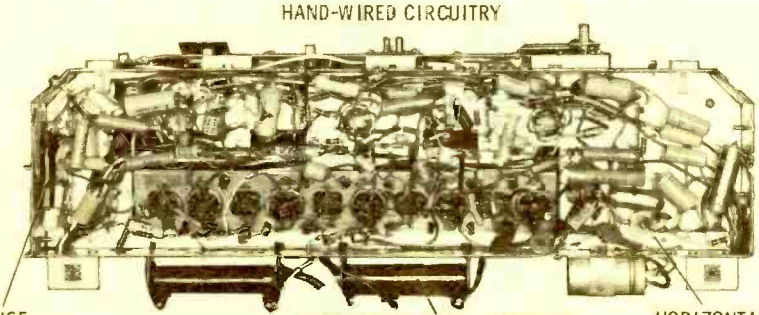






SWITCH-TYPE VHF TUNER

HAND-WIRED CIRCUITRY



Delmonico Model UHF-19

The 19" Delmonico portable shown above is a Japanese-manufactured set with built-in dipole antenna, earphone jack, and carrying handle. The hand-wired chassis uses a 19EMP4 picture tube and is housed in a plastic cabinet. The switch-type VHF tuner uses a 4GK5 as the RF amplifier, and a 7GS7 functions as mixer and oscillator. The tube-type UHF tuner has a 2N-H12 operating as its oscillator, and either a 1S543 or 1S750 signal diode acts as UHF mixer.

This transformerless receiver receives its B+ from two silicon rectifiers connected as a half-wave voltage doubler. Silicon protection is afforded by a 4.7-ohm, 8-watt resistor. A 2-amp pigtail fuse is located in the AC line and is mounted beneath the chassis; thus, it is necessary to remove the chassis to replace the fuse. The series-parallel filament circuit has a tapped 30-watt dropping resistor—one leg using 81 ohms, the other 126 ohms. The only tubes common to both branches are the UHF oscillator and the picture tube.

Several unfamiliar tube types are used in this receiver. Among these are: 16A8 audio amplifier/output, 6AB8 sync separator/amplifier, 18GV8 vertical multivibrator/output, 25E5 horizontal output, and 30AE3 damper. Also, it would be a good idea to check your tube stock for the 1S2 used as the high-voltage rectifier.

Focus can be varied by connecting the CRT focus anode (pin 4) to either of three B+ voltages or to boost. Width is adjustable by connecting the horizontal-output screen grid to either of three connections on the width socket. Each connection provides a different resistance in the screen supply. Normal adjustment of horizontal hold is accomplished by the oscillator coil; however, the waveform coil is also tunable in case additional adjustment is necessary.

Located on the rear of the receiver are the vertical-linearity, auxiliary vertical-linearity, AGC, and height controls. Mounted on the side of the receiver are the on-off-volume, brightness, contrast, and vertical-hold controls.

Each individual VHF-oscillator slug is adjustable; simply remove the channel-selector and fine-tuning knobs and rotate the fine-tuning rotor until the oscillator slug and the hole in the rotor coincide.

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Emerson
Model D2011
TV Chassis 120744G
AM-FM Chassis 120730
Amplifier Chassis 120716

This Emerson combination consists of a 23" television set, a four-speed stereo phonograph, an AM-FM radio, and a stereo amplifier. The TV section uses a total of 14 tubes including the picture tube and VHF tuner. The UHF tuner is transistorized—using an NPN transistor as the UHF oscillator and a 1N82 mixer diode.

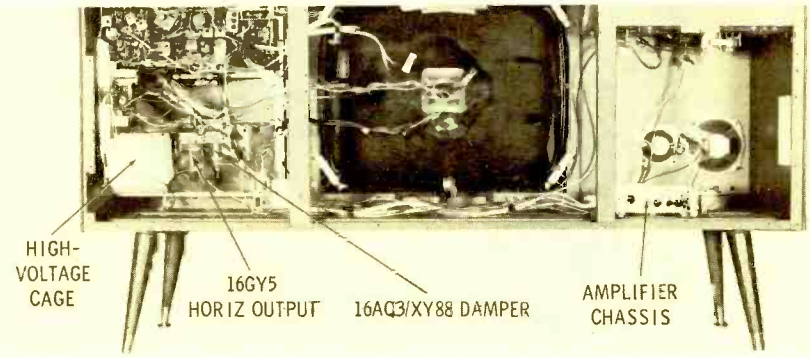
The low-voltage section of the TV chassis uses a single silicon rectifier which is protected by a 1.2-amp chemical fuse and a 5-ohm, 7-watt surge-limiting resistor. The series filament string has a 48-ohm, 20-watt dropping resistor.

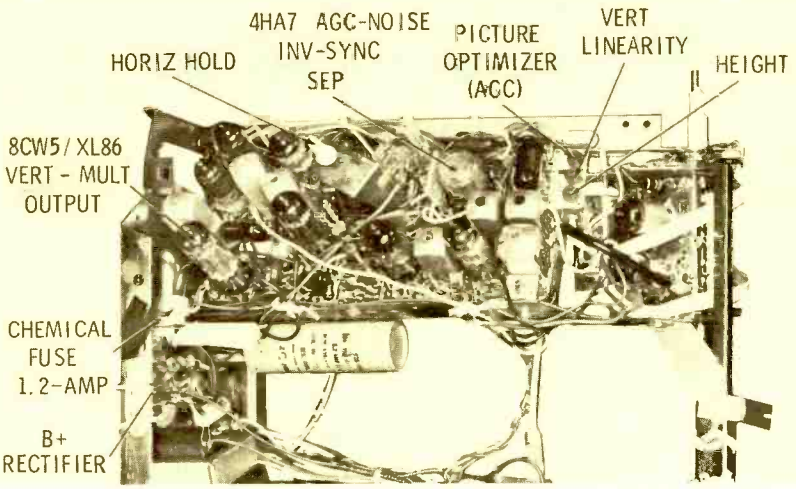
The stereo amplifier and AM-FM radio chassis derive their B+ from a single selenium rectifier located on the amplifier chassis. Selenium protection is afforded by a 6-ohm, 2-watt resistor.

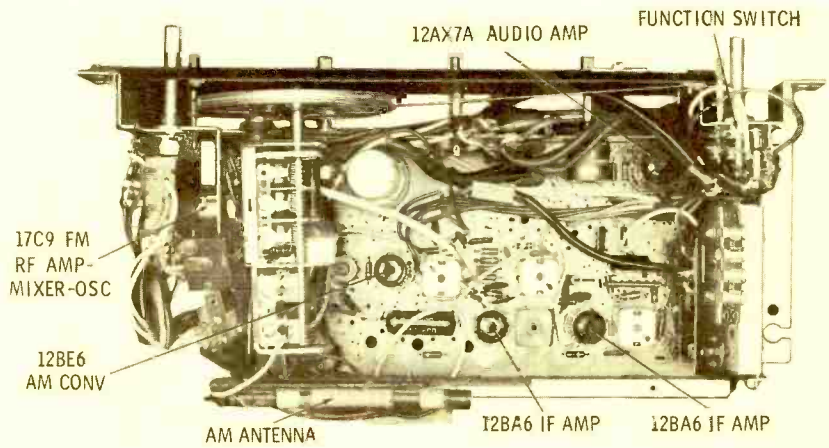
This same TV chassis is also used in 16" and 19" models. The 23" model shown here uses a 23FKP4 picture tube; 19" models use either a 19DNP4 or 19-EHP4, and either a 16ANP4 or 16BRP4 may be found in the 16" receivers. Other tubes worth noting are the 8CW5/XL86 found in the vertical-output socket, the 16AQ3/XY88 damper. The horizontal output may be either a 16GY5 or a 13-GB5/XL500. The functions of AGC keying/sync separator may be performed by a 4HA7 or 4HC7—both of which are compactrons with dual triode sections. Some models may use a 6K11 or 6Q11 in this application; both of these latter compactrons have three triode sections and the additional section is used as a noise inverter, in which case three resistors and one capacitor are added to the circuit. The sound-IF amplifier/horizontal-oscillator may be a 4BL8 or 5GH8.

Channel-selector, fine-tuning, brightness, contrast, and vertical-hold controls are at the top of the receiver. Horizontal hold is accomplished by adjusting the oscillator-coil slug, and is accessible from the rear. Height, vertical-linearity, and picture-optimizer (AGC) controls are all together in one triple-section printed unit; these controls may be adjusted from the rear of the receiver.

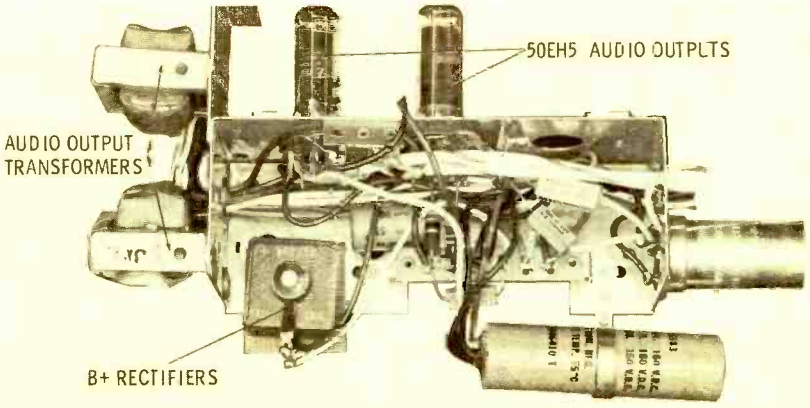
The video detector is a 1N295 diode located beneath a removable shield covering the final IF transformer. Horizontal-AFC action is provided by a dual diode connected so its cathodes are common.





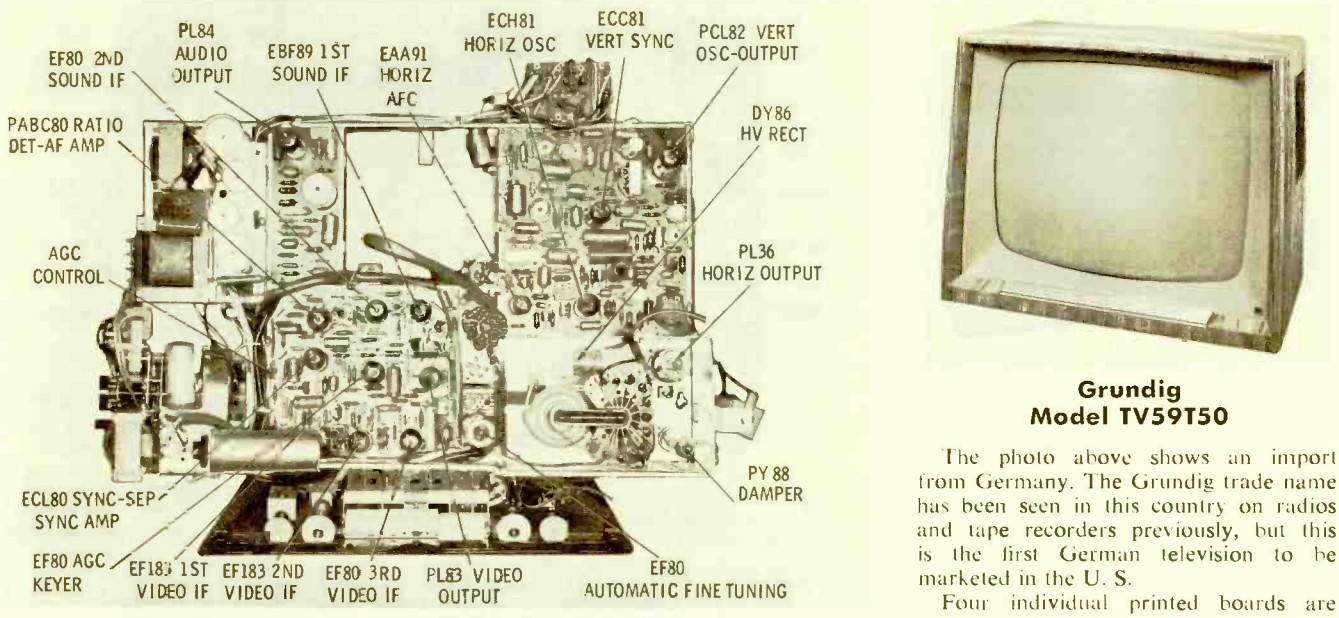


TOP VIEW — AM-FM RADIO CHASSIS



BOTTOM VIEW — AMPLIFIER CHASSIS

Grundig



Grundig Model TV59T50

The photo above shows an import from Germany. The Grundig trade name has been seen in this country on radios and tape recorders previously, but this is the first German television to be marketed in the U. S.

Four individual printed boards are used: one of the two larger boards is devoted to the horizontal- and vertical-sweep circuits, and the other to video, sync, AGC, and sound networks. The PL84 audio-output tube and its associated components are mounted on a separate board. The fourth board consists of an automatic fine tuning circuit using an EF80. A sample of the video-IF signal (taken from the video-detector input) is coupled to the control grid of this tube and used to control the VHF oscillator: much the same as in horizontal-AFC circuits.

The low-voltage power supply consists of two selenium rectifiers protected by two 3-amp fuses—one in each side of the AC line. A voltage-selector plug is provided for operating the receiver on either 117 or 220 volts AC. The line fuses are each 2-amp units when 220 volts is used. A third fuse (.2 amp) is found in the cathode circuit of the PL36 horizontal-output tube. This fuse protects against overload in the horizontal-output stage.

A multipushbutton selector-switch assembly provides the following functions: on-off, two-step volume level, two-step brightness level, manual or automatic fine tuning (depress for manual operation), and channel selection. In this same assembly are the tone, brightness, volume, and contrast controls.

Tube functions and types are as follows: (American equivalents are in parentheses) first and second video-IF amplifier EF183 (6EH7), third video-IF amplifier EF80 (6BX6), video output PL83 (15A6), first sound-IF amplifier EBF89 (6DC8), second sound-IF amplifier EF80 (6BX6), ratio detector/AF amplifier PABC80 (9AK8), audio output PL84 (15CW5), AGC keyer EF80 (6BX6), sync separator/sync amplifier ECL80 (6AB8), vertical-sync amplifier/cathode follower ECC81 (12AT7), vertical oscillator/output PCL82 (16A8), horizontal AFC EAA91 (6AL5), horizontal oscillator ECH81 (6AJ8), horizontal output PL36 (25E5), damper PY88 (30AE3), and high-voltage rectifier DY86 (1S2).

Zenith
Model M2231LU
Chassis 14M27

This deluxe 19" portable is equipped with a Space Command 300 remote-control unit, a clock-timer assembly, and a built-in dipole antenna for VHF reception. Connections for an external UHF antenna are provided. The chassis is physically the same as ones used in previous years, and the circuitry is similar; the use of compactrons, however, has led to fewer tubes in this chassis.

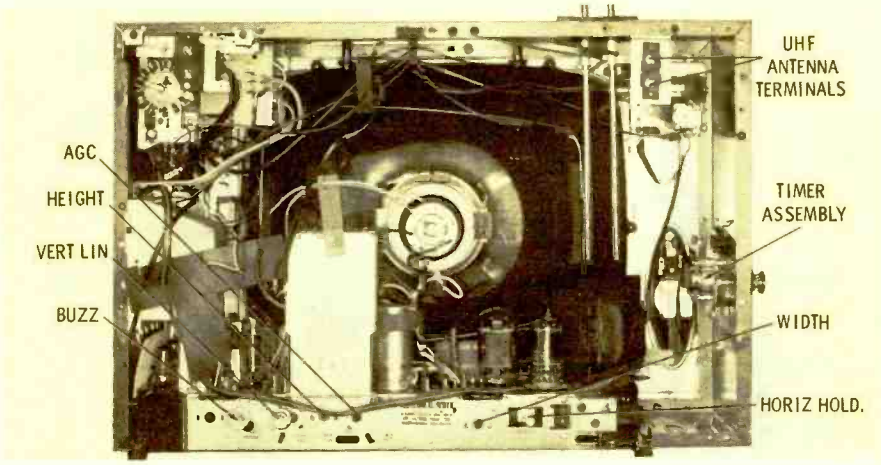
A 12-pin compactron, 6BA11, functions as sync separator/AGC keyer/noise limiter/vertical multivibrator. A second compactron, the 6J10, serves the purpose of audio detector/output. Another tube worth mentioning is the 6KD8 (sometimes a 6GH8) used as horizontal AFC/oscillator. The sweep circuits use a 6GK6 vertical output, 6JM6 horizontal output, 6AY3 damper, and 2AS2 high-voltage rectifier. The picture tube may be either 19CXP4 or 19DP4, but these two types are not directly interchangeable.

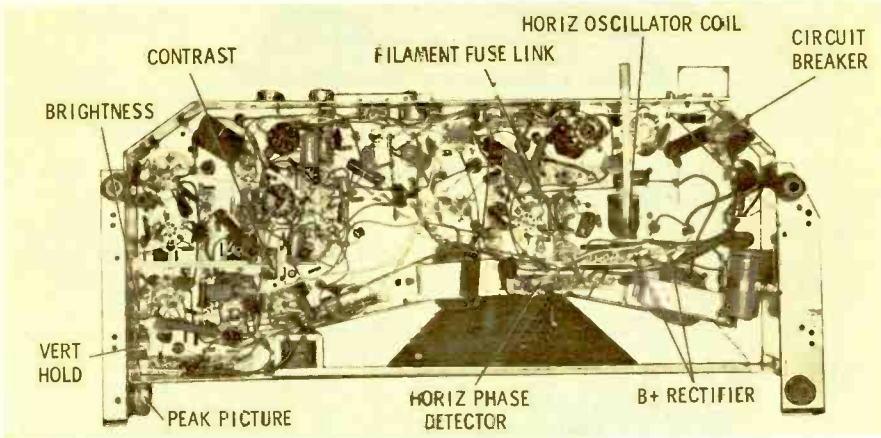
The television low-voltage power supply consists of a power transformer and two silicon rectifiers connected as a full-wave voltage doubler. Along with the entire power supply, these silicons are protected against shorts and overloads by a circuit breaker in the primary winding of the power transformer. The parallel filaments are similarly protected by a 1½" piece of copper wire—the filament fuse link.

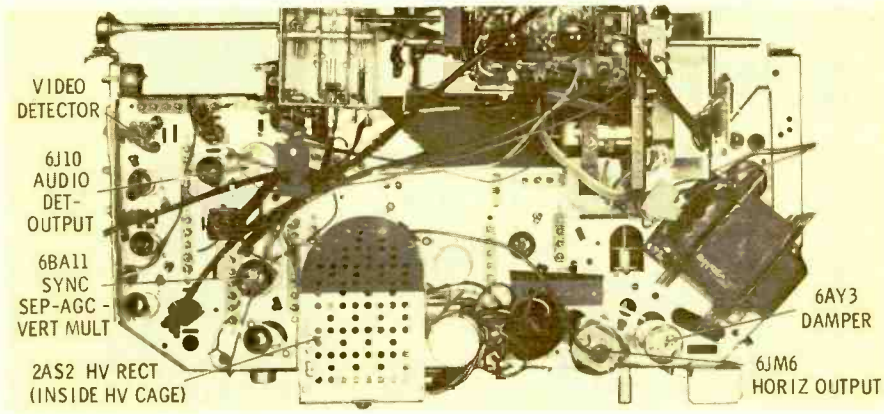
The hand-wired, transistorized, remote-control unit has its own selenium rectifier. In this subchassis, rectifier protection is not provided. The UHF tuner uses a transistor oscillator with the transistor located inside the tuner shield.

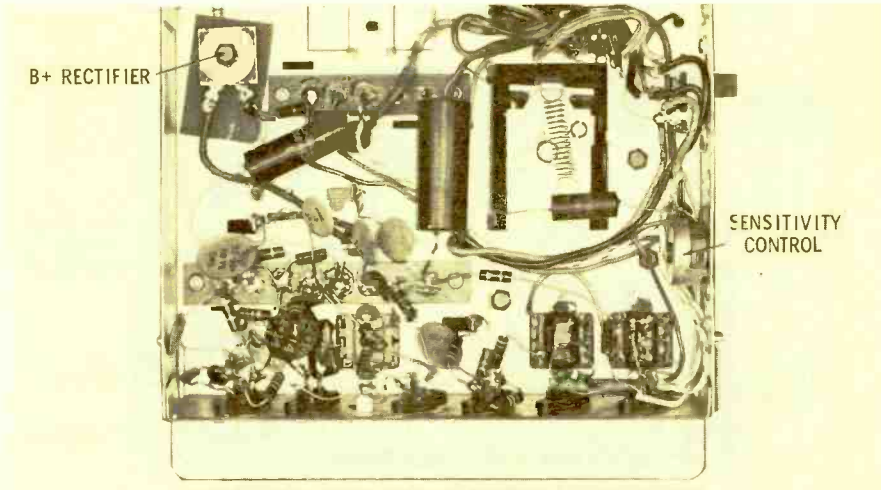
The viewer may use the timer assembly to turn off the set at a predetermined time. The three positions on the timer switch are marked on-hold, off, and timer.

On the rear of the TV chassis are adjustments for width, horizontal hold, AGC, height, vertical linearity, and buzz. Controls mounted on the side of the chassis include picture peaking, contrast, vertical hold, and brightness (all of these controls are noted in the accompanying photos). Focus may be varied by connecting the jumper from pin 6 of the CRT to B+, boost, or ground; the focus connections will not normally need to be changed unless the CRT is replaced.









BOTTOM VIEW REMOTE-CONTROL CHASSIS — HAND WIRED

See PHOTOFACT Set 608, Folder 1

See PHOTOFACT Set 608, Folder 1

Mfr: DuMont **Chassis No.** 120591A, 592B, 593A, 650C, 657A

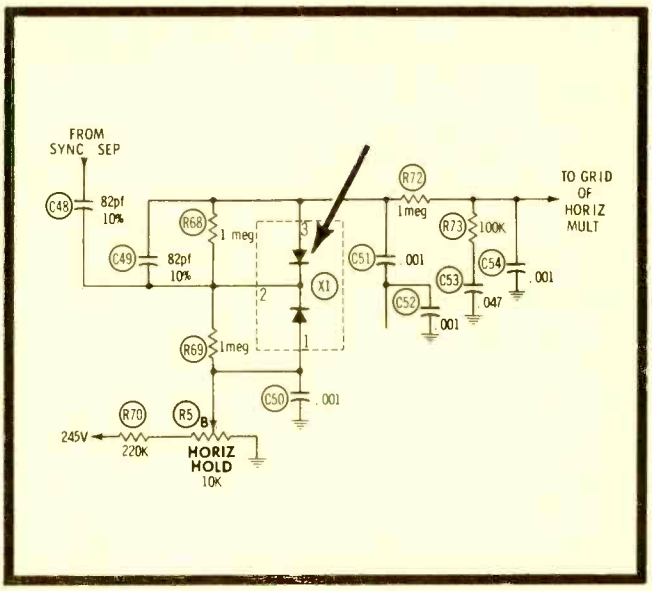
Card No: DM591A-1

Section Affected: Horizontal sync.

Symptoms: Hold control at end of range; loses sync with noise interference.

Cause: Phase detector unbalanced.

What To Do: Replace X1.



Mfr: DuMont **Chassis No.** 120591A, 592B, 593A, 650C, 657A

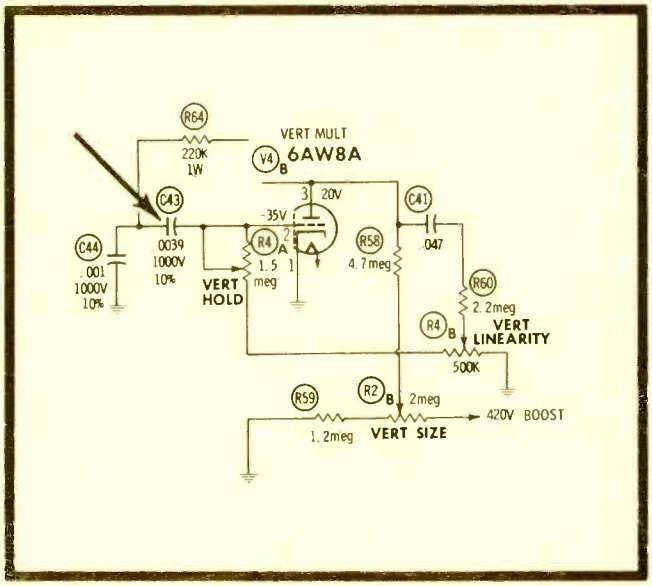
Card No: DM591A-2

Section Affected: Vertical sweep.

Symptoms: Vertical hold control at end of range; possible vertical jitter.

Cause: Vertical feedback capacitor changed value.

What To Do: Replace C43 (.0039 mfd—1000V).



Mfr: DuMont **Chassis No.** 120591A, 592B, 593A, 650C, 657A

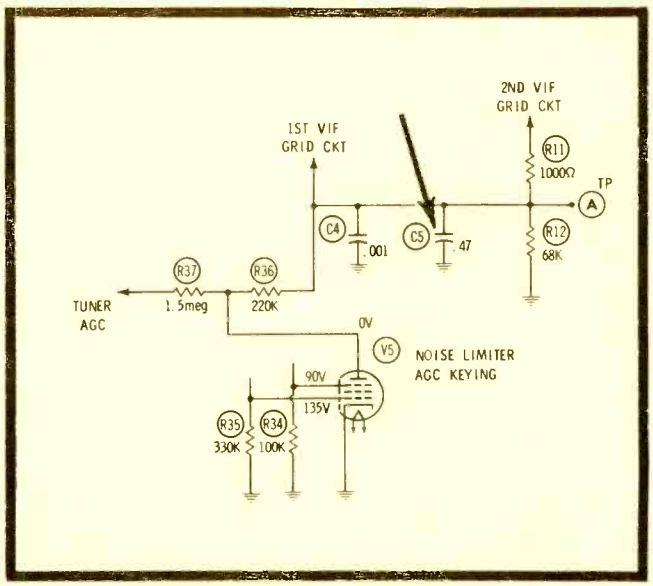
Card No: DM591A-3

Section Affected: Vertical sweep.

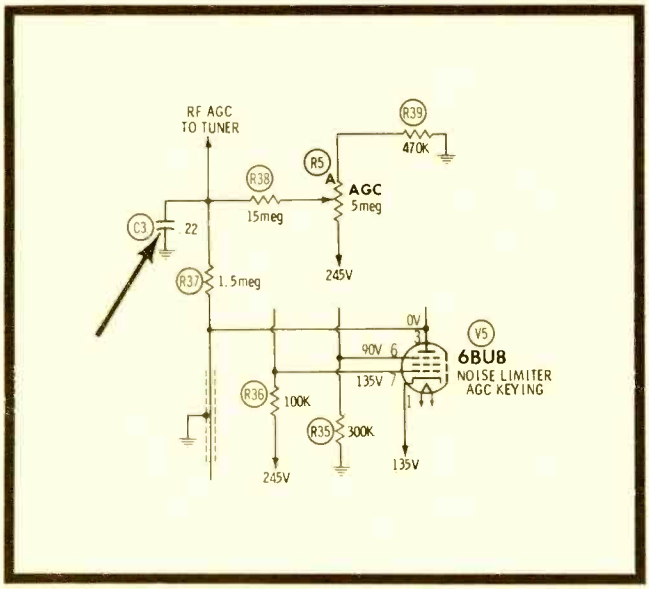
Symptoms: Critical vertical hold; vertical jitter.

Cause: IF AGC bypass capacitor open.

What To Do: Replace C5 (.47 mfd).



See PHOTOFACT Set 608, Folder 1



See PHOTOFACT Set 608, Folder 1

Mfr: DuMont **Chassis No.** 120591A, 592B, 593A, 650C, 657A

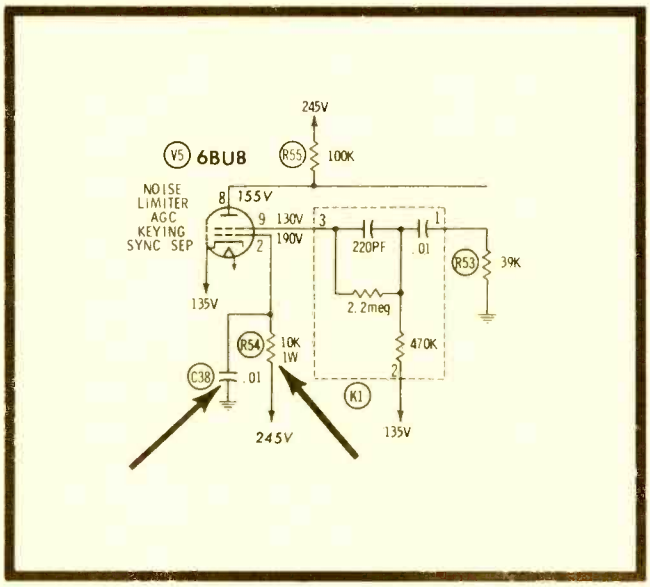
Card No: DM591A-4

Section Affected: Pix and horizontal sync.

Symptoms: Black shaded bar on left side of raster; critical horizontal sync.

Cause: Tuner AGC bypass capacitor open.

What To Do: Replace C3 (.22 mfd).



Mfr: DuMont **Chassis No.** 120591A, 592B, 593A, 650C, 657A

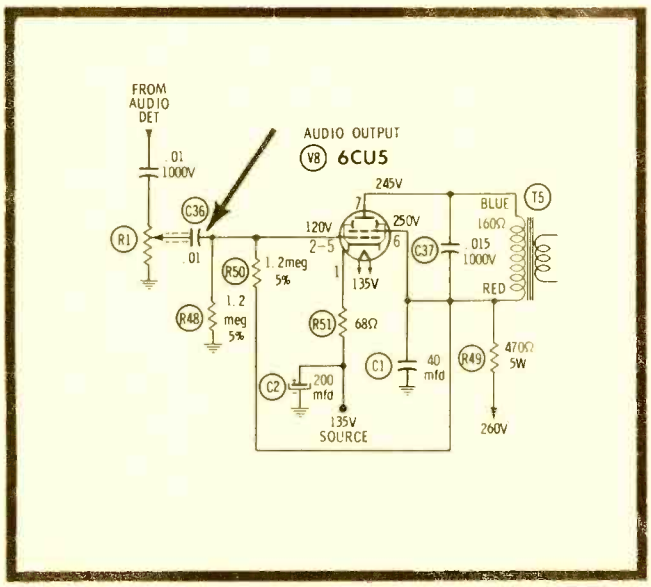
Card No: DM591A-5

Section Affected: Sync.

Symptoms: No vertical or horizontal sync; missing or low voltage on screen grid (pin 2) of V5; screen grid resistor burns.

Cause: Sync separator screen bypass shorted.

What To Do: Replace C38 (.01 mfd) and R54 (10K—1W).



Mfr: DuMont **Chassis No.** 120591A, 592B, 593A, 650C, 657A

Card No: DM591A-6

Section Affected: Sound.

Symptoms: No audio; loud hum.

Cause: Audio coupling capacitor shorted.

What To Do: Replace C36 (.01 mfd).

See PHOTOFACT Set 705, Folder 3

See PHOTOFACT Set 705, Folder 3

Mfr: Philco **Chassis No.** 14N50

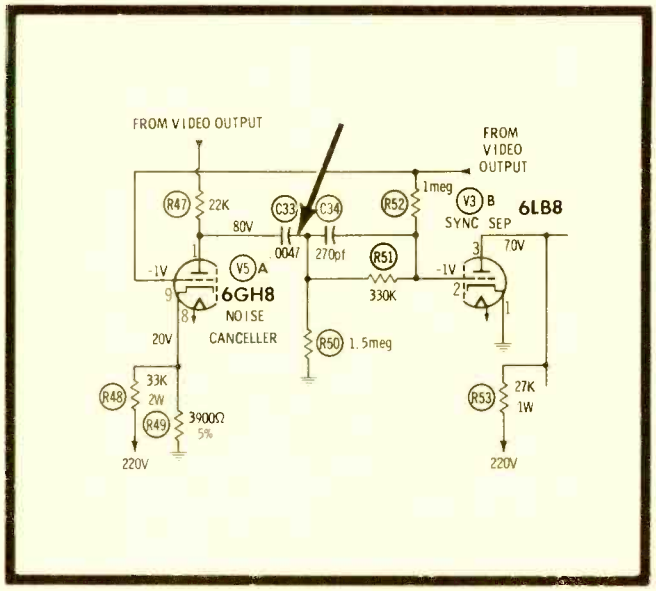
Card No: PH 14N50-1

Section Affected: Sync.

Symptoms: Poor vertical sync; horizontal pulling; voltage on grid of V3B is positive.

Cause: Leaky coupling capacitor from noise inverter to sync separator.

What To Do: Replace C33 (.0047 mfd).



Mfr: Philco **Chassis No.** 14N50

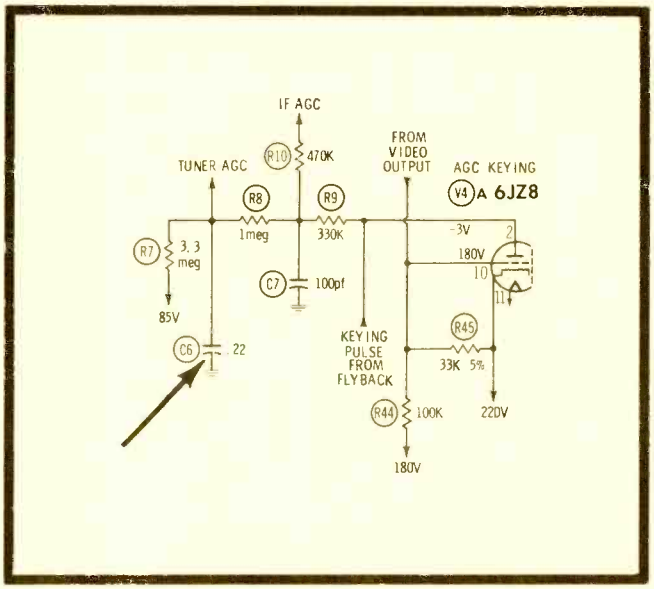
Card No: PH 14N50-2

Section Affected: Pix and sound.

Symptoms: Receiver operates normal on weak signals, but overloads on medium to strong stations; contrast control has little effect in reducing contrast.

Cause: AGC filter C6 shorted.

What To Do: Replace C6 (.22 mfd).



Mfr: Philco **Chassis No.** 14N50

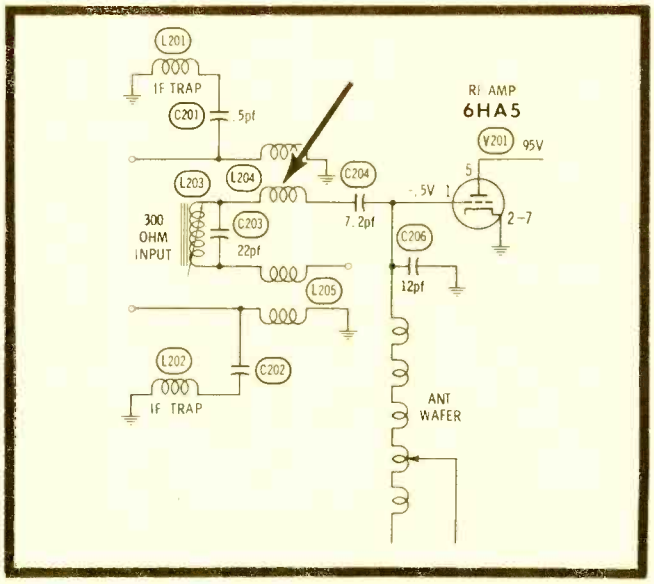
Card No: PH 14N50-3

Section Affected: Pix.

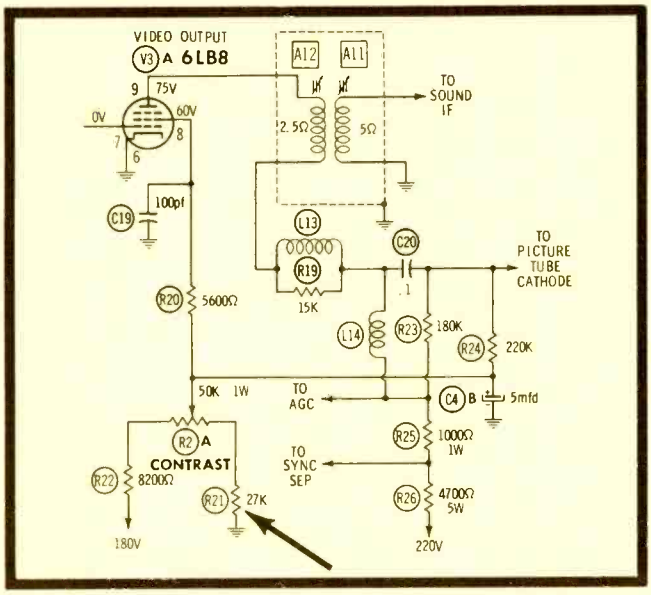
Symptoms: Oscillation in picture indicated by erratic horizontal lines; unstable sync; symptoms are minimized when antenna leads are shorted.

Cause: Antenna balun coil open.

What To Do: Repair or replace antenna balun coil (located on tuner);
Philco part #32-4725-5.



See PHOTOFACT Set 705, Folder 3



See PHOTOFACT Set 705, Folder 3

Mfr: Philco **Chassis No.** 14N50

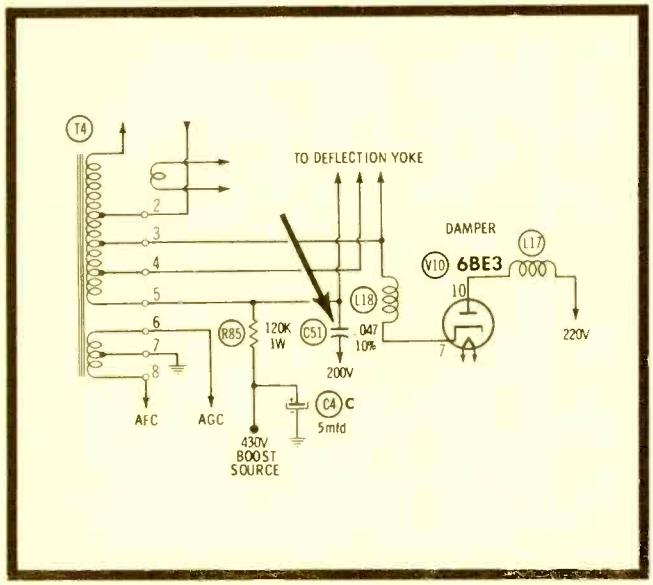
Card No: PH 14N50-4

Section Affected: Pix and sound.

Symptoms: Sound and picture "cut off" below 1/3 setting of contrast control; upper 2/3 of control works normally.

Cause: Contrast control range is too great.

What To Do: Remove 27K resistor R21 and replace with a jumper wire.



Mfr: Philco **Chassis No.** 14N50

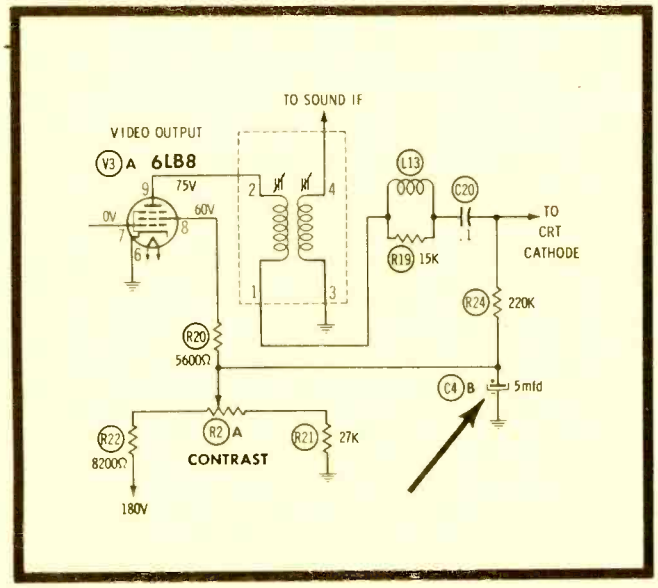
Card No: PH 14N50-5

Section Affected: Pix and raster.

Symptoms: Insufficient width; dim picture; low boost voltage.

Cause: Leakage in boost filter capacitor.

What To Do: Replace C51 (.047 mfd).



Mfr: Philco **Chassis No.** 14N50

Card No: PH 14N50-6

Section Affected: Pix and sync.

Symptoms: Intermittent vertical sync; poor picture quality.

Cause: Open capacitor C4B in screen circuit of video output stage.

What To Do: Replace C4 (5-5-100 mfd—400-250-25 V).

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CONTENTS

ABOUT THE COVER

Increased activity on the inland waterways demands new standards of accuracy for navigation and ranging in pleasure craft. The Raytheon Model 1500 radar installation shown on this month's cover is typical of low-cost marine installations that provide an interesting and profitable servicing field. See page 38 for an introduction to marine radar servicing.

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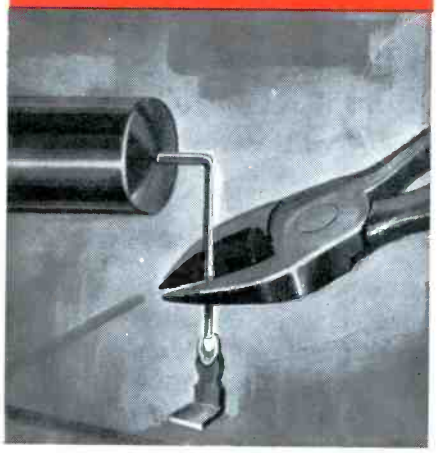
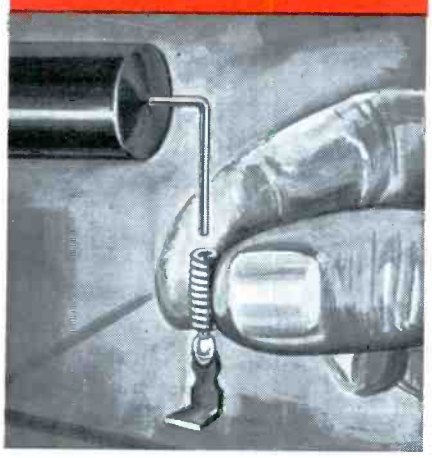
Mechanically sturdy and electrically reliable, the revolutionary QUIG provides fast, expertly-soldered connections as easy as A-B-C!

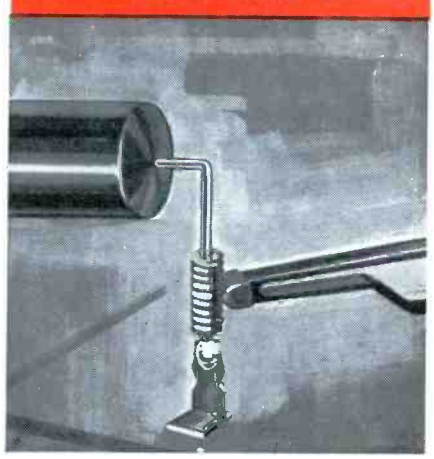
A Snip Lead



B Slip on QUIG



C Heat QUIG, Connection Made!



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WORLD'S LARGEST MANUFACTURER OF CAPACITORS

65-410d

Circle 3 on literature card

For window-size blow-ups of this message, send 10¢ to Sprague Products Co., 105 Marshall St., North Adams, Mass., to cover handling and mailing costs.

You'll never see your doctor advertise a special sale on appendectomies . . .

You'll never see your lawyer announce cut-rates for divorce cases . . .

You'll never see your dentist hold a "2-for-1" sale on extractions . . .

AND You'll never see the day when you can take your TV set in for a service "bargain" and be sure you're getting a square deal!

"Bargains" in home electronic service are as scarce as the proverbial hen's teeth! Here's why—

The expert service technician, just like other professional people, must undergo years of study and apprenticeship to learn the fundamentals of his skill. And a minimum investment of from $3000 to $6000 per shop technician is required for the necessary equipment to test today's highly complex sets. Finally, through manufacturer's training courses and his own technical journals, he must keep up with changes that are developing as fast as they ever did in medicine, law, or dentistry. Those best equipped to apply modern scientific methods are almost certain to be most economical for you and definitely more satisfactory in the long run.

Unfortunately, as in any business, there will always be a few fly-by-night operators. But patients, clients, and TV set owners who recognize that you get only what you pay for, will never get gypped. "There just ARE no service bargains" . . . but there is GOOD SERVICE awaiting you at FAIR PRICES!

THIS MESSAGE WAS PREPARED BY SPRAGUE PRODUCTS COMPANY,
DISTRIBUTORS' SUPPLY SUBSIDIARY OF SPRAGUE ELECTRIC COMPANY, NORTH ADAMS, MASSACHUSETTS, FOR . . .

YOUR INDEPENDENT TV-RADIO SERVICE DEALER

65-124-65

Circle 4 on literature card

Letters to the Editor

Dear Editor:

As an ardent reader of your magazine who is a rated pilot, I'd like to call your attention to the frequency range of omni stations noted in the article on aircraft radios in the December 1964 PF REPORTER. The author lists 112 to 117.9 mc as the band of frequencies used for omni stations; in fact, the actual limits are 108 to 117.9 mc. In the 108- to 112-mc segment, omni stations operate on even tenths-of-megacycles, while ILS systems operate on the odd tenths.

Another small point—the author says that a pilot may "determine his bearing from a ground station within two degrees," when to be absolutely accurate he should have said, "bearing to *or from* an omni ground station."

W. W. HENSLER

Indianapolis, Ind.

With three pilots (some recent, some not so) on our staff, our faces sting a bit for not having caught those inaccuracies. Just goes to show that editors are bothered by gremlins, too.—Ed.

Dear Editor:

While recently rereading the item called "Death Stalks the Rooftops," I wondered if *ungrounding* the antenna wouldn't keep lightning from striking the system. I realize that if lightning struck a grounded system, it would be bypassed to ground with little damage to the set or the house. Being grounded, however, was what caused the problem that almost killed that technician mentioned in the article. Since lightning is electricity, wouldn't it avoid an ungrounded antenna altogether? Using this logic, I and other technicians in this area have stopped grounding antenna systems. Let us know if we are off in our reasoning.

ROBERT P. NEAL

Wadsworth, Illinois

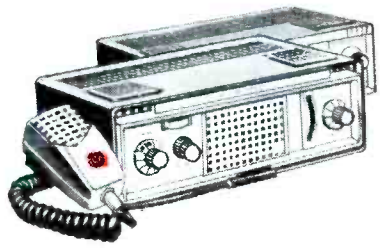
Gosh yes, Bob, your theory is wrong—and dangerous! Two factors are important to remember: Lightning will strike the highest point of least resistance to ground—after all, a house built from wood is not grounded, but it does present a lower resistance to lightning than does the atmosphere and is often struck; and, the passage of charged air past an ungrounded antenna system will build up a static charge that will actually attract a charge of lightning. In an ungrounded system that is struck, the tremendous charge is just let loose in the system possibly to burn up the set, the house, and anyone in it. Remember, too, that when we speak of grounding an antenna, we mean the mast. We recently heard of one technician who was grounding one side of the lead-in! We urgently recommend that you return to those installations you mentioned and ground them properly. For further information on safe and sane installations, see "Antenna Systems Can Be Safe" in the August 1964 issue of PF REPORTER.*—Ed.* ▲

FREE from RCA!

WIN ONE OF BRAND-NEW 1965

Plus over 100 additional prizes awarded in

EACH GRAND PRIZE CHEVY-VAN LOADED WITH THESE RCA PRODUCTS

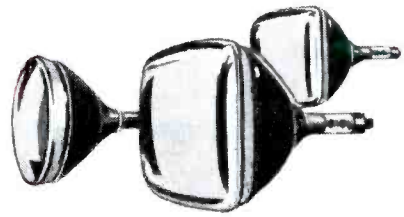


A.

A pair of new RCA Mark-Nine CB radio units for fastest shop-to-truck communication in your neighborhood.

B.

An RCA Treasure Chest Tube Caddy fully loaded with the fastest selling RCA replacement receiving tube types.

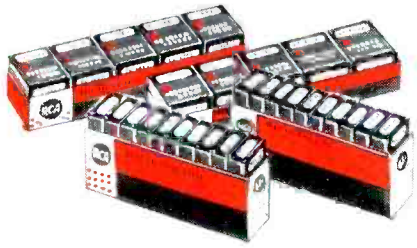


C.

One RCA Colorama picture tube and two popular RCA Silverama black-and-white replacement picture tubes.

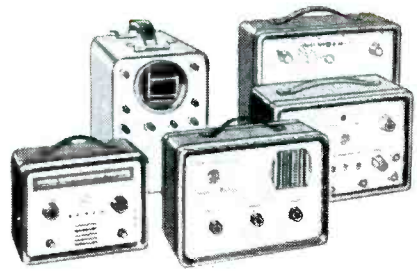
D.

A colorful, attractive counter merchandiser fully stocked with RCA transistor radio batteries.



E.

Two complete kits of RCA's "Top-of-the-Line" replacement transistors for entertainment-type equipment.



F. Five RCA popular and versatile test instruments:

RCA WR-64A Color Bar/Dot/ Crosshatch Generator
RCA WO-33A Super-Portable 3" Oscilloscope
RCA WR-69A Television/FM Sweep Generator
RCA WR-99A Crystal-Calibrated Marker Generator
RCA WR-70A RF/IF/VF Marker Adder

THESE NINE CHEVY-VANS!!!

nine separate regions of the United States!

ADDITIONAL PRIZES INCLUDE:

18
SECOND PRIZES:
RCA Victor Color TV Sets

27
THIRD PRIZES:
RCA Victor Black-and-White Portable TV Sets

72
FOURTH PRIZES:
RCA Victor Portable Transistor Radios

RCA's 1965 Regional Sweepstakes is for Radio/TV/Hi-Fi Service Dealers and Technicians EXCLUSIVELY!

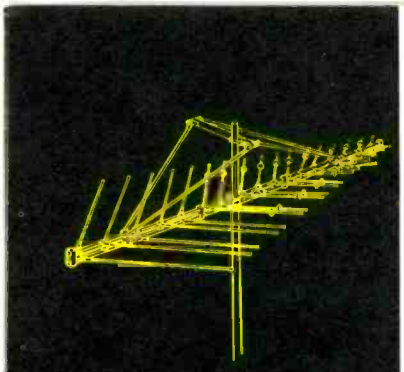
NO JINGLES TO WRITE—NOTHING TO GUESS—NOTHING TO BUY! Simply pick up and fill out an entry blank and official rules at your RCA Distributor.

Enter as often as you like. Each entry must be submitted and mailed separately. See your Participating RCA Distributor right away.

This offer not made in states and localities where restricted or prohibited, such as Wisconsin and Florida.

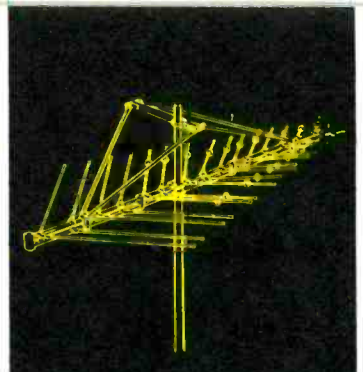
RCA ELECTRONIC COMPONENTS AND DEVICES, HARRISON, N.J.

The Most Trusted Name in Electronics



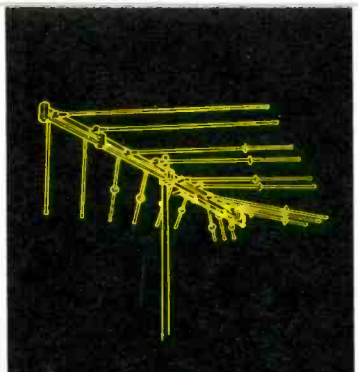
Model LPV-VU18
List $69.95

Description
18 Active Cells
VHF—up to 175 miles
UHF—up to 90 miles
FM —up to 75 miles



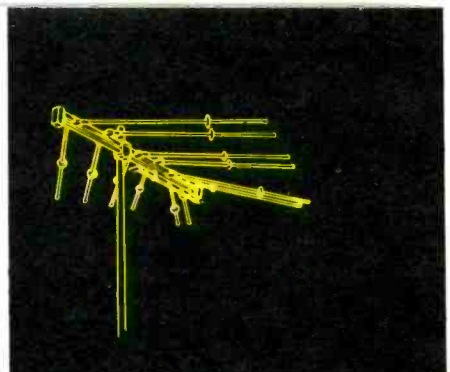
Model LPV-VU15
List $59.95

Description
15 Active Cells
VHF—up to 150 miles
UHF—up to 90 miles
FM —up to 60 miles



Model LPV-VU9
List $39.95

Description
9 Active Cells
VHF—up to 100 miles
UHF—up to 40 miles
FM —up to 40 miles



Model LPV-VU6
List $27.50

Description
6 Active Cells
VHF—up to 75 miles
UHF—up to 25 miles
FM —up to 30 miles

Licensed under one or more of U.S. patents 2,958,081, 2,985,879; 3,011,158; 3,108,280; 3,150,376 and additional patents pending in U.S.A. and Canada. Produced by JFD Electronics Corporation under exclusive license from the University of Illinois Foundation.

Model LPV-VU12
List $49.95

Description
12 Active Cells
VHF—up to 125 miles
UHF—up to 65 miles
FM —up to 50 miles

Who Says

You Can't Have Everything You Want in a TV Antenna?—

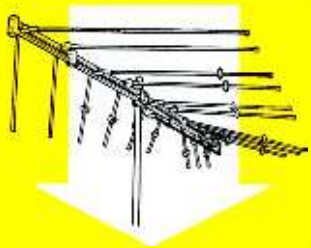
VHF? UHF? FM Stereo? Single Down-lead?

You most definitely can—when you install the remarkable new

JFD LPV-VU LOG-PERIODIC

FEATURING THE CAP-ELECTRONIC DIPOLE

The World's first all-channel VHF/UHF/FM/Stereo antenna (with single Down-lead) is here. (And only JFD has got it!)



You can't satisfy today's complex VHF/UHF/FM reception needs with yesterday's antennas. Today's "VU" TV sets call for a single all-*powerful* all-*band antenna that delivers the signals you need for picture-perfect reception on all channels 2 to 83—plus FM Stereo.*

That's why smart installers and dealers are switching to the new JFD LPV-VU. This newest antenna advance from the JFD Champaign, Illinois R&D Laboratories, teams (1) the acclaimed JFD Log-Periodic concept with (2) a totally new antenna design principle—the *capacitor-coupled electronic dipole.*

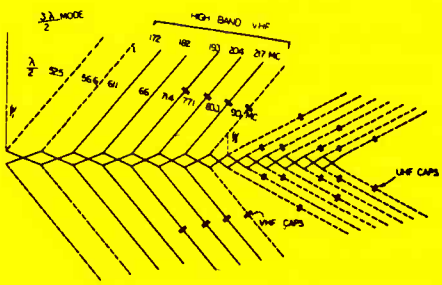
Result? More driven elements than ever before possible for the most efficient performance ever on VHF, UHF, FM/Stereo —from *one* antenna, **with one lead-in.**

And you can choose from five gold alodized LPV-VU Log-Periodics to satisfy every location, any budget: model LPV-VU-18, LPV-VU-15, LPV-VU-12, LPV-VU-9 and LPV-VU-6.

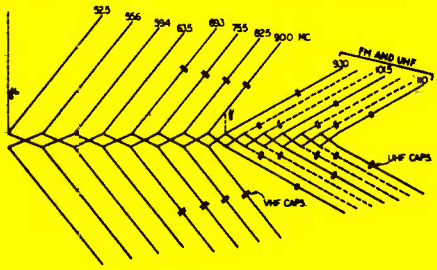
New from JFD—another outstanding advance in dipole design, the *capacitor-coupled electronic dipole!*

By introducing parallel plate capacitors into predetermined positions along the dipoles, and by precisely adjusting the value of each capacitance:

1. *More* dipoles are made to resonate on the high VHF band with a corresponding increase in gain.



2. *Higher mode* operation in UHF band achieves higher gain on channels 14 to 83—equal or better than that of parabolics. Improves FM stereo performance.
3. *More uniform* gain across each band, with narrower beamwidths. High front-to-back ratios greatly improve ghost rejection—insure excellent color fidelity.

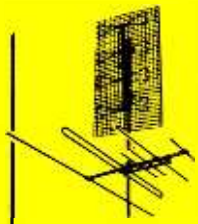


PLUS . . .

1. *Patented frequency independent Log-Periodic design* maintains same high performance efficiency regardless of station or band tuned in.
2. *Only one downlead needed.* A JFD AC80 splitter, included with each LPV-VU, permits you to tie directly into VHF, UHF and FM set inputs.
3. *New low-impedance twin crossarms* function as crossed feeder harness. Step up gain and improve signal transfer.

LPV-VU OFFERS NEW *MECHANICAL* ADVANCES, TOO!

■ Twin square aluminum crossarms. ■ Stainless steel terminals. ■ Oversized unbreakable Celanese "Fortiflex A" insulators. ■ Solid aluminum bus bar transformers. ■ Tubular crossarm supports on larger LPV-VU's. ■ Double U-bolts with 4 serrated-gripping profiles for 6-inch gripping span. ■ Electrically conductive gold alodizing.



INSTALLER BEWARE!

Don't spoil your VHF reception!

Addition of a separate UHF antenna to a present VHF installation may cut the VHF signal being delivered to your set. Incoming signals from a VHF transmitter may be scattered from the UHF antenna. Scattering produces less signal and multiple signals which cause ghosts.

SO WHY USE TWO WHEN *ONE LPV-VU* WILL DO?

Install the *all*-channel JFD LPV-VU and get the best VHF and UHF from *one* antenna with *one* down-lead!

A SPACE-AGE PRODUCT OF THE WORLD'S GREATEST TV/FM ANTENNA LABORATORIES

This newly completed laboratory, located on a ten acre site in Interstate Research Park, in Champaign, Illinois (home of the University of Illinois) marks a milestone in antenna history. It is dramatic proof of JFD leadership in antenna technology. Its fully staffed and equipped engineering staff, under the supervision of Dr. Paul E. Mayes, is blazing new trails in antenna design. This priceless know-how is built into each LPV-VU you sell.

The JFD LPV-VU is adapted from the geometrically derived Log-Periodic antenna formula developed by the Antenna Research Laboratories of the University of Illinois.

JFD

JFD ELECTRONICS CORPORATION
15th Avenue at 62nd Street, Brooklyn, N. Y. 11219
JFD Electronics-Southern Inc., Oxford, North Carolina
JFD International, 64-14 Woodside Ave., Woodside 77, N. Y.
JFD Canada, Ltd., 51 McCormack Street, Toronto, Ontario, Canada

SEE YOUR DISTRIBUTOR. WRITE FOR BULLETIN 806 FOR COMPLETE DETAILS.

Circle 7 on literature card

Want your radio battery business to grow?

1. PICK THE BRAND NAME PEOPLE ASSOCIATE WITH RADIO–RCA.

With a small-ticket item such as batteries you want each sale to be final—sealed with customer satisfaction. That's the only way to keep the customer coming back. That's the only way to keep the profit in the till. To sell with confidence, rely on the name your customers have come to look to for quality and dependability—RCA.

With over 70 million transistor radios in use today and with other battery-operated devices sprouting in all directions, batteries can ease the squeeze on profits and more than rate the little space they require.

Advertised over Network TV on Walt Disney's "Wonderful World of Color"

Then take these two simple steps today.

2. PICK THE PACKAGE BEST SUITED TO YOUR NEEDS.

How do you want your batteries—blister-packed or regular? With RCA Batteries you have your choice. With attractive pricing either way. How much space can you afford to allocate to batteries? Is it 4 inches? Or 2 feet? You can surely meet your needs from this wide selection of attractive, practical RCA battery merchandisers.

And every battery...every merchandiser...proudly and clearly displays the RCA name, your assurance of satisfied customers. Get the most out of the booming battery business with the name people associate with radio: RCA. For details, contact your Authorized RCA Battery Distributor, or RCA Electronic Components and Devices, Harrison, N.J.

The Most Trusted Name in Electronics

The Electronic Scanner

news of the servicing industry

More '65 Color

The new 1965 color TV line, in which **Zenith Sales Corp.** introduces six key models "designed to broaden further the rapidly accelerating consumer demand for color television sets." will be launched by a powerful advertising and merchandising program. The 19 models include four different consoles, a table model, and a consolette, all in the under-$500 bracket. Highlights of the line include automatic Color Clarifier (Zenith's automatic degaussing), and transistorized "Space Command 600" remote control system that now gives the viewer control of color hue in addition to the usual remote controls without increasing the number of pushbuttons on the hand-held unit.

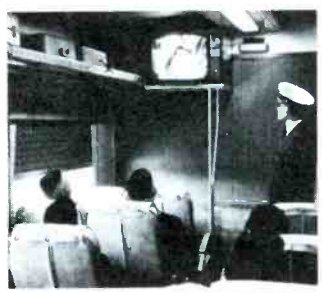
Laser Communications

Space technologists indicate that a communication system using lasers, optical detectors, and modulation devices can provide two-way telemetry, voice, and down-TV from distances of the order of 50 million miles. Feasibility and competitiveness of such a system with microwave communication was established in the initial study phase of NASA's Deep Space Optical Communication Program.

Researchers narrowed the search for an optimum deep-space communication system to two types: pulse-position modulation using a gallium-arsenide diode, and PCM polarization modulation employing a CW gas laser. For an immediate communication system, the researchers then concluded that the practical problems of implementing a PPM system eliminated it in favor of the PCM system. The latter can be reliably implemented with existing system components.

While component development is rapidly expanding, the results of this study favor the use of an earth-based deceiver system utilizing incoherent (quantum-counter) detection at frequencies in the visible portion of the spectrum. However, technicians advise additional study of coherent reception. Earlier theoretical studies showed that good system performance with coherent reception in the infrared portion of the spectrum is possible from a synchronous satellite with a microwave or optical link to earth. A definite decision can be reached only through increased knowledge of atmospheric effects on coherent reception and improved detection techniques for IR.

TV on Trains



For the first time in railroad history, passengers will be able to watch television on the way to their destinations. Black-and-white television sets have been installed in all coach, lounge, and recreation cars on the Atlantic Coast Line "Florida Special" which began its 77th season between New York and Florida in December. **Olympic** sets were chosen for the installation. Tests indicate that reception is extremely good throughout the route of the "Special." Passengers on test runs greeted the innovation with enthusiasm. Each television set is mounted on an overhead shelf at ceiling height in the special cars, and is connected to the train's television antenna system.

Please turn to page 24

Any type of TV lead-in...

BELDEN makes it!

Your BELDEN distributor has it!

PERMOHM* 8285 . . excellent for color TV. Gives stronger, clearer UHF and VHF signals under conditions of extreme salt spray, industrial contamination, rain, and snow. 300 Ohm.

WELDOHM 8230 . . resists pulling, whipping, twisting. Weldohm has two and a half times the flexing life, and one and a half times the breaking strength of ordinary 300 ohm lead-in.

COAXIAL TRANSMISSION LINES—RG/U AND FOAM RG/U TYPES . . low-loss signal transmission for multiple TV installations such as motels.

STANDARD 300 OHM LINE 8225 . . low losses at high frequencies. Well suited for use with FM receiving antennas.

CELLULINE* 8275 . . installs easily . . no end sealing necessary. Has excellent resistance to sun, abrasion, and wind. Delivers strong UHF and VHF signals. 300 Ohm.

DECORATOR CABLE 8226 . . for interiors . . neutral color blends into decor of any room. No dark brown color to contrast with light carpets or walls. 300 Ohm.

Your Belden distributor has a complete line of Belden TV lead-in cable . . . in standard lengths for easy handling. He also carries microphone and shielded power supply cables; hi-fi, stereo, and phonograph cables; power supply cords; multiconductor portable cordage; antenna rotor cables; hook-up wire; TV and cheater cords; aluminum ground wire . . . plus many other related items.

Better Built . . . Better Buy . . . **Belden**
WIREMAKER FOR INDUSTRY
SINCE 1902 — CHICAGO

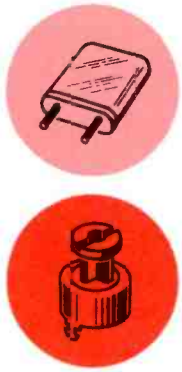
WELDOHM, PERMOHM, CELLULINE are Belden Trademarks
Reg. U.S. Pat. Off. *Belden Patents U.S. 2,782,251 and 2,814,666

8-9-3

cord sets and portable cables • electrical household cords • magnet wire • lead wire • automotive wire and cable • welding cable

Circle 9 on literature card

COLOR-PARTS GUIDE



Listed here are many of the resistors, capacitors, sweep components, and miscellaneous items needed to repair color TV receivers. The majority of these close-tolerance components are seldom used in black-and-white servicing, so it may be necessary to update your replacement stock to handle the demands of color servicing. Resistors designated "G" are used mainly in demodulator circuits and should be replaced by glass-type units; those with "Th" indicate thermistor type.

The manufacturer's part number is listed for all sweep-circuit and miscellaneous components. Check the appropriate PHOTOFACT Folder or have your distributor consult Counter-Facts to determine an exact replacement for these components.

In addition to the items listed here, you'll probably want to stock a few 750-ma silicon rectifiers, as well as some 1N60 and 1N64 signal diodes. Depending on how much color servicing your shop handles, you can decide which items listed here are most practical for you to keep in stock. You also may find it advantageous to keep on your shelf certain of the special controls and coils used in color receivers. It's a good idea to keep color parts separated from normal stock.

Motorola Chassis TS-908 TS-912 WTS-907

Fixed Capacitors

1	pf			10%
2.2	pf	NPO	1000 V	
3.9	pf	NPO		5%
5.6	pf	N150		5%
10	pf	N750		5%
12	pf	N150		10%
22	pf	N150	2000 V	10%
56	pf	N150		5%
68	pf	N150		10%
100	pf	N750	3000 V	10%
130	pf	N1500	2000 V	10%
130	pf		6000 C	10%
260	pf	N2200	3000 V	10%
270	pf		2000 V	
470	pf		2000 V	
560	pf		2500 V	
680	pf		3000 V	10%
800	pf			10%
.001			2000 V	
.0015			1400 V	
.002			2000 V	
.003			1000 V	10%
.0033			2000 V	
.005			1000 V	
.01			2000 V	

Electrolytics

2	mfd	350 V

Resistors

5	ohm	25 W	
(Th)26.5	ohm	Cold	
52	ohm	25 W	
(Th)110	ohm	Cold	
(G)390	ohm	1 W	5%
550	ohm	20 W	
(Th)900	ohm	Cold	
1800	ohm	15 W	
(G)3900	ohm	2 W	5%
15	meg	2 W	
22	meg	2 W	
47	meg	6 KV	
270	meg	22KV	

Miscellaneous

Boost Rectifier
- 48D66653A03 (TS-908)

Circuit Breaker
- 80C66390A08 (TS-908, WTS-097)
- 80C66390A09 (TS-912)

Convergence Rectifier
- 48C66037A10 (TS-908)
- 48D66037A03 (TS-908)
- 48C66653A02 (TS-912)
- 48D6653A02 (WTS-907)

Crystal 3.58 mc
- 48C66865A01 (TS-908, WTS-907)
- 48C66865A02 (TS-912)

Delay Line
- 24D66855A02 (TS-908, WTS-907)
- 24D66855A03 (TS-912)

RCA Chassis CTC7 thru CTC16

Fixed Capacitors

1.3	pf			
1.5	pf	N3300		
4	pf	NPO		
5	pf	N1500		5%
6	pf	NPO		5%
7	pf	N150		2%
10	pf	NPO		10%
15	pf	NPO		10%
18	pf	NPO		10%
22	pf		1000 V	
33	pf	N150		
47	pf		4000 V	10%
56	pf		6000 V	
68	pf		4000 V	10%
82	pf	NPO		10%
100	pf	N1500	3000 V	5%
120	pf	N750		10%
120	pf	N1500	4000 V	10%
130	pf	N2200	6000 V	
150	pf			5%
180	pf		1000 V	10%
220	pf	N750		10%
270	pf		2000 V	
330	pf			5%
390	pf			5%
470	pf	N750		5%
560	pf	N3300	2500 V	10%

Electrolytics

2	mfd	350 V
40	mfd	25 V

Resistors

3.6	ohm	1 W	
3.8	ohm		
(Th)79	ohm	Cold	
(Th)120	ohm	Cold	
270	ohm	3 W	5%
910	ohm	18 W	
1250	ohm	18 W	
1500	ohm	3 W	5%
1600	ohm	10 W	
1800	ohm	3 W	5%
2700	ohm	7 W	5%
3000	ohm	7 W	5%
(G)3900	ohm	1 W	5%
4300	ohm	5 W	
6800	ohm	7 W	5%
13	K	7 W	
16	K	7 W	
(G)22	K	2 W	5%
39	K	4 W	5%
(G)47	K	1 W	5%
110	K		5%
(G)270	K	1 W	5%
1.5	meg	1 W	5%
2.2	meg		5%
2.4	meg		5%

Miscellaneous

Boost Rectifier
- 113391 (CTC15, 16)

Circuit Breaker
- 106541 (CTC7)
- 109835 (CTC11, 12, 15)
- 113950 (CTC16)

Convergence Rectifier
- 105064 CTC7, 9, 10, 11, 12,)
- 113321 (CTC15)
- 113392 (CTC15)
- 114013 (CTC16)

Crystal 3.58 mc
- 105330 (all chassis)

Delay Line
- 105253 (CTC7, 9, 10)
- 109837 (CTC11, 12, 15, 16)

Focus Rectifier
- 113397 (CTC15)

	Fixed Capacitors				Electrolytics	Resistors			Miscellaneous
	680	pf		5%		2.7	meg	5%	
	750	pf	N2200	5%		3.9	meg	5%	
	.001		2000 V	10%		6.8	meg	5%	
	.0027		1600 V	10%		8.2	meg	5%	
	.0082		1000 V			10	meg	5%	
	.01		1400 V			22	meg 2 W	5%	
						47	meg		
						66	meg ½ W		
						100	meg 1 W	5%	

	Fixed Capacitors					Electrolytics	Resistors			Miscellaneous
Zenith Chassis 25LC20 25LC30	.22	pf			10%	200 mfd 25 V	11	ohm	20 W	Circuit Breaker 85-763 (25LC20, 26KC20)
	.47	pf			10%	80 mfd 475 V	1000	ohm	50 W	
	.62	pf			10%	4 mfd 450 V	14	K	7 W	Convergence Rectifier 212-25 (all chassis)
	.62	pf			10%	4 mfd 450 V				
25MC30	2	pf			10%	50 mfd 450 V	30	K	5 W	
26KC20	3	pf			10%	40 mfd 450 V	1.5	meg	1 W 5%	Crystal 3.58 mc 103-28 (25LC20, 26KC20, 27KC20, 29JC20)
27KC20	5	pf	NPO		10%	40 mfd 450 V	18	meg	2 W	
29JC20	6	pf	NPO		10%	4 mfd 150 V	22	meg	2 W	
	7	pf	NPO		10%	80 mfd 375 V				103-71 (25LC30, 25MC30)
	12	pf	N1500		5%	80 mfd 375 V				Delay Line S-62358 (25LC20, 25LC30) S-65296 (25MC30)
	13	pf	NPO		5%	4 mfd 450 V				
	20	pf	N080		10%	4 mfd 450 V				
	27	pf	N750		10%	50 mfd 450 V				S-53443 (27KC20, 29JC20) S-59190 (26KC20)
	36	pf	N220		5%	40 mfd 25 V				
	47	pf	N075			4 mfd 150 V				
	47	pf	N750	5000 V	10%	50 mfd 450 V				
	47	pf	N1500	6000 V		40 mfd 450 V				
	53	pf	NPO			40 mfd 25 V				
	56	pf	N750		10%	4 mfd 150 V				
	75	pf	N1500	6000 V	10%	90 mfd 475 V				
	90	pf	N1500	6000 V		4 mfd 450 V				
	100	pf	NPO		5%	4 mfd 450 V				
	100	pf		3000 V	10%	4 mfd 450 V				
	130	pf	N750		10%	Brackets indicate one unit.				
	150	pf	N750		10%					
	150	pf	N1500	6000 V						
	220	pf		3000 V	10%					
	300	pf	N750	2000 V	5%					
	470	pf		1000 V	0%					
	.01			1000 V	0%					
	.015			1000 V	0%					
	.0033			2000 V	0%					

Sweep Components

Motorola

Focus Coil	24P65127A93 (TS-908) 24P65132A55 (WTS-907)
Horiz Linearity Coil	24P65131AC6 (TS-908)
Horiz Output Transformer	24D66876A02 (TS-908) 24D66876A03 (TS-912) 24D6756-A03 (WTS-907)
Vertical Output Transformer	25D66761AC2 (TS-908) 25D66761A03(-E) (TS-912) 25D66761A01 (WTS-907)
Yoke	24D67215AC1 (TS-908) 24D66872A01 (TS-912, WTS-907)

RCA

Focus Coil	109264 (CTC10, 11, 12) 113640 (CTC15) 113999 (CTC16)
Horiz Linearity Coil	105196 (CTC7, 9, 10, 11) 112675 (CTC12, 15) 114006 (CTC16)
Horiz Output Transformer	106359 (CTC7, 9) 109521 (CTC10, 11) 112820 (CTC12) 113382 (CTC15) 113992 (CTC16)
Vertical Output Transformer	106360 (CTC7, 9) 109263 (CTC10)

Sweep Components

RCA Continued

	109850 (CTC11) 112821 (CTC12) 113390 (CTC15) 114047 (CTC16)
Yoke	106305 (CTC7, 9) 109457 (CTC10, 12, 15, 16) 109845 (CTC11)

Zenith

Focus Coil	S-53551 (27KC20, 29JC20)
Horiz Linearity Co	S-59194 (25LC20, 25LC30) S-62016 (25MC30) S-53754 (27KC20, 29JC20) S-59102 (26KC20)
Horiz Output Transformer	S-58518 (25LC20, 25LC30, 26KC20) S-65739 (25MC30) S-58518 (26KC20) S-53620 (29JC20)
Vertical Output Transformer	95-2109(-C) (25LC20) 95-2139(-A) (25LC30, 25MC30) 95-2050 (26KC20) 95-1905(-D) (27KC20, 29JC20)
Yoke	95-2067 (25LC20, 25MC30, 26KC20) 95-1974 (27KC20) 95-1793 (29JC20)

crease in demand for color television receivers, together with a peak year in black-and-white set sales; a tremendous increase in imports of black-and-white receivers and tape recorders.
2. Encouraging indications that defense contractors, either experiencing on anticipating a decrease in military procurement, may be finding outlets in the expanding industrial electronics market or in new civilian public works programs.
3. Evidence that the industry may end the year with a more favorable balance of trade, but with some of its major markets severely pressured by imported products.

Year-end estimates of factory sales show heaviest increases scored by consumer products and industrial electronics. The government market, although somewhat diminished by defense cutbacks, held its own, while the replacement-components segment reversed the dropoff in sales experienced in 1963. In statistical summary, 1964 factory sales in the four major product areas look like this:

(In billions of dollars)

Market	1963	1964*
Consumer Products	$ 2.58	$ 2.86
Industrial Products	3.06	3.43
Government Products	8.94	9.37
Replacement Components	.59	.62
Total	$15.17	$16.28

*EIA Estimates

In the consumer products area, sales of television receivers —both color and b-w—and of products in the "other category" are responsible for a 12% increase over 1963 sales, and worked to offset a leveling in sales of radios and phonographs. Sales of color TV sets, which reached a substantial 1.4 million units last year, are no less impressive than those of b-w receivers, which moved to 7.9 million—the highest level since the 7.7-million-set boom year of 1955. Value of the total 9.3 million TV sets sold at the factory was $1.32 billion, compared with $1.08 billion in 1963.

Stimulated sales of devices in the "other consumer products" category—tape recorders, electronic boating aids, educational

Scanner

(Continued from page 20)

See in the Dark

Light-amplifying tubes that make it possible for soldiers to see in the dark without revealing their presence will be produced for the U.S. Army by The Machlett Laboratories, Inc., a subsidiary of **Raytheon Co.** The image-intensifier tubes permit soldiers to see objects hidden in light levels far below the threshold of normal human vision. Developed by Machlett, the new tubes intensify the natural low-level night illumination to present a bright image, thus providing the soldier with fire power and mobility at night comparable to that of daylight.

State of the Industry

For you technicians who want to know where your industry stands and where it's going, here are some significant facts and statistics we've gleaned from a paper by Dr. Harper Q. North, president of **Electronic Industries Association.** The figures represent factory prices, but they'll give you an idea of the trends taking place. Continuing a year-by-year expansion which began 14 years ago, factory sales of the electronics industry should rise to $17 billion by the end of 1965. This compares with $16,3 billion for 1964 and $15.2 billion in 1963—a healthy gain for any industry. Electronics business has nearly trebled in a single decade.

In a preliminary analysis of this year's state of the industry, the EIA Marketing Services Departments and Requirements Committee have identified these trends, working both for and against the industry's progress:
1. A long-anticipated and (to some) surprisingly strong in-

The domestic electronic components market, its growth rate severely blunted by imports during the past several years, is expected to gain slightly from $3.72 billion in 1963 to $3.79 billion, aided by increases in sales of semiconductors from $583 million to $612 million. Sales of replacement components showed a $30 million rise to $620 million.

A noteworthy trend is the increasingly heavy demand for silicon transistors, which pushed total sales of transistors to a record $303 million, compared with $296 million in '63. A decade ago, silicon transistors were outsold by germanium types at a ratio of about 65 to 1. By 1963 the ratio was 5 to 1, and the gap is expected to close further this year. Rapid yearly growth in sales of integral-circuit packages—including microelectronic devices—continued, with volume climbing to $225 million from the $155 million recorded for 1963.

Sales of electronic tubes, on the decline for the past five years because of pressure from imports, dropped off again—from $274 million in 1963 to $260 million. Similarly, sales of power and special-purpose tubes moved downward from $311 million to $250 million.

Efforts to encourage electronics manufacturers to find markets overseas may show a healthy increase of the industry's share in the balance of trade. Based on data for the first eight months of this 1964, total electronics exports should have increased by 7% over the $846 million for 1963, while imports remained close to $307 million. The influx of goods from abroad continues to have heavy impact on segments of the electronics industry, particularly in the consumer products area where imports rose from $107 million in the first eight months of 1963 to $113 million during the same period in 1964. Imports of television sets climbed steeply from $13.3 million in the 1963 January-August period to $17 million in '64, while imports of tape recorders rose from $19.7 million to $26.5 million.

The rises shown here indicate that the electronics industry parallels—indeed, leads—the general business and economic growth of the country. ▲

kits, door controls, electronic ovens, to name a few—helped boost the total value of these sales by $45 million, moving from $705 million in 1963 to $750 milion.

Unit sales of radios were up—home models to 10.6 million, auto sets to 8.2 million—but total dollar value remained just below 1963's levels, reflecting the inroads of imported products. Sales value of home radios was $172 million, compared with $177 million in 1963, while auto sets approximated $205 million, compared with $206 million. Phonographs sales declined to $415 million from the $417 million 1963 volume.

In terms of percentage increase, the industrial electronics segment leads the industry in annual expansion, as it has for the past several years. The industrial electronics industry ended the year with sales of $3.43 billion as against $3.06 billion the year before. As in the past, the most vigorous gain was in sales of computing and data-processing equipment, moving to $1.38 billion from $1.25 billion. Sales of industrial control and processing equipment climbed from $244 million in 1963 to $270 million; test and measuring devices from $280 million to $300 million; communications, broadcast, commercial sound, and navigational aids from $935 million to $1.07 billion; nuclear-electronic equipment from $47 million to $55 million; and medical, scientific, educational, and other industrial equipment from $314 million to $365 million.

Substantial gains appeared in such specific product areas as video-tape recorders, closed-circuit television, electronic machine tools, and switching equipment for telephone and communications systems. Particularly noteworthy is the impressive rise in sales of Citizens-band transceivers and accessories—up an estimated 18 percent to $39 million. The value is nearly double that of sales in 1960.

The federal government remains by far the heaviest consumer of electronic products and, despite reductions in defense spending and other economy moves, EIA expects it to remain so for many years to come. Expenditures, however, will show a year-by-year leveling. Calendar year expenditures should reach $9.37 billion in 1964, compared with $8.94 billion in calendar 1963.

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— NOT EVEN YOU!

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Address . . . . . .

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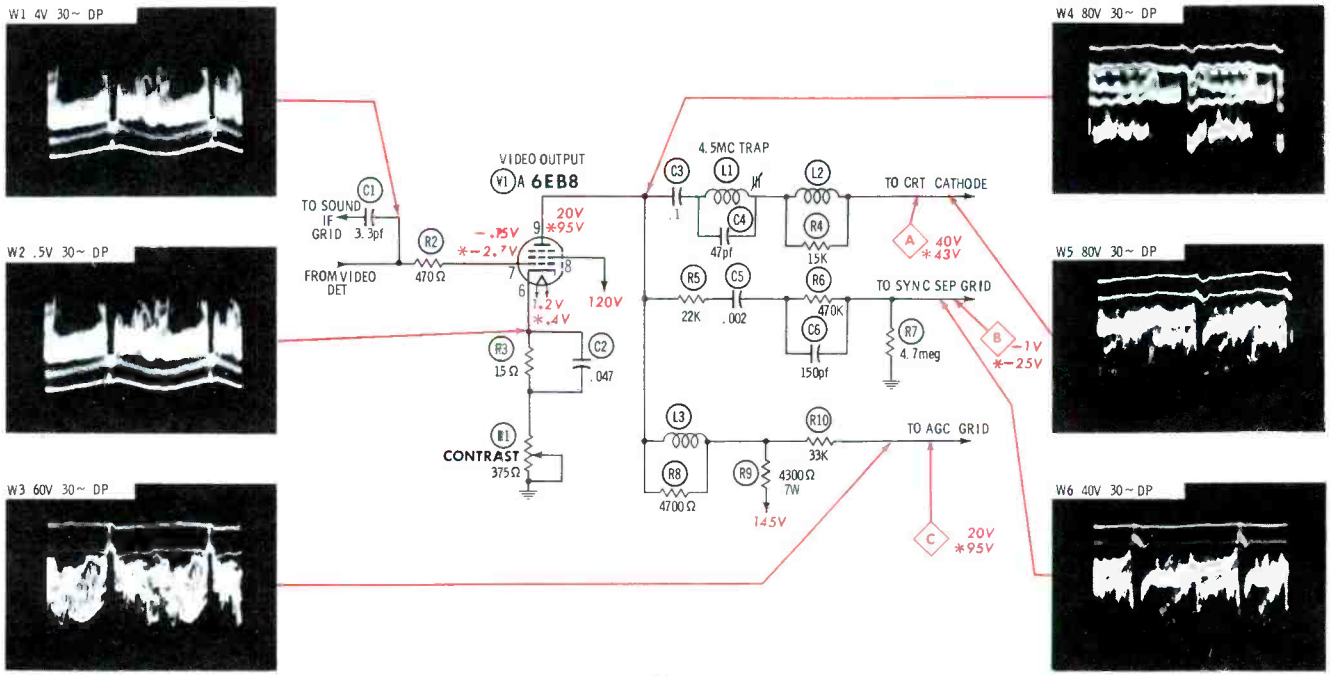
Video-AGC -Sync

Takeoff Network



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

WAVEFORMS taken with wideband scope; TV controls set to produce normal picture and sound. DP (direct probe) usable at all points throughout the circuit.

Normal Operation

Takeoff networks for AGC, sound, sync, and video shown here (from Magnavox Chassis U47-05-00) are typical of modern receivers. Here, sound takeoff is from grid of video-output stage; sometimes it's from plate, like other three. Gain of output tube is determined by contrast potentiometer which controls bias on stage. Signal strength at antenna terminals and amplification of video IF stages (controlled by AGC voltage) are responsible for amplitude of signal at takeoff point. Plate circuit of V1 has three individual parallel takeoff paths. Negative-going video signal to CRT cathode is coupled through C3, C4, L1, and L2. L1-C4 also traps 4.5-mc sound signal, keeping sound hash out of picture. Proper adjustment of L1 can be checked by connecting 4.5-mc signal (from signal generator) to grid of V1; connect scope to CRT cathode and adjust L1 for minimum deflection on scope. High frequencies of video signal are peaked by L2 and R4. Video is coupled to sync separator through C5 and C6. Negative bias for sync-separator grid is developed by R7 — strength of signal determines amount of bias. Video signal for AGC-keyer control grid is supplied through peaking coil L3 with shunt resistor R8. DC voltage for plate of V1 is fed through R9; voltage for AGC grid is via R9 and R10. Screen of V1 is tied directly to B+ source (some sets use screen-supply resistor, and screen voltage is clue to whether tube conduction is normal—especially in receivers using parallel paths from plate and screen to B+ sources.)

Operating Variations

Pin 6 DC voltage is determined by position of contrast control. With signal, voltage varies from .1 to 2 volt; without signal, ranges from .5 to 3 volt—normal is .4 and 1.2 volt.

Pin 7 Without signal, voltage remains constant regardless of contrast setting. With signal, its strength helps determine DC voltage. Normal is −2 to −2.8 volts, more negative on strong stations.

Pin 9 Without signal, DC voltage from 20 to 115 is determined by contrast setting. Normal reading with signal, 95 volts, may increase to 110 with strong station.

A DC here changes only slightly with contrast setting or signal amplitude. CRT cathode voltage is determined mainly by brightness control (not shown on this schematic).

B Negative voltage remains constant without signal. Changing setting of contrast control, thus amplitude of signal, varies DC from −5 to −30 volts when station is received.

WAVEFORMS Amplitude of W1 is determined by signal strength at antenna terminals. All others depend on both signal strength and contrast.

Sync Loss

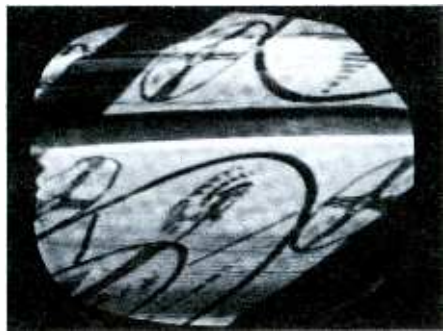
SYMPTOM 1

Both Vertical and Horizontal

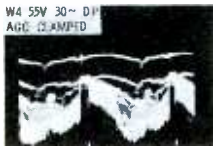
C5 Open

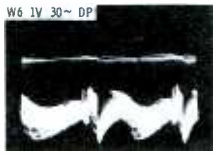
(Sync-Coupling Capacitor — .002 mfd)

Symptom Analysis



Picture shows complete loss of sync—both vertical and horizontal. Can't be stabilized at any setting of vertical- or horizontal-hold controls; suggests trouble in sync separator. Considering takeoff point, however, AGC or video defect could be responsible.

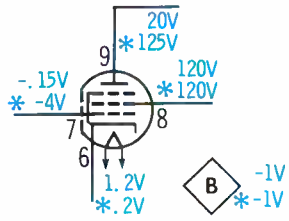




Waveform Analysis

Video signal (W4) at plate of V1 is low in amplitude and distorted—offers no real clue because, with picture out of sync, AGC stage is affected, causing abnormal signal at plate of video-output tube. Signal in W4 becomes almost normal with AGC line clamped (notice sync pulses are okay); proves signal path is normal to output tube. The very small signal seen at W6 is real clue to trouble spot—normal W6 is 40 volts p-p.

Voltage and Component Analysis



Without signal, voltages on V1 are normal, so defects are unlikely in components supplying operating voltages for output tube. Valuable voltage clue is obtained from with-signal reading at point B—only −1 volt (normal is −25 volts). Voltage at B (grid of sync separator) remains constant, suggests signal isn't reaching this point; throws suspicion on signal-coupling components between video output plate and sync-separator grid. C5 leaking would give similar symptom, but voltage at B would be positive and would change with signal.

Best Bet: Scope, bias box, and VTVM.

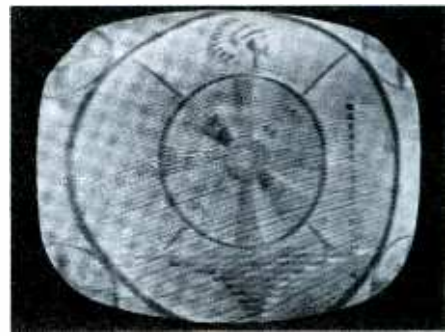
Video Weak

SYMPTOM 2

Contrast Control Works

C3 Open

(Video-Coupling Capacitor — .1 mfd)

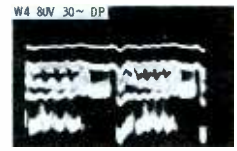


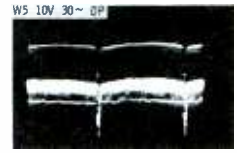
Symptom Analysis

Symptom gives some indications of defective picture tube. Video is extremely weak and has virtually no contrast, although contrast control is operative. Sound and sync circuits seem to be functioning normally. Video-output stage or CRT is most likely responsible.

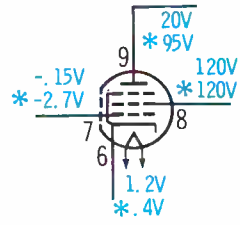
Waveform Analysis

Signal shape and amplitude of W4 are normal—sign that preceding stages are not at fault. CRT cathode signal (W5) is only 10 volts p-p (normal is 80 volts p-p), proving reduced amplitude is reason for weak picture—thus CRT isn't causing trouble. Defect must be somewhere in signal path between plate of V1 and cathode of CRT. Absence of normal signal at junction of C3 and L1 points definitely to open C3 or break in printed-circuit board.





Voltage and Component Analysis



Information gained from voltages on V1 is of absolutely no assistance—all readings are normal, with or without signal. Checking voltage at point A also proves to be of no help—normal reading is found. Open capacitor in signal path is often extremely difficult to locate with voltage and/or resistance measurements. Leaky C3 would cause decreased range of brightness control, and could be detected by increased voltage at point A. If C3 were shorted, symptom would be no raster, as excessive voltage would cut off picture tube.

Best Bet: Scope finds exact source of trouble.

SYMPTOM 3

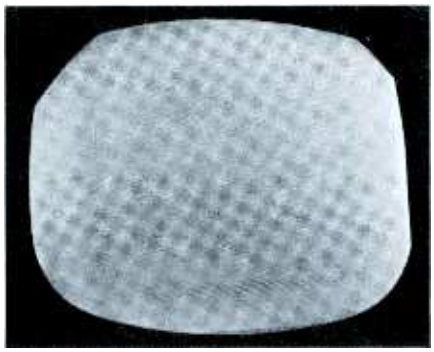
No Picture, No Sound

Insufficient Width

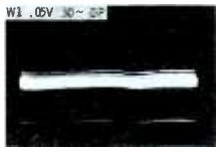
R10 Open

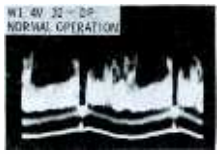
(AGC Grid Resistor — 33 K)

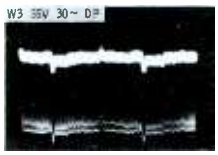
Symptom Analysis



Screen is blank on all active or inactive channels. No sound can be heard from speaker; no snow is present on vacant channels. Width is reduced slightly—raster is in about ½″ on each side. Exact source of trouble is questionable; however, video trouble seems likely.



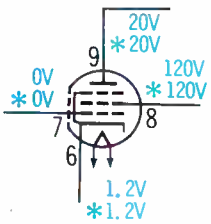




Waveform Analysis

Restoration of picture and sound is first concern. Loss of signal in W1 (see accompanying normal W1) hints that IF strip is inoperative. Valuable clue is gained from fact that W1 is normal until raster appears; W3 is abnormal and remains so. This suggests that IF stages operate okay until AGC voltage is developed by keying pulse from flyback. Constantly abnormal W3 suggests trouble is between grid of video stage (W1) and grid of AGC tube.

Voltage and Component Analysis



Without signal, all voltages on V1 are normal; same readings are obtained when active station is tuned in. Voltage readings strongly indicate signal is missing on grid, since voltages don't vary. Best voltage clue is 0-volts at point C. Width reduction is explained by fact that AGC control grid is floating and screen grid is connected to boost. Screen grid tends to act as positively biased control grid, thus causing tube to conduct extremely hard. Screen current is greatly increased; boost voltage is therefore loaded; causing narrow picture.

Best Bet: Scope, followed by voltage checks.

SYMPTOM 4

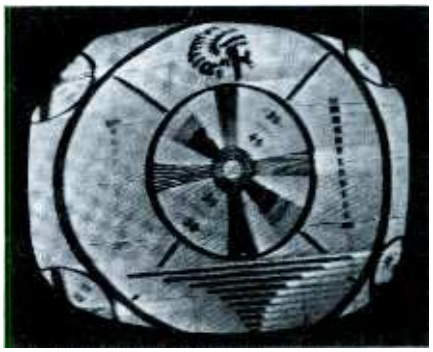
Contrast Lowered

Smeared Video

L1 Open

(4.5-mc Trap Coil)

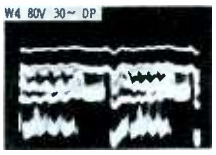
Symptom Analysis

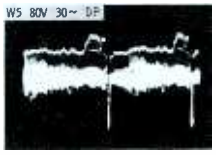


Contrast control is operative; however, even at maximum setting, contrast is insufficient. Equally important, picture is smeared. Trouble could be caused by defect in either video-IF or output stage. Most logical point to begin troubleshooting is at video-output tube.

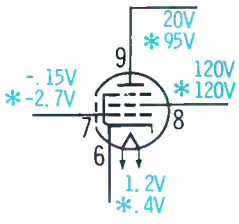
Waveform Analysis

Signal at plate of V1 (W4) is normal; so, amplification and response of video output and preceding stages are probably okay. W5 is of primary importance in locating trouble; it contains only high-frequency video information and negative vertical - blanking pulse. Another W5, taken with blanking pulse disconnected from CRT grid, shows only high-frequency components of video signal. Scope isolates trouble to path between V1 and CRT.





Voltage and Component Analysis



All voltages on V1 are normal, with or without signal; therefore, meter isn't really useful in locating defective component. With L1 open, low frequencies of video signal and sync pulses are not permitted to reach CRT cathode; this range of frequencies just can't pass through 47-pf capacitor. Negative blanking pulse in waveform at CRT cathode is result of vertical-blanking pulse being coupled from grid to cathode capacitively inside the picture tube. Loss of low-frequency video signal is reason for video smear and weak contrast.

Best Bet: Scope and circuit analysis.

Video Overloaded

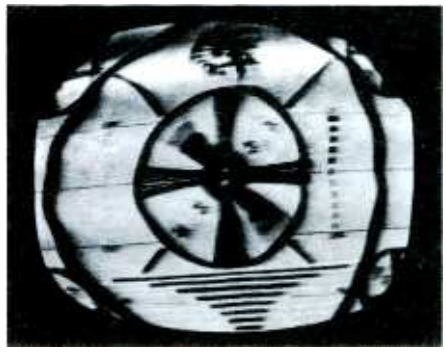
Buzz in Sound

SYMPTOM 5

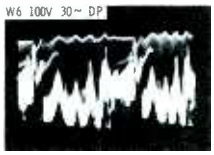
R9 Increased in Value

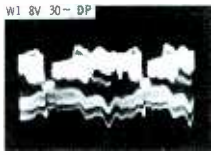
(Plate-Supply Resistor — 4300 ohms, 7 watt)

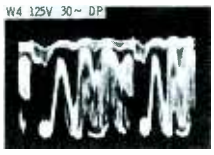
Symptom Analysis



Problem looks typical of overloaded picture caused by AGC defect. Adjusting contrast control improves condition, but evidence of trouble is present even at minimum setting. Clamping AGC line helps, but doesn't restore picture completely to normal operation.



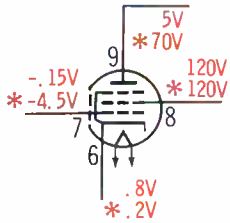




Waveform Analysis

Increased amplitude and compressed sync pulses in W6 don't suggest trouble—only prove that IF stages are operating at high gain. Remember that clamping AGC line won't help if trouble is in non-AGC-controlled stages (third IF or video output). W1 is doubled (now 8 volts p-p); clamping AGC returns W1 to normal, throws suspicion to video stage. Amplitude of W4 is increased, but not in proportion to W1—gain of V1 is reduced.

Voltage and Component Analysis



Voltage measurements prove most helpful in locating this defect. With or without signal, cathode and plate both have decreased readings. Decrease in plate voltage could mean tube is drawing excessive current; accompanied by decreased cathode voltage, however, means low plate current. All this points to increased value of R9. Above-normal negative grid voltage, with signal present, is caused by high amplitude of grid signal. If R9 were open, CRT would display only raster—no video. Resistance checks pin 9 to B+ isolate R9.

Best Bet: Voltage and resistance checks are adequate.

Sync Unstable

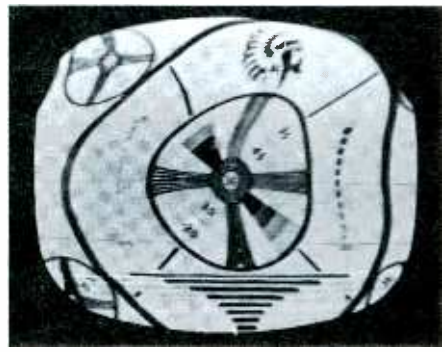
Both Vertical and Horizontal

SYMPTOM 6

C6 Open

(Sync-Shaping Capacitor — 150 pf)

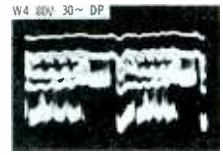
Symptom Analysis



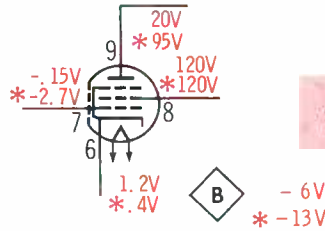
Horizontal and vertical sync both are quite erratic. Picture remains stable for short periods, then drops out of sync; sometimes horizontal bending occurs with picture in sync vertically. Symptom seems to indicate horizontal sync is affected more drastically

Waveform Analysis

With picture in sync, W4 is normal, both in content and amplitude; proves preceding stages and video-output tube are functioning properly. Input to sync separator (W6) is very distorted (see accompanying normal W6); amplitude is reduced and sync pulses are extremely compressed. Horizontal-sync pulses are almost entirely missing. Scope proves trouble precedes sync-separator grid; therefore, must be somewhere in sync-takeoff network.



Voltage and Component Analysis



All voltage readings on V1 are normal; only abnormal indication is at point B—reads −13 volts with signal, −6 volts without signal. Decreased negative voltage with signal suggests trouble in coupling network at sync-separator grid or change of value in R7. Open C6 is difficult to isolate with meter. Capacitor-substitution box can quickly locate defect. Practically any defect in sync-takeoff network can be found with scope. Good rule for any sync-circuit troubleshooting is: scope first, then meter, then component substitution.

Best Bet: Scope followed by component substitution.

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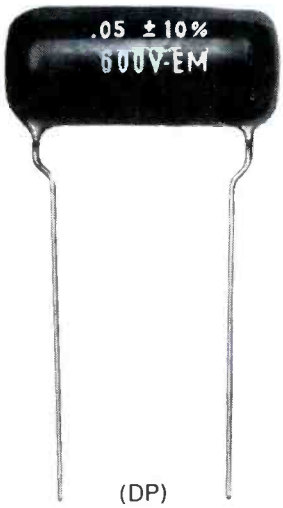

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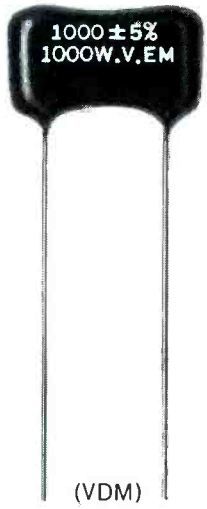

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Circle 11 on literature card

TRACKING ADJUSTMENT For AM and FM

Tune-in on this "clear" course for correct alignment.

by Philip R. Powell

Customer complaints of station mixing and fading are among the toughest auto-radio repairmen face. The repairman has to judge his customer to determine if a legitimate complaint actually exists. Often it is very difficult to pin down the complaint to anything tangible, and a road test can, in some cases, be too time-consuming to result in anything near a profitable repair job.

The big question is: Why are there more complaints of this type each year? There are two answers:

1. The number of AM broadcast stations on the air has increased tremendously. With so many signals being transmitted, a sensitive receiver must be in perfect alignment to prevent station mixing.
2. With the introduction of FM radios in automobiles, fading occurs when the receiver is in the 25-mile fringe area of reception. Defective tuned circuit components or poor alignment shows up quickly under these conditions.

Initial checks for mixing or fading should begin with the car antenna. Tune the radio off station and whip the antenna mast. If even the slightest noise is generated, check for loose connections or poor grounds, and replace the antenna if necessary. A check for leakage between the center wire and the shield using an ohmmeter is also useful, but a megohmmeter is required if the test is to be conclusive.

One item that *must* be checked on a complaint of this type is the antenna trimmer (AM receivers). This adjustment is often overlooked by both the factory and the installing automobile dealer. Fig. 1 illustrates a "hidden" location of this adjustment on some current models; removing the tuning and dummy knob exposes an entrance hole

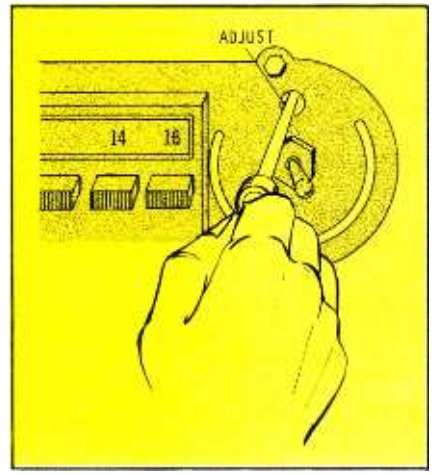


Fig. 1. Correct adjustment of antenna trimmer will improve reception.

through the dash of the automobile. Most models have the antenna trimmer located on the back of the receiver, usually close to where the antenna plugs in.

The adjustment is made by tuning the receiver to a very weak station, or noise, in the range of 800 to 1400 kc. The trimmer is then set for maximum signal or noise. A definite peak should be obtained with the screw neither extremely loose nor tight. This adjustment should be made with the antenna at its usual height and 30″ is a good height. This adjustment is also a secondary check as to whether the

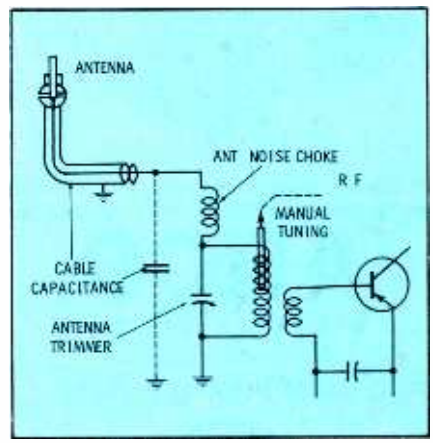


Fig. 2. Antenna coil circuit is most efficient when trimmer is peaked.

antenna is good. Any antenna that does not peak may need to be replaced. (By the way, antenna-trimmer adjustments are not made on FM, but a 30″ antenna height gives best performance.)

You are probably wondering why such a simple adjustment can have such a marked effect on station mixing and fading. Fig. 2 illustrates that the antenna and cable capacitance (no two antennas are equal) is part of the resonant antenna coil circuit. If the antenna trimmer is not adjusted correctly, one of the five tuned circuits in the receiver is thus rendered useless. To make matters worse, there is always the possibility that it may be misadjusted to accentuate the very station that is interfering with your listening enjoyment.

AM IF Alignment

If the receiver sensitivity is near normal and no obvious defects are apparent, alignment can be a good troubleshooting technique. There are those who still refuse to use test equipment for alignment, preferring a station signal instead; but with broadcasting conditions being what they are today, this is not wise except for very cheap, low-sensitivity receivers.

The modulated IF signal from a generator can be connected to the antenna jack, provided the receiver is not completely out of alignment. Turn the receiver dial to the high end, and connect an AC voltmeter to the speaker voice coil. Using a weak generator signal (.5- to 1-volt reading on the meter, with volume control turned up), align each IF coil. Touch up each coil several times until no further improvement can be realized (the sequence is not important). Carefully note the sharpness of the peak; a broad characteristic is a good tipoff to

trouble. Replace any coil whose action is erratic, does not peak, or does not produce a *sharp* peak.

FM IF Alignment

FM IF alignment does not have to be complicated. Fig. 3 (point A) shows where to connect a DC voltmeter for a dependable output indication. An accurate unmodulated 10.7-mc signal can be connected to the antenna jack, with the generator output adjusted for a reading of *not more than 1 volt* on the meter. The AFC is grounded out, and the manual tuning is set to the high end of the dial.

Working toward the antenna, adjust the ratio detector *primary* and each IF coil for a peak reading. Be sure to keep the signal level below a 1-volt reading. FM IF coils should peak very sharply in automotive receivers, so be on the lookout for offenders. Defective coils can be accurately spotted by this alignment check, even though they are practically impossible to detect by resistance readings (except, of course, a completely open winding).

After the IF adjustments have been made, the radio detector *secondary* will have to be adjusted for zero with a DC meter connected at point B in Fig. 3. When the adjustment is rocked back and forth, the voltage should swing positive or negative on each side of the zero point. Failure to achieve exact zero will result in distorted sound.

Tuner Adjustments

AM Tracking Checks

Tracking is a term used to indicate the accuracy of a receiver's alignment at various points on the dial. A perfect receiver would have the antenna, RF, and oscillator circuits exactly coinciding for all stations across the dial. In reality, the three tuned coils are never exactly the same in every radio, so some error is bound to exist.

The three tuned circuits, shown in Fig. 4, usually have coils that are wound in a special manner to spread the stations out on the upper half of the AM dial. Since they are wound with more wire on one end of the coil, proper tracking is more difficult to achieve.

Fig. 5 illustrates by the use of "phantom" pointers the locations where each tuned circuit reaches resonance. When the circuits are "out of track," this spreads out a portion of the dial, allowing adjacent stations to interfere. The following steps must be taken to determine if the tuner is tracking:

1. Connect the modulated signal generator to the receiver antenna jack through the dummy antenna recommended for the set. A dummy capacitor is usually used to stimulate the loading effect of an antenna connected to the input circuit.
2. Connect an AC voltmeter across the speaker for an output indicator.
3. The oscillator slug setting is usually set up at some standard slug depth—see Fig. 6. For example, 1⅜" from the back of the slug to the rear of the coil form is commonly specified as a starting point. This is measured with the dial tuned to the extreme high frequency end. The slug depth should be checked before alignment, since the alignment you do may have to be completely redone if you later discover the oscillator slug has been tampered with.
4. With the receiver tuned to the high frequency stop, set the signal generator for 1615 kc (varies on some models). The volume control should be set at maximum. Using a weak signal, tune the oscillator, RF, and antenna trimmers for maximum. All circuits should now be tuned exactly to 1615 kc.
5. Move the signal generator dial to 600 kc. Manually tune the receiver to the generator signal using the output meter as an aid. Readjust the generator output if necessary to keep the signal weak.

The receiver is now on 600 kc; but, unless tracking is perfect, the antenna and RF circuits are prob-

•*Please turn to page 83*

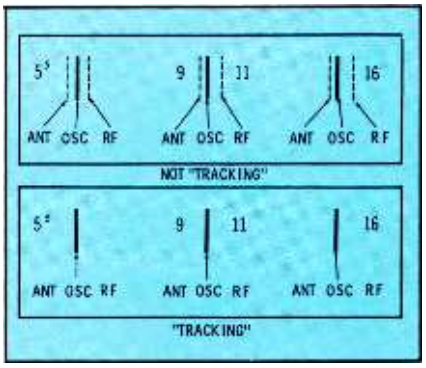


Fig. 5. Adjacent stations interfere when radio circuits aren't tracking.

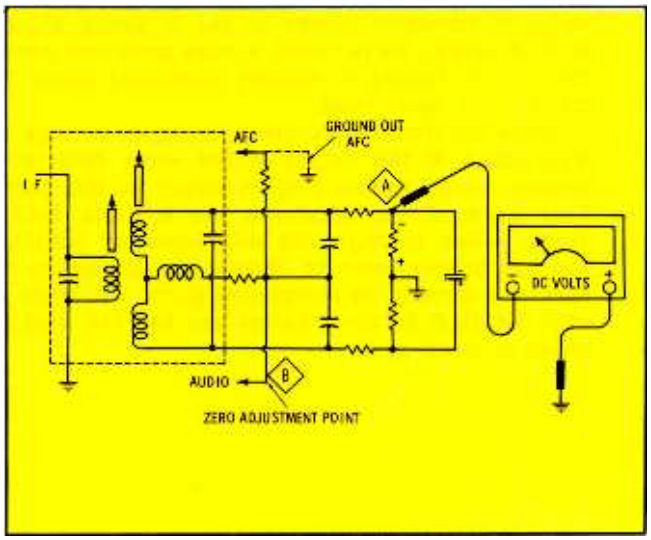


Fig. 3. Connect VTVM to detector output during alignment.

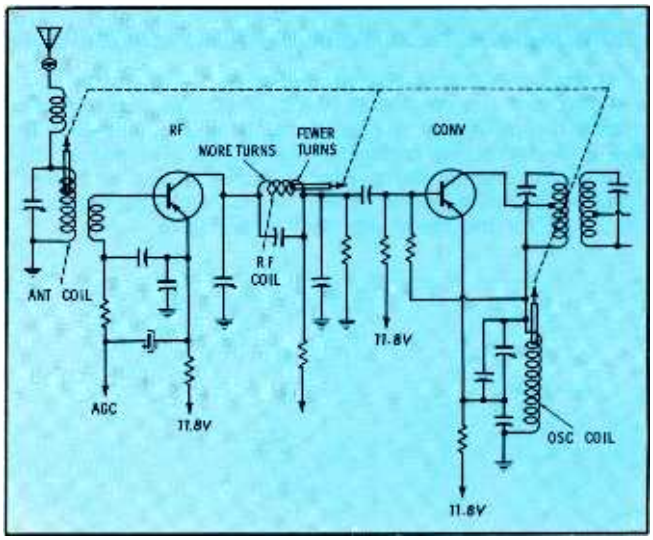
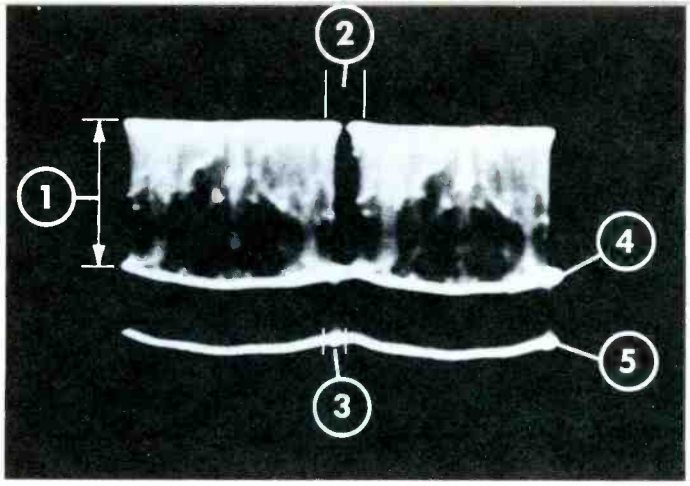
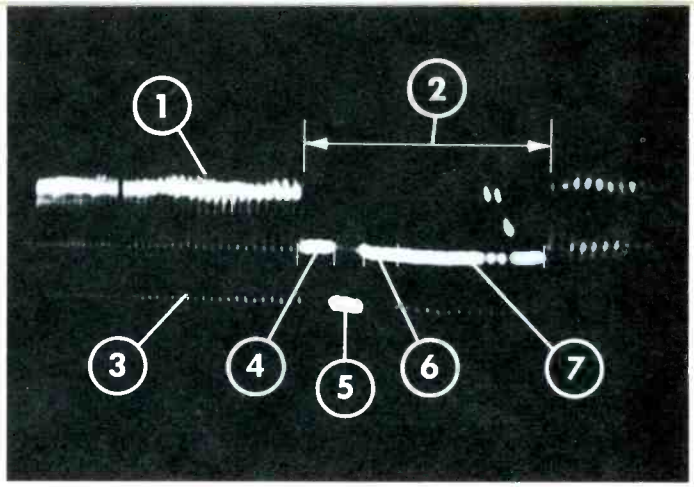


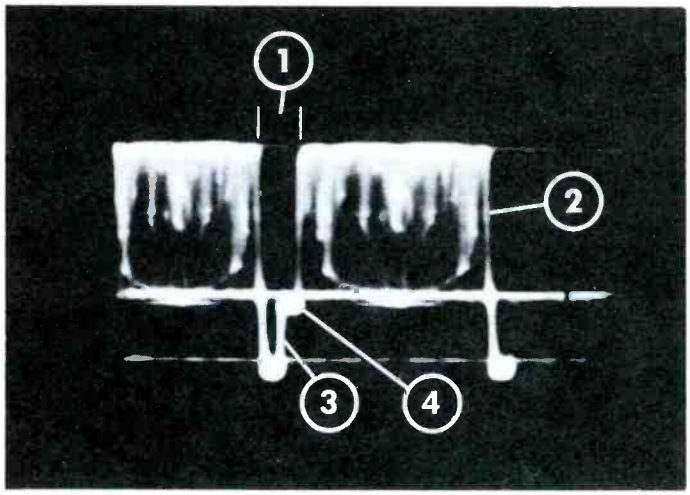
Fig. 4. Align antenna, RF, and oscillator for good tracking.



This is the normal vertical-rate composite waveform showing the various individual components that make up the video signal. (1) video region—top is white level, bottom is black level; (2) vertical-blanking interval; (3) vertical-sync-pulse tip; (4) bright trace from horizontal-sync pedestals; (5) bright trace from horizontal-sync-pulse tips. Sweep frequency of the scope is set at exactly 30 cps.



Same composite signal, except sweep rate is 60 cps and horizontal gain is expanded to show vertical-sync-pulse area. (1) Video region; (2) time of vertical-blanking pulse; (3) horizontal-sync-pulse tips; (4) leading equalizing pulses; (5) tips of serrated vertical-sync pulse (serrations not visible); (6) trailing equalizing pulses; (7) horizontal-sync pulses present during the vertical-blanking period.



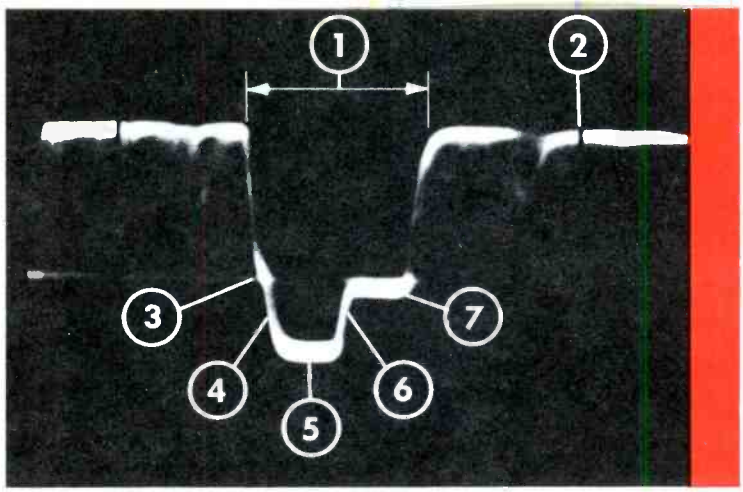
The scope's sweep frequency has now been changed to 7875 cps to present two horizontal fields so we can examine the horizontal components. (1) Horizontal-blanking interval; (2) video information; (3) horizontal-sync pulse; (4) back porch of the horizontal-sync pulse. For this waveform, as for others in this series, the scope is synchronized internally, and sync level is set for the steadiest, most stable trace.

WAVEFORMS

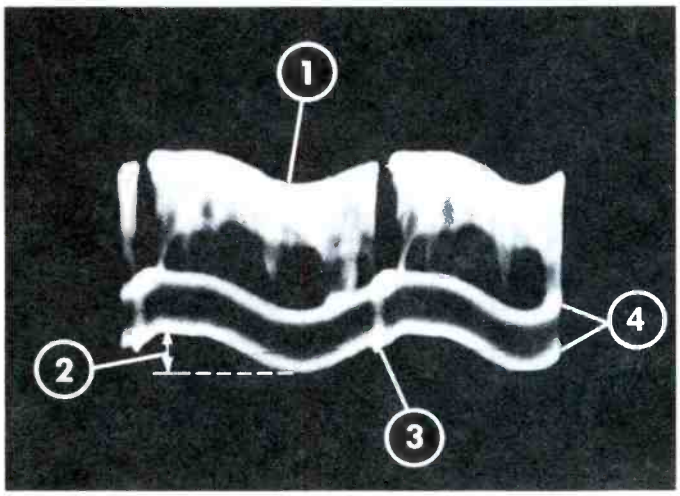
Save Analysis Time

Last month we presented a practical and useful series of waveform photos to aid in sweep alignment of TV IF stages. We're taking a more analytical approach this month, hoping to provide additional useful information at a basic level.

These waveforms were taken, using an average shop-type scope, at the output of the video detector with various sweep frequencies as noted in the captions. They represent the waveforms you will find, both with proper scope settings and with incorrect settings, so you can quickly learn to observe the composite waveform and identify its component parts. You must know what SHOULD be there before you can tell what's distorted or missing.

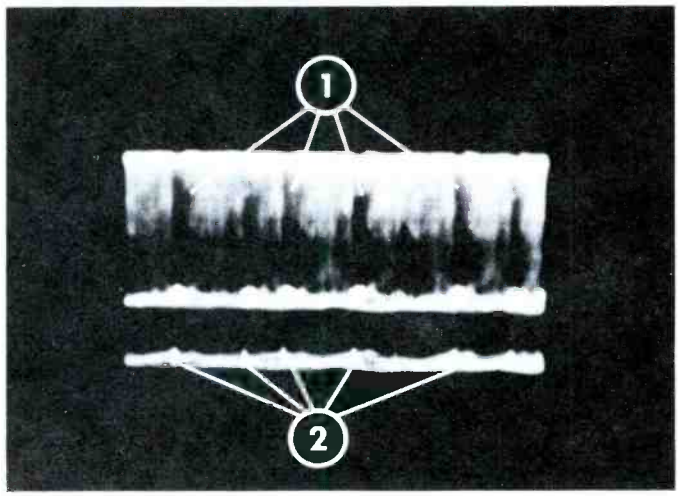


Same as photo 3, except that sweep is 15,750 cps, to obtain one field, expanded to show the horizontal-sync pulse. (1) Horizontal-blanking interval; (2) video region; (3) front-porch notch; (4) leading edge of sync pulse; (5) sync-pulse tip; (6) trailing edge of sync pulse; (7) back porch. Some scopes may give greater or lesser definition of the pulse, but all components of the composite signal can be identified.



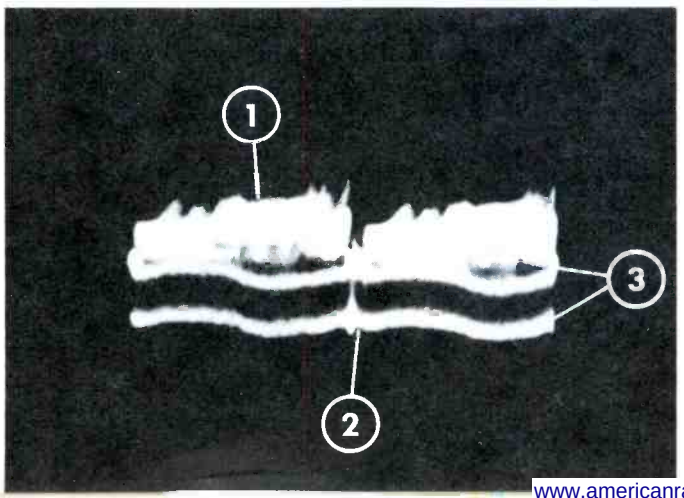
This signal waveform was taken under the same conditions and with the same scope settings as in photo 1, except that excessive 60-cps hum is present. (1) Video information; (2) maximum excursion of 60-cps distortion; (3) vertical-sync-pulse tips; (4) horizontal-sync-pulse pedestal and tip traces. Hum of this level would cause objectional distortion on the receiver's picture tube. The hum would appear as bars.

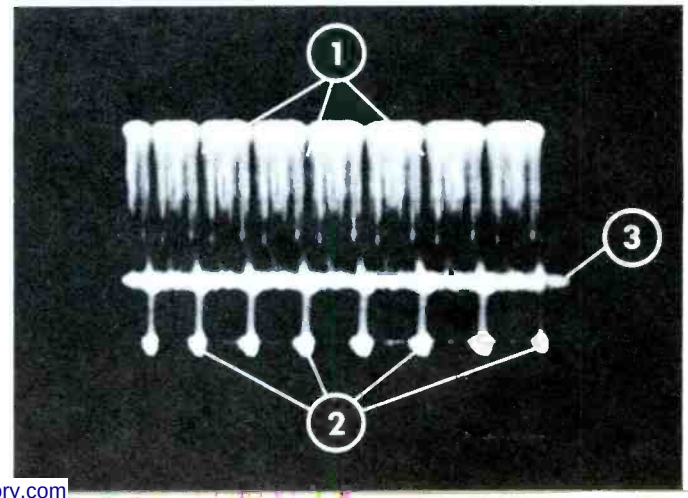
This waveform might be obtained where trouble exists in the front-end of the receiver. Snow (noise seen as hash or grass in waveform) indicates RF problem. (1) Low-level video information indicates poor signal-to-noise ratio; (2) vertical-sync pulse is down in the noise level—may cause rolling; (3) horizontal-sync pulse is also in noise, but picture should hold horizontally. Sweep frequency is 30 cps.



If you see something like this when scoping for a vertical-rate trace to check the vertical components of the composite waveform, the answer lies in selecting the correct sweep frequency. Waveform was obtained using a slower-than-normal sweep frequency. Remember: 30 cps for two vertical fields, 60 cps for one field. (1) Vertical-blanking pulses; (2) sync-pulse tips at random intervals on lower trace.

Wrong sweep frequency will cause as much grief in trying for a horizontal-rate display as in the vertical display shown in photo 6. This unsynchronized display was obtained at a sweep rate of approximately 1700 cps. Remember: Use a sweep frequency of 7875 cps for two horizontal fields, 15,750 cps for one. (1) Horizontal-blanking pulses; (2) sync-pulse tips; (3) indefinite pedestals.





ShopTalk by Stuart Hoberman

LINEAR SWEEP FOR FLAT CRT's

The "flat-face" or bonded-shield CRT offers many advantages over the conventional rectangular, curved-face tube. From the consumer's standpoint, the bonded-shield CRT reduces glare and reflection, increases contrast, permits easier cleaning of the screen, and provides a more uniform, larger image area.

The conventional rectangular CRT uses a separate safety glass that has a number of disadvantages, not the least of which are the two additional surfaces which collect dust and require periodic cleaning. A comparison between the conventional tube and the bond-shield CRT is shown in Fig. 1. The conventional tube (Fig. 1A) has a total of four reflecting surfaces. In addition to dirt and dust collecting on these surfaces, the picture contrast is diminished by reflected light. The bonded-shield CRT, with special construction for the safety glass, has at best only two reflecting surfaces (Fig. 1B) which do not permit dust to collect, reducing glare and increasing contrast. Four basic types of these tubes are available.

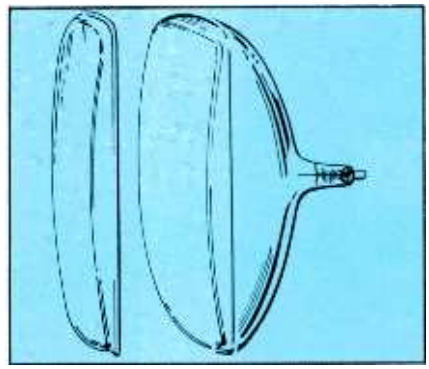


Fig. 2. Contoured-cap shield is laminated to the CRT face using epoxy resin.

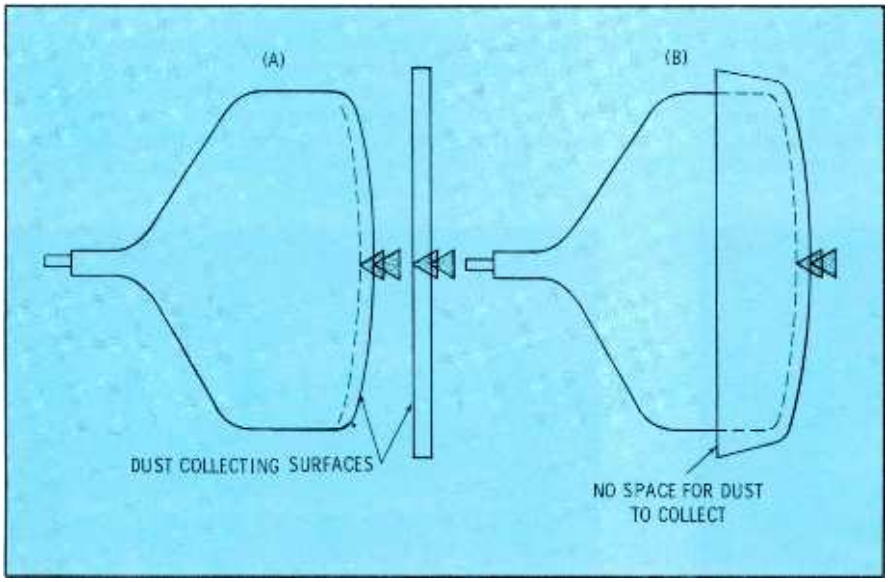


Fig. 1. Bonded-shield CRT's eliminate two dust-collecting surfaces from tube.

Construction

The bonded-shield (contoured-cap) picture tube shown in Fig. 2 uses a permanently bonded wrap-around glass panel attached to the picture tube at the factory. When this CRT is placed in a receiver, no additional safety glass is needed. A cut-away view showing the construction of the bonded-shield tube is shown in Fig. 3. The contoured glass shield is manufactured separately, with an inside contour that corresponds to the contour of the picture tube and is bonded to the CRT using a special resin. The cap becomes an integral part of the tube.

The epoxy resin used to bond the glass shield to the CRT face has the same index of refraction as the picture tube and glass cap to avoid distortion of the television image. With this type of construction, the only surface which can collect dust or dirt is the front of the wrap-around panel. Since this is exposed, and is actually the viewing surface itself, cleaning the face is a simple matter for the set owner.

Aside from eliminating the dirt problem and reducing glare, three other improvements are noticeable:

1. The CRT screen presents a larger viewing area as well as a larger viewing angle.
2. The screen is flatter, providing less curvature distortion.
3. The picture contrast is improved. When the curved screen of a conventional picture tube is fully scanned, the corners are "over-scanned" as shown by the shaded areas in Fig. 4A. Electrons striking the walls of the CRT bulb are reflected to the screen; the result is reduced picture contrast, particularly at the corners. The straighter sides and squarer corners of the bonded-shield-type CRT appreciably reduce the amount of corner-scan (Fig. 4B) improving picture contrast.

Three other similar CRT's also provide a safety shield. One type uses a bonded-on glass panel similar to the basic bonded-shield, except that it does not have a wrap-around cover glass. As shown in Fig. 3B, a glass panel fits over the front surface and is bonded to the tube. A

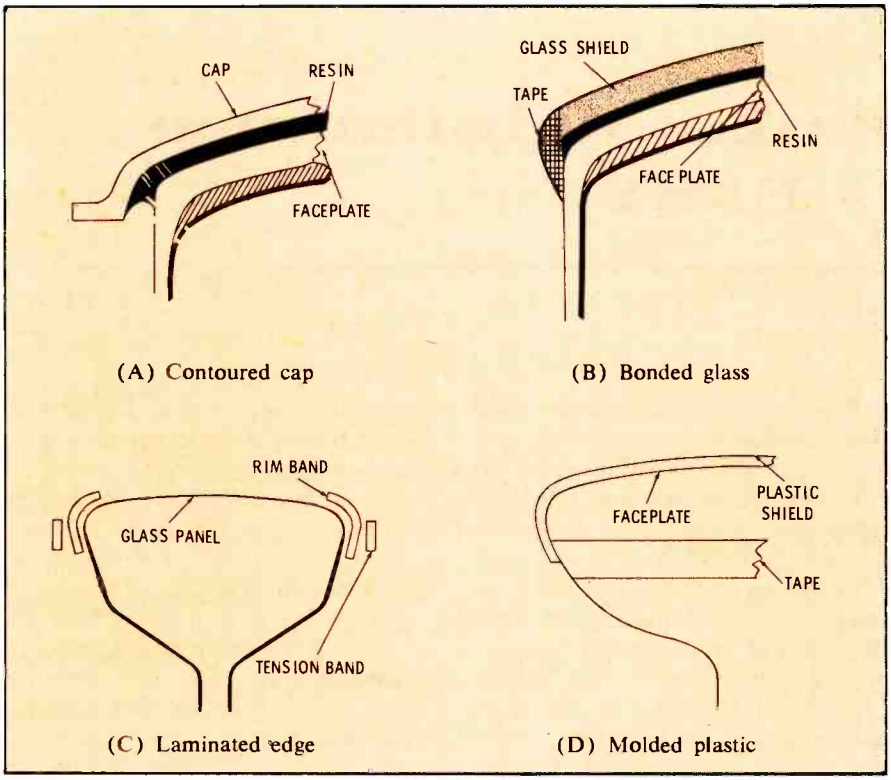


Fig. 3. Bonded-shield CRT's are built using one of the four methods shown here.

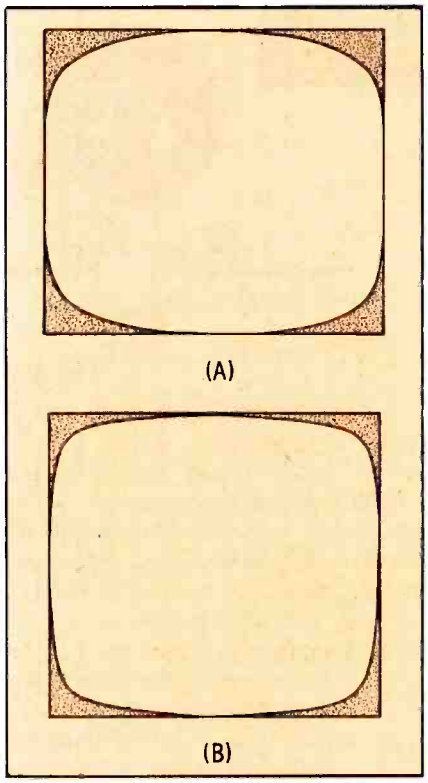


Fig. 4. Shaded areas show overscan on conventional (A); bonded (B) CRT's.

cavity is formed, usually by plastic tape, between the face-plate of the CRT and the cover glass; this cavity is filled with a laminating resin.

Another type uses a laminated fiber-glass band which is bonded to the reinforced tube bell but does not cover the front surface of the CRT. As shown in Fig. 3C, a steel band holds the glass faceplate in position behind the lip of the fiber-glass rim band.

The CRT (Fig. 3D) using a plastic-laminate faceplate is also similar to the original bonded-shield, except that a plastic rather than a glass shield is used. This laminated plastic sheet is vacuum-formed so that it completely covers the CRT face and wraps around the edges. This type of CRT is commonly used in portable TV sets where weight saving is an important consideration.

Mounting Techniques

Mounting techniques for the flat-face CRT are more or less standard, the only possible exception being that used to mount the original bonded-shield CRT. Four lugs, or ears (one at each corner of the glass faceplate), are fitted into cabinet-mounted sockets and clamped in place to secure the tube. A note of CAUTION here: when replacing this type of CRT, *make sure* that the four lugs are properly seated before the mounting clamps are tightened. This will prevent any possibility of damage due to uneven stresses on the CRT itself.

Sweep Circuits

Sweep circuits used with conventional CRT's having convex faceplates rely on a linear sawtooth sweep waveform to obtain a linear sweep. However, because of the flatter face of the bonded-shield CRT, an "S"-shaped current waveform is needed to provide linear sweep through the central region of the screen. Pincushion distortion in the corners (due to the increased radius) is corrected in the yoke by shaping the coils to produce less deflection at the edges of the CRT.

•*Please turn to page 81*

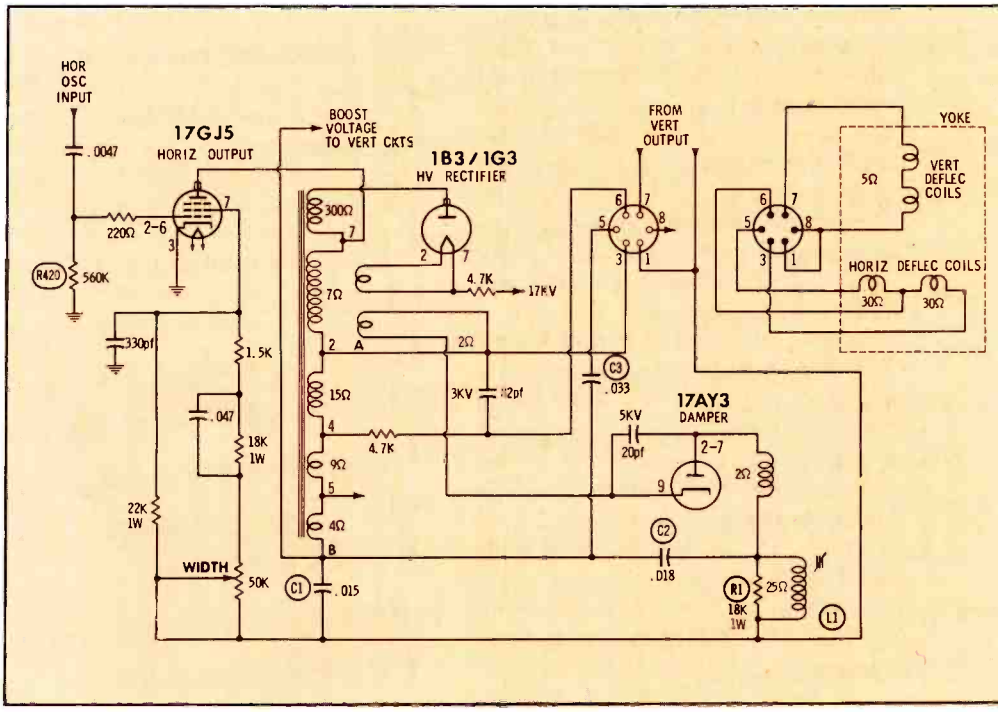


Fig. 5. Compensating network C1, C2, L1, and R1 provides proper sweep.

Servicing Industrial Electronics
by
Forest H. Belt

Radar Maintenance is EASY

In the search for a line which could be profitably added to the service load of any shop, certain special types of equipment are often passed by. Sometimes this is intentional; more often it results from just not being aware that a market for such service exists.

Why would a potential market for service be intentionally passed up by many technicians? The answer probably lies in the psychological "fear of the unknown." Lack of familiarity with seemingly complex circuits, lack of knowledge as to how to go after the new line of business, constitute the major facets of this "fear."

Such an orphan in the servicing field is marine electronics. A few technicians who live near oceans, lakes, or rivers have discovered a multiplicity of electronic equipment and instruments that need servicing on board the ships and boats that ply these bodies of water. Intercom systems, ship-ship and ship-shore radio-telephones, depth sounders, radio and television receivers, and radar systems are all in constant use on ocean vessels, lake tankers and ore carriers, riverboats, and pleasure yachts. This field of service is little understood, possibly because much of the equipment is not a type which a customer will carry into the service shop; but, then, neither is television, generally speaking. Service calls must be made on marine equipment, the same as on home TV sets.

Of all the electronic systems on board ships, the radar system is probably the least understood by the average TV technician, yet is in need of service as often or more often than probably any other unit on the ship. Competent radar technicians are so difficult to find that some boat companies even have to hire and train their own electronic staff to maintain equipment on their own ships; other radar servicing is done by field representatives of the manufacturer, or by a very few large companies that specialize in marine electronics servicing.

In this series of three articles, we shall try to overcome any fear you may have of this unknown gear, replacing unfamiliarity with knowledge, by discussing (1) the ways and means of getting this service business, and from whom, (2) the technical characteristics of the equipment which the service technician is likely to encounter, and (3) how to actually go about servicing a typical marine radar system.

Where and When?

Where must these service calls be made? To answer poses the question—who uses marine radar? As the name implies, marine radar systems are installed on boats. The marine radar system is a surface-search radar which is capable of showing land, other boats, channel markers, and other "targets" in a way usable to the navigator of the boat. Therefore, radar sets are used on boats plying our inland waterways, the Great Lakes, and the Gulf and Coastal waters of our country. In addition, ships using our ports as terminals for ocean voyages almost invariably carry radar equipment. So, to answer the question of where, we can say service calls must be made on board a ship or boat, or at any point where it is likely to dock.

Here's a deck-mounted radar indicator.

Now, lets go into a bit more detail about the peculiar problems of servicing boats at these various locations. River craft, which includes commercial towboats and pleasure yachts, quite often use radar. A survey last summer of commercial boats passing a certain point on the Illinois Waterway System during a given period showed well over half the commercial boats equipped with radar systems, and a significant number of pleasure craft so equipped. This proportion goes even higher on lakes and larger rivers, especially the proportion among pleasure yachts.

In making service calls on commercial towboats, their schedules must be taken into consideration. These boats can pick up a technician at some point, he can work on the equipment while under way, and he can disembark at another dock which he finds convenient along the river. Occasionally, a river boat can be serviced while tied at some dock to discharge cargo, exchange a barge, or while in drydock for other repairs. The important consideration for the technician is meeting the schedule of the boat; the boat operator can more economically pay the technician to meet the boat's schedule, than he can pay an entire boat crew to stand by while the technician completes some repair.

The many pleasure craft that have been equipped with radar since the advent of relatively inexpensive radar systems can usually be serviced in a yacht harbor or at any docking facility, and schedules are not so important. This is not to say the yacht owner deserves less prompt

service, but time demands on the technician are less.

On the Great Lakes, the percentage of pleasure craft that are radar-equipped is much larger than on rivers. The service-call circumstances, however, are the same as with river-based yachts, and may be handled in the same manner.

Also on the Great Lakes are found the huge fleets of ships carrying iron ore, coal, limestone, petroleum products, and other commodities between lake ports. And since the opening of the St. Lawrence Seaway, ocean-going vessels, both domestic and foreign, are becoming commonplace in lake ports. These ships are almost invariably equipped with radar systems; and more recently the trend is toward two radar systems on a ship—one large radar system, and a smaller one for emergency use if the larger one should fail in a critical situation.

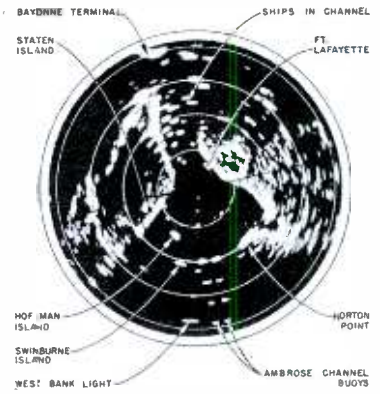
The servicing of lake and ocean ships must necessarily take place at dockside, while the ship is discharging or loading cargo. Some are dockside as little as three or four hours, while others require two or three days, sometimes even a week, to load or unload—depending on the ship, the cargo, and the dock facilities.

Who?

Who is in the market for this type of service activity? Superficially, we have already answered this question: the boats who are radar equipped. But from a practical standpoint, the answer is more involved, because the independent service technician needs to know who to see about obtaining this service business, and which boats and ships are in need of service facilities. Here's a bit of background about the business as it exists today.

Radar systems are installed in commercial boats under two general plans—leasing and purchasing. The major manufacturers of marine radar systems have developed plans for leasing their equipment to users. This was prompted by two important considerations. The first involves the bookkeeping and tax people; the second concerns servicing.

Frequently a ship-owner prefers to own his radar equipment, and almost all pleasure-craft installations are owned by the user. In these



Radar paints map of New York harbor.

cases, the owner must either arrange with independent service people at points where his boats visit, or he must use personnel provided by the manufacturer. Often, either of these are too few and too far to take care of servicing needs promptly. The answer would be *competent* (I stress that word as it is the key to the service problems of these customers) service technicians at any point not covered by the manufacturer (and at some points that are).

Finding Business

The following suggestions are offered for any service technician who is interested in looking into marine radar servicing activity and its possibilities:

(1) Find out if the major manufacturers of marine radar systems have a service facility at or near your location (see List of Manufacturers—Table 3).

(2) Contact the manufacturers to determine if they are interested in providing service at your location. Some manufacturers are interested in establishing service agents at key locations to take care of servicing needs of their customers in the area.

(3) Make a survey of the boats touching (or passing) your location; then contact the owners to determine if they would be interested in using competent service facilities if such facilities were available. Many are interested. Owners of commercial vessels are listed in marine directories published by companies specializing in compiling such data. Typical are: Inland River Record, 121 River Ave., Sewickley Pennsylvania, and Marine Engineering/Log, 30 Church St., New York 7. Ocean vessels and

Table 1. Tubes used in radar systems

Notes:
Where quantities are not shown, item is magnetron or cathode-ray tube, not recommended to carry in stock unless service volume warrants.
Quantities are recommended tube-caddy stock for one technician, and are for a guide when all popular makes are serviced.
RA—Raytheon RCA—RCA Service Co., Radiomarine Division
SP—Sperry-Piedmont
* Industrial types available from distributors—see text.

2	OA2*	2	6AG7		10KP7A RCA
1	OB2*	5	6AK5		10WP7 RA
2	OC3*	2	6AL5		
2	OD3*	1	6AN8	2	12AT7
		2	6AQ5	5	12AU7
2	1B3GT	2	6AS6, RA, RCA	2	12AX7
1	1B24A RA, RCA	2	6AS7, RA, RCA		12DP7A RCA
1	1B35 RA, RCA	2	6AU5	1	12DQ6
2	1V2	2	6AU6		
2	1X2A/B	1	6AW8A		16ADP7 RA, RCA
		1	6BG6G		
2	2D21W*	2	6BQ7A	1	KU-99/3C45 RA
	2J42 RA	5	6CB6	1	721B/BL696 RA
	2J55 RA	1	6CD6G		725A RCA
	2J70 RA	2	6D4*	2	807*
1	2K25 RA	2	6EW6	2	866A*
2	2X2A*	1	6J4*	1	1641/RK60 RA
		2	6J6	1	5642 SP
2	3B24W RA	2	6L6G	1	5651*
2	3B29 RA	1	6SH7GT	1	5670*
		2	6SJ7	1	5687*
1	4C35A RA	1	6SL7WGT*	1	5692*
1	4PR60 RA, RCA	5	6SN7WGT*	1	5704 RA
		1	6X4	1	RK6043 RA
3	5R4GY*	2	6Y6GT/G	1	8013A RCA
2	5U4GB		5ADD7 SP		
2	5Y4G		7ABP7 RA		
2	5Y3GT		7BP7A RA		
			7MP7 RCA		

Table 2. Tools for servicing radar

Screwdrivers	**Miscellaneous**
Setscrew	Allen wrench set
Stubby standard	Bristol wrench set
Stubby Phillips	8" crescent wrench
Regular Phillips	Misc. alignment tools
Regular standard	Neon tester bulb
Long standard	AC-DC soldering iron
Nut Drivers	Flashlight and spare batteries
Set of 3/16 through 7/16	1/4"—drive rachet set, with
Stubby—1/4, 5/16, 3/8	sockets to 5/8", and std.
Long—1/4	and flexible extensions
Pliers	Klystron tuning tool*
Diagonal cutters	Fuse puller
Long chain nose	
Snipe nose	
Gas-type	
Channellocks	

* RCA has a tool which combines the klystron tuning tool with a tool for removing crystals from their special mounting in the RCA sets.

lake boats are best contacted through their agents, and in transportation guides. Pleasure yachts are now almost all registered by number with the Department of Conservation in their state.

(4) Contact harbor-masters, tug operators, ship stores, and ship hardware dealers to discover what boats frequent your area; these businessmen can usually help you contact the captains, owners, or operators of the ships.

(5) Pleasure-craft owners are easily contacted through the yacht harbors they use, through local yachting clubs, and units of Power Squadrons and the Coast Guard Auxiliary. When arrangements are made with a manufacturer for handling their service agency in an area, the manufacturer usually refers all pleasure-craft service requests to the agent as well as those for commercial service.

Now, suppose you have made the necessary inquiries, and have come to the conclusion this would be a profitable addition to the services your shop presently offers. Your next question should be, what do I need to perform this service, in addition to electronic parts I already stock, and equipment I already have? You will need: a technician with a Second (or First) Class Commercial FCC License with radar endorsement; a stock of special-purpose tubes of certain types (listed in Table 1); a set of tools (listed in Table 2), some of which are special for radar systems; a volt-ohm-milliameter and a good portable oscilloscope; and service manuals for the radar systems you will be servicing.

The technician need only be a conscientious, courteous person with a good grounding in electronic fundamentals, experienced in trouble-shooting electronic gear, willing to dig into a piece of equipment to locate trouble, and capable of doing a neat, practical job of completing a repair. His radar experience need not be extensive, but a knowledge of radar circuits must be acquired. Of course, he must have the necessary license and endorsement, but the endorsement is simple enough to get; he must merely pass a short test covering Element 8 of the FCC commercial examination.

The special-purpose tubes listed in Table 1 are usually available from any supply house specializing in industrial-type tubes. Those types are marked with an asterisk (*). The tubes best obtained from the radar manufacturer are accompanied by the initials of the manufacturer. Recommended caddy quantities are given, but the technician must be guided by the equipment he services most. The remainder are common receiving types found in any electronic supply store.

Radar indicator near pilot's position.

Tools listed in Table 2 are commonly found in any television service caddy, with the exception of some of the heavier tools used for mechanical work on radar systems.

The test instruments listed, the VOM and scope, are all that are needed for 99% of the service jobs encountered. The few other troubles that occur (we shall mention a few in Part 3) are best left to manufacturer engineers for servicing under controlled conditions with special equipment. The scope, while not absolutely necessary, can be a great time-saver on certain service jobs.

Service literature is provided by all manufacturers of radar systems. Service manuals are very complete on most equipment, and well worth their nominal cost. Binders of schematics alone are available from some manufacturers for certain models, and are handy to carry along after the technician is thoroughly familiar with the adjustment and tube-changing instructions found in the more complete service manuals.

Pricing

Having equipped ourselves with the necessary tools, supplies, knowledge, and some potential customers, how do we go about pricing our new service so we can realize a profit? Among TV and radio technicians, the most-oft-repeated misconception about the commercial marine electronic servicing field stems from this question. In most cases, this misunderstanding is the result of being unaware of billing procedures used in commercial servicing.

For comparison, we shall take an example from television service billing practices. The customer phones for a service call, wanting his television set repaired. The technician has a fixed charge, the "service-call charge," which applies no matter where the specific location of the call (except in some large cities). This charge, if the technician expects to survive, is sufficient to cover the following items: an average amount of time to travel to and from the call, an average amount of car mileage covered to and from the call, and an average amount of time to complete the repair or decide to

• *Please turn to page 79*

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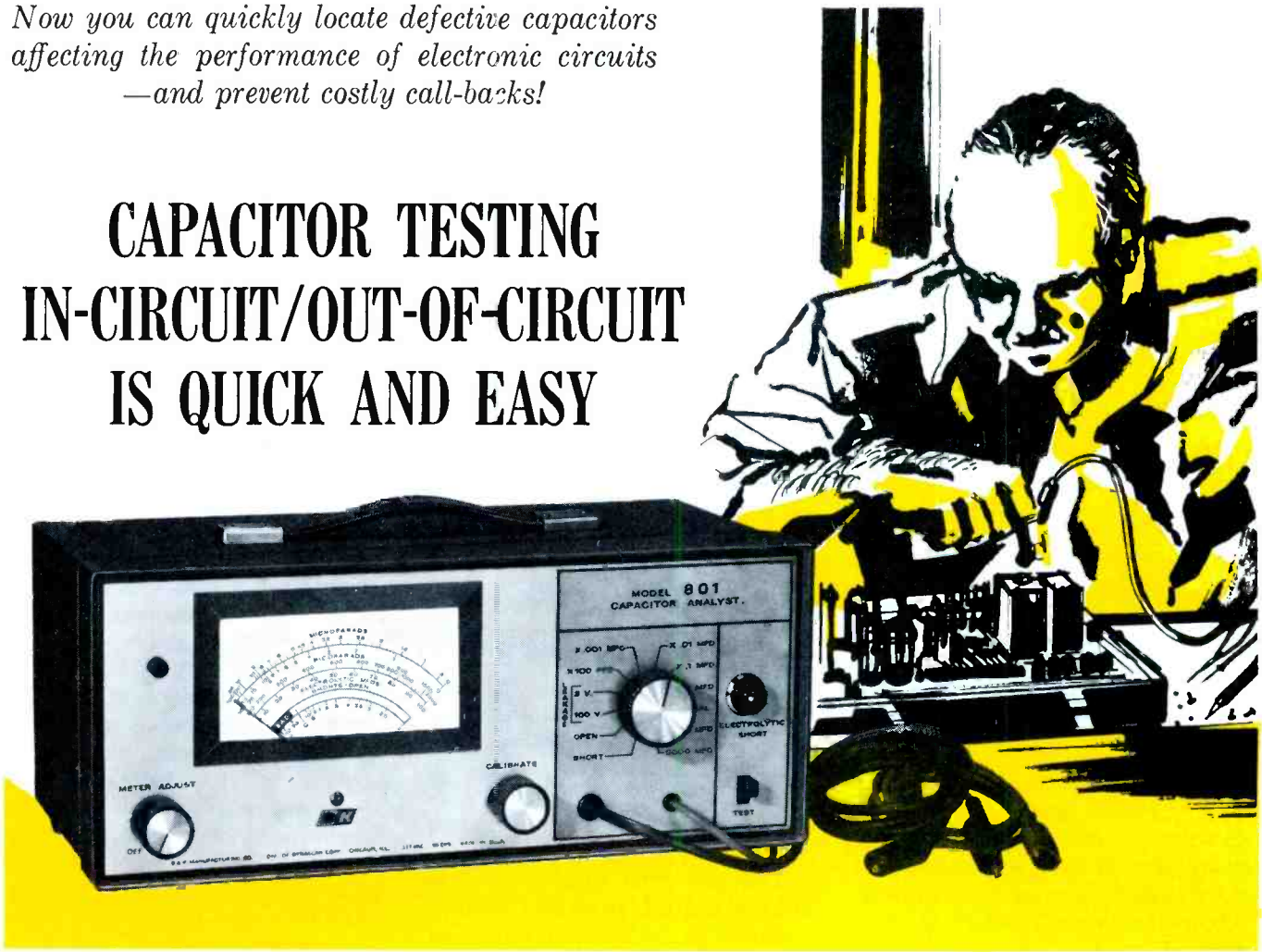

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CATV REVISITED

Report: Current happenings in the wired industry

by Allen B. Smith

It's practically impossible these days to pick up a trade or business publication covering any phase of radio or television without finding prominent mention of CATV or of pay TV. Charges and countercharges "statistical analyses," "absolutely unbiased reports," and "expert opinions" fill the pages, and the result appears little short of total confusion. Contradictory statements in most areas of discussion suggest several things to most of us: There may be partial (sometimes it seems complete) misrepresentation on many subjects by opposing factions; there may be unintentional misrepresentation through failure to consider all facets of the situation—it has been said that confidence and authority are what you feel before you completely understand the issue; or, maybe nobody knows what the problems are or cares what the solutions may be unless they are to his advantage.

Realistically, we have to recognize that CATV systems provide a service required by some and desired by many. We must concede this fact because since 1950, more or less in spite of itself, CATV has grown into an industry that grosses nearly $1 billion a year! This kind of growth simply is not possible unless the service fills a need. The efforts of the STV pay-TV system on the West Coast indicate that unless the public is ready to accept an idea, no amount of money spent on promotion will ensure success. The ultimate demise of the STV venture may be attributed to the California state referendum that held STV to be against the public interest; but, the fact is, STV's widely publicized attempt to sell the public on pay TV, whatever its merits, was in very shaky condition long before the November ballot dealt the final blow. The public, in California at least, doesn't appear ready for that kind of TV. CATV, on the other hand, has grown tremendously, not only in areas served inadequately by local stations, but in local-station areas as well.

The July 1963 issue of PF REPORTER carried an article devoted primarily to the technical aspects of CATV systems, their reasons for being, and some situations the serviceman might experience if a cable company came to his town. Since that time, several rather thorny questions have arisen among service technicians. In the true sense, most servicemen are not too impressed by most of the questions tossed back and forth between broadcasters and CATV people, or between CATV and pay-TV groups, or even by many of those questions often discussed in much heat by CATV representatives and various manufacturers of antennas, towers, and accessories. The serviceman wants to know what a local CATV system means to him in the everyday operation of his shop, and how it will affect his financial statement. No matter how you look at that final question, it's a serious one, and a tough one to answer.

As a matter of fact, there is no *single* answer, because CATV systems vary in many ways, and so, of course, do service technicians. To clear the air a bit, however, let's examine some of the most widely encountered questions asked by shop owners who learn that a cable system has been franchised for operation in their area:

1. *I'm a serviceman who also sells television receivers. What can I expect?* This usually depends on what sort of a signal area you're in. In deep fringe areas where there is only a moderate distribution of sets, you will undoubtedly see your set sales rise. This is particularly true if you take advantage of proven merchandising methods and sell your sets convincingly. On the other hand, if CATV service merely supplements existing services, the quality of the picture delivered by the cable will greatly influence whether or not there will be a greater demand for receivers. A cable system with technical faults can be a headache for you as well as for its technical people. A first-class cable-delivered signal will undoubtedly boost sales (particularly of color)—new sets to take advantage of the improved signal, low-priced and used sets for family room or den, and those high-priced color sets for many who have been waiting long

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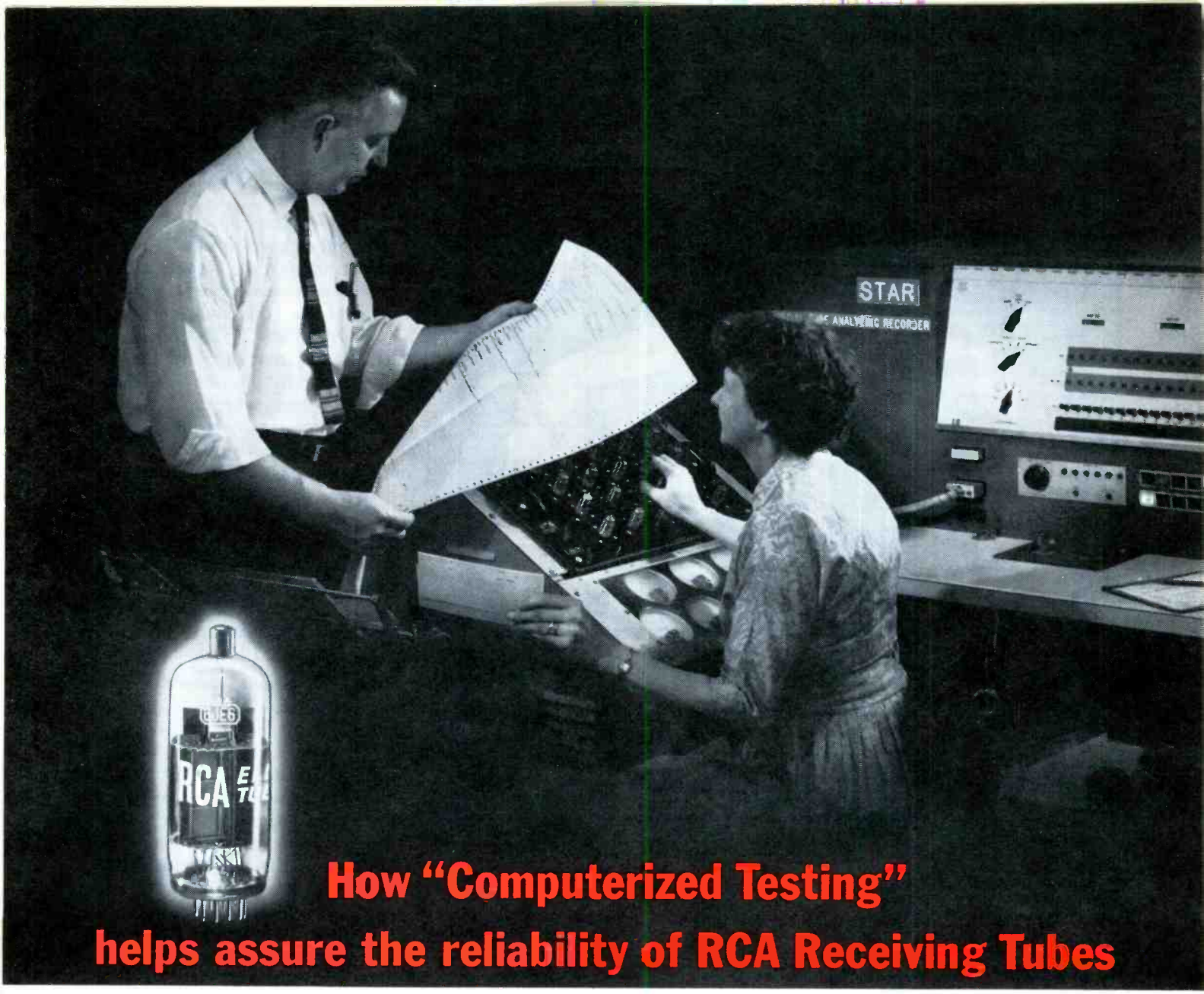
enough.

2. *If those set owners who hook up to the cable have trouble, and it is the fault of the cable system, will they bring me in on a service call I can't very well charge for?* Probably. A lot can be done to keep your temper down, however, and most CATV operators try to educate their customers to recognize where the trouble lies. Most cable technicians are interested in keeping their system operating efficiently. That's what *they* get paid for.

3. *I've heard there are often sync problems when sets are hooked up to the cable. Is that so—and if so, what do I do about it?* Yes, there can easily be sync problems, especially in deep fringe areas. With a very weak signal available at the antenna terminals, the AGC system is, for all practical purposes, out of the circuit—RF and IF sections work wide open. The standard input signal from a cable tapoff is 1000 microvolts, a strength that will (or should) pull the AGC into vigorous action. If the set's AGC system is functioning properly, there will probably be no sync problems. With AGC difficulties, however, you can expect a handful of malfunctions. See articles in these recent issues of PF REPORTER for tips and suggestions on troubleshooting AGC systems: January, March, and September 1964.

4. *What can I do if I find I'm spending too much time on unprofitable calls—calls where there's nothing wrong with the set?* This is a situation that requires a bit of old-fashioned diplomacy. First of all, as mentioned before, keep in mind that the cable folks are usually trying to keep a good signal on their system. Remember, too, that unless the set owner also called the cable office about the trouble, they may not be aware of it. So, call the chief technician and tell him how the situation looks from your standpoint. Unless he is completely unreasonable, you should be able to reach an amicable solution. It never hurts to get to know (on a personal basis) people with whom you must often deal. If you can't get satisfaction from the technical people, see the manager on a businesslike basis. You're both businessmen trying to keep a customer happy. See if you can't do it cooperatively.



How "Computerized Testing" helps assure the reliability of RCA Receiving Tubes

This engineer is studying final test results of another production run of RCA Receiving Tubes. Nothing surprising here . . . except for one thing: the production run had been completed only hours before!

A few years ago, a thorough quality evaluation of a day's production run of a certain tube type took days, even weeks. But now, at RCA, it's done automatically, with computers, the same day.

Computers in conjunction with the Special Tube Analyzing Recorder (STAR) accumulate and store test data on every receiving tube type we make.

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Thus, in a mere half-hour of running time each night, a full day's receiving-tube output can be evaluated before it is released for shipment. Equally important, the test data for any day's production of a particular tube type together with the historical record for that tube type are on the desks of the production, quality-control and design engineers the following morning. With these data, the engineers can evaluate performance, analyze trends and quickly initiate any corrective measures necessary to assure the consistent quality of RCA Receiving Tubes.

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5. *On multichannel systems, how much of a problem is adjacent-channel interference?* Once again, that depends in large part on the system and in the condition of the set. Some systems, because of inadequate engineering preparation or faults that have worked in later, do cause interference between closely spaced channels. Understandably, too, a receiver that has been used for receiving only widely separated channels may tune sloppily and allow interference. In the first situation (but first make sure that the system *is* causing the trouble), get out that diplomat's hat, and see your friendly chief technician. In the second case, tell the customer what the problem is and sell him a complete and accurate realignment. See articles in the following issues of PF REPORTER for helpful tips and techniques: September 1962, February and March 1963, and March and July 1964.

6. *Since the signal level on the cables themselves are high, can the system radiate and interfere with sets not connected to the cable?* Anytime you deal with RF at the higher frequencies you may have radiation problems. The FCC sets maximum allowable radiation limits, and these are generally sufficient to avoid a problem, if adhered to. The tapoff units and drop cables (to the individual houses) are generally the greatest offenders where excessive RF leakage exists, and since channel translating (changing the frequency of an incoming signal to another channel for cable use) can cause interference to block off-the-air signals in sets not connected to the cable, you'll undoubtedly be called in sooner or later to explain why Gunsmoke's Doc has Dr. Kildare's nurses in his Dodge City offices. Once again, the answer is cooperation. If that doesn't work, you can always get a field-strength meter, map the interference pattern, and call the FCC.

7. *What about tube replacement? I hear that the strong signal fed to a customer's set lets a lot of marginal tubes go unnoticed.* Well, that may be true, but there is still some question as to what the overall effect on tube replacement will be. At first it was thought by many servicemen in areas now served by CATV systems (and by local distributors, too)

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that tube sales were down because of the reason you mention—and they probably are, a bit. There's no question that sales *are* down, but sales are down all over the country, even in areas not served by CATV systems! Manufacturers generally attribute the fact to increased material reliability and tubes with longer lives. Improved circuit design in newer sets also puts less strain on many previously marginal tubes. So, in answer to your question, the strong CATV signal may allow a few front-end and IF tubes to get by; but, go after the rest as you should, and you'll probably not notice the difference. Picture tubes? No reason why sales shouldn't continue exactly as without CATV.

8. *Well, I'm sure going to notice a loss in antenna, tower, and accessory item business.* You sure are, and that is an inescapable fact. But selling and installing antennas is only one part of service-selling. Any good businessman must recognize the fact that, in the business world, practically nothing remains constant. Customer demands change as often as women's styles, and often for no more reason. The operator of any successful service shop knows that the way to meet competition is to try his best to get out in front; so, if you're in any area in which there will soon be a CATV system, act first—before it arrives. Determine what percentage of your antenna and tower business you *might* lose, then lay plans to develop an additional service (hi-fi and stereo, perhaps, or CB, or ham gear, or test equipment) to make up the difference. Who knows? You may not see all your antenna business evaporate, anyhow. How about FM antennas, CB antennas and towers, business-radio installations, etc?

Certainly, the answers presented here touch on only a few of the many questions that arise daily in areas where CATV cables are being strung. There is no doubt, however, that cable systems are here to stay. That they will grow and flourish in almost all geographical areas is an inescapable fact of life. If you see CATV in your future, you may now have a slightly clearer view of what to expect. But, don't forget that the greatest ally a small businessman can find is that sometimes elusive thing called ingenuity. ▲

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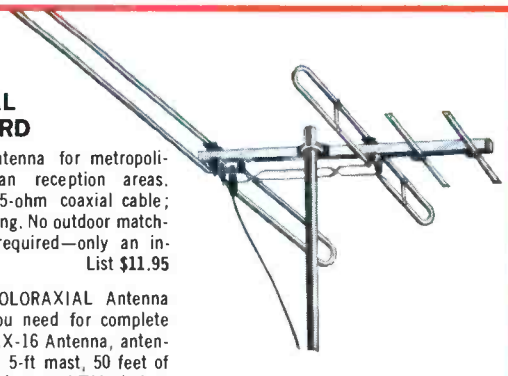

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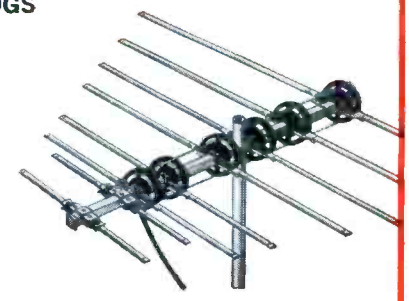

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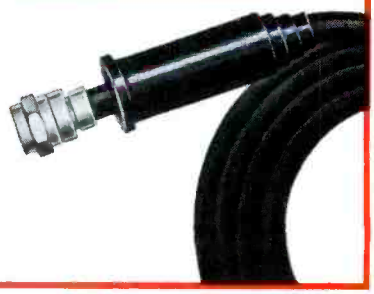

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Filter Buzz

A most puzzling type of buzz originates in equipment having multisection filters in which cathode and B+ filters are contained in the same electrolytic unit. The defect is AC leakage from one filter section to another. The only sure way the trouble can be detected is through scope tracing, for the hum or buzz caused by this condition appears with a distinctive trace that is easy to remember.

A typical example of such a circuit is presented in Fig. 1. The filter section C1C can have AC leakage to either section C1A or C1B. The positive-going ripple peak feeds the output-tube cathode, is inverted and amplified in the tube, and becomes negative at the plate. The dip seen on the plate-supply ripple waveform in Fig. 2A is the result of mixing the positive cycle of ripple with this simultaneous negative excursion from the tube. Fig. 2B shows the pulse developed

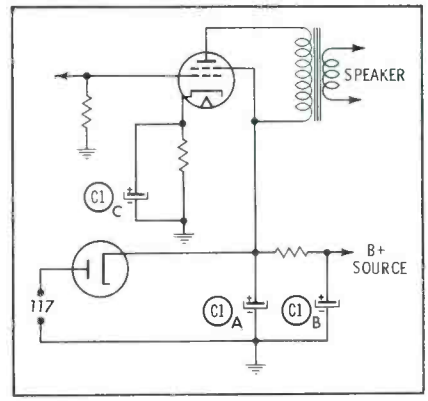
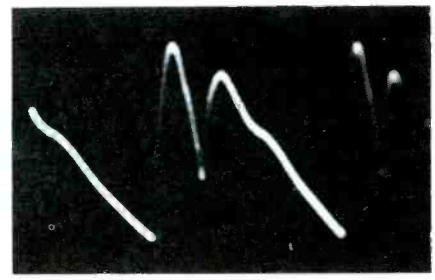


Fig. 1. Many audio output tubes have electrolytic bypass in cathode circuit.

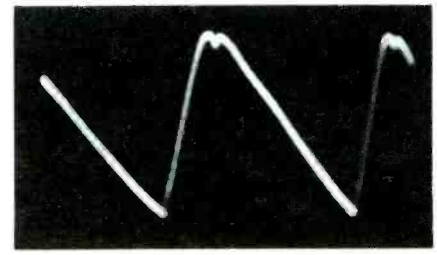
at the cathode filter C1C. Fig. 2A reveals severe intersection leakage, while Fig. 2C shows a milder amount. The hum or buzz from the speaker may be almost equal in either case, due to the harsh shaping of the waveform.

The waveforms shown in Fig. 2 are found in equipment using B + derived from a half-wave rectifier, and the waveforms have a 60-cps frequency. When it arises in full-wave rectifier systems, the traces look identical but are at a 120-cps frequency. This particular type of trouble can be encountered in virtually every kind of electronic equipment that receives power from AC lines. ▲



(A) Plate—severe

(B) Cathode—severe



(C) Plate—mild

Fig. 2. Different degrees of leakage.

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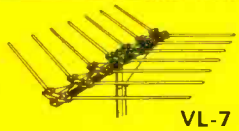

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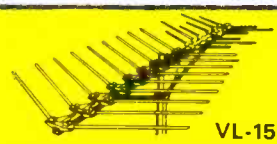

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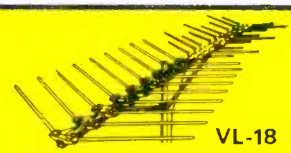

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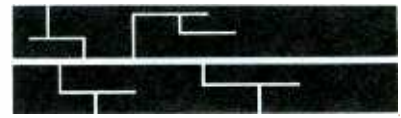

and how it works

Articles about simple resistive voltage dividers generally remind the service technician of his knowledge of basic theory. In this article, we hope to cover the operation of resistive voltage dividers with an eye to understanding ways in which voltage division is accomplished sometimes without resistors. We should be able to help you recognize several apparently complicated circuits for what they really are—simple voltage dividers.

Simple Resistive Dividers

Voltage dividers that use resistors must have at least two; it is the voltage dropped by or developed across each resistor that is thus divided. The voltage being divided by resistors can be either AC or DC. Let's assume the voltage we're considering is DC.

It would be very nice if a circuit always appeared on the schematic in its most recognizable form. However, if it did, there would be no need to learn to pick out the little rascal when it's in disguise. For example, in Fig. 1, we see three forms of the same resistive circuit. The one easiest to recognize is, of course, Fig. 1A. The various configurations of this divider do not alter its primary function. The same 250-volt potential—applied between points A and C—is felt across both R1 and R2, in all three versions.

As you may remember from Kirchhoff's law, the sum of the voltage drops across each resistor in a series resistive circuit is equal to the total applied voltage. The 250 volts we have chosen as the applied potential must be divided between R1 and R2, or else Professor Kirch-

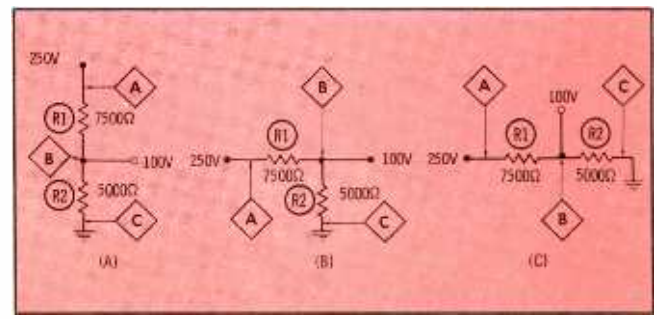

Fig. 1. Simple voltage dividers look alike, drawn differently.

hoff has been kidding us for quite a few years. We assure you—he hasn't.

Since we've taken the liberty of applying 250 volts across the two resistors, we might as well stipulate what voltage will appear at point B, also. This will be 100 volts, measured between points B and C. Notice, if you will, that the 100 volts appears between B and C in any of these three circuit arrangements.

So far, we have two resistors, with 250 volts applied across both, and a 100-volt tap between them. So what? Don't panic; an explanation is on the way—the resistors have been given values. You'll notice that R1 is 7500 ohms and R2 is 5000 ohms. Kirchhoff has served his purpose for now, so enter Dr. Frederick Ohm and *his* law. Ohm's law can be one of our best helps in the troubleshooting department. In fact, we can apply this law to almost any troubleshooting problem—if we know how. Our ultimate goal is to learn how, so . . . back to our voltage divider.

Ohm's law is stated as: E (applied voltage) equals I (current) times R (a resistance). This equation may be stated in different ways to find any one of the unknown factors. We're certain you recall that, in a series resistive circuit, current is the same through every one of the resistances (another of Kirchhoff's conclusions). Well now, that does make our voltage divider seem more understandable doesn't it? We don't have to assume a current value now—we can calculate it. Let's apply Dr. Ohm's law, changing it around to make I the unknown quantity. We thus find (by dividing 12,500 ohms into our 250 volts) that the total current flowing in the circuit is .020 amp, or 20 ma.

Now, can you say how much current flows through R1? How much through R2? Right! According to Kirchhoff, the same as the total—20 ma. Is it possible to prove that the voltage between points B and C actually is 100 volts? You bet your boots it is! Just multiply the current through R2 by the resistance value. The current—.020 amp—multipled by the resistance—5000 ohms—equals, of course, 100 volts.

We can approach this in a different way and arrive at the answer to other unknown quantities. As an example, let's suppose we didn't know the current flow in the circuit, nor the value of R2. Remember that the sum of the voltage drops in a series resistive circuit is equal to the total applied voltage? If so, the difference between 250 volts and 100 volts is 150 volts. Since 150 volts is the drop across R1, all we have to do to find the current flowing through R1 is divide 150 volts by 7500 ohms. Figure it out. If your answer is 20 ma, you're right. Okay, we still don't know the value of R2; but we do know that 20 ma is the current through the series resistors, and we do know what Kirchhoff said about current in series resistors. Therefore, here's what we now know about R2: The voltage drop across it is 100 volts, and 20 ma of current is flowing through it. Calling Dr. Ohm! By dividing 100 volts by 20 ma, we derive an answer of 5000 ohms. There it is—the value of R2!

Complex Dividers

There you have it—the simple resistive voltage divider. Uh-oh, did I say *the* simple resistive divider? *Any* divider is simple if you understand it. For an example, take a look at Fig. 2. *Looks* harder, doesn't it? Is not

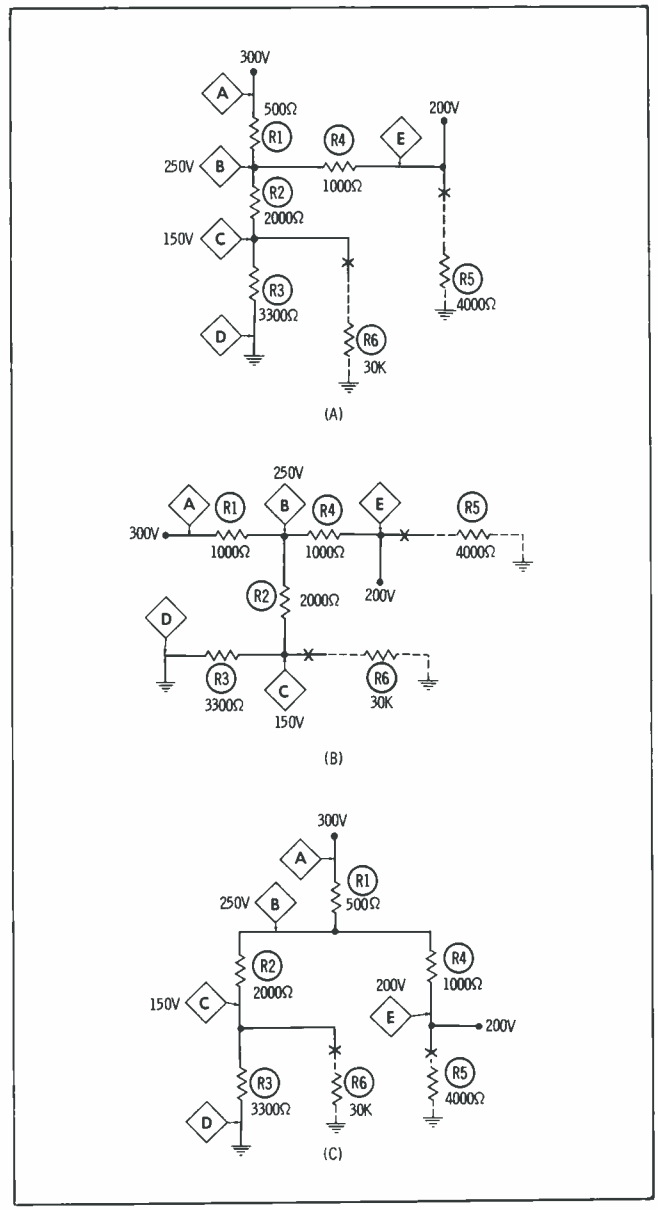

Fig. 2. More complicated voltage dividers can be laid out in different ways on schematics, but they are really simple.

so (Old Chinese ploverb.) What say we tackle this one? Let's pretend it's a power-supply divider and that 300 volts is dropped across (or applied to) series resistors R1, R2, and R3. From the power supply, we expect this circuit to draw 100 ma of current. This simply means that, using Ohm's law, we find the actual circuit resistance from point A to point D is 3000 ohms. This is fine information, but we're talking about voltage dividers. Right?

Let's take a look at the full picture presented by Fig. 2. What is the purpose of R5 and R6? These are "phantom resistances." (We've met Professor Kirchhoff, Dr. Ohm, and now—*The Phantom Resistance!)* Phantom resistance is a term applied to the circuit loads (tubes, resistances, etc) that are supplied from any branch of a power-supply voltage divider. In making computations using Ohm's law for troubleshooting, the phantom resistance must be taken into account if an accurate analysis is to be made. Remember—the resistances in dotted lines in Fig. 2 are not actual resistors, but only values of the loads present across the 200-volt and 150-volt supply points (E and C).

We've drawn this divider in various ways just as we did the one in Fig. 1. In Fig. 2C, we have drawn it in the way that is probably easiest to understand. Here you can see what we actually have is a pair of series and parallel resistive legs. Note that the voltage at point B is 250 volts. R1 has dropped 50 volts, leaving 250 of the original 300 volts developed across the two legs of a parallel circuit—R2-R3-R6 and R4-R5. We can think of this voltage as applied to both legs.

What do we know of parallel resistive circuits? Well, we know from Kirchhoff that current is divided between two legs of a parallel circuit in inverse proportion to the resistance in each leg. Basically, this means the higher the resistance, the lower the current through that leg. When the resistances in both legs of a parallel circuit are equal, current flow in each is also equal. There's a formula that says: To find the total resistance of a parallel circuit containing two legs or branches (such as we're talking about in Fig. 2) multiply their resistances and then divide that answer by their sum. In Fig. 2C, then, we will consider the parallel circuit formed by R3 and R6 as one resistance with a combined value: 3300 ohms times 30K (9.9 megs), divided by the sum of 3300 ohms and 30K (33.3K), for a net of approximately 3000 ohms.

As we mentioned before, 50 volts (300 −250) is dropped across 500-ohm resistor R1. The total current flow is thus proven to be 100 ma. It's easy from here to figure the current value that is flowing in the right leg. Subtract the 200-volt indication at point E from the 250 volts at point B. This gives the voltage drop across R4, from which we can compute the current through R4 to be 50 ma. As the current is the same through all resistances in a series circuit, we know 50 ma also flows through R5. What does this tell us? That our phantom resistance R5 (the load) draws half the total current supplied from the main feeder at point B. As we'll soon see, it could also suggest that, if the phantom resistance drops in value due to some trouble (short), R4 might overheat and burn out or change value.

We now can stand on our "right" leg, but how about the left? It does appear a bit more complicated. In truth, however, it isn't, for we've already shown how to combine R3-R6 into effectively one resistance. Old Professor Kirchhoff stated (in one way or another) that the sum of currents through resistances in parallel is derived by adding the currents in each branch. We already know the sum, for it's flowing through R1. The difference between this total current (100 ma) and that in the right leg (50 ma) is what's left to go down the left leg—by coincidence in this case, also 50 ma.

In order to cover this divider completely, we'll go on to describe the last bit of resistive parallelism in it. We'll calculate currents in the two "sub-legs" we previously combined—R3 and R6. (We think that this is a most interesting part and you may, too.)

The 250 volts at point B applies to both legs, and current of 50 ma is flowing through R2. Figuring the voltage drop of 100 volts across R2 leaves 150 volts applied to R3 and R6. Here, however, we have a split in current at point C that just can't be equal, because bleeder resistor R3 and phantom resistance R6 aren't of equal value. Feast your eyes on those resistor values. We can figure current in them either of two ways. Let's

examine both. As in the two main legs, we can subtract the current in one leg from the total to learn what is flowing in the other branch, but how do we get the first? We've got to know the applied voltage and the resistance values, or we can use the current flow through both legs and the ratio of resistances.

For a practice run, let's assume we don't even know the total current flow, but only that 150 volts is applied. Picking R6 we divide 30K into 150 volts. The answer is 5 ma of current through R6. If we knew the total current flow in R3 and R6, the value of the current flowing, through R3 could be determined by subtracting current in R6 from the total. For our practice, we don't, so we have to divide 3300 ohms into 150 volts, for an answer of approximately 45 ma—close enough for practical purposes. Thus, R3 draws 45 ma, while our phantom resistance (actually the load circuits) is drawing only 5 ma of the total coming through resistor R2.

That's a power-supply type of voltage divider we've looked at—one that supplies these voltages: 300, 200, and 150. If this were used in a piece of electronic equipment, other voltage divider networks might (and probably would) be used to drop a few other volts here and there as needed. Some might not draw enough current to consider at all, while others could be very important to the choice of accompanying components. For example . . . take the case of wattage. Lend an ear (an eye, actually) and we'll explore the watts aspect of resistive dividers.

What's Watt With Power

When we speak of power being used, we call it dissipation. Power dissipation is measured in . . . guess watt? Right you are! A *watt* is defined as a unit of electric power required to do one joule of work in one second. It is also: The power expended when one amp of current flows through one ohm of resistance, and this is the part that concerns us. "Joules" will therefore be dropped in favor of the second definition, which is expressed in three formulas: P (in watts) equals E (in volts) times I (in amps); P (in watts) equals I (in amps) squared and then multiplied by R (in ohms); and, P (in watts) equals E (in volts) squared and then divided by R (in ohms). Voltage divider resistors for power supplies are generally rated for power dissipation.

Heat is generated whenever current flows through a resistor. The heat is radiated into the air surrounding the resistor, and is thus dissipated. If more heat is gen-

"You may have some trouble locating the difficulty. I know I sure did!"

erated in a resistor than it is designed to dissipate, the resistor becomes very hot. You can see from the $P = I^2R$ relationship that too much current could easily overheat a resistor.

Thus, if a circuit being supplied voltage from a divider network were to develop a short, the load (phantom) resistance would drop to near zero and current would shoot up to a high value. The divider resistor through which the circuit is being supplied would become very, very hot and dissipate its little ol' self right into oblivion. A burning resistor thus points out the importance of selecting resistors for a voltage divider in accordance with power requirements.

In normal divider service, a certain amount of current flows through a resistor at all times. This generates some heat; but, if the resistor is selected properly, the normal heat will be hardly noticeable even if you touch the resistor body directly. To maintain this desirable low temperature, a "safety margin" must also be allowed.

Let's figure the power rating for R1 in Fig. 2. The actual voltage across this resistor is 50, and its resistance is 500 ohms. Using our number-three formula for power, we divide 2500 volts (50 volts squared) by 500 ohms. This gives us an answer of 5 watts. What do you think would happen if we put a 5-watt resistor in the circuit? It would feel warm during normal operation. And if a short occurred? That's right; before the fuse could blow, R1 would very probably be a cinder. To allow for the extra margin of safety, and to keep the unit normally cool, R1 should be at least a 7.5-watt resistor. An engineer usually designs at least a 50% safety margin into his creations; however, someone who repairs this equipment may not be quite so discreet. If you, as the service technician, find a burned-out resistor, check the schematic or calculate the power rating required for a margin of safety in the replacement.

Conclusion

Certainly, after traveling through the voltage divider as we have, we must draw a conclusion. As you must realize, there are many different ways to draw conclusions (just as there are ways to draw voltage dividers), but we prefer to draw the most simple one. So, we will.

The ability of a service technician to recognize a complex (or seemingly so) arrangement of resistors on a schematic as a voltage divider, which he now understands, can be quite an asset toward deciding what the circuit should be doing. What, then, is our basic conclusion? It is: An understanding of the action of resistive dividers, plus an ability to know one when you see it, will enable you quickly to evaluate whether strange meter readings you find are abnormal for the circuit or are caused by a malfunction in another circuit.

Practice. Go over schematics and try to pick out as many applications of voltage dividers as you can. Draw them in simple form and compare them with the way they appear on the schematic. Do this until they stand out as you look at a schematic and you'll have quite an edge on the type of guy who just changes components until he replaces the right one. ▲

finding and keeping CB customers

By Thomas R. Haskett

Users of Citizens-Band equipment spent more than $50 million last year for new equipment and service. If you're not getting your share of this market, and plan to, the first thing you should do is get on the air yourself. Unless you are already using CB Business Radio in your service vehicles, you should install CB gear at your shop and similarly equip your trucks. Stop and think a moment. If *you* don't have enough faith in CB gear to use it, why should you expect a customer to buy from *you?* Besides, when you get on the air you'll learn something about the Citizen's Radio Service, and thus be able to talk your customer's language.

Who Uses CB — and Why?

To sell and/or service CB gear, it's important to understand what motivates the user. To get the facts, we went to an expert—Mike Weber, of Coston Radio-TV, in Cincinnati. Since adding CB sales and service in 1959, Mike has seen this phase of his business grow until today it provides a sizeable percentage of his total income.

Coston's sells and services black-and-white and color TV, AM, FM, and FM-stereo radios, phonographs, auto and transistor radios, CB and ham gear. They have found, through sometimes bitter experience, that there are some product lines that don't mix well. While radio and TV repair or service shops are naturals for CB service, they aren't necessarily equipped for a profitable sales program. Then, too, sometimes the CB crowd is more a "bargain basement" type, in contrast to the "luxury" crowd that usually buys color TV. It's usually not wise to have a single showroom for both color TV and CB equipment, because you're not selling both products to the same types of people. This is not, however, always true of service. And, if you do any ham business, you may find that CB'ers and hams don't get along too well. Such conflicts can be the source of some embarrassing moments.

To sell equipment, display where the customer can see and examine features.

Generally speaking, there are two basic types of CB users. The majority of those on the band seem to enjoy being on the air simply for the fun of it. They form clubs and associations, do volunteer Civil Defense work, organize emergency and safety networks, rescue stranded motorists, and enjoy being of service to others. While the activities of this large group may be limited by new CB rules, it would be a mistake for any service dealer looking for CB sales to look down his nose at CB'ers. Mike Weber has always respected them, treated them as he would any other customers, and tried to encourage responsible operation. As a result, these people return to get their TV's and car radios fixed—many even become hams and buy their rigs from Coston's. The outstanding feature of this type of CB user is that he is constantly on the alert for something new and better in equipment. He is a natural for accessory sales —tone squelch, beams, hand-held portables, etc. He wants his equipment to be in top shape. Although a few of this type are "do-it-yourselfers," most don't know beans about electronics, and if you treat them squarely, they will be glad to let you do their service. In many areas, there is a real need for a full-time service shop that handles nothing but CB work.

The other type of CB user employs his equipment in his business or professional life, as an adjunct to other activities. Examples: Doctors, lawyers, private policemen, trucking firms, etc. These users don't go in much for gadgets or gimmicks; they are usually interested only in effective communication. However, they want reliability; and, since they are seldom able to make their own repairs, they are willing to pay for it. By making a good sale you usually get followup service business. This type of customer generally needs his radio to continue his business profitably, and

Always service what you sell. An efficient shop insures a good CB income.

a guy could get hurt this way

...we wouldn't want it to be YOU.

All electronic manufacturers say they love their dealers.

But do they? In embracing you, manufacturers often squeeze too hard. They squeeze you right out of the profit picture, in fact.

How?

By selling to national mail-order catalog houses and their captive discount chain stores. To tube-checkers. And to other outlets that by-pass you, the dealer.

We won't spell out any names, mind you. But just pick up an A----d catalog, for example, and look at the antennas (Pages 420-430). Or look at the rotators in the L-------e catalog. (Page 414). Or the picture and receiving tubes in the O---n catalog. Or the booster and other TV products in the R---o S---k catalog. (Pages 247-255).

You'll see that all these catalog houses sell the same products you sell—for approximately the same prices you pay for them.

You're entitled to an honest profit, of course. But how can you compete when your own prices must seem excessive by contrast.

Poor you. Your business—not to mention your profits—is cut right out from under you.

Many dealers are happy exceptions, of course. Dealers who handle Channel Master products, for example.

It's dead against Channel Master's policy to sell to any outlet that by-passes the dealer, or that sells to consumers at dealer prices. This way we protect your business and let you reap a full profit. The highest in the industry, by the way. We feel that the very least we owe the dealer who sells our product is a decent living.

We think it's just plain good business to support the firm that supports you. What do you think?

CHANNEL MASTER Ellenville, N.Y.

Circle 29 on literature card

he will stick with the shop he trusts.

Finding Customers

It almost goes without saying that you must advertise, but the importance of advertising should be emphasized. If you already have an ad schedule, your existing copy should be revised to include a line like this: "We sell and service CB gear." Or, you may want to take separate space in the phone book's yellow pages for CB alone. Don't overlook billboards, car cards, and local radio stations. Most importantly, affiliate with the local CB club. Take an ad in their newsletter. Make an appearance at their field days and at informal get-togethers. Take along handbills, product information, and a few small prizes. Perhaps once or twice a year you can give away a complete rig or other major equipment. Do as much promotion as you can. (If you are a franchised dealer, investigate the possibility of having the manufacturer share the cost of such promotional prizes.) Keep your shop name on the list of every CB user you can. Remember, when you sell or service one CB user and satisfy him, he'll tell others about it. Since he often tells them on the air, the word gets around fast.

It's no secret that the large mail-order houses offer CB equipment at low prices. Just as the small corner grocery must employ different tactics to compete with the large super-market, your shop must offer something more than the mailorder houses. By stocking the CB gear you sell, you can offer immediate delivery. You should establish a reputation for reliable, fairly priced service, and have a good trade-in policy. Not too surprisingly, there is a good market for used CB gear. The club-type CB'er is a most likely prospect for upgrading his equipment. Many of these people buy relatively inexpensive units at first. As they get on the air and their enthusiasm mounts, they want more sophisticated rigs. You can profitably take the old one in trade and sell a new one. For example, Mike reports he can't keep enough $300 rigs in stock right now, because most of the customers in his vicinity demand these newer, more versatile outfits. Many of his time-plan sales are of used gear.

Demonstrate and sell accessories to give yourself a broader base for sales.

Keeping Customers

Coston's sales volume of used equipment is almost as high as for

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YES, Philco, I want faster, complete parts service! Tell the nearest Philco Parts Distributor to send me information about special Philco Parts offers, prices and facts. And tell him to hurry!

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He stocks direct replacement parts for just about every model Philco TV, radio, phonograph and record-changer ever made—plus a wide range of national brand components and accessories for all makes and models such as Sprague Capacitors, Eveready Batteries, Rembrandt Antennas, G.C. Products, Semitron Transistors, Speco Components, Sencore Test Equipment, Colormagic Antennas.

If by chance he's out of a part you need, Philco's Lifeline Emergency Service goes into action. Your requirement is quickly transmitted to Philco's new National Parts Depot at Bedford, Indiana—and your part is on its way to you by air within 24 hours or less.

If you're not getting this kind of fast, complete parts service, don't you think you ought to be? Just mail the coupon and start doing business with your nearest Philco Parts Distributor.

PARTS & SERVICE DEPARTMENT

PHILCO®

A SUBSIDIARY OF Ford Motor Company

new equipment. Trade-ins are overhauled and guaranteed for 30 days and seldom remain on the shelves for long. Customers find bargain deals almost irresistible and keep coming back to the shop. When they need service or products, they think of Coston's.

Mike says that, when he first began selling CB equipment, he tried to stock too many lines. He now feels that was a mistake, as he was unable to order very many units from any one manufacturer, and hence didn't receive volume discounts. Moreover, the various brands confused the customer, and often the same equipment could be purchased somewhere else at a different price. He now stocks a single brand and cites the advantages of volume-buying discounts, a wide price range to fit every pocketbook, dependability and good reputation, and—most important—an exclusive franchise in his area. Since no other dealer in the market can handle the same equipment line, Coston's prices can be firm. The shop can guarantee quality without being undersold.

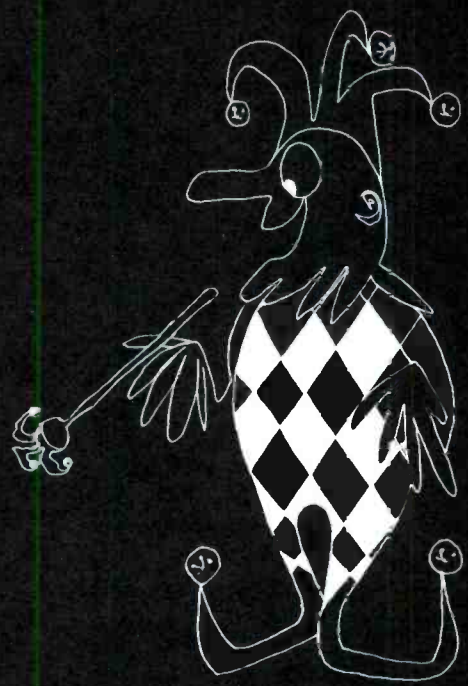
Mike recommends keeping new and used equipment in separate areas of the store. He usually protects new gear with plastic covers and doesn't allow demonstrations of stock items — the radio-equipped service vehicles are his best demonstrators, anyway. All new equipment remains bright and shiny; when a customer purchases one of these items, he is assured of fresh-from-the-factory condition. Mike doesn't recommend allowing used gear to be taken home overnight by the customer, either, as this encourages wear and breakage and often makes the item more difficult to sell at a profit. Customers are usually impressed by a firm policy that insures the quality of what they buy.

A good service policy is also essential to keeping CB customers. We asked Mike how he handles user-mangled equipment brought in for service. "We don't touch it," was his reply. Coston's policy is to take any job, large or small, provided there is a reasonable chance it can be repaired. "We've found," he continues, "that undoing a layman's mistakes is too time-consuming for us and too expensive for the customer. We point this out and encourage the customer to let us fix it *first* next time. In most cases, it works." There is a fine line between refusing to service a butchered set and insulting the customer. You have to be careful to let people know that you're on *their* side. It's a free country; if they want to, they can fix their own set—that's fine. But, unless they're an expert, they may get into difficulty. You, on the other hand, are an expert and guarantee your work.

Conclusion

If we have talked much of sales rather than service in this article, it's because today's market is changing considerably. Today's CB market is more and more a sales market and less a service business. Equipment is more rugged, better built, and it lasts longer than, for example, ham gear of 15 years ago. While some shops will undoubtedly continue to exist on service alone, they may soon become the exception rather than the rule. If you plan to offer CB service, you would do well to consider selling, too. In CB, at least, sales and service complement one another. ▲

GOOF-PROOF VOM



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1. Reset button pops out to indicate overload.
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Circle 33 on literature card

VARIABLE LINE TRANSFORMER as a TS AID

Obscure DC faults can often be isolated with AC instruments. Here's how.

by George F. Corne, Jr.

Most technicians have their own choice methods of locating intermittent troubles in electronic equipment. Similarly, by experience they have found means for a quick, thorough before-delivery checkout —to prevent callbacks. Now, far be it from us to discourage any proven methods. However, it sometimes becomes expedient to try new ones, in hopes of finding ways more suitable to specific circumstances. The troubleshooting system we'll discuss here—using a variable line transformer (VLT)—isn't applicable to all repair jobs, but it is to most of them.

Usually, line transformers (isolating types included) have some means of selecting taps to control the output voltage; most are switch- or slider-controlled. This "variable" feature makes the instrument useful in many applications.

We've selected for discussion several servicing jobs in which we've used a variable transformer, including troubles in both radios and television sets. From these examples, you'll get a general idea of the troubleshooting versatility of this low-cost item, and you'll probably think of other similar uses for it.

Power-Supply Checkout

We recently worked with a Westinghouse Chassis V-2233-2 that had a hum problem. In fact, the hum was so severe that only a partial raster was visible on the screen. The trouble was found (by bridging) to be an open "B" section of filter capacitor C1 (see Fig. 1). After a new unit was installed, the B+ source was within tolerance (275 volts DC at point A), and the receiver presented a fairly decent picture.

Receivers using this chassis are more than ten years old and, as with similar "oldies," a few preventive callback checks should be made after all evident troubles are cured—for instance: checking components visually, running all tubes through a tester, and checking the action of all controls. During the process, we replaced a few resistors, capacitors, tubes, and the height control. Then we put our variable line transformer to work in search of hidden troubles.

Line voltage in our lab runs close to the standard 117 volts AC, and this was the voltage to which we set our variable. As we mentioned, the operation of the set was okay at this value (see photo in Fig. 2). However, lowering the input voltage to 100 volts produced the condition shown in Fig. 3. The raster shrank in both directions, vertical and horizontal sync became critical (needing continual readjustment), and the picture took on a washed-out appearance. Reducing the AC input to 95 volts caused the video to disappear, and the raster naturally shrank further.

Now, what conclusions can we draw from these conditions? First, operation should remain satisfactorily stable with an input of 100 volts AC — that is, such drastic changes in set operation shouldn't occur. (Most TV receivers are designed to operate in the range from 100 to 125 volts; some as low as 90 volts.) Sync, sweep, and video were all affected, indicating trouble in the power supply. Following are the B+ voltages we measured at point "A" at different input voltages: 275 volts DC at 117 volts AC; 230 volts DC at 100 volts AC; and 200 volts DC at 95 volts AC.

This simple test suggested that the power supply was operating on the borderline, and further troubleshooting was in order before the set was returned to the customer. Actually, the trouble was simple to find: both 5U4's were weak under load, although they checked good on a tester. In the process, we found another possible trouble spot in the power supply. When we checked the condition of R1 (a high-wattage, surge-protecting resistor), we found

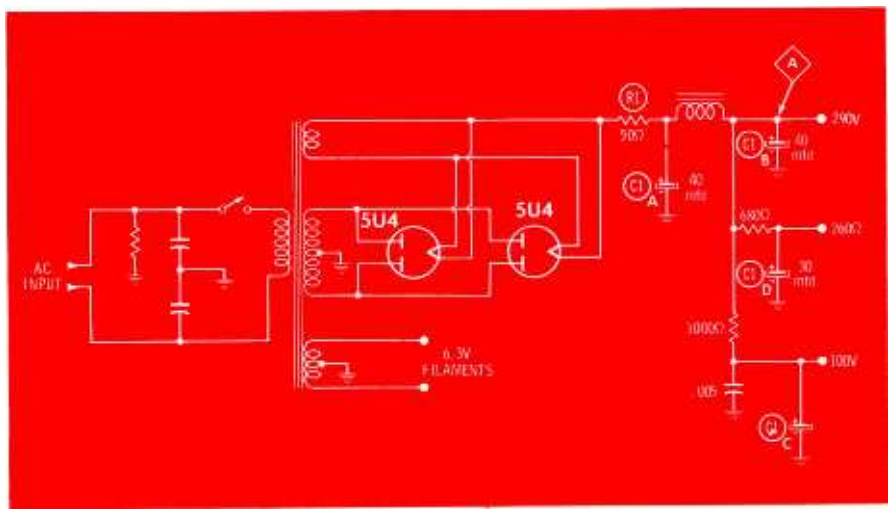
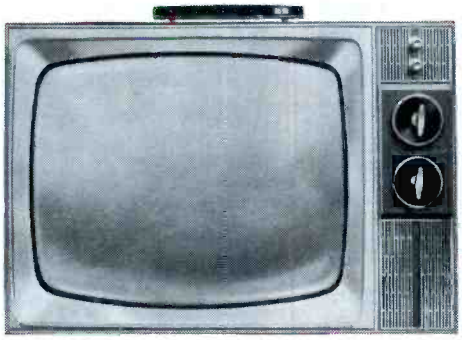
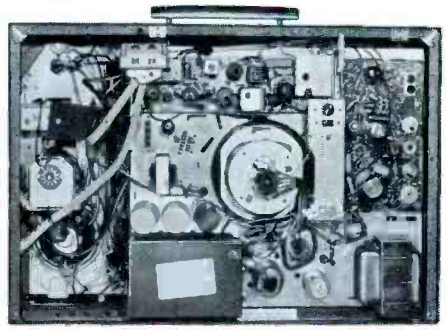


Fig. 1. Some older TV receivers have 5U4's connected in parallel.

If you sell or service TV sets





can we interest you in making a few extra dollars?

New RCA Stratomaster—
for both VHF and UHF channels.

New RCA Stratoscope—
for VHF channels only.

If you're in the TV business, why not include these two natural profit makers in your line? These RCA indoor TV antennas are styled so smartly they virtually sell themselves. And they work so well they keep customers sold on you!

SMART STYLING. An instant selling point. The first indoor antennas you can recommend with pride as a decorative asset to any interior.

EXCELLENT PERFORMANCE. These RCA indoor antennas are designed by the same RCA engineers who develop antennas for satellites and space. They include (a) an automatic signal-phasing device to pull in the strongest, sharpest picture possible with an indoor antenna, (b) a channel selector switch to block out ghosts and interference, (c) super-fine tuning, (d) telescoping 45-inch arms turnable in any direction without moving the base.

and they're advertised nationally in POST and TV GUIDE

for immediate customer recognition and acceptance.

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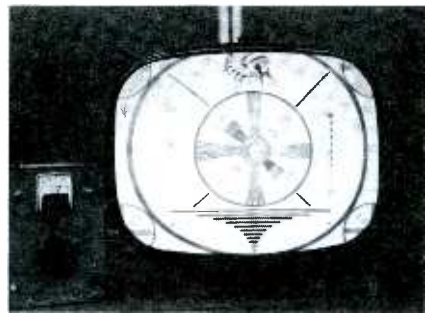

Fig. 2. Operation in Westinghouse receiver okay at 117 volts input.

it to be low in resistance, measuring only 15 ohms. Changing R1 probably prevented a future callback, too. We made another final check on the receiver after replacing the tubes and R1. Here are the results, measured at point "A" in Fig. 1: 300 volts DC at 117 volts AC; 275 volts DC at 100 volts AC; and 250 volts DC at 95 volts AC. The supply would now operate well with any input voltages likely to be encountered in the home.

This final test using a variable transformer isn't limited to locating power-supply failures. Assume, for instance, poor video had been the only symptom when AC power was reduced or that only vertical sync had become critical. If this were the case, borderline operation in the affected stage would be indicated.

Width and Arcing Problems

If your service business includes calls to rural or thinly populated areas, you'll find your variable transformer valuable in many instances. As an example, assume you return a set after repair, and it operates normally—except for a small amount of black showing on both sides of the screen. You know that in the shop the width was good. What policy do you follow? Your first check under these conditions should be of the line voltage available in the home — especially in rural locations. You'll probably find it is lower than your shop supply.

On the other hand, say the set develops arcing in the high-voltage cage on delivery, and you know it wasn't present on the shop bench. Here, *high* line voltage could be causing the trouble.

There's a simple solution to both of the above problems: A line check using your VTVM in the home, and a test of the set using your variable

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Speed, Accuracy and Profit, Plus Obsolescence Protection IN AN ALL NEW, NO-COMPROMISE MULTI-SOCKET TUBE TESTER!

From the laboratories of the world's leading tube tester manufacturer comes the model 799 "Mustang"—a completely new tube tester. Built to put profit in your pocket, the "Mustang" checks *more* tubes, checks them *faster* and checks them *honestly*.

Multi-socket tube testers used to have two serious drawbacks: circuit limitations made them obsolete overnight and, at best, no more than 10% of their tests were actually mutual conductance. But the Hickok "Mustang" doesn't compromise: it delivers *honest* mutual conductance tests. And a unique circuit approach, together with an easily replaceable accessory socket panel, makes it "circuit ready" for any possible new tube types.

A solid state power supply gives increased accuracy and dependability. An all-transistorized gas and leakage test circuit sets a new standard of reliability for spotting "tricky" tube defects that can "chew up" your profit.

We call it the "Mustang" because it uses fresh, new engineering ideas and because it gives you a real opportunity to break into new profits.

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transformer in the shop. If you're servicing sets in an area where line voltage may be high *or* low (sometimes, the amount or direction will depend on the time of day), take a line reading in the home before you take the chassis to your shop. Then, on the bench, adjust your transformer to duplicate the value you read on your VTVM in the home—and proceed to service the receiver. Before final delivery, vary the voltage at least 5 or 10 volts on either side of the normal-operation value, and you'll be reasonably sure of operation within the spread encountered in the home. Borderline cases of many faults can be detected in this manner.

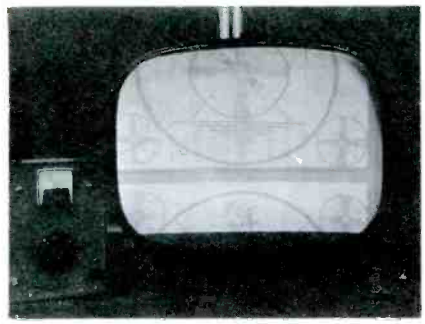


Fig. 3. Trouble in several forms appeared with 100-volt power source.

Repeat Tube Failure

Here's an interesting case, experienced by a technician reader of ours, that demonstrates another use for your variable line transformer. A call was made on an old Capehart for a no-raster complaint. A new output tube in the horizontal section restored operation. However, two weeks later the technician was on a return trip—for the same condition. The new tube was defective? Probably, for another new one again brought a raster. The technician let the receiver play for about ten minutes, and then took a look at the output tube, checking to see if it was running hot. It wasn't, so he deduced the first tube had failed of its own accord. On

the *next* repeat call, several days later, he pulled the chassis for bench work!

On the bench, operation of the output stage was normal, and he could find no reason for the repeated tube failure. Here was the final solution. He found the line voltage in his shop was between 112 and 118 volts; in the home, it averaged 118 to 124 volts. With an input voltage in this latter range, he noticed the plates in the tube took on a slight reddish glow, indicating excessive plate current. To prevent similar failures, he installed a low-cost line-voltage regulator ($3.50) in the home. Here too, the VLT had come in handy for trouble-shooting.

Other Applications

There are a few more cases in which the VLT can be useful:

1. When servicing tube-type portable radios, reduce the line voltage to approximately 90 volts. If the radio stops playing, substitute the oscillator tube (usually a 1R5), the B+ rectifier, the input filter, and the filament dropping resistor, in that order. Replace whichever brings the set back to life. Otherwise the radio will soon be back.
2. When thermal problems are evident, regardless of equipment, increase the line voltage slightly. This action will usually cause components to run a bit hotter, making the defective ones easier to locate.

Conclusion

We've suggested only a few of the ways to troubleshoot with a variable line transformer, selected to start you thinking of instances where, had you checked the receiver with different values of input voltage, your job might have been easier. The VLT can have a useful place in your servicing procedures . . . why not make it a habit? ▲

The Troubleshooter

answers your servicing problems

Negative Picture

Can you please help me out? I have an Olympic Chassis GB which has a faint negative picture. All tubes from tuner to picture tube are okay. I have checked the 1N64 video-detector diode, contrast control, and am using a test CRT. Sound is normal except there is a slight audio buzz; however, my main concern is how do I correct the negative picture?

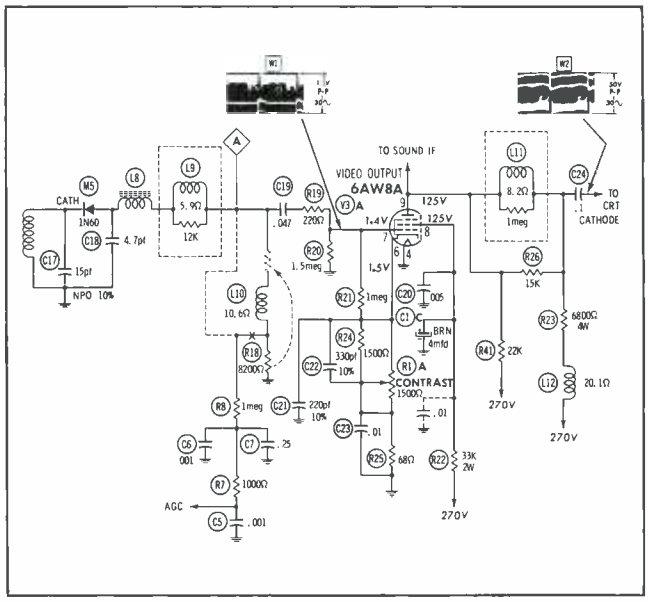
J. J. CIERESEWSKI

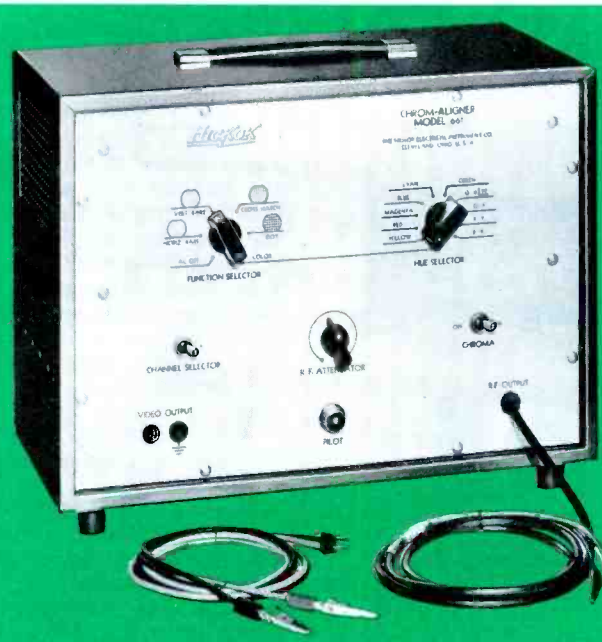
Wyandotte, Mich.

This chassis is covered in PHOTOFACT *Folder 415-1. I'd suggest that you recheck the installation of the video-detector crystal; to insure it is properly connected in the circuit. Also, be sure you make a check of the video-detector load circuit, which consists of L10 and R18.*

Make sure the tuner is on the correct channel. I've seen several sets that produced a negative picture simply because the oscillator was off the operating frequency so far that the signal was inverted in the tuner stages. This is a rare occasion and perhaps is not the case here, but it is worthwhile to check the positioning. Have you checked waveform W1 on the grid of the video-output stage? If the inversion is being caused by the tuner or one of the IF stages, you'll find a positive—going signal here, rather than the normal negative. This would also be true if the diode was reversed.

Make a detailed check on the following components in the AGC circuit, to be certain one of them is not defective and causing the problem through the AGC line to the tuner. Especially check R7, C5, R8, and C7. What are the voltages on the grids of the first and second IF stages? It would be well to make a complete voltage check on the grids, the cathodes, the screens, and plates in these stages. To eliminate possible open decoupling caps for the plate in the screen circuits, bridge the bypass capacitors with known good units. Normally, if a bypass capacitor opens, you'll have an oscillation appearing on the screen. This is a common occurrence in the





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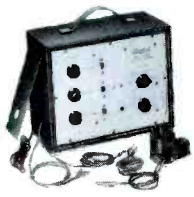
Model 661—NTSC Bar-Dot Generator—$349.50

Based on the same designs as Hickok's famous Model 656XC NTSC color bar generator, the NEW Model 661 is literally the answer for progressive service technicians who recognize the opportunities in color TV service but have been stopped by the cost of equipment. *The 661 is not a compromise—there are no short cuts—it's not "NTSC-like"; it is a complete instrument generating correct, 100% saturated, NTSC color signals complete with sync, blanking and burst at the right pedestal position and of the correct amplitude and phase, as well as demodulator alignment signals (R-Y, B-Y, —G-Y, G-Y 90°), plus dots and crosshatch.* In short, you can expect the same kind of performance standards from the new 661 that have established Hickok's reputation with leading Color TV manufacturers as COLOR-APPROVED.

Compact, weighing just nine pounds, ideal for installation, convergence and in-the-home servicing, the new Model 661 provides everything needed for complete color service.

Ask your Hickok distributor to demonstrate the Model 661 for you . . . Write for our free booklet, "Why NTSC?" which explains why the NTSC standard tests are important. There is no obligation.

Equip your shop with these other Hickok Color-Approved instruments to provide your customers with complete color TV service:



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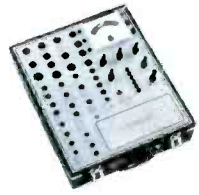

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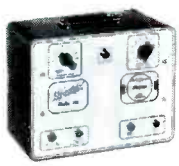

691
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Circle 41 on literature card

last video IF stage; if the stage isn't properly decoupled, it tends to break into oscillation, producing a rash of bars on the screen of the CRT.

Voltage Checks Are Impossible

I have a Crosley TV Chassis 431, covered in PHOTOFACT Folder 263-6, in for repair. The customer stated the set had been to another shop for repair, but when it was returned it didn't work. I turned the set on and found it was completely dead. The volume control made a frying noise and R78 read 450 ohms. After replacing both these components, the tube filaments came on but the plates of M1 and M2 became very hot, as did R78. There was sound but not raster. There apparently has been trouble with this same problem before, as both the rectifiers have been replaced with high-density type units.

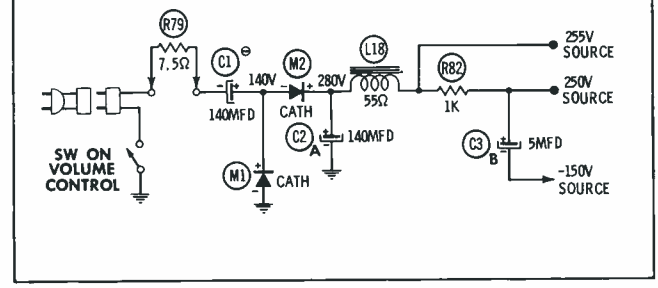
R79 checks okay, as does L18. The resistance readings are far from normal on the 25L6 (V9). Ohmmeter checks of C1, C2, and C3 indicate these filters are normal. There is a definite disadvantage to this type of problem, as voltage measurements can't be taken without burning out a number of components. Can you possibly advise me how to best find the trouble? One other note: This set was equipped with a 200-mfd capacitor for C1 rather than the 140 mfd shown in PHOTOFACT. Could this be the cause for overload?

ERVIN LAY

Portland, Ore.

The voltage doubler capacitor used in this chassis may be 140 mfd or 200 mfd, as the note on the schematic in PHOTOFACT Folder 263-6 indicates. If you have traced the wiring in the chassis and are satisfied the diodes are connected properly, the following procedure should isolate a defective (shorted) component.

1. *Take the load off the power supply by disconnecting L18 from the 250V and 255V lines.*
2. *Turn the chassis on; if the condition of overheating rectifiers persists, either C2 is shorted or you have connected something wrong.*
3. *Should the rectifiers run cool and B+ increase, connect the 255V line in the circuit, leaving the 250V line disconnected. If the diodes begin to heat, and B+ decreases, you have a short in the circuits fed by the 255V line, and a component by component check of these circuits must be made; assuming the rectifiers run cool and B+ remains constant, the 255V leg is "OK."*
4. *Disconnect all leads from the negative terminal of C3.*
5. *Reconnect the 250V line (R82). Observe the results; do the diodes seem to be heating? Is B+ dropping? If so, make a component by component ohmmeter check of circuits fed from the 250V source. If the diodes remain cool and B+ constant, the 250V line is "OK."*
6. *If the 255V and 250V lines check out, the trouble has to be in the –150V line. Start with C3 and proceed to check all components relative to the circuits fed from the –150V line, paying particular attention to the divider network in the cathode of V9 (25L6). Check multisection filters and bypass electrolytics for leakage from positive terminal to positive terminal, in addition to checking from positive to negative terminals.* ▲



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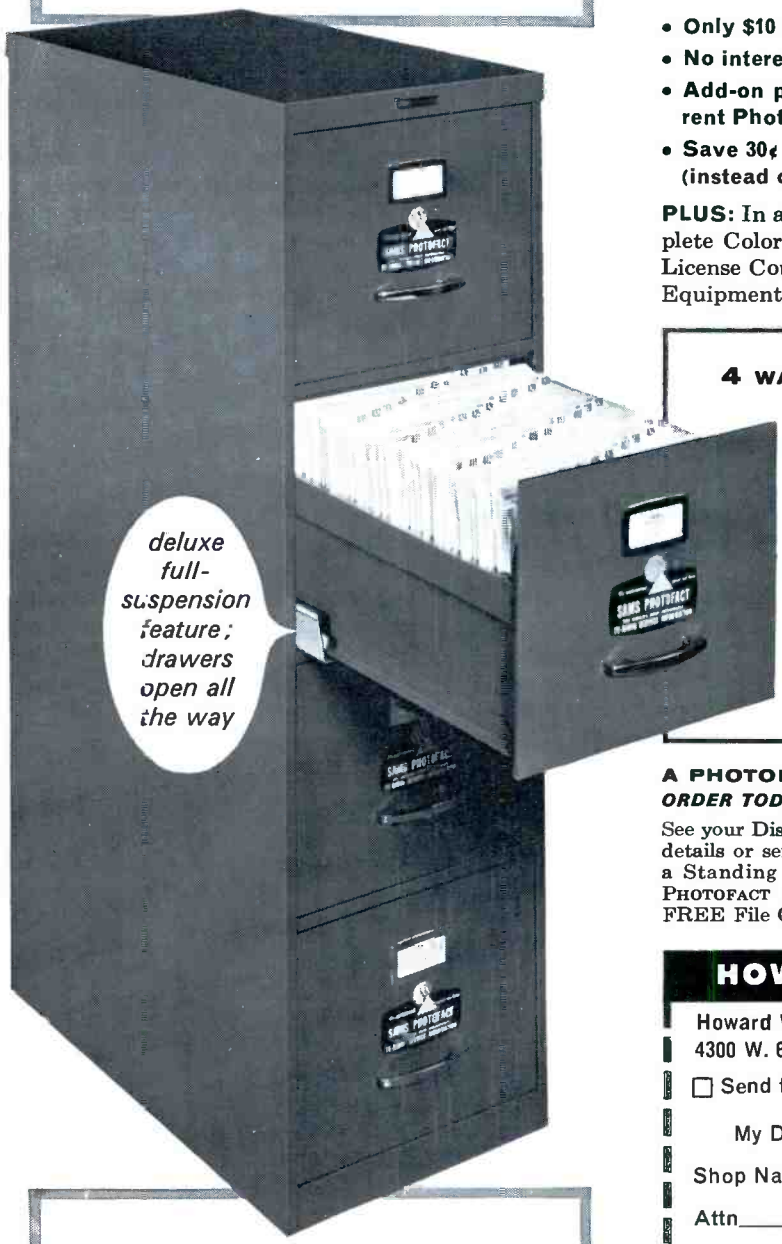

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Notes on Test Equipment

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

by Allen B. Smith

Compact Multiplex

Fig. 1. Compact, battery-powered FM stereo generator is fully transistorized.

The all-transistor FM-stereo generator pictured in Fig. 1 provides all signal elements required to align or service stereo receivers or adaptors. Th Hickok Model 727 generates its own 1000-cps audio signal, and individual left- and right-channel signals are obtainable. The 727 incorporates a 100-mc RF oscillator/FM modulator that feeds a separate RF-output jack. Other signals developed by this 12-transistor, battery-powered unit are the 19-kc pilot, the suppressed 38-kc carrier, and the 67-kc SCA signal.

A functional block diagram is shown in Fig. 2. Let's examine the circuit arrangement a little more closely to understand what actually happens in each section to provide the necessary outputs.

A crystal-controlled 19-kc oscillator is used to generate the 19-kc pilot signal. Due to the stringent stability requirements for both phase and frequency of the pilot signal, an accuracy of ± 2 cps is maintained in the oscillator circuit. Output from the oscillator is coupled to a 19-kc amplifier stage; signal amplitude is determined by the setting of a chassis-mounted 19-kc level potentiometer.

The collector circuit of the 19-kc amplifier is tuned to 19 kc and applied to a pair of doubler diodes, for developing the 38-kc sine wave, and to the base of an emitter-follower stage. Output of the emitter follower is applied to the 19-kc position of the FUNCTION switch and to the composite adder circuit. Amplitude of the 19-kc pilot applied to the adder circuit is adjustable by a second chassis-mounted 19-kc level control.

The 38-kc output of the doubler is applied to an amplifier whose output is a sinusoidal 38-kc signal which is coupled to the AM modulator stage. A second input to this modulator stage is the 1000-cps audio signal generated by the 1000-cps oscillator and

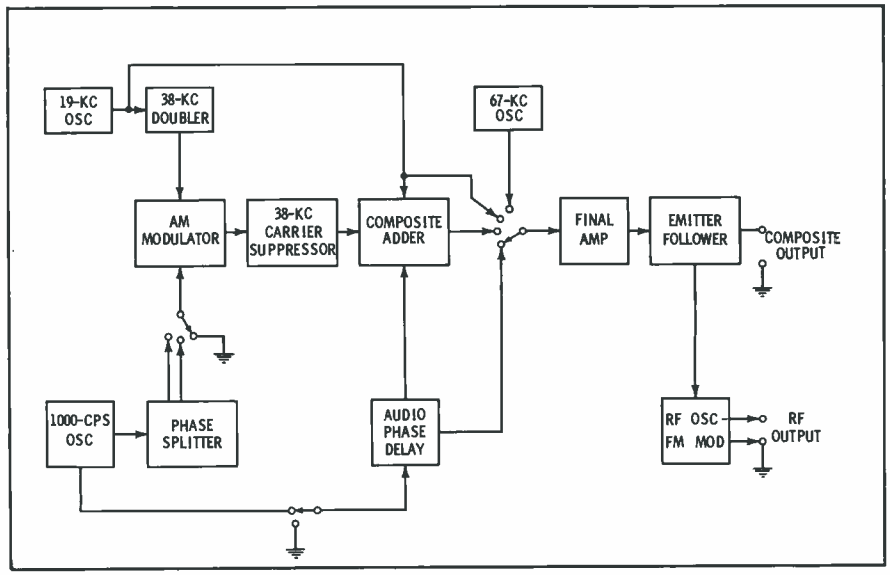
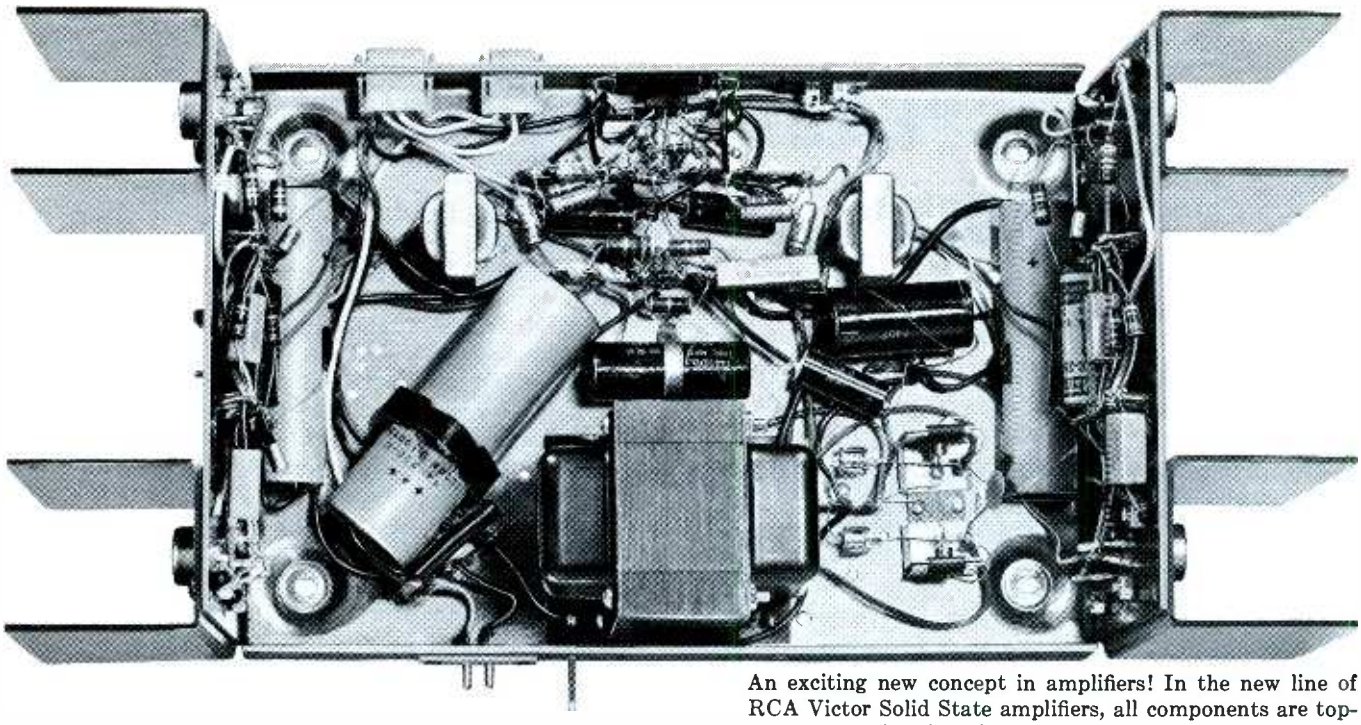


Fig. 2. Signal components are mixed together in the composite-adder stage.



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coupled through a phase splitter to the AUDIO selector switch. Either the left or right signal can be chosen by this switch. The selected audio signal is impressed upon the 38-kc carrier in the modulator stage.

The modulated 38-kc carrier is fed to the carrier-suppressor stage where the L and R sidebands are developed. These sidebands, along with the 19-kc pilot and the L + R (1000-cps audio), are then fed to the composite-adder stage. You will notice in Fig. 2, the L + R signals goes through an audio phase-delay circuit before reaching the adder stage. This phase-delay circuit consists of an audio-phase control adjusted to assure the proper phase relationship betwen the L + R and L − R signals. The MONO position of the function switch provides an L + R output directly from the phase-delay circuit.

With the function switch in STEREO position, a composite stereo-output signal is obtained. The 19-kc position provides a 19-kc pilot-signal output, and the 67-kc position selects the 67-kc signal from the internal 67-kc oscillator circuit. The desired output, selected by the function switch, receives additional amplification in the final-amplifier stage before it is coupled to the emitter-follower output stage. Emitter-follower output is available as a composite stereo signal at the AUDIO COMPOSITE output jack. This signal is used when the generator output is connected directly to the input of the FM stereo receiver.

An RF OUTPUT jack (100mc) is provided on the front panel. The RF signal consists of the composite stereo signal and a 100-mc RF signal. The RF output is used when the 727 is connected to the antenna terminals of an FM receiver.

Our lab experience with this unit left us convinced it is most suitable for troubleshooting or aligning any stereo receiver. We were equally impressd by the size, weight, and compactness of the Model 727 generator. As it is powered by a 22.5-volt battery, it requires no warm-up period.

An accessory plug-in, 117-VAC, 60-cps power supply is available in case continuous operation is desired. This supply may be interchanged with the battery supply in only a few minutes.

For further information, circle 62 on literature card

Hickok Model 727 Specifications

RF Output:
100 mc adjustable ±250 kc by RF fine-tuning adjust; output level 500 uv.

Composite Stereo Output
From 0 to 4 volts peak-to-peak, variable; contains either full stereo signal left or right-channel composite), monophonic signal (L-R only), 19-kc pilot carrier, or 67-kc signal.

Internal Signals:
1000-cps audio sine wave to modulate L and R channels.

Channel Separation
35 db.

Front-Panel Controls and Switches:
Two rotary switches—FUNCTION, AUDIO; one variable resistor; composite attenuator; three toggle switches; POWER, L + R ON and OFF, and 19-KC PILOT OFF, 5%, and 10%; output jacks—AUDIO COMPOSITE and RF OUTPUT.

Size (HWD):
8½" x 11" x 5".

Weight:
6 lb.

Power Source:
22.5-volt dry battery (not supplied with the unit). Use Burgess No. 4156, Eveready No. 76), or equivalent.

Price:
$140.00

Time-Saving Tester

Fig. 3. Six CRT sockets accommodate most currently manufactured types.

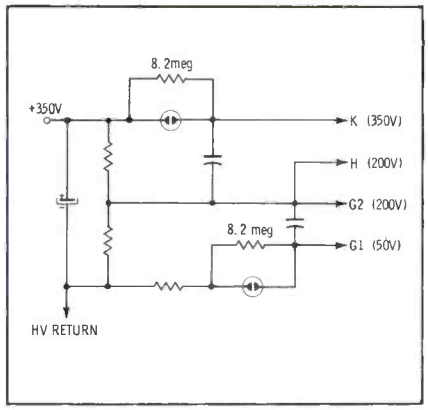


Fig. 4. Resistive voltage divider with neon indicators serves as short-finder.

Since the television set's CRT is the final and most obvious point at which the picture can be degraded, it is important to have some sure method for determining the merit of the tube. If the testing method also offers corrective measures for common faults, so much the better. The SENCORE Model CR128 CRT Tester—Fig. 3—fulfills these requirements and will perform quickly and easily in the hands of any service technician who will spend an hour or so learning its various capabilities.

Circuitry of the Model CR128 can be divided into three general categories: that required for the SHORTS test; that required for the EMISSION test and meter readout; and, the RC circuit used in the four corrective functions. Fig. 4 shows the simplified schematic of the voltage-divider/neon-indicator circuit used to indicate interelectrode shorts. The approximate voltages applied to the various elements are also shown. Operation (in the SHORTS position of the FUNCTION switch only) is simple and straightforward: with the indicated voltages applied, any leakage path caused by direct shorts, gas, or high-resistance paths will cause sufficient current to flow through one 8.2-megohm resistor or the other to generate a voltage drop that will light the associated neon indicator.

Meter readout for beam current is made under static conditions with a fixed, predetermined voltage applied to G1 and K, and a voltage on G2 selected by the G2 switch as determined from the setup chart for the CRT under test. The meter is in series with the voltage fed to G2 and is shunted by a diode for protection.

The simplified schematic shown in Fig. 5 shows the power supply for the Model CR128 tester, a conventional voltage tripler, and the special RC charging circuit comprised of a 500-ohm resistor and a 125-mfd capacitor. Capacitor C1 is the source for the rejuvenation, short removal, and welding pulse. The REJ pushbutton is spring loaded, so whenever it is not depressed it provides a charging path for the capacitor. At all times, then, the capacitor is charged until the pushbutton is depressed. When REJ is pushed, the capacitor may discharge through any one of four paths as determined by the FUNCTION switch: RMV SHTS, REJ 1, REJ 2, or REJ 3. A separate section of the FUNCTION switch provides four filament voltage conditions, one for each corrective

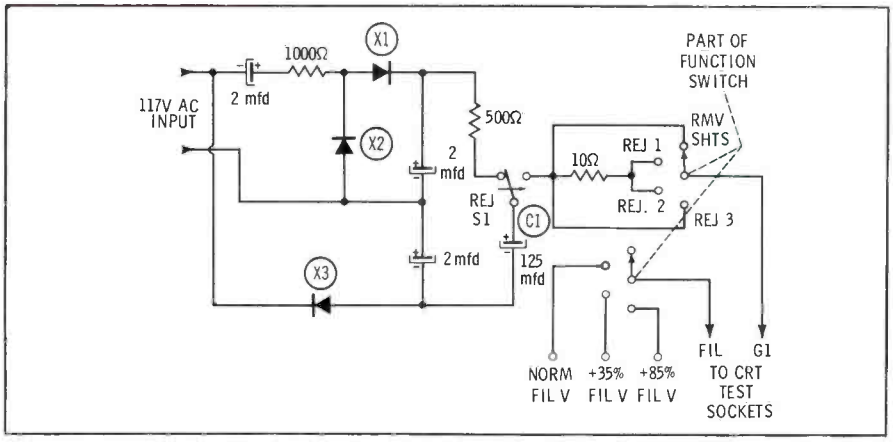


Fig. 5. Rejuvenation, short-removal and welding circuits, with power supply.

function. In the RMV SHTS position, the pulse from C1 is applied directly to G1 with the filament voltage removed from the CRT; in REJ 1 position, the pulse is fed through the 10-ohm resistor to G1 with normal filament voltage on the CRT; in REJ 2 position, the pulse passes through the same resistor to G1, and filament voltage is increased by 35%; and, in REJ 3 position, the pulse is fed directly to G1, while the filament voltage is increased by 85%. Each successive function provides increased stimulation of emission in the tube being rejuvenated.

A full set of instructions for operation of this instrument is provided, and we recommend that close attention be paid to the several precautionary notes. The instructions are easily understood and will help the technician realize maximum benefit from the tester.

Understandably, the number of tube faults that can be corrected by any method of rejuvenation is limited, but in cases where improvement can be obtained, the Model CR128 should do it. The unit operates quickly and reliably for determining what to expect from a CRT in terms of brightness and contrast, and, to a limited extent, what life remains in the old bulb. As can any reliable tester, it can save a great deal of time by establishing, at the outset of troubleshooting, the merit of the CRT. ▲

SENCORE Model CR128 Specifications

CRT's tested:

All presently manufactured TV types—both color and black-and-white.

Tests performed:

Interelectrode shorts; beam-current flow (emission); control-grid action and cutoff point; life test.

Corrective functions:

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

Price:

$69.95

Controls and Indicators

Function:

Selects SHORTS, EMISSION, GRID CHECK, REMOVE SHORTS, REJ 1, REJ 2, or REJ 3.

Grid Bias:

Applies variable voltage to control grid to determine grid action and cutoff point.

Filament:

Selects proper filament voltage as shown on chart for each CRT under test.

G2:

Selects reference voltage for grid 2 to establish correct meter indication.

Life Test:

Provides means for estimating reserve-emission capability.

Color Gun:

Selects RED, GRN, or BLU color-CRT gun for separate evaluation; either of two color-CRT sockets can be used.

Shorts:

Two neon lamps indicate interelement leakage and/or gassy tube.

Rej:

Pushbutton switch to discharge 125-mfd capacitor through grid circuit of CRT for corrective functions.

Meter:

Shows tube emission capability in terms of BAD, ?, or GOOD.

For further information, circle 63 on literature card

Radar Maintenance

(Continued from page 40)

bring it to the shop for repair. The charge is based on known costs, and allows a margin of profit to be made from the day's service calls.

This cannot be done in commercial servicing, at least not when it is as involved as marine servicing usually is. First of all, time is sometimes wasted when a boat fails to meet its schedule to or from a certain point. The technician cannot be expected to take this loss; if he does, he is very soon out of business. The miles traveled often vary widely, depending on exact conditions of meeting the vessel. Other costs occur, such as bridge tolls, taxi fares, meals on the road, etc. And the time actually spent repairing the system always varies. This last item deserves more comment.

In the case of the television example, if the set is not done in a predetermined time, the set goes to the shop where it is subjected to bench service procedures. The radar system, on the other hand, cannot be taken to the shop for bench service, so every job becomes a field repair. This sometimes complicates things, even as it would if applied to all television service calls, but with the radar system there is no alternative.

Therefore, it is necessary that marine service be charged on a portal-to-portal basis, and an hourly rate be charged from the time of leaving the shop until the time of return.

Table 3. List of major radar manufacturers.

Bendix-Pacific Division
Bendix Aviation Corp.
8211 Lankershim Blvd.
North Hollywood, California

Decca Radar, Inc.
386 Park Avenue, S.
New York 16, New York

Raytheon Company
Marine Radar Division
Newton, Mass.

RCA Service Company
Radiomarine Service
4265 Duncan Avenue
St. Louis, Missouri

Sperry Gyroscope Co.
Division of Sperry-Piedmont
3807 West 150th Street
Cleveland 11, Ohio

Note: Addresses are of service divisions of the various manufacturers, to whom inquiries about service can be directed.

Some marine technicians prefer to charge one rate when traveling or waiting for a boat, and another, higher rate for the time actually on board and working on the radar system. Some charge a premium for hours before or after regular shop hours, while others charge a straight hourly rate.

In determining a fair hourly rate, the shop owner must use the same methods he uses in determining an hourly rate for other work, considering his costs for manpower, overhead, and a fair rate of profit. Another factor worthy of consideration is the cost of stocking special-purpose tubes and special parts. This cost occurs because there is very little, if any, markup or profit margin in special items of this nature; therefore a normal profit cannot be made, even though the items represent substantial investment of capital. So this cost must be borne by the overhead of the service establishment, and must be included in determining what to charge for service labor.

Hourly rates vary over the country, ranging from $5.00 per hour to as much as $12.00 per hour for straight time. Some servicers add a premium for overtime, and there are many different methods for determining what constitutes overtime. Others charge a lower rate for travel or waiting time, as mentioned before.

Here is a typical example showing one operator's system of charges; this same schedule has proven acceptable in several areas: $7.00 per hour is charged from 8 AM to 5 PM on weekdays. $10.50 per hour is charged for other time except Sundays and holidays; for these latter, $14.00 per hour is charged. Travel or waiting time is charged at a straight $7.00 per hour, no matter when it occurs. Car mileage is charged at 12¢ per mile, portal to portal. Any other expenses incurred during the trip or job are charged to the customer at cost.

The system outlined works well in the areas where it is being used, but it is only a guide; the individual shop owner must determine his own plan. Once adopted, the plan should be explained thoroughly to all customers, to alleviate any possible misunderstanding over billing procedures.

Sometimes questions arise as to the charging of travel and waiting time. It is rare that a customer will pose this question, for the delays caused to his ship by NOT having the radar serviced at a convenient point, in a convenient manner, would far outweigh the bill he will receive from the technician who provides such prompt service. A more likely customer complaint would stem from *lack* of adequate service, caused either by incompetence, or by a technician who just plain wasn't there when and where service was promised.

In this first part of this service, we have considered the problems of who, what, when, where, and why; in the second and third parts we will talk about an even more important aspect of servicing marine radar systems—HOW? ▲

BOOK REVIEW

Basic Electronics; Bureau of Naval Personnel; Dover Publications, Inc., New York, New York; 459 pages, 6½ x 9¼, paperback, $2.75. This republication of Navy Training Course NavPers 10087-A has not been changed from the Navy version except for the omission of a list of training films. Nineteen chapters include fundamentals of electron tubes and transistors, tuned circuits, amplifiers, oscillators, transmission lines, transmitters, receivers, and an introduction to radar. The last two chapters serve as an introduction to computers. An appendix lists electronic color codes and symbols. An 8½-page index is also included.

The reader must already have an understanding of basic electricity if he is to comprehend this text. A knowledge of basic algebra and trigonometry is needed to thoroughly understand some sections. Line drawings, schematics, charts, graphs and waveform drawings are used throughout to supplement the text.

The introduction urges the reader to study the book with pencil and paper and to refrain from skimming the text. This is excellent advice if the aspiring technician is to get the most from the volume.

Flat CRT's

(Continued from page 37)

Since this type of correction is made at the expense of focus, the yoke is never fully focus-corrected and the remainder of the correction is accomplished by small pin-cushion magnets mounted on the yoke.

In the vertical-sweep circuits, the required yoke-current waveform is determined primarily by the characteristics of the vertical-output tube and the output-transformer impedance at high currents; final shaping of the grid-drive waveform is achieved through the selection of circuit components as in conventional sets.

As far as the horizontal-sweep circuits are concerned achieving good horizontal linearity becomes somewhat more difficult, since most methods used to generate the sweep "stretch" the left side of the screen. This distortion is corrected in the horizontal-sweep circuit shown in Fig. 5 through the addition of a linearity circuit—C1, C2, L1, and R1.

Fig. 6 illustrates the development of the "S"-shaped deflection waveform. Keep in mind that these are waveforms of current in the yoke, not voltage waveforms. Fig. 6A shows the ideal "S" waveform; 6B shows the sawtooth sweep waveform normally found in sweep circuits used with conventional rectangular CRT's. Note that this latter waveform tends to be exponential at the left and slightly flattened out at the right to accommodate the sweep to the face of the CRT and yoke windings. The exponential change is the result of RL discharge of the yoke current through the damper circuits; the flattening is caused by general circuit losses. Insertion of a .033-mfd capacitor in series with the yoke (C3, Fig. 5) introduces the parabolic current shown in Fig. 6C. The combination of this parabolic current with the sawtooth in Fig. B results in the waveform of Fig. 6D. Note that the addition of this "parabolic correction" component has modified the waveform by flattening the right side as desired, but also has intensified the exponential change at the left side. This nonlinearity of the left side of the waveform would normally result in compression at the left side of the screen; but, in this instance, it is corrected for by the addition of the linearity

circuit described previously. The fully corrected "S"-shaped waveform is shown in Fig. 6E.

Troubleshooting Tips

Standard troubleshooting techniques may be used when checking the sweep circuits associated with "flat-face" CRTs. However, special attention should be given to scope examination of the circuit waveforms to ensure that the sweep circuits are providing the proper shaping. Horizontal linearity, as mentioned earlier, is largely dependent on two things: (1) components in the horizontal-linearity circuit; and (2) the parabolic-correction capacitor connected in series with the horizontal-yoke winding. If horizontal nonlinearity results, especially apparent at the left side, carefully check these circuit components by substitution. Also check for correct operating voltages and waveforms against the schematic diagram and note carefully any symptoms of overheating, leaky capacitors, charred resistors, and so on.

Vertical-sweep circuits merit the same careful consideration as the horizontal circuits, but be especially careful of shorted or grounded vertical-output transformer windings, leaky or shorted feedback capacitors, and shorted yoke windings.

A lack of focus throughout the raster may be caused by improper settings of the focus voltage taps or potentiometer (if used). A lack of definition in the corners of the raster may result from a defective yoke winding, local electrostatic charges, or mispositioning of the yoke pincushioning magnets.

Two final notes of caution: When replacing bonded-shield CRTs, be careful to (1) replace the CRT with the same type; and (2) avoid placing undue stress or pressure on CRT mountings and yoke windings, as you would with any other CRT. ▲

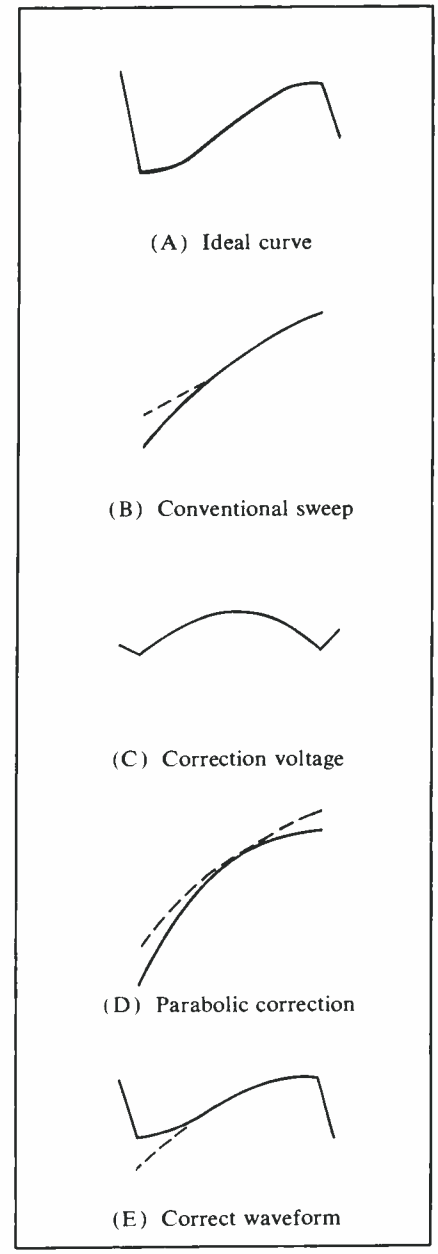


Fig. 6. Waveforms show steps in formation of the "S" curve horizontal sweep.

Tracking Adjustments

(Continued from page 33)

ably off resonance. The trimmer capacitors have not changed value; however, the inductors will cause tracking errors, as we mentioned. The antenna and RF slugs (not trimmers) must now be peaked on 600 kc. The amount of tuning required to reach the peak indicates how well they are tracking. If considerable adjustment is necessary, tracking is poor and step 4 (1615 kc trimmer adjustment) should be repeated.

The trimmers should be peaked at 1615 kc and the slugs at 600 kc, back and forth, until no improvement can be realized. Once this point has been reached, the receiver is in best possible alignment.

FM Tuner Tracking

FM tracking techniques are practically identical to AM. The output connections shown in Fig. 3 are used. The frequencies used are different, but the approach is the same. The trimmers are usually adjusted at 108.5 and the slugs at 88 mc. Proper FM tracking results in maximum receiver sensitivity, which can solve some customer complaints of fading in the auto radio FM fringe area. Tracking checks and/or adjustments will often help locate defective tuned-circuit components, too.

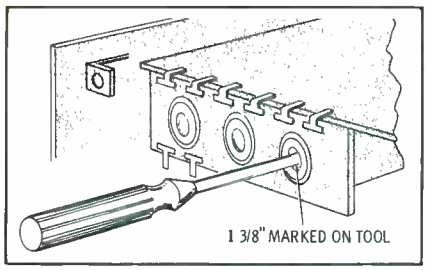


Fig. 6. Oscillator slug is usually preset as the first alignment step.

Troubles Uncovered

Open or leaky tuned-circuit capacitors show up immediately during tracking adjustments, as do open or partially shorted coils. Erratic behavior, or failure to settle down "on track," can reveal intermittent coils or capacitors that would be impossible to locate otherwise. Temperature-sensitive or otherwise defective capacitors will make it difficult to adjust the set for proper tracking, and in some cases the set will refuse to track.

Most coils are wound with a special pattern that requires that they be wired properly. If a replacement coil is soldered into the set backward, tracking will be impossible. Tracking will also be affected if some of the turns were left off of the coil during manufacture.

It is very important that the antenna trimmer be peaked, as previously described, when the radio is reinstalled in the car. The only way the antenna circuit can be adjusted precisely is with the antenna it normally uses.

Summary

Alignment and tracking checks can be a significant troubleshooting aid particularly on tough borderline radios. The larger manufacturers are now aligning AM radios with automatic equipment, which suggests the possibility of improving the alignment if a new-set customer is dissatisfied. The significance of alignment can be realized even when you satisfy a customer by merely peaking his antenna trimmer. The thorough job makes the difference between a happy and an unhappy customer. ▲

Product Report

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

TV Preamp (129)

A five-transistor coaxial TV amplifier has been introduced by **Jerrold Electronics Corporation.** Designated the Model SPC-132 Super Powermate, the new preamp is designed to replace the "De-Snower" Model DSA-132, a tubed unit. The SPC-132 consists of two separate units. Model SPC is a boom-mounted two-transistor preamplifier. Model 132 is a combination remote power supply and three-transistor post amplifier. The SPC-132 provides 29 db gain on the high VHF band and 25 db gain on the low. Noise figure is 4.9 db on the low band and 7.9 db on the high. These noise figures include the loss in 75′ of RG-59 coaxial cable between the SPC and the 132. The SPC-132 is expected to find wide application as a broadband and preamplifier for master TV antennas in motels, apartments, and commercial buildings.

CB Crystals (130)

CB crystals to fulfill most popular replacement requirements are offered by **Semitronics.** These heremetically sealed crystals have a frequency tolerance of .005% or better, are available for all 23 channels, and are fully guaranteed. They are packaged in two-tone plastic boxes and are priced at $2.95 each.

Junior Seizers (131)

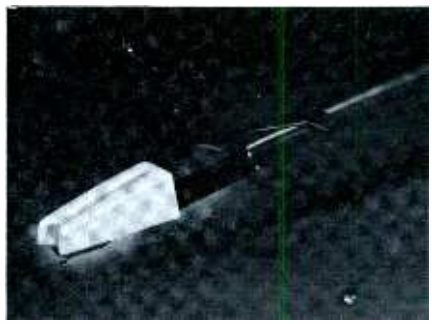
New straight- and curved-nose Junior Seizers only 5″ long are now offered by **Xcelite.** Smaller and slimmer than regular 6″ Seizers, the new Seizers reach more readily into tight spots and facilitate close-quarter work involving fine wires and small components. Prices are the same as for 6″ Seizers—$5.70 for straight, $5.90 for curved.

Capacitor/Desoldering-Tool Kit (132)

A new servicemen's kit, the AKU-102 from **The Aerovox Corp.,** consists of 150 Type DBE Dipped Bi-Electric Mylar-paper capacitors, packed five each in see-thru plastic bags. The ten most popular values are included. In addition, the kit offers an Ungar #270 De-Soldering Kit with two extra tips and complete instruction manual. The entire kit is offered to dealers at a price of $27.95.

Auto Radio Suppressors (133)

A new line of ignition suppressors and condensers from **Duosonic,** Models D-201 and D-301, are hermetically sealed in molded bakelite, and are impervious to heat and moisture.



Semiconductor Transducer (134)

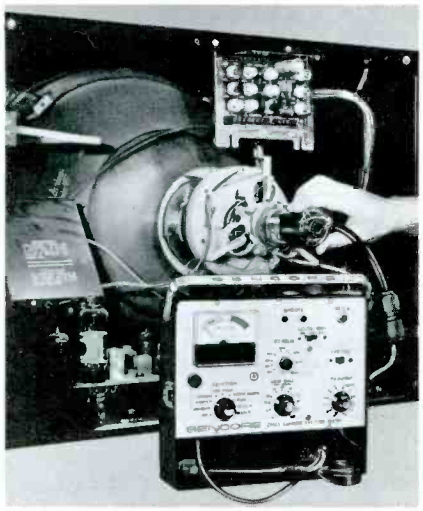
A new stereo transducer, the "Siliconic" U-15, utilizes small silicon elements and is designed to match low-resistance inputs of transistorized amplifier circuitry, resulting in a boost in the electrical energy transferred from transducer to amplifier. The U-15 provides greater power than is normally available from ceramic or magnetic cartridges and has a frequency-response range from DC to beyond 30,000 cps. The **Euphonics** transducer is to be used with an external power source and a low-mass tone arm.

Mobile Sound System (135)

Any car or truck can be equipped for soundcasting in just 45 seconds with the new Ampli-Vox Sound Cruiser, mobile sound system from **Perma-Power Company.** The Ampli-Vox Sound Cruiser amplifier plugs into the automobile cigarette lighter socket, the speakers clamp to the roof, and the unit is ready for use. The system includes a 32-watt (EIA music power) all-transistor amplifier, a noise-cancelling microphone for intelligibility, and two weatherproof horn speakers. The amplifier is supplied with a handle for carrying or mounting under the dash. The amplifier offers frequency response of 50 to 15,000 cps, with less than 5% distortion at full output. It has a master volume control, an auxiliary (radios, tuners, records, etc.) control, auxiliary standby switch, tone control, two outputs for 8- or 16-ohm speakers, and two inputs for microphone and auxiliary. Signal-noise ratio is 80 db. The amplifier operates on 12 volts DC, with idle current of 40 ma, but can be adapted for AC or flashlight-battery operation. The two Implex horn speakers are mounted on a cartop carrier which clamps to the car. Suggested user net price is $169.95.

Transistorized Antenna Booster (136)

A high-gain, low-noise antenna booster, designed to help improve both fringe and metropolitan area color TV, has been announced by **The Alliance Manufacturing Co., Inc.,** subsidiary of Consolidated Electronics Industries Corp. Called "Genie-Color Booster," the new device has an "on-off" switch to bypass the unit when using an external UHF converter. The high overload factor and resistance to cross-modulation helps provide trouble-free use in any type of signal area. The new TV antenna amplifier combines an insertion gain of from 10 to 12 db, with a noise factor as low as 4 to 6 db, and includes an FM trap. List price, complete with mounting hardware, is $42.95.



CRT Checker (137)

The new CR133 CRT Checker by **SENCORE** is designed to test all present picture tubes—plus future tubes, too. The 10-lb unit checks emission, interelement shorts, control-grid cutoff capabilities, gas, and expected life. Checks conventional b-w, new low-drive b-w, round color, and new rectangular color tubes. Two plug-in replaceable cables contain all sockets required. G2 voltage is variable from 25 to 300 volts, insuring non-obsolescence when testing new "semi-low G2" CRT's. Automatically controlled rejuvenator (ACR) applies rejuvenation voltage as required by individual tube condition, precisely timed to prevent over-rejuvenation or tube damage. The ACR feature is most useful for color-tube gun equalization to insure proper gray-scale tracking. Price of the hand-wired, steel-encased unit is $89.95.

CB-Marine Combo (138)

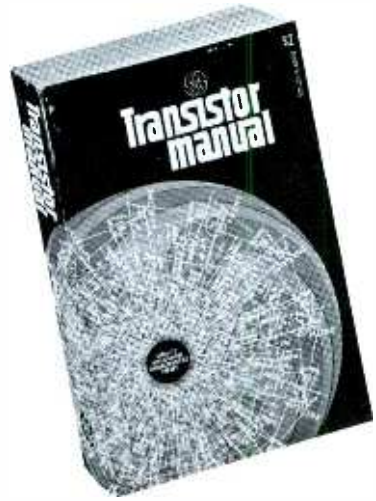
Something new in marine communications is a self-contained CB module that converts the **Pearce-Simpson** "Catalina" 68-watt marine radiotelephone to a dual-system marine/CB radio. This doubles the number of effective communications channels—a total of 11 (5 marine and 6 CB). Called the "Sea-B-Mate," the unit provides contact with home, office, or mobile CB units as well as the usual marine facilities. The cabinet is 3 1/16" wide, 6 7/8" high, and 12 1/2" deep; weighs 3 lb 11 oz; and—complete with noise-canceling push-to-talk microphone and crystals—is priced at $89.90.

Temperature-Controlled Iron (139)

The user can now specify the temperature setting of the soldering iron he needs. These new pencil irons from **Hunter Tools** are available in seven different temperatures ranging from 450°F to 1000°F. Other features include an air-cooled handle and stainless steel jacket on the element. All are lightweight, balanced, and available in various handle colors.

New Literature

Technical Booklets You Can Buy



Transistor Manual (140)

General Electric Semiconductor Products Division has completed the seventh edition of their transistor manual. This paperback publication contains 652 pages and 20 chapters of authoritative information on transistors and diodes. Nearly 80% of the material in this latest edition is new and includes an explanation of tunnel-diode circuit applications. Oscillators, small-signal characteristics, high-frequency considerations, and logic are discussed. The manual contains a wealth of technical information on all aspects of semiconductors and is available from **General Electric Semiconductor Products Department, Syracuse, New York,** priced at $2.00.

INDEX TO ADVERTISERS

FEBRUARY, 1965

FREE Catalog and Literature Service

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

Please allow 60 to 90 days for delivery.

ANTENNAS & ACCESSORIES

64. *ANTENNACRAFT*—Latest literature on *Channel-Spanner*, a new broad-band, high-gain VHF-UHF TV antenna.*
65. *ALLIANCE* — Colorful 4-page brochure describing in detail all the features of *Tenna-Rotors*.
66. *BLONDER-TONGUE* — Information on both indoor and outdoor VHF-UHF TV amplifiers.*
67. *CORNELL-DUBILIER* — Replacement component selector, TV-FM reception booklet, 4-page rotor brochure, and vibrator replacement guide.
68. *FINNEY*—Catalog UVF describes new swept-element log-periodic type VHF-FM antennas.*
69. *GC ELECTRONICS*—Complete TV antenna brochure No. FR-632-G representing latest *Colormagic* antennas.
70. *JFD*—Literature on complete line of antennas for VHF, UHF, FM, and FM-stereo. Brochure showing converters, amplifiers, and accessories; also complete '64-'65 dealer catalog.*
71. *MOSLEY ELECTRONICS* — Illustrated catalog giving specifications and features on large line of antennas for Citizens band, amateur, and TV applications.
72. *MULTITRON*—Illustrated literature on FM-stereo antenna No. MA-44 and Multituner Model M-11.
73. *STANDARD KOLLSMAN* — Catalog sheet on UTC-051 transistor UHF converter kit with IF amplifier.
74. *TRIO*—Brochure on installation and materials for improving UHF translator reception.*
75. *ZENITH*—Informative bulletins on universal loudspeakers and a new line of log-periodic vee-type antennas for FM and monochrome or color TV.

AUDIO & HI-FI

76. *ADMIRAL*—Folders describing line of '65 equipment; includes black-and-white TV, color TV, radio, and stereo hi-fi.*
77. *ASTATIC*—Catalog C-64 phono-cartridge cross-reference replacement guide.
78. *ATLAS SOUND*—Illustrated data sheet describing C-46 and C-66 sound columns, two-way wall speaker system, and bidirectional baffle speaker combinations.*
79. *GIBBS SPECIAL PRODUCTS*—Folders describing principles of sound reverberation and *Stereo-Verb* reverberation units for automobiles.
80. *JENSEN*—24-page catalog, No. 165-K, illustrates and describes speakers and speaker system kits.
81. *NUTONE*—Two full-color booklets illustrating built-in stereo music systems and intercom-radio systems. Includes specifications, installation ideas, and prices.
82. *OAKTRON*—"The Blueprint to Better Sound" an 8-page catalog of loudspeakers and baffles giving detailed specifications and list prices.
83. *OXFORD TRANSDUCER*—Product information bulletin describing complete line of loudspeakers for all types of sound applications, including replacements for public address and intercom systems.
84. *PERMA-POWER* — New catalog sheet describing Ampli-Vox Model S-300 and Sound Cruiser sound system Model S-310.
85. *QUALITONE* — Information on selling diamond needles and earning free gifts.
86. *QUAM-NICHOLS*—General catalog listing replacement speakers for public address, hi-fi, and radio-TV applications.
87. *SAMPSON* — Full-color catalog pages showing new line of Waltham transistor radios, tape recorders, and portable televisions.
88. *SONOTONE*—Brochure on micro-ceramic stereo cartridge for low-mass, lightweight tonearms.*
89. *SWITCHCRAFT* — Product bulletin No. 148 describes latest insulated "Hi-D-Jax" ¼" phone jacks.

COMMUNICATIONS

90. *COMMUNICATION PRODUCTS* Communication systems handbook No. 664 includes base station and vehicular antennas, duplexers, coaxial cable systems, accessories, and technical data.
91. *ELTEC*—Brochure on transistorized tone and/or monitor receivers Model 600B frequency standard, signal generator, and 5-kc deviation standard.
92. *E-Z WAY PRODUCTS*—Information on communications towers for varied applications.
93. *PEARCE-SIMPSON*—Specification brochure on *Companion II*, *Escort*, and *Guardian 23* Citizens-band transceivers.

COMPONENTS

94. *BUSSMANN*—Bulletin SBCU on BUSS fustat box cover units that offer simple, low-cost way to protect work bench tools, soldering irons, drills, etc. against damage and burnout.*
95. *CBC INDUSTRIES*—Catalog of picture-tube brighteners; featuring new all-voltage types.
96. *IEH*—Information on replacement sockets, various types available.
97. *J-B-T-INSTRUMENTS*—General catalog 563A has information on frequency meters, elapsed-time meters, and numerous relays and switches.
98. *MILLER*—Brochures listing replacement radio IF transformers.
99. *PERMACEL* — Product specifications on plastic tapes listing types, technical data, uses, and product features.
100. *SPRAGUE*—Latest catalog C-616 with complete listing of all stock parts for TV and radio replacement use, as well as *Transfarad and Tel-Ohmike* capacitor analyzers.*
101. *TRW*—General catalog No. 165 covers all standard capacitors offered by company. Other technical information on tolerance, reliability, and other characteristics of capacitors.

SERVICE AIDS

102. *CASTLE*—How to get fast overhaul service on all makes and models of television tuners is described in leaflet. Shipping instructions, labels, and tags are also included.*
103. *CHEMTRONICS* — Colorful catalog No. 64 contains information on chemicals as aids to the electronics serviceman.
104. *PRECISION TUNER*—Literature supplying information on complete, low-cost repair and alignment services for any TV tuner.*
105. *YEATS*—The new "back-saving" appliance dolly Model 7 is featured in a four-page booklet describing feather-weight-aluminum construction.

SPECIAL EQUIPMENT

106. *ATR*—Descriptive literature on selling new, all-transistor *Karadio* Model 707, having retail price of $29.95. Other literature on complete line of DC-AC inverters for operating 117-volt PA systems and other electronics gear.*
107. *GREYHOUND* — The complete story of the speed, convenience and special service provided by the Greyhound Package Express method of shipping, with rates and routes.
108. *LECTROTECH*—Bulletins on new color TV test instrument, meter-protective devices, substitute for VTVM battery, and transistorized DC power supplies.*
109. *SETCHELL-CARLSON*—Full-line catalog for both color and b-w receivers, plus educational receivers.
110. *TERADO*—Bulletin on *Galaxy* Model 50-205 transistorized DC-AC power inverter.
111. *VOLKSWAGEN* — Large, 60-page illustrated booklet, "The Owner's Viewpoint," describes how various VW trucks can be used to save time and money in business enterprises, including complete specifications on line of trucks.

TECHNICAL PUBLICATIONS

112. *CLEVELAND INSTITUTE OF ELECTRONICS*—Free illustrated brochure describes electronic slide rule with four lesson Instruction Course and grading service.*
113. *RCA INSTITUTES*—64-page book, "Your Career in Electronics," detailing home study courses in TV servicing, communications, automation, drafting, and computer programming; for beginners and experienced technicians.*
114. *HOWARD W. SAMS* — Literature describing popular and informative publications on radio and TV servicing, communications, audio, hi-fi, and industrial electronics, including special new 1964 catalog of technical books on every phase of electronics.*

TEST EQUIPMENT

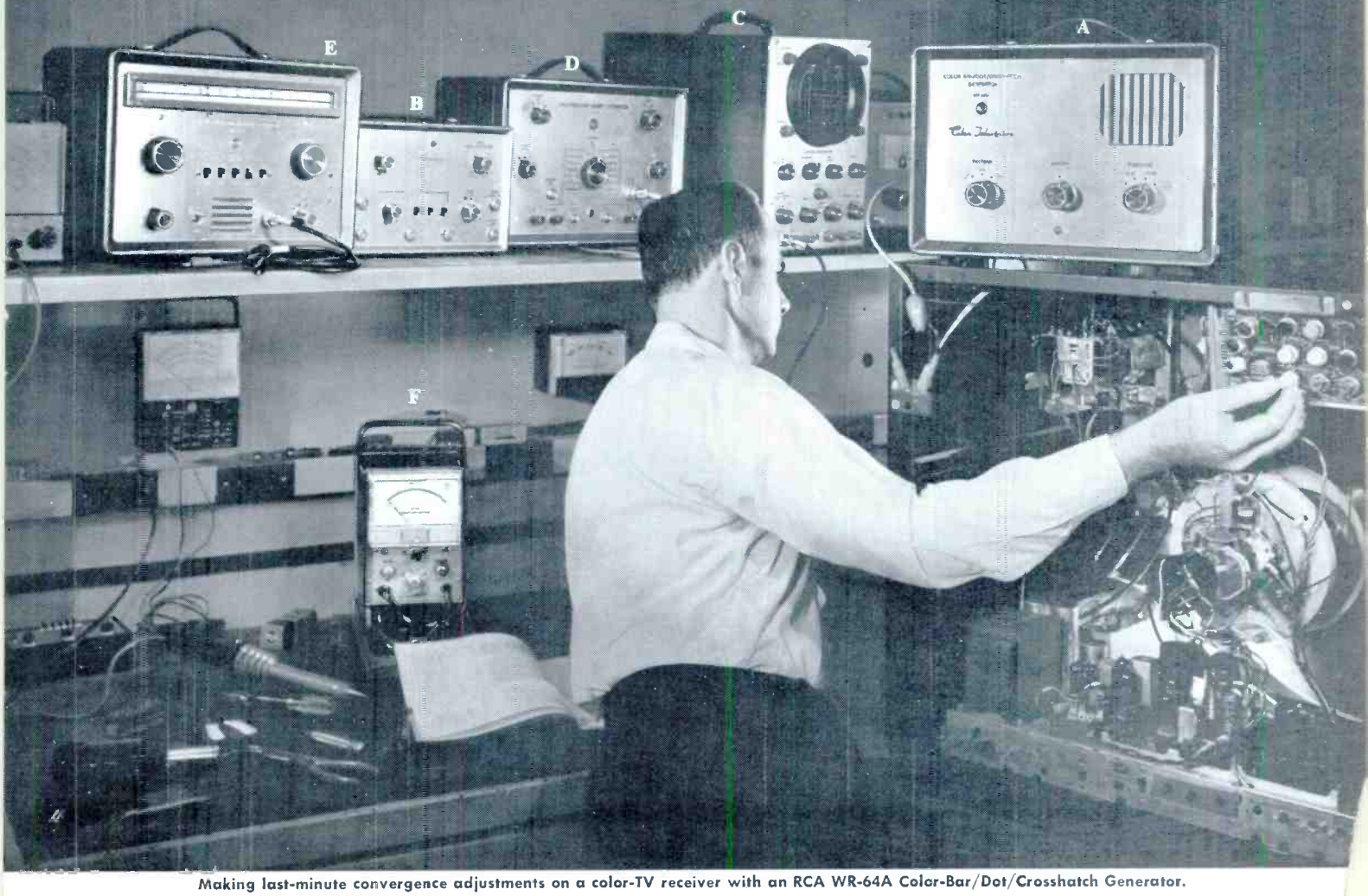
115. *ANTRONIC*—Catalog sheet on line of test equipment and adaptors.
116. *B & K*—Bulletin No. 124-R on new Model 1240 color generator. Catalog AP-21R describing uses for and specifications of Model 1076 Television Analyst, Model 1074 TV Analyst and Color Generator, Model 700 and 600 *Dyna-Quik* Tube testers, Model 445 CRT Tester-Rejuvenator Model 960 Transistor Radio Analyst, Model 360 *V-O-Matic* VOM, Model 375 *Dynamic* VTVM, Model 1070 *Dyna-Sweep* Circuit Analyzer, and Model 230 Substitution Master.*
117. *CADRE*—Form CTC-20-2S gives specifications on *Commander* series of solid-state test equipment, including new type of color-bar generator.*
118. *DUNWELL*—Catalog sheet CS110-D describing portable, low-cost continuity tester for all tubes except nuvistors.
119. *EICO*—New 1965 catalog listing over 200 products including color-bar generator, oscilloscopes, and others; all available in kit form.
120. *HICKOK*—Complete description and specification information on newly introduced Model 662 installer's color generator, portable FM multiplex generator, Model 235A VHF-UHF field strength meter, and Model 800 tube tester.*
121. *JACKSON* — Complete catalog describing all types of electronic test equipment for servicing and other applications.
122. *MERCURY*—Complete catalog on line of test equipment to help the serviceman.
123. *SECO*—Data sheets on self-service tube testers and caddy-pack tube testers that carry over 200 tubes.
124. *SENCORE*—New color catalog on complete line of company products; oscilloscopes, generators, testers, and many others.*
125. *SIMPSON*—Complete 16-page brochure on entire line of electronic test equipment; also, catalog on line of panel meters.*
126. *TRIPLETT*—All new test-equipment catalog No. 46-T showing complete line of VOM's, tube testers, transistor analyzers, and signal generators.

TOOLS

127. *ENTERPRISE DEVELOPMENT*—Time-saving techniques in brochure from Endeco demonstrate improved desoldering and resoldering techniques for speeding up and simplifying operations on PC boards.*
128. *LUXO LAMP*—New catalog No. 114-2 showing illuminated magnifiers and low-voltage lights.
129. *UNGAR*—Catalog No. 763 giving information on series of soldering irons and accessories.

Color-TV servicing is profitable

GET THE MOST OUT OF IT WITH COLOR-TV TEST INSTRUMENTS FROM RCA—PIONEER OF COLOR TV



Making last-minute convergence adjustments on a color-TV receiver with an RCA WR-64A Color-Bar/Dot/Crosshatch Generator.

(A) RCA WR-64A COLOR-BAR/DOT/CROSSHATCH GENERATOR

Low-cost, lightweight, portable instrument that provides all essential Color-TV test patterns:
• *Color-bar pattern:* ten bars of color for checking phase and matrixing, and for automatic frequency and phase alignment.
• *Crosshatch pattern:* thin sharp lines for adjusting vertical and horizontal linearity, static and dynamic convergence, raster size, and overscan.
• *Dot pattern:* small dots to facilitate accurate color convergence.

$189.50* with output cables

(B) RCA WR-70A RF/VF/IF MARKER ADDER

For use with a marker generator and a sweep generator. Used for RF, IF, and VF sweep alignment in color and B&W TV receivers.
• Choice of four different marker shapes
• Provides very high-Q markers of high amplitude and narrow bandwidth

$74.50* complete with cables

(C) RCA WO-91A 5-INCH OSCILLOSCOPE

A wideband scope for checking colorburst signals and general troubleshooting.
• 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

$249.50* including direct/low capacitance probe and cable, ground cable, and insulated clip.

(D) RCA WR-69A TELEVISION FM SWEEP GENERATOR

For visual alignment and troubleshooting of color and B&W TV receivers, and FM receivers.
• 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

$295.00* including all necessary cables

(E) RCA WR-99A 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.
• Most-used IF and RF frequencies indicated on the dial scale
• Sound and picture carrier markers available simultaneously

$256.50* complete with output cable and phone tip

(F) RCA WT-115A COLOR PICTURE TUBE TESTER

Designed specifically to test color-TV picture tubes, either in or out of the set. Tests each gun for emission quality, inter-electrode leakage and shorts.
• Large sensitive meter with separate 3-color scales
• Provision for accurate adjustment of cut-off point for each gun

$89.50* with cable, carrying case and socket assembly

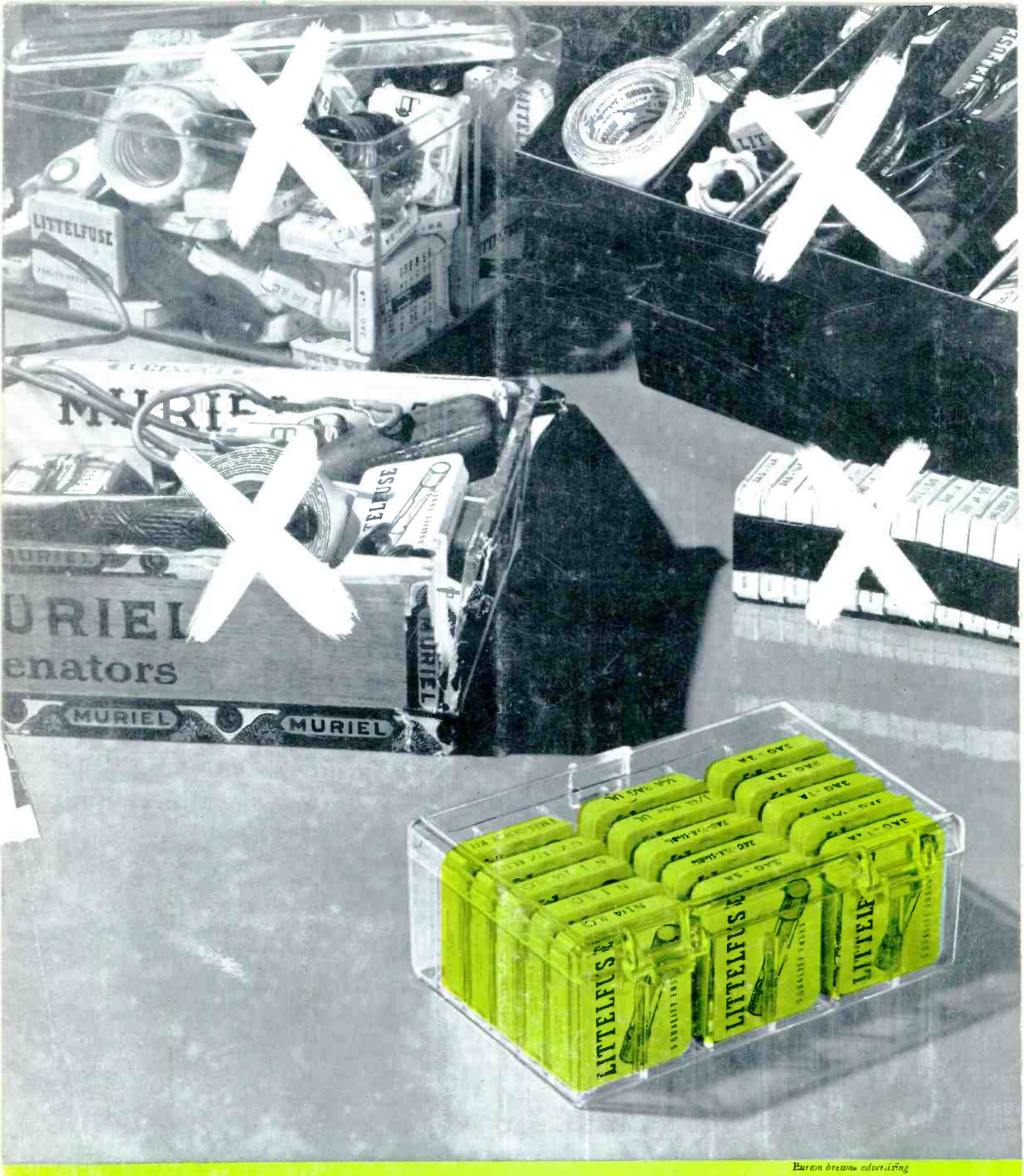
FREE! You have a chance to win a new 1965 Chevy-Van...and over 100 additional prizes ...in the RCA 1965 Regional Sweepstakes. For details, see page 14&15

See them all at your Authorized RCA Test Equipment Distributor.

**Optional Distributor Resale Price All prices are subject to change without notice. Prices may be higher in Alaska, Hawaii and the West.*

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

The Most Trusted Name in Electronics



Burton brown advertising

THERE'S ONLY ONE RIGHT WAY

A *fuse caddy* for your *tube caddy*: 18 individual compartments for fingertip selection. The fuse caddy is complete with the 15 boxes of fuses required to service 93% of all TV sets. Three spare compartments are provided for additional fuses of your own selection.

LITTELFUSE *Des Plaines, Ill.*

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