

# ELECTRONIC TECHNICIAN

WORLD'S LARGEST ELECTRONIC TRADE CIRCULATION

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COLOR  
REVIEW  
FOR  
1967



OCTOBER 1966



# NEW STAR ON COLOR TV



He could be you! This fall, Jerrold is priming the antenna market with the industry's first really extensive TV spot advertising campaign. Millions of viewers in key markets coast-to-coast will be seeing hard hitting, full-color Jerrold antenna spots. And here's what they'll tell your customers:

1. You need an excellent antenna for good color TV reception.
2. Jerrold Coloraxial antennas are best because they use shielded coaxial cable—like TV studios use.
3. Your antenna should be installed by a professional—the Jerrold Coloraxial Reception Specialist.

Yes, the Jerrold Coloraxial Reception Specialist

plays a starring role in these commercials. He is a man of stature, the recognized antenna expert in his selling area. And this massive TV ad campaign creates tremendous consumer demand for his services.

Think you have the experience and know-how to qualify as a Jerrold Coloraxial Reception Specialist? Want to increase your antenna sales substantially this fall? Contact your local Jerrold representative or write:

**JERROLD**

Distributor Sales Division  
4th and Walnut Streets  
Philadelphia, Pa. 19105

... for more details circle 125 on postcard



# Getting a hernia and not getting paid for it?

Let Arcolytic® capacitors lift the load off your mind.  
Or anywhere else it happens to be.

These aluminum electrolytics are built to last: wound with computer-grade 99.99% pure aluminum foil so they'll keep operating in your customers' sets even at continuous temperatures of 85°C.

You'll find they take the worry right out of premature failure, lost customer confidence and costly call-backs.

There's no premium cost, either. Arcolytics are priced along with other home entertainment capacitors.

Ask your Authorized Arco Distributor for Arcolytic electrolytic capacitors in single-section tubular, multiple-section tubular, or twist-mount designs. It may be the best break you get this year.

## Arco Electronics

A DIVISION OF LORAL CORPORATION  
Community Drive, Great Neck, N. Y./  
Dallas, Texas/Pasadena, Menlo Park,  
California/Write for our free catalog.



... for more details circle 106 on postcard





### Introducing EICO's New "Cortina Series"!

Today's electro-technology makes possible near-perfect stereo at moderate manufacturing cost: that's the design concept behind the new EICO "Cortina" all solid-state stereo components. All are 100% professional, conveniently compact (3 1/8"H, 12"W, 8"D), in an esthetically striking "low silhouette." Yes, you can pay more for high quality stereo. But now there's no need to. The refinements will be marginal and probably inaudible. Each is \$89.95 kit, \$119.95 wired.

Model 3070 All-Silicon Solid-State 70-Watt Stereo

Amplifier: Distortionless, natural sound with unrestricted bass and perfect transient response (no inter-stage or output transformers), complete input, filter and control facilities; failure-proof rugged all-silicon transistor circuitry.

Model 3200 Solid-State FM/MPX Automatic Stereo Tuner: Driftless, noiseless performance; 2.4μV for 30db quieting; RF, IF, MX are pre-wired and pre-tuned on printed circuit boards — you wire only non-critical power supply.

# 7 New Ways to make Electronics more Fun!

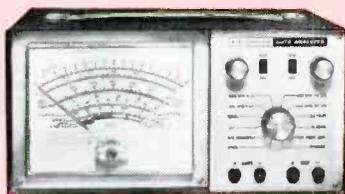
Save up to 50% with EICO Kits and Wired Equipment.



You hear all the action-packed capitals of the world with the NEW EICO 711 "Space Ranger" 4-Band Short Wave Communications Receiver — plus ham operators, ship-to-shore, aircraft, Coast Guard, and the full AM band. 550KC to 30MC in four bands. Selective, sensitive super-het, modern printed circuit board construction. Easy, fast pinpoint tuning: illuminated slide-rule dials, logging scale, "S" meter, electrical bandspread tuning, variable BFO for CW and SSB reception, automatic noise limiter. 4" speaker. Headphone jack. Kit \$49.95. Wired \$69.95.



More "ham" for your dollar than ever — with the one and only SSB/AM/CW 3-Band Transceiver buy for 1966" — Radio TV Experimenter Magazine. 200 watts PEP on 80, 40 and 20 meters. Receiver offset tuning, built-in VOX, high level dynamic ALC, silicon solid-state VFO. Unequaled performance, features and appearance. Sensationally priced at \$189.95 kit, \$299.95 wired.

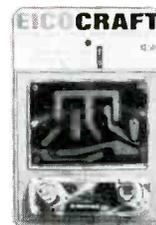


### NEW EICO 888 Solid-State Engine Analyzer

Now you can tune-up, troubleshoot and test your own car or boat.

Keep your car or boat engine in tip-top shape with this completely portable, self-contained, self-powered universal engine analyzer. Completely tests your total ignition/electrical system. The first time you use it — just to tune for peak performance — it'll have paid for itself. (No tune-up charges, better gas consumption, longer wear) 7 instruments in one, the EICO 888 does all these for 6V and 12V systems; 4, 6 & 8 cylinder engines.

The EICO 888 comes complete with a comprehensive Tune-up and Trouble-shooting Manual including RPM and Dwell angle for over 40 models of American and Foreign cars. The Model 888 is an outstanding value at \$44.95 kit, \$59.95 wired.



New EICOCRAFT® easy-to-build solid-state electronic TruKits:® great for beginners and sophisticates alike. As professional as the standard EICO line — only the complexity is reduced to make kit building faster, easier, lower cost. Features: pre-drilled copper-plated etched printed

circuit boards, finest parts; step-by-step instructions, no technical experience needed — just soldering iron and pliers. Choose from Fire Alarm, Intercom, Burglar Alarm, Light Flasher, "Mystifier", Siren, Code Oscillator, Metronome, Tremolo, Audio Power Amplifier; AC Power Supply. From \$2.50 per kit.



There's more PUNCH in the new EICO "Sentinel-Pro" 23-channel Dual Conversion 5-watt CB Transceiver. New advanced Big-Reach "Range Plus" circuitry lengthens "talk-power" reach. Automatic noise limiter super-sensitizes for weak signals. "Finger Tip" antenna loading and transmitter tuning controls. 23 crystal-controlled transmit and receive channels — all crystals supplied. Rear-illuminated S/R/F meter. Transistorized 12VDC and 117VAC dual power supply. Wired only, \$169.95. Positive-Negative Ground/Mobile Marine Modification kit (optional \$5.95).



Model 460 Wideband Direct-Coupled 5" Oscilloscope. DC-4.5mc for color and B&W TV service and lab use. Push-pull DC vertical amp., bal. or unbal. input. Automatic sync limiter and amp. \$99.95 kit, \$139.50 wired.

### FREE 1967 CATALOG

ET-10

EICO Electronic Instrument Co., Inc.  
131-01 39th Ave., Flushing, N. Y. 11352

Send me FREE catalog describing the full EICO line of 200 best buys, and name of nearest dealer. I'm interested in:

- test equipment                       ham radio  
 stereo/hi-fi                             Citizens Band radio  
 automotive electronics

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Address \_\_\_\_\_

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Model 232 Peak-to-Peak VTVM. A must for color or B&W TV and industrial use. 7 non-skip ranges on all 4 functions. With exclusive Uni-Probe.® \$29.95 kit, \$49.95 wired.

OCTOBER 1966  
VOL. 84 NO. 4

# ELECTRONIC TECHNICIAN

WORLD'S LARGEST ELECTRONIC TRADE CIRCULATION

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## Cover

Our art and photographic departments pooled their resources this month to create a symbolical cover emphasizing the primary editorial content of this issue which spot-lights the color-TV parade in which the nation's service-dealers and technicians are now participating.

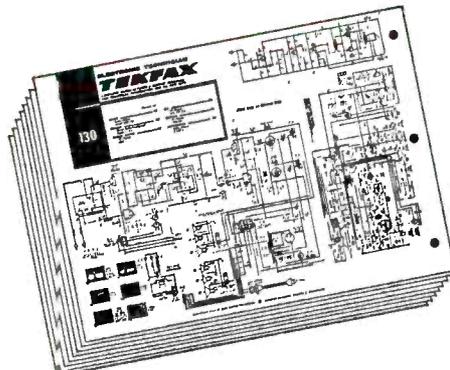
## FEATURES

- Color Review for 1967** ..... 47  
*A two-part article tells you what's ahead in color and B/W for next year. The second part of the article will appear in the November issue*
- Color Servicing Tips and Countermeasures** ..... 51  
*An expert color TV benchman opens up his bag of tricks for your benefit*
- Marching in the 'Peacock Parade'** ..... 55  
*A service-dealer tells how he sells and services color TV equipment*
- Ten Frequent Color Troubles** ..... 58  
*Another active technician opens up his service records for service technicians who want to learn all about color*
- Servicing Solid-State TVs** ..... 59  
*A service engineer tells how it's done*
- Semiconductor From A to Z** ..... 64  
*All about how solid-state components function*
- The Electronic Technician's 'Piggy Bank'** ..... 67  
*This one will inform you and tickle your 'funny bone' at the same time*

## DEPARTMENTS

- |                                |                                 |
|--------------------------------|---------------------------------|
| Letters to the Editor ..... 22 | Book Reviews ..... 92           |
| Editor's Memo ..... 26         | Catalogs and Bulletins ..... 94 |
| Technical Digest ..... 28      | News of the Industry ..... 108  |
| New Products ..... 70          | Advertisers Index ..... 114     |

## TEKFAX — 16 PAGES OF THE LATEST SCHEMATICS



- Group 170 October • 1966
- AIRLINE TV Model GEN-1867A
- GENERAL ELECTRIC Color TV Chassis KC
- RCA VICTOR Color TV Chassis CTC25 Series
- SEARS — SILVERTONE TV Model 720, 7121
- TRUETONE TV MODEL 2DC3741
- ZENITH TV Chassis 14X21

# LETTERS TO THE EDITOR

## Try the Library

Regarding the letter from Owen Fraser (p26, August ET). Recently when we needed a schematic for an old radio I followed a hunch and wrote to the Detroit Public Library and asked about borrowing the out-of-print edition of Riders radio schematics. They wouldn't lend it to me but for a \$1 charge I got a full photo-

stat of the needed schematic. Mr. Fraser could probably get that same service from his library in New York. The photostat was clear and no doubt easier to work from than the book.

F. HANES

Northport, Mich.

## Where Have You Been?

In the past years I have often wondered why there is not to my knowledge an Electronics Technician Organization. All other trades of a technical nature have such an organization. The electronic field is getting

more and more complex . . . The small independents should have a large voice in the field because I believe we know the problems better than anyone else. We are in a very skilled and responsible field and should act and organize as such. Can something be done?

MARVIN E. PEELEY

Mitchell, S. Dakota

•There are two national organizations of technicians in existence and many state organizations. — Ed.

## Another Experience

Regarding the trouble Gilbert Gahler had with the RCA KCS98A, I had the same trouble with a set and cured it by replacing a very low emission CRT. The set has been going strong for over a year and a half with the same 1X2B in it.

GERALD HOGAN

Cleveland, Ohio

## He's 'Kept Informed'

I'd like to take this opportunity to express my compliments on your fine magazine. ET has kept me well informed of the constantly changing developments in the field and your color articles are just the greatest. Keep up the good work.

ED WEBER

New York, N.Y.

## Needs Schematic

Can anyone help me locate a schematic on an AM/FM tuner called "B & G." In appearance it is somewhat like a Harman Kardon and it has some tubes with "H-K" marked on them . . . We have received many helpful hints in ET.

WARDELL TV

Los Angeles, Calif.

## Long-Time Reader

I am renewing my subscription to ELECTRONIC TECHNICIAN for 3 years. Have been a subscriber since the early 50s. In my opinion it is the best of its kind. Don't change it. Keep it just like it is. I have filed all my copies from the first one and get a lot of good out of going back over them — reading the articles again that are of particular interest to me. I do not see an index of TEKFAK to date.

LOREN CAWOOD

Tampa, Fla.

• The December 1966 issue will carry TEKFAK index. See "Editor's Memo," page 22, June 1966 issue. —Ed.



## SOLID STATE

# Model 1900 COLOR GENERATOR



All Mercury Instruments GUARANTEED for ONE FULL YEAR

**EXCLUSIVE FEATURE**  
Line Width Adjuster... enables you to select vertical and horizontal line thickness—or dot size from the smallest to the largest.

Provides more 'troubleshooting' flexibility . . . produces more patterns . . . and offers a big 'saving bonus' in its extraordinarily low cost

If you're looking for a Color Generator that offers every essential feature needed to tackle lucrative Color TV servicing in the home and in the shop consider the outstanding new Model 1900. *Features:* Crystal controlled keyed rainbow color display . . . Separate horizontal and vertical bars . . . Color level control . . . Connects easily to antenna . . . Color coded gun killer switches on panel . . . Includes lead piercing clips . . . High RF output on channels 3, 4 or 5. Factory set at channel 3. Adjusts easily for channels 4 or 5 without removing unit from cabinet . . . All calibrations can be made rapidly without removing unit from cabinet . . . One full year guarantee on parts and workmanship . . . Size: 10"x6¼"x4¼".

\$99<sup>95</sup> Net

No additional charge for gun killers

See your parts distributor . . . write for complete catalog

## MERCURY ELECTRONICS CORP.

315 Roslyn Road, Mineola, New York 11501

In Canada: William Cohen Corp.  
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. . . for more details circle 130 on postcard



# 1,863 reasons why Sprague Twist-Lok® Capacitors help you to protect your reputation

When you fool around with makeshift or "fits-all" capacitor replacements by substituting sizes and ratings, you leave yourself wide open for criticism of your work, you risk your reputation, and you stand to lose customers. With so much at stake, it just doesn't pay to use makeshifts when it's so easy to get exact replacement capacitors from your Sprague distributor.

With 1,863 different Sprague Twist-Lok Capacitors as standard catalog items, and more being added regularly, Sprague gives you the world's most complete selection of exact replacements.

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And who better than Sprague knows which values and sizes are needed in the replacement market? Sprague, the world's largest component manufacturer, has the most complete specification file on original set requirements. That's why you're always right when you work with Sprague Twist-Lok exact replacements!

GET YOUR COPY of Sprague's comprehensive Electrolytic Capacitor Replacement Manual K-107 from your Sprague Distributor.



## HAVE YOU TRIED KWIKETTE\* CONNECTORS?

Not just another wire spring connector! Copperweld wire inner core, a layer of flux, and an outer coating of solder . . . all you supply is heat! Now being packed with Sprague Atom® Capacitors at no extra cost to you! See your distributor!

\*TRADEMARK



WORLD'S LARGEST MANUFACTURER OF CAPACITORS

Sprague Products Co., 65 Marshall St., North Adams, Mass. 01248  
 . . . for more details circle 148 on Postcard

# LETTERS

## TO THE EDITOR

### Hickok Tester

I have a Hickok tube and transistor tester, model 820, for which I need an instruction manual. The company says this instrument is no longer available and manuals are out of print. If any ET reader can supply a copy, either original or photocopy, I will defray expenses. I like your magazine very

much but would like to see more on industrial electronics.

A. D. MAUS

Little Rock, Ark.

• *We are increasing coverage on industrial electronics.—Ed.*

### Likes Profile Articles

Liked your article "Growing in a Competitive Market." Also find TEK-FAX schematics valuable for the electronic technician.

E. SANDER

Experiment, Ga.

### Retires

I am retiring from service work. Thank you for all the kind help I have received from ELECTRONIC TECHNICIAN. I advise every young man going into TV-radio to subscribe. ET will be of great help. Thanks again.

W. H. ROTHENBAUM

Vineland, N. J.

### New Reader

Congratulations on a fine magazine. I have been reading ET for only a year but now look forward to each issue. I am a recent graduate of RCA Institutes and am now employed. Would like to see articles on lab tests in addition to TV and stereo.

BRUCE DILLINGHAM

W. Acton, Mass.

### Rider Chanalyst Manual

I have complete Rider Chanalyst, Mod. 11 Manuel, like new. Will send by insured Parcel Post upon receipt of \$3 money order. Reply via ET.

WALT C. SONNENSTUHL

Chester, Calif.

### Enjoys First Contact

Received my first copy of ET and am very well pleased with the list of features. Enjoy your shop visits. Let's have more. It does not hurt anyone to know what his fellow technicians and service-dealers are doing.

I. E. MINER

Cornell, Ill.

### Grundig Manual

An ET reader asked for a schematic for a Grundig TK819. We have the complete repair manual for this equipment available at a cost of \$2.

NORTHWEST Hi Fi CENTER

5618 W. Irving Park Road  
Chicago, Ill. 60634

### 'Lonely' Cover Girl

On the August '66 ET cover, the 'lonely girl on the beach' appears saddened because the solid-state TV is not working right for some reason, at least there's no image on the screen. But I'm sure a girl so beautiful will not be lonely for long.

E. B. RISLEY

Davis, Calif.

• *The B/W portable had a perfect picture on it at the time the photo was made. An airplane was distinctly visible on the screen. But the strong sunlight and the 4-color process left little to be seen in the printed photo.—Ed.*



IT'S THE FINEST

## Model CRO-3 5-inch

# Wide-Band, High Sensitivity Oscilloscope

essential for booming  
**COLOR TV**  
servicing ...

basic for  
**BLACK/WHITE TV**  
servicing ...

... also widely used  
in the laboratory  
and in industry



### SPECIFICATIONS

- Wide band amplifier, flat within 1 DB from 20 cycles to 5 MC
- Two range vertical deflection sensitivity from 0.018 RMS volts per inch
- Highly stable amplifier circuits...no balancing required
- Positive or negative internal horizontal sync
- Linear sawtooth sweep oscillator, 20 cycles through 50 KC
- Input calibrating voltage, 10 volts peak-to-peak
- Vertical polarity reversal
- Horizontal sweep expansion
- Return trace blanking
- Z-axis modulation...external or internal 60 cycle
- Direct connections to deflection plates when required Size: 10 1/8" W x 16 3/8" D x 13 1/8" H.

Wt.: 18 lbs. 6 oz. Dealer Net \$234<sup>95</sup>

*The Jackson CRO oscilloscope was designed as a wide band scope when color TV first made its entry into the field. It is widely used by professionals who laud its stable circuitry, accuracy and extraordinary laboratory quality. It has constantly been improved upon by Jackson engineers, making the present Model CRO-3 the finest instrument of its type.*

**ACCESSORY PROBES FOR THE JACKSON CRO-3**

LC2-1P Low Capacity Probe .....	\$19.95
LC10-P High Voltage Low Capacity Probe .....	7.95
DEM-P Demodulation Probe .....	9.95

*See your Jackson distributor, or write for catalog*

## JACKSON ELECTRICAL INSTRUMENT COMPANY

124 McDonough Street, Dayton 2, Ohio

In Canada: William Coffin Corp., 8900 Park Ave., Montreal

Exports: Morfran Export Corporation, 458 Broadway, New York 13, N. Y.

IF IT'S A JACKSON...IT'S THE FINEST

... for more details circle 122 on postcard

A COMPLETE FAMILY OF QUALITY UHF-VHF-FM ANTENNAS

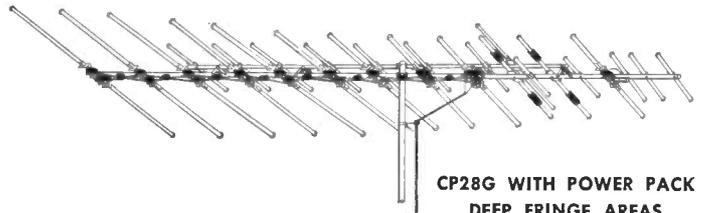
# KAY-TOWNES

OVER 900 MODELS FOR EVERY AREA — EVERY PURPOSE

## colorphase

WITH PIGGY BACK POWER PACK

Gives the EXTRA PUNCH needed to produce the best in color and improved black and white. High Gain, high front to back ratio. Double U-bolts and double cross-arms for rugged rigidity. 2-piece locking mast clamp. No boom braces needed.



CP28G WITH POWER PACK  
DEEP FRINGE AREAS  
LIST \$53.75



CP23G WITH POWER PACK  
FRINGE AREAS  
LIST \$44.80



CP19G WITH POWER PACK  
NEAR FRINGE-FRINGE  
LIST \$35.05



CP15G WITH POWER PACK  
SUBURBAN-NEAR FRINGE  
LIST \$26.10



CP11G  
SUBURBAN  
LIST \$20.19

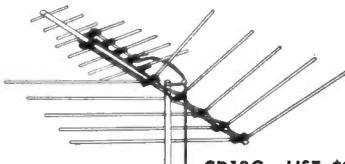


CP7G  
CITY AREAS  
LIST \$13.02

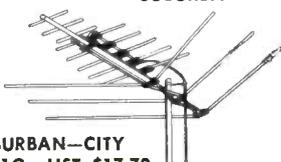
## COLORDYNE

COMBINATION UHF-VHF-FM

An antenna for all channels 2 through 83. Simplicity of design permits high gain reception at low cost.



CD13G LIST \$21.92  
SUBURBAN-NEAR FRINGE



SUBURBAN-CITY  
CD11G LIST \$17.70

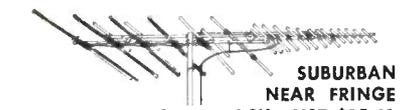
## Colorphase Combination

ALL-BAND UHF-VHF-FM WITH PIGGY BACK POWER PACK

One antenna to cover all channels 2 through 83 with single down lead for all areas including FRINGE AREA.



FRINGE  
CPC27G WITH POWER PACK LIST \$40.75



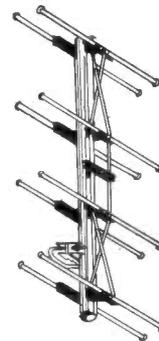
SUBURBAN  
NEAR FRINGE  
CPC24G WITH POWER PACK LIST \$35.41



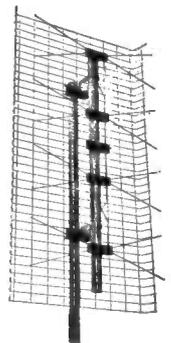
CITY AREAS  
CPC12G LIST \$17.42

## NEW U-12G

Outperforms 4-Bay Bow Tie. Features resonating reflector to provide more gain across entire band. Folds into small carton, can be mailed by Parcel Post. Gold Anodized.



LIST \$8.75  
COLOR FRINGE  
AREAS



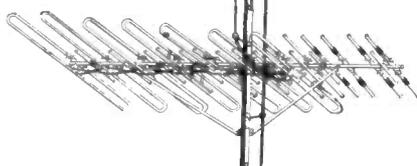
UHF-4BT  
LIST \$7.65  
FRINGE AREAS

## COLORVISTA UHF

Converts any existing VHF antenna to 82 channel reception with a single lead. Receives UHF in one direction and VHF in another with no rotor or coupler necessary.



CVU-13G LIST \$14.15



KAY-TOWNES  
ORIGINATOR-  
DESIGNER OF  
World Famous

Cross Phase Circuit  
used in most modern antennas

GENUINE GOLD ANODIZED Not A Spray To Wash Away!

SALES TERRITORIES OPEN IN SOME AREAS

QUALITY • PERFORMANCE • ECONOMY



**KAY-TOWNES**  
antenna company

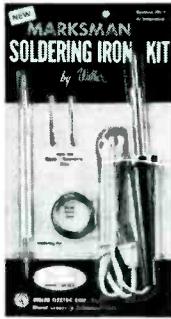
HEADQUARTERS OFFICE AND PLANT — 1511 DEAN AVE., ROME, GA. 30182

... for more details circle 127 on postcard

SEE YOUR ELECTRONICS PARTS DISTRIBUTOR:

# Weller® for every soldering job

## Pencil Soldering Irons by Weller



"Marksman" Kit with pencil soldering iron; screwdriver, cone and chisel tips; handy soldering aid and a supply of solder. **\$444** list Model SP-23K.



"Marksman" Iron at popular price. Stainless-steel long-reach barrel. 1/8" replaceable tip. Maximum tip temperature, 750°F. **\$298** list Model SP-23.



Weller Iron is industrial rated, highly efficient. Does work of bigger irons. Only 7 7/8" long including the tip. 25 watts. 115 volts. **\$520** list Model WP-S.

## Temperature Controlled Soldering Unit

For universal hobby soldering, including heavy-duty metal work. Temperature control is in the tip. Interchangeable tips give a choice of 500°F, 600°F, 700°F and 800°F controlled temperatures. Operates on 24 volts. Complete with 3/16" 700°F tip and 60 watt, 120 volt, 50/60 cycle power unit with soldering pencil stand and tip cleaning sponge attached. Model W-TC. **\$2600** list



## Dual Heat Soldering Guns

100/140 Watts. Two trigger positions let you switch instantly to high or low heat to suit the job. Tip heats instantly and spotlight comes on when trigger is pulled. Tip has exceptionally long reach. Model 8200. **\$695** list

145/210 Watts. A professional model with all Weller gun features: instant heat, dual heat, spotlights. Model D-440. **\$995** list

240/325 Watts. Heavy-duty model with all Weller gun features: instant heat, dual heat, spotlights. Model D-550. **\$1095** list



## Dual Heat Soldering Gun Kit

Includes Weller 100/140 watt dual heat gun, 3 soldering tips, tip-changing wrench, soldering aid, flux brush, supply of solder . . . all in a colorful utility case of break-proof plastic. Model 8200PK. **\$895** list



## Heavy-Duty Soldering Gun Kit

Features Weller 240/325 watt dual heat gun; tips for soldering, cutting and smoothing; tip-changing wrench; solder; metal-tone utility case of break-proof plastic. Model D-550PK. **\$1295** list



Utility Grade Solder On Hang Cards 5 feet of 40/60 alloy solder in each pack. Acid core, AC-40. Rosin core, RC-40. **39¢** list



Superior Grade Solder In Dispenser Tubes 10 feet of 60/40 alloy rosin-core solder in each tube. Number RC-60. **59¢** list

# EDITOR'S MEMO

## It's About Time!

Word from various areas of the country, particularly from some sections of California, indicates that service-dealers are boosting their charges for basic service calls. The perspective appears to be around \$10 for B/W and \$12.50 for service calls on color sets. This is encouraging. TV-radio service-dealers have been notoriously lax in establishing realistic charges for house-calls and bench work.

But most small service-dealers are still not charging realistic prices for their work. And, as the record of past TV-radio shop failures show, they will slowly starve their businesses out of existence — unless they soon begin to charge properly for their work.

The cost of making a service call in most areas — the breakeven point — is around \$6. Considering the average time involved, a \$10 charge for a service call does not appear anywhere near exorbitant. This compares favorably with charges made by electricians, plumbers, carpenters, bricklayers, etc. And \$12 for a house call on a color set, where the time involved is usually greater, also appears reasonable.

It is reported that General Electric has been charging \$11.05 for a B/W and \$12.05 for a color set house call for quite some time. And large companies can operate more economically than 'one-horse' TV-radio shops.

TV-radio shops rank close to the top in business failures. And a majority of these failures are caused by faulty business practices — primarily insufficient profit on service calls and shop work.

Despite all the evidence piled up during the past few years by national and state service-dealer and technician organizations to prove the point, many small service-dealers still charge from \$4.50 to \$6.50 for house calls and around \$6 an hour for bench work. This is business suicide!

Good TV-radio technicians are scarce today and many are getting around \$4 an hour pay. Considering all the other costs in operating a service-dealership, no businessman in his right mind will attempt to operate with service charges below the breakeven point.

It's about time, then, for small service-dealers to wake up before the golden opportunities now before them — especially in color TV — have flittered away, 'thither and you,' with the autumn leaves.

WELLER ELECTRIC CORPORATION, Easton, Pa.

WORLD LEADER IN SOLDERING TECHNOLOGY

. . . for more details circle 152 on postcard

# install ALLIANCE Tenna-Rotor®...now

*Profit now with world-famous  
Tenna-Rotors®.*

**You'll sell more than ever before.  
And they're twice as easy to sell!**



**In-store demonstrations sell on sight!** Hook up a Tenna-Rotor . . . Every color set needs one . . . Then, watch their faces light up when you turn the dial and they see a beautiful color picture. Switch to black & white or FM Stereo. Same result: Tenna-Rotor pulls 'em in sharp, clear, bright and strong! **Use the color-TV delivery lag to sweeten up profits** with Tenna-Rotor sales, antenna and lead-in wiring jobs. Then, you'll be all set for fast, easy deliveries and installations.



Install the world famous Alliance Tenna-Rotor®

*"TV's Better Color Getter"*



The **ALLIANCE** Manufacturing Company, Inc.  
(Subsidiary of Consolidated Electronics Industries Corp.) **ALLIANCE, OHIO**  
Maker of **GENIE®** Garage Door Openers

# TECHNICAL DIGEST

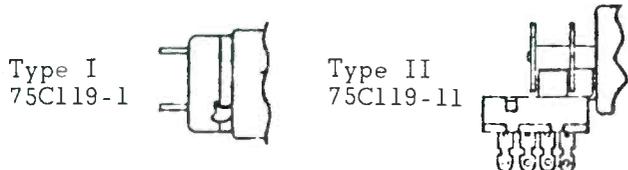
## ADMIRAL

### Solid-State Stereo—Revised Alignment Data

After extensive tests on Admiral solid-state stereo-radio chassis, it has been found that more constant curves can be obtained by using the weakest possible sweep RF signal, rather than the more conventional curve level set at the -3db limiting threshold. Please note this revision in service data manuals S1018, S1020, S1033, S1034 & S1047.

Also, when aligning late run 24A3 chassis, you will find that the alignment of T1 is satisfactory with both slugs at their outermost peaks.

Using the sweep levels above and data supplied in News Letters EDL6605 and EDL6607, all tuners (including the 24A3) may be aligned with the IF sample taken off at the discriminator electrolytic through the



standard decoupling network (be sure that the discriminator secondary slug is turned out while you observe the IF curve).

Much alignment information for other solid-state chassis appears in alignment procedures for the 22D5 chassis (service manual S1047).

**REPLACEMENT CONTROL:** Because of an error in specifications, the 75C119-1 control was purchased from two suppliers with two different types of switches. We have assigned a different dash number for the second type to permit proper field replacement.

Type I with SPST switch remains -1 but type II with DPDT switch is now 75C119-11. Orders for 75C119-11 can be filled without question, but 75C119-1 should be ordered with description "Control, SPST Switch," so we can be sure you are aware of the difference!

This control has been used on tuner clusters GC2155-1, -2 & -4 and is in parts lists in manuals S1022A, S1022B, S1025A and S1043.

## RCA VICTOR

### Color Chassis—Purity Adjustments

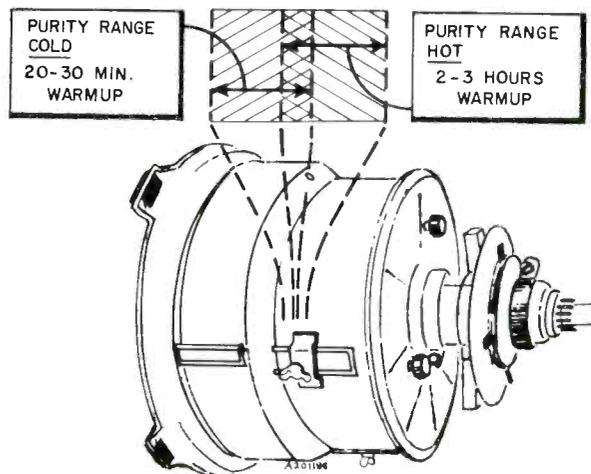
The effects of stray magnetic fields and the importance of North-South instrument orientation during purity adjustment are well known by most technicians. But it may be helpful to repeat detailed procedures.

Place the TV set in a North or South orientation, check center convergence, set center purity with the disc magnets, and set over-all purity by location of the deflection yoke.

Exact and lasting purity in any color receiver requires care during all adjustments. However, in TV sets using 90deg rectangular color CRTs, the *positioning of the deflection yoke* must be more *selective*, and instrument

operating time must be considered. By a specific procedure, a stable purity setting can be obtained on rectangular CRTs that remains pure from initial warm-up time (20-30 minutes), up to and beyond any extended period of time.

RCA Victor service data for rectangular color equipment include a special note regarding purity adjustments; "If purity adjustments are made during minimum operating temperature conditions (20-30 minutes), the yoke should be set as close to rear edge of adjustment as is



consistent with good purity." Receiver warmup may be accelerated by operating the TV set at a high brightness level (without blooming) for approximately 10-20 minutes; preferably 20 minutes. (The yoke will arrive at approximately the same physical location, regardless of "cold" or "hot" setup.)

To clarify the action and importance of yoke position and warmup time, see illustration. As shown, a 90deg yoke housing, and simulated movement of the yoke within this housing (dotted lines extended into expanded areas above the housing). Notice there is a "range" through which purity is maintained as the yoke is moved forward or backward (the range represents slightly over 1/4 in. of physical yoke travel). During "cold" conditions, the range extends in the forward direction—the yoke can be moved forward, *without losing purity*. During "hot" conditions, this range extends rearward.

The normal tendency would be to locate and set the yoke in the center of its purity range, compensating for any plus or minus change from "cold" to "hot" conditions — *this procedure is incorrect for rectangular CRTs*.

A further study of the illustration will disclose an *overlapping* area where purity will remain stable through all operating temperature conditions. Special attention must be given to locate the yoke in this "lasting" position.

If adjustment is made after a minimum warmup time (20-30 minutes), use the following procedure: Adjust center purity, slide yoke *forward* for good red field, then slide *rearward* until slightly impurity appears, *then* move slightly *forward* to just clear impurity.

Use the following procedure for adjustment during "hot" conditions, after 2-3 hours operation: Slide yoke to

Sencore has done it again—introduced the right instrument at the right time at the right price. FM-Stereo Multiplex is here, now, and growing as fast as Color TV. This new field is just waiting for qualified men. All you need to start "channelizing" profits your way is the new Sencore Econoline MX11 Channelizer Multiplex Generator. So light and compact you take it with you on your TV service calls, and when in the home suggest an alignment on that FM-Stereo hi-fi in the corner.

So simple to operate, you need no other instrument. Just hook up the RF output cable to the receiver antenna terminals; connect the two speaker leads in place of the speakers; then read the channel separation directly on the meters. Two meters with built-in loads substitute directly in place of speakers. When you flick on the left channel switch you have left channel output; now flip on the right channel switch and you have both. That's all there is to it.

All solid state circuitry—battery operated. Feature for feature, dollar for dollar, the Sencore MX11 Channelizer is your No. 1 buy in multiplex generators. Sencore has paved the way—so take the quickest road to your distributor. In stock now for only .....

**\$99<sup>50</sup>**

(Less than the price of a kit.)

# CHANNELIZER

## PAVES THE WAY TO ADDED PROFITS

With Simplified FM-Multiplex Servicing



### SENCORE MX129 FM STEREO MULTIPLEX GENERATOR AND ANALYZER

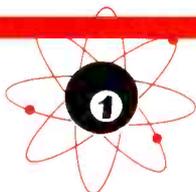
#### A Complete FM Stereo Service Center

The ultimate in multiplex generators for this field that's growing as fast as color TV. Like having your own FM stereo transmitter on your bench or service truck.

The MX129 produces all signals needed for trouble-shooting and aligning the stereo portion of the FM multiplex receiver. It is a complete trouble-shooting analyzer with a sensitive transistorized AC voltmeter calibrated in peak to peak volts and decibels. It can be used as a stereo demonstrator even when no stereo program is being broadcast. With the MX129 you can use external sources to modulate the carrier, re-balance the system at any time, and adjust the crystal controlled pilot signal to any level. Instantaneous warm-up—all solid state, A.C. powered.

The Sencore MX129 gives you features comparable to equipment costing up to \$350.00, yet its priced at only .....

**\$169<sup>50</sup>**



# SENCORE

NO. 1 MANUFACTURER OF ELECTRONIC MAINTENANCE EQUIPMENT

426 SOUTH WESTGATE DRIVE, ADDISON, ILLINOIS 60101

... for more details circle 143 on postcard

# Experience for Sale.....45¢

**Sure seems we started something!**

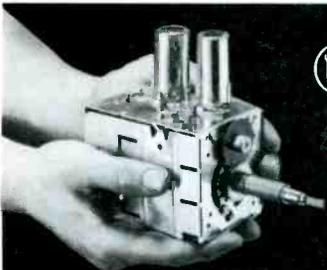
Yes; over ten years ago, when we started overhauling tuners (all makes and models), we set a price of \$9.95 for this service.

Apparently there are those who would like to imitate our achievement—and for 45¢ less.

Maybe the special skills, special equipment and downright old fashioned experience we built up during these past years are worth that little extra.—You be the judge.

Remember; 45¢ buys you more than a quarter of a million man/hours of experience, plus true devotion to our business . . . our only business . . . overhauling your television tuners the best way we know how. And in over ten years we sure know how!

**Castle — The Pioneer of TV tuner overhauling**  
Not the cheapest — just the best.



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

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

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

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

## CASTLE

TV TUNER SERVICE, INC.

MAIN PLANT: 5713 N. Western Ave., Chicago 45, Illinois  
EAST: 41-92 Vernon Blvd., Long Island City 1, N. Y.

**CANADA:** Castle TV Services, Ltd. . . . Nation-wide service.  
For service in Canada write to Chicago or use reader service card in this magazine.

\*Major parts are charged extra in Canada.

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## TECHNICAL DIGEST

most forward position for good red screen, then slide forward until slight impurity appears, then move slightly rearward to just clear impurity.

Although reference is made primarily to rectangular CRTs, the same procedures apply to round color tubes. The 21in. round CRT is somewhat less critical regarding yoke placement.

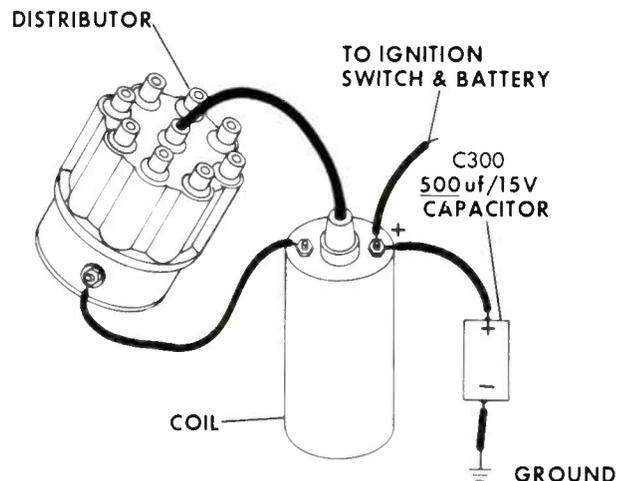
Quality performance from color television depends a great deal on proper setup—including purity. Technicians should remember the advantages of North-South orientation and proper yoke placement while making purity adjustments on color receivers, particularly those using rectangular CRTs. This procedure gives the best assurance of stable purity during the warmup period and operation.

### TRUETONE

4DC7600 Stereo Tape Player—Noise Suppression

**Ignition Noise** If audible noise is detected in the tape player output while the engine is running and (ignition) noise or alternator noise is detected, a 500ufd, 15v capacitor must be installed when an engine emits spark plug noise to the player. The installation of the capacitor as shown in illustration is necessary.

1. Locate the battery terminal of the ignition coil. The wire that leads to the distributor will not be connected to this terminal.
2. Locate the positive end of the 500ufd capacitor, marked plus (+), and connect this end of the capacitor to the battery terminal of the ignition coil.
3. Securely connect the other end of the 500ufd capacitor, marked minus (-), to a ground on the engine.



ENGINE NOISE SUPPRESSION

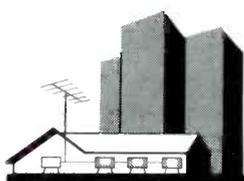
**Alternator Noise** Alternator noise manifests itself as a high pitched whine that varies in pitch with the speed of the engine. A 4uh choke must be installed to suppress this source of noise.

1. Cut open the red lead of cable between the fuseholder and connecting plug. Strip the insulation from the opened ends of the red wire.
2. Connect and solder a 4mh choke between the opened ends of the red wire. Insulate the connections.

# Dealer acceptance has made Channel Master MATV equipment the fastest-growing line in a booming, color-oriented market.

## Here's why

- **Technical Superiority:** Channel Master MATV components are the latest in electronic design...not reworks of early model equipment.
- **Policy:** Only Channel Master protects you, the dealer, no direct bidding, no direct or one-step selling, no cut-rate mail order listings.
- **Price:** Channel Master offers the lowest-priced commercial grade MATV equipment in the industry, making any dealer competitive at a profit.
- **Rapid Layout Service:** Got a big, tough job? Channel Master will give you technical assistance and layouts that are yours alone to get the business.
- **Easy Installation And Servicing:** Channel Master equipment is designed with the service dealer in mind...down to exclusive features like access doors on amplifiers and built-in test positions for maintenance without interruption of service.
- **Training Program:** Leader in recognizing the tremendous residential MATV market the Color Explosion is creating, Channel Master offers a thorough training course in home and small commercial installation.



MATV...for homes, for business...is growing. You can grow with it because it is not a packaged product but a needed service that only you, the technician-dealer can perform. Call your Channel Master distributor or write

**CHANNEL MASTER CORP.** ELLENVILLE, NEW YORK

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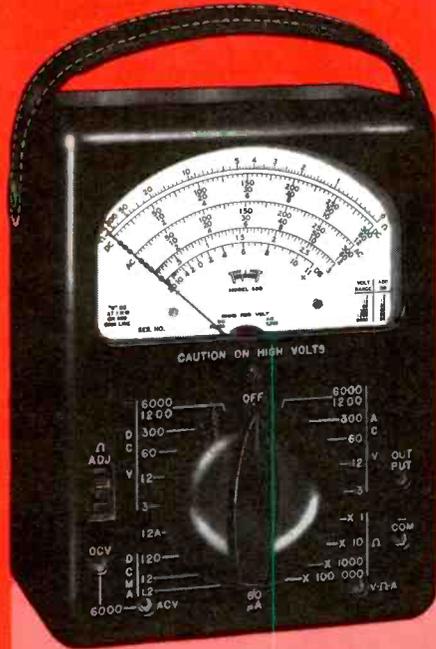
ANTENNAS • PREAMPLIFIERS • SPLITTERS • AMPLIFIERS • ATTENUATORS • TAP-OFFS

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**HIDDEN\*  
QUALITY**

**MODEL 630 V-O-M**



Standard  
Of the  
Industry

PRICE†  
\$55.00



EXCLUSIVE TRIPLETT BAR RING  
SHIELDED MOVEMENT

EASY TO CHANGE  
STANDARD BATTERIES

FUSED

HIGH FLUX  
MAGNET,  
SPRING  
BACKED  
JEWELS  
—FOR  
RUGGEDNESS

SIMPLE TO  
REPLACE  
MULTIPLIERS  
OR SHUNTS

HEAVY MOLDED CASE

SPARE FUSE

COMPLETELY WIRED CIRCUIT



**FACTS MAKE FEATURES:**

- 1 Popular streamlined tester with long meter scales arranged for easy reading. Fuse protected.
- 2 Single control knob selects any of 32 ranges—less chance of incorrect settings and burnouts.
- 3 Four resistance ranges—from .1 ohm reads direct; 4½ ohm center scale; high 100 megohms.

Attention to detail makes the Triplet Model 630 V-O-M a lifetime investment. It has an outstanding ohm scale; four ranges—low readings .1 ohm, high 100 megs. Fuse affords extra protection to the resistors in the ohmmeter circuit, especially the XI setting, should too high a voltage be applied. Accuracy 2% DC to 1200V. Heavy molded case.

† 630A same as 630 plus 1½% accuracy and mirror scale only \$65.00

**TRIPLETT ELECTRICAL INSTRUMENT COMPANY, BLUFFTON, OHIO**

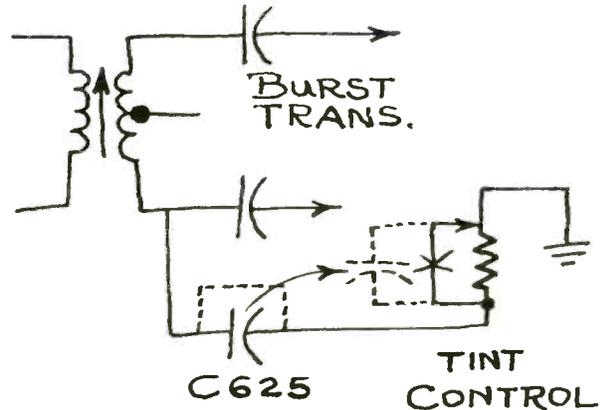
THE WORLD'S MOST COMPLETE LINE OF V-O-M'S  
AVAILABLE FROM YOUR TRIPLETT DISTRIBUTOR'S STOCK.

**TECHNICAL DIGEST**

**SYLVANIA**

**DO3 Chassis—Tint Control**

If the tint control of DO3 chassis affects color, causes horizontal instability or left-hand oscillations the following modifications should be made. Remove C625 (120 pf



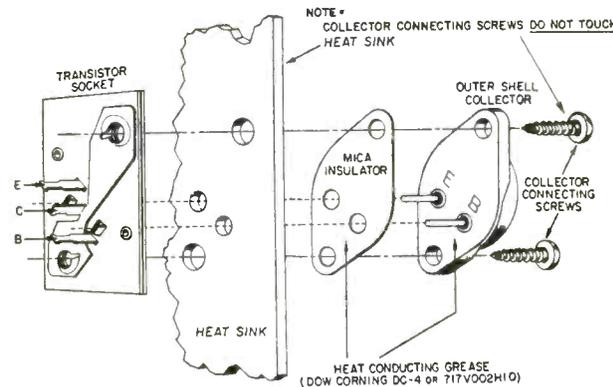
in series with tint control) and install a jumper. Remove loop on tint control between the pot arm and pot end. Reinstall capacitor between arm and "hot" end of pot.

**WESTINGHOUSE**

**Power Transistors—Replacement**

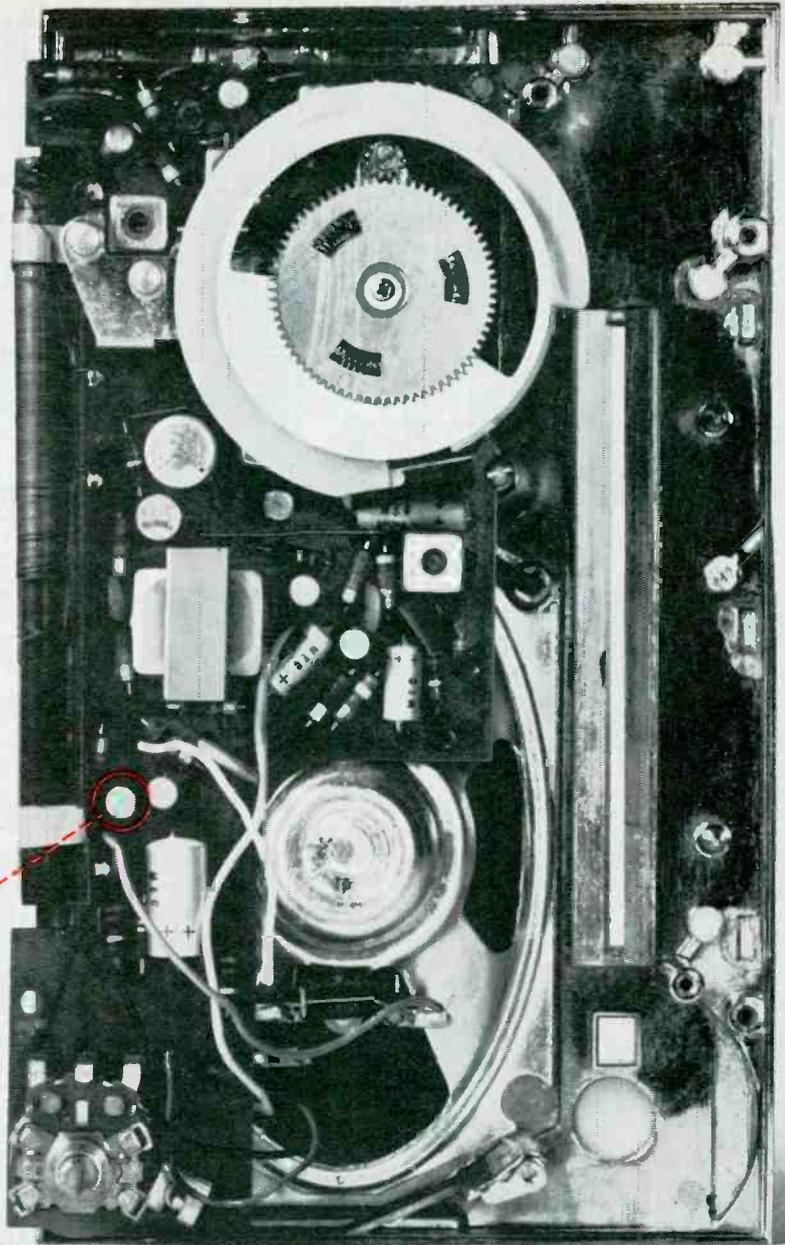
The entire outer case of the transistor is internally connected to the collector. This means that the outer case carries the collector current. Screws go through the heat sink but they do not touch it. To do so would short the collector to ground. The collector case is insulated from the heat sink by a mica insulator.

The relatively high current in power transistors pro-



duces a corresponding amount of heat which must be dissipated. This is done by making the collector surface large, so it can radiate heat to the surrounding air. Then, by mounting the transistor to a heat sink on the side of the chassis, the chassis and heat sink absorb some of the transistor heat and radiate it to the air. The mica washer electrically insulates the collector from the heat sink, but permits good heat transfer from the collector to the heat sink. A coating of silicone grease is applied to the mica washer to help transfer heat.

← ... for more details circle 150 on postcard



***One RCA SK-3004 can replace this transistor and more than 700 other transistors as well!***

And it will work! Because RCA SK-3004 is one of RCA's "Top-of-the-Line" series of replacement semiconductors—16 transistors and 2 rectifiers. Each of these top quality replacement semiconductors has been carefully designed for a specific application in entertainment-type equipment. Result: You can quickly choose the one type that will provide top performance in the equipment you are servicing.

All 18 RCA Top-of-the-Line types and the devices they replace—more than 4,000 transistors, foreign and domestic, and more than 1,300 selenium and silicon rectifiers—are listed in RCA's Replacement Guide, SPG-202A. You should have a copy handy if you service solid-state entertainment-type equipment. Ask your RCA Distributor about it or write: RCA Commercial Engineering, Section J46SD, Harrison, N. J. RCA Electronic Components and Devices, Harrison, N. J.



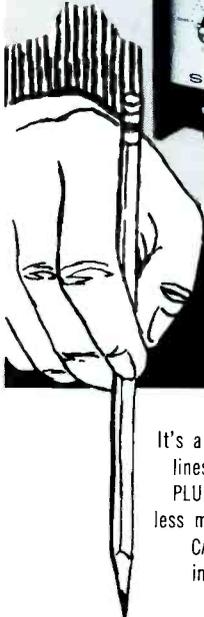
AVAILABLE FROM YOUR RCA DISTRIBUTOR

The Most Trusted Name in Electronics



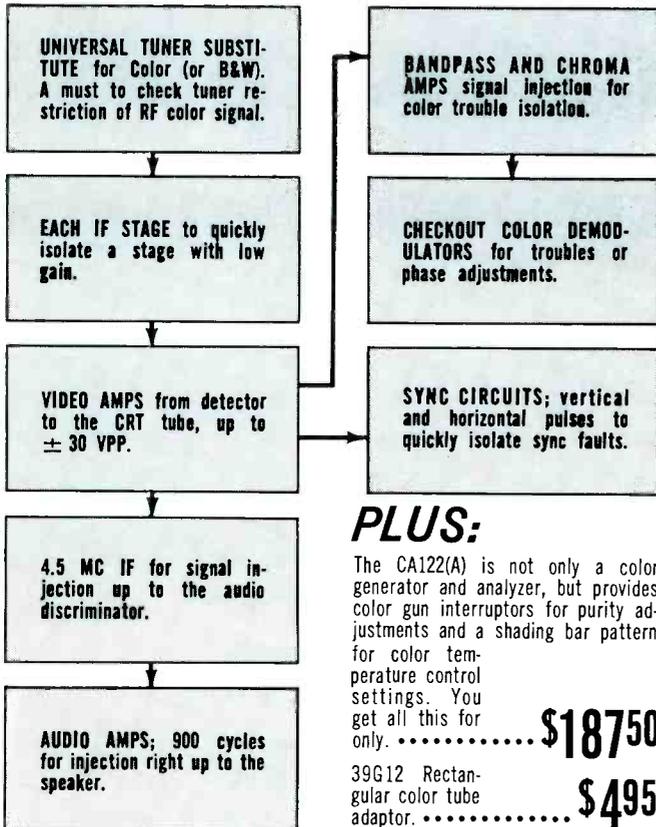
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# PINPOINT COLOR TV TROUBLES IN SECONDS...



## WITH THE NEW IMPROVED SENCORE CA122(A) COLOR CIRCUIT ANALYZER

It's a standard ten color bar generator; produces vertical lines, horizontal lines, crosshatch, and adjustable dots, PLUS a complete TV analyzer for color and B&W — at less money than color generators only. Here is what the CA122(A) will do for you by tried and proven signal injection into these stages.



### PLUS:

The CA122(A) is not only a color generator and analyzer, but provides color gun interruptors for purity adjustments and a shading bar pattern for color temperature control settings. You get all this for only..... **\$18750**  
 39G12 Rectangular color tube adaptor..... **\$495**

See your distributor today. He has the CA122(A) in stock now.

# SENCORE

426 SOUTH WESTGATE DRIVE • ADDISON, ILLINOIS

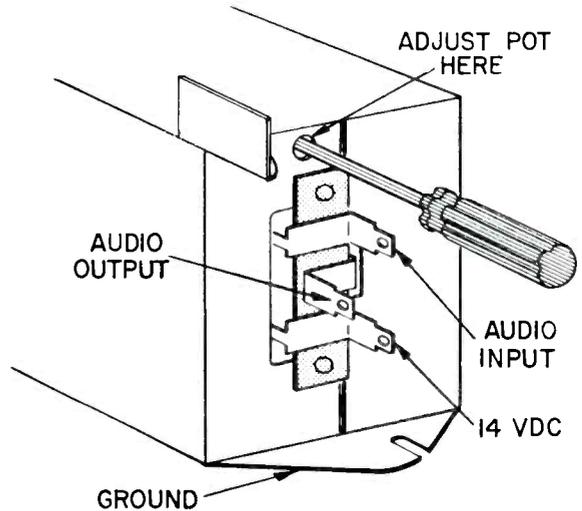
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## TECHNICAL DIGEST

### PONTIAC

#### Reverberation Unit—Rear Speaker Adjustment

Pontiac reverbs use a volume potentiometer in the input to set up the amount of signal that is fed to the rear speaker. On some of the 1966 units equipped with



the direct coupled circuit board amplifier the rear speaker volume must be increased to satisfy some customers.

- (1) Adjust the radio volume control to normal listening level on the REAR ONLY position. (2) Switch to REVERB and adjust the pot in the reverb for adequate volume. Switch back to the REAR ONLY position for comparison.

### MAGNAVOX

#### T918/T919/T920 Chassis—Improved Horizontal Range

The horizontal hold control is being changed from 35K (part No. 220146-48) to 45K (part No. 220146-69) to provide improved hold control operation.

A 10K resistor has been added in series between R533 (180K) and point D (top of the hold control) on the deflection board, in conjunction with the 35K pot.

In replacing the hold control, the 45K pot (220146-69) should be used. The 10K resistor should be removed and R533 returned to point D.

### GENERAL ELECTRIC

#### SB-5C Chassis—Sound Distortion

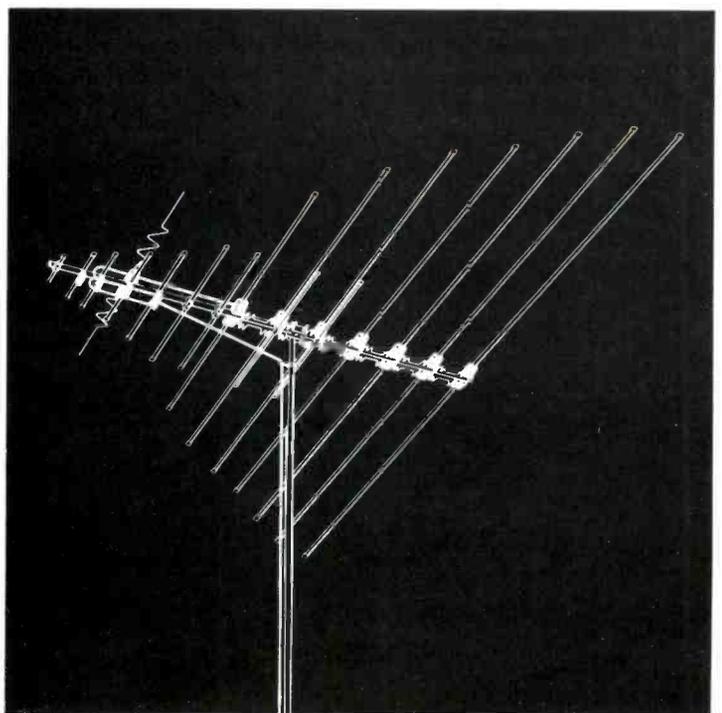
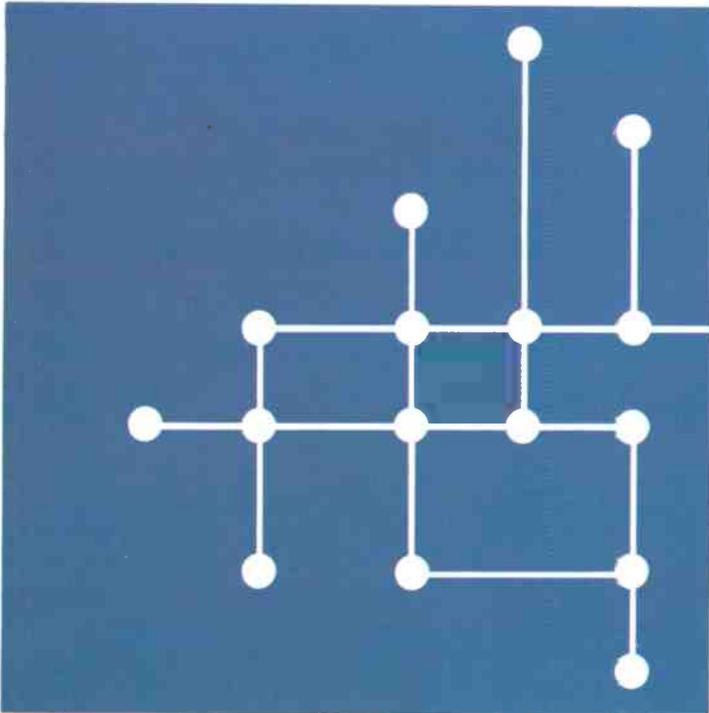
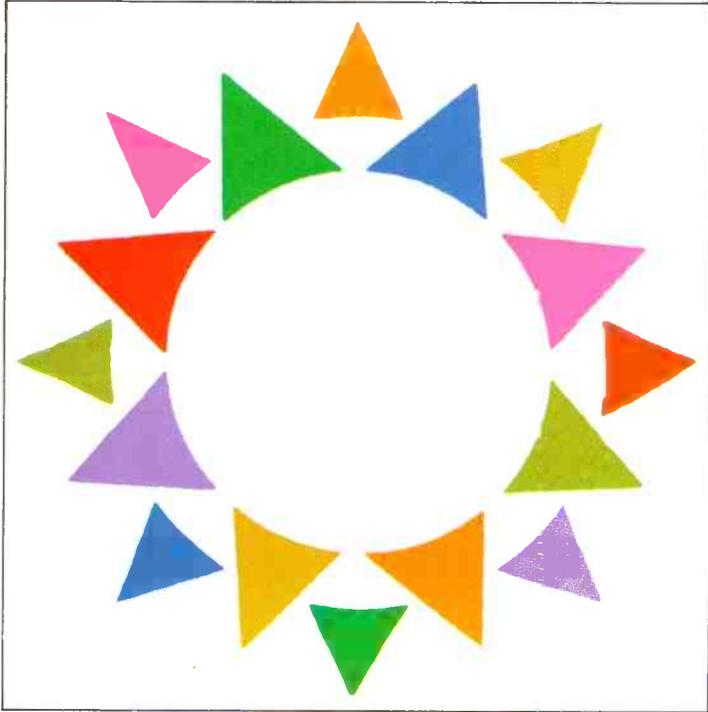
Buzz in sound, distortion, or a narrow sound fine tuning range can be caused by a poor crimp on the seams of the shield cans surrounding L-302 quadrature coil or L-301 interstage coil. The poor crimp can cause detuning of the stage involved and may vary with heat, age and the looseness of the crimp.

It is recommended that prior to sound alignment and in all cases of sound problems outlined above, a bead of solder should be run up the seam of the quadrature and interstage shield cans.

The shield can seams are now being soldered.

... for more details circle 154 on postcard →

**Color comes clearer  
& sales come faster  
with engineered-for-color  
Winegard antennas!**



## National Advertising!

Seems like we've been telling people (millions of them) about engineered-for-color Winegard antennas long before there were color tv sets. Not true, of course. But it's been a long time. Longer than any other antenna manufacturer. Since 1955, to be exact.

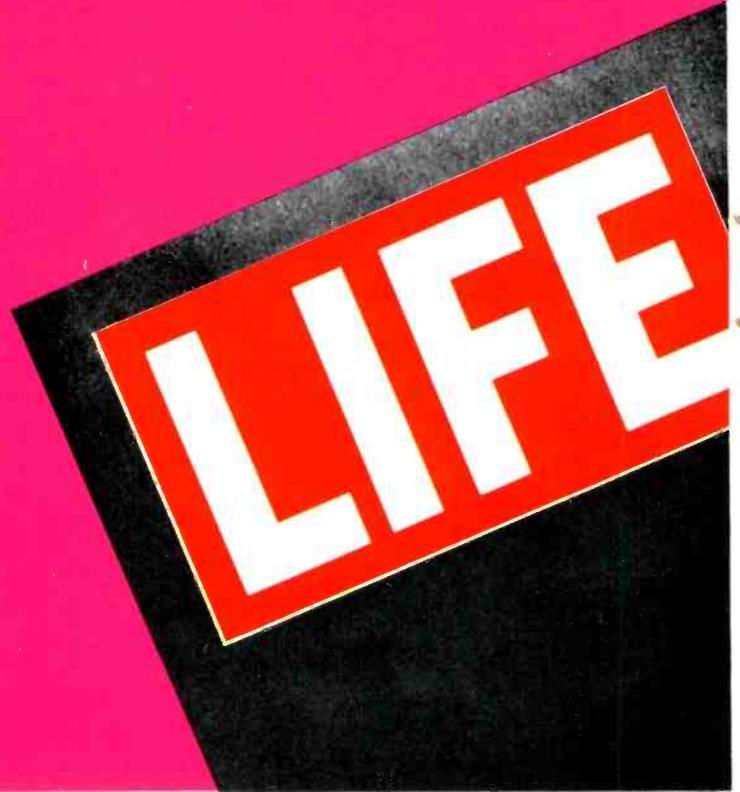
After 11 years of national advertising, it's gotten to the point that when most people think about color tv, they just naturally think Winegard.

And with 4-million or so families getting ready to buy color tv, that's the kind of thinking that can get your antenna sales moving. Fast!

This year Winegard has planned more national advertising than ever before.

## Life Magazine

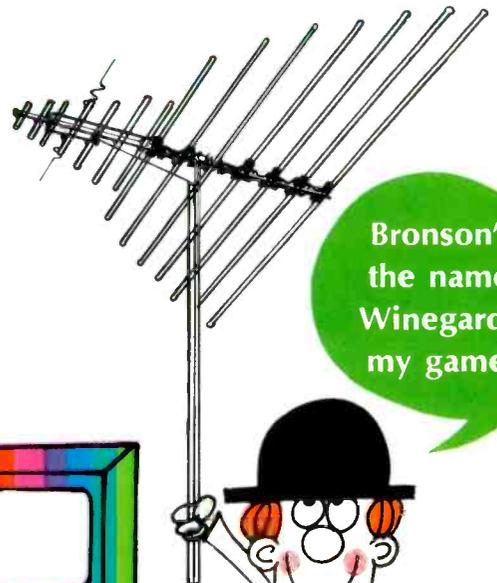
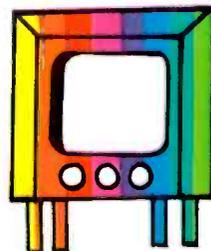
The more than 32,000,000 (that's right, 32 million) readers of Life magazine will start seeing Winegard ads in September. And they'll keep seeing them every month right through next March. They are prospects for color tv sets—and your prospects for engineered-for-color Winegard antennas. Will they remember Winegard when they buy color tv? We guarantee it!



# HERE'S WHY SALES COME FASTER

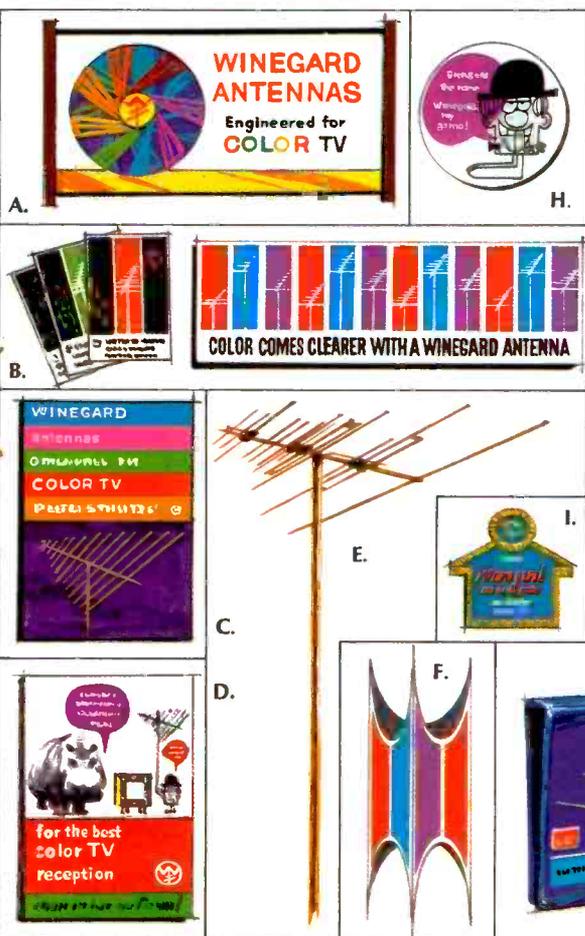
## TV Commercials Coast-To-Coast

Winegard has scheduled thousands of color tv commercials to be seen from coast to coast starting in September. They will be seen in major markets by millions of people shopping for color tv sets. And they'll have all those people pre-sold on engineered-for-color Winegard antennas, no matter which set they buy.





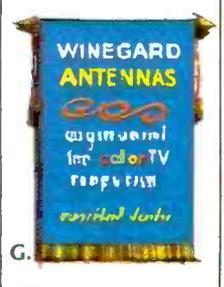
# AND EASIER WITH WINEGARD!



## A Treasure of In-Store Merchandising Aids

When people in your area start looking for an engineered-for-color Winegard antenna, better make sure they know that you're a Winegard dealer. Winegard makes it easy to do with a treasure of good-looking, hard-selling merchandising sales aids. They're all brand new and ready to help you attract and sell every antenna prospect!

- A. Top-of-Set/Wall Window Lighted Display
- B. Hanging Pennants
- C. Wall Banners
- D. Window Banners
- E. Antenna Display Pole
- F. Antenna Pole Display Sign
- G. Silk Wall Banner
- H. Salesman's Coat Badge
- I. Shirt Emblem
- J. Dealers' Sales Presentation Book
- K. Dealer Vehicle Identification Program



True, we've been telling people about engineered-for-color Winegard antennas for more than 10 years. But it takes more than advertising to guarantee the best possible color reception.

It takes outstanding products...engineered-for-color antennas, amplifiers, couplers and accessories:

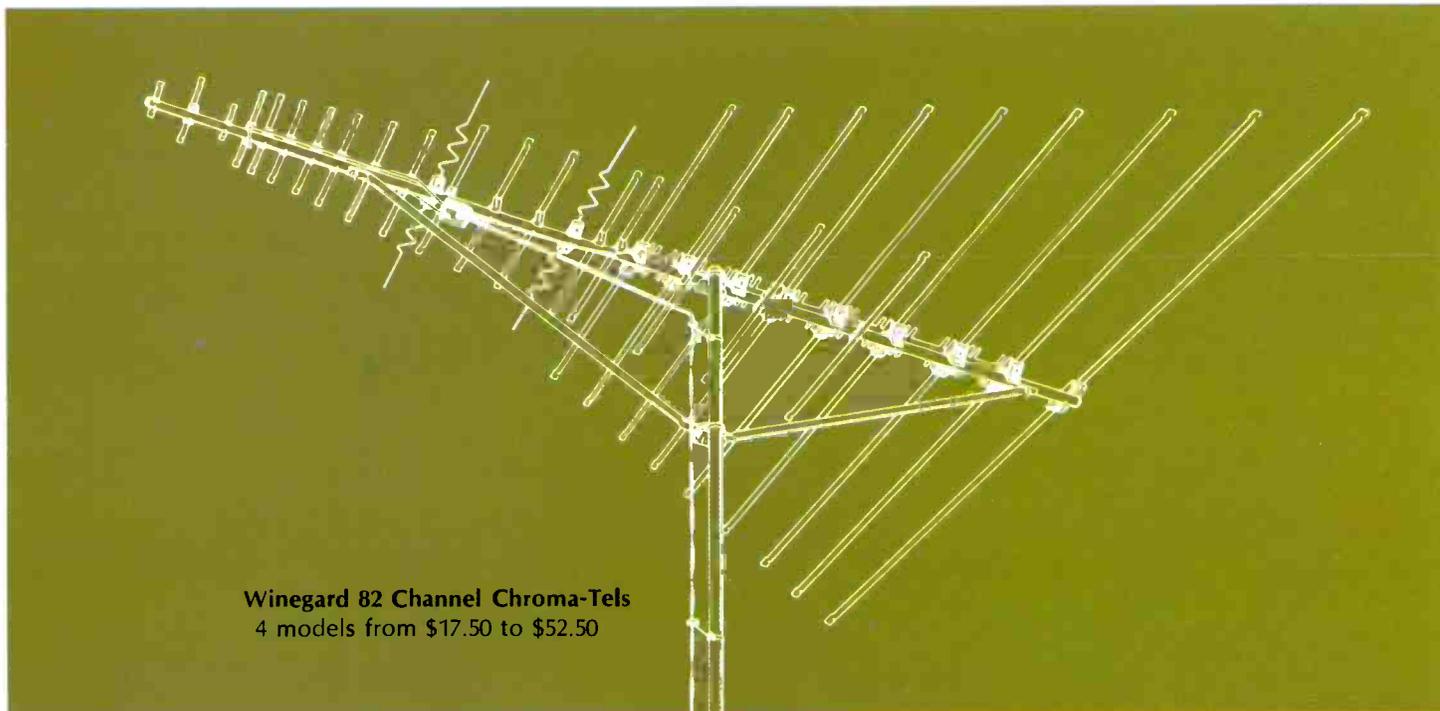
...engineered to capture color tv signals—and reject interfering signals!

...engineered to effectively reduce ghosts and snow and fading and stripes and distortion in *all* reception areas—metropolitan, suburban and deep fringe!

...and engineered to help provide perfectly balanced, consistently natural color.

That's what you get with engineered-for-color Winegard products—together with more profits and more satisfied customers. Join Winegard this season. Call your distributor today!

## AND HERE'S WHY COLOR COMES CLEARER WITH WINEGARD ANTENNA SYSTEMS

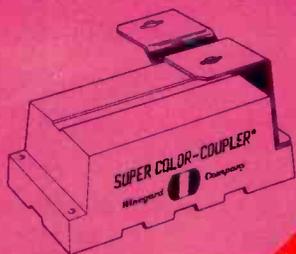


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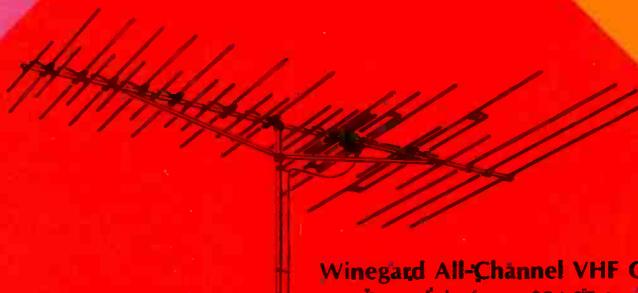
model CC200 \$4.50

model CC400 \$5.50



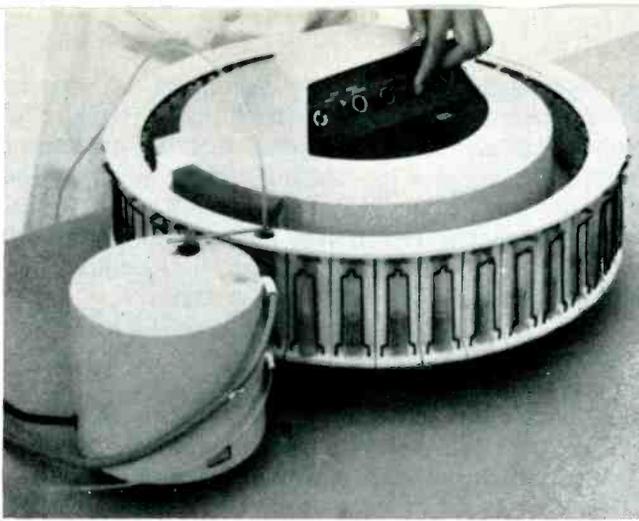
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A reader mounted in the sampler reads identification numbers from a punched card stub attached to the specimen carrier as each specimen is sipped.

## Computer Processes Clinical Tests

Laboratory specimens are tested and data analyzed by computer system

■ A new electronic data acquisition system has been developed by IBM to help hospitals cope with a rising flood of laboratory tests and provide an additional safety factor in handling tests.

A typical hospital laboratory procedure with this system starts when a physician requests tests from the nurse station on a patient's floor. The nurse writes the patient's name and number, checking the tests to be made, on a special two-part form containing a specimen identification number.

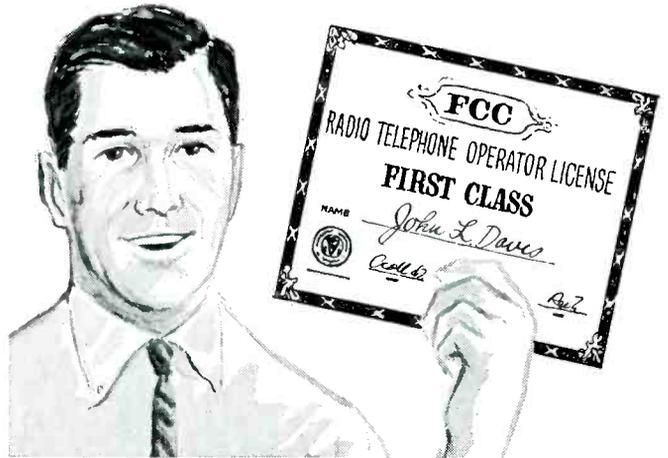
When the technologist arrives to draw specimens, the form's two parts are separated. The top part is sent to the hospital's data processing department for keypunching and entry into the computer file. The second part contains five detachable stubs, each pre-punched with the specimen identification number. Four stubs are used to identify samples, while the fifth stub is retained in the technologist's file. As the technologist obtains each sample from a patient, she immediately identifies it by attaching one of the pre-punched stubs to the test tube with a special rubber strap.

The specimens to be analyzed are loaded into a 40 test tube sampler turntable with their pre-punched stubs still attached. As the turntable moves each specimen to the sipper, the sampler reads the identifying data punched on the stub card. This information is punched on a card or tape. When the test data regarding the sample is collected from the analyzer, it is punched into the same card or tape for positive identification.

The analyzer performs such programed operations as aspiration, dilution, reagent addition, mixing, heating and color development. Even centrifuging can be accomplished without removing the identifying card stub. Measuring instruments used with these automatic devices include colorimeter, spectrophotometers, flame photometer and fluorimeters.

Besides accommodating instruments with automatic specimen handling, the unit can be used with manual instruments. When the sample is ready for analysis,

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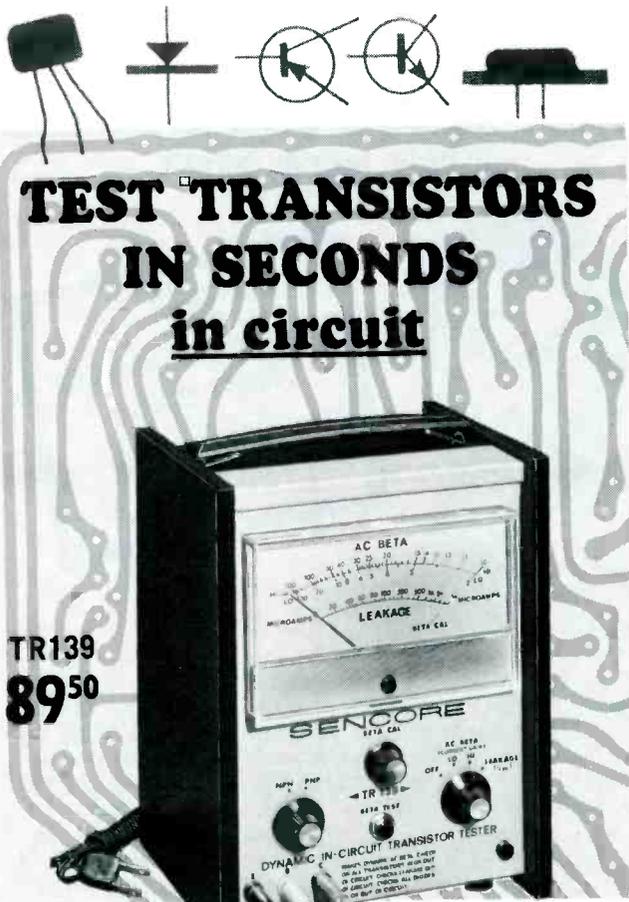
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**BETA MEASUREMENTS**—Beta is the all-important gain factor of a transistor; compares to the gm of a tube. The Sencore TR139 actually measures the ratio of signal on the base to that on the collector. This ratio of signal in to signal out is true AC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

**ICBO MEASUREMENTS**—The TR139 also gives you the leakage current (Icbo) of any transistor in microamps directly on the meter.

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

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

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

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the technologist places it in the instrument. As soon as the instrument produces a steady output signal, the technologist signals the computer that the instrument is ready to be heard by inserting a card containing the same pre-punched number as on the stub card attached to the specimen. The system immediately gives both the instrument reading and the specimen identification and punches this data into a card or tape.

The system can accept readings from 100 laboratory instruments. The unit can capture this data whether an instrument puts out a digital signal, a steady analog signal or a series of analog peaks. A multiplexor scans the instruments in sequence and automatically combines analog and digital data into one digital record.

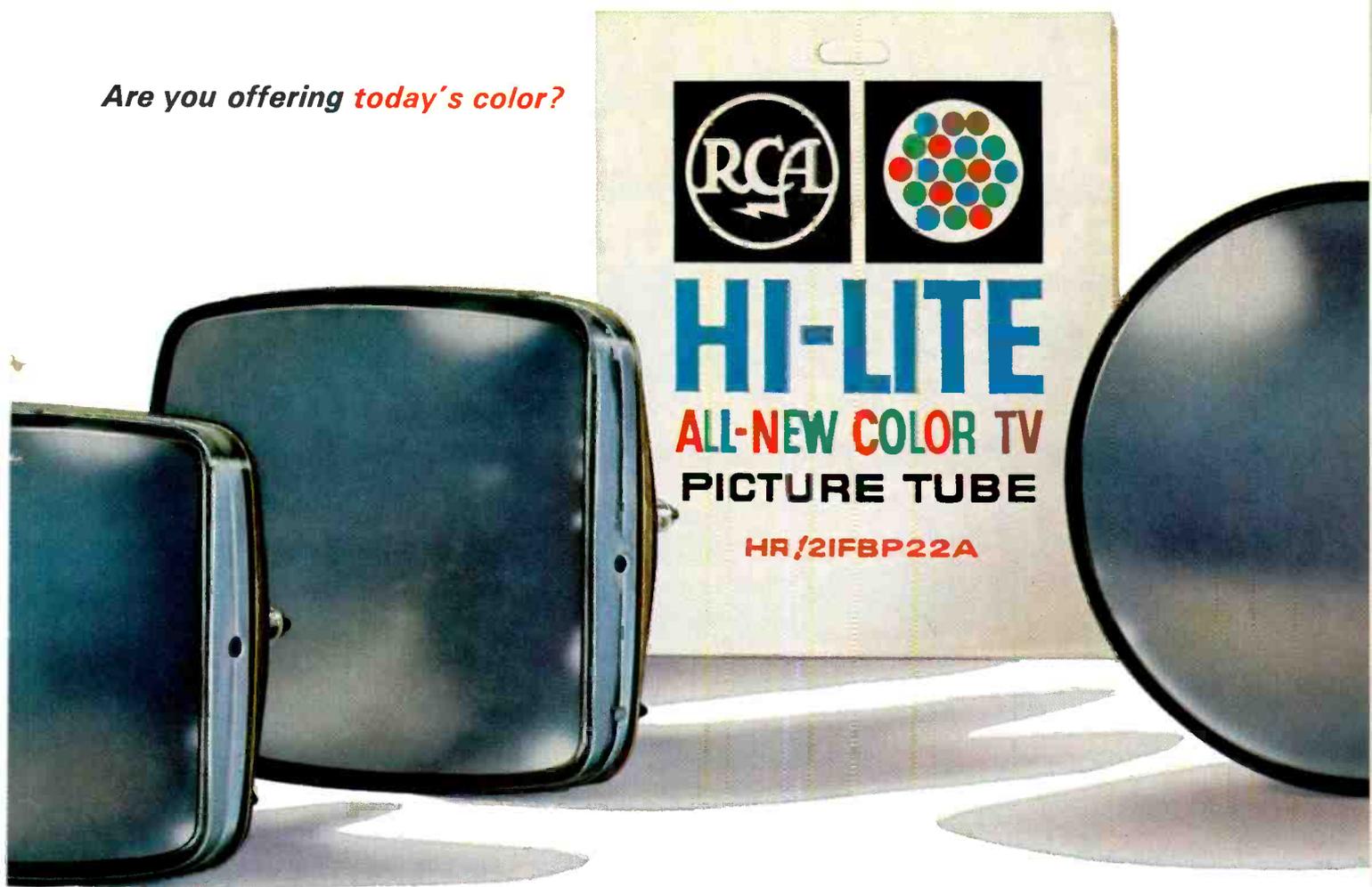
Output cards or tape from the data acquisition system go to the hospital data processing department where they are read into a computer. When computing meaningful test results from the raw data supplied by the instruments, the computer performs the following calculations, normally made manually by a technologist: establishes the calibration function for the instrument and checks its validity, adjusts the calibration function if drift occurs; adjusts for any interaction between successive samples; corrects the zero value if "blank" samples are inserted for this purpose; calculates the analysis of serum tested for quality control purposes, determining its deviation from stored norms and prints out the results.

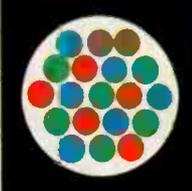
Since the computer system can store results of all previous tests for each patient, it can be programmed to perform many reasonability checks including: mean value and standard deviation of all results from a test run (these should not change significantly from day to day); a comparison of results of the same tests performed on a given patient on preceding days with the new test results; correlation of the results of several interrelated tests on the same patient. ■



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**PICTURE TUBE**  
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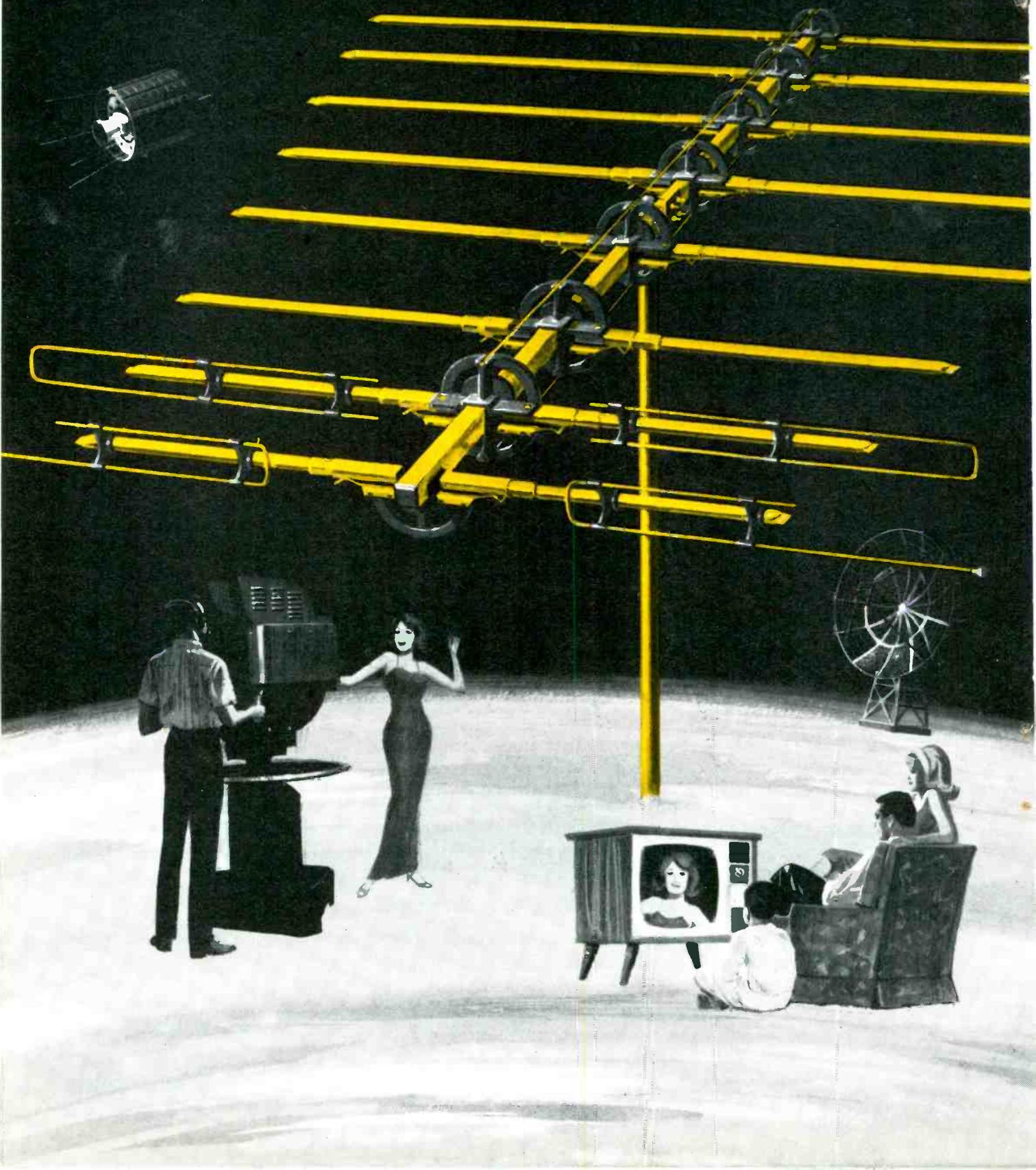
**How about you? Are you offering your customers today's color?**

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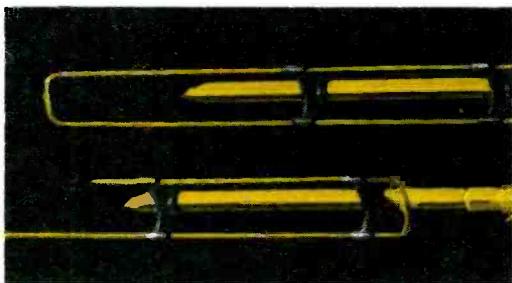


# PARALOG *Plus*<sup>TM</sup>

## Improves Color Reception Three Ways

1. **Plus GAIN**—Color carriers are detected in phase. Therefore, more directivity is needed for good color reception than for black and white. The extra high gain of the Paralog-Plus provides sharp directivity, producing excellent color pictures.
2. **Plus FLATNESS**—Tilt causes incorrect colors. Industry experts say that a flatness of  $\pm 2$  db per channel is required for good color reception. Paralog-Plus is flat within  $\pm 1$  db per channel.
3. **Plus MATCH**—A poorly matched antenna shifts the phase of incoming signals, distorting color. Excellent match of Paralog-Plus prevents color-distorting phase shifts.

The unique feature of the Paralog-Plus is a **BI MODAL DIRECTOR** system which makes the parasitic elements unusually effective.



The **BI MODAL** parasitic elements combine two high band directors into a single director covering all low-band channels, plus the entire FM band. These directors are resonated to overcome the natural tendency for fall-off in gain at 108 MHz and 216 MHz. Thus, the Paralog-Plus is exceptionally flat across the entire VHF television and FM bands.

The Paralog-Plus driven elements work in two modes simultaneously: (1)  $\frac{1}{2}$  wavelength for low-band channels, and (2)  $\frac{3}{2}$  wavelength for high-band channels. Thus, each element in the Paralog-Plus serves double duty.

In the Paralog-Plus, more of the elements work to bring in any given channel. The result is an "ungimmicked" antenna that is unusually compact. An antenna that returns to the basic periodic principle and gives it new direction. Test the Paralog-Plus against any antennas comparable in size and price. You'll be surprised at the difference.

### Plus CHOICE OF 300 AND 75 OHM OUTPUTS

The Paralog-Plus includes *both* 300 and 75 ohm outputs, for match to *either* twinlead or coax.

### FM RECEPTION

Like color TV, FM stereo requires an especially strong, clean signal. Every Paralog-Plus model provides full, flat gain over the *entire* FM band.

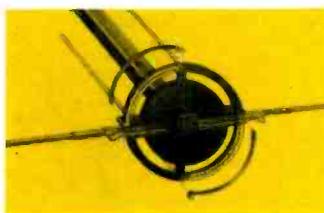
### Plus THESE QUALITY MECHANICAL FEATURES

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The wedge-snap lock actually tightens and improves with vibration. The spring pressure of the clamp jams the wedge aperture over the squared dipole's end. Since it cannot seat all the way down, a sharp pressure is maintained on the edges of the dipole. Vibration merely tightens the pressure, jamming the wedge into the dipole so that it is both self-cleaning and self-tightening.

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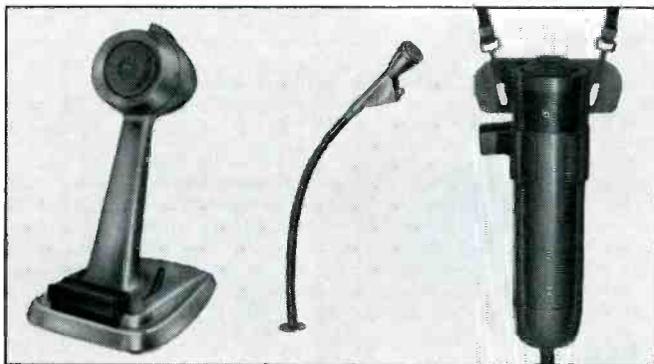
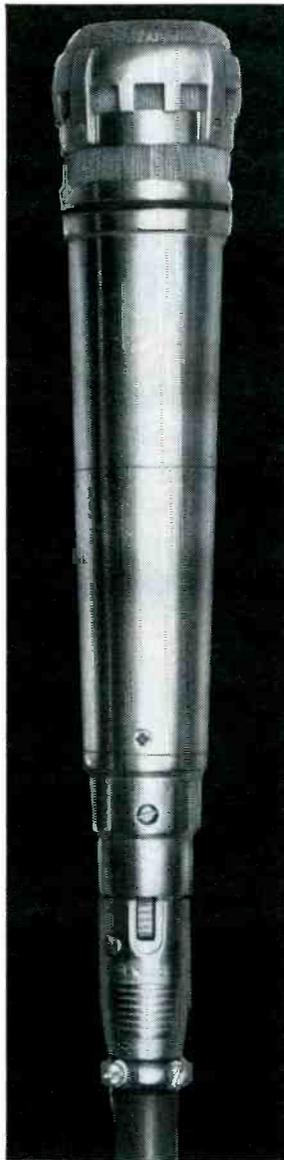
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## Portable Instrument Locates Faults in Buried Communications Cable

■ A portable two-unit fault finder has been developed for tracing the course of buried communications cables and pinpointing their defects from the surface of the ground.

Breaks in a cable's plastic insulation will cause eventual deterioration of the inner metal sheath. Short circuits and service failures will result. It is the discontinuity in the insulation of the cable that is used for fault location.

Test measures common to all cable repair procedures indicate faulty underground sections. In an area where trouble is suspected, the detector's transmitter unit makes an electrical contact between the cable and ground. The system will establish a circuit through the cable's inner sheath to the fault point and then back to the ground stake. To do this it must generate the proper signal level for various factors of resistance — soil condition, moisture, length of loop, size of fault, etc. A single control in conjunction with a flashing light permits the operator to quickly set the proper level.

Once the circuit is established, the technician is ready to locate the precise underground course and also the depth of the cable at any point. His tools consist of a lightweight, 3-ft probe and a camera-sized receiver unit which reproduces the pulsed signal through a loudspeaker. Operating like a radio direction finder, the receiver produces a null signal when pointing directly toward the energized cable. Moving the probe to either side of the course of the underground cable produces an audible signal. The technician reportedly can describe the entire course as fast as he can walk across open fields, lawns or parkways. As he passes the fault point, the signal strength diminishes to indicate the fault's approximate location within 5 to 10 linear ft.

Since the inductive probe senses a null when pointed directly at the cable, the cable depth can be determined by moving the probe away from the cable at a 45 degree angle. The depth of the cable will then equal the surface distance between the probe and the point directly over the cable.

With the receiver's second probe, it is claimed that faults can be located within a fraction of an inch. With two metal prongs, the conductive probe is inserted into the ground along the fault zone previously located by the inductive probe. When a null signal is noted, in line with the cable and at right angles across the known cable course, the fault is located.

Made by the Delcon Div. of Hewlett-Packard, the model 4900A underground fault locator will operate for approximately 50 hours on a standard 6v lantern battery. It is claimed that faults can be located over underground sections exceeding a mile in length in all environmental and soil conditions. ■

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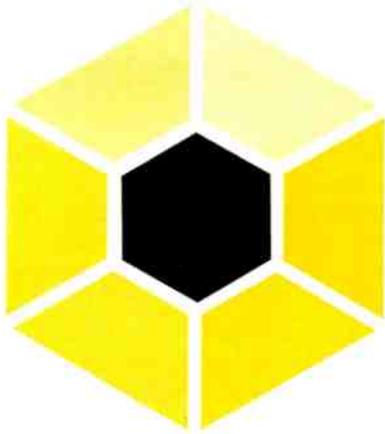
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ELECTRONIC TECHNICIAN

# Color Review For 1967



**Rainbow-hued boom expected to continue unabated into foreseeable future if nation's economy holds firm**

■ It is predicted that 10 million color receivers will be in U.S. homes by the end of this year and a major increase in sales is seen for next year — well ahead of 1966.

More hybrid and solid-state color receivers, more remote channel selecting and other remote controls are expected in 1967.

Sylvania has announced an improved "rare earth" color CRT with improved color fidelity that claims to provide pictures 9 to 16 percent brighter than CRTs now on the market.

Tuning meters and tuning eyes are forecast for G-E and Philco sets for 1967.

Major glass manufacturers are planning to produce more bulbs for color CRTs.

RCA Sales Corp. announced postponement of its 15 in. portable color set until next year in order to permit production of more 25in. color consoles.

The consensus is that 1967 will

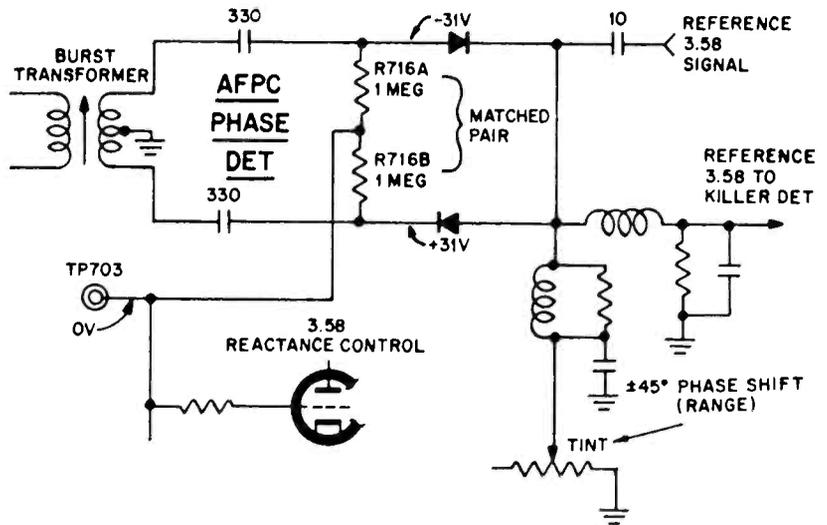
be a banner year for color TV and antenna sales — offering another opportunity for alert and aggressive service-dealers to improve and consolidate their positions for handling increased business in the future.

No revolutionary circuit changes are forecast for 1967. New innovations are expected to arrive through relatively slow changes — although, as predicted a year ago, new and more economical manufacturing and merchandising techniques and other factors will gradually lower the retail prices of color receivers. Printed circuits and integrated circuits will play a major role in this area.

## **RCA VICTOR**

The CTC21 chassis is used in RCA's deluxe 25in. color sets for 1967. All equipment using the new chassis are provided with motor driven power tuning (channel selection), operative by merely pushing a

## Color Review...



touch bar. In addition to automatic tuning of VHF channels, the chassis also features automatic tuning for UHF channels. Up to a total of 24 UHF channels may be reset and programmed for automatic tuning.

The CTC21s have new VHF and UHF tuners. The KRK131 VHF tuner features four tuned stages, with a 6DS4 nuvistor RF amplifier and a 6KZ8 tube used as mixer/oscillator. The UHF tuner, designated KRK132, is transistorized.

Both the VHF and UHF tuners have automatic frequency control (AFC). The AFC circuitry automatically compensates for slight errors in manual tuning or "drift," keeping the local oscillator tuned correctly.

Certain models are equipped for remote operation using a new 8-function remote control system — the CTP12. With the all transistorized "Wireless Wizard" remote, customers can change stations, switch between VHF and UHF, turn the TV on or off and adjust VOLUME, TINT, and COLOR.

The CTC21 color chassis also features automatic chroma control (ACC) in the color circuitry. ACC, sampled in the color stages, keeps the color intensity (or saturation) constant during changing reception conditions.

Other features in sets equipped with the CTC21 include a picture sharpness control (peaking control), an all-range TONE control, and a dial light dimming control. The latter can be used to adjust the brightness level of the channel indicator

light to suit individual viewing preference.

All models using the new chassis will be equipped with the 25in. rectangular CRT (25AP22A or 25BP22A). It is said that an important improvement has been made in the method used to mount the shadow mask within the 25in. color CRT. The new mounting will compensate for the slight "bowing" that occurred in color CRT shadow masks during equipment warm-up. This refinement in color CRT manufacturing will make purity adjustments less critical to achieve during initial installation of the equipment in the customer's home or the shop, according to the company.

Some of the circuits in the CTC21 use transistors or other solid-state devices. A transistorized control circuit is used for AFC—automatic frequency control for the VHF and UHF tuners; solid-state phase detectors in the color stages for ACC, AFC and killer detector circuitry. One of the newest components to be used in these color chassis is the integrated circuit (IC) in the sound stages. The complete sound circuitry in the CTC21 chassis uses solid-state components: operating in conjunction with and following the IC are a driver and single-ended audio output stage — both using transistors.

The integrated circuit in the CTC21 requires approximately 7v power. This supply voltage is obtained from the emitter of the output transistor.

The driver in this sound circuit

functions as a dc gain, feed-back circuit to hold the emitter voltage on the output fairly constant. Any emitter voltage change will alter the base bias on the driver stage.

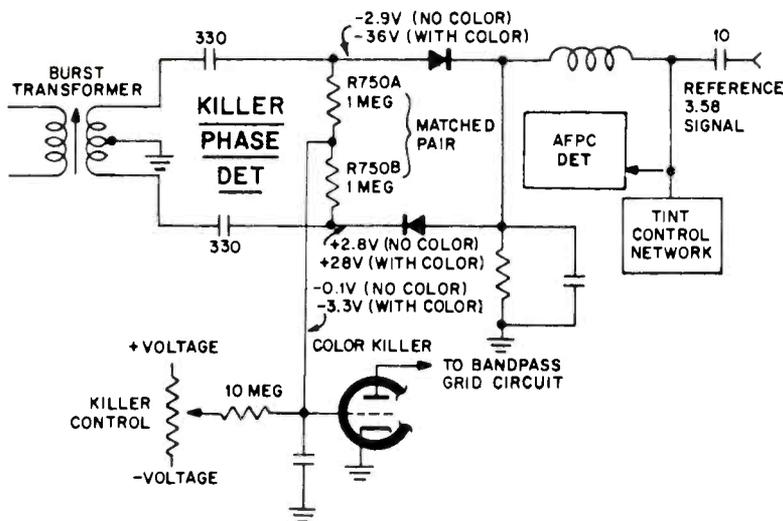
The audio output transistor is a "high voltage" unit, and under normal conditions, the collector voltage is approximately 160v emitter potential is approximately 7v, and emitter current 32 to 40ma. Nominal emitter current is 36ma. Of this, the IC draws approximately 17ma.

The automatic features of the CTC21, in addition to its high reliability and serviceability, make this chassis RCA's most advanced color television receiver, according to the company.

Several solid-state components are used in the color stages of the CTC21. There are three separate solid-state detectors, one for AFPC control, one for the killer detector function and one for automatic chroma control. The AFPC and the killer detectors, although using diodes, operate in similar fashion to the circuitry used in previous chassis. These functions were performed by the 6JU8, (a quadruple diode) in the previous chassis.

The addition of a third detector — the ACC circuit — provides controlled gain through the chroma bandpass stage, with varying levels of incoming chroma signals.

**AFPC Detector:** In the CTC21, the tint control is part of a phase shift network in the 3.58MHz reference feedback circuit. Adjusting the tint alters the phase of the 3.58MHz



reference signal coupled to the AFPC and killer detectors; the range of the tint control is  $\pm 45$  deg.

The phase of the reference signal applied to the AFPC diodes (with the oscillator on frequency and in phase with color burst) is such to produce equal conduction from both diodes — yielding no correction voltage at the output. If the phase is changed, a correction voltage (of the polarity needed to bring the oscillator on frequency and in phase) is developed.

**Killer Detector:** The noise-immune killer detector in the CTC21 employs a separate pair of diodes. Under no color burst conditions, diode conduction is virtually equal, giving zero correction voltage at the output. The color killer then operates, biasing off the bandpass amplifier. When color burst is applied (during color reception), diode conduction is unequal. A negative potential develops (approximately 3.3v), sufficient to cut off the killer, permitting the bandpass amplifier to conduct.

**ACC Detector:** The ACC circuit using a third pair of diodes, functions on the amplitude of the incoming burst signal. Color burst is intended to be transmitted and received as a fixed amplitude wave and can be used as an indication of undesirable fluctuation in color information. That is, amplitude variations of color burst are indicative of undesirable color video amplitude changes; changes that may result from atmospheric conditions, for example.

When a color signal is received,

the phase relationship between the burst signals applied to the diodes cause unequal conduction. In this unbalanced condition, the bottom diode (in phase) conducts very little (keeping approximately the same voltage output); the upper diode (out of phase) conducts more. Under these conditions, a negative voltage develops at the output. The amount of voltage so developed will be proportional to, and vary with, the amplitude of the incoming burst.

#### ADMIRAL

Admiral's 10A9N color TV remote unit consists of two chassis. The first is a 4A9N preamplifier; the second is the 6A9N relay control chassis. A S366AN hand held electronic transmitter (actuator) generates any one of six available frequencies in the 17 to 22kHz range when a push button is depressed. Each push button applies power to the electronic oscillator and selects a proper frequency determining trimmer capacitor. These constant-carrier signals are doubled in the output transducer, thus radiating ultra-sonic audio tones ranging from 35kHz to 43kHz.

Radiated ultra-sonic tones from the transmitter are received and re-converted to electrical signals by a microphone located in the front grille of the television receiver. Because the microphone is dc biased, it has a high sensitivity and linear operation. Three stages of preamplification are provided in the 4A9N with an emitter-follower output. Because horizontal frequency har-

monics fall in the range of the remote frequencies, extensive shielding, mounting of the preamplifier chassis integral with the microphone and "floating" the preamplifier are necessary. Bandpass selection is determined by the resistor-capacitor values and by the microphone. Since the remote signals are unmodulated, AGC is unnecessary; however, variable emitter degeneration is provided in the third preamplifier stage. This allows gain adjustment when triggering is encountered from ultrasonic sources outside the system such as coins, keys, etc.

Amplified signals from the pre-amp are fed to the 6A9N chassis. The input transformer improves the skirt selectivity of the bandpass and equalizes the gain (or tilt) across the spectrum. The driver stage is then inverted, being an NPN transistor operating from a negative supply. Its collector load consists of six sampling windings of the input transformers and an RC noise rejection network.

The six sampling windings are parts of six sharply tuned input transformers. When an ultrasonic electrical signal of the same frequency as one of the transformers, is fed into the driver stage, a large signal will be developed across that transformer.

When a signal from the transformer is fed into the base of the keyer stage, base rectification will occur. This results in pulsating collector current which is filtered by the collector electrolytic capacitor. The dc current then trips the relay,



# Color Servicing Tips and Countermeasures

Look over the 'old pro's' shoulder and see how it's done

■ There's nothing like taking a little time out to review some case histories and check into procedures used by others in locating faults in color TV sets. We'll take a look first at some horizontal problems. Horizontal sweep systems seem to develop plenty of trouble and it's usually a tough section to troubleshoot. You may have employed some of these procedures before, but we'll try to pass along one or two tips that may help you.

Up-to-date test instruments (like a good calibrated P-P scope) and the knowledge necessary to use them efficiently, are the first troubleshooting consideration. If used correctly, your test instruments can help you isolate the trouble quickly and efficiently.

The first step in shop procedure is a complete scope check to determine the percentage of ac ripple and after this, a VTVM check is made on the power supply voltages.

## Horizontal Sweep Troubles

Let's look at a color chassis that has horizontal sweep problems and make a few observations that may help you determine which component in the sweep section is at fault. Switch the set on and listen for the high voltage crackle. And then note if a raster is present. If these tests are negative, use a VTVM and proper high voltage probe to check the high voltage at the anode lead. If little or no high voltage is measured, look at the horizontal output tube plate and see if it has turned a cherry red—indicating too much current drain.

If the horizontal output tube is

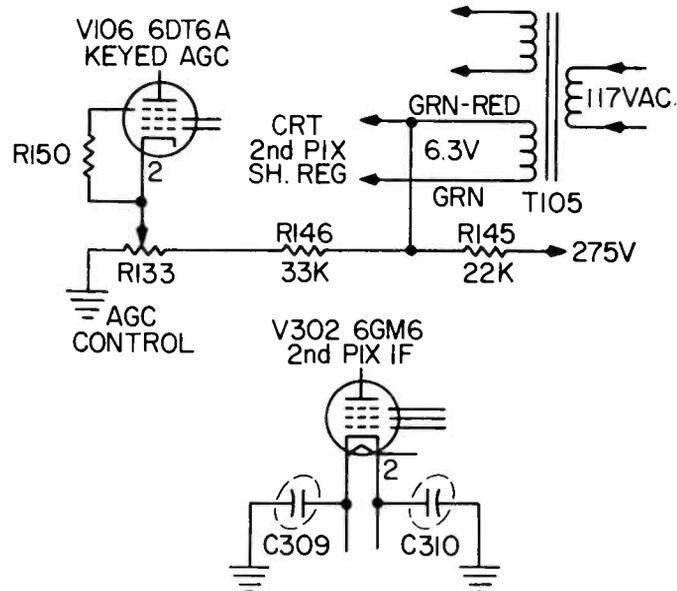


Fig. 1—Shorted bypass, C310, caused low voltage at junction of R145/146.

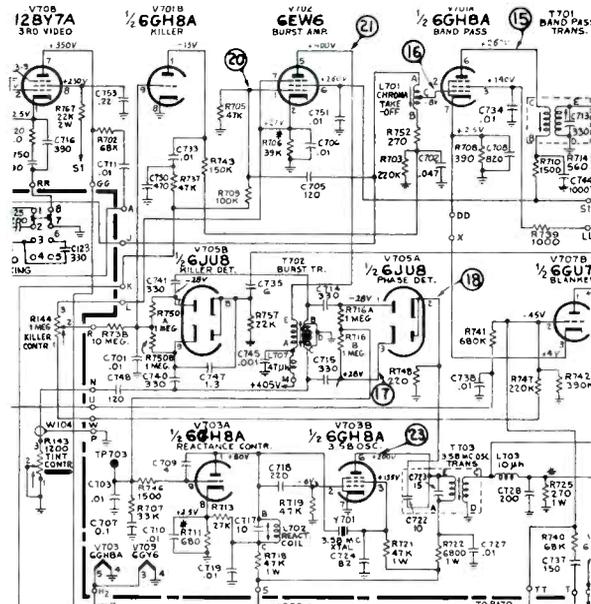


Fig. 2—Scope check of T702, burst phase transformer, showed it has shorted turns.

## Servicing Tips...

drawing too much current, check the horizontal oscillator for correct frequency and check P-P horizontal drive pulses with a calibrated scope. A VTVM can be used to measure for correct drive, but a scope will reveal much more information. If the drive is correct, measure the screen voltage, check by-pass capacitors and cathode resistance, if any.

It should be noted that some set manufacturers use a positive voltage on the horizontal output suppressor grid (6JS6A, for example) to help eliminate snivets. This positive voltage will sometimes make this tube draw too much current and will cause premature tube failure. It is recommended that this voltage be removed and the suppressor grid grounded.

If the trouble still persists after these checks, investigate the condition of the boost and other capacitors in the sweep section. If they are OK make a resistance check of all loads on the sweep circuits. A more positive method is to disconnect the leads to the boost, vertical sweep and convergence sections—one at a time.

For checking the deflection yoke we use a variable inductance in place of the horizontal yoke winding. This is a coil that can be adjusted from 10 to 50mh. If you do not have a variable inductance or a substitute yoke, you may try this trick: Let the set cool and slip the yoke off the CRT neck and place it where the tubes on the chassis will not heat it. Now switch the set on and let it operate about 15 minutes. Turn the set off. Carefully feel all the yoke windings. This works equally well for horizontal or vertical windings. If all components check out good, the problem is narrowed down to the horizontal sweep transformer. The sweep transformer and yoke can be tested by using a horizontal transformer and yoke analyzer. Several good

instruments are on the market today.

But field tests show that these testers are not always accurate and fail-safe and all leads should be disconnected from the coils being checked. A good check for any coil is the ringing test. Use an oscilloscope to feed a horizontal sawtooth at about the resonant frequency that

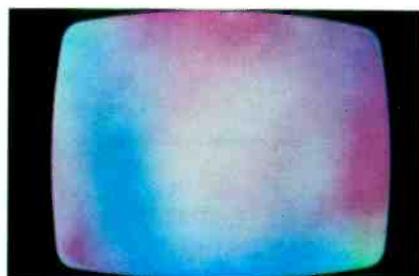


Fig. 3—A pure red field could not be obtained when the yoke was in the normal position.



Fig. 4—Proper red field but with neck shadow.

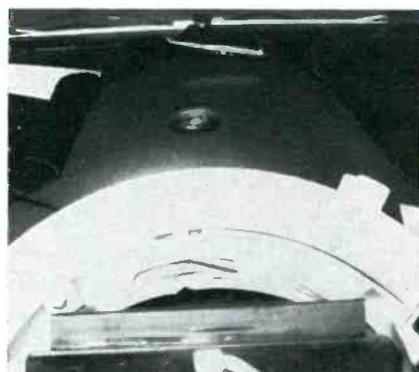


Fig. 5—Metal shield shown cut and bent back.

the coil is tuned to and by viewing the scope see if you can cause the coil to ring.

Use the following check to determine the condition of the sweep transformer: Let the chassis cool off. Switch the set on and let it operate about 10 minutes. Switch

the set off and feel the transformer windings to see if they are warm. If you detect a slight warmth, you probably have shorted turns in the coil.

As noted from previous checks, no simple solution exists for diagnosing sweep circuit problems. The best way is to develop your own systematic procedures. In the final analysis, it all amounts to a process of elimination.

A number of causes for loss of high voltage in color TV sets are frequently overlooked: faulty shunt regulators, defective CRTs and faults in the video amplifier circuit. If the shunt regulator circuit has a defect causing too much current to flow through the regulator tube or the high voltage supply is not adjusted to the correct value, it can cause a loss of high voltage.

A gassy CRT or capacitor leakage in the CRT and video output section can also cause excessive current flow that kills the high voltage. If you suspect the CRT and related circuits, just remove the CRT socket and then check for a return of high voltage.

The service SETUP and NORMAL switch on the back of most color sets can be used as a handy aid to narrow down trouble. In checking a set with loss of high voltage, just flip this switch to the SETUP position and if the high voltage returns, the defective parts are ahead of the SETUP switch.

Always use an accurate VTVM and high voltage probe to adjust the high voltage supply to manufacturers' specifications. Remember, also, you have to consider the line voltage for this adjustment. Most service manuals have this voltage chart listed. If the anode voltage is not correct this can cause various other picture defects, premature part failures and malfunctions in other systems.

### Other Problems

Now let's look over the "old pro's" shoulder and see how he finds and resolves some other color TV difficulties.

One bright, sunny morning an RCA color TV chassis, CTC10AB, was glaring at us from the service bench with what looked like simple

AGC trouble. The screen was blank except for the raster and the audio section emitted only a slight warbling sound.

Scope checks were made on the power supply and the AGC keying pulse looked OK. After a few circuit checks with a VTVM, it was determined that the AGC voltage was slightly negative on pin 5 of the 6DT6A keyed AGC and noise inverter tube. It was also noted that pin 2, the tube's cathode, was about 12v positive. The schematic indicated the value as 14v positive, which seemed within tolerance.

After a lot of circuit tracing, checking and cups of coffee, the failure was pinned down to C310, a small filament bypass capacitor which checked out shorted. This caused the B+ voltage at the R145 and R146 junction to drop to about 20v. This junction is also connected (note schematic Fig. 1) to the filament winding that supplies 6.3vac to the 2nd IF tube, shunt regulator and also the CRT.

If you should encounter AGC trouble in this chassis, the tip-off is to see if R145 is overheating. Also measure the voltage at the junction of R145 and R146.

We have had 4 or 5 of these color chassis with this fault. In most cases, the customer had mentioned a loud cracking noise before the TV set went out. This leads us to believe that these capacitors break down because of an arc in the 6BK4 regulator tube or from the plate cap to ground. Close inspection reveals most of the plate caps have deteriorated. It would be wise to install one of the large, new, improved and insulated caps.

### We Wondered Where the Color Went

No color sync-lock was the problem of the hour for this RCA color chassis, CTC16N. One of the first checks was to ground test point 703 and zero beat the 3.58MHz sub-carrier oscillator which checked correct. A few voltage checks were made with the VTVM at the burst amplifier, V702, (see Fig. 2) and the phase detector, V705A. These checks revealed no faults. A visual inspection was made for cracks and cold solder joints on the chroma

board but no clues were uncovered.

The scope and color bar generator which had been warming up were wheeled into position and quickly put into action. All waveforms in the chroma and burst amplifiers checked normal until we arrived at pin 2 and 3 of the 6JU8 phase detector. The burst sync pulse was nonexistent at this point. The 6GH8 3.58MHz oscil-

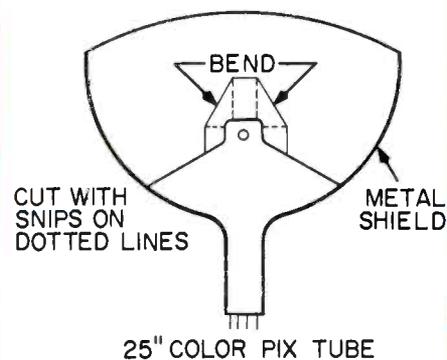


Fig. 6—Diagram shows where to cut and band metal shield around color tube anode connection.

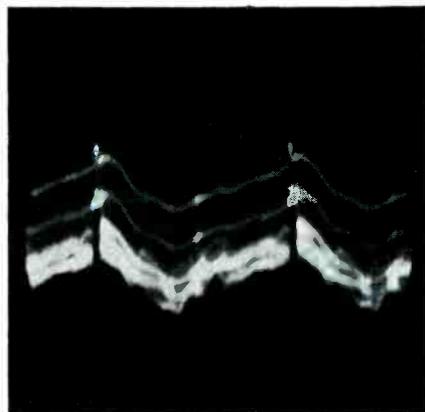


Fig. 7—Waveform at pin 9 of the 6KT8 indicated sync pulse riding on 60Hz ac.

iator tube should be pulled while making these checks to prevent erroneous burst pulses.

A prime suspect at this time was burst phase transformer, T702, but a VTVM resistance check revealed no information. Checking the other resistors and capacitors in this

circuit also proved nothing conclusive.

By scoping T702 at terminals B and C, tuning the slug of the coil back and forth and observing no response on the scope, it was then quite evident that T702 had shorted turns.

A replacement was installed. A complete color alignment was then made and perfect color-lock was obtained. Once again, a good scope and color generator proved their worth.

### Backward CRT Creates Wierd Purity Problem

While checking out a color set that had been in operation a few months, it was found that red purity could be obtained only by pulling the yoke back two or three inches from the bell of the CRT. The blue and green fields were also good with the yoke in this position—but a neck shadow appeared in the lower left corner (see Fig. 3). When the yoke was up close to the CRT bell, in the normal position for obtaining a correct pure red field, the photo in Fig. 4 shows the result. This is the first color CRT we have seen with this rare purity problem and we hope it will be the last.

As far as could be determined, the aperture mask probably slipped back a fraction of an inch from the face plate or it was under a stress and popped or warped out of shape.

It has been noted on some of the 23 and 25in. color tubes that purity could be not be achieved on one corner. After the set has been allowed to operate a few weeks and the same trouble persists, try this trick:

Use the large size degaussing coil near the corner of the CRT and rapidly turn it off and on. The magnetic field will sometimes snap the corner of the shadow-mask into place. During shipment, one corner of the mask has slipped out of its notch on some of these CRTs.

While on the subject of 25in. color CRTs, a common complaint seems to be arcing around the high voltage anode lead. One of the first reasons found for arcing is a burned and deteriorated rubber

# Service Tips...

anode cap. Obviously, the cap must be replaced, but experience and investigation show that this does not solve the corona discharge problem for very long.

To solve this problem on sets that have a metal shield around the CRT, use tin snips to cut the shield and bend it back from around the anode connection (see Fig. 5 and Fig. 6).

Try to leave about 5 or 6 in. of air space around the anode connection. Clean this area very thoroughly and install a new rubber cap. This will clear up most corona discharge problems.

If you are servicing color sets in an area having high humidity, try spraying around the anode with anti-condensation spray. As a last check, make sure the high voltage is set at the correct level—as specified by the manufacturer.

Technicians should exercise care in cutting the metal shield. Use the slim type tin snips and do not scratch the CRT surface. This may cause an implosion. Use the same caution as when installing a new CRT.

## Devious Sync-Choke Trips Up 'Old Pro'

While making a routine service call on a Zenith 26KC20 chassis an unusual sync problem came up. When the set was first switched on there was no vertical or horizontal lock. The tubes in the sync section were substituted but the trouble continued. After the set had operated five or ten minutes the picture locked in solid. This was also confirmed by the customer.

The 'old pro' decided to pull the chassis for shop diagnosis. All tubes were checked in the shop and a visual inspection was made. No faults were turned up. The chassis was then connected to the color test set and a check was made for cold solder joints or short circuits while

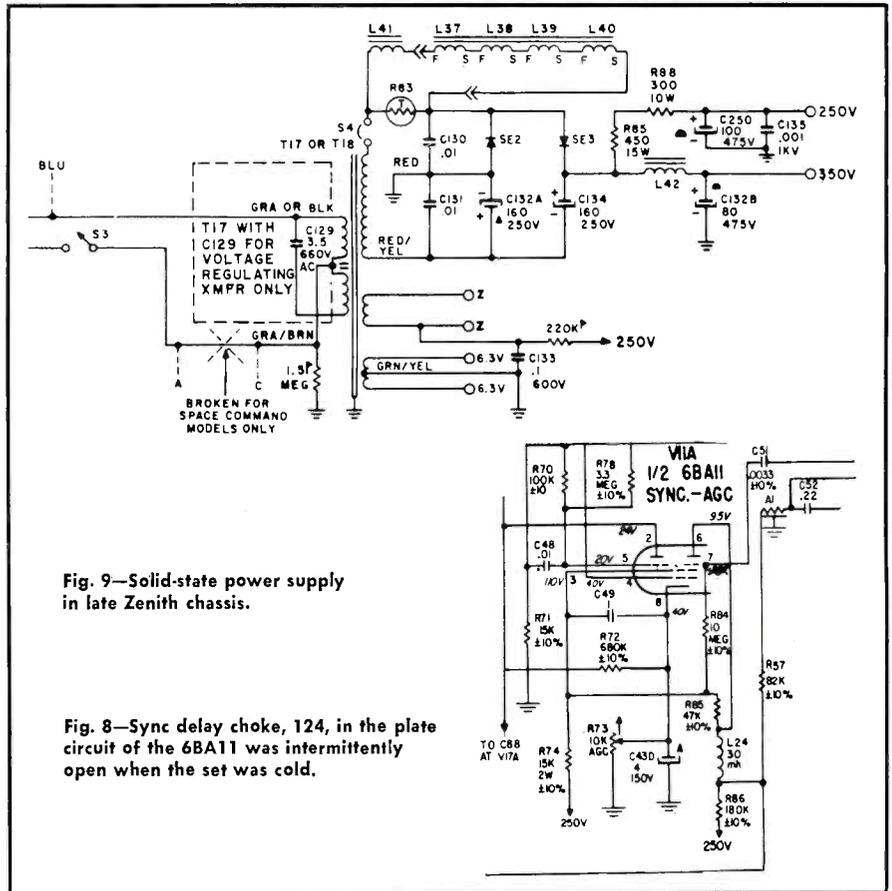


Fig. 9—Solid-state power supply in late Zenith chassis.

Fig. 8—Sync delay choke, L24, in the plate circuit of the 6BA11 was intermittently open when the set was cold.

the set was warming up. Still no cause for the fault was located.

The VTVM was then used but the voltages in the sync section checked OK. It was at this point that "rapid Robert" reached for the probes of his trusty scope and narrowed the trouble down to the 6KT8 sync amplifier and 6BA11 sync and AGC tubes. With the scope probe at pin 9 of the 6KT8, the sync pulse looked like it was riding on a 60Hz ac signal (see Fig. 7). Ah! Now we're getting somewhere. But all the B+ and filter capacitors checked out good! This was one time the scope gave some misleading information.

After isolating each component in the sync stages and freezing them with circuit cooler, a 30mh sync delay choke, L24, was found opening intermittently when the set was cold. L24 is located in the plate circuit of the 6BA11 (see Fig. 8). When the choke was warmed up it checked out OK. The resistance checked 50Ω when the choke was warm (which was a little high), but when cold it jumped up to 150K

and it was also erratically open. We have some across several other open chokes in later chassis, but this first one really led us on a merry chase.

## Filter Capacitor Blows Its Top

Would you like to prevent callbacks on some of the later model Zenith color sets? On a lot of service calls we are finding silicon diode, SE2, shorted (see Fig. 9). This diode is replaced and the set seems to operate normal. But, within a week or two, the set frequently has no picture or audio. Again, SE2 and sometimes SE3, is shorted.

After replacing these diodes and the set is fired up, the filter capacitor, C132B, is found to be shorted or will get very hot. On two occasions this filter has completely blown apart.

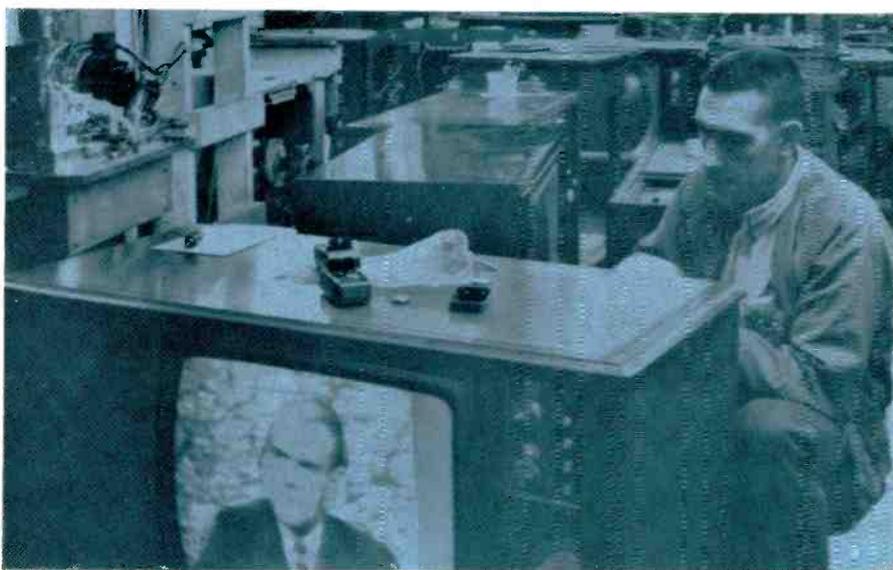
When SE2 shorts, it puts raw ac on all the filter capacitors. It may be several weeks before they will break down. The best solution is to replace filters C132AB, C134 and both silicon diodes. If the circuit breaker doesn't kick out, it will also burn L42 filter choke. ■

Sales training is based on good demonstration procedures that always begin by showing the top of the line.



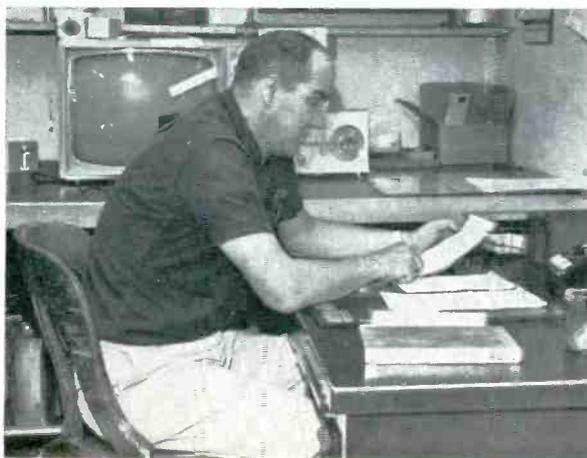
## Marching In The 'Peacock' Parade

Dealer 'Sells-up' on color and Hi Fi stereo



A jampacked service shop is evidence of the big job being done on color TV and stereo.

Bob Yanezek, shop foreman, organizes service calls and routes for the days work.



■ "The color TV boom gives dealers the opportunity of a lifetime to upgrade the market," says Tom Carmichael, TV and stereo manager, Balcom & Vaughan, Seattle, Wash.

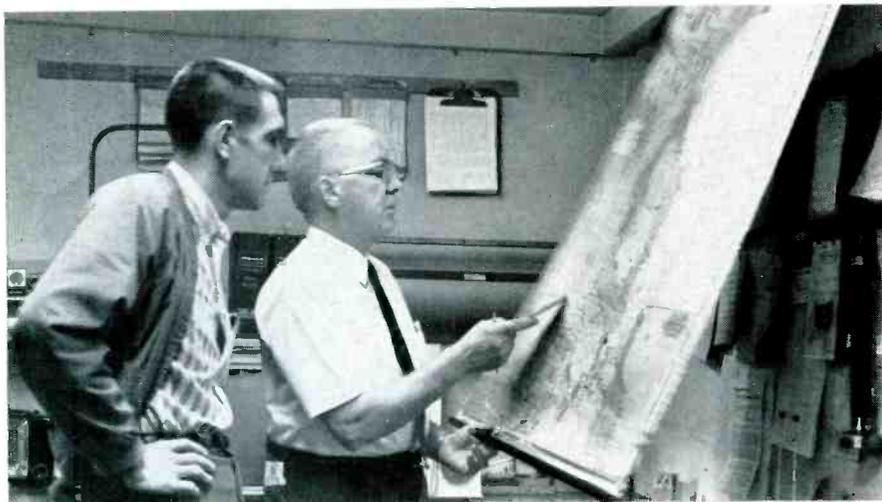
The company will top \$750,000 gross in TV and stereo sales during 1966, Mr. Carmichael declares, and 30 percent of this volume will be in color TV and stereo "theatres." The sales increase in 1966 is running a steady eight percent monthly over 1965.

"I believe our sales figures strongly indicate that the specialty dealer can compete effectively with leading department stores and quality home furnishers who have previously had more or less a corner on selling TV and stereo as both home decor and entertainment," declares Mr. Carmichael.

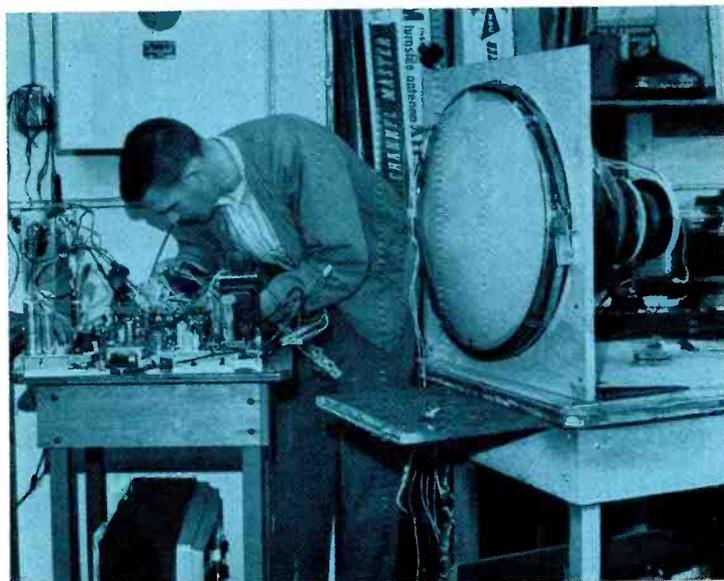
"It's our experience that the independent dealer has a considerable advantage since the general public believes the independent will give better personal attention and follow-up on service after a sale than will department stores and home furnishings stores," he adds.

"We live up to this impression.

## 'Peacock' parade



A large roll-down map is the best aid in laying out the tightest possible day's run of service calls.



Technician Art Perrenoud works with color jig.

It probably costs us a little more to handle the warranty, since customers expect more from us than they do from the big boys, but by the same token, our service becomes a considerable source of referrals."

### Advertising Program

Gearing to the booming TV market begins with a strong advertising campaign. The follow-through depends on the proper kind of sales setup — and the bedrock of this merchandising structure rests on the quality of the service shop.

To bring in the traffic, Mr. Carmichael budgets approximately three percent of gross sales to advertising. The company is a one-brand dealer and uses co-op advertising exclusively — which gives a

fat budget for presenting color and stereo wares to the public.

A full-page ad goes in the Sunday TV supplement of Seattle's leading newspaper every week. Approximately half of this is on color TV and half on color TV stereo theaters. Four column wide by 10 in. deep ads are also used in both local daily newspapers for a mid-week exposure — increasing to three ads a week during the fall selling season.

An occasional ad features B/W portables, but the big push is on color TV sets and color TV stereo theaters, with major emphasis on decor cabinetry. Except for a yearly sale, tied in with the manufacturer, the company does not price-promote color.

Though many independent dealers may have as much stock and as good a selection as their big competition, they generally won't spend enough money to let the public know it. Mr. Carmichael says, "Advertising is what generates the traffic, and with the present favorable co-op situation we can get the 'big look' in advertising."

"The full page every week enables us to request a favored location in the newspaper. We're able to nail down the page between the Monday and Tuesday TV program schedules. This is the best advertising position, we've found.

"With a good advertising location assured," he continued, "we stress quality, not price, in our ads. This stress may change as time goes on but with the present color shortage it doesn't make sense to promote from the price view.

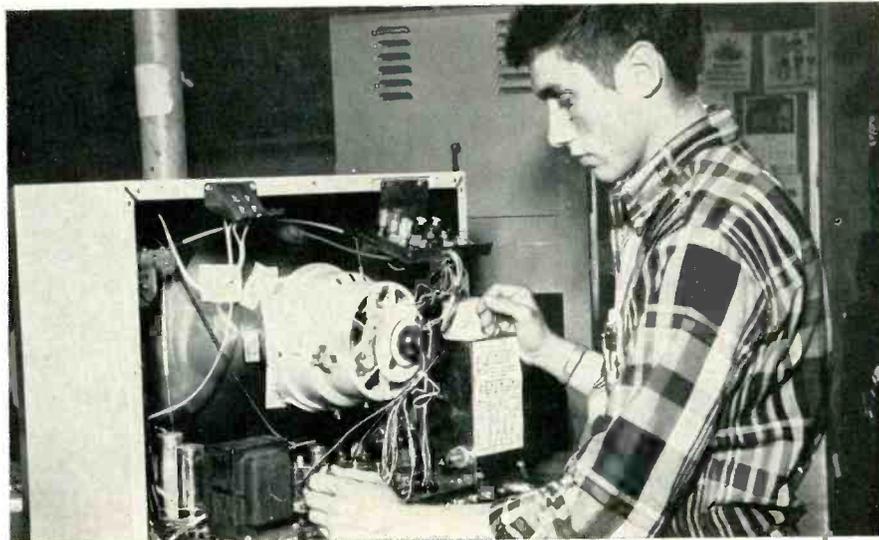
### Sales Program

"Training salesmen to sell quality is an essential follow-through at the point of sale," Mr. Carmichael says. He is always on the lookout for young, aggressive men willing to take the several months required to learn how to sell home electronics equipment.

"The basic requirement is a man who likes to sell, not a man who knows electronics," he says. "We can train a man to talk electronics, while an electronics technician usually tends to talk over the heads of shoppers. Shoppers aren't interested in how the set works, they want to know and see how it performs for



Apprentice-technician checks tubes in an RCA 19in. chassis during assembly-line troubleshooting process.



# Ten Frequent Color Troubles

Keep a file on the troubles you encounter and you'll find yourself saving a lot of troubleshooting time

■ Many service technicians find color-set troubleshooting more difficult than it really is. This is probably true because we see nothing but electronic troubles from 8 to 12 hours each day—twelve months a year.

Although the ten frequent receiver troubles outlined here may be easy for some and difficult for others, we believe every technician will benefit in some measure by reading about them.

## 1. No Raster — No Audio

A CTC11 color chassis was in a dead condition—only the tubes were alive as far as could be determined by the eye. This trouble could have been caused by a blown fuse or, on some color sets, by a kicked-out circuit breaker.

Sure enough, the circuit breaker was out but would not stay when reset. This told us we had an overloaded circuit in the B+ supply.

The trouble could easily have been a leaky voltage doubler capacitor, shorted silicon rectifier or heavy leakage in the voltage take-off section of the power supply. Since most silicon diodes are mounted on top of the chassis, they were checked first.

We were correct again. The sili-

con diode from the red-green wire was shorted (Fig. 1). In a case like this, don't stop here and just replace one diode. Check the other one for open or short.

A good silicon diode will read between 6 and 10 $\Omega$  in the forward direction and in the reverse direction it will read into the very high megohms area. Most silicon diodes will average around 10 $\Omega$  in the forward direction. When you check it, place the VTVM ohmmeter scale switch on Rx1 or you'll get an incorrect reading. If a diode reads

around 5 $\Omega$  in both the forward and reverse directions, it's open.

Check the filter capacitors for a short or leakage. Be sure the load across the B+ supply is not too heavy. A silicon diode may become defective with an overloaded circuit or it may become shorted inside.

## 2. No Raster — Rushing Audio From Speaker

This trouble could have been caused by a fault in the high voltage stages but the rushing audio in the speaker told us a different story.

1. No Raster—No Audio
2. No Raster—Rushing Audio from Speaker
3. Intermittent UHF
4. Poor VHF but Good UHF
5. Intermittent Color
6. White Horizontal Line
7. Poor Focus—Intermittent Focus
8. Poor Color—Poor Picture—Low Brightness
9. No Raster—No High Voltage
10. Too Much High Voltage

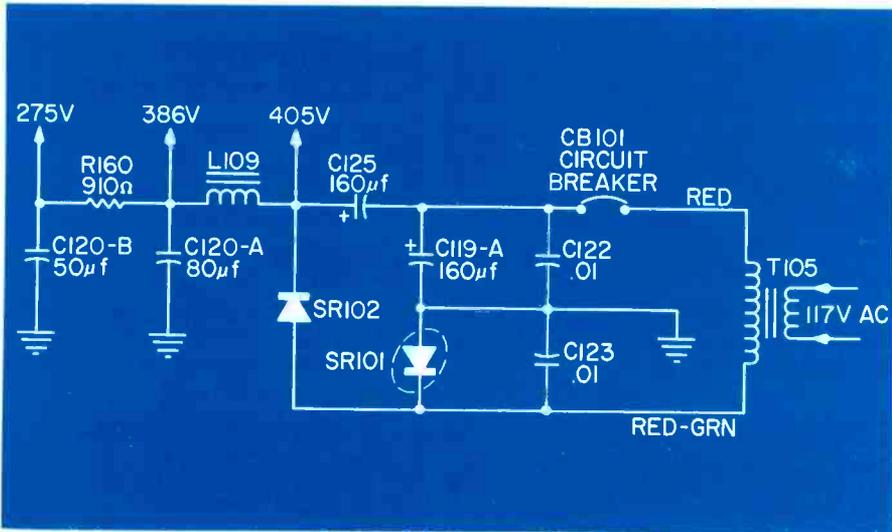


Fig. 1—Silicon diode, SR101, was shorted.

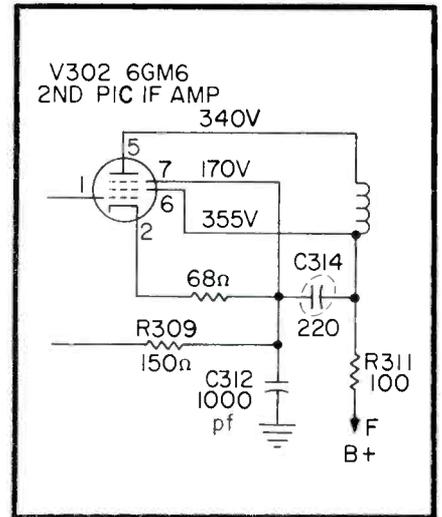


Fig. 2—Bypass capacitor C751 shorted and resulting in resistor R127 overheating and opening up.

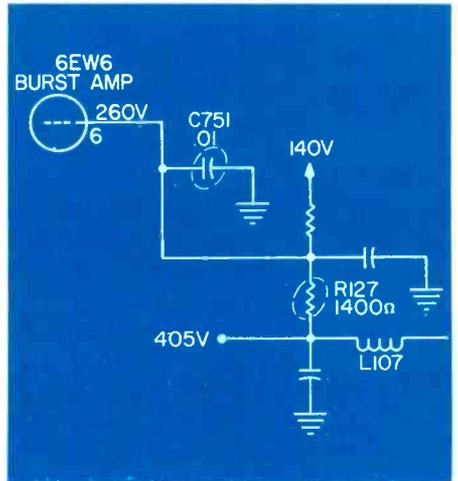
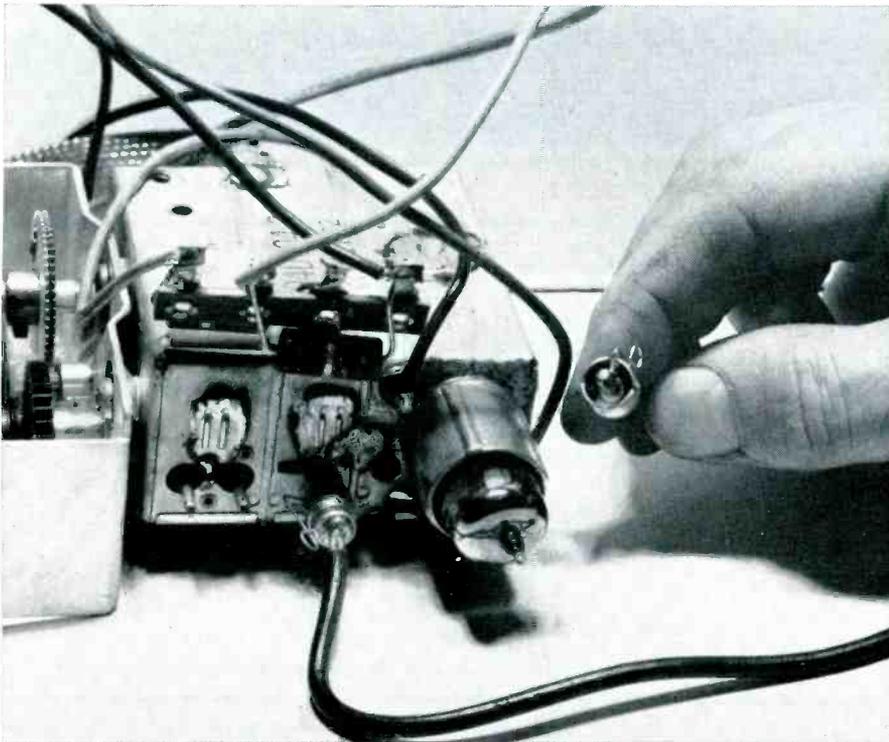


Fig. 3—C314, a 220 µf capacitor, checked out with a 12K leakage.

Since no program noise was coming from the speaker, we knew the trouble could be in either the IF or video amplifier stages. Plenty of high voltage was going to the CRT and we checked the IF and video stages next. All tubes were checked and found good in these two stages.

The first time we ran into this trouble in a CTC16 chassis, the trouble was difficult to locate (see Fig. 2). In fact, a rather warm and burned resistor, R127, showed where the trouble was. This resistor was checked and found open—and

the ceramic casing was cracked.

We then checked on both sides of the resistor with a VTVM and one side, leading to the color stages, checked out with a low resistance short. A red wire went directly to pin 6 of the burst amplifier. A 0.01µf bypass capacitor was shorted from screen grid to ground.

We have had at least three cases where the same capacitor was defective. In a CTC16 chassis, resistor R127 had not changed value but was red hot. When replacing, be sure the wires are not burned.

The UHF male plug had a 15 ohm resistance. A soldering iron to the tip corrected the intermittent condition.

### 3. Intermittent UHF

A new color receiver had been in the customer's home five weeks when a complaint came in that channel 70 was intermittent. The lower UHF channel, 21, was good and didn't fade in and out as 70 did. The trouble was located in the UHF tuner.

When the UHF transistor oscillator becomes weak, the high channels frequently fall out. Be careful when replacing this transistor. Cut the terminal leads the same length

## Color Troubles . . .

as the original and place the transistor in the same position. Use a small pencil soldering iron.

UHF channel 70 was checked and operated normally. But within nine days an irate customer complained of the same trouble. Channel 70 would sometimes stay in for an hour and then drop out completely. At other times the channel would not come on the receiver at all. Then again it would stay on all day long.

This receiver was hauled back to the shop and the VHF and UHF tuners were removed from their mountings. It seemed possible that the new UHF transistor, previously replaced, could be defective. In fact, the UHF transistor could have been damaged by overheating when it was installed.

Before the UHF tuner was opened, channel 70 came on good and then disappeared. When the tuner was moved around, channel 70 would come and go. When the UHF shielded cable going to the VHF tuner was checked, the trouble was located. A bad solder joint was found in the small phono-type plug. This cable was checked for continuity and at times a 15Ω resistance existed between plug tip and the inside wire of the shielded cable. By applying a hot iron tip to the male end of the plug, the trouble was eliminated.

We have since checked several UHF shielded cables and have found some phono tips not even soldered. Always check the IF cable going to the VHF tuner for a short or poor connection. Check the IF and VHF shielded cables for snowy or intermittent pictures.

### 4. Poor VHF But Good UHF

This RCA CTC16E chassis brought in local UHF stations very good but the VHF channels were weak. We concluded that the trouble was in the AGC circuits. When the AGC control was adjusted, the brightness disappeared from the screen.

*continued on page 96*

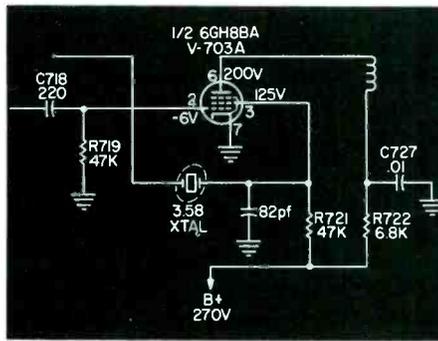


Fig. 4—The 3.58 MHz crystal was defective.

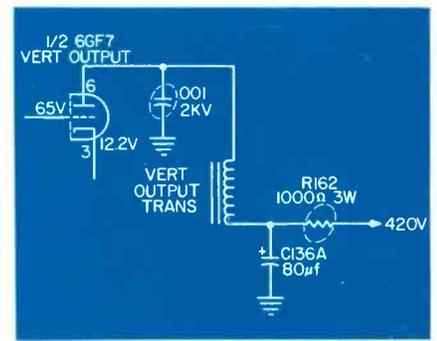


Fig. 5—The .001 capacitor was leaking and was replaced with a 2kv type.

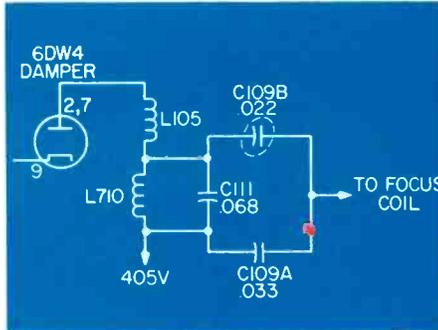


Fig. 7—A shorted or leaking C109A or C109B may cause loss of high voltage.

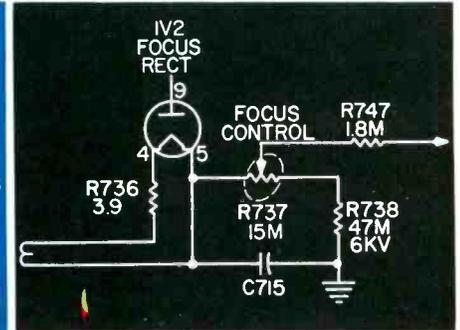


Fig. 6—R737 resistance 'jumped' from 10 to 15M with slight touch of control shaft.

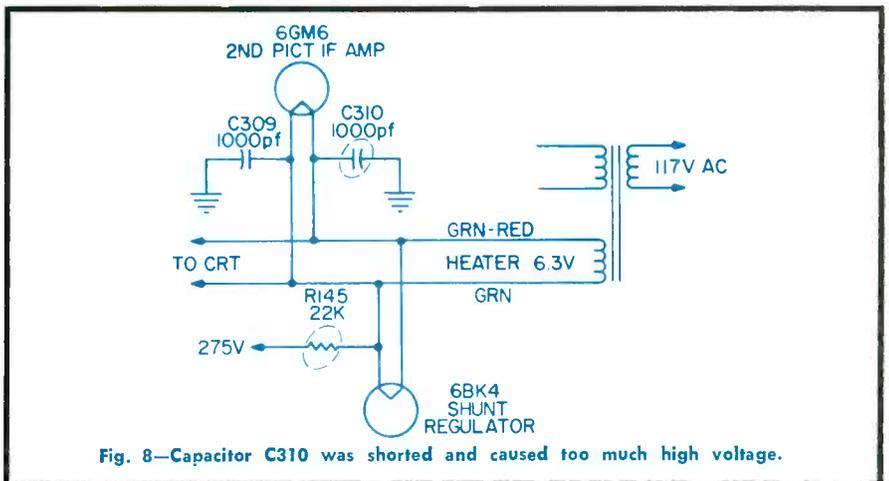
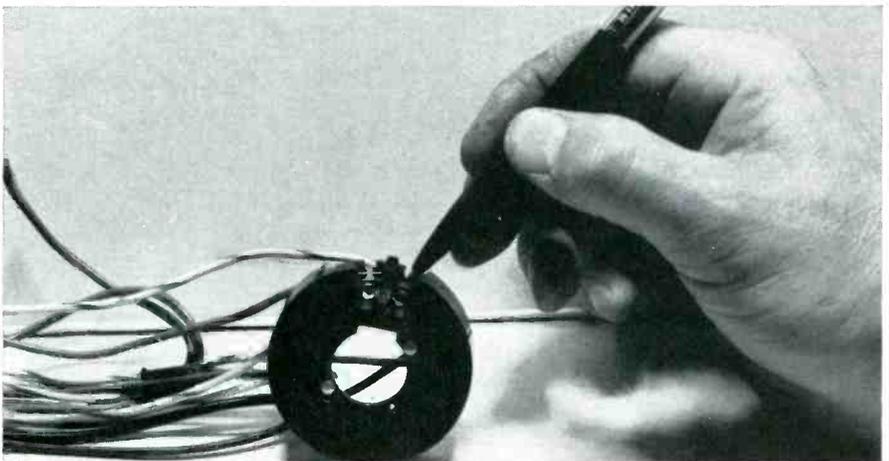
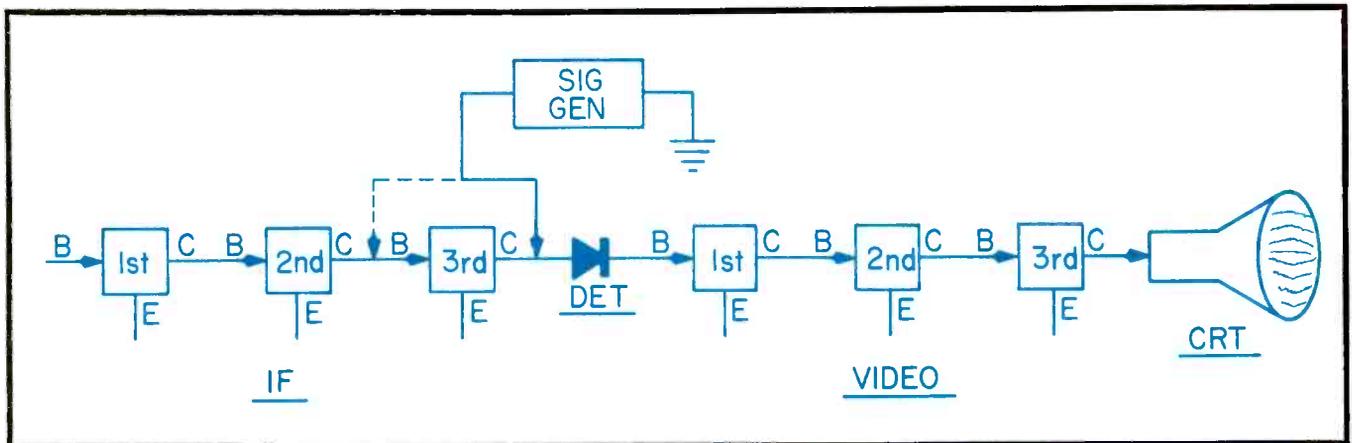


Fig. 8—Capacitor C310 was shorted and caused too much high voltage.



Check the color picture tube socket for green coloring around the pin contacts. Look closely for poor connections and signs of arc-over.

# Servicing Solid-State TVs



Learn how to quickly locate defective components and increase your labor productivity

■ Technicians adept at their trade go through a logical troubleshooting procedure almost automatically. To begin with, they have only the information given to them by the faulty set's owner. The best technicians do not simply accept this information and go on their way, however. Careful customer questioning can often tell you that what the customer calls "flop" means "roll" to you. Also, you may find out that the customer can tell you how the set was acting before it "went out."

### Using Your 'Noodle'

Armed with the customer's statement of symptoms (and neither ignoring it nor placing all faith in it) you are ready to begin your work. First, the symptom must be associated with that section of the set which your experience tells you may cause this particular trouble. When this cannot be done, it is generally an indication of a lack of experience (even the most experienced become more experienced daily). This is an essential process because once the section has been

isolated it is then reasonable to suspect a certain stage or even a single defective part.

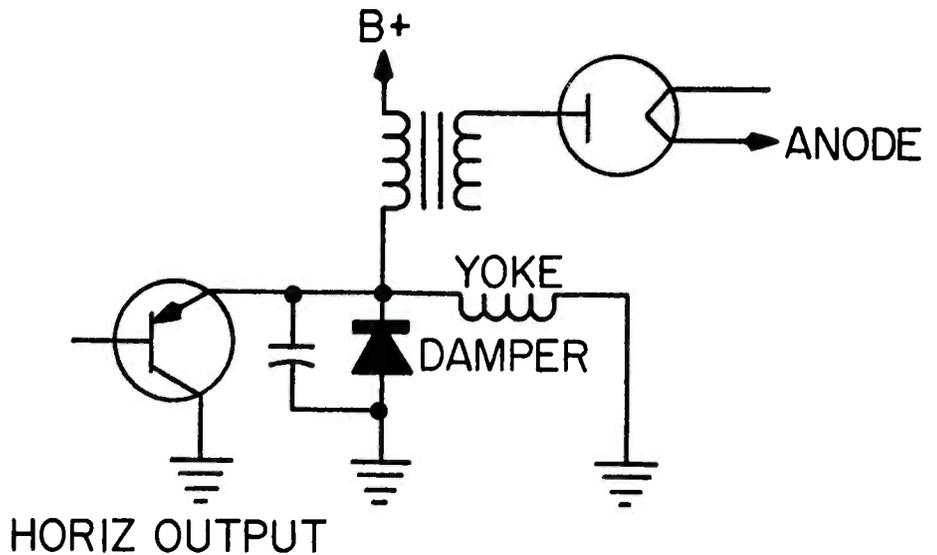
But suppose you only get as far as the section: You have no picture and no sound but the raster seems normal. The trouble could be in the tuner, IF strip or even the 1st video amplifier. Where do you go from here?

Before you go too far, you should get out the service literature for the set you're working on. Without the schematic you might stumble for hours not knowing, for example, that the sound take-off is at the video amplifier output.

### Using Test Instruments

After using your "noodle," it's time to use your test instruments. The best test instrument in the world is no good if the technician who uses it has no idea of what he's doing or how to use the instrument properly. But the best technicians are frequently hindered by insufficient test instruments. Exactly what you will need is, for the most part, determined by you. You will defi-

# Solid-State



nitely need a good VTVM or VOM and a modulated signal generator. A noise generator and scope are also helpful under certain conditions.

Any time a malfunction is present which could possibly involve AGC, the AGC bus should be biased to a normal operating point by an external bias supply. (This should also be done during signal injection and gain measurements.) This important consideration should not be overlooked.

Isolating the stage can be easy or not so easy, depending on what is causing the trouble. A few key preliminary checks may help. Measure the collector voltage on the suspected stage or stages. You may find one with low or high voltage or one with voltage missing entirely. Frequently, several "suspect" stages are supplied from the source and all may be without power. If all the stages have proper collector voltages, you have two directions in which to go. The easiest way will depend on how familiar you are with the problem set.

The tried and proven test method is signal injection. Starting at either end of the circuitry under suspicion, inject the proper type of signal into the base and collector of each stage (Fig. 1). When the signal disappears (or appears if you are going toward the output) you will locate the defec-

tive stage. Keep in mind that the signal output (which you will observe on the CRT or by listening to the speaker) will become stronger as you move toward the "front end."

A modulated signal generator is all you need for signal injection. Keep in mind that when troubleshooting the sound IF you will need to inject at 10.7MHz signal, FM modulated, up to the detector. The video IF is, of course, AM. Video IFs vary in TV and the best way to set the generator frequency is with the service literature recommendations. Small generator tolerances and unexplained traps can be taken into account by "rocking" the generator frequency control slightly to obtain maximum output. Be sure your test instruments and the set being checked are isolated from the ac line.

## Direct Measurement

Another approach often used by technicians who are very familiar with the set being checked, is direct voltage measurements in each stage. Experienced technicians generally make two preliminary checks on each stage and proceed to the next stage. Since the stages under suspicion are usually few and often easily located, these checks are rapid.

First, the emitter bias is measured. This is easily done by placing

the VTVM (or proper type VOM) probes directly between the emitter and base. The proper polarity for the bias and the meter leads can be easily determined by observing manufacturers' service data. The circuitry may be designed with either plus or minus as common "ground." The meter leads should be placed accordingly if you don't want to get confusing readings.

The voltage to expect across the emitter and base will be the same in almost all cases. All silicon transistors will have about 0.7v and all germanium types will have about 0.2v. But this will vary, depending on the particular circuit functions.

When an incorrect voltage is discovered, most technicians are at a loss to explain why. *Incorrect emitter junction bias almost always means a faulty transistor*, although off-value bias or current stability networks could also cause it.

If the bias appears to be normal, or near normal, measure the base and emitter voltages separately. Even with proper bias, the transistor may not be drawing enough current. A good rule-of-thumb is that all transistors within a particular section will be drawing approximately the same current. What if the stage gain is below normal or weak?

A set plagued by a weak signal can be the toughest one of all to

service. In many cases, all stages will seem to be operating properly. The problem is to find the stage that is weak. (Don't forget to bias the AGC bus.)

Again, we can use a rule-of-thumb: The gain for individual stages in a specific section should be about the same. Gain can be easily estimated by using signal injection and by observing the signal at the CRT screen or audio output. First, inject a signal at the collector of a suspected transistor. Adjust the signal injector output until the "interference" (when using a noise generator) or signal on the screen or in the speaker, is just noticeable. Without touching any controls, move the signal injection probe to the base of the same stage. The signal output should improve dramatically. Each stage in the IF or each stage in the video section should act the same as the others.

A scope with a detector (demodulator) probe may also be used in the later stages of the IF or even earlier if it has enough gain. In this way a station signal can be traced with the scope. The TV's detector output makes a fine test point since only a low capacity probe is needed for the scope.

Technicians should not overlook the possibility of a completely dead stage causing weak reception. This is fairly common in transistor sets. Of course, the easiest way to locate a dead stage is by voltage measurements. Even weak stages are often easily located with the voltmeter and this should always be used in preliminary checks.

#### **Odds and Ends**

Oscillators and output stages are no more difficult to troubleshoot than in the tube sets. Most often you will find a bad transistor in the output stage. This is true because the transistor will not tolerate the spikes and surges that sometimes occur at the outputs. Intermittent arcing (or arcing caused by the technician) can produce output failure. Replacing the output transistor is usually the quickest way to find a fault. These units are generally screwed-down plug-ins.

Remember, the oscillators are self dependent. That is, they do not

need an operating stage in front of them to oscillate. Yokes are generally interlocked in transistorized sets and even in some sets where the yoke does not appear to be interlocked, the waveforms, particularly in the output section, will be very misleading if the yoke is not connected.

The speaker should also be connected. Failure to connect the speaker can cause output transistor failures or incorrect symptoms since less over-all current is drawn in some sets when the speaker is not connected.

Transistors can be fragile when exposed to things outside the set itself. For example, if you shunt a capacitor in an operating set, this can mean sudden death to a transistor. Actually, what happens is that the full voltage from one side of a capacitor is transposed to the other for an instant; all it takes to "do in" a transistor. Where a coupling capacitor is used, this may mean that the full collector voltage on one stage is applied to the base of another. The best way to substitute parts is with the set off. After the part is substituted, the set can be switched on again.

One troublesome problem that technicians encounter is leakage in a B+ circuit — in tubes or transistors. Most technicians spend hours tracing out all the connections to the B+ section and connecting them one at a time to find the trouble. Although this is certainly an accurate and valid troubleshooting method, it wastes time: your most expensive commodity.

Here's a quicker way: First, you check the electrolytics and rectifiers. Use an ohmmeter and make sure the electrolytics are OK. Next, switch the set on and place a jumper across the circuit breaker or fuse. Keep your eyes open for signs of overheating. When you see or smell signs of overheating, then you have the section causing the trouble isolated. Granted, you may damage a part or two using this process but parts are still cheaper than your time. You may also find out that you simply had a bad circuit breaker. Not only that, but the parts that burn have probably been subjected to an overload which might

have already shortened their life. (Don't over-do it; You can destroy a transformer this way.)

Just as in electron tube sets, there is still no substitute for visual inspection. Actually, this should be a first order item. Bad solder joints, discolored parts and arcing can all be most easily found by visual inspection. If you stop and think you will probably agree that your "toughest" set to repair was one that you spent hours at and finally found some simple and obvious item at fault.

Most of the work you will do on TV will be with PC boards. No one will argue that it takes a "knack" to service them. But with the advent of bottom and top roadmaps it is becoming easier. Most of your work with these boards will be on the bottom (soldered) side since it is most accessible and all connections are made there. Consequently, when you have to replace a part it is usually easier to replace it on the bottom side. Simply check for clearance and solder it in. Manufacturers can't do this because the manufacturing process makes it virtually impossible since the PC board could not be run through a solder pot with parts on both sides. When modifications are required at the factory, however, this is frequently how the parts are installed on finished boards.

When you become as familiar with transistors as you are with tubes, you'll undoubtedly agree that transistor sets are much easier to service. You'll rarely get a burned finger and the voltages are much lower so shock hazard is reduced appreciably.

Perhaps best of all, that perennial stumper, the flyback, has been completely removed from the sweep circuit in many designs (Fig. 2). Its only remaining function is to generate high voltage. Most modern transistor outputs drive the yoke directly.

Low voltage, low current and resultant low heat makes most transistor components relatively long-lived. The electrolytics (used profusely in transistorized equipment) will probably be most troublesome but the transistors should be suspected along with all the other components. ■

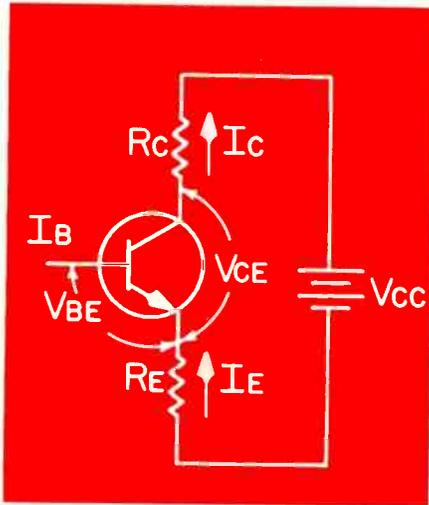


Fig. 2—Voltage drops within a circuit equal the applied voltage.

# Semiconductors From A To Z

Understand transistor characteristics and make your troubleshooting and repairs easier.

■ Many transistor characteristics must be taken into consideration before you can understand the circuits well enough to troubleshoot them efficiently. Descriptions of transistor characteristics are simplified to give you a better understanding of transistors without having to “dig” through electrical engineering concepts.

### Emitter Current Gain

A previous article indicated that the ratio of collector current ( $I_C$ ) to emitter current ( $I_E$ ) is called alpha ( $\alpha$ ). ( $\alpha = \frac{I_C}{I_E}$ ) This is a ratio of dc currents and is frequently expressed as  $\alpha_{dc}$ ,  $H_{FB}$  or  $h_{FB}$ . It was indicated that the emitter current is equal to the sum of the base and collector currents ( $I_E = I_B + I_C$ ). The collector current must, therefore, be smaller than the emitter current and the value of  $\alpha$  ( $\frac{I_C}{I_E}$ ) must always be less than one. The value of  $\alpha$  in typical junction transistors lies between 0.9 and 1.0.

Resistors reduce the currents flowing through a transistor. But transistor specifications would be too complicated if circuit resistors were taken into consideration. Hence, when specifications refer to fluctuations in the emitter and collector currents, we assume the transistor is connected directly to a constant voltage source — with emitter or collector resistors shorted out of the circuit. The ratio of these fluctuations ( $\frac{\Delta I_C}{\Delta I_E}$ ) is frequently expressed as  $\alpha$  or  $h_{FB}$ .

### Base Current Gain

A previous article also indicated that the ratio of the collector current ( $I_C$ ) to the base current ( $I_B$ ) is called beta ( $\beta$ ). ( $\beta = \frac{I_C}{I_B}$ ). The dc beta is frequently expressed as  $H_{FE}$  or  $h_{FE}$ .

When specifications refer to fluctuations in the collector and base currents, we also assume the transistor is connected directly to a constant voltage source. The ratio of these fluctuations is frequently expressed as  $\beta$  or  $h_{FE}$ .

With algebra (Fig. 1) we can see that a definite relationship exists between alpha and beta. ( $\alpha = \frac{\beta}{\beta + 1}$ ,  $\beta = \frac{\alpha}{1 - \alpha}$ .)

Since alpha and beta refer to both dc and small signal current ratios, more specific terms will be used henceforth. Alpha will be referred to as  $H_{FB}$  or  $h_{FB}$  and beta as  $H_{FE}$  or  $h_{FE}$ . Those in upper case describe dc current ratios while those in lower case describe ac signal current ratios.

If we wish to know a transistor's small-signal base-current gain ( $h_{FB}$ ), when the small-signal emitter-current gain ( $h_{FE}$ ) is 0.98, we must make the following calculations:

$$h_{FB} = \frac{h_{FE}}{1 - h_{FE}} = \frac{0.98}{1 - 0.98} = \frac{0.98}{0.02} = \frac{98}{2} = 49.$$

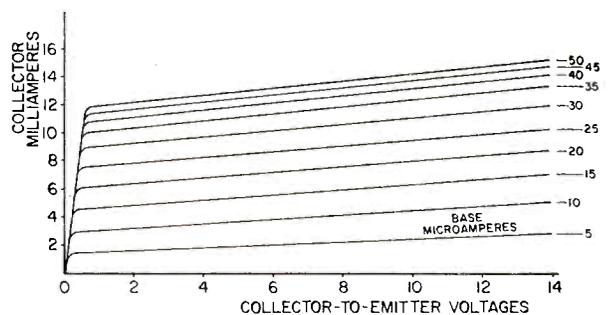


Fig. 3—Curves are used to show transistor dc characteristics.

$$\beta = \frac{I_C}{I_B} \cdot \frac{1}{\beta} = \frac{I_B}{I_C} \cdot \alpha = \frac{I_C}{I_E} = \frac{I_C}{I_C + I_B}$$

$$\frac{1}{\alpha} = \frac{I_C + I_B}{I_C} = 1 + \frac{I_B}{I_C} = 1 + \frac{1}{\beta}$$

$$\frac{1}{\alpha} = 1 + \frac{1}{\beta} \cdot 1 = \alpha + \frac{\alpha}{\beta} \cdot \alpha = 1 - \frac{\alpha}{\beta}$$

$$\alpha \beta = \beta - \alpha \quad \beta - \alpha \beta = \alpha$$

$$\beta (1 - \alpha) = \alpha \quad \beta = \frac{\alpha}{1 - \alpha}$$

$$\alpha \beta + \alpha = \beta \quad \alpha (\beta + 1) = \beta \quad \alpha = \frac{\beta}{\beta + 1}$$

Fig. 1—Calculations show a relationship between alpha and beta.

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

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

#### Voltage Drops Within A Circuit

Kirchhoff's second law states that the applied voltage within any closed circuit is equal to the sum of the voltage drops. The voltage drops within the emitter and collector circuits of an NPN transistor are shown in Fig. 2. Here the voltage source ( $V_{CC}$ ) equals the voltage drop across the collector resistor ( $I_C R_C$ ) plus the collector-to-emitter voltage ( $V_{CE}$ ) and the voltage drop across the emitter resistor ( $I_E R_E$ ). ( $V_{CC} = I_C R_C + V_{CE} + I_E R_E$ ). Since a transistor's collector current nearly equals its emitter current ( $I_C \approx I_E$ ), the equation can be simplified as follows: ( $V_{CC} = I_C R_C + V_{CE} + I_C R_E$ ).

If the base of a transistor could cut off the collector current completely, no voltage drops would

exist across the emitter and collector resistors — the collector-to-emitter voltage would equal the voltage source. (When  $I_C = 0$ ,  $V_{CE} = V_{CC}$ .)

If a transistor could conduct sufficient current to cause the voltage drop across its collector resistor and emitter resistor to equal the voltage source, there would be no collector-to-emitter voltage. (When  $I_C R_C + I_C R_E = V_{CC}$ ,  $V_{CE} = 0$ .) The collector current can be calculated for that condition. (When  $V_{CE} = 0$ ,  $I_C = \frac{V_{CC}}{R_C + R_E}$ .)

#### Graphing A Circuit's Load Line

Transistor circuit design is dependent upon the characteristics of the transistor selected, the desired output load and the voltage source used. The load of the NPN transistor in Fig. 2 consists of its collector resistor and its emitter resistor. ( $R_L = R_C + R_E$ )

Manufacturers frequently use curves to help describe the characteristics of transistors marketed. Fig. 3 describes the dc characteristics of the NPN transistor selected for the circuit shown in Fig. 2. From this graph we can see that the collector current is more dependent on the base current than it is on the collector-to-emitter voltage.

There is no one collector-to-emitter voltage or collector current at which a transistor must function. The values selected, however, must not exceed the power rating of the transistor.

A 6v voltage source and a 750 $\Omega$  load were selected for this circuit. ( $V_{EE} = 6v$ ,  $R_L = 750\Omega$ .) With these values a load line can be drawn on the characteristic curves of the transistor (Fig. 4). This line can be plotted by using two points. When there is no collector-to-emitter voltage ( $V_{CE} = 0$ ), the collector-to-emitter voltage equals the voltage source ( $V_{CE} = V_{CC} = 6v$ ).

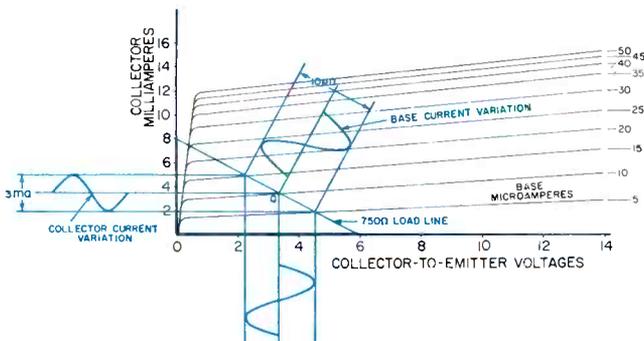


Fig. 4—A load line can be drawn to show transistor voltages and currents in a circuit.

# Semiconductors

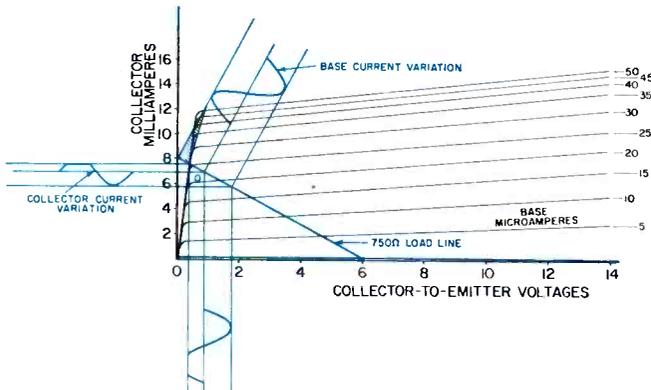


Fig. 5—Too high a Q point may result in a clipped output signal.

## Determining A Transistor's Base Current

At any point along this load line we can find the combination of base current, collector current and collector-to-emitter voltage that the transistor will experience under these load-line conditions.

A  $10\mu\text{A}$  dc base current has been selected as the operating current for this circuit. This operating point on the load line is called the "Q point." Variations in the base current about this Q point cause corresponding variations in the collector current and collector-to-emitter voltage. At this Q point the transistor has a 5ma dc collector current and a 3.4v dc collector-to-emitter voltage. When a  $10\mu\text{A}$  signal is applied to the transistor's base at this Q point, a 3ma collector current signal and a 2.4v collector-to-emitter voltage signal results. Under these conditions the change in collector current is 300 times as large as the change in the base current. (This should not be confused with the value of  $h_{fe}$  since there is a load resistor in the circuit.) This current gain in the circuit is expressed as  $A_i$ .

Suppose the dc base current was increased to  $22.5\mu\text{A}$ . The Q point would then be higher on the

load-line slope (Fig. 5). With this base current the transistor has a 6.8ma dc collector current and a 0.9v dc collector-to-emitter voltage.

The ratio of dc base currents and the dc collector currents is not the same at the two Q points. Because of the transistor's characteristics, the higher base currents are shown closer together.

There is a point where the load line passes through all of the remaining base-current curves. At that point on the graph there is no base current capable of increasing the collector current above 7.5ma.

The  $10\mu\text{A}$  base-current signal applied to the higher Q point is the same as that used in Fig. 4. It appears smaller since the characteristic curves are closer together around this Q point. For simplicity this input signal is shown as a sine wave. It should appear more distorted, however, during the positive half cycle since the characteristic curves are much closer together in that area along the load line.

Since only 7.5ma of collector current can result from the base current signal, the output signal is "clipped." The  $10\mu\text{A}$  base current signal has produced a 2ma distorted collector current signal and a 1.4v distorted collector-to-emitter voltage signal. Under these conditions the change in collector current is only 200 times as large as the change in base current — this being the current gain ( $A_i$ ) of the circuit.

The graphs indicate that by increasing the Q point, the transistor's current gain can be decreased. It also indicates that too high a Q point will result in distorting or clipping the output signal.

## Changing A Circuit's Load Line

When the voltage source is increased to 7v while the load resistance remains  $750\Omega$ , the new load line is parallel and to the right of the old one (Fig. 6). With the new load line the  $10\mu\text{A}$  signal at the same higher Q point will produce a collector current signal and a collector-to-emitter voltage signal that is not clipped.

If the load resistor is reduced to  $500\Omega$  the load line will become steeper (Fig. 7). If a  $22.5\mu\text{A}$  dc base current is supplied to provide the same Q point as before, the  $10\mu\text{A}$  base signal will not produce a distorted collector current signal or collector-to-emitter voltage signal.

*continued on page 104*

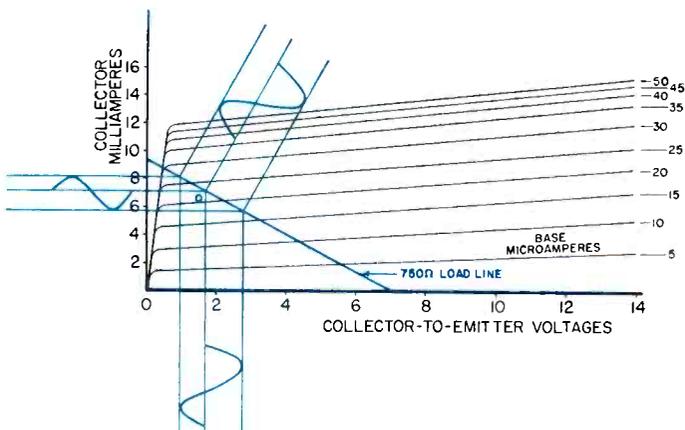


Fig. 6—Signal distortion is reduced by increasing the voltage source.

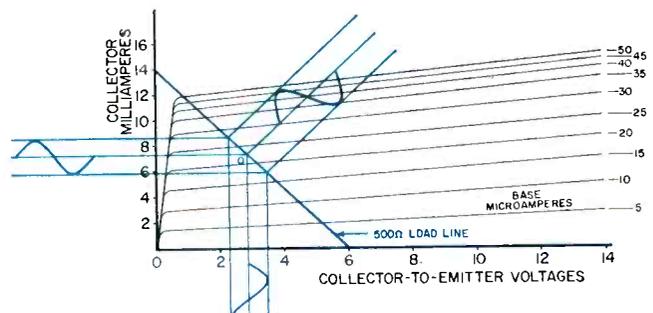


Fig. 7—Reducing the load resistance can improve the output signal.

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# The Electronic Technician's 'Piggy Bank'

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Or why keep your money in a 'tin-can?'

■ Two years ago I was standing in a Detroit stereo store chatting with the manager while he carefully stacked rolls of change in his safe. It was a squat, solid looking cube done up in gray enamel and chrome trim.

"That's a pretty stout box," I observed.

"Yes, sir," he said, with obvious pride, "it's a regular little Fort Knox. Where your cash is concerned, there's nothing like real protection."

Well, as a professional safecracker with fifteen years experience, I have looked at many safes in many electronics stores — and I can tell you that most of them, indeed, are nothing like real protection. This particular safe was a common variety, built along the lines of an onion. It had a thin outer skin of steel backed up with laminations of fire-proofing material and concrete. These surrounded an inner layer of steel that formed the interior chamber. It was perfectly adequate for holding a day's receipts and a few current records. But, far from

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*The author of this article is now serving a term in a state prison. His name has been withheld but the facts are true.—Ed.*

being a "little Fort Knox," it offered about as much protection as a good, sturdy piggy bank.

## Opening One Is Easy

When I returned to that stereo store the next night, well after closing time, I couldn't help smiling at the manager's cheerful confidence. If he could only have seen what a pushover his box was. It took just about one blow with a ten-pound hammer and the dial of his safe went clattering off into a Hi Fi display. This exposed the dial shaft where I could get at it with a steel punch — and a few hammer blows on that punch drove the shaft clear back inside the safe. Then, with a wire coat-hanger from a nearby rack, I fished inside the door and tripped the opening mechanism.

The technique I used is a common one known in the trade as "punching." From the time I got my hands on that safe, it had taken me exactly five minutes to get at the cash inside it. The toughest part of the whole job, in fact, had been keeping a straight face while talking with the manager earlier in the day.

## Don't Make These Mistakes

By making two very bad mistakes, that unfortunate man had practically worked as my accom-

plish. First, he did not understand the purpose and the limitations of his safe. He assumed that it was impregnable and he was relying on it for a degree of protection it was never designed to give. His second mistake was allowing me — a total stranger — to get a good look at the interior of his safe.

Both of his mistakes are very common ones, and I took full advantage of them. A standard procedure of mine was to drop in to an electronics shop and make some small purchase, offering in payment a very large but indisputably good cashier's check. As a rule, that not only got me a close look at the safe and its contents — it also guaranteed me a little something extra in the form of that still negotiable check when I came back to crack the safe.

These and similar mistakes help to account for the increasing underworld popularity of safebreaking, even in face of the fact that the better safes coming onto the market today are making the racket increasingly more difficult.

## Things to Remember

An important thing to remember about safes is that their quality is not gaged by whether or not they can be cracked (the safe that can't

## 'Piggy Bank'

has yet to be built) but by how much time and effort is needed to do the job. A safe that can be opened with only fifteen minutes or so of light labor does not offer much protection. Just as you may idly shell a peanut to see if it's worth eating, a safecracker will open one of these light duty jobs on the off-chance that it may contain worthwhile loot.

### Not All Safes Are Easy

A good safe, on the other hand, is one that requires more risky hours of effort than a thief may care to spend. The better safes, the money vaults, won't yield to so simple a procedure as punching. You have to open them by "peeling" — drilling a small hole in the upper corner of the door and prying away the steel face with a wrecking bar. This is about as easy as opening a can of sardines with a toothpick.

Another approach to these tough jobs is with a cutting torch. The usual technique is to burn a hole in the door that will bypass the locking mechanism. This won't work for all safes. On some, you have to burn a hole big enough to reach inside with your entire arm. Either way it takes a long time and there is a constant risk that someone will spot the bright light of the torch. As a further complication, all good safes contain copper in their laminations. This dissipates heat and makes cutting very difficult. Some safes even contain a layer of chemical compound that vaporizes as tear gas when exposed to the heat of a torch. A very mean trick, I always thought.

Other safes can only be cracked by using high-speed drills or explosives, though nitroglycerine is a method more talked about than

practiced. The last time I tried it, on a music store in Akron, the explosion scattered the contents of the safe all the way from the alley to the far side of the street. All I got out of it was a ruptured eardrum.

### 'Tin Cans'

The majority of safes used by electronics service dealers, however, don't even begin to present problems of this nature — because most of them aren't really safes at all. They are fire resistant vaults, or antiques of the brass-bound, rivet studded variety that look like family heirlooms. The weakest, and most common, is the type that is built into a filing cabinet or steel locker. I used to pry them open with a screwdriver.

Tin cans of this sort, and the fairly widespread habit of stuffing them with a week's receipts, are exactly what the average safecracker depends on to make his work possible. Safe-cracking, at best, is a very difficult profession and very few thieves care to bother with it unless you make it easy for them.

### Protecting Your Valuables

By checking yourself on a few essential points, you can make it very difficult for safe crackers, at the same time, assure yourself of the best possible protection against loss.

Your most basic assurance is to know the limitations of your safe. Use it only for the purpose it was intended to serve. If your safe was designed to protect necessary records against fire or to guarantee a day's receipts against pilferage, don't fall into the dangerous habit of allowing cash to accumulate in it. A weak safe is no substitute for regular banking habits.

The importance of a good burglar alarm cannot be over-emphasized. But check with your local police or with your insurance company to be sure that it is a good one. An antiquated alarm system, or one that is in serious disrepair, will give nothing but a false sense of security.

If you keep a copy of the combination on the premises, try to exercise a little imagination when you

tuck it away. Whenever I ran into a tough safe, I used to look for a filing cabinet and check for a folder under the name of the manufacturer of the safe. On many occasions, that's exactly where I found the combination. Even when there was no combination, I could usually count on a set of specification sheets — which were almost as good.

For most business applications, wheels on a safe are about as functional as a third nostril. At best, they are a convenience for thieves who often roll safes away to work on them in private. I was usually content to push them into a stockroom, but some guys take them clear out of town.

If your safe has wheels, either spike them yourself or have the manufacturer's representative immobilize them.

Assuming that your safe is too heavy to carry and that you have prudently gummed up the wheels, very few safecrackers will venture to touch it if it is properly lighted and, where applicable, easily visible from the street. Obviously, no sensible safe-cracker is going to deploy his cumbersome arsenal of tools and set up business right out in the open as if he were some kind of a window display.

Make absolutely certain that your safe can be seen from outside the building. Use a good, bright night-light and be sure to inform the police that you are using it. If a would-be safe-cracker is silly enough to turn it out, the first passing prowler will nab him.

Remember, safecrackers won't bother a good safe that is adequately protected unless they have reason to believe that it will be worth their trouble. See to it that strangers don't get a look at the contents of your safe and impress upon *all* employees the importance of not gossiping about cash movements.

Your chances of avoiding a severe financial loss to someone in my business are just as good as the pains you take to avoid it. If *you* don't bother to take inventory of your security measures, there is an excellent chance that before too long some hardworking safecracker will be doing it for you. ■



CG138



CG10

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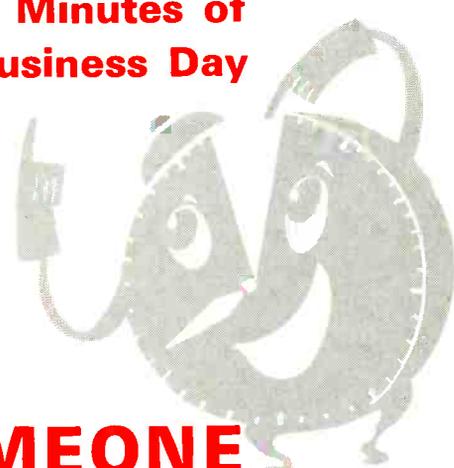
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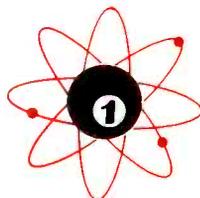
**SENCORE CG138.** A performance giant just like the CG10 except AC operated with a zener regulated power supply for added stability even with line voltage variations. Has 4.5 mc crystal controlled signal for fine tuning as recommended by color set manufacturers. . . . .Only

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# NEW PRODUCTS

FOR MORE INFORMATION CIRCLE NEW PRODUCT NUMBERS ON POSTCARD INSIDE LAST COVER.

## Pocket Tape Recorder 700

Announced is a portable tape recorder weighing less than 2 lb. that features a built-in flywheel powered generator which reportedly keeps the



battery voltage constant—eliminating wow and flutter. The specifications indicate a frequency response of 200 Hz to 3kHz at 15 to 16 ips for 90 minute recordings, 0.7% wow and flutter and a 5hr battery life for the four penlight cells. Dimensions 7 $\frac{3}{8}$  x 3 $\frac{3}{8}$  x 1 $\frac{7}{8}$  in. Price \$89.95. Telmar.

## Pocket Transmitter 701

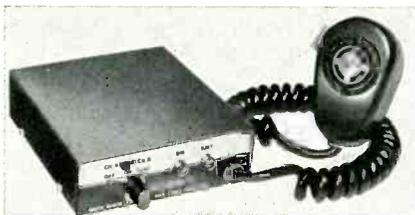
An entirely self-contained multitone pocket radio transmitter is introduced. Key persons are enabled to speak to



base from wherever they happen to be. It reportedly operates effectively inside and outside buildings with a one or two mile line of sight range. Weight, 2 $\frac{1}{2}$  oz. Multitone.

## CB Transceiver 702

A two-channel CB transceiver designed for use with the car radio is announced. It contains a complete 5w transmitter section and frequency conversion receiving section while the car radio supplies the second fre-



quency conversion, IF amplification, audio and speaker. The only connection to the broadcast receiver is through the antenna connector. The receiver has a tuned RF amplifier, crystal controlled oscillator/mixer and a sensitivity rated at  $\frac{1}{2}$  mv for 10db s/n ratio. Its use in conjunction with a standard broadcast receiver results in eight tuned circuits for nominal selectivity and high image rejection ratio. Dimensions 4 $\frac{3}{8}$  x 1 $\frac{1}{2}$  x 5 $\frac{3}{4}$  in. Shipping weight, 3 lb. Price, \$49.95. Multi-Elmac Co.

## Aerosol Solvent 703

Introduced is an aerosol solvent for on-the-job spray cleaning and degreasing sensitive operating equipment. The aerosol is said to be safe for personnel without affecting plastics, metals, elastomers or insulation materials while dissolving oils and



greases. It is made for spray cleaning electronic components, circuit boards, relays, motors, tape heads, optical and precision instruments. Price for a carton of 12 16oz cans, \$29. DuPont.

## Shielded TV Lead 704

An all-channel shielded TV transmission line is introduced which reportedly requires no standoff installation insulators for interference-free reception of B/W or color. The new shielded line has its two copper-plated steel conductors individually encased in cellular polyethylene tubes. The conductors and tinned copper ground

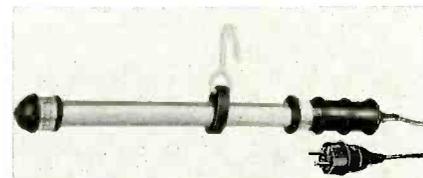
wire are wrapped in an aluminum mylar shield and is protected from weathering by a jacket. This method of construction is said to allow technicians to tape the transmission line directly to the antenna mast and run



the line by the most convenient route (even through gutters) without insulators. Columbia Wire.

## Inspection and Work Lamp 705

A butyl rubber enclosed fluorescent lamp is announced for general illumination in confined work areas and



shop use. The standard fluorescent bulb is enclosed in a plastic tube which features a reflector for additional direct light. The chemical and grease resistant properties of the molded rubber reportedly make these lamps ideal for motor and servicing work. Price \$19.95. Hunter.

## Stereo Tape Recorder 706

A kit version of the professional Magnecord 1020 4-track transistor stereo tape recorder is announced. Assembly involves wiring two circuit boards and additional mechanical mounting of the transport components.



The die-cast mainplate features 3 motors and the brakes, tape gate and pinch roller are solenoid-operated. There are 3 tape heads for erase, record and playback plus a 21 transistor, 4 diode amplifier. Price \$399.50. Heath.

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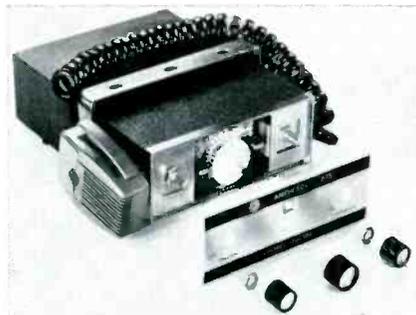
## NEW PRODUCTS

### Amplifier/Control Center 707

Announced is a stereo amplifier and control center designed for installations where stereo is desired throughout the home. The solid-state stereo amplifier uses 24 silicon transistors and 4 silicon diodes. It is covered by a three-year warranty on defective parts and workmanship. At 40 w it is rated at 20Hz - 20kHz  $\pm$  1db. It measures 14x4x10½ in. and weighs 22 lb. Price less case \$229.50. Sherwood.



knobs and two shaft nuts from its front panel controls. The panel can then be lifted away, exposing the bank of crystal sockets and channel indicator dial. Receiver image rejection is rated at 50db, and sensitivity at 0.4 mv for a 10db s/n ratio. By turning the transceiver's squelch control completely counter-clockwise, the audio output circuitry is changed into a public address amplifier. Dimensions, 2½x6½x9 in. Price \$179.95. Amphenol.



A solid-state color-bar generator is announced that uses a 3.58MHz oscillator and linear delay line with positive switching to produce the independent selection of full-saturated full-field primary colors (red, blue, green) three full-field complementary colors (cyan, yellow, magenta) and a full-field white which permits checking non-chromatic portions of a color set. The generator also features crystal-controlled selection of horizontal and vertical crosshatch and dot patterns. A front panel control adjusts line width and dot size. The generator

### CB Transceiver 708

A transistorized CB transceiver is introduced which features crystal socket accessibility and solid-state switching. The new ten-channel five-watt mobile transceiver permits the addition of transmitter and receiver crystals merely by removing three

### Color-Bar Generator 709

can be connected directly to the set's antenna without requiring gun killers. Size 8½x5¾x6¾ in. Price \$169. EICO.

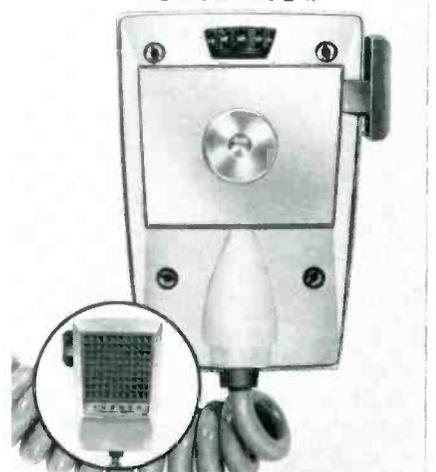
knobs and two shaft nuts from its front panel controls. The panel can then be lifted away, exposing the bank of crystal sockets and channel indicator dial. Receiver image rejection is rated at 50db, and sensitivity at 0.4 mv for a 10db s/n ratio. By turning the transceiver's squelch control completely counter-clockwise, the audio output circuitry is changed into a public address amplifier. Dimensions, 2½x6½x9 in. Price \$179.95. Amphenol.



Microphone 710

A mobile type microphone is announced with a volume control located on the back of its case, plus a self-contained two transistor pre-amp. The microphone is designed particu-

### BACK VIEW



larly for use with mobile transceivers that may need more output or must work under conditions requiring a variable output level. Turner.

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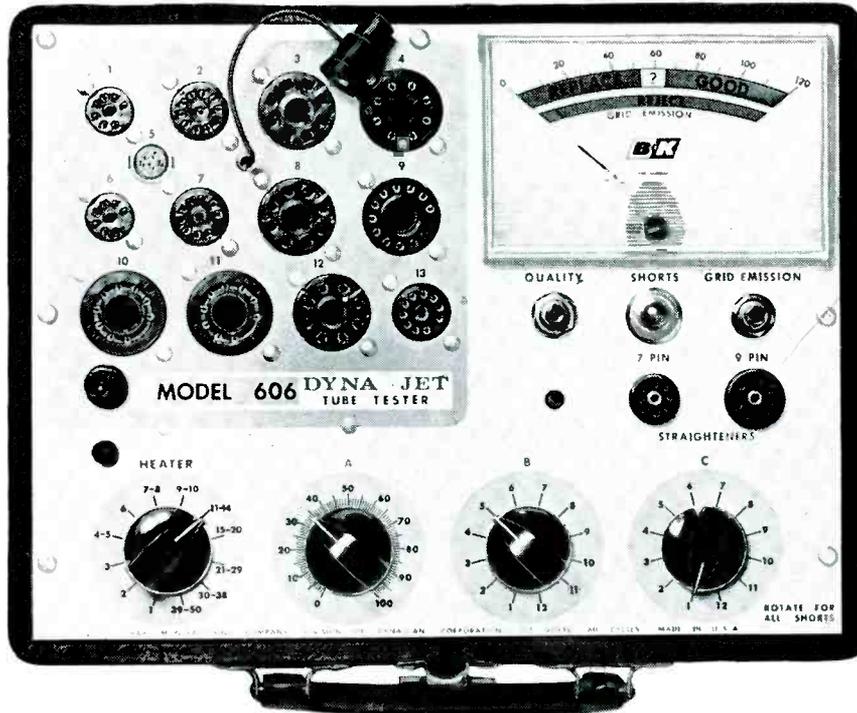


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## NEW PRODUCTS

### Solid State Inverter 711

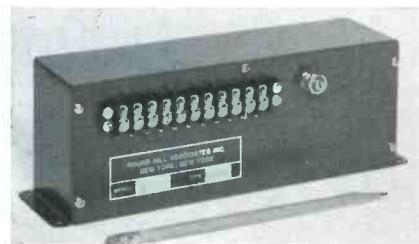
A new transistorized inverter that converts 12v dc battery power on boats, planes or cars to 250w at 117v 60Hz is announced. It features an optional remote control console, a built-in "start" switch to facilitate



hard-to-start loads, an indicator light which shows the battery's condition and warns when the output is shorted or overloaded, plus automatic electronic overload protection. Voltage regulation is 11% of no-load voltage, and frequency regulation is 4Hz from no load to full load. Dimensions, 4½ x10x7½ in. Weight, 9 lb. List price, \$89.50. Electro Products.

### Audio Amplifier 712

Announced is a solid state audio amplifier with a frequency response rated at ±1db from 20Hz to 20kHz and harmonic distortion of less than 1%. Its circuit of 7 transistors and one thermistor includes a shielded input transformer for 50 to 150Ω low-



impedance microphones and an 8 to 500Ω output transformer that can reportedly be shorted without damaging the transistors. It is rated at an 80db gain capable of delivering 200mw of undistorted audio power. The amplifier measures 9x2¾ x3¼ in. and weighs 28oz. Price \$34.50. Round Hill.

For more information on these

NEW PRODUCTS

See pages 115 & 116

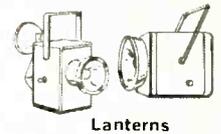
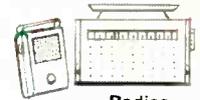
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## NEW PRODUCTS

### Electrical Tape

713

Vinyl plastic electrical tape in eight colors is introduced for identification color coding, safety marking applica-



tions and other uses. It is available in red, white, blue, yellow, green, orange, gray and brown. Rolls are 1/2 in. by 20 ft and 7 mils thick. 3M.

### Dictating Machine

714

A tape recorder is announced which is able to continuously record a conference for 10hr. It may also be used



for transcription with the secretary having a choice of finger-tip or foot pedal control and is said to be sufficiently sensitive to pick up sound 30ft away. Full controls are on the microphone—back space to play, stop and start. American Geloso.

### Stereo Cartridge

715



A piezo-electric cartridge has a frequency response from 20 Hz to 20kHz and reportedly tracks at less than 5g with a vertical stylus force ranging from 1.5 to 2.5g. The effective dynamic mass at the stylus is rated at 1.8mg with a compliance of  $15 \times 10^{-6}$  cm/dyne and a cartridge sensitivity at the 1kHz output point of 6mv. The cartridge is designed in a slim miniature housing with an integrated mounting bracket to fit all standard changers and professional tonearms. Net price, \$32.50. Sonotone.

# we looked into your future, then created the "little corporal," a most remarkable CRT tester.

B & K has done it again . . . put you a "jump ahead" by looking into your future . . . your problems, *your* needs. This is the "Little Corporal," the CRT Rejuvenator and Checker, designed to provide maximum obsolescence protection by providing continuously variable voltages for all CRT elements. You can make the most accurate possible tests, even on future CRT types, because the heater

voltage is metered and is continuously variable from 0 to 13 volts with any tube heater current. And, using the required adaptors, you can test and correct all tube, transistor or integrated circuit black and white and color picture TV tube troubles (including GE 11" color and imported color tubes) in a few minutes . . . in the home or on the bench . . . without removing tubes from the TV set.

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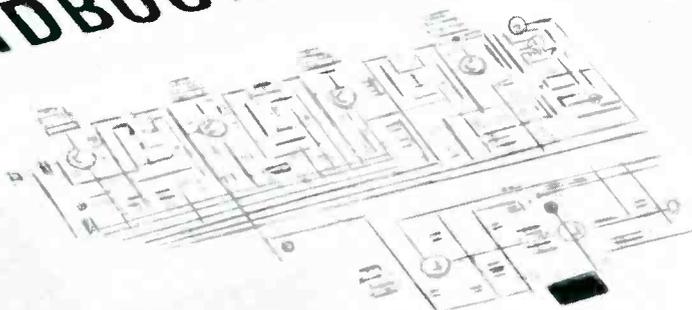
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## NEW PRODUCTS

### Stereo Tape Player 716

A 13 transistor car stereo tape player is announced that plays standard 8 track cartridges. Tracks



can be changed by pressing a knob or with a remote foot control. The player's frequency range is said to be from 60Hz to 10kHz with either 2 or 4 speakers. Duosonic.

### CRT Cleaner 717

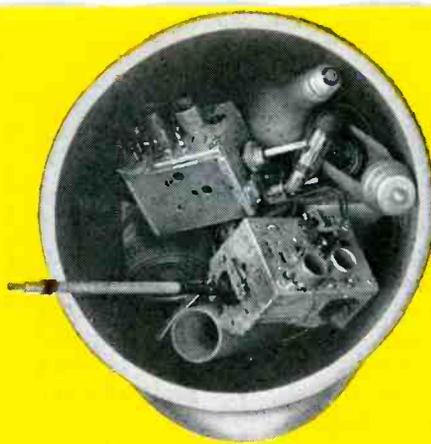
Announced is an ammonia-base glass cleaner containing an anti-static agent to discourage the accumulation



of dust on CRT screens. It reportedly repels dust for a far cleaner picture. List price, \$1.65 for an 8oz. can. GC Electronics.

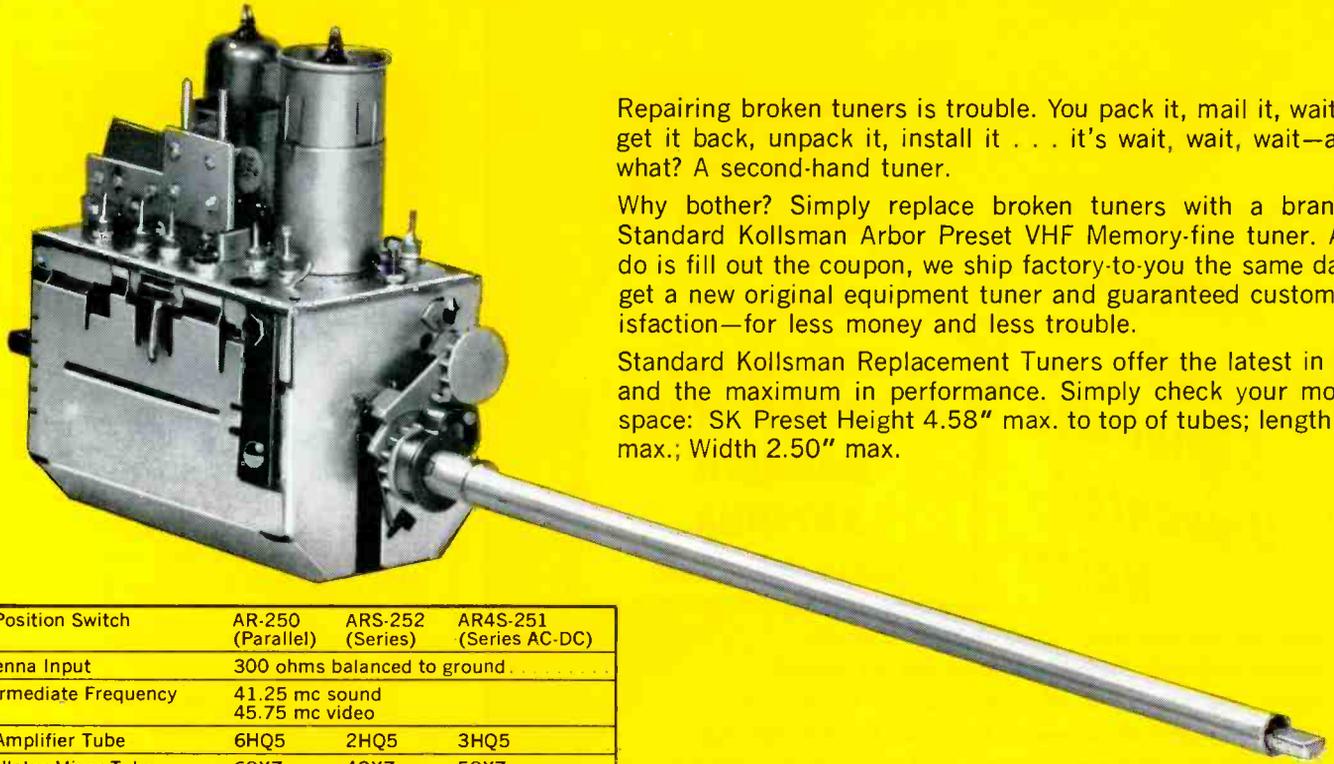
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## NEW PRODUCTS



### Marine Radiotelephone 718

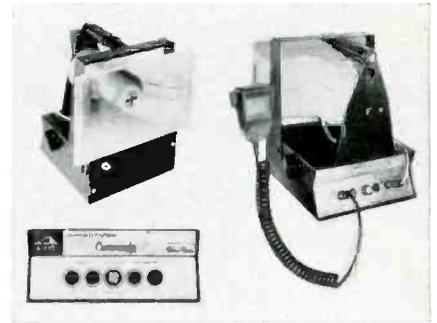
A solid state 50w 12 channel FM marine radiotelephone is announced which operates on VHF FM frequencies—eliminating interference caused by turbulent atmospheric conditions and ignition noises. The Coast Guard now monitors VHF call and safety channels. The radiotelephone uses an antenna less than 2ft tall and is designed for pleasure boats and commer-

cial vessels which ply local high traffic waters. An instantaneous automatic deviation limiting circuit keeps transmissions within the FCC required band widths. Dimensions, 11½x4¾x10½in. Weight 20 lb. Price \$650.00. Pearce-Simpson.

### Megaphone 719

A solid-state megaphone is intro-

duced with an all-transistor 25w amplifier, weatherproof horn speaker and noise-cancelling hand-held microphone. The amplifier has a rated gain of 105db, 50Hz - 50kHz frequency response and is powered by 10 "D"



cells which reportedly provide a full year's service. It has an auxiliary input for phono, turner, tape recorder, etc. Price \$129.95. Perma-Power.

### Headphones 720

Stereo headphones with two ¾in. loudspeakers and cushion ear-pieces are available with a five-year warranty. Frequency response is 20Hz to



18kHz and its impedance matches 4, 8 or 16Ω amplifier outputs. Normal listening level is attained with 1mw input power per phone and distortion is rated at less than 1%. Piezoelectric.

### Tube Luggage 721

A vinyl case is announced which holds over 160 tubes and comes with egg-crate separators to hold tubes in



position. Has vinyl covering, plastic handle, snap lock and nickel-plated steel hardware for long wear. G-E.

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WO-91B RCA 5" Scope

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Here's how it works: Simply buy one, or all, of the four instruments shown, the WR-64B, WR-69A, WR-99A, or WO-91B—ALL essential color TV test instruments—from your Authorized RCA Test Equipment Distributor between now and November 15, 1966. Fill out your warranty registration card and attach the white identification label on the carton. Send them to RCA, Test Equipment Headquarters, Bldg. 17-2, Harrison, New Jersey. We will send you the enrollment form and a binder

containing the first two lessons. When you complete the lessons and forward them to RCA Institutes for grading, the next lessons will be supplied to you directly from RCA Institutes, all without charge to you.

But do it now. This offer is good only for equipment purchased between September 1, and November 15, 1966. To allow for postal delay, we will honor cards received up until December 1, 1966. Here's your chance to equip your shop for color servicing while we train your people for FREE!



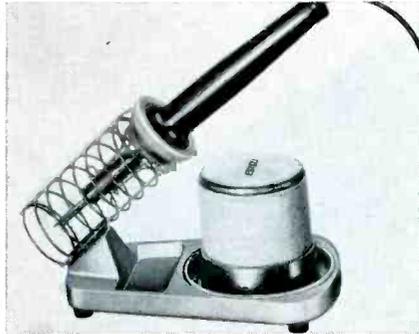
Electronic Components and Devices, Harrison, N.J.

The Most Trusted Name in Electronics

# NEW PRODUCTS

## Soldering Iron Holder 722

A soldering aid is announced that combines a tip cleaner with a holder designed for miniature soldering irons.



The holder has a protective collar to prevent tip damage when inserting the iron. A stroke of the soldering iron tip across the cleaner's wet, vertical sponge removes undesirable residues. ESICO.

## VOM 723

A 100K/v VOM with 33 ranges is announced that features a yellow



function indicator which visually indicates the exact range being used. The meter is 6½ in. wide with a two color, full range 90° arc. The VOM includes built-in protection against burnout and bent pointers. Dimensions, 7½ x 6¾ x 3½ in. Meter movement sensitivity, 9µa for full scale deflection. Price \$44.95. Lafayette.

## Transistor Tester And Analyzer 724

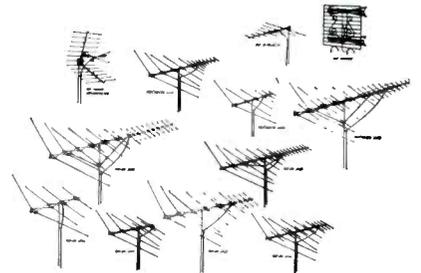
A transistor tester and set analyzer designed to replace the variety of test instruments usually needed for checking transistors and transistor radios is announced. All low or high power transistors can be checked. The tester checks dc current gain to 400 and checks for transistor or diode leak-



age. It can be used as a circuit signal generator or tracer, measure supply voltages on a 20-v scale and measure current drain to 100ma. Semitronics.

## Color Antennas 725

A line of color-TV antennas for VHF, UHF and VHF/UHF reception is announced. These antennas range from a 23-element VHF/FM



model to decorator styled indoor UHF antennas. They are said to be made of flexible aluminum with double-lock hardware. Gavin.

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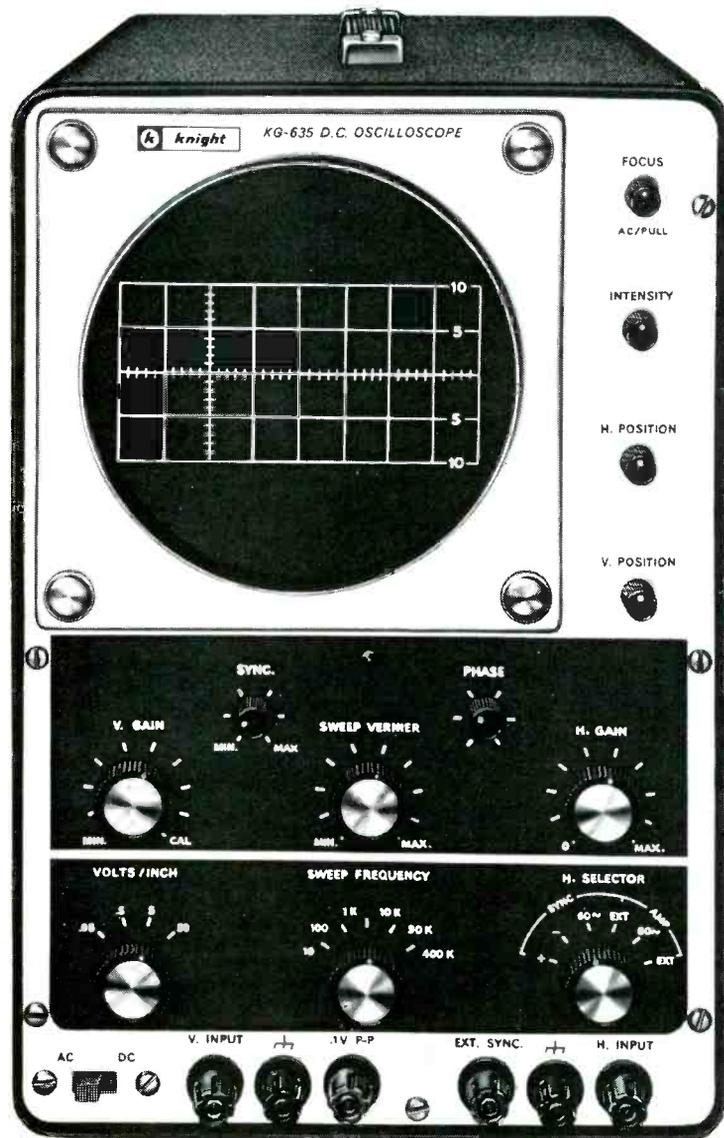
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*Don't just take our word for it...*

# READ WHAT THE EXPERTS HAVE TO SAY ABOUT THE **knight-kit**® KG-635 5-inch DC to 5.2 Mc OSCILLOSCOPE KIT



Read the unique money-back guarantee below . . . exclusive in the industry . . . then mail the coupon at right for full details and Special Introductory Offer.

## KNIGHT-KIT GUARANTEE

Build a Knight-Kit in accordance with our easy-to-follow instructions. When you have completely assembled the kit, you must be satisfied or we will return your money, less transportation charges, under the Allied guarantee of satisfaction.

**ALLIED RADIO**

**From May, 1966, RADIO-ELECTRONICS:** "This is a real-solid, honest-to-gosh kit! The instructions are superb. This scope is about as close as you can get to a "professional" or "lab" scope . . . The sweep circuit is a sophisticated one with amplified, polarity-switchable sync . . . The trace is bright enough for most shop applications . . . The kit was a joy to build . . . All parts, structural, mechanical, electronic, were obviously of good quality and everything fit together perfectly."

**From November, 1965, ELECTRONICS WORLD:** "Midway between the low-cost simple, general-purpose scope and the expensive, elaborate laboratory scope lies a class of instrument called a "wide-band service scope." The new Knight-Kit KG-635 is just such an instrument. A sync limiter circuit keeps the trace steady at just about any input signal level that the scope can handle. Also contributing to the stability of the waveforms on the 5-inch CRT is the use of polystyrene and Mylar capacitors in the sweep-generating circuits. All in all, the instrument is well-engineered and a very worthwhile addition to the bench."

Yes, the Knight-Kit KG-635 5-inch Wideband Oscilloscope handles virtually every service and test requirement. Exceeds the critical demands of color TV for fast profitable servicing.

The unique Knight-Kit dynamic sync limiter assures uniform traces. Five linear time base ranges provide wide versatility. Calibrated vertical attenuator directly reads volts-per-inch. Polystyrene and Mylar capacitors assure sweep stability. Sharp, bright displays with 1650-volt potential on CRT. Auto astigmatism correction. Easily and quickly calibrated without extra equipment and without removing from case.

Complete with all parts, tubes, CRT, case, instructions and assembly manual . . . **\$109<sup>95</sup>**  
Available factory assembled for \$159.95

### ALLIED RADIO, Knight-Kit Div.

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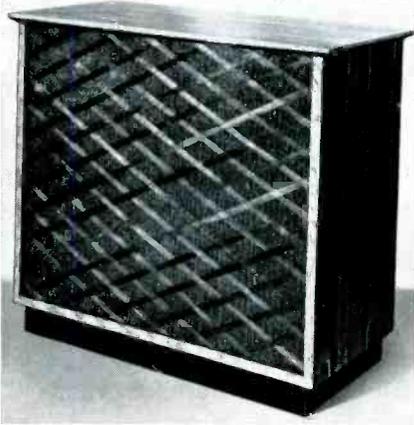
. . . for more details circle 103 on postcard

## NEW PRODUCTS

### Speaker System

726

A speaker system is announced that contains four electrostatic radiators for mid and high range frequencies and two dynamic woofers for the bass.



The woofer cones are reportedly capable of  $\frac{5}{8}$  in. excursions without breakup or doubling. The speakers are sealed in a fiber-glass filled walnut enclosure and are said to have a low distortion response from 27Hz to beyond 30kHz. The speaker system comes with a built-in power supply

and high-pass filter and may be used with any high quality amplifier of 20w or more. Size 28x31 $\frac{1}{4}$ x15 $\frac{1}{2}$  in. Price \$399.95. Neshaminy.

### CB Accessories

727

A CB antenna matching system is announced consisting of two simple devices, antenna meter and CB matchbox, designed to work together to cor-

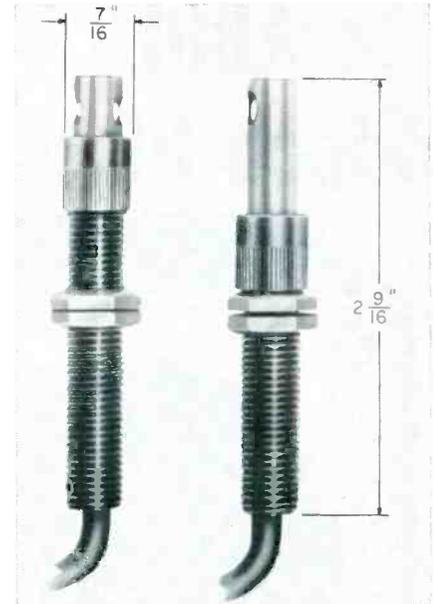


rect an improper impedance match between the transmitter and antenna of any base or mobile CB station. The antenna meter is a small measuring instrument inserted temporarily in the feedline between the transmitter and the antenna to measure both forward and reflected power in the feedline—giving a direct reading SWR (standing wave ratio) reading. The matchbox is intended as a permanent part of any CB installation where an impedance mismatch occurs between transmitter and antenna and has two simple controls to allow an SWR as high as 5:1 to be corrected to 1.1:1 or less. Price of Meter \$14.95, Matchbox \$15.95. E. F. Johnson Co.

### Miniature Photocell And Light

728

A side-view photocell and light-source set designed for counting and controlling small objects at operating ranges of from  $\frac{1}{4}$  to 6 in. is introduced. They are 2  $\frac{9}{16}$  in. long, have a



$\frac{7}{16}$  in. diameter, and have threaded bases for easy installation. The light-source has two apertures and can be used to illuminate two photocell units, if desired. Standard Instrument.

# new!

## All-Transistor Color Bar Generator

*Rugged, solid-state Seco 900 puts you on top of the booming Color-TV Service Market... with the finest unit in the field!*

Setting new standards in both engineering and design, Seco's new Model 900 will outperform every other color bar generator on the market!\* A true precision instrument that offers brightest dots and purest color quality, the 900 takes the "guess" out of color TV-servicing, makes possible big new profits in the booming color service field!

*Only the Seco 900 offers all of these features:*

- Single Burst Dots are bright—"rock" solid... will not move
- Purest Color Quality—10 completely different color bars... positive graduation from color to color
- Single Trace Horizontal Lines—are bright, sharp... begin and end during horizontal retrace
- No Blinking On Cross Hatch—at any intensity level
- All Transistor Circuit—for highest reliability and instant operation with no warm-up
- Outstanding Stability—Zener regulated power supply... crystal controlled oscillators!



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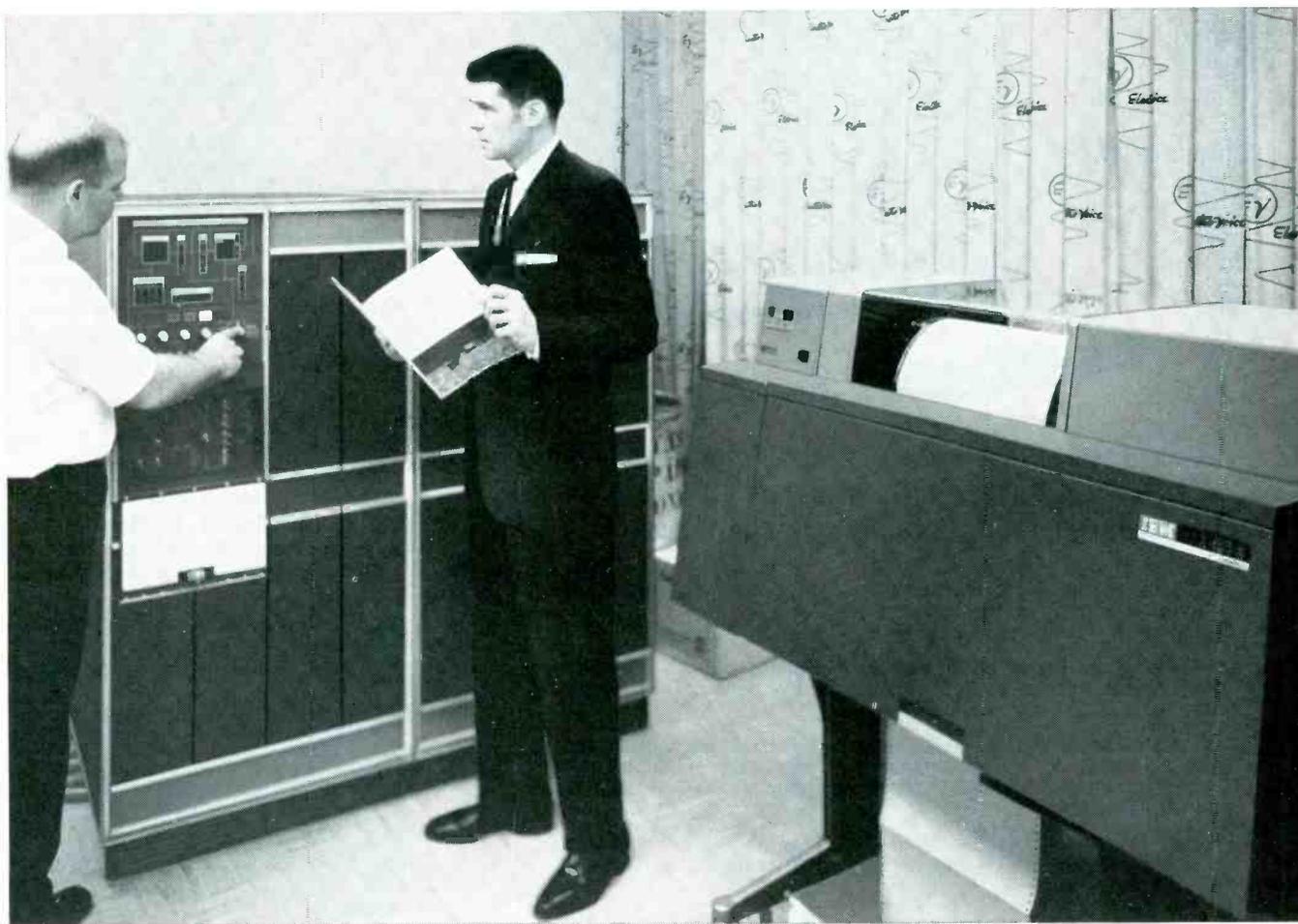
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**PS 127 5" WIDE BAND  
OSCILLOSCOPE**

**Technicians everywhere are talking about the PS127 5" Wide Band Oscilloscope. Try one and you, too, will send us comments like these—**

"So easy to use! With my Sencore scope I can read high or low frequency signals without band switching. As easy to use as a voltmeter."—R. L., Portland, Ore.

"I've only had my PS127 a couple of months, but it's more than paid for itself already with the extra jobs I've been able to handle."—S. O., New Orleans, La.

"With the direct peak-to-peak readout I can compare voltage readings to those on the schematic without wasting valuable time setting up my scope with comparison voltages."—J. M. F., Plymouth, Michigan.

"Those Sencore exclusives really sold me, like the extra 500KC Horizontal Sweep range and the free high voltage probe."—D. N., Brooklyn, N.Y.

You'd expect a wide band scope of this quality to cost at least double."—W. L., Chicago, Ill.

"With the PS127, I find I can trouble-shoot those tough ones twice as fast as before—especially color TV."—F. C., Burlingame, Calif.

"Once I compared the specs, I knew Sencore had the best buy in scopes. We now have three PS127's in our shop."—J. S., Ft. Lauderdale, Fla.

#### SPECIFICATIONS

Vert. Freq. Resp. 10 CPS to 4.5 MC  $\pm$  1 db, — 3 db @ 6.2 MC • Rise Time .055 Microseconds • Vert. Sens. .017 Volts RMS/inch • Horiz. Freq. Resp. 10 CPS to 650 KC • Horiz. Sens. .6 Volts RMS/inch • Horiz. Sweep Ranges (10% overlap) 5 to 50 CPS, 50 to 500 CPS, 500 CPS to 5 KC, 5 to 50 KC, 50 to 500 KC • Input Impedance 2.7 megohms shunted by 99 MMF, 27 megohms shunted by 9 MMF thru low-cap. jack • High Voltage Probe 5000 Volts Max. • Dimensions 12"x9"x15½", Wt. 25 lbs. • Price Complete \$189.50



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## NEW PRODUCTS

### Tuner Cleaner 729

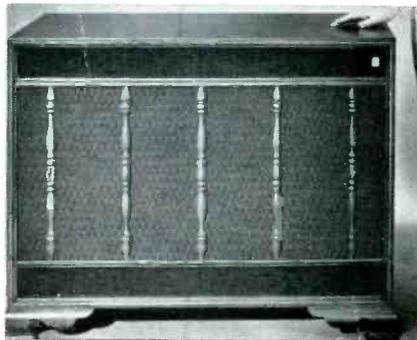
A tuner designed for color TV tuners is announced. It has low surface tension and is guaranteed not to



contain petroleum products, alcohol, carbon tet or chlorinated hydrocarbons which will harm some plastics used in tuners and will cause harmonic oscillations and drifts. Colman.

### Speaker System 730

A speaker system designed for high-fidelity audio and cabinet styling is introduced. It consists of a seven-speaker four-way system (four 15in. woofers, a compression-driver



horn loaded midrange, a compression-driver horn super-tweeter and a direct radiating ultra-tweeter) for reproduction of the range rated from 15Hz to 25kHz. The crossover points are at 500Hz, 4kHz and 10kHz. Impedance 8 $\Omega$ . Power rating 100w. Jensen.

For more information on these

NEW PRODUCTS

See pages 115 & 116

READERS SERVICE

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## "has 'em both"



MODEL #65-1 \$29<sup>95</sup> list



MODEL #65-2 \$39<sup>95</sup> list

## BOOSTER COUPLERS IN 300 OR 75 OHM For Deluxe Home & Commercial Use

Finco's famous 2-tube, 4-set VHF-TV OR FM Distribution Amplifier is now available for 75 OHM CO-AX or 300 OHM operation.

Price? You can't beat it! Rugged quality? Finco's got it! Performance? Finco challenges 'em all!

Equip either model with Finco low-loss splitters (#3001 or #3003) and you can drive up to 16 sets in a master antenna system!

### FINCO MODEL #65-1 \$29.95 list

#### Outstanding Features:

- 350,000 microvolts maximum input with +8dB to each output • Maximum signal output of .85 volts in each of 4 outputs • Low noise 6HA5 premium tubes • One 300 ohm input — 4 300 ohm outputs • Silicone diode rectifier for dependability • Flat response —  $\pm 1/4$  db per 6 mc channel • Ventilated perforated steel cabinet  $6\frac{1}{8} \times 3\frac{1}{8} \times 3\frac{1}{8}$ " • Metal enclosed to eliminate shock hazard — easy access for servicing • Easy mounting and connecting • All fittings & brackets supplied • UL listed AC cord—117 volts, 60 cycles • 100% test for all electrical characteristics

### FINCO MODEL #65-2 \$39.95 list

#### Outstanding Features:

- 400,000 microvolts maximum input with +6dB to each output • 200,000 microvolt input — 1 volt output per band • Low noise 6HA5 premium tubes • One 75 ohm input — 4 75 ohm outputs • Most compatible "F" type input and output fixtures • Ultra-flat frequency response and complete RF isolation • Ventilated perforated steel cabinet  $6\frac{1}{8} \times 3\frac{1}{8} \times 3\frac{1}{8}$ " • Metal enclosed to eliminate shock hazard — easy access for servicing • Easy mounting and connecting • All fittings & brackets supplied • UL listed AC cord —117 volts, 60 cycles • 100% test for all electrical characteristics



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When it's a Quam speaker—you sell it and forget it. Quam speakers are built to give long, trouble-free performance. Return time would eat up your profit—but Quam speakers don't come back!

Quam's factory is a manufacturing plant, not merely an assembly shop. By making our own speaker parts, we can guarantee the quality of the materials that go into them. Our voice coils are centered precisely; each and every speaker is thoroughly tested; the product you get meets the standards we have insisted on for almost forty years.

Quam Quality Line speakers are enameled in gold—and while the color has no effect on performance characteristics, it symbolizes the quality and reliability that's built into every Quam speaker.

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## BOOK REVIEWS

**HANDBOOK OF RELAY SWITCHING TECHNIQUE.** By J. Th. Appels and B. H. Geels. Published by Philips Technical Library, 322 pages, hard cover.

The windings, magnetic flux and time constants of relay coils are described in detail along with various types of switching components activated by coils. The book discusses the nature of semiconductor materials and how they are used as diodes and transistors for switching circuits. The major portion of the book describes these components being used in a wide variety of circuits designed for memories of decisions, switching algebra, number combinations, binary code, counting, decoding, checking, locking, measuring potential changes, registering and identification. Functions of these many circuits are explained by circuit diagrams, tables, equations and sample problems. The book is printed in The Netherlands and uses some symbols and terminology unfamiliar to most readers on this continent. Since these are explained in chapter 14, they should pose no problem. This book should be of interest to anyone with a background in higher algebra, interested in switches used in telephone exchanges, accounting machines and digital computers.

**SERVICING TRANSISTOR TV.** By Robert G. Middleton. Published by Howard W. Sams and Co., 224 pages, soft cover. \$3.95.

Transistors must be treated with greater caution than tubes when servicing consumer electronic equipment. The book discusses reasons for these necessary precautions when servicing TV sets. Graphs showing transistor characteristics are used to help explain the design of the various TV circuits. With the aid of pictures showing waveforms and CRT images, many circuit troubles are discussed. Each section of a TV set is described in detail as a separate chapter. The book may prove valuable to both the experienced technician and the apprentice desirous of expanding his electronics background.

**DIGITAL COMPUTER FUNDAMENTALS.** By Thomas C. Bartec. Published by McGraw-Hill, 402 pages, hard cover. \$6.95.

The revised and updated edition covers a brief history of computers

and their applications. It discusses computer languages, the binary system, Boolean algebra, positive and negative binary-coded-decimal numbers, basic transistor computer circuits, logic and memory circuits. This information is applied to input-output equipment, error detecting and correcting codes and specific computers. The theory is developed in such a manner that the reader need only have a basic understanding of algebra.

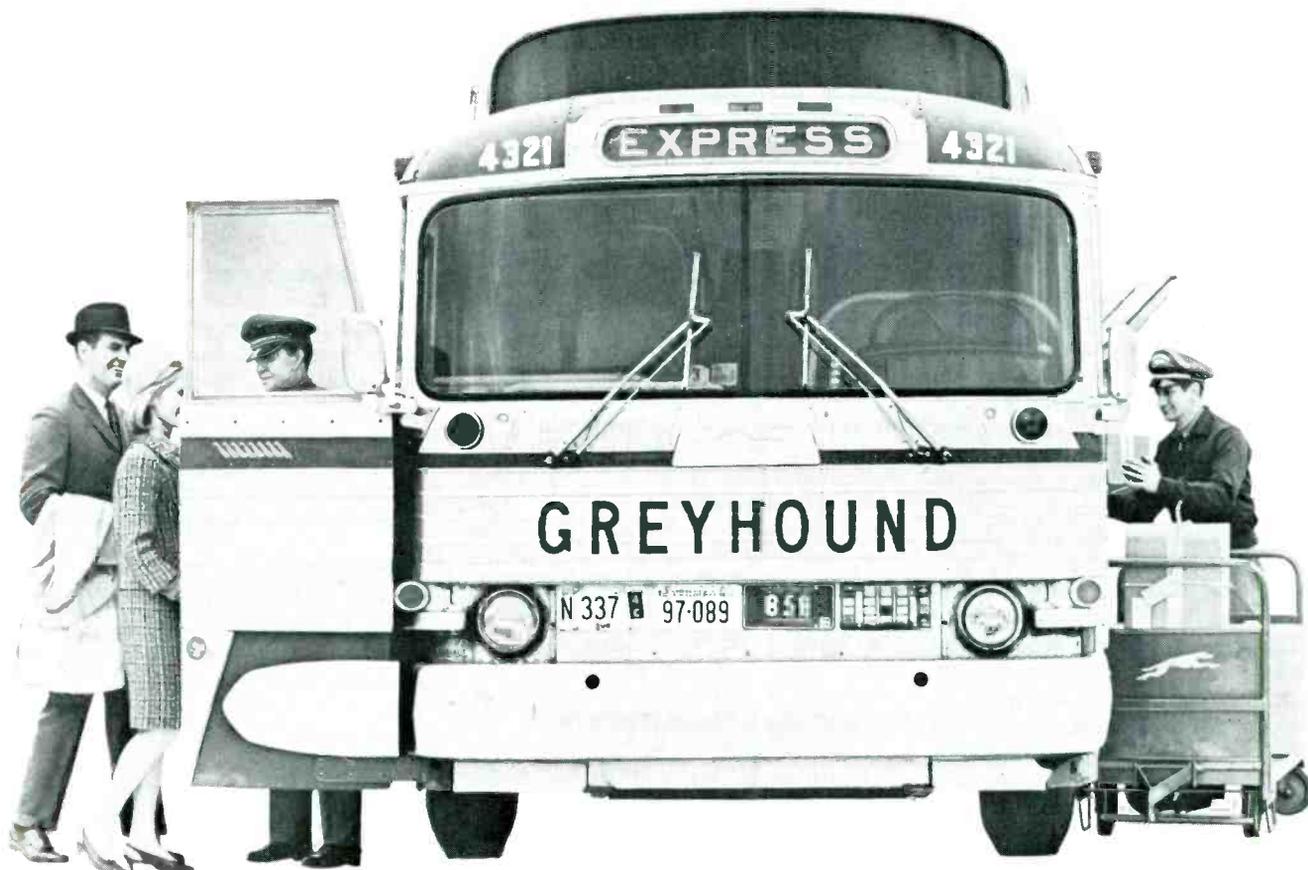
**CATV SYSTEM MANAGEMENT & OPERATION.** By Robert B. Cooper, Jr. Published by Tabo Books, 256 pages, soft cover. \$12.95

This volume contains an interesting history of Community Antenna TV — its technical development and legal problems. It describes franchises, construction techniques, joint pole agreements, antenna site surveys, plant construction techniques, choosing equipment, financing, promotion, expenses, public relations and future trends. The appendix contains a sample ordinance, agreement, construction specifications, cash flow chart and contract. This book would be of interest to anyone who is thinking of going into the CATV business.

**ELECTRONIC TROUBLESHOOTING.** By Philco Technical Institute. Published by Prentice-Hall, 276 pages, hard cover. \$12.50.

Troubleshooting procedures are presented in a programmed form with a question following each new concept. By turning to the page corresponding to the answer selected, the reader is either advised why his choice was not correct or that the correct choice has been made. He then continues to read the text and a new question on the page that contained the correct answer. The material is not presented in a page number sequence and the reader finds himself paging back and forth through the book as he selects the correct answers and reads additional material. The book is based on the application of a troubleshooting procedure to many types of electronic equipment. The procedure includes selecting the defective functional units by their symptoms, locating faulty circuits with test instruments, giving that circuit a visual inspection or checking the active component and finally checking waveforms, voltages, resistances and continuities to pinpoint the trouble. The book is not intended as a resource book and cannot be skimmed. It may be of value to technicians who wish to expand their troubleshooting techniques.

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PITTSBURGH— CLEVELAND	11	1 hr. 50 mins.	1.80	2.05	2.40
INDIANAPOLIS— CHICAGO	10	4 hrs. 0 mins.	1.90	2.20	2.55

\*Other low rates up to 100 lbs. Lot shipments, too.



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

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**PROFESSIONAL ENGINEER'S EXAMINATION — QUESTIONS AND ANSWERS.** By William S. LaLonde, Jr. Published by McGraw-Hill Book Co., 589 pages, hard cover. \$9.95.

This volume is a revised comprehensive guide to assist candidates for a professional engineer or engineer-in-training license in the various engineering fields including land surveying. The book discusses prerequisites for registration and the various registration boards that do the license testing. The major portion of the book contains sample questions that may be encountered during such testing. These questions are arranged in groups according to both general subjects and specific licenses. One portion of the book provides answers to the questions. In solving problems, the author assumes that readers already possess fundamental knowledge in the fields tested. Suggested study text books are listed in the appendix in the same sequence as sample tests. A list of standard symbols is also included. This book may help those who have already had sufficient

training in engineering and are preparing to obtain FCC commercial operators license.

**PRINCIPLES OF ELECTRONIC OSCILLATORS.** Written and published by Techpress, 84 pages, soft cover. \$1.95

Very detailed descriptions of an Armstrong oscillator are used to develop the reader's understanding of oscillator theory. It would require calculus to develop some of the equations used and, therefore, they are merely presented in their simplified form for circuit application. The book discusses grid bias used to improve oscillator efficiency from class A to class C, the effect a resistor in series with the capacitor has on time constant and the function of grid-leak bias circuits. Other oscillator types are described and compared. We feel the cover misrepresents the book by showing a transistor circuit and saying, "Full and complete explanations on all types of circuits," while only electron tube oscillator circuits are discussed. Though some of the theory would apply to transistor circuits, the reader should remember that tube circuits are generally of low impedance and forward biased.

### Crystals 400

An 8-page bulletin describes a line of crystals for aircraft, marine, industrial, diathermy and frequency standard use. Also described are transistor oscillators, VHF converters, and a CB crystal activity checker. Peterson.

### Microphones and Speakers 401

This 12-page catalog includes technical data, a photograph and price for each item in a line of microphones and speakers. Electro-Voice.

### Rear Seat Speaker Kits 402

A bulletin describing two lines of automobile rear deck and rear seat loudspeaker kits is available. Jensen.

### TV/FM Antennas 403

The characteristics of five exponential antennas for TV and FM reception are described in a four-page bulletin. GC Electronics.

### Speakers 404

An assortment of speakers, line transformers and enclosures are described in this 12-page catalog. Utah.

### Rectifiers 405

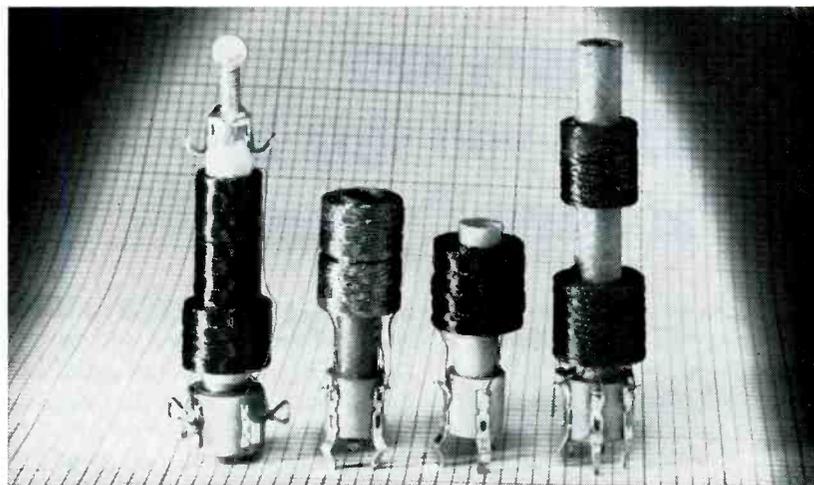
A 4-page catalog lists silicon and selenium rectifiers for replacement applications and tube replacement silicon rectifiers. In addition to carrying detailed information on standard replacement rectifier devices, the catalog lists many of the newer rectifier replacements designed especially for color TV. Sarkes.

### Dry-Film Lubricant 406

A four page pamphlet tells when, where and how to use a dry-film lubricant, mold release and anti-stock agent. These films are aerosol-spray particles of tetrafluoroethylene. Chemplast.

### Horizontal Transformers 407

Exact replacement horizontal and high voltage output transformers for various models of Admiral TV sets are listed in two single sheet bulletins. Merit.



### Exact Replacement Linearity Coils for More than 25 Color TV Manufacturers

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

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**Metered Knobs 408**

A four-page bulletin describes metered knobs for variable transformers. The voltmeter remains stationary inside the knob rim and does not turn with the knob. Superior.

**Variable Transformer 409**

A two-page sheet describes four variable line transformers. These transformers are rated from 1.75 to 18.0a. Staco Inc.

**Two-Way Radio 410**

The ways in which a two way radio system increases productivity, reduces dead mileage and backtracking are among those told in a 12-page booklet. The necessary initial steps are explained to the businessman contemplating two-way radio. Motorola.

**Electronic Catalog 411**

A 48-page catalog contains pictures and specifications for an assortment of 250 products including test instruments, stereo Hi Fi components, CB transceivers and ham equipment in assembled and kit form. EICO.

**Test Equipment 412**

Both an 8- and 12-page catalog list an assortment of professional test

equipment. Some of the instruments included are a color-TV analyst, radio analyst, wide-band oscilloscope, signal generator, tube checker and volt - ohm - milliammeter. Dynascan Corp.

**Speakers/Microphone Stands 413**

A 10-page catalog gives specifications and application information on a line of public address speakers, microphone stands, baffles and other accessories. Indoor and outdoor paging and talkback speakers are described. Atlas.

**Portable Intercom 414**

A transistorized two-channel portable intercom that can be plugged into any ac electrical outlet is described in a 4-color bulletin. FASCO.

**Spray Cleaning 415**

Application and technical data for a spray cleaner, including lists of properties and effects on various materials plus toxicity and Kauri-Butanol tables are included in this bulletin. Colman.

**Nutdriver Sets 416**

Three color-coded nutdriver sets in molded plastic trays are described in an illustrated, four-color bulletin. Xcelite.

**Two-Way Radios 417**

A 12-page folder contains pictures and descriptions for a line of transistorized portable FM two-way radios. Motorola.

**Tape Player 418**

A compatible four- and eight-track cartridge car stereo-tape player with electronic program selection is described in this sheet. Ranger.

**Spray Lubricants 419**

A 4-page pamphlet discusses spray film products for aerosol-spray applied dispersions of micron-size particles of tetrafluoroethylene. It tells when, where and how to use this dry-film lubricant, mold release and anti-stick agent. Chemplast.

**Hi Fi Products 420**

A colorful folder contains photographs and descriptions for a line of component speakers and speaker systems plus some solid-state electronic components. Electro-Voice.

**Overload Protected VOM 421**

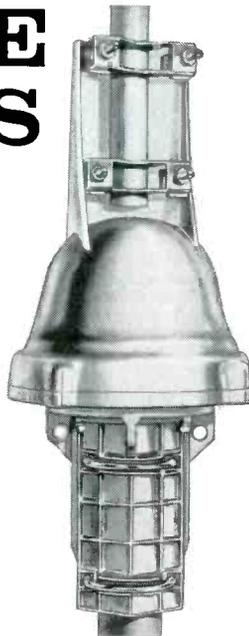
A data sheet describes a VOM having a transistorized switching circuit to guard against accidental burn-outs, bent pointers and provide overload protection safeguarding resistors, shunts and coils. Triplet.

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## Zenith's new heavy-duty rotor

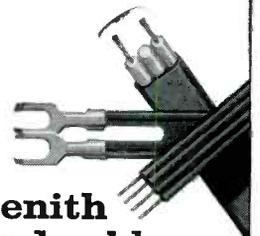
can turn a 150-lb. antenna in a complete circle in only 45 seconds! Rugged, dependable Zenith quality throughout.

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*continued from page 60*

**CB Transceiver 422**

Specifications and special features of a 5-channel solid-state CB transceiver are listed in this bulletin. B&K.

**Speakers 423**

A 24-page, two-color catalog describes a complete line of speakers — from low power to superpower and from high fidelity to maximum efficiency types. Jensen.

**Capacitors 424**

A 48-page service-designed catalog and replacement guide for entertainment capacitors contains a catalog section on aluminum tubular and twist-prong electrolytic capacitors with a special section on paper-mylar capacitors. There are 29 pages in the cross reference replacement guide section for TV and auto radio capacitor replacements plus an 8-page competitive cross-reference. G-E.

**Microphones 425**

A 34-page catalog provides detailed specifications for a professional line of microphones. Electro-Voice.

The AGC tubes were checked and substituted. A quick voltage check on these circuits showed everything normal. Since the AGC circuits checked good, we didn't know what to think at this point. Starting at the tuner, all voltages and tubes checked good, also the tubes were substituted with ones known to be good.

Next, the IF stages were checked. A funny thing happened when the 2nd IF tube was pulled from its socket. Before the filament of the new 6GM6 IF tube heated, the VHF reception was good. Then it went dead again.

The voltages on the 6GM6 tube checked very close to specs. A drop of 20v on the cathode was the only discrepancy. An ohmmeter check showed a 12K reading across capacitor C414. This threw a little light on the trouble. Of course, this reading could be feeding back through the B+ circuits and still be OK. A drop of voltage on the cathode showed leakage, but a hunch told

us that the trouble was definitely in this IF section.

One end of capacitor C314 was disconnected and we "lucked out." The 200  $\mu$ f capacitor had a 12K leakage. Although this trouble is not frequent, it just goes to show that sometimes hunches do pay off (see Fig. 3).

**5. Intermittent Color**

The B/W was good on an RCA CTC15 chassis but when the color contrast control was advanced, only a green picture appeared on the screen. Sometimes a normal color picture would come on after the set operated for an hour. At other times, the color picture would stay on for weeks without trouble.

The set was brought to the shop and the chassis plugged into the mock-up color unit. For three days the chassis performed perfectly on color programs. Finally, the receiver started to act up. When a color picture was being broadcast, only a green tint was seen, with red and blue missing.

This made one think that the trouble was in the demodulator or XYZ amplifier stages. But if this guess was true, the tint of the B/W picture would have been too green. This wasn't the case—the B/W picture was good.

From the picture symptoms, the trouble had to be in color oscillator or reactance circuits. A quick voltage check was made on the 6GH8 oscillator tube. Practically all of the voltages were off compared to values specified on the schematic. The oscillator grid voltage would vary from -2v to 0.5v.

Another new oscillator tube was plugged in but the voltage remained the same. A low grid voltage indicated that the color oscillator was just barely oscillating. The normal potential is -6v. Replacing the 3.58MHz crystal solved the problem (see Fig. 4).

**6. White Horizontal Line**

Most horizontal white lines are caused by a collapse of the vertical amplifier tube. An RCA CTC16 chassis was an exception, however. The 6GF7 vertical tube was substituted but did not help and the chassis had to be pulled.

The plate potential on pin 6 measured 47v. The trouble could have been a bad vertical output trans-

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former, shorted bypass capacitor or a filter capacitor. Even a shorted 6GF7 vertical tube can damage the vertical output transformer.

A resistance check was made from pin 6 of the 6GF7 to ground. At this point the resistance was 290Ω. One end of the 0.001 bypass capacitor was clipped from the circuit. Switching the ohmmeter to the megohm scale, the capacitor was checked and showed that it was leaking.

This capacitor was replaced with another 0.001μf rated at 2 kv. The receiver was switched on again and we still had a horizontal white line! A voltage check on the red lead of the vertical output transformer showed low voltage on this junction. The casing of resistor 162 was cracked indicating that it had been quite warm at one time. The voltage dropping resistor had increased in resistance and when it was replaced we obtained a good raster (see Fig. 5).

Be sure and make a few more checks in the vertical section. Make sure the 6GF7 tube is good and doesn't show element shorts. Measure the supply and vertical transformer voltages and see that

they are as shown on the receiver schematic. Check voltage dropping resistors. An open or dried up filter capacitor, C136A, can also cause vertical bunching and vertical "crawling."

#### 7. Poor Focus — Intermittent Focus

We had an Admiral 3G11 chassis that would go out of focus about every three days. The focus control setting was very critical and would only focus at one spot. An ohmmeter check showed a R737, a 15M focus control, would change at the 10M point. The reading would jump from 10 to 15M with only a slight movement of the control shaft (see Fig. 6).

The focus control was replaced. These high-megohm controls are generally difficult to find locally and must come from the Admiral distributor. Replace the high-voltage wax over the metal holding-tabs of the focus control. This control is mounted on a fiber board.

Also check the 1V2 focus rectifier tube for shorts and quality. Make an ohmmeter check of the 47M high-voltage ribbon resistor to ground. A change in resistance of

R138 will also affect the focus range.

#### 8. Poor Color — Poor Picture — Low Brightness

Every now and then you work on a color TV receiver that's messed up in a number of ways. This particular receiver was out of focus, had poor brightness and a poor B/W picture. Even the color programs were blurry.

The tint of the B/W picture was a little on the green or pinkish side and changed with the brightness control. We began to wonder who messed up all the adjustment controls. But a quick check of the CRT socket solved all these problems.

In the last year we have replaced at least a dozen CRT sockets. Some color receivers were not a year old. The socket contacts had turned green and the molded sockets showed signs of high voltage arc-over. Replace the socket and cable with a new one. Do not splice into the CRT wiring cables.

#### 9. No Raster — No High Voltage

In a new RCA CTC17X chassis there was no brightness, no raster

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but good sound. Right away we went to the high voltage section and replaced the 6JE6, 6DW4 damper, 6BK4 shunt regulator, 3A3 hi-voltage rectifier and the 6FQ7 horizontal oscillator tube. Still no high voltage so we dug deeper into the 25in. chassis.

After the set was switched on for three minutes, the plate of the 6JE6 tube got red hot. The screen voltage dropped from 325 to 168v. The grid potential was -56v, which indicated good horizontal drive.

The flyback transformer had a lot of wax melted down from it. A VOM check indicated poor boost voltages. Be real careful here as these potentials are quite high: 850 and 1150v. CR101, a boost rectifier, was substituted but still no high voltage.

The trouble "smelled" like a shorted hi-voltage transformer, deflection yoke or trouble in the damper circuits. Since the hi-voltage transformer, T102, and the deflection yoke represented a lot of work, we checked into the damper circuit first.

Lucky enough, the trouble was in the damper circuit. An ohmmeter

check showed that C109B was shorted. We have replaced several of these shorted or leaking capacitors since. C109A, a 0.33 $\mu$ f capacitor, will cause the same trouble (see Fig. 7).

#### 10. Too Much Hi-Voltage

A technician brought in an Admiral 25VB6 color chassis that had 30kv on the CRT instead of 25kv. Generally, the high voltage is too low instead of being 5kv too high. Of course, we had hi-voltage arc-over and "spitting." Also, the 6BK4 didn't last very long.

A burned resistor, R145, that's tied to one leg of the shunt regulator tube, tipped off the possible trouble. Checking the schematic we found the 275v supply to this circuit was only 15v.

The ohmmeter showed a 150 $\Omega$  leakage from heater to ground. Looking at the schematic, we found only the shunt regulator tube, CRT and the 2nd picture IF amplifier were being supplied by this heater circuit. It was possible that the heater winding in the power transformer was shorting inside to ground. The heater wires were cut

loose and the short was traced to the 6GM6 IF picture amplifier tube (circuit). Capacitor G310 caused this trouble.

If you keep a "symptom" file and detailed records of all the color TV problems you run into, the time will come when you will find yourself confronted with the same problems again and again and the records in this file will help you locate the troubles fast. ■

#### PEACOCK PARADE . . .

*continued from page 57*

the field. With more sets in warranty, because of the heavy selling program, it is not possible to make the shop pay its own way.

This year, warranty calls have been requiring 60 percent of the shop's total service. In 1965, the shop was carrying in-warranty service on a half-million dollars of sales. Though 2¼ percent of the gross sales is allocated to cover in-warranty, Mr. Carmichael says the ends still do not quite meet.

"Our objective is to build the la-

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bor income of the shop to as nearly the labor salaries paid as we can, and we are close to reaching that objective," he says. "Fundamentally, there are no more, perhaps even fewer, customer problems on color TV than on B/W.

"In general, a requirement on color TV is more careful checking for color information in the response area where you have hue changes," Mr. Carmichael notes. "Another basic problem of the booming market is cooking the sets in the shop. We find it requires a half day minimum to be sure all the bugs are out.

"We work closely with our manufacturer to keep our service men informed of all the latest developments in electronics. Since there is no fundamental difference, other than new equipment requirements and a more careful shop technique in servicing color, the problem of shop efficiency is mostly one of management.

Mr. Carmichael says, "A good B/W TV technician with good equipment, and some attention by management to seeing that all the necessary knowledge is available

to him, has no more problems servicing color than B/W TV sets.

### House Calls

Proper routing of calls before service technicians move out for the day is essential for an efficient operation. To see that calls are routed properly, Mr. Carmichael is in the shop every work day 15 minutes before technicians' work day begins.

Service calls are routed on a mimeographed route sheet (Fig. 4) punched at the top to go on the route spindle. The two outside service men are expected to make a minimum of 10 calls per day on in-warranty and pay calls. Periodically they phone in to see if there are any nearby calls to make. If there are, these are added to the route sheet.

The service call charge is \$9.50 for the first half-hour on color TV, \$7 per hour thereafter, and \$7.50 on B/W TV and stereo for the first half-hour, \$7 thereafter—plus parts when the set is out of warranty. A triplicate service order (Fig. 5) is written up on each call. This form has been the most efficient one for the purpose, Mr. Carmichael says.

A large roll-down wall map covering Seattle and suburbs hangs above the service shop desk. This map is always referred to in laying out the route run so that service technicians don't have to backtrack.

The service area is broken down into three sections—the metropolitan area and two outlying areas in opposite directions. The areas are roughly 25 miles long and 15 miles wide. The routes are scheduled to have a technician in each area twice weekly. Technicians also take some calls in the metropolitan area.

To cut down on callbacks, Mr. Carmichael finds it advisable to have all service calls referred directly to him rather than to the shop. A telephone extension is located on the sales floor so that he can even take calls from there.

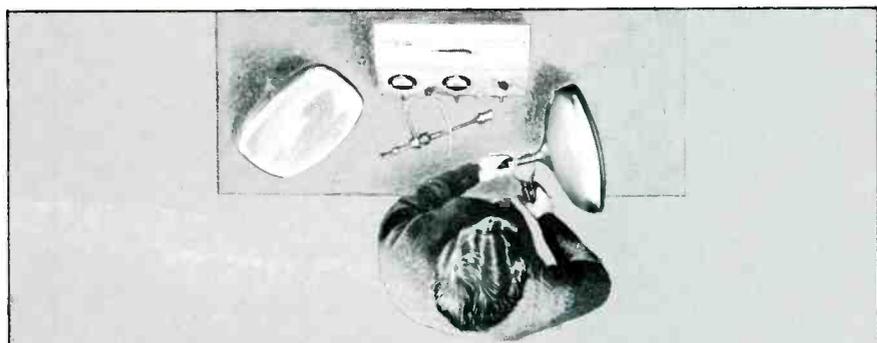
Since he takes all service calls unless he is out of the building, this centers the responsibility, and enables him to get a description of the problem—sometimes solving it right on the telephone without sending a man out. This system takes the strain off the service shop and has the merit of keeping management in touch with the customers. And it pleases the customers who like to talk with an identifiable person, not to an anonymous shop. And they know the call will get attention.

With this system Mr. Carmichael is in a position where he can "train" customers to phone in by 9 a.m. if they wish to cancel a service call—cutting down the cases of finding no one at home.

Mr. Carmichael does not believe in service contracts, particularly on color TV sets. He feels too much paper work is involved to make it profitable, and customers would have to pay at least \$50 yearly to make the contract worthwhile. "Customers can buy a lot of service for that!" he emphasizes.

"The future in all metropolitan areas is in color TV," Mr. Carmichael concludes. "The only B/W sets we're selling are portables. In Seattle, we now have five stations broadcasting in color.

"Our total operation is geared to reaching the total color market. We're spending plenty of money now to reach that market because now is the best time to make customers for the future. Both our sales and our service are completely geared to color," he says. ■



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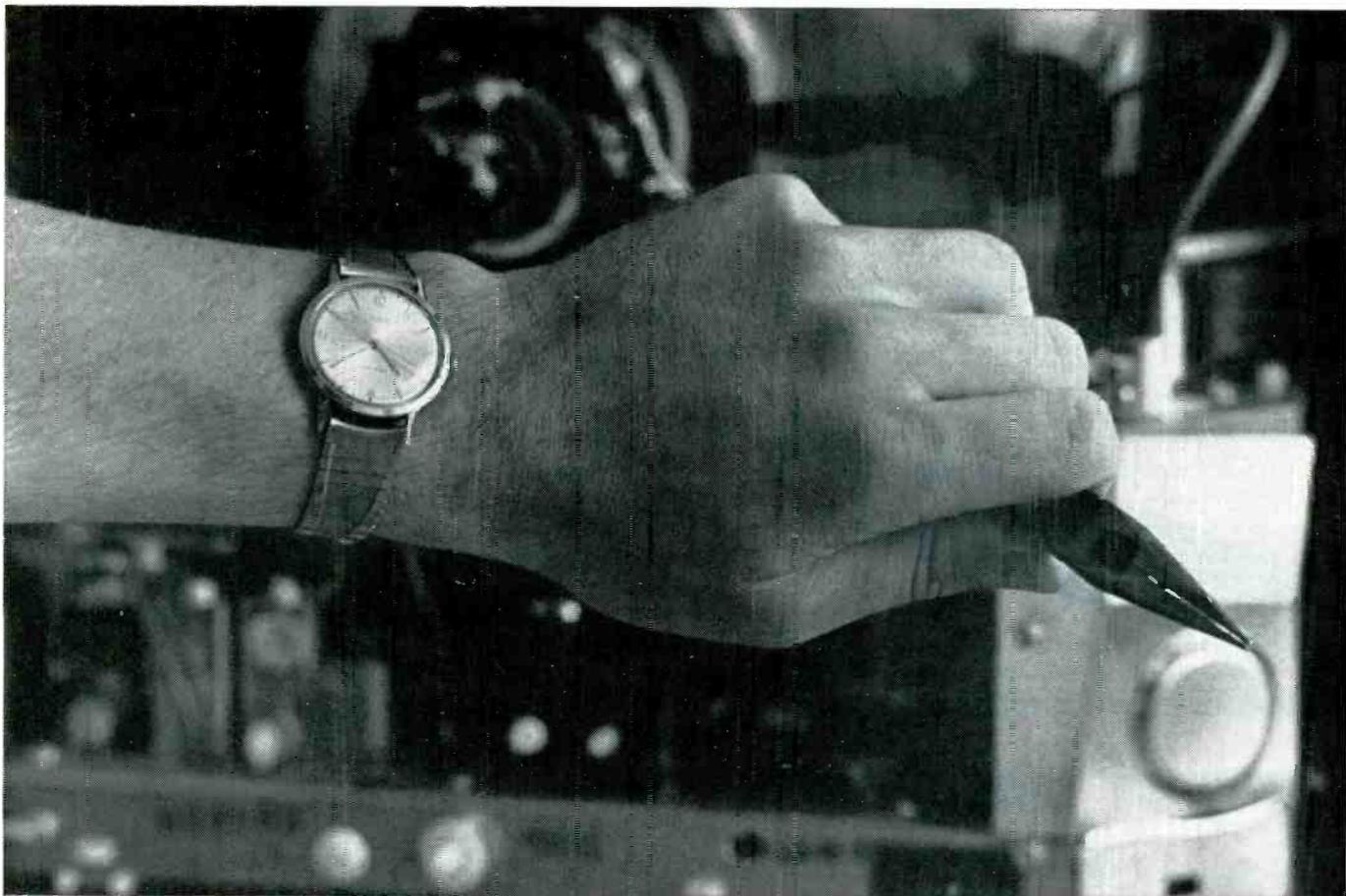
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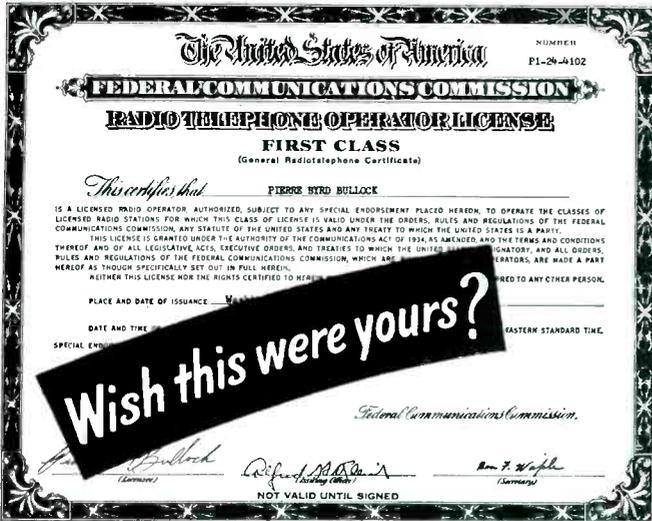


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## SEMICONDUCTORS...

continued from page 66

Although the collector current shown in Fig. 7 has remained nearly the same as that in Fig. 6, the collector-to-emitter voltage has become smaller. This is despite the fact that the dc collector-to-emitter voltage is larger at the Q point in Fig. 7 than in Fig. 6.

### Determining A Transistor's Base Voltage

When the voltage source ( $V_{CC}$ ) in Fig. 2 is varied so that the collector-to-emitter voltage ( $V_{CE}$ ) remains constant during changes of collector current ( $I_C$ ), a graph can be made to show the relationship between the base current ( $I_B$ ) and the base-to-emitter voltage ( $V_{BE}$ ). The graph in Fig. 8 shows this relationship in the NPN transistor when the collector-to-emitter voltage is held at 2v. We can see from the graph that this relationship changes with temperature. We will deal with the transistor's characteristics at room temperature ( $25^\circ\text{C}$ ).

Since we know the base-to-emitter voltage and the corresponding base current, we can calculate the transistor's effective base-to-emitter resistance ( $r_b$ ) for each point along the curve.

$$(r_b = \frac{V_{BE}}{I_B})$$

This resistance ranges from 230K at 0.23v and 75K at 0.3 to 11  $\frac{2}{3}$ K at 0.7v.

From the graph we can see that the transistor's effective base-to-emitter resistance ( $r_b$ ) changes with the base-to-emitter voltage as well as with temperature.

When the base is conducting  $22.5\mu\text{a}$  this transistor has an effective base-to-emitter resistance ( $r_b$ ) of about 22K with a drop of about 0.5v. We can see from the curve that at  $17.5\mu\text{a}$  the drop is 0.46v while at  $27.5\mu\text{a}$  it is 0.53v. When the dc base current is  $22.5\mu\text{a}$ , a  $10\mu\text{a}$  base current signal corresponds to a 0.07v base-to-emitter voltage input signal. When the transistor has the same load line as shown in Fig. 6, this signal varies the collector-to-emitter output voltage from 1.0v to 2.8v. With this information we can calculate the voltage gain ( $A_v$ ) of the circuit.

$$(A_v = \frac{V_{CE}}{V_{BE}} = \frac{1.8v}{0.07v} = 25.9)$$

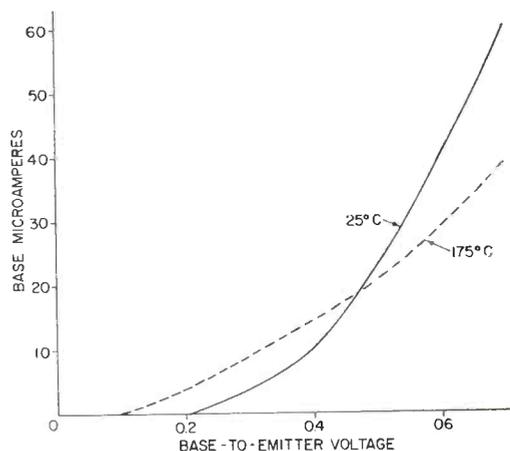
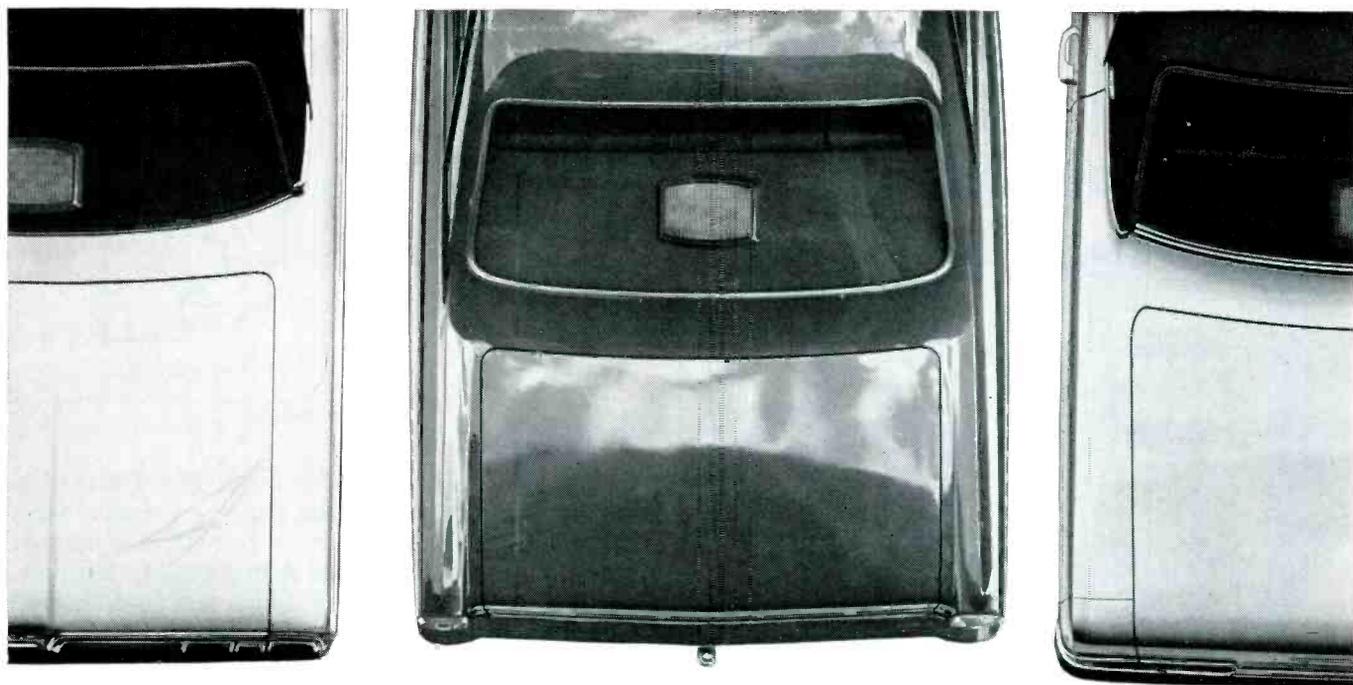


Fig. 8—There is a varying relationship between base current and base bias.



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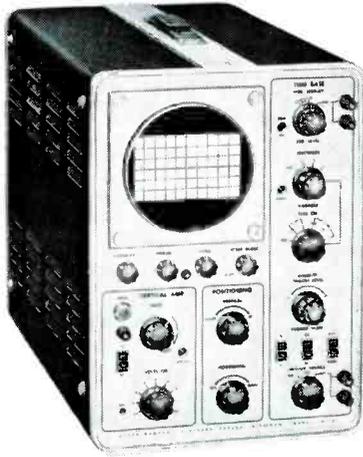
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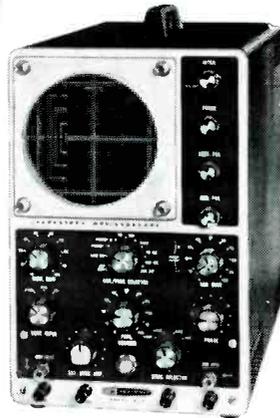
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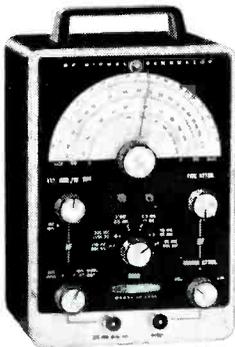
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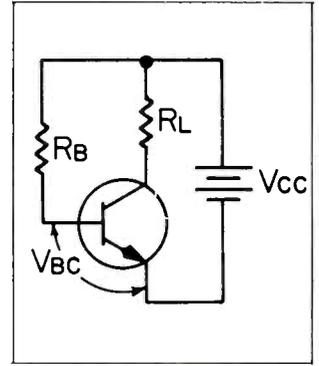


Fig. 9—The transistor is biased by a base resistor.

## Calculating Bias Circuits

The base resistor ( $R_B$ ) shown in Fig. 9 is used to bias the transistor. The circuit requires a resistor ( $R_B$ ) that will permit a  $22.5\mu\text{a}$  base current ( $I_B$ ) to pass through it from a 6v voltage source ( $V_{CC}$ ). Since the base is to have a 0.5v forward bias, a 5.5v drop must be developed across the base resistor.

$$(I_B R_B = V_{CC} - V_{BE})$$

$$R_B = \frac{6.0\text{v} - 0.5}{22.5\mu\text{a}} = 267\text{K.}$$

A previous article indicated that the transistor's base could be biased more stably with a voltage divider (Fig. 10). An infinite combination of values can be used for resistors  $R_B$  and  $R_1$  that make up the voltage divider. If  $R_1$  is too large however, the current flowing through  $R_B$  will be primarily dependent on the base current ( $I_B$ ) and the circuit will be less stable, but if  $R_1$  is too small it will short the incoming signal and reduce the gain.

If we let  $R_1 = 35\text{K}$ , it must conduct  $14.3\mu\text{a}$  to develop a 0.5v base-to-emitter voltage.

$$(I_1 = \frac{V_{BE}}{R_1} = \frac{0.5\text{v}}{35\text{K}} = 14.3\mu\text{a})$$

The current flowing through the base resistor ( $R_B$ ) consists of the base current ( $I_B$ ) plus the current ( $I_1$ ) that flows through the other resistor in the voltage divider ( $R_1$ ). Since there is to be a 0.5v base-to-emitter voltage, a 5.5v drop must be developed across the base resistor.

$$[(I_B + I_1) R_B = V_{CC} - V_{BE}]$$

$$R_B = \frac{6.0\text{v} - 0.5\text{v}}{22.5\mu\text{a} + 14.3\mu\text{a}} = \frac{5.5\text{v}}{36.8\mu\text{a}} = 150\text{K.}$$

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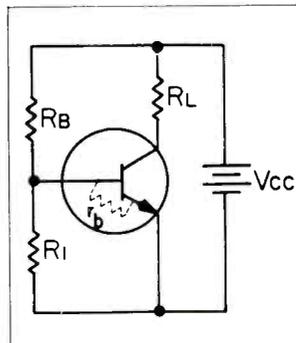


Fig. 10—Better stabilization is obtained with a voltage divider.

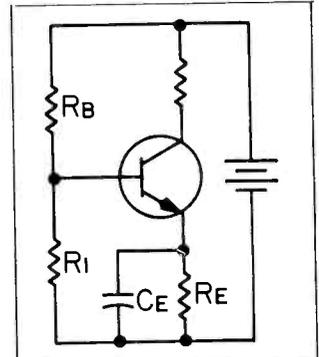


Fig. 11—A negative feedback circuit is used for additional stabilization.

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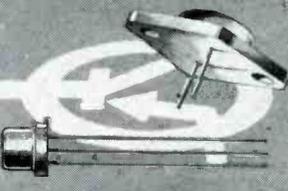
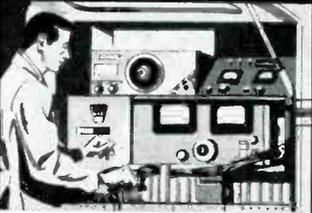
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with the same code number have exactly the same characteristics. Manufacturers cannot afford to design each circuit manufactured to match the transistor used. Instead they sacrifice gain for the economy of being able to exchange transistors. This is done by using negative feedback circuits. A typical negative feedback circuit is shown in Fig. 11. If a transistor conducts a higher than average dc emitter current for a given base bias, the additional voltage drop across the emitter resistor ( $R_E$ ) has the effect of reducing the base's forward bias which in turn reduces the emitter current. The ac signal in the emitter is not affected by this resistor but is shorted to ground by a capacitor ( $C_E$ ).

Other circuits use the outputs of later stages as a negative feedback signal source for transistor stabilization. If a transistor has more gain than expected, it develops more negative feedback and its efficiency is lowered. If a transistor has less gain than expected it develops less negative feedback and operates at a higher efficiency. In this manner transistors with various characteristics can be used interchangeably in the same circuit.

The next article will deal with the frequency response of transistors and will describe the operation of some practical transistor circuits. ■

## NEWS OF THE INDUSTRY

### New Color CRT Tube

A "Perma-Chrome," 25in. rectangular color CRT is being introduced by RCA. It will reportedly permit optimum color reception almost immediately after the set is switched on — reducing set-up time by technicians and providing the customer more satisfying set performance. The tube contains a temperature-compensated shadowmask assembly which overcomes the problem of expansion that has previously limited performance during the period in which the tube was warming up. An appreciable saving in servicing time can, therefore, be realized since technicians can completely and reliably adjust the tube to optimum performance within minutes after the set is switched on.

For the TV viewer the tube means truer color-viewing regardless of viewing habits — whether the set operates for a half-hour or a half day, the report said.

### Japan's Profits Improve

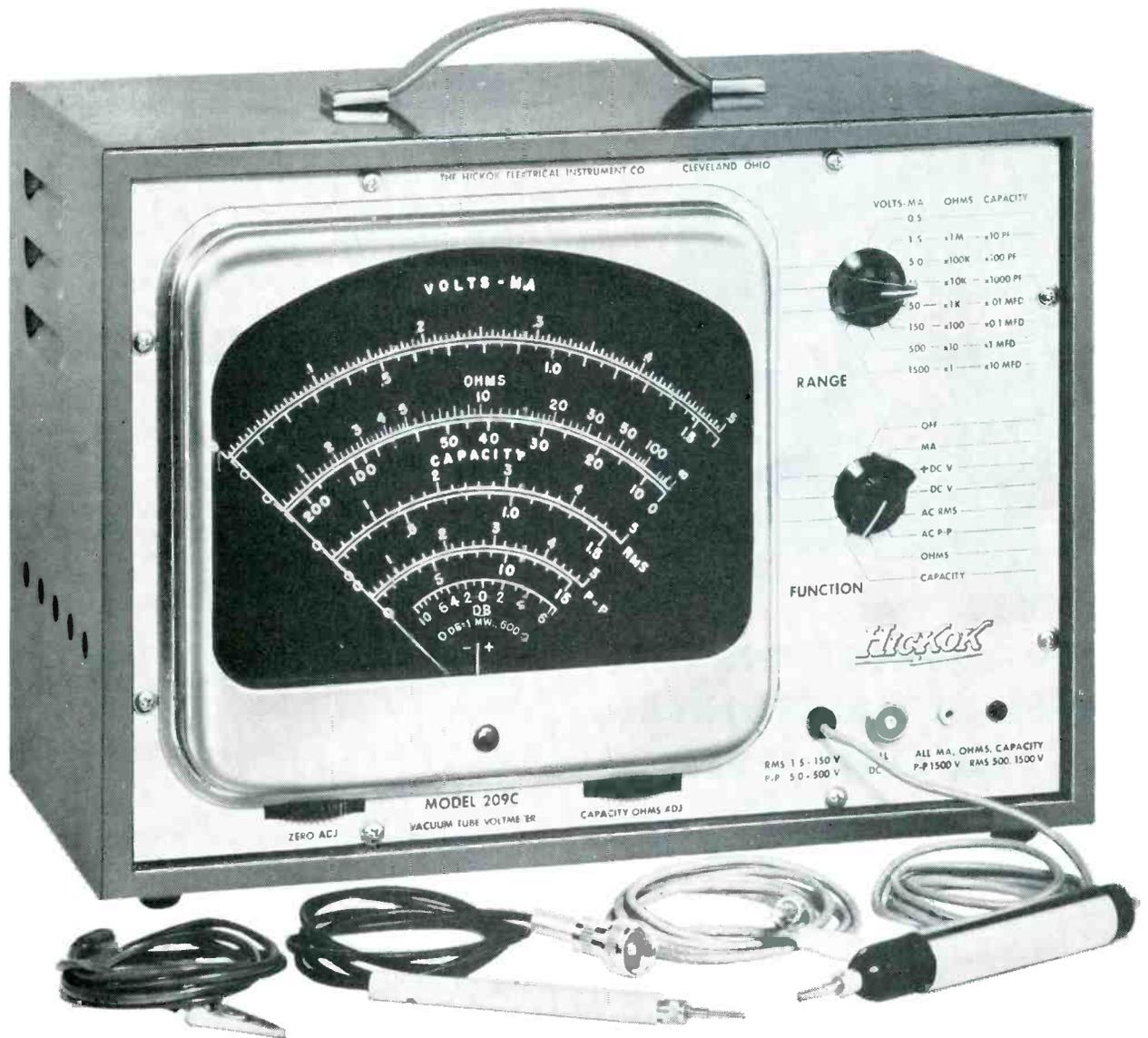
Japan's major corporations have reversed a prolonged earnings decline and profits are increasing substantially according to The Fuji Bank, Ltd.

The continued decline of private equipment investment has made government fiscal policy and exports the most important current elements in Japan's recovery.

The outlook for telecommunications apparatus and electronic appliances centering on computers is favorable, but heavy and household electrical appliance makers need to promote exports and stimulate new demand for luxury items like color TV and room air conditioners. Fiscal 1965 production in this category reached \$4.68 billion, a decline of three percent from the previous year.

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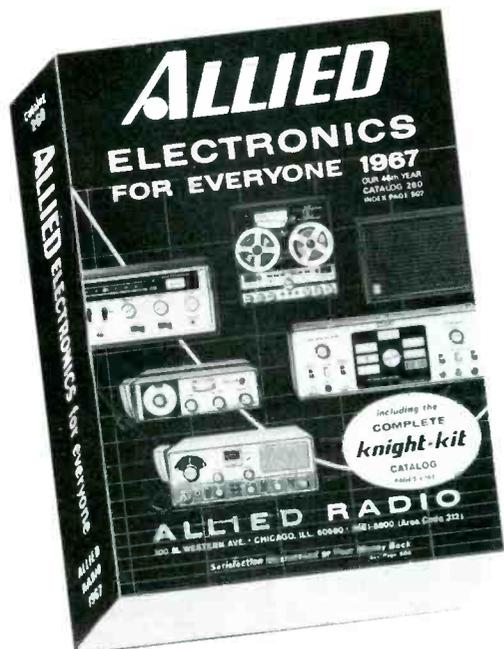
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## NEWS OF THE INDUSTRY

### New Technicians Needed

When announcing their plans to merge with DeVry Technical Institute, Bell & Howell President Peter S. Peterson predicted that America's industrial economy will require more than one million new technicians in the next decade to fill its manpower needs. He noted that, according to a U.S. Dept. of Labor study, America's demand for technicians is expected to increase by more than 75% by 1975 and that at the present training rate there will be a shortage of 350,000 technicians by that year.

The institute was founded in Chicago in 1931 and trains technicians in industrial electronics, nuclear instrumentation, communications electronics, computer technology, electronics engineering technology, and related fields. From a total of 31 students in 1931, it has grown rapidly until today there are over 3000 students in its resident training center in Chicago and 400 in Toronto. There are over 17,000 students in the extension programs throughout the United States and Canada and the institute has pioneered in using audio-visual teaching techniques in the home.

Completion of the proposed transaction is subject to formal ratification by Bell & Howell's board of directors, shareowners of De Vry Technical Institute and a favorable ruling by the Internal Revenue Service.

The plan involves the acquisition of all the institute's assets in exchange for an undisclosed number of Bell & Howell common shares.

The institute will function as a wholly owned subsidiary with its present management and staff of over 600 people.

### Mallory Distributor Products Moves

The Mallory Distributor Products div. of P.R. Mallory & Co. is being relocated in a new 50,000 sq-ft facility at the company's Indianapolis, Ind., headquarters site.

The plant, 50 percent larger than the previous facility, provides space for new automated order assembly equipment, enlarged warehousing areas and a modern data processing center. The new automated equipment and order assembly procedures will enable the division to reduce the handling of materials by some 90 percent. An inventory of more than 14,000 items will be assembled from warehouse stock on a new 600-foot long conveyor belt system and processed for air, railroad or truck shipments throughout the U.S.

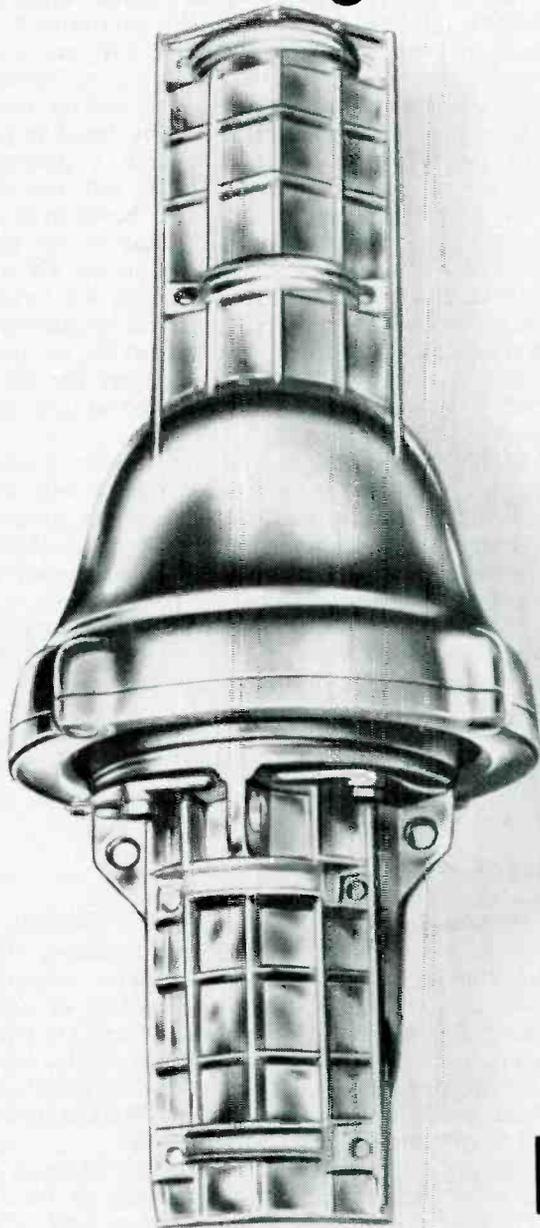
### Allen Organ Settles Suit

Allen Organ Co., Macungie, Pa. has reached an out-of-court settlement with Rodgers Organ Co. in a patent infringement suit filed June 1964, by Allen Organ Co.

The suit involved the use of certain tonal circuits which were specially related to the production of transient speech effects — an essential part of organ sound.

The settlement includes granting a license and royalty arrangement to Rodgers Organ Co. which gives the company permission to use the patented process, and dismissal of the suit by the Allen Organ Co.

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## NEWS OF THE INDUSTRY

### Advances in Subscription Tv

In response to a request issued by the Federal Communications Commission in March, Zenith Radio Corp. has filed additional technical data on its subscription TV system. The document gives full details on its Phone-vision system and describes a new decoder engineered to decode color and B/W subscription telecasts.

The subscription decoder contains a TV tuner that can accommodate any UHF/VHF channel. It is installed by shifting the subscriber's antenna connection from receiver to decoder and then attaching the decoder output wires to the TV set's antenna terminals.

The new decoder operates with a credit billing system, a method that has proved successful in Hartford, Conn. Instead of printing program purchase charges on a tape, however, the decoder records them on a "subscription ticket" which identifies the subscriber, records purchases for subsequent billing and assists in the decoding process. When the subscriber wishes to watch a program, he turns his set to the proper channel and the decoder to the proper program code — as shown in a special program guide. By inserting the ticket in the decoder, the decoder is functionally connected to the TV receiver and a series of pins are driven through the ticket in a pattern dictated by the program's code number. The sound and picture are then unscrambled for the program.

The ticket can be left in the decoder for the entire period it is valid or may be removed at any time to prevent the decoder's use.

Shortly before the end of the validity period, the subscriber receives his next ticket with a self-addressed envelope for returning the used ticket to the subscription-TV company. The returned ticket is processed through a computer, which provides a bill to be mailed to the subscriber.

A highly automated billing system can accommodate a high volume of business and can be used by several small operations for maximum utilization of the equipment.

The document indicates that the system accepts both color and B/W signals in the present channel bandwidth without any loss in quality.

### Research Grant in American Music

An American music research grant, believed to be the first ever set up by an electro-acoustic firm, is announced by Electro-Voice. Preliminary research has proved that we have a tremendous heritage of American music lying dormant in libraries across America, the announcement said. This legacy of fine music, adaptable to the organ, should be ferreted out, compiled, edited, and made available for the listening enjoyment and use of all Americans, the announcement urged.

The first grant has been made to Jon Spong, a young artist who, until recently, was a member of the faculty at Drake University's College of Fine Arts. He has conducted considerable research in many libraries across the country, including the Library of Congress, and has found a wealth of virtually unknown American music, according to the announcement.



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Amperex Electronic Corp. ....	3rd Cover
Amphenol Distributor Div. ....	103
Arco Electronics ....	19
Arrow Fastener Co., ....	114
B & K Div., Dynascan Corp. ....	73, 77
Borden Chemical, Krylon Div. ....	72
Browning Laboratories, Inc. ....	86
Castle TV Tuner Service ....	30
Channel Master Corp. ....	31
Cleveland Institute of Electronics ....	39
Cornell-Dubilier ....	111
E. C. I. Electronics Communications, Inc. ....	45
EICO Electronic Instrument Co. ....	20
Electro-Voice, Inc. ....	89
Finney Co., The ....	91
Greyhound Corp. ....	93
Heath Co. ....	106
Hickok Electrical Instrument Co. ....	109
Jackson Electrical Instrument Co. ....	24
Jensen Manufacturing Div., Muter Co. ....	105
Jerrold Electronics Corp. ....	2nd Cover, 42-43, 82
Kay-Townes Antenna Co. ....	25
Lectrotech, Inc. ....	112, 114
Mercury Electronics Corp. ....	22
Miller Co., J. W. ....	94
National Radio Institute ....	104
Oaktron Industries, Inc. ....	74
Olson Electronics, Inc. ....	114
Philco Corp. ....	46
Precise Electronics ....	96
Quam-Nichols Co. ....	92
Quietrole Co. ....	114
Radio Corp. of America RCA Electronic Components & Devices ....	4th Cover, 33, 41, 75, 85, 113
RCA Institutes, Inc. ....	108
S & A Electronics, Inc. ....	84
Seco Electronics ....	88, 100
Sencore, Inc. ....	29, 34, 40, 69, 90
Sprague Products Co. ....	23
Standard Kollsman Industries, Inc. ....	83
Sylvania Electric Products, Inc. ....	71, 107
Triplett Electrical Instrument Co. ....	32
Turner Co., The ....	44
UNIVAC, Div. of Sperry Rand Corp. ....	76
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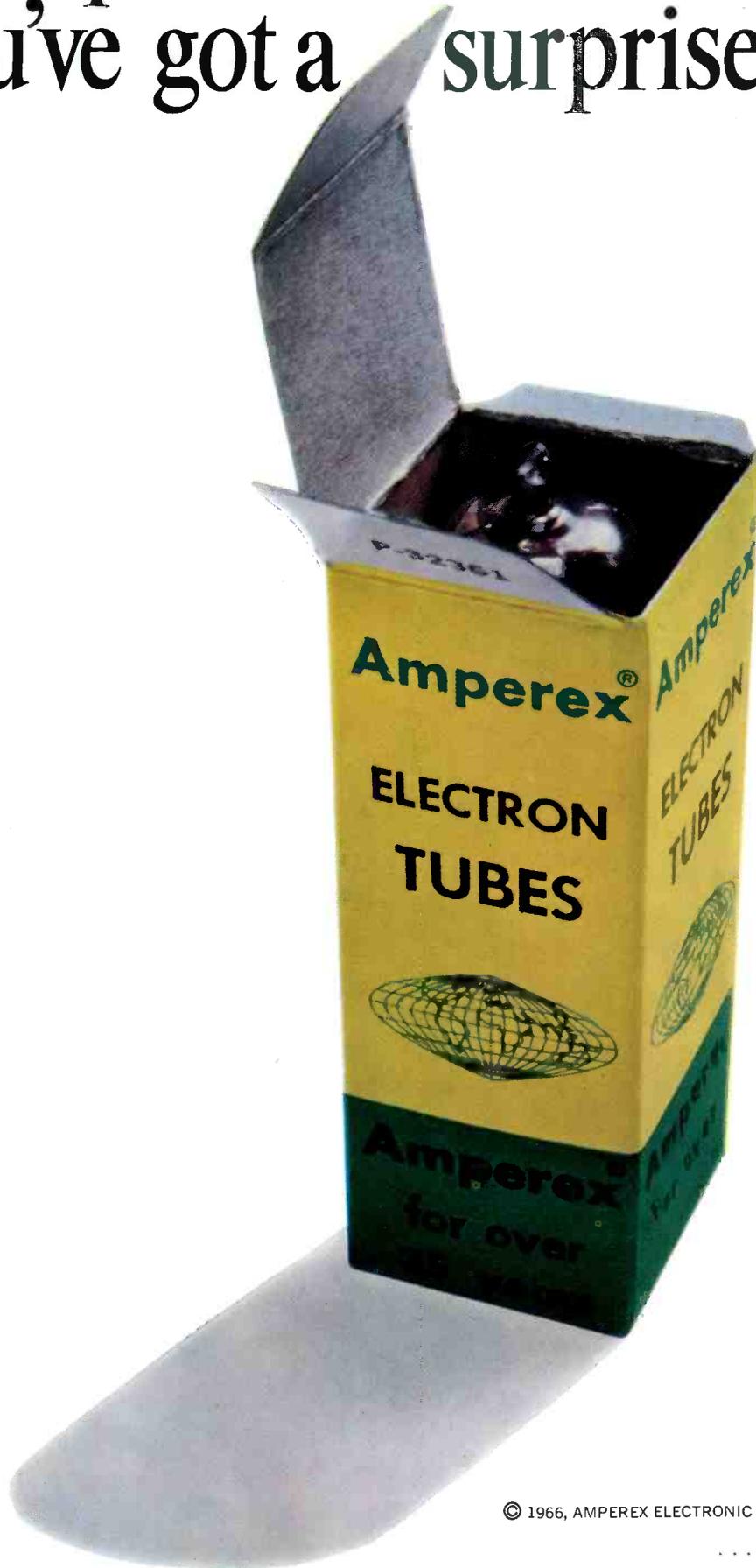
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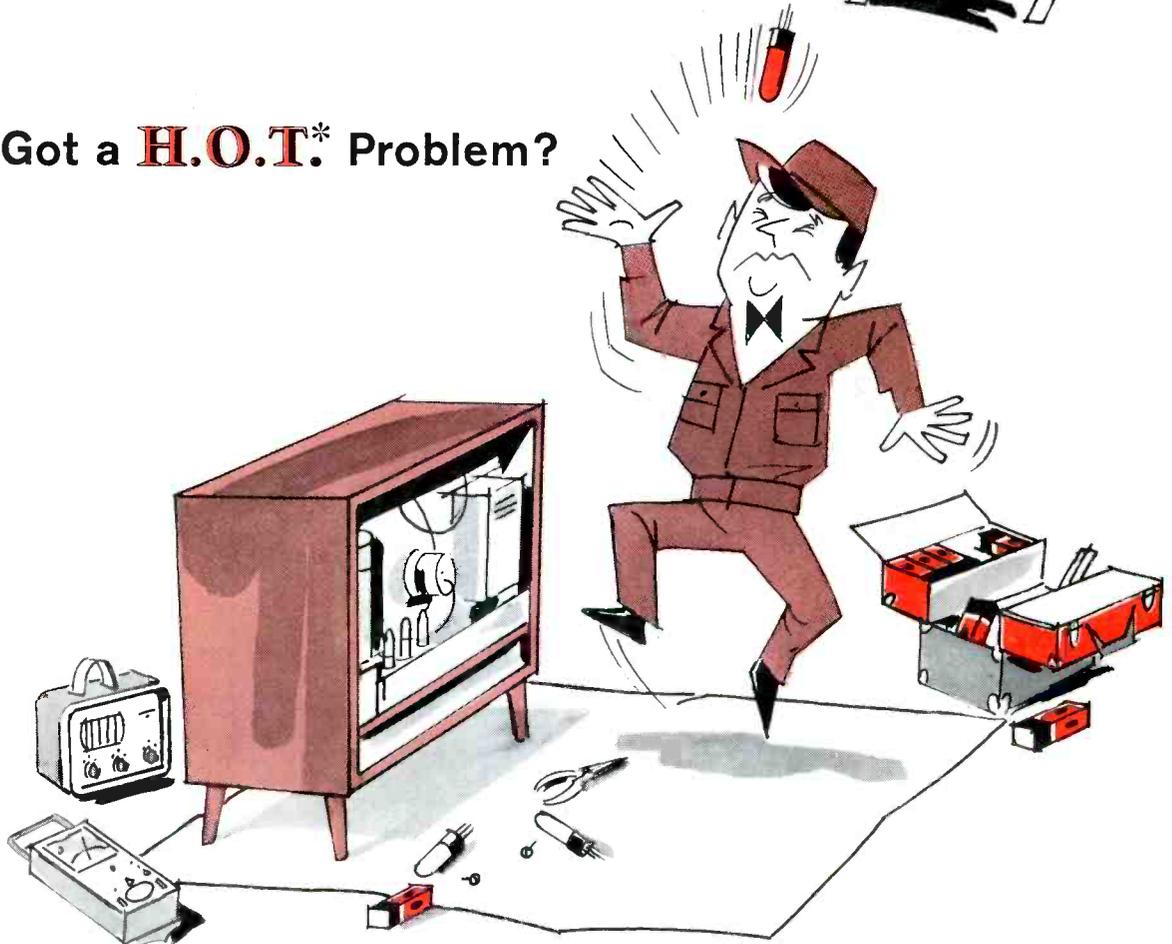
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2. **Don't** apply power to a "warm" set if the oscillator tube is cold. Wait a few minutes, or heat the oscillator tube in a tube tester.
3. **Don't** risk H.O.T. damage by shorting out overload devices.
4. **Don't** disconnect the H.O.T. plate cap to kill high voltage. Use the method recommended by the set manufacturer.
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