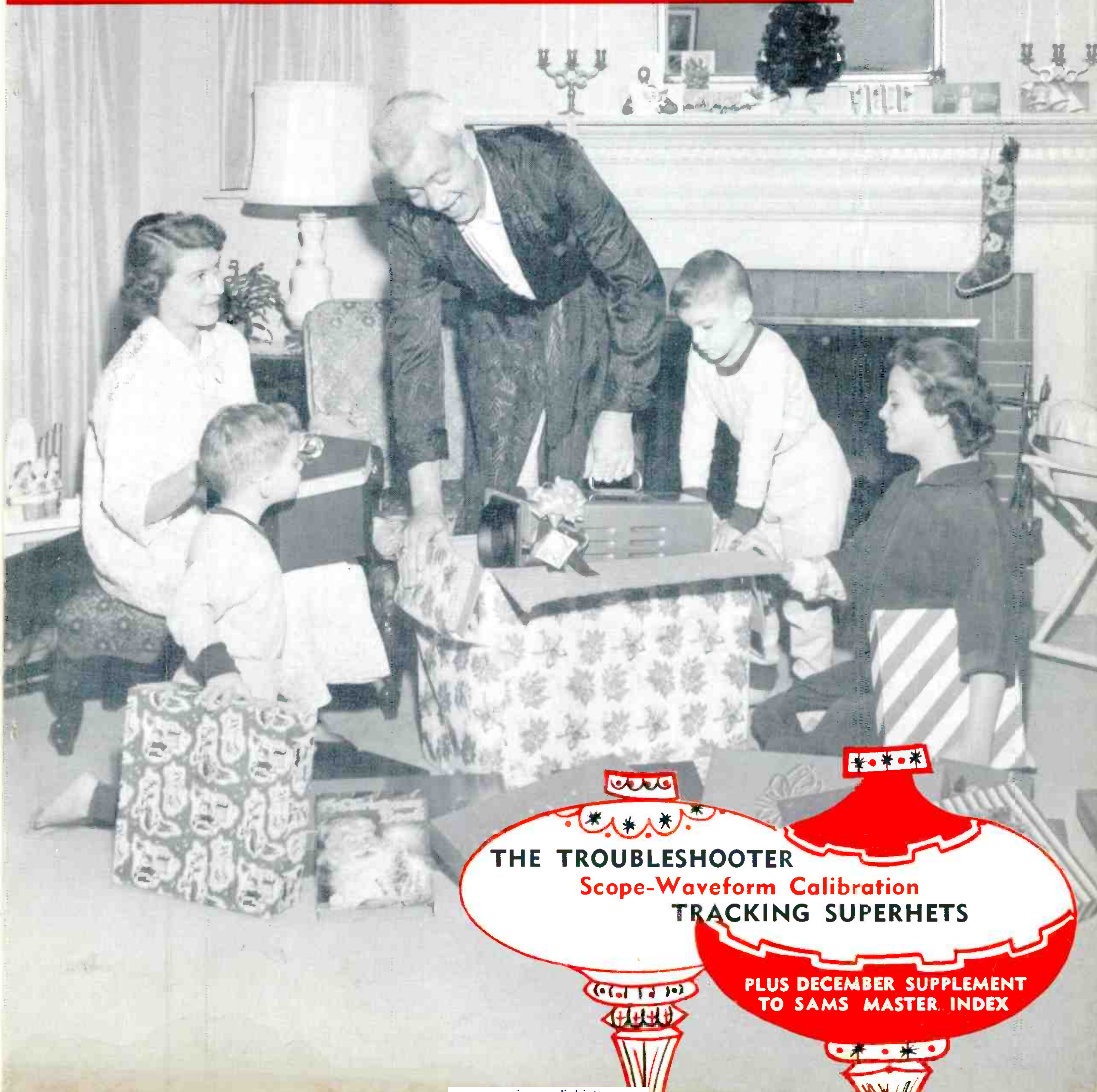
DECEMBER • 1957 25 CENTS

PHOTOFACT

PF REPORTER

FOR THE ELECTRONIC SERVICE INDUSTRY



THE TROUBLESHOOTER

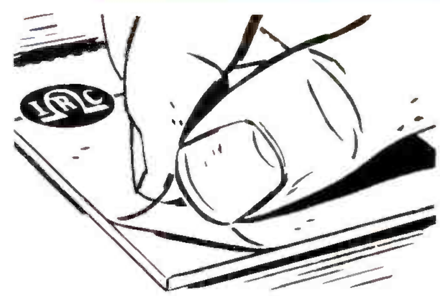
Scope-Waveform Calibration

TRACKING SUPERHETS

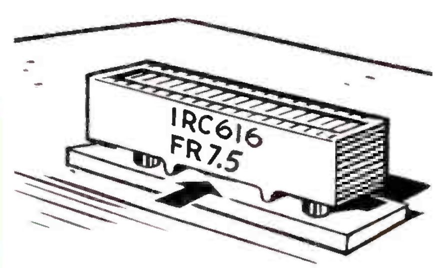
PLUS DECEMBER SUPPLEMENT TO SAMS MASTER INDEX

IRC "Skin-Packed" Fuse Resistors

CONVENIENT TO BUY—Your IRC Distributor has IRC fuse resistors now on perforated display cards. You can buy one, a dozen or more—each on an individual "skin-packed" card section.



EASY TO STOCK—Heavy card helps prevent breakage or damage . . . "skin-packing" keeps every fuse resistor factory-fresh. Just peel off plastic skin, and you're all set.



HANDY TO USE—Sturdy terminal pins. Simply plug fuse resistor into receptacle. Projections on bottom of case leave air space so receptacle won't overheat.

- **Improved plug-in type for fast, easy replacement in the newer TV receivers. Terminal pin holes facilitate attaching leads where necessary.**
- **Featuring sturdy terminal pins—both attached inside a rugged ceramic case.**
- **"Skin-packed" cards protect each fuse resistor from dirt and handling.**
- **Available in 2 types—FR5.6 at 5.6 ohms and FR7.5 at 7.5 ohms to meet popular TV requirements.**
- **Type and range clearly identified on both fuse resistor and "skin-packed" card.**

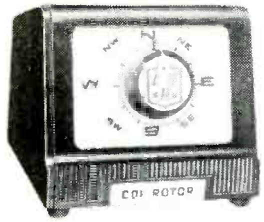
ORDER NOW FROM YOUR IRC DISTRIBUTOR

Wherever the Circuit Says— IRC

INTERNATIONAL RESISTANCE CO.

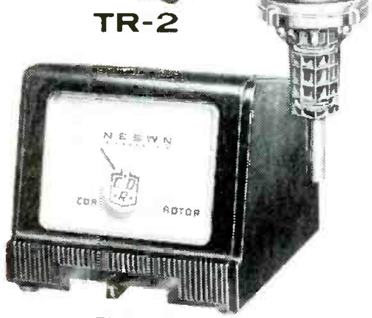
Dept. 361, 401 N. Broad St., Phila. 8, Pa.

In Canada: International Resistance Co. Ltd., Toronto, Licensee



AR-22

TR-2



TR-4

5-star feature...

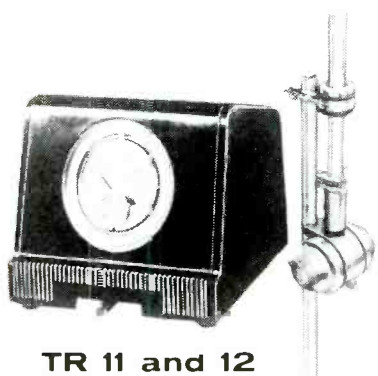
★ 1 **the best color TV picture**

the growth of color TV means an even greater demand for CDR Rotors for pin-point accuracy of antenna direction.

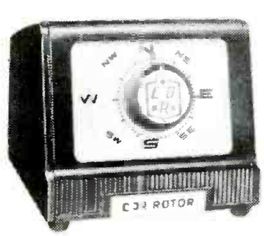
★ 2 **a better picture on more stations**

CDR Rotors add to the pleasure of TV viewing because they line up the antenna perfectly with the transmitted TV signal giving a BETTER picture . . . and making it possible to bring in MORE stations.

CDR ROTORS



TR 11 and 12



AR 1 and 2

★ 3 **tested and proven dependable**

thousands and thousands of CDR Rotors have proven their dependability over years of unfailing performance in installations everywhere in the nation. Quality and engineering you know you can count on.

★ 4 **pre-sold to your customers**

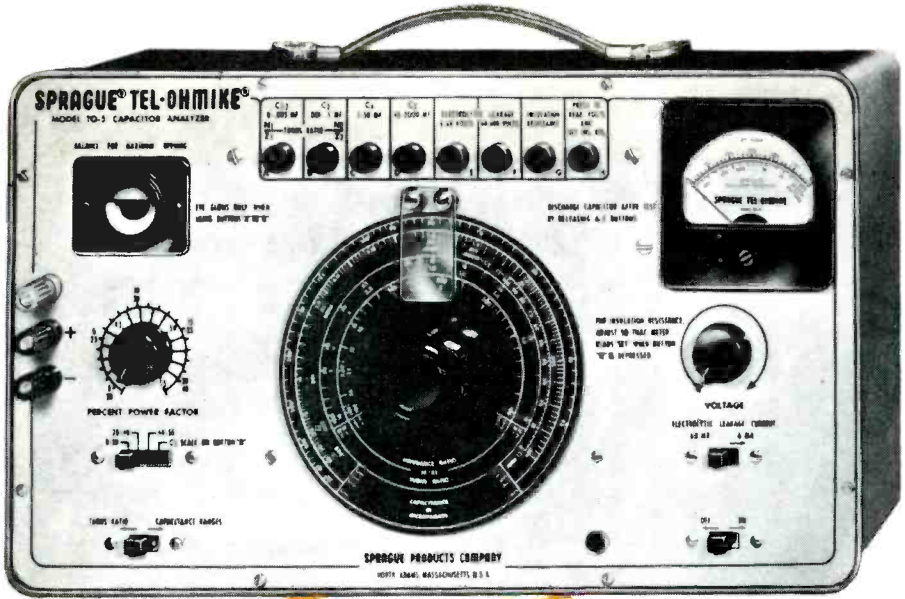
the greatest coverage and concentration of full minute spot announcements on leading TV stations is working for YOU . . . pre-selling your customers.

★ 5 **the complete line**

a model for every need . . . for every application. CDR Rotors make it possible for you to give your customer exactly what is needed . . . the right CDR Rotor for the right job.

CORNELL-DUBILIER
SOUTH PLAINFIELD, N. J.

THE RADIART CORP.
CLEVELAND 13, OHIO



NEW TO-5 TEL-OHMIKE® capacitor analyzer

measures all 4 . . . plus

1 CAPACITANCE	2 POWER FACTOR	3 LEAKAGE CURRENT	4 INSULATION RESISTANCE	extra feature TURNS RATIO
Measures up to 2000 μf in five overlapping ranges . . . including an accurate 1 to 100 μμf range, exclusive with Sprague.	Power factor of electrolytic capacitors is measured by the highly accurate bridge method. Reads up to 55% in three ranges for convenience in measurement.	Leakage current of electrolytics is measured directly on the meter, with exact rated voltage up to 600 v. applied from continuously adjustable power supply. Two ranges—0-6-60 ma.	Insulation resistance of paper, ceramic, and mica capacitors is read directly on meter . . . up to 20,000 megohms.	In addition to its function as a complete capacitor analyzer, the TO-5 also measures the turns ratio of power and audio transformers.

The NEW TO-5 TEL-OHMIKE Capacitor Analyzer is one of the fastest and surest ways of measuring . . . capacitance, power factor, leakage current, insulation resistance, and turns ratio. This compact, easy-to-use instrument has the highest accuracy of any instrument of its type available to the service trade.

New jumbo dial makes meter reading easy. Special color-keyed pushbuttons permit instant range selection . . . and allow automatic safety discharge of capacitors after testing. Magic-eye tube simplifies bridge balancing for capacitance and power factor measurements.

SEE THE NEW TO-5 TEL-OHMIKE IN ACTION . . . AT YOUR DISTRIBUTOR!

This 4-in-1 test instrument is only 8⅞" high, 14⅝" wide, and 6⅛" deep . . . weighs a mere 12½ pounds. The complete price for . . .

MODEL TO-5 (115 VAC/50-60 cy) . . Only **$83.90 net**

Also available: Model TO-5X for 115-230 V/25-60 cy. . . . $89.90 net
Model TP-5RM for rack mounting . . . . . $93.90 net

SPRAGUE®
world's largest capacitor manufacturer

SPRAGUE PRODUCTS COMPANY, DISTRIBUTORS' DIVISION OF SPRAGUE ELECTRIC COMPANY, NORTH ADAMS, MASS.

PUBLISHER
Howard W. Sams

GENERAL MANAGER
Mal Parks, Jr.

EDITOR
Verne M. Ray

ASSOCIATE EDITORS
Leslie D. Deane
Thomas A Lesh
Calvin C. Young, Jr.

CONSULTING EDITORS
William E. Burke, C. P. Oliphant, Robert B. Dunham, George B. Mann, Paul C. Smith

ART DIRECTOR
Don W. Bradley

EDITORIAL ASSISTANT
Judy Ann Hurley

PHOTOGRAPHY
Robert W. Reed

CIRCULATION
Pat Tidd

ADVG. PRODUCTION
Carol B. Gadbury

ART ASSISTANT
Phillip W. Lee

ADVERTISING SALES OFFICES

MIDWESTERN
PF REPORTER,
2201 East 46th Street, Indianapolis 5, Ind.
Clifford 1-4531

EASTERN
Paul S. Weil and Donald C. Weil,
39-01 Main Street, Flushing 54, New York.
Independence 3-9098.

WESTERN
The Maurice A. Kimball Co., Inc.
2550 Beverly Blvd., Los Angeles 57, Calif.
Dunkirk 8-6178; and 681 Market Street,
San Francisco 5, Calif. EXbrook 2-3365.

Published monthly by Howard W. Sams & Co., Inc., at Indianapolis 5, Indiana.
Entered as second class matter October 11, 1954, at the Post Office at Indianapolis, Indiana, under the Act of March 3, 1879.

Subscription prices in U.S.A. and possessions: 1 yr., $3.00; 2 yrs., $5.00; 3 yrs., $7.00. In Canada and Pan America: 1 yr., $3.60; 2 yrs., $6.00; 3 yrs., $8.50. Foreign subscriptions: 1 yr., $6.00; 2 yrs., $11.00; 3 yrs., $15.00. A limited quantity of back issues are available at 35c per copy.

next month

TROUBLESHOOTING WITH THE SCOPE

If you are not utilizing your scope to best advantage in isolating TV troubles, don't miss this analysis of the key waveforms associated with typical circuits.

SUFFERING FROM THE BENDS?

Your customer's TV picture, we mean! If so, don't become exasperated—read this article in the January issue. It's guaranteed to put you on the right track!

SELECTION AND USE OF HAND TOOLS

We've all been guilty of using tools improperly at one time or another, either because we were rushed or because the right implement wasn't available. This feature brings you up-to-date on the very latest items and how to get the most out of the ones you use every day.

VOLUME 7, No. 12 DECEMBER, 1957

PF REPORTER

FOR THE ELECTRONIC SERVICE INDUSTRY

CONTENTS

SUBJECT REFERENCE INDEX

USE HANDY CARD AT BACK TO ENTER YOUR SUBSCRIPTION

the VOM that outsells all others combined

...now better than ever!

For years, the rugged dependability of the Simpson 260* has made it the world's most popular volt-ohm-milliammeter. Now . . . Simpson offers a new and improved 260 . . . easier to operate, more sensitive, more accurate . . . a better buy than ever before.

To date, over 3/4 million Simpson 260s have been purchased by technicians, service organizations, laboratories, factories, and the armed forces. Such overwhelming preference is proof that the 260 best meets the needs of VOM users. Sound basic design gives it day-in, day-out dependability and ruggedness. "Extras," such as the Adjust-A-Vue handle (standard on 260s), not only provide convenience but save time. When you are in the market for a VOM, you can be sure that a 260 is your best buy. Have your jobber show you this new model of the world's most popular volt-ohm-milliammeter—the Simpson 260.

*TRADEMARK

MANY NEW FEATURES.

make the new 260 more valuable than ever!

NEW FEATURES

- **POLARITY REVERSING SWITCH:** Makes d.c. measurements easier and faster . . . no lead reversal.
- **50 MICROAMPERE-250 MILLIVOLT RANGE:** Gives more sensitive measurements . . . provides complete current coverage in six easy steps!
- **EASIER-TO-READ SCALES:** Black and red scales have been spread out for faster reading, less chance of error!
- **LESS CIRCUIT LOADING:** Sensitivity of a.c. voltage ranges increased to *5000 ohms-per-volt!*
- **POPULAR DBM RANGES:** −20 DBM to +50 DBM. one milliwatt in 600 ohms!
- **IMPROVED FREQUENCY RESPONSE IN A. C. MEASUREMENTS:** 5 to 500,000 cycles per second!
- **FULL-WAVE BRIDGE RECTIFIER SYSTEM:** Provides more accurate a.c. voltage measurements!
- **RUGGED PRINTED CIRCUIT**
- **ALL COMPONENTS EASILY ACCESSIBLE**

RANGES

D.C. VOLTAGE (20,000 ohms-per-volt): 0-250 mv; 0-2.5 v; 0-10 v; 0-50 v; 0-250 v; 0-1000 v; 0-5000 v.

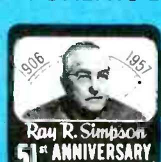
A.C. VOLTAGE (5000 ohms-per-volt): 0-2.5 v; 0-10 v; 0-50 v; 0-250 v; 0-1000 v; 0-5000 v.

A.C. VOLTAGE (With 0.1 uf internal series capacitor): 0-2.5 v; 0-10 v; 0-50 v; 0-250 v.

VOLUME LEVEL IN DECIBELS (Zero DB equal to 1 milliwatt across a 600 ohm line): −20 to +10 DB; −8 to +22 DB; +6 to +36 DB; +20 to +50 DB.

D.C. RESISTANCE: 0-2000 ohms (12 ohms center); 0-200,000 ohms (1200 ohms center); 0-20 megohms (120,000 ohms center).

DIRECT CURRENT: 0-50 ua; 0-1 ma; 0-10 ma; 0-100 ma; 0-500 ma; 0-10 amp.



Simpson ELECTRIC COMPANY
5200 West Kinzie Street, Chicago 44, Illinois
Phone: EStebrook 9-1121
In Canada: Bach-Simpson Ltd., London, Ontario

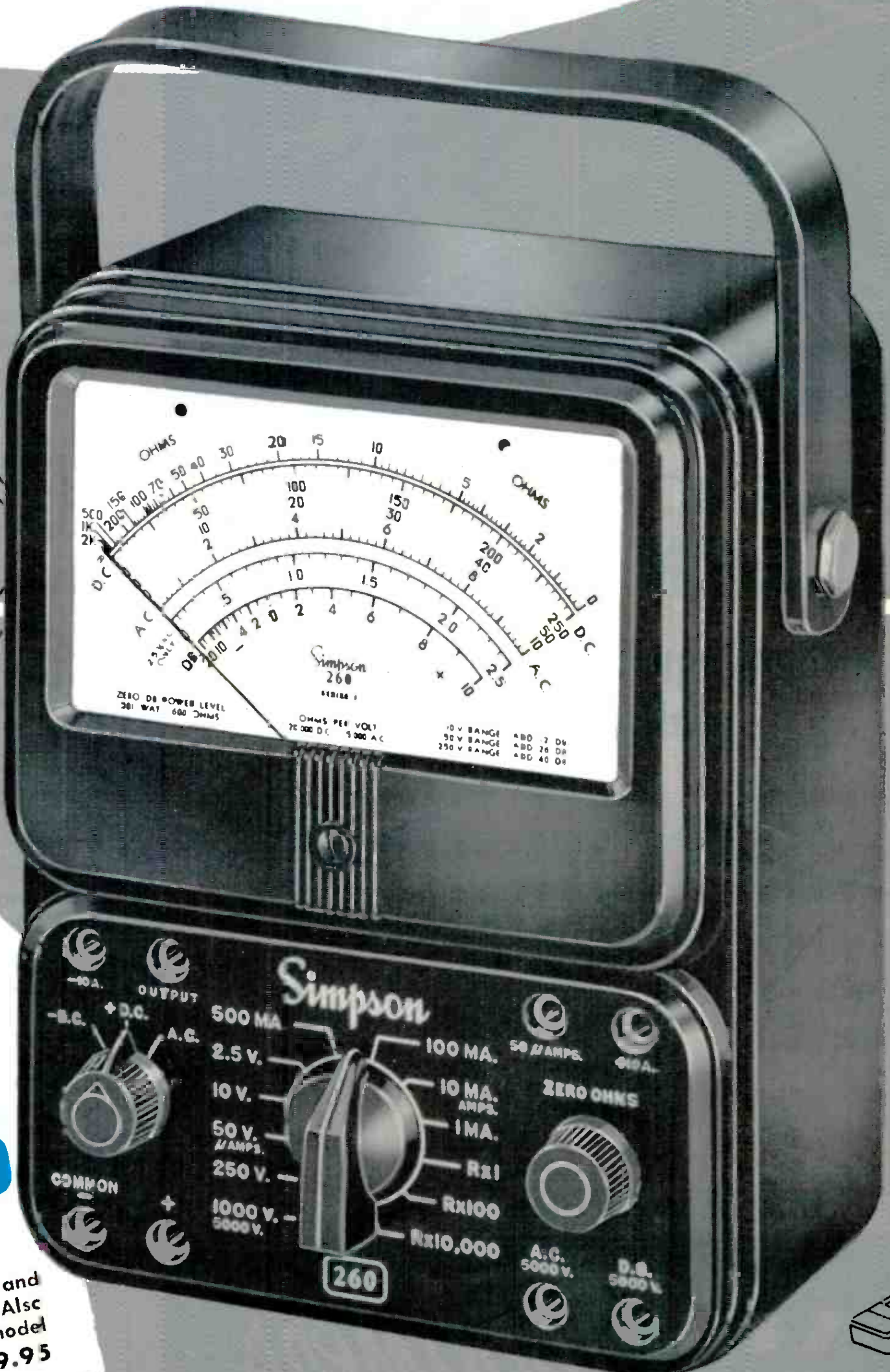
WORLD'S LARGEST MANUFACTURER OF ELECTRONIC TEST EQUIPMENT

NEW improved model

Simpson 260!

TRADEMARK

RUGGED PRINTED CIRCUIT!



still only

$43.95

Complete with leads and Operator's Manual. Also available in Roll-Top model at only $49.95

Adjust-A-Vue Handle—holds the 260 at convenient viewing angle. Eliminates separate gadgets and makeshift props.

Letters to the EDITOR

Dear Editor:

Your story on capacitor color codes in the October issue cleared up a lot of questions I had. I keep turning back to it to help me figure out capacitors as I run across them. Can I get an extra copy of this information, so I can post it on the wall and not have to rip up the magazine?

WM. JACKSON

Miami, Fla.

Yes, reprints of the article on color codes, printed in two colors on heavy stock, are available free to readers on request to the Editor, PF REPORTER, 2201 E. 46th St., Indianapolis, Ind. —Editor

Dear Editor:

For a long time I've been wondering about the way to repair the bases of picture tubes which become loose. I tried to get information through different sources but never got an idea of the proper cement to use. Also, can you give me any suggestion for fixing a loose plate cap on a 6CD6 or similar tube?

JUSTO MAHIA

Havana, Cuba

Speaker cement (such as "Service Cement" by General Cement Mfg. Co., Rockford, Ill., or "Radio Cement" by Walsco Electronics Corp., Los Angeles, Calif.) will take care of loose tube bases. As far as we know, there is no cement available for repair of plate caps on horizontal-output tubes; if the tube gives trouble, it is best to replace it.—Editor

Dear Editor:

You usually anticipate my needs, and long before I realize that certain information will be needed, you have furnished it. That keeps me re-reading the old copies in my files.

Just lately, however, I have found that there seem to be no new automobile battery voltage and ground charts. My last one ends in 1953, and there are later model car radios needing service. So, please publish a list covering all cars including the foreign makes sold over here, designating the battery voltage and the grounded terminal. (Don't tell me that as the sets do not use synchronous vibrators, the polarity of the battery does not matter—because in testing it sometimes does.)

K. CUTLER

Myrtle Point, Ore.

Publication of such a list is tentatively scheduled for the March, 1958 issue. As many foreign cars as possible will be covered; we might even include battery information for Sputnik—if we can get the facts!—Editor

Make MORE Money FASTER with B&K

LABORATORY-ACCURATE

DYNA-QUIK

NEW Model 650

Today's Fastest, Most Complete, Portable

DYNAMIC MUTUAL CONDUCTANCE

TUBE & TRANSISTOR TESTER

CUT TESTING TIME IN HALF—DOUBLE TUBE SALES

Measures *true dynamic mutual conductance* with laboratory accuracy under actual operating conditions *right in the home*. Makes complete tube test in seconds. Quickly detects weak or inoperative tubes. Shows customer the true condition and life expectancy of the tubes and *sells more tubes right* on the spot. *Cuts servicing time, saves costly call-backs, wins customer confidence, and brings more profit*. One extra tube sale on each of 5 calls a day pays for the Dyna-Quik in a few weeks.

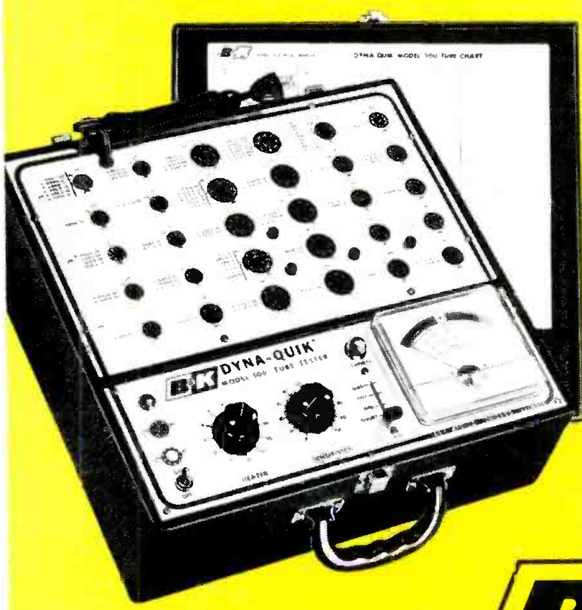
Offers **New** Features—**More** Features! Checks over **99%** of the tubes most widely used in television receivers, plus popular home and portable radio tubes. **Tests over 500 tube types. Lists over 125 tube types,** with settings, on socket panels for maximum operating speed. Complete listing in **fast telephone-index type selector.** Includes 16 spare sockets and sufficient filament voltages for future new tube types. Phosphor bronze socket contacts. **Tests each section of multiple tubes separately** for **Gm—Shorts—Grid Emission—Gas Content**—and **Life.** Gives instantaneous **Heater Continuity** check. Shows tube condition on "Good-Bad" scale and in micromhos. Special bridge assures automatic line compensation. Simple to operate. **No multiple switching—No roll chart.** Includes pin straighteners. **Transistor Tester** checks junction, point contact and barrier transistors, germanium and silicon diodes, selenium and silicon rectifiers.

Net, **$169.95**

FAMOUS Model 500

World's Fastest Selling Portable

DYNAMIC MUTUAL CONDUCTANCE TUBE TESTER



This is the B&K quick-check tube tester that has revolutionized TV set servicing! Servicemen* say: *"Best tube tester I've ever owned for speed and dependability." "Wonderful instrument. Makes money." "Paid for itself several times. Really indispensable." "Have two ... one for the shop and one for house calls." "Adds income and saves unprofitable call-backs."* That is why thousands of the Model 500 are now in profitable use all over the nation. Tests tubes for **Shorts, Grid Emission, Gas Content, Leakage,** and **Dynamic Mutual Conductance—in a matter of seconds. Life Test** detects tubes with short life expectancy. Shows tube condition on "Good-Bad" scale and in micromhos. **One switch tests everything.** No multiple switching—No roll chart. Special bridge maintains automatic line compensation. 7-pin and 9-pin straighteners.

Net, **$109.95**

See your B&K Distributor, or write for Bulletin 500-650-R

B&K MANUFACTURING CO.
3726 N. Southport Ave. • Chicago 13, Illinois
Canada: Atlas Radio Corp. 50 Wingold, Toronto 10, Ont.
Export: Empire Exporters, 458 Broadway, New York 13, N.Y.

*Names on request

Dear Editor:

In the September issue of PF REPORTER, on page 19, Fig. 4 shows a spring scale which measures pulling forces up to 8 oz. Can you tell me who manufactures this?

M. W. SEAVEY

Los Angeles, Calif.

The Exact Weight & Scale Co. of Columbus, Ohio. Weighing your calories these days, Mr. Seavey?—Editor

Dear Editor:

It was with interest that I noted the Industrial Electronics series starting in the September issue. It is hoped that a portion of the series will be devoted to computers. Perhaps this could be a series in itself.

The tape recorder servicing article also was of interest. Could we have additional and detailed tape recording features? One other subject which I had hoped would be covered long before this is a series on electronic organs.

LEE RUETZ

St. Paul, Minn.

A basic coverage on computers will appear later on in the Industrial series. Tape recorders will also receive further coverage. At the moment, electronic organs do not seem to present much of a potential to radio-TV servicemen, although we do know of one technician who would like to service his neighbor's multichord—so it doesn't work at 2:00 a.m.—Editor

Dear Editor:

A step-by-step analysis of new circuits would be very helpful in my work. Oftentimes there is a delay before a new circuit is described in available service literature. If this could be included in "Servicing New Designs," it would be fine.

JOHN H. CONDON

Manchester, N. H.

Thanks for your suggestion. If there are any particular circuits you'd like to see covered, drop us a line.—Editor

Dear Editor:

I read with interest in "Quicker Servicing" Bernard Parrott's idea to keep service data handy.

I have been using an idea that I would like to pass along for what it's worth. Being an ex-clarinet player, I still have my music stand which I use to hold service data. When you want to stand up while servicing in the shop, you can raise the stand to the proper height. There are wire holders on the stand to hold everything in place when that good old California breeze comes blowing in the window.

HAROLD HASTINGS

El Cajon, Calif.

Harold seems to have found an excellent method of keeping service data close at hand and still out of the way. Wonder if he's cleared this with Petrillo?—Editor

Shop Talk

MILTON S. KIVER

Author of . . .
How to Understand and Use TV Test Instruments and Analyzing and Tracing TV Circuits

Interpreting Graph Forms

The technician may not think of it as such, but much of the information he receives concerning his work is supplied in the form of graphs. For example, graphs are presented in the magazines or books he reads, and also in many of the specification sheets and other descriptive literature that accompanies almost every electronic component or product. Television technicians do much of their servicing by means of graphs —usually without realizing it— when they analyze the waveform patterns on the face of the oscilloscope screen. Surprising as this statement may seem to many readers, the simple fact of the matter is that what you see on an oscilloscope screen is a graph, with the horizontal base representing time for frequency (usually) and the vertical axis representing amplitude.

In spite of their very evident importance, graphs, as a whole, have received very little attention in the technical press. Because of this, it may be desirable to examine them, see what they portray, and determine how best to interpret what they say.

Graphs come in a variety of forms, each governed to a large extent by the type of information to be presented. Probably the simplest type of graph is the straight-line type with linear vertical and horizontal scales. One such example, shown in Fig. 1, represents the behavior of a simple electrical circuit containing a 5-ohm resistor. As the voltage across the resistor is changed, the current through it varies, and Fig. 1 illustrates this relationship pictorially.

Let us look more closely at this graph, because much of what we learn and understand here can be carried over with very little modification to more complex graphs, some of which are often real stumpers.

First, consider the two side scales. Each deals with a different electrical quantity (here, amperes and volts). The figures selected for each axis are determined by the relationship existing between them (here, $E = IR$). In the present instance, low voltages are being applied to a low-valued resistor; consequently, the resulting current flow is small. Furthermore, showing the voltage values in steps of 5 volts is sufficient for our purpose. We could have indicated what happens to the current when the voltage is varied by smaller amounts—in steps of .01 or .1 volt, for instance. However, this fine a representation was not required.

The straight line stands for the formula $E = IR$ and it tells us either the overall behavior of the circuit or what the conditions will be at specific points. For example, if we are interested in the over-all behavior of the circuit, then we see that as the voltage varies from 0 to 40 volts, the current will vary from 0 to 8 amps. Furthermore, this variation of voltage will produce a current change that moves in step with it, i.e., linearly or in direct proportions. If one doubles, the other will double; if one drops by a third, the other will drop by a third. That is what we mean when we say that a linear relationship exists between the two. Whatever happens to one quantity will happen to the other in like proportion.

Suppose, however, we wish to become more specific and desire to know how much current a specific voltage will produce. The first step is to find the voltage value in question, say 25 volts. From this point we move straight across to the right until we reach the curve (or line, as in this case). As long as we go straight across, we remain on the 25-volt line. The next step is to determine the current value corresponding to this point on the curve. This is done by dropping straight down from

· *Please turn to page 60*

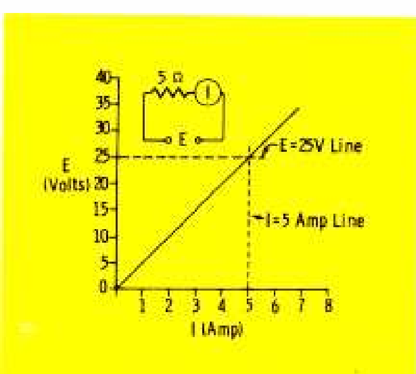


Fig. 1. Example of straight-line graph.

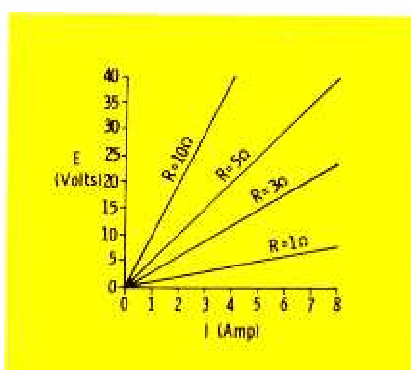


Fig. 2. Straight-line graph which involves a third variable.

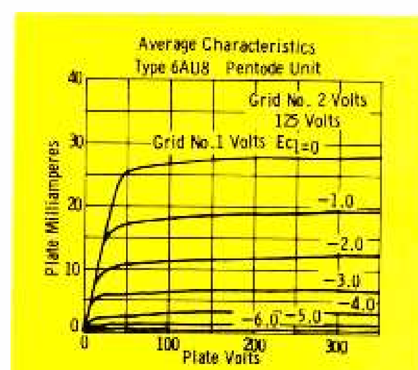


Fig. 3. Characteristic curves of the pentode section of a 6AU8 tube.

The first low priced tube tester to provide DUAL SENSITIVITY SHORT TEST

Triplett Model 3413-B Tube Tester $79.50

BURTON BROWNE ADVERTISING

to do more ...today and tomorrow!

And here are just 2 answers that tell you why.

Question:

Why Will Triplett Model 3413-B "do more" tomorrow?

Answer:

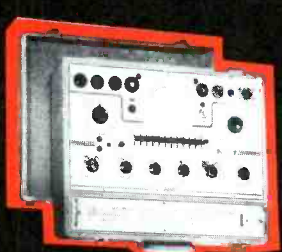
Because it will test *any new tube*. Unlike testers with preset panels of test sockets which become obsolete with the release of a new tube, Triplett flexibility of switching allows a set-up to test any new tube.

Question:

Why Will Triplett Model 3413-B "do more" today?

Answer:

Because it combines provision for conventional short test (0.25 megohms) with high sensitivity leakage test (2.0 megohms)—will test series string tubes without adapter. At only $79.50 today's and tomorrow's biggest value.



And for the ultimate in laboratory quality testing examine MODEL 3423 MUTUAL CONDUCTANCE TUBE TESTER $199.50. Proportional Mutual Conductance testing of *all* radio and TV tubes plus selenium rectifiers, crystal diodes, pilot lamps, thyratrons, transistors, etc., by a new patented circuit.

At leading Parts Distributors everywhere, see the finest and most complete line of test equipment by

TRIPLETT

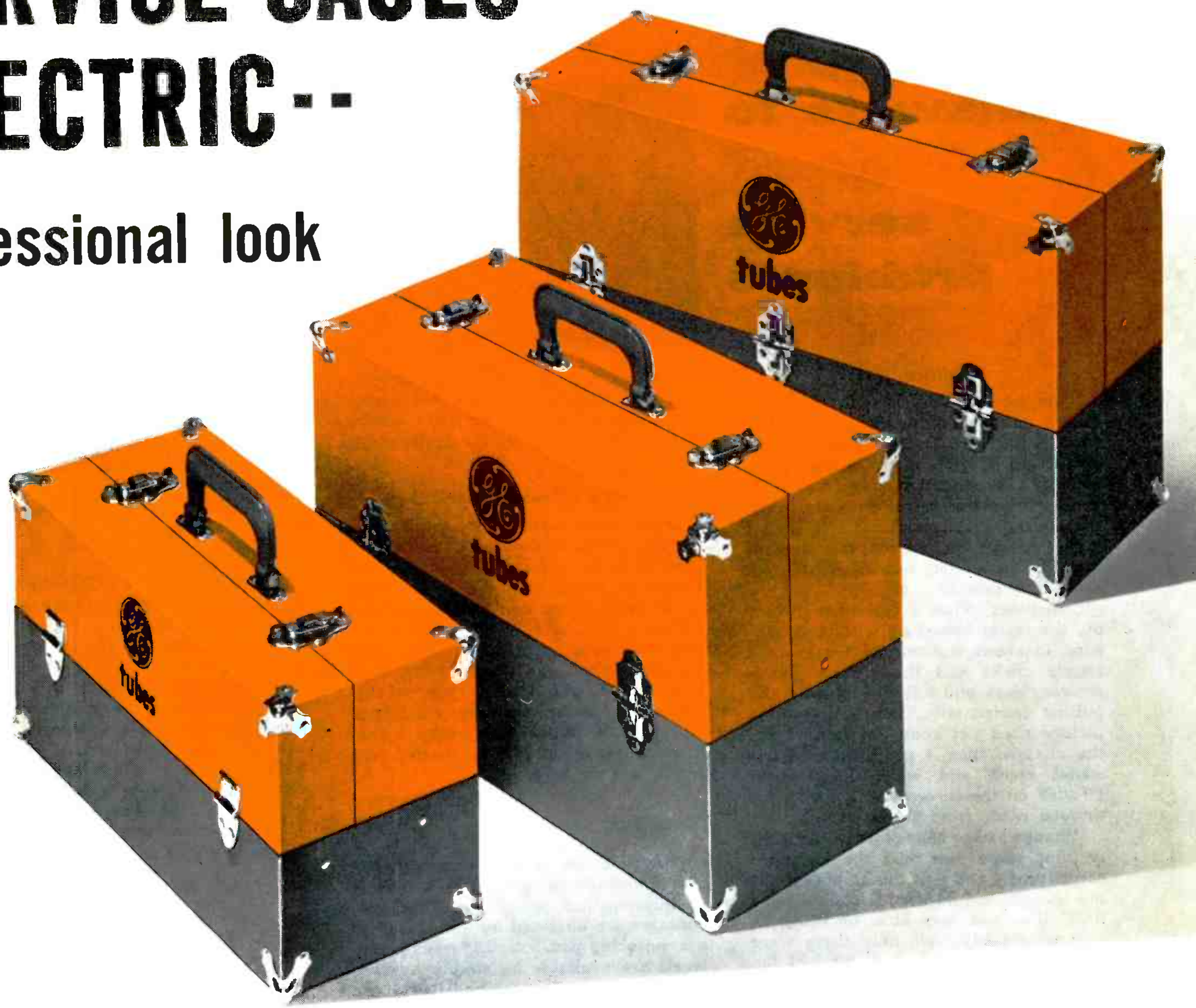
Triplett Electrical Instrument Company
Bluffton, Ohio

53 years of experience.


NOW!
MATCHED TV
FROM GENERAL
for that smart, efficient,
Exclusive with General Electric tube dealers!
Your prestige with customers will rise sharply.
Same modern two-tone styling for all your equipment.
Everything conveniently at hand for television repairs.
Expertly organized to save your working time.
Be first with the newest in home-service equipment!

SERVICE CASES ELECTRIC--

professional look



SERVICE TOOL CASE. 16" by 8" by 6 3/16". Weighs 5 1/2 lbs. without contents.

SPECIAL "160". Holds over 160 tubes. 17 7/8" by 8 3/8" by 11 7/16". 8 lbs. without contents.

SERVICE MASTER "240". Holds over 240 tubes. 22 1/8" by 9 9/16" by 12 3/4". 9 1/2 lbs. when empty.

These new matched service cases are a G-E "first". You can get them nowhere else. They are built just as strongly as their smart appearance indicates . . . with rugged construction, heavy-duty hardware, craftsmanship in every detail. And planned by service experts! You carry with you—compactly—everything you need for home service calls.

The cases are fully matched in design and in their attractive orange-and-gray colors. The leatherette-type finish is scuff-resistant for plenty of hard wear. You will be proud to carry these handsome cases into the finest home. Their smart, up-to-the-minute appearance stands for the quality television service you offer.

Waiting for you . . . now . . . is your set of matched service cases. Your General Electric tube distributor will tell you how to obtain them. Phone him! *Distributor Sales, Electronic Components Division, General Electric Co., Owensboro, Ky.*

Progress Is Our Most Important Product

GENERAL ELECTRIC

161-1A22

the TROUBLESHOOTER

answers to readers' service problems

Amplified AGC

I am having trouble with the AGC circuit in an RCA Model TC-125, Chassis KCS34B. The set is overloading and is out of sync vertically and horizontally. There is voltage on the AGC threshold control, but it does not work; the control itself checks OK. I cannot get a voltage reading on the plate of the AGC amplifier, but other voltages are OK within 10% or 20%.

Sometimes, when I first turn the set on, the raster comes on without a picture. In about one minute there are a couple clicks and the picture comes on, very dark and rolling vertically and pulling horizontally. Other times, the picture does not come on until I tap the chassis; then I get straight horizontal black and white lines about 1" wide on the screen and a loud continuous noise from the speaker.

I changed some capacitors in the AGC rectifier stage and also the capacitor across pins 4 and 6 of the amplifier, but the changes did no good. I clamped the AGC line and was able to bring in channel 2 fairly well, only there were thin white lines in the top third of the picture.

Julius E. Banko

Jersey City, N. J.

You are not alone—this AGC circuit has given many technicians a headache. Since you had some success in clamping the AGC line, you can rightly suspect trouble in the AGC rectifier or amplifier rather than in the video circuits or in the AGC line. Here are a few checks you might make:

When a signal is being applied to the receiver, are the rectifier cathode and amplifier grid voltages less negative than they are on inactive channels? If so, the rectifier is developing an output. Check the spread between grid and cathode voltages on the amplifier—if this is too great, the grid voltage may never be able to rise enough to bring the tube out of cutoff. If this is the case, check resistor values in the circuit.

If no change in voltage is observed at the rectifier cathode, check the grid of this tube with a scope for presence of a composite video input signal. This signal is applied to both the AGC rectifier and sync separator through a common connection from the first video amplifier, and a defect in this connecting circuit would account for your severe loss of sync as well as the faulty AGC action.

Multiple Speakers for P.A.

There have been a lot of articles on the constant-impedance method of speaker hookup for P.A. systems, but I have been able to find out very little about the constant voltage method. May I have a concise explanation of where and when it is best to use the constant voltage method and why? In my work I am faced with varied types of installations under exacting conditions, and I have found that every bit of information I can get, no matter how small, is a big help.

Stan Farmer

Grand Junction, Colo.

There are two primary advantages to the constant voltage system — simple hookup and low power loss. These advantages are obtained by not having to use matching pads, etc. Different power levels are available by simply hooking the speaker to the required power tap on the line transformer.

If you wish to have different or adjustable power levels at the speaker, a switch could be provided to connect the speaker to the different power taps of the transformer and still preserve the efficiency of the system. With this setup, the speaker could be operated at different power levels or even turned off without any bad effects upon the system, provided that the power output limits of the amplifier are not exceeded. The power levels are a function of the transformer design; other levels could be obtained by selecting a different line transformer.

Now, in the constant-impedance system, you must use pads if different power levels are required at the various speakers. As a byproduct, the variable output feature is thus automatically provided. However, you still have inefficient operation due to power losses in the pads.

Puzzling Symptoms

Would you please help me on a problem I have encountered in repairing a Hoffman TV, Chassis 171? On Channel 3, I am able to receive picture and sound; however, on all other channels, I have a clear picture but no sound at all.

James Mazzone

Phoenix, Ariz.

Since this is a split-sound receiver, the symptoms point directly to misalignment; thus, there are two possible solutions to the problem. You might either realign the RF and IF circuits as outlined in the service literature, or you might consider converting to an intercarrier IF system. Our November, 1956 issue contained an article presenting the details for converting from split-sound to intercarrier.

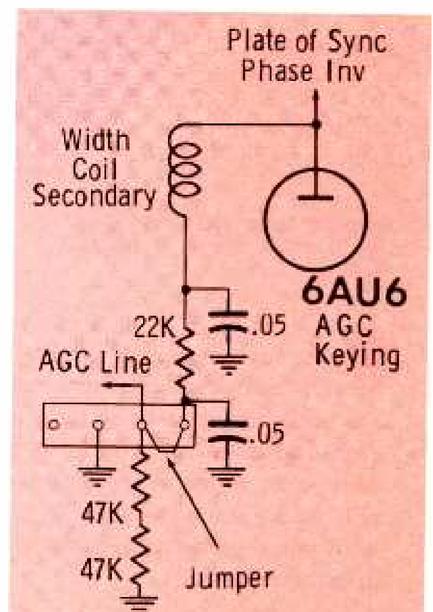
Horizontal Floating

I have a Westinghouse TV set in my shop for repair, Model number is H-640T17. The picture has a horizontal floating at times, and it washes out on a strong signal. On a weak signal the picture stays OK.

L. D. Payne, Jr.

Port Lavaca, Texas

In this chassis, the AGC tube is keyed by connecting its plate to the AGC line through a secondary winding on the width coil. Note that the connection includes a jumper, which is on a terminal board mounted on top of the chassis at one rear corner. This feature was provided so that a color converter, which was planned at the time the set was built, could easily be added to the receiver. If the jumper were removed, no AGC voltage whatsoever would be applied to the tuner and IF!



The width coil also supplies a pulse to the plate of a special type of sync phase inverter stage that controls the horizontal oscillator; therefore, any interference with the width-coil circuit would tend to affect horizontal sync. The keying pulses to this circuit would not be entirely disabled, since they would find a return path to ground through the .05-mfd capacitors.

another first for

RAYTHEON
BONDED
ELECTRONIC
TECHNICIANS

Now eligible for

GROUP LIFE INSURANCE

from RAYTHEON

SPONSORING BONDED PROGRAM DISTRIBUTORS

at no added cost................

Registered Bonded Dealers who by preference use Raytheon Receiving Tubes are now eligible for valuable life insurance coverage through their sponsoring distributors. It is obtainable without the necessity of a physical examination.

This Group Life Insurance Plan for Raytheon Bonded Electronic Technicians is underwritten by one of America's leading insurance companies for the exclusive use of sponsoring distributors of the Bonded Dealer Program.

Any Sponsoring Bonded Distributor who meets the necessary requirements for setting up a Group Life Insurance Plan for Bonded Dealers may help them obtain this important protection.

Check with your Raytheon Sponsoring Distributor and see if he has available to you this automatic way to gain personal security for you and your family. If you're not already a Raytheon Bonded Dealer, here's another wonderful reason why you should call your distributor and see if you can qualify. Being a Raytheon Bonded Dealer makes you stand out from the crowd. And using finest quality Raytheon Receiving Tubes for replacement work makes you the fair-haired boy with your customers, too.

RAYTHEON MANUFACTURING COMPANY

Receiving and Cathode Ray Tube Operations

NEWTON 58, MASS. 55 Chapel Street · **CHICAGO, ILL.** 9501 Grand Ave. (Franklin Park) · **ATLANTA 6, GA.** 1150 Zonolite Rd. N.E. · **LOS ANGELES 7, CALIF.** 2419 So. Grand Ave.

Raytheon makes all these { Receiving and Picture Tubes, Reliable Subminiature and Miniature Tubes, Semiconductor Diodes and Transistors, Nucleonic Tubes, Microwave Tubes.

RAYTHEON®
Excellence in Electronics

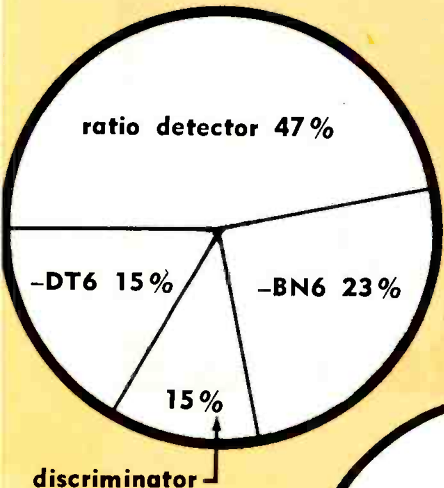
CIRCUIT POPULARITY GUIDE

Usage percentages of 1957 TV circuit designs

Ever stop to wonder how quickly the latest innovations in TV circuit design are "catching on?" And what about the design features introduced a few seasons ago—to what extent have they replaced older types of circuits?

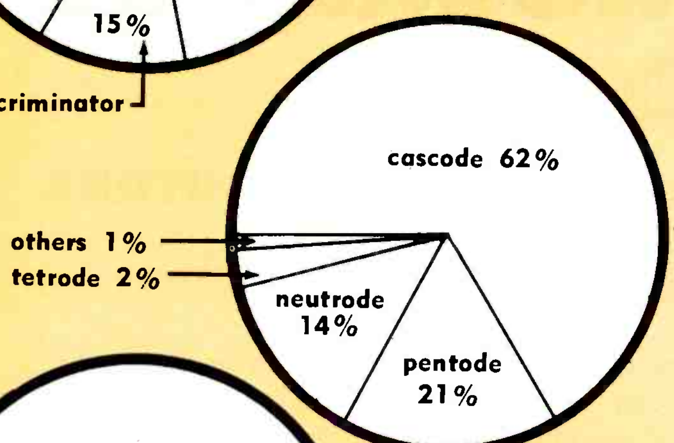
In order to keep track of important design trends, we have made a special study of all receiver chassis produced during the 1957 model year. The results are presented in the charts on these pages.

The percentage figure given for each design feature answers the question, "What proportion of the nearly 7 million *individual* 1957 model TV sets produced contain this feature?" Our estimates, based on the most accurate quantity-of-production data available for different models, will enable you to tell at a glance the directions in which to channel your studies of circuit theory.



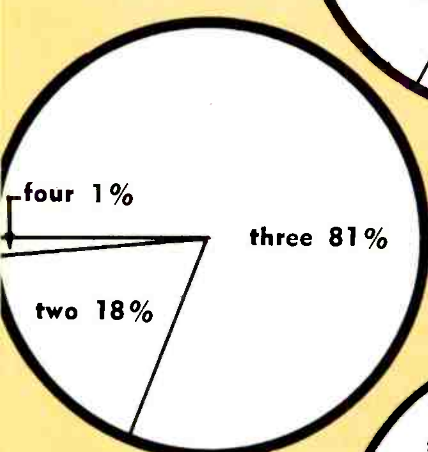
fm detector

Better brush up on the operation of –BN6 and –DT6 quadrature-grid detectors! These new circuits gained a lot of ground this past year, and indications are that they'll increase in popularity during '58.



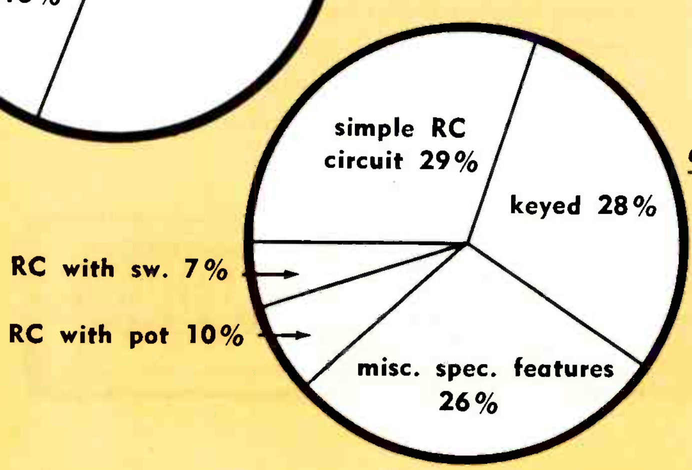
tuner

The familiar cascode tuner still holds the center of the stage, but the newly-introduced neutrode and tetrode designs are already making inroads on its popularity. You can expect to see more and more of these new types.



no. of if

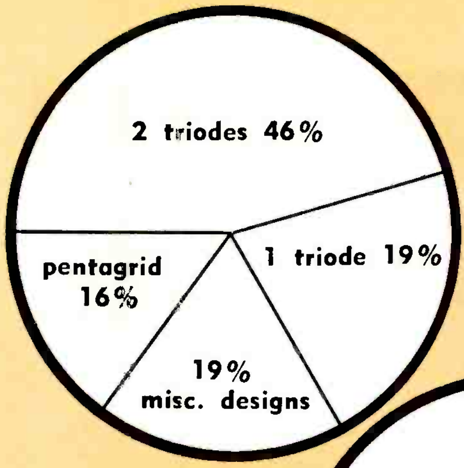
Goodbye to the 4-stage IF strip, except in a few of the plushiest receivers. Of the sets with only two IF stages, a majority (but not all!) are small-screen portables. Incidentally, only a few manufacturers now produce sets with 21-mc IF ranges.



agc

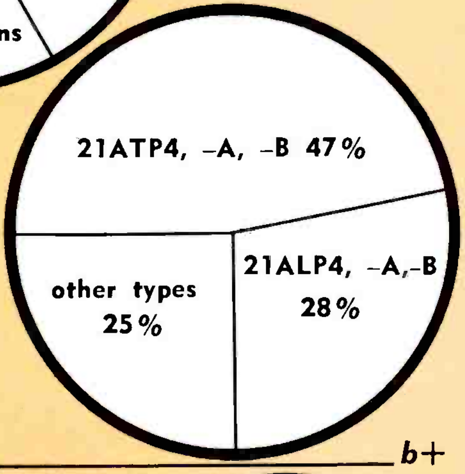
In a majority of 1957 receivers, AGC is obtained simply by feeding the video detector output through an RC network. Frills such as an AGC control pot or area switch are often added to improve operation. Keyed AGC maintains its status as strictly a deluxe feature. The "miscellaneous" category in this chart includes RC-type circuits with various special features such as fixed delay networks and clamp diodes for tuner AGC voltage; in addition, it includes the new –BU8 noise-limiting amplified AGC circuit, which has not yet gained wide popularity.

sync



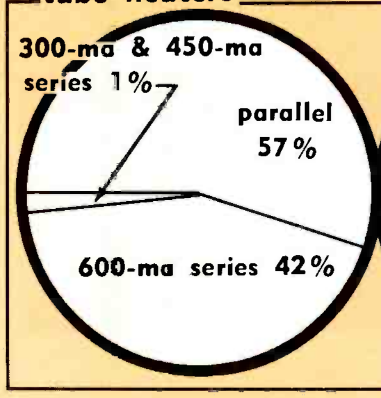
Although a stripped-down single-triode circuit has been widely used in portable sets, a sync section including two triode stages is more typical of 1957 receivers. Of the more elaborate sync circuits, the one most commonly employed is the pentagrid tube (–CS6, –BE6, or –BY6) used as a sync separator and noise limiter. Other special circuits such as triode-type noise limiters are lumped together under "Miscellaneous."

21" picture tubes

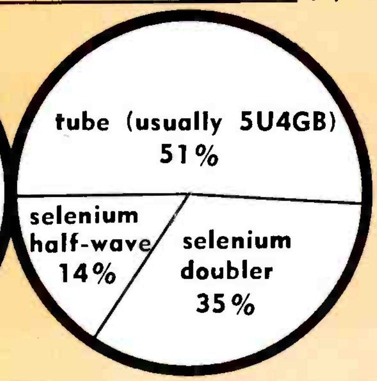


Only two basic 90° types account for three-fourths of all 21" picture tubes used in 1957 sets. This pleasant situation is due for a drastic change in '58 because new types of 110° and short-neck 90° tubes are being almost universally adopted.

tube heaters

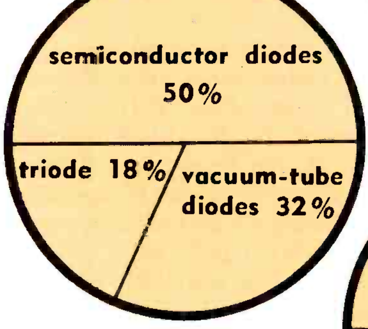


b+ rectifiers



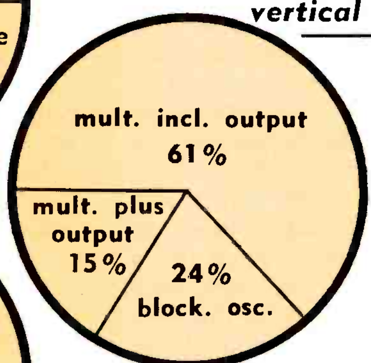
Seeing is believing! We have heard many comments to the effect that series-string sets have taken over the TV field, but the facts show that the transformer set is holding its own. Stop and think—virtually the entire 21" set production of such "big names" as RCA Victor, Zenith, and Silvertone contained parallel tube heaters during the past season. The new 450-ma series-string tubes have made a very small dent in the market thus far, but they'll be appearing in several makes of portables for '58.

afc detectors



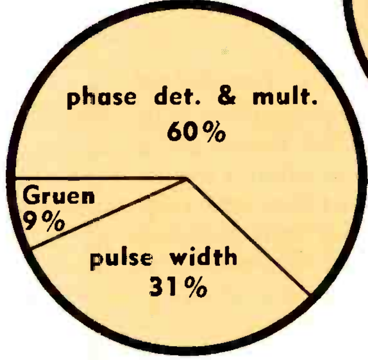
One definite trend is toward the use of selenium or germanium diodes to develop AFC voltage for multivibrator-type horizontal oscillators. As this chart illustrates, the new components have to a great degree replaced 6AL5's and other vacuum-tube diodes in this application.

vertical sweep



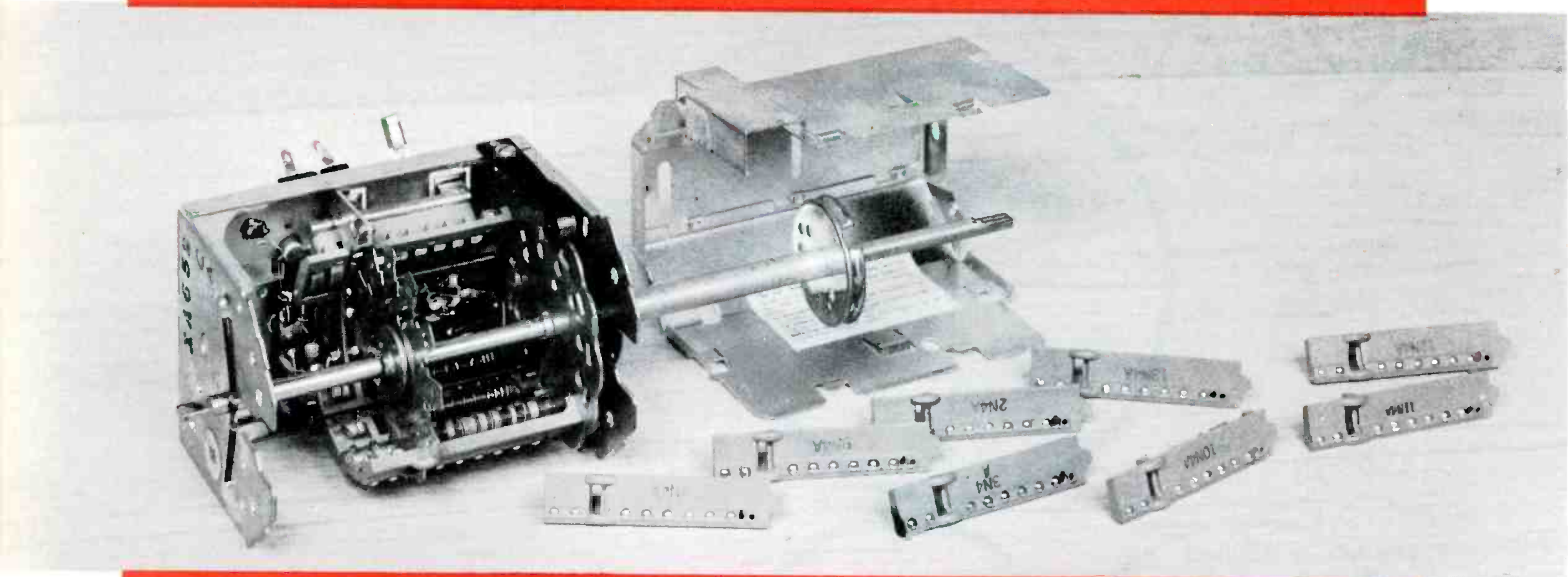
"The Modern Vertical Sweep Circuit" (multivibrator with second section serving also as an output stage) has rapidly taken over the No. One position. In some cases, a specially-designed dual triode such as the 6CM7 is used in this circuit; in other cases, a triode is used for the first half of the multivibrator and a beam power tube such as the 6W6GT or 6AQ5 for the second half. A vertical blocking oscillator is still favored by some manufacturers, but the 3-stage vertical sweep section seems to be going the way of the sound discriminator and the 4-stage video IF strip.

horizontal sweep



Although new developments in circuit design have not affected the horizontal AFC and oscillator stages as much as some other parts of the receiver, it is interesting to compare the popularity of the different systems in use. Multivibrator and pulse-width blocking oscillator systems both have large followings among manufacturers. The Gruen system (phase detector, AFC, oscillator and discharge tube) is used principally in Zenith sets.

inside TV tuners



part 5 UHF Design and Operation

by Calvin C. Young, Jr.

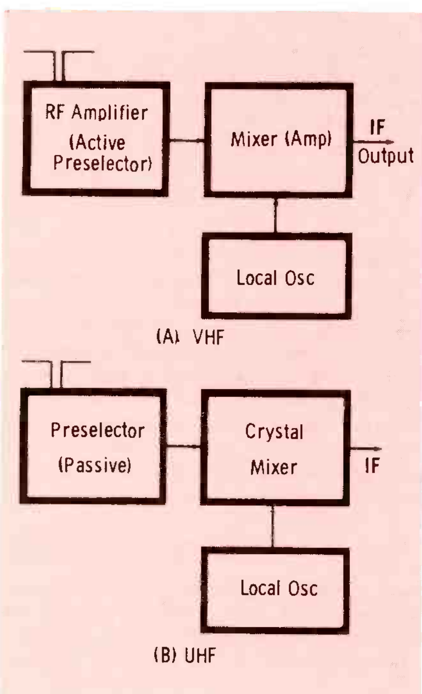


Fig. 1. Comparison of basic UHF and VHF block diagrams show similarities.

Even though a UHF tuner must cover 70 channels (14 through 83, 470 to 890 mc), its basic configuration is very similar to that of a VHF tuner. This is illustrated by the comparison of the UHF and VHF tuner block diagrams in Fig. 1. The RF amplifier in a VHF unit is an active preselector because it provides gain as well as selectivity, while the preselector in the UHF tuner is passive because no gain is provided.

The mixing of RF and local oscillator signals takes place in the grid-to-cathode circuit of a VHF mixer, and the difference frequencies produced by this heterodyne action are then amplified in the plate circuit. Thus, compared with the gain of the RF and the mixer stages in a VHF tuner, the UHF tuner with its passive preselector and crystal mixer would seem to have quite a disadvantage. However, the UHF tuner is never used alone; there is always in addition a VHF tuner in the receiver. By using a suitable switching network and a few extra components, the RF and mixer stages of the VHF tuner, as illustrated by the block diagram in Fig. 2, can be converted into a two-stage, low-noise IF amplifier so that the gain and signal-to-noise ratio of the UHF tuner will approach that of the VHF unit.

Now that we have had a brief look at the basic UHF tuner, let's examine each circuit separately.

Preselector

The preselector is the first stage in a UHF tuner, and even though it is not often a source of trouble, its functions are very important. Not only must the preselector provide adequate selectivity in order to reject image frequencies, but it must also provide a match between the antenna line and the crystal mixer, prevent undue feed through at intermediate frequencies, prevent local oscillator radiation, and offer as small an insertion loss as possible. With these many requirements, it is easy to see why the design of a preselector network is critical. However, since there are no vacuum tube circuits associated with the preselector network, it gives little or no trouble—provided, of course, that the unknowing individual doesn't tamper with its adjustments.

In Fig. 3. we have removed the shields and covers from a typical UHF tuner employing a two-stage, passive-type preselector so that you will be able to see something of the construction and adjustment features of both preselector and oscillator sections. The trimmer capacitors for the preselector stages are simply flat pieces of metal which can be bent toward or away from the stator section of the respective tuning capacitor. Tracking across the entire UHF band is made possible by the slotted rotor plates which can be bent or "knifed" as required. Antenna coupling into the preselector is balanced and provides a match between the antenna line and the first tuned circuit.

Coupling from the first stage of the preselector into the second is by virtue of the aperture (Fig. 4) in the divider between the two sections. Signal energy reaches the mixer circuit via the coupling loop L4 which is positioned near L3. This coupling loop provides the proper matching impedance between the preselector and mixer stages.

Crystal Mixer

The mixer is a simple 1N82 low-noise, UHF crystal diode of the plug-in variety. Mixing action takes place in the diode when signal energy picked up by L4 is heterodyned with the local oscillator signal. This local oscillator energy is provided by the pickup loop that connects to the anode and projects into the oscillator compartment. Since a mixer need only be a nonlinear device to provide heterodyne action, the crystal diode serves the purpose very well. In fact, less noise is generated in a crystal diode than in other types of mixers, which is the main reason for its use in UHF tuners.

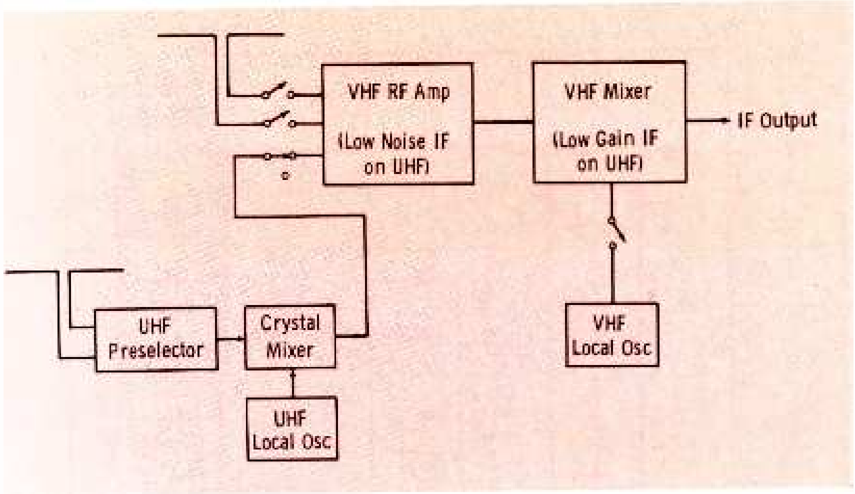


Fig. 2. Block diagram of UHF-VHF tuner.

The high frequency component of the mixing action is filtered out by the combination of L5 and C10, leaving only the 42 mc IF signal present at the mixer output jack. The mixer will retain its low-noise characteristics only if the oscillator injection current is maintained somewhere between .5 ma and 3 ma over the entire UHF tuning range. Furthermore, the maximum to minimum ratio should be as near 2 to 1 as possible. This means that if the minimum injection current is 1 ma, the maximum should be only 2 ma if best operation is to be insured.

Local Oscillator

The circuit shown in Fig. 4 uses a modified tuned line to vary the frequency and provide a feedback path to sustain oscillations. The .5 to 3 mmf trimmer is located very near the tube socket and is of the conventional, screw-adjust piston type. The other trimmer is shown in Fig. 3 and consists of a flat metal plate which is adjusted by positioning it with respect to the stators of the dual tuning capacitor. In this tuner, two trimmers are provided in the oscillator circuit so that both the low and high ends of the band may be adjusted. The trimmer near the tube socket provides adjustment at the low end of the band.

Troubles In UHF Tuners

Trouble in UHF tuners is generally due to tube or crystal failure, and this is where most technicians get into difficulty. If the replacement tube or crystal fails to cure the trouble, they either give up or start to twiddle the adjustments or probe around,

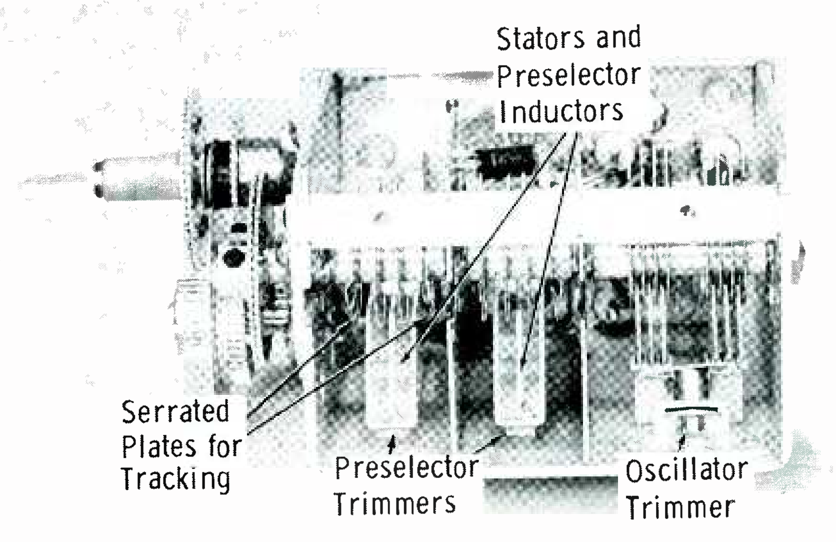


Fig. 3. UHF tuner with shields removed exposing preselector tuning assembly.

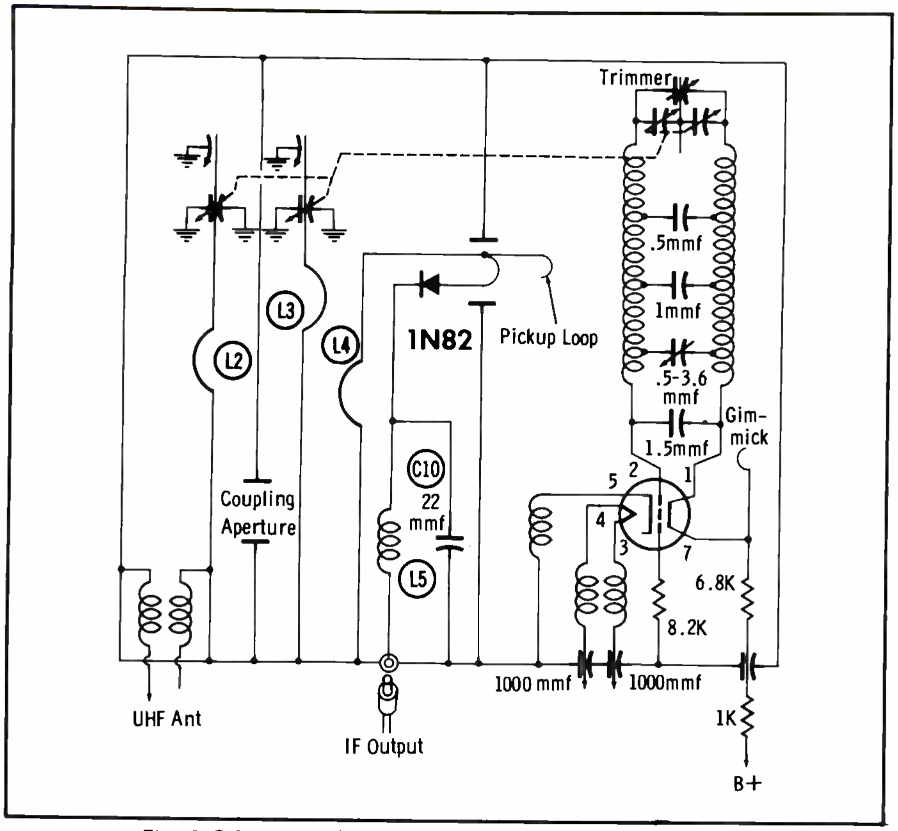


Fig. 4. Schematic of UHF tuner with two stage preselector.

moving components until everything is goofed up.

Before giving up, try substituting 5 to 6 tubes or 3 to 4 crystals. If the trouble is due to tube or crystal, you should be able to find one which will operate; it is not unusual to find that every replacement will not work. If multiple tube and crystal substitution fails to restore the UHF tuner to normal operation, a UHF sweep and marker generator and other suitable equipment will have to be employed to find the cause of the trouble. So just save yourself a lot of time and trouble and leave the thing alone unless you have the required equipment. Even if you can locate and replace a defective component in the oscillator circuit, chances are that the oscillator and mixer stages will require touch-up alignment to insure proper operation.

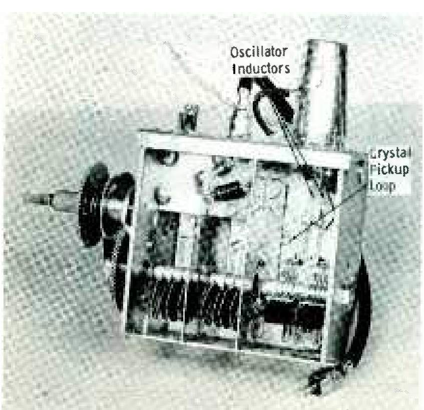


Fig. 5. Crystal injection loop.

We mentioned earlier that the crystal-mixer injection current should be maintained at .5 to 3 ma with a max-to-min ratio of 2 to 1 over the tuning range. The data given in the service literature for your particular tuner should be followed to check the crystal current. In this case, the IF output jack is terminated with a 100-ohm resistor and the voltage across it measured with a VTVM. A reading between .05 and .4 is normal. If this voltage is not obtained over the entire tuning range, the pickup loop shown in Fig. 5 should be repositioned to bring the reading into tolerance. Several replacement tubes and crystals may be required before a reading within tolerance is obtained. If the service literature outlines some method of testing crystal injection, rely on the information it provides as much as possible.

A word of caution on testing UHF oscillator tubes. Never test one in an emission tester and never make a shorts test on it in any checker. Either of these checks can cause permanent dam-

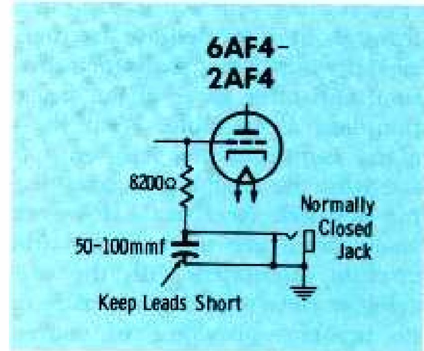


Fig. 6. Modification used in the measurement of oscillator grid current.

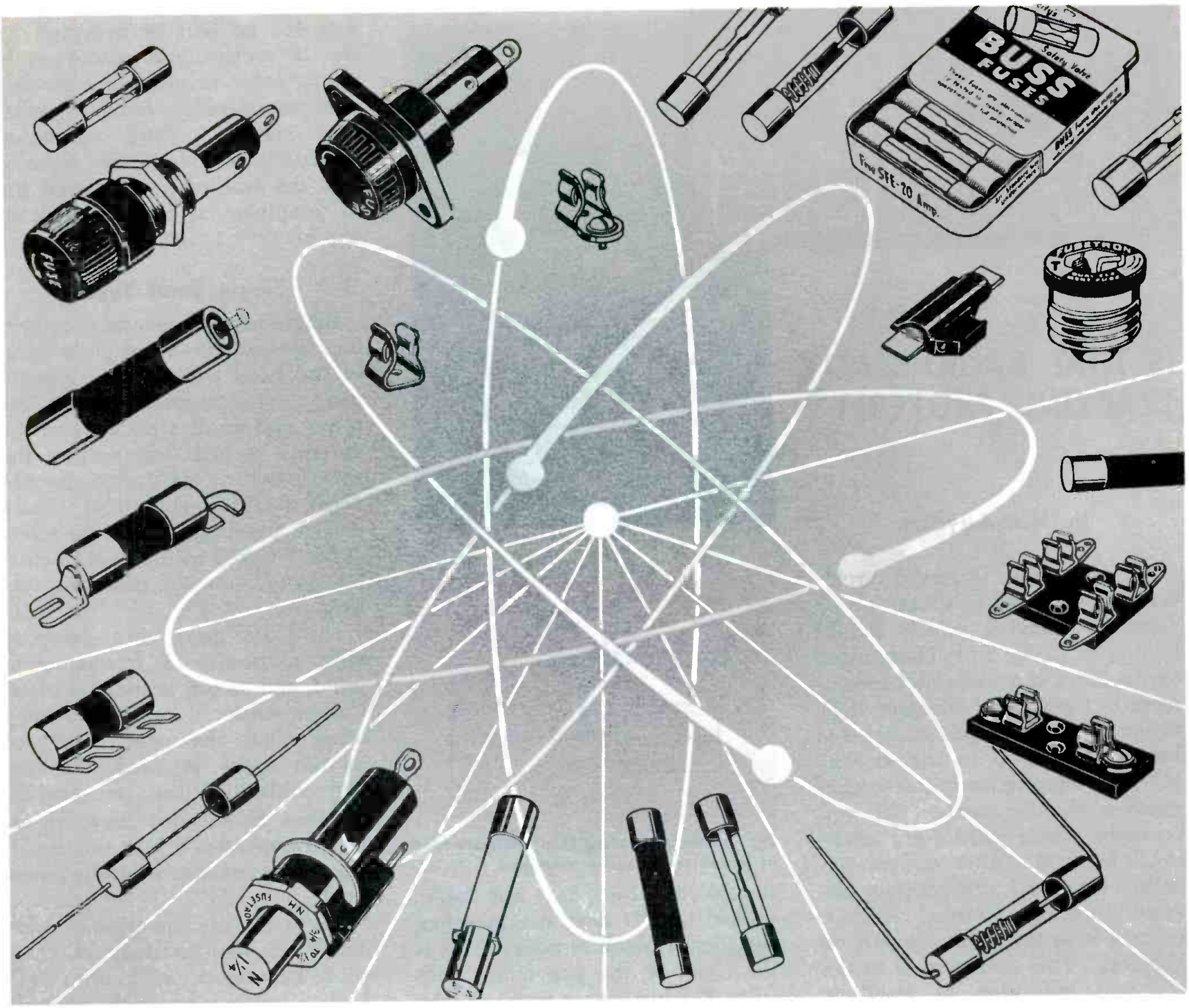
age which result in its immediate failure or shorten its life.

One well-known tube engineer states that the best tester for 6AF4 and 2AF4 tubes is a UHF tuner that has been modified so that the filament voltage can be reduced 10%. This would entail a switch and three resistors. In addition, the circuit must be modified so that oscillator grid current can be measured. This modification (Fig. 6) consists of ungrounding the grid resistor and installing a jack so that a 200-μa meter can be inserted into the grid circuit. The small capacitor should be of the ceramic-disc type and is used to bypass the inductance of the jack and meter movement, thereby preventing spurious action on the part of the oscillator tube. The leads to the meter are then equipped with a suitable polarized plug (grid end negative) so that its insertion into the jack will permit a reading of the grid current.

To make a test of the 6AF4 or 2AF4 tube, measure the grid current obtained under normal signal conditions. Then reduce the filament voltage 10%; if the grid current drops by 25% or more, don't use that tube on that particular channel. It may be all right for use on other channels.

By now you may have reasoned that, outside of tube and crystal replacement, there is not much you can do in the way of UHF tuner servicing—and you would be right. Unless you're doing it for knowledge rather than money, complete replacement of a UHF tuner will prove to be more profitable in the long run if service other than that mentioned is required. ▲

Editor's Note: This article marks the end of the series on tuners. Future issues will continue to present coverages on those circuits which seem to trouble the service technician most.



To assure proper operation *under all service conditions* Every BUSS and FUSETRON fuse is Electronically Tested

You can rely on BUSS and FUSETRON fuses for dependable electrical protection because . . . every fuse is tested in a sensitive electronic device that automatically rejects any fuse not correctly calibrated, properly constructed and right in all physical dimensions.

By standardizing on electronically tested BUSS and FUSETRON fuses, you are providing equipment with maximum protection against damage due to electrical faults. And, you are guarding against the possibility of faulty fuses blowing needlessly and causing unnecessary shutdowns.

Because BUSS and FUSETRON fuses do operate properly, they help you avoid 'call-backs' and adjustments that waste your time and cut into your profits. And, dependable BUSS and FUSETRON fuses help protect your good name for quality and service.

Complete Line: To meet service needs, there is a complete line of BUSS and FUSETRON fuses in sizes from 1/500 ampere up . . . plus a companion line of fuse clips, blocks and holders.

For more information on BUSS and FUSETRON Small Dimension fuses and fuseholders . . . Write for bulletin SFB. Bussmann Mfg. Division McGraw-Edison Co. University at Jefferson, St. Louis 7, Mo.

BUSS fuses are made to protect—not to blow, needlessly

FUSETRON
TRUSTWORTHY NAMES IN ELECTRICAL PROTECTION
BUSS

MAKERS OF A COMPLETE LINE OF FUSES FOR HOME, FARM, COMMERCIAL, ELECTRONIC, AUTOMOTIVE AND INDUSTRIAL USE.

1157

tracking SUPERHETS

IS THAT RADIO REALLY TRACKING PROPERLY?

by H. M. Layden

There exist in technical circles certain erroneous ideas about superhet tracking which should be nipped in the bud! These ideas spring from the loose and incomplete but generally accepted definition of tracking. This situation is best summed up in the answer of an experienced technician queried on the matter. "If you complain that a radio is not tracking," he said, "nine out of ten technicians will immediately assume that the stations are not coming in at the correct points on the dial." This corresponds to the accepted definition of tracking, which is, "A term used to indicate how the tuned circuits of a receiver follow the dial pointer as to frequency as the set is tuned through its entire range."

This definition is too loose and it can be very deceiving. The word *how,* as used here for instance, deserves close scrutiny because it attempts to cover too much territory and includes something which should be, but has not been, spelled out. It does not mention, specifically, peak response. This is the heart of the prevailing difficulty. For instance, a receiver may be bringing in all of the stations within its range, agreeing with the dial as to frequency, yet it may be bringing in some of them so poorly that the response is down as much as 6 db when compared to the response realized at the high and low ends of the band.

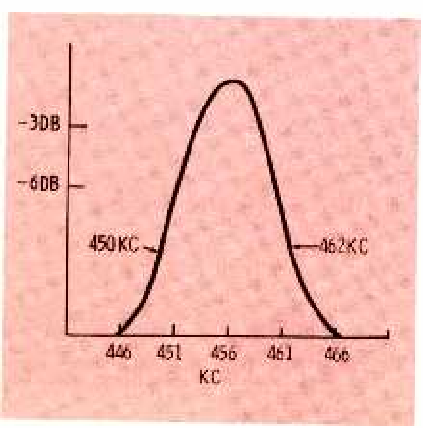


Fig. 1. Typical IF curve.

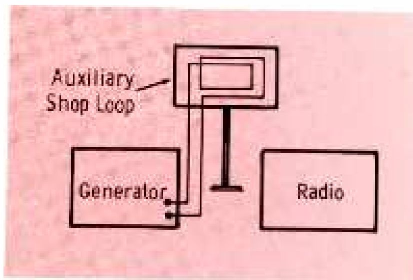


Fig. 2. Loose coupling thru auxiliary loop of generator to radio antenna.

Such a set, despite the agreement with the dial calibrations, can hardly be said to be tracking properly! Discounting the likelihood that the loss in response is due to a weaker signal from the stations involved, the only remaining conclusion is that it must be due to mistracking.

The result of taking this definition literally is to cause confusion and grossly mislead the technician. It may also result in passing on to the customer a receiver severely affected by a loss of sensitivity and selectivity. With an IF frequency of 456 kc and an IF curve like that in Fig. 1, for instance, any signal between 450 and 462 kc will be accepted by the IF section and passed on to the detector, resulting in considerable interference between adjacent stations. Thus, maximum selectivity and sensitivity demand that the wanted signal reach the IF amplifier at the IF peak of 456 kc.

Single Band Types

Single band broadcast receivers usually employ a cut-plate gang in the head end. In this type of gang, the oscillator section has fewer and smaller plates than the antenna section; but despite the theory behind its design, its use does not, unfortunately, insure proper tracking. The wide tolerances invoked in the manufacturing process are the defeating factors.

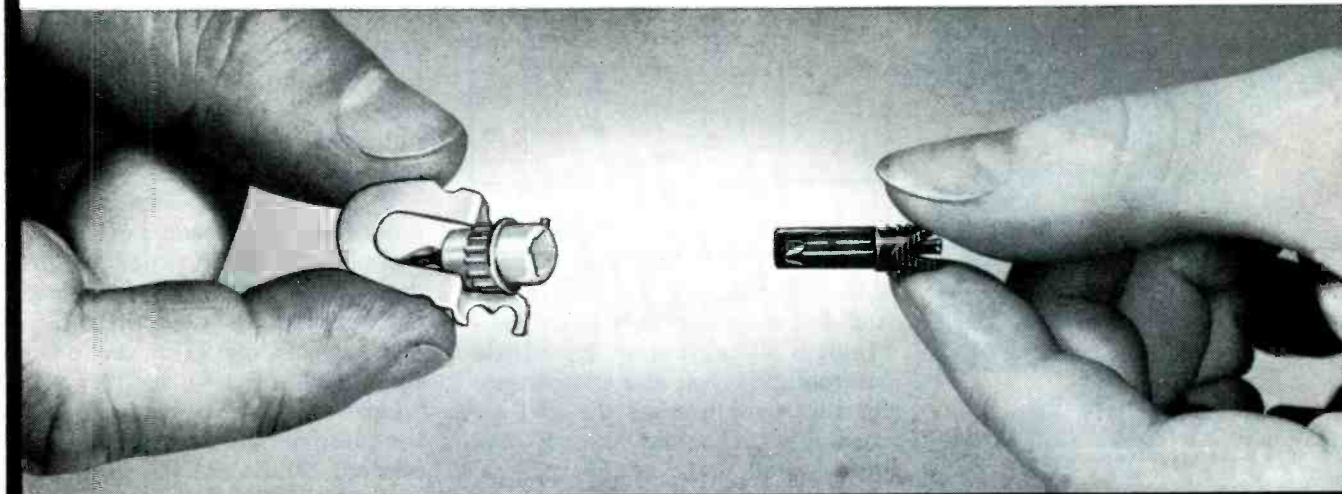
Cut-plate gangs are designed with a specific IF frequency in mind, and so too, is the dial plate. Consequently, if some frequency other than the one called for in the specs is used, tracking and calibration can be severely affected. How much they are affected depends on how far the IF frequency deviates from that specified.

Many technicians take a quick check on the accuracy of their shop generators as follows: (1) Use a radio in good working order, and set it a few feet from the generator. (2) Loosely couple the generator to the set through an auxiliary loop (Fig. 2). (3) Tune in a station in the neighborhood of 910 kc. Use a modulated signal and vary the generator dial in the vicinity of 455 kc (½ the dial indication). At some point near there you should hear the tone of modulation. (4) Turn off the modulation and listen for a high-pitched beat which appears on both sides of "zero beat." At zero beat the whistle tends to disappear into a low frequency rumble.

The generator at this point will accurately correspond to half the transmitting frequency of the station tuned in, and since this assigned frequency is accurate within 20 cycles as demanded by the FCC, the signal from your generator will assume the same order of exactness. The actual reading of the generator dial at

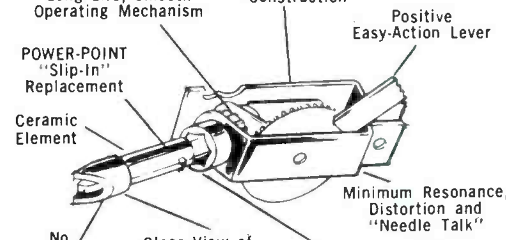
Electro-Voice® POWER-POINT

For Profit and Customer Service Without Problems!



POWER-POINT is the unique, easily installed, miniaturized unit containing BOTH a fresh ceramic cartridge and jeweled playing tips. You sell POWER-POINTS for LESS than the cost of a separate cartridge or two comparable phono needles alone! Most models $3.95 list. Only ¾″ long and less than ½″ in diameter, they're in color-coded nylon cases, blister-packed in plastic to keep them clean, factory-fresh, easy to handle.

YOU install the mount. Once that's done, the CUSTOMER can remove and replace units in a matter of seconds. You get the replacement business but none of the grief. You stock just three types of mounts and seven types of POWER-POINT units to service virtually all modern phonos. You save on inventory costs, conserve shelf space, take no risk of obsolescence.



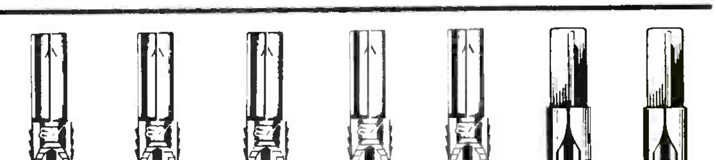
Typical POWER-POINT and Turnover Mount
POWER-POINT
Case—Nylon
Element—Ceramic
Tip Material—Superior Synthetic Sapphire or Natural Diamond
Tracking Force—5 to 8 grams
Net Weight—300 milligrams
Terminals—Berylium Copper, Self-cleaning Type
Load—1 meg. 100 mmfd
Compliance—1 x 10^{-6} cm/dyne
Average Output Voltage at 1000 cps
Test Record RCA 12-5-49V .85 Volt Col. 10004M 1.75 Volt
PT1 Mount
Material—Steel and Nylon
Finish—Cadmium Plate
Connector Size—.050″

THE MARKET IS BIG: OVER TWO MILLION NEW PHONOGRAPHS USE POWER-POINTS AS ORIGINAL EQUIPMENT! THE PROFITS ARE BIG—AND E-V HELPS YOU SELL WITH THESE MERCHANDISING AIDS.

Fact-crammed folder tells the full POWER-POINT story. Ask for Bulletin No. -223. Colorful, compelling envelope stuffer for mailing. Bulletin No. -225. Write Dept. R710.

Plastic-sealed blister-packed Power-Points are always in perfect condition. Package gives model identification, color-coding and instructions.

These are the color-coded POWER-POINT units, actual size



RED	GREEN	BLACK	BLUE	ORANGE	WHITE	PINK
Model 51-1, two 1-mil sapphire tips, $3.95 list.	Model 52-2, two 2-mil sapphire tips, $3.95 list.	Model 53-3, two 3-mil sapphire tips, $3.95 list.	Model 56, one 1-mil, one 3-mil sapphire tip, $3.95 list.	Model 56DS, one 1-mil diamond, one 3-mil sapphire tip, $16.50 list.	Model 76S, one 1-mil, one 3-mil sapphire tip, $4.25 list.	Model 76DS, one 1-mil diamond, one 3-mil sapphire tip, $16.50 list.

CALL YOUR E-V DISTRIBUTOR TODAY!

Electro-Voice

ELECTRO-VOICE, INC. • Buchanan, Michigan
Export: 13 East 40th Street, New York 16, U.S.A. Cables: ARLAB

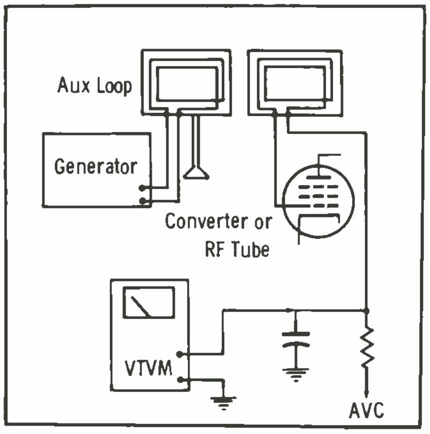


Fig. 3. VTVM monitors AVC and serves as output indicator during alignment.

this point will indicate how much, and in what direction, the generator is off calibration. By a little interpolation you can compensate for this error and set the dial accordingly to obtain the IF frequency called for in the specs.

Assuming that the IF has been properly aligned (the oscillator adjusted at the high end and the antenna circuit peaked at about 1400 kc), the next step is to investigate the response at 1000 kc, the middle of the band. A local station transmitting at or near this frequency, or a generator signal loosely coupled as in Fig. 2, may be used—the latter being preferable. A VTVM can be connected to the AVC bus (the outside lead of the loop) and used as the output indicator (see Fig. 3), allowing the technician to work undistracted by loud volume from the speaker (the volume control may be set at minimum) and unworried about the signal being below the AVC threshold. Then too, an unmodulated signal may be employed, if working with the generator, to obtain a sharper peak response. Modulation tends to broaden AVC response.

The radio is now tuned to the

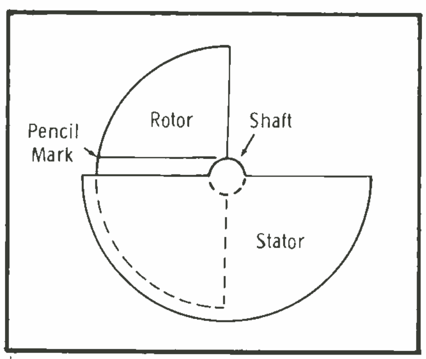


Fig. 4. Pencil mark rotor at point where it adjoins the stator.

signal, and the meter reading noted. The antenna trimmer is next turned slightly one way and then the other. If the circuits are tracking properly at this point in frequency, the slightest addition or subtraction of capacity will cause the meter reading to decline. If the meter reading increases, the circuits are not tracking. In either case, return the trimmer to its former setting as indicated by the original meter reading.

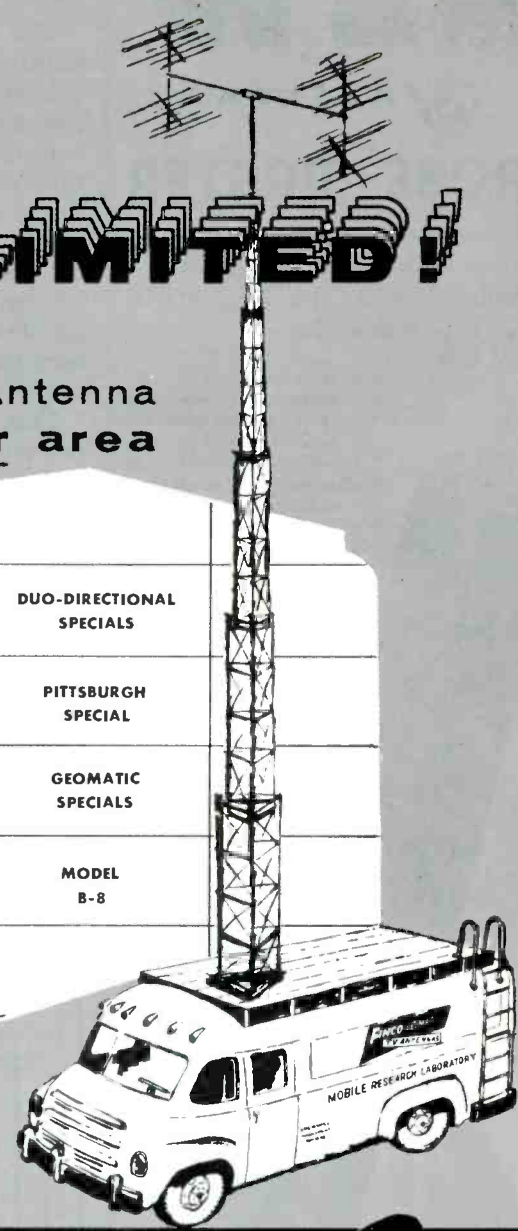
If this test indicates that the antenna circuit needs more or less capacity to track properly, proceed as follows: (1) Pencil mark the outside rotor plate of both the antenna and oscillator sections of the gang (Fig. 4) at the point where the unmeshed section of the plate divides from the meshed section. (2) Rotate the gang until the plates are completely unmeshed. (3) Locate the pencil mark on the antenna section, and apply a light pressure at this point. The idea is to narrow the spacing between rotor and stator in the area of the pencil mark so that capacity in that area will be increased.

The spacing may already be too close, prohibiting further narrowing without causing the plates to short. In such an event, the problem will have to be solved from another angle. Since we are interested in peak response at the IF frequency, it matters little if this is achieved by lowering the frequency of the antenna circuit, or by raising the frequency of the oscillator. This can be achieved by bending the oscillator rotor plate outward in the area of the pencil marking; hence, the reason for the pencil markings on both rotors.

It is in the area just below the pencil marking where capacitive compensation is needed for peak response. After each compensation, test for peak response via the trimmer manipulation. Once peak response is evident in the middle of the band, the same test and procedure is followed at 600 kc. When tracking is achieved at the middle and low end, the high end is investigated and touched up as needed. If this procedure is executed with care, both calibration and peak response throughout the

FINCO® announces

MODELS UNLIMITED!



NOW . . . you can sell a TV Antenna
designed for your area

	BUFFALO SPECIAL	SYRACUSE-ROCHESTER SPECIAL	DUO-DIRECTIONAL SPECIALS
	SAN DIEGO B-6	CHICAGO SPECIALS	PITTSBURGH SPECIAL
LONGVIEW, TEXAS SPECIAL	VICKSBURG SPECIAL	FLORIDA, WEST COAST SPECIAL	GEOMATIC SPECIALS
	PATENTED FIDELITY PHASING	DETROIT-TOLEDO SPECIAL	MODEL B-8
UHF-VHF SPECIALS	MODEL B-66		
MODEL B-7	FRONT-TO-BACK SPECIALS		

• IN SOLVING UNUSUAL, LOCALIZED RECEPTION PROBLEMS, FINCO has proved that the only positive way to develop the most efficient and economical TV Antenna is by actual MOBILE RESEARCH LABORATORY TESTS combined with Expert Topology and Channel Power Plotting.

If a distributor qualifies, Finco's research department assumes the task of studying the specific, local reception problems. If the problems can possibly be solved the result is an *exclusive* Red-Hot, *High-Profit* Hi-Performance Antenna For Your Area —

Hundreds of FINCO research projects are now in process or already completed, giving dealers and servicemen a big jump on their competition. The total cost to your Jobber IS HIS COOPERATION . . . urge Your Jobber to write, wire or call *FINCO TODAY!*

FINCO®
is often imitated . . .
the leader always is!

FINCO®

THE FINNEY COMPANY • 34 West Interstate Street • BEDFORD, OHIO • Telephone: BEdford 2-6161

Form No. 20-189

band should result.

Multiband Types

The tracking procedure for multiband receivers is more involved and takes a little longer to perform, but the end result in pep and freedom from adjacent station interference is well worth the time and effort. In contrast to single band receivers with their cut-plate gangs, multiband receivers employ a gang with uniform sections. It may incorporate three sections to handle the tuned RF, mixer, antenna and oscillator.

This, however, is relatively unimportant. The main consideration is that one gang tunes two or more bands! In making the big jump in frequency from one band to another, the coils are changed, but the same gang is used to tune them. This one fact precludes any bending of rotor plates to achieve proper tracking. It may develop that more capacity is called for to reach peak response in band A, less capacity is needed on band B, and perhaps no change in capacity is necessary for band C. Obviously, some other means than the bending of rotor plates must be used to make these sets track on all bands! The means employed is known as coil pruning, on which there will be more later.

As opposed to single band alignment, multiband alignment requires that the technician follow the instructions specifically outlined for each particular receiver. Service literature is a must. These receivers, while using one gang to tune all bands, require a different set of trimmers for each. Locating their physical position on the chassis and associating them with a particular band can be a difficult task without the aid of pictorial layouts. In receivers using series connected coils, a mixup in the selection of the proper trimmers can ruin the entire head end alignment! These receivers employ a series padder for each band (sometimes omitted on the highest band). The padder does for these sets what the cut-plate gang does for single band receivers; i.e. it changes the maximum capacity of the oscillator tank. On the broadcast band the padder is adjustable; on the others it is fixed.

Fig. 5 is a diagram of a three band receiver employing three tuned circuits in the head end—RF, mixer and oscillator. While the coils in this circuit are shunt

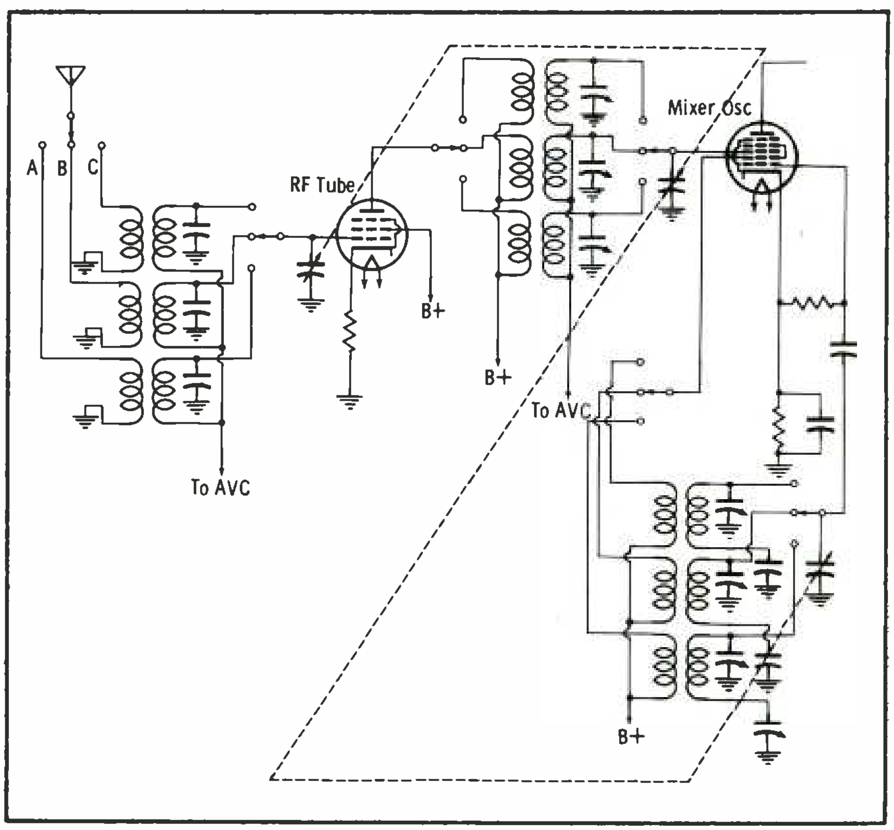


Fig. 5. Input circuits for three-band, triple-tuned superheterodyne.

To help you...

4 NEW CBS TECHNICAL AIDS

Here are four new CBS technical publications on tubes and semiconductors. Each is especially designed to make life easier for electronic technicians and engineers:

Technician's Handbook...

compact, comprehensive ready-reference data by and for the electronic service technician. Only $1.50 net.

Engineer's Handbook...

complete EIA data and two-color curves by and for engineers — and technicians who want all the facts. Only $7.50 net.

Transistor Course...

fast, fascinating home-study course — teaches basic fundamentals of transistors through use. Available from CBS Tube distributors.

Tube Tips...

monthly inside information on tubes and semiconductors — especially for service technicians. From CBS Tube distributors only.

You'll want all four of these CBS technical aids. See them . . . examine them . . . get them at your CBS Tube distributor's . . . today!

ELECTRON TUBES
CBS®
SEMICONDUCTORS

CBS-HYTRON, Danvers, Mass.
A Division of
Columbia Broadcasting System, Inc.

For the best in entertainment tune to CBS fed, some receivers employ a series-fed hookup. In the latter design, the highest band must be aligned first, then the next highest, etc. Shunt-fed receivers are not held to this rule, and any band may be aligned first.

The tracking setup is the same as in Fig. 3 with but one exception. The output on the high bands of some generators is not sufficient to permit the use of loose coupling, therefore, direct coupling through a dummy antenna is used (a 400-ohm carbon resistor for the short wave bands, and a 200-mmf capacitor for the broadcast band).

Assuming that the IF has been carefully and correctly aligned, the tracking procedure parallels, to a point, that outlined for single band receivers. The oscillator trimmer is adjusted at the high end, making doubly sure that this setting puts the oscillator *above* the incoming signal by the amount of the IF, and not below it as sometimes happens. The RF and mixer are peaked at the specified frequency near the high end.

The broadcast band of these sets requires a setting of the low-end padder before the tracking situation at the middle of the band can be checked. The padder adjustment may follow or precede the high end adjustments. On the other bands, the high end adjustments are immediately followed by a check of the response in the middle of the band. The same test for peak response, through a manipulation of the trimmers of the RF and mixer, is possible if a nonmagnetic, low capacity tool is used. A better means, however, would be the use of a tuning wand, or better yet, by the use of a "slicer" which consists of a paper thin piece of plastic, like the material used for dial faces on old radios, shaped in the form of a crescent. Inserting this between the rotor and stator increases the capacity at the point of insertion.

Evidence of mistracking is registered on the meter as with single band receivers, but the remedy differs. Instead of altering the capacity of the circuit to reach peak response, the inductance is altered. A need for more or less capacity is translated to mean a need for

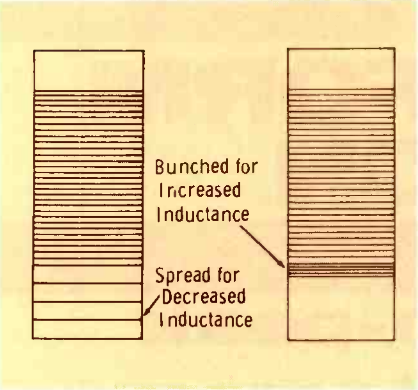


Fig. 6. Principle of coil pruning.

more or less inductance. Coil pruning consists of bunching or spreading the three or four end turns of a coil to alter its inductance. Bunching the turns increases the inductance, whereas spreading them decreases it.

Fig. 6 illustrates a coil altered in inductance value by pruning. Reasonable care should be exercised lest the coil wire become severed in the operation. The wax covering is gently scraped free, exposing the turns. A blunt instrument, thin enough to penetrate between the turns but not sharp enough to cut them, is used. A wood dowel or lead pencil does the job well—don't use the blade of a screwdriver or knife! Make sure also, that the winding being worked on does not carry B+.

The low end of the broadcast band should be rocked for best tracking. This means that after each trial setting of the padder, the gang is moved slightly in both directions, noting on the meter which direction of rotation (more or less capacity) contributes to an increase in AVC. That direction which shows a gain in AVC is pursued with each new setting of the padder, until a happy medium of gang setting and padder adjustment produces the highest meter reading. This is the final padder setting; the top of the band is given a touch-up, if needed, and the job is done.

These hints on tracking are addressed to the technician who takes his job seriously, who is proud of the work he turns out, and for whom nothing less than precise alignment will do. Happily, he constitutes a vast segment of the servicing profession, and his ranks are growing by leaps and bounds. ▲

SCOPE-WAVEFORM CALIBRATION

measuring peak-to-peak signal values

by Leslie D. Deane

When TV troubleshooting with a scope, how often have you said to yourself—"the shape of the waveform looks okay but I wonder about its amplitude?" To properly evaluate a signal at any given point, one should not only be concerned with the frequency and shape of a signal, but also its peak-to-peak voltage value. Signal amplitude is important because in practically all cases, it must be sufficient to drive or control a stage, picture tube, speaker, or deflection yoke.

The trouble symptom involved will naturally govern the importance of investigating signal amplitude, but in most cases this will become a pertinent servicing factor. Since it does play such a major roll in troubleshooting, the neophyte might well ask—"How do you actually go about measuring the peak-to-peak value of a scope waveform?"

Basic Setup Procedure

The basic procedure, regardless of instruments used, consists of comparing the "unknown" amplitude with one which is known. Suppose a technician has a general purpose oscilloscope that does not have internal calibration features. His first concern is to obtain a standard AC voltage from an outside source.

There are, at the present time, several commercial oscilloscope calibrators available to the service industry. Use of a switching arrangement permits rapid selection of either the calibrating signal or the waveform to be measured. It operates from the AC power line and usually develops a square or sine-wave signal having a peak-to-peak value of as much as 100 volts.

The basic hookup for such an instrument is illustrated in the drawing of Fig. 1. From it we see that the measured voltage is applied to the input terminals of the calibrator while its output is connected directly to the vertical input terminals of the scope. With this arrangement, the technician first places the calibrator switch in the direct position, thus feeding the signal to be measured directly into the scope. Placing the vertical gain control of the scope near mid position, he then selects an input attenuation and a horizontal sweep width that will cause the waveform to occupy approximately half of the screen area. After centering the pattern, the technician should record the overall amplitude of the waveform by making two straight lines on the scope screen with crayon, grease pencil, or tape. (See the horizontal lines at the top and bottom of the waveform of Fig. 1A.) Many commercial scopes have ruled calibration markings on a mask covering the screen. In this case, the technician need only note the number of horizontal lines or vertical divisions occupied by the waveform under investigation.

In the next step, the calibration switch is thrown to the calibrate position which applies a square or sine-wave from the instrument to the scope. The calibrator adjustments are then manipulated so that the height of the test signal matches that of the "unknown" waveform. During this operation, the input attenuator and the vertical gain control of the scope are not to be touched. If the "unknown" and calibration signals are equal in frequency and the sweep frequency of the scope is not changed, the test signal will appear as shown in Fig. 1B. The amplitude of both waveforms will be automatically indicated on the calibrator by either a graduated scale on a voltage calibration control or by a meter as shown in Fig. 1.

Other Calibration Methods

If the technician is without the services of an oscilloscope calibrator, he must then turn to some other voltage source for measurement purposes. The amplitude of a nonsymmetrical waveform can be truly indicated only by its peak-to-peak value; viz., the RMS value of this type of signal has little meaning unless its value is given in the service literature. The true RMS value of a symmetrical signal, however, can be readily measured with a VTVM or AC voltmeter within, of course, certain frequency limits. For all other signals, the scope calibration method is the most accurate. With this in mind, the technician should seek a reliable source of calibrating voltage such as that derived from a 60-cycle power line.

One method of using the line voltage for calibrating purposes

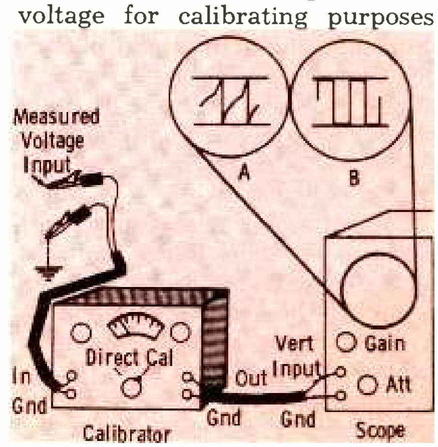


Fig. 1. Oscilloscope-Calibrator arrangement for peak-to-peak measurements.

involves the use of a variac. After setting up the unknown signal on the scope screen as previously recommended, the AC voltage obtained from the variac is applied to the scope input. The variac control is then rotated until the signal amplitude equals the height of the waveform to be measured. Remember that the vertical amplitude controls are not to be moved during this step.

Since the calibrating signal is sinusoidal, its RMS value has a direct relationship with its peak-to-peak amplitude. The RMS value of the variac voltage can be measured with a meter. Since the peak-to-peak amplitude is twice the peak value, the RMS meter reading must be multiplied by twice 1.414 or 2.828. For example, if the variac voltage measures 10 volts RMS then the peak-to-peak value equals 2.828 times 10 or 28.28 volts.

Another source frequently used for calibration is a known filament supply voltage. Conventional tube-heater lines will usually have an RMS value of 6.3 volts. This value is equivalent to approximately 18 volts peak-to-peak and may be used as such for all practical calibration purposes. Thus, without using a meter or any special signal generating device, the technician is able to compare the unknown waveform to this relatively standard voltage source.

Very seldom will the amplitude of the unknown waveform exactly equal that of the fixed filament voltage; therefore, it will usually be necessary to establish a ratio between the two signals as follows:

$$\frac{\text{height of unknown}}{\text{height of cal. volt.}} = \frac{\text{P-P unknown}}{\text{P-P cal. volt.}}$$

Fig. 2. Source of calibration voltage located on front panel of oscilloscope.

The height of each waveform should always be expressed in the same units, generally inches or the number of divisional markings on a calibrated mask.

A scope having a DC vertical input terminal can also be calibrated by a known DC voltage supply. To such an instrument, a DC voltage appears as a peak-to-peak signal; i.e., if we apply DC voltage to the vertical input terminals of the scope, the trace on the screen will move vertically. The amount of vertical displacement will be proportional to the amount of input voltage (within the maximum input limits of the instrument). Without a signal applied to the scope and the internal sweep producing a single horizontal trace, the trace line can be positioned to any convenient reference level on the screen with the centering controls.

The distance the trace line moves from its original reference will be the same as that produced by an AC signal having a peak-to-peak value equal to the DC poten-

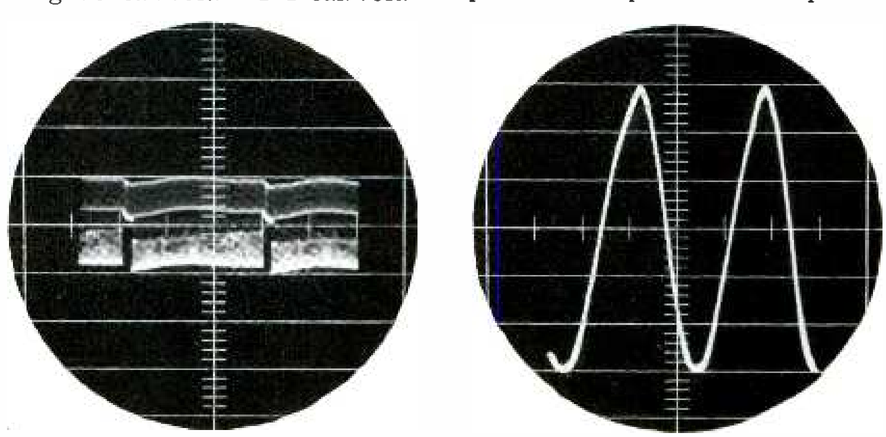


Fig. 3. Photographs taken directly from the screen of a typical service scope.

(A) Composite video signal. (B) 18 volt calibration pattern.

tial. We may thus compare the peak-to-peak distance covered by the unknown wave to the distance the trace line moves when a certain known DC voltage is applied.

Built-in Calibration

In order to simplify the task of measuring the peak-to-peak value of complex waveforms, many commercial scopes incorporate a built-in calibration feature. The calibration signal, usually a sine-wave, is applied internally to the vertical amplifier system through a switch or by connection of the test probe to a special jack. In the latter method, the procedure is similar to that used with an external voltage source. Scopes provided with this feature will usually have a front panel binding post where the test or calibration

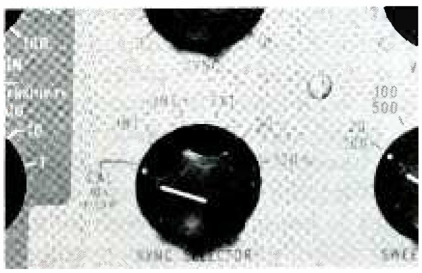


Fig. 4. Sync selector includes CAL. position for internal calibrating voltage.

voltage is readily available. (See example pictured in Fig. 2.) Using a scope having this feature, let's see how one might go about measuring the peak-to-peak amplitude of an actual waveform.

Supposing we had a TV trouble involving composite video and we wished to know the signal level at the video amplifier grid. After setting up the scope to view the waveform at a 30-cycle sweep, we adjust the vertical gain control until the signal occupies, say 10 of the small vertical calibration divisions on the scope mask. With the pattern centered, there should be 5 divisions both above and below the center reference line as shown in Fig. 3A.

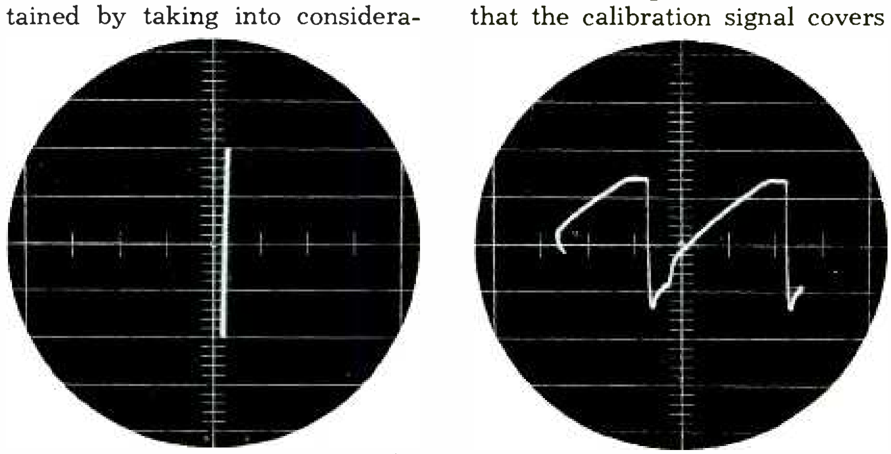
Removing the test probe from the set, we then touch it to the test signal jack. Adjusting only scope centering, we now obtain a sine-wave on the screen as shown in Fig. 3B. Knowing that the test signal has a peak-to-peak value of 18 volts, we then count the number of divisions occupied by the calibration voltage and calculate the value represented by each division. In the example shown, the calibration wave covers 15 divisions above and below the reference line for a total of 30. Dividing 18 by 30, we find that each division equals .6 volts. The original video signal had occupied a total of only 10 divisions; therefore, 10 times .6 equals the peak-to-peak value, or 6 volts. Actually, we might have used the larger mask divisions for comparison purposes in this particular case.

Rather than have the calibration voltage terminate on the front panel, some scopes use a switching arrangement to apply the test signal to the vertical system. The switch controlling the calibration voltage will often be found as part of another adjustment such as the sync selector switch pictured in Fig. 4. With the switch of Fig. 4 in the calibrate position, a 10 volt peak-to-peak signal is automatically applied to the vertical attenuator input circuit.

At this point one might ask, "Why take into account the setting of the vertical attenuator in some cases and not in others?" The answer to this question depends on where the calibration voltage is applied to the vertical system. If it is applied to the vertical input terminals and undergoes the reduction offered by the attenuator circuit, then obviously the scale markings represented by both test and "unknown" signals will have the same value. If, however, the calibration voltage is applied directly to the vertical system without passing through the input attenuator, the true value of the unknown signal can only be obtained by taking into consideration the attenuation setting. This will usually be a multiplying factor of .1, 10, or 100.

Fig. 5. This scope permits the use of 4 different calibrating voltages.

The built-in calibration feature of other instruments may sometimes include a switch for the individual selection of more than one fixed voltage. This type of instrument often incorporates a front panel adjustment such as that pictured in Fig. 5. To illustrate a procedure one might follow when using a scope of this type, let's check the amplitude of a typical signal found on the grid of a horizontal output tube. Realizing that the drive voltage at this point is generally between 50 and 100 volts, the technician might prefer to calibrate the scope first. In this case, he merely flips the calibration switch to the "100" position and sets the scope up to view the calibration wave at a convenient height on the screen. Many technicians would rather compare peak-to-peak measurements with the horizontal sweep of the scope reduced to zero. Neither sweep-width, shape of the wave, nor sweep frequency actually affect waveform amplitude. With the sweep-width reduced to zero and the gain control set so that the calibration signal covers



(A) Calibration wave with sweep-width reduced to zero.

(B) Waveform of horizontal drive voltage.

Fig. 6. Waveforms as they might appear in a typical calibration procedure.

20 scale divisions, the pattern resolves into a single vertical line as shown in Fig. 6A. Since the calibration deflection represents 100 volts, each scale division thus equals 5 volts.

We next turn the calibration switch to its "off" position and center the unknown wave on the screen at a 7,875 sweep frequency (see Fig. 6B). Without moving the vertical attenuator or gain control, we note that the unknown signal occupies 14 divisions on the mask scale. Multiplying 5 times 14, we find that the peak-to-peak value of the wave is 70 volts.

An example of a somewhat more elaborate method of internal scope calibration is where the instrument incorporates a peak-to-peak reading voltmeter. A panel portion of such an instrument can be seen in Fig. 7. The vertical

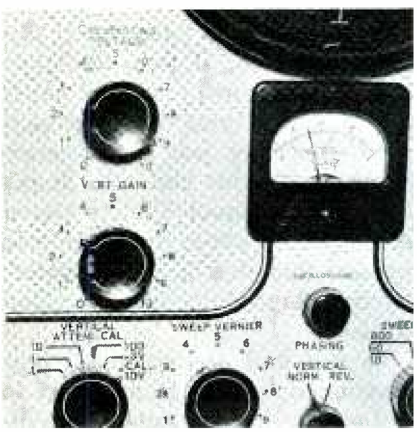


Fig. 7. Internal calibration feaures which include peak-to-peak reading voltmeter.

attenuator in this example has two added calibration positions, 3 and 10 volts, corresponding to two scales on the panel meter. The calibrating voltage control provides signal amplitude variations from zero to 3 or from zero to 10 volts depending on the "Cal." switch position. The peak-to-peak value of the internal calibration signal is indicated directly on the built-in meter.

The technician should keep in mind that any accessory probe used with a scope may introduce a certain amount of signal attenuation. In addition, the shunt capacitance offered by the feed-through circuit of an external calibrator may be too high for best results when using a low-capacity probe. These factors must be considered if accurate peak-to-peak measurements are to be realized. ▲

QUICKER SERVICING

by Calvin C. Young, Jr.

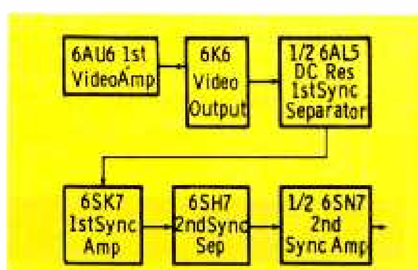
Well, I guess its my month to preach again. All of the old timers will probably agree with me that it's oftentimes harder to "repair" the customer than it is his TV set. This situation arose once again the other day when a custom 630-type receiver was returned to a customer. When the set was taken into the shop it had a multitude of troubles and the customer was informed that the repair bill could be quite high—on the order of $100 or more. This was to include conversion to intercarrier sound, tuner repair, realignment, plus a general going over. This particular set had been converted to a 20" picture tube from its original 16" size at some previous time, when considerable circuit modification had also been made in the sync, video and DC restorer stages.

After making the intercarrier conversion, repairing and realigning the tuner, video IF and sound IF, the set was tuned to a local station to check its operation. Sync was found to be very poor, and naturally, the tubes in the sync section were substituted. This is when the extent of the sync circuit modifications became known. In the original circuit, the DC restorer was used as the sync takeoff point and then a 6SK7, 6SH7 and ½ of a 6SN7 were employed as shown in Fig. 1A. A thorough check of the circuit revealed that now 6SN7's were employed as shown in Fig. 1B. Notice that one stage of sync amplification has been eliminated in addition to the gain originally furnished by the video output stage.

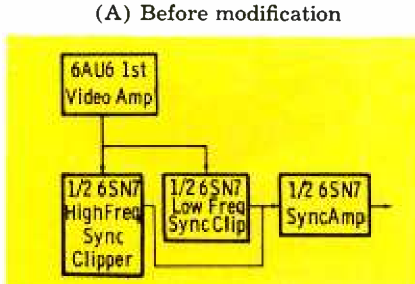
The modified circuit approximated the one used in some later Mattison and Tech-Master 630-type chassis; however, no consideration was given to the fact that these commercial designs employed a cascode tuner and four 6CB6 IF stages.

A scope check of the entire modified sync section revealed that, instead of sync pulses, composite video was present at the output of the sync amplifier. A comparison of the circuit with that of a Mattison receiver revealed that, in addition to the different gains of the tuner and IF sections, different voltage sources were employed in the two circuits. It was therefore decided that the sync section should be restored to its original state.

When this had been accomplished, vertical hold was satisfactory, but horizontal sync seemed to be unstable. In fact, the picture would shake from side to side spasmodically. A complete tracing of the horizontal oscillator and AFC networks uncovered another circuit modification. Just for curiosity, this network (a .1-400V capacitor and a 10K-resistor in the control grid circuit of the 6AC7



(A) Before modification



(B) After modification

Fig. 1. Block diagram of the sync section of a 630-type chassis.

reactance tube) was disconnected with the result that the picture shaking stopped and the receiver operation was restored to normal.

Customer Reaction

Now that you have the background of the technician's effort, let's get into the customer's reaction at the sight of the $118.25 repair bill. This was itemized even to the $47.50 charge for the 9½ hours required to rewire the sync, video, DC restorer and horizontal AFC stages to conform with the original design.

Even though the customer had been informed of the possible repair charges, agreed to have the set repaired, and openly stated that set operation was to his satisfaction, he would not pay the repair charge. Instead, he said that he would try it out first and pay later.

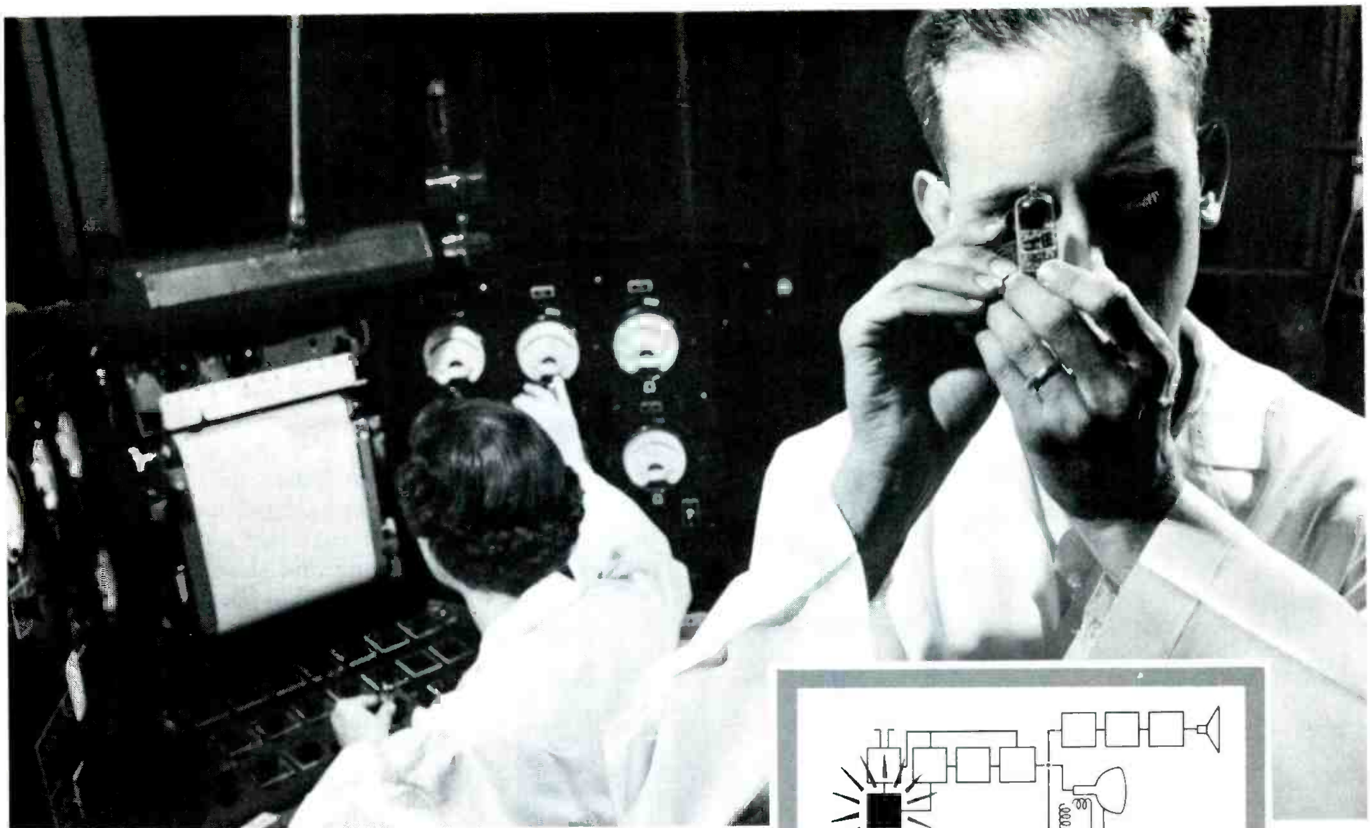
As you know, a situation of this kind is loaded. If you say okay and leave the set, you may never collect, and if you insist on payment you may lose a customer. Realizing all this and also knowing that no Small Claims Court existed in his state, the technician decided that this customer wasn't worth $115 and decided to collect or else.

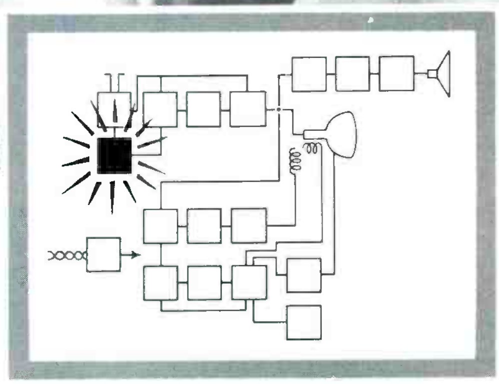
To this end, the customer was questioned further in an effort to find out the reason for his unwillingness to pay. It was finally determined that he had been under the impression that the estimate of $100 was to be a maximum and would most likely be less. This gave the technician his clue. He offered to settle the repair bill for $100, and the customer accepted.

Now that the technician had collected most of what he deemed to be more than fair, he departed, fully convinced that he would no longer accept service jobs from that customer other than make-good calls.

Recall

Almost within the hour, the phone rang and who should it be? You guessed it—the guy we were just talking about! He couldn't get the picture to lock in. There was nothing to do but agree to have another look at the set. Wanting to clear the situation up as quickly as possible, the technician went back immediately. When the set





G-E DESIGN ENGINEER M. W. LeClear examines the structure of a 6U8 through a magnifier. Characteristics of the tube have been plotted by the two-axis recorder in background. Outstanding quality of G-E oscillator-mixer tubes—consequently, their popularity as replacements—comes from a balanced application of advanced design principles, precision manufacture, and careful testing.

Superior quality of G-E oscillator-mixer tubes proved by their high gain and uniform electrical characteristics!

Time is your most valuable commodity. Any replacement that conserves your working time and makes it more productive, puts extra dollars in your pocket.

The case for General Electric oscillator-mixer tubes rests on that benefit. These quality types—such as the 6U8, 6X8, 6CL8, 6CG8—have uniform tube-to-tube electrical properties. Install them as head-end replacements, and no adjustment of the coarse oscillator frequency control normally is needed.

Add the saving in call-back time that comes from first-class performance of customers' receivers! For high-gain General Electric oscillator-mixer tubes reduce noise. Their low microphonics mean minimum streaking and similar picture disturbances.

Complete redesign of the pentode section was necessary to obtain the high tube gain you require for top performance. Rigid tube structure and precision control of grid-rod and mica-aperture diameters keep down microphonics. Uniform electrical characteristics of G-E oscillator-mixer types are a product of (1) the industry's most advanced methods of manufacture to high-quality standards, (2) testing and retesting.

Install General Electric tubes for superior performance you can count on . . . every time, from every tube! Your G-E tube distributor makes fast deliveries. Phone him! *Distributor Sales, Electronic Components Division, General Electric Company, Owensboro, Kentucky.*

Progress Is Our Most Important Product

GENERAL ELECTRIC

161-1A11

had been turned on and allowed to warm up, the picture rolled and flopped in both directions. As expected, simply adjusting the horizontal and vertical hold controls restored normal operation.

The deep-seated moral of this story is to have a clear understanding with the customer before taking a set in and special authorization for any additional repairs which are later deemed necessary. In addition, it emphasizes just how a customer can be expected to act on receipt of a large repair bill—at least one nuisance call is standard procedure.

The case just outlined is a very bad one and should be avoided if at all possible because of the long-range problems it may generate. Such situations can result in the loss of a great many good customers, particularly if the offended one happens to be an influential person who is intimate with many of your good customers. The only sure way to avoid such a situation is to avoid repair jobs on old sets where the lion's share of the charges will be for labor.

Callbackitis

This business of callbacks is a tough nut to crack. It must, however, be solved if your service business is to operate at a profit while charging fair and competitive rates. The following case history cites an example of the type of trouble that can easily result in callbacks.

The set in question, a 21" Sylvania, had neither sound nor picture when the technician arrived, so he wasn't surprised to see that

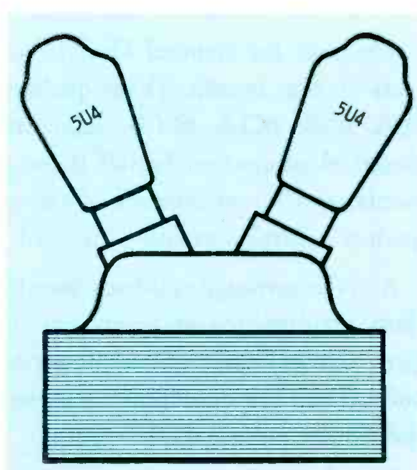


Fig. 2. Transformer-mounted 5U4G's.

one of the 5U4G tubes atop the power transformer (Fig. 2) wasn't lit. Since 5U4G tubes are often operated in parallel, both tubes were replaced. Sure enough, this restored both picture and sound. After testing the various controls and adjustments to make sure no other troubles were present, the technician collected his fee and left, feeling that the trouble had been corrected.

The next evening the customer called and said the picture and sound had failed again. The technician, a naturally curious sort, consulted his service literature and found that one 5U4G was used to develop 320V and the other 125V (Fig. 3) and weren't connected in parallel at all. Armed with this data, he returned to the customer's home and found the same symptom as before, the same 5U4 did not light.

Just to make certain that the tube had really failed, the technician inserted it into his filament checker. Lo and behold, the tube filament was good. He now knew that one of two things had happened. Either the filament winding for that tube was intermittent or there was a poor solder joint on the tube socket filament connections.

The receiver was taken into the shop where the trouble proved to be a poor solder joint. Needless to say, every 5U4 found with an open filament is now tested and one more possible source of callbacks has thereby been eliminated.

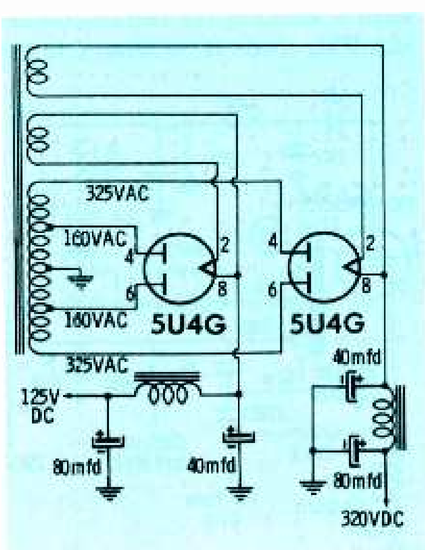


Fig. 3. Power supply circuit with separate high and low voltage rectifiers.

Shop Headache

It has long been known that intermittents are among the hardest troubles to locate and cure. This conviction was strengthened considerably by the intermittent, momentary collapse of vertical sweep in a Zenith receiver. The trouble was labeled intermittent and momentary because it happened frequently but lasted for only an instant. In fact, the time duration of the failure was so short that a bright white line would appear across the screen superimposed on the regular image. The picture would flop vertically each time this occurred, further confusing the issue.

In an attempt to isolate the trouble to a portion of the vertical sweep circuit, every point in the oscillator and output stages was monitored with an oscilloscope and a VTVM, but no usable information was discovered. The tubes were substituted several times and all capacitors and resistors either substituted or replaced without gaining even one clue.

The sync input was removed and the vertical oscillator adjusted to as near 60 cps as possible with the hold control. When the bright white line appeared in the slowly moving picture, it was obvious that the trouble wasn't due to a noise pulse in the sync signal. This left only one thing that hadn't been checked—the vertical output transformer.

As you can see in Fig. 4, this unit was a special autotransformer with a winding for retrace blanking. This made it necessary to get

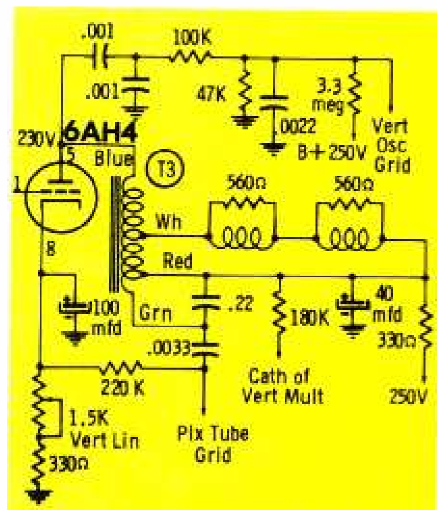


Fig. 4. Zenith vertical output circuit.

an identical replacement unit from a local parts distributor. Sure enough, replacement of the unit cured the trouble, but since the circuit is quite complex, a considerable amount of time was spent in locating the trouble.

In the final analysis, it was decided that two of the turns on the transformer winding were probably shorting, causing the momentary collapse of vertical sweep. It was further decided that this was just one of those troubles that make a technician earn his money and that the time spent was necessary.

Had a replacement transformer been on hand, it might have been tried sooner just on a hunch; but it is obviously not possible to stock replacement units for every set made, and this was one that was not stocked.

Another Shop Job

A receiver that employed a pulse width type of horizontal AFC (*Synchroguide*) oscillator network was brought into the shop recently because it would drift out of sync after it heated up. When the chassis was out of the cabinet it seemed to work okay, yet when the chassis was reinstalled, the trouble would appear. Rather than waste time, the chassis was again removed and the .01-mfd capacitor between C and D on the transformer (Fig. 5), the 180-mmf between F of the transformer and the oscillator grid, and the 8.2K-resistor between A and C, were all replaced since they are generally the components that cause frequency drift. This failed to cure the trouble and left the technician wondering what to do next.

Figuring that the trouble was due to increasing heat, a soldering iron was used to heat the leads of various components. Naturally, the iron wasn't left on any lead long enough to damage the component. No results were obtained until the lead on the 560-mmf coupling capacitor was heated. Replacement of this item restored normal operation.

This example just points out the futility of trying to memorize and categorize all TV troubles. One would do better to cultivate a good, logical technique for finding the actual trouble.

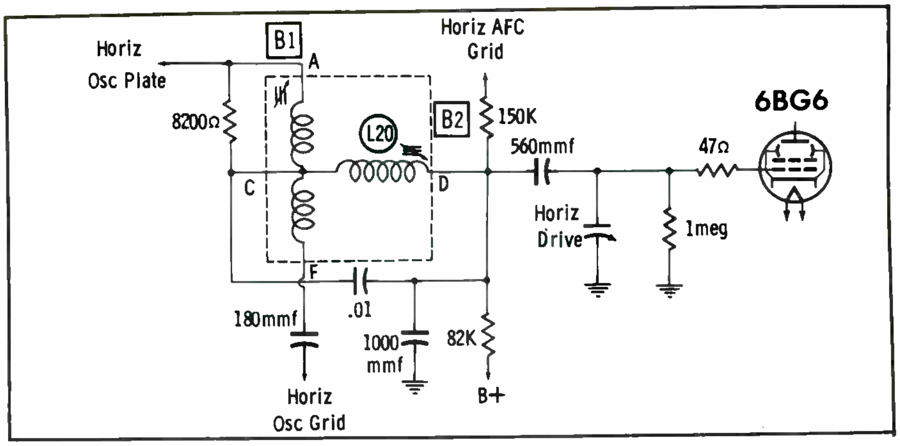


Fig. 5. Schematic of "Synchroguide" horizontal oscillator circuit.

servicing new designs

Chairside TV Tuner

Most remote-control devices used with TV sets are designed only for the purpose of regulating the operation of such receiver stages as the tuner and audio amplifier, and are not intended to take the place of these stages.

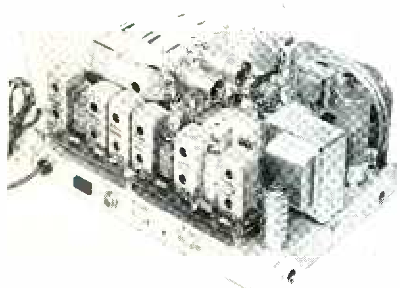


Fig. 1. The Tech-Master Model 23 delivers a complete composite video signal.

An entirely different approach to remote-control design is found in the Tech-Master Model 23 "Duo-Master" (Fig. 1), which contains substitute circuitry for nearly half of the TV set. As shown in the block diagram of Fig. 2, the 15-lb. remote unit has its own VHF pentode tuner, 3-stage IF strip, video detector and sound IF and audio section. Channel-selector, fine-tuning, volume, and contrast controls are also included. The audio circuit drives a small speaker or earphones for low-level listening at the remote location.

The "Duo-Master" puts out a composite video signal and would therefore be capable of operating a closed-circuit monitor type of receiver having only video, sync, sweep, and high-voltage circuits. For remote operation of a conventional TV set, a coaxial cable from the video output jack of the remote chassis is connected to the video detector load circuit of the receiver in place of the set's own detector diode.

For this cable run, the manufacturer suggests RG-58/U coax, which is convenient to handle because of its small diameter. Even though the shunt capacitance of this type of cable is relatively low, it does have a noticeable effect on high video frequencies if the cable run is much longer than 25 ft. Extended runs up to 60 ft. can be made if a resistor of 100 to 330 ohms is connected across the cable output (between center conductor and chassis ground) to lower the effective resistance of the video detector load.

Note that the video output of the "Duo-Master" is obtained from a cathode follower consisting of both sections of a 6J6 in parallel. Details of this circuit are shown in Fig. 3. The contrast control on the remote unit governs the level of the signal applied to the cable.

The audio circuit (Fig. 4) offers

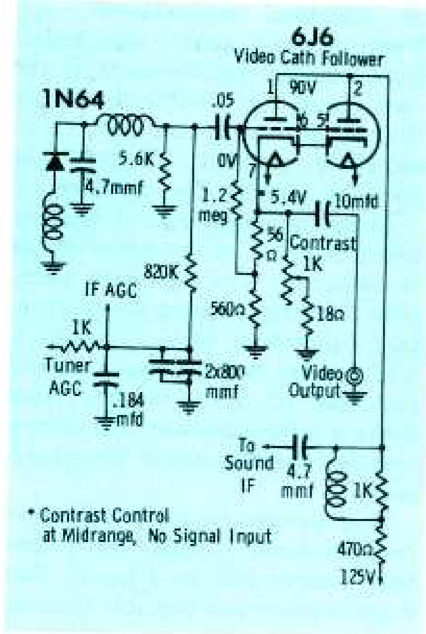


Fig. 3. Details of video cathode follower circuit.

a choice of three outputs. A 4" speaker and an earphone jack are hooked in parallel across the output transformer and a phono jack is wired across the cathode circuit of the tube. The signal obtained at this last point is suitable for application to an external hi-fi amplifier or tape recorder. The user can also listen to sound from the regular TV speaker if he so desires—provided that the receiver is of the intercarrier type with sound take-off somewhere in the video amplifier circuit.

The remote unit has its own power supply, consisting of an isolation transformer and a half-wave selenium rectifier. Tube heaters are parallel-connected to a 6.3-volt winding on the transformer. NOTE: The "Duo-Master" *cannot* be used with a "hot-chassis" transformerless set unless the latter is connected to the AC line through an isolation transformer.

FM Radio Plays Through TV Set

One of the most unusual pieces of equipment we've seen in a long time is the Regency RC-103 "Tele-Verter," a transistorized, battery-powered tuner which equips a TV set for FM radio reception. (See Figs. 5 and 6.) This self-contained unit is hooked up much the same as a booster or external UHF converter, receiving a signal from a TV antenna and delivering an output at some VHF channel frequency to the antenna terminals

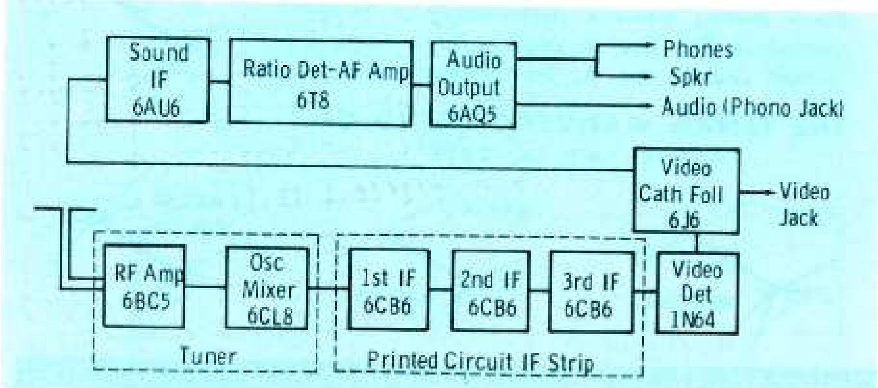
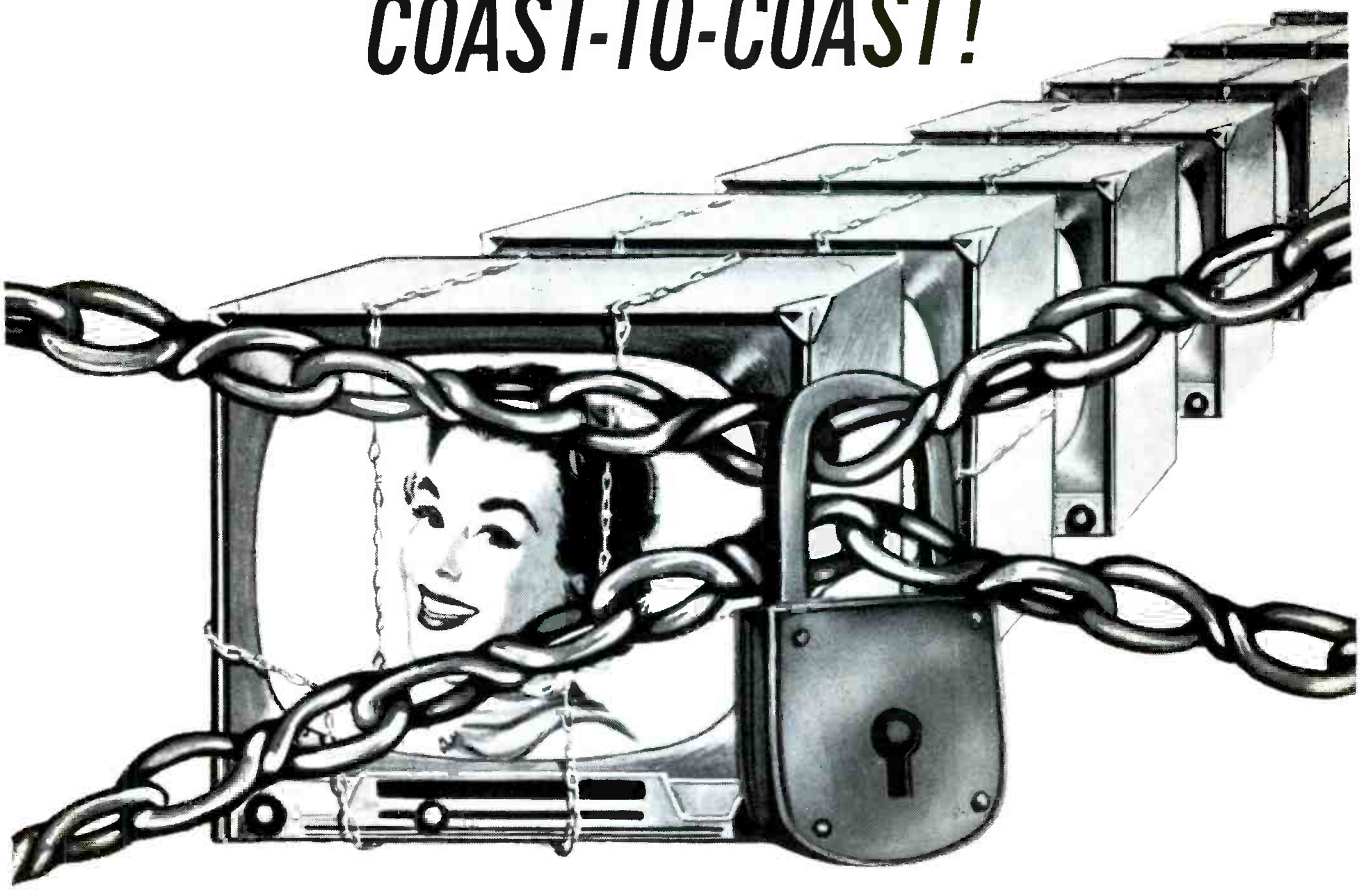


Fig. 2. Block diagram of the circuits used in "Duo-Master" chassis.

103 TV TUBE "TORTURE TESTS"

COAST-TO-COAST!



"Locked TV" prove WESTINGHOUSE tubes work better, cut call-backs!

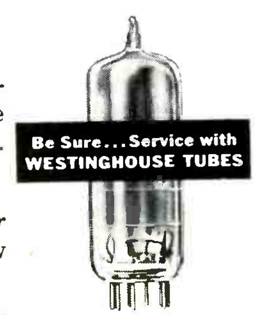
RIGHT NOW leading Electronic Parts Distributors across the nation are giving Westinghouse RELIATRON® Tubes the most grueling test in TV history!

RIGHT NOW 103 standard make TV sets—like those used by your customers—are performing continuously! Every set is locked tight. Every set is 100% equipped with Westinghouse RELIATRON Tubes taken right from regular Distributor stock to prove they outlast, outperform other tube brands—in any make TV!

RIGHT NOW these 103 sets are racking up fantastic performance records! For example, one "Locked TV" has run over 17,000 hours . . . more than 11 years' average viewing time!

SEE THE "LOCKED TV" TEST right now at *your* Westinghouse Tube Distributor. Find out how it can pay off in profits for *you!*

Electronic Tube Division • Elmira, New York



YOU CAN BE SURE...IF IT'S Westinghouse

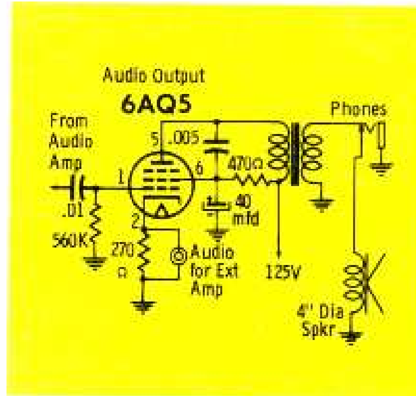


Fig. 4. Plate circuit of audio output tube in "Duo-Master" drives either speaker or phones; cathode circuit furnishes signal for external amplifier.

of a TV set.

The RC-103 features an ingenious method of converting a signal in the FM band to some other frequency usable by a TV receiver. "Pair of frequencies" would be a more accurate description, since modern intercarrier sets require two RF signals spaced 4.5 mc apart in order to reproduce sound. The "TeleVerter" not only converts the FM signal to the equivalent of a modulated TV sound carrier, but also generates a "dummy picture carrier"—an unmodulated RF signal 4.5 mc above the sound-carrier frequency. This whole process is accomplished very simply by setting the local oscillator frequency so that its third harmonic will be equal to the FM station frequency plus 4.5 mc. To show how this works out, let's assume that a broadcast is being received on 106.5 mc. Oscillator frequency would be:

$$\begin{array}{r} 106.5 \text{ mc} \\ +\ \ 4.5 \text{ mc} \\ \hline 111.0 \text{ mc} \end{array}$$

divided by 3 = 37.0 mc.

The modulated "sound carrier" fed to the TV set is obtained by beating the oscillator signal against the incoming signal. The difference frequency therefore is:

$$\begin{array}{r} 106.5 \text{ mc} \\ -\ 37.0 \text{ mc} \\ \hline 69.5 \text{ mc} \end{array}$$

The dummy picture carrier is merely the second harmonic of the oscillator frequency, thus:

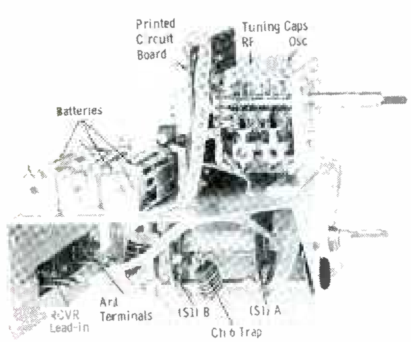
$$\begin{array}{r} 37.0 \text{ mc} \\ \times\ 2 \\ \hline 74.0 \text{ mc} \end{array}$$

The difference between the two carriers is:

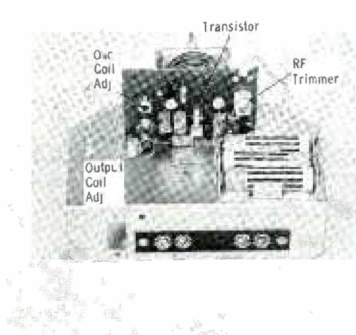
$$\begin{array}{r} 74.0\text{ mc} \\ -69.5\text{ mc} \\ \hline 4.5\text{ mc} \end{array}$$

The modulated carrier falls within the passband of channel 4 (66-72 mc) and the unmodulated one falls just above it in the "gap" between channels 4 and 5. At lower FM station frequencies, the converter output frequencies also become lower. In most cases, the response curve of a TV tuner on either channel 3 or 4 is broad enough to pass both carriers through to the IF stages; however, reception of stations toward the ends of the FM band may sometimes be improved by tuning the TV set to channels 2 or 5. The presence of a TV signal on one of these channels does not necessarily prevent clear FM reception on that channel. As long as the radio signal is at least twice as strong as the TV sound, the former should be able to suppress the latter.

Four switch wafers (both sides of S1A and S1B) are ganged on the two-position FM-OFF switch. One set of contacts on the front



(A) Side view of chassis.



(B) Close-up of printed wiring board.
Fig. 5. Regency RC-103 "TeleVerter."

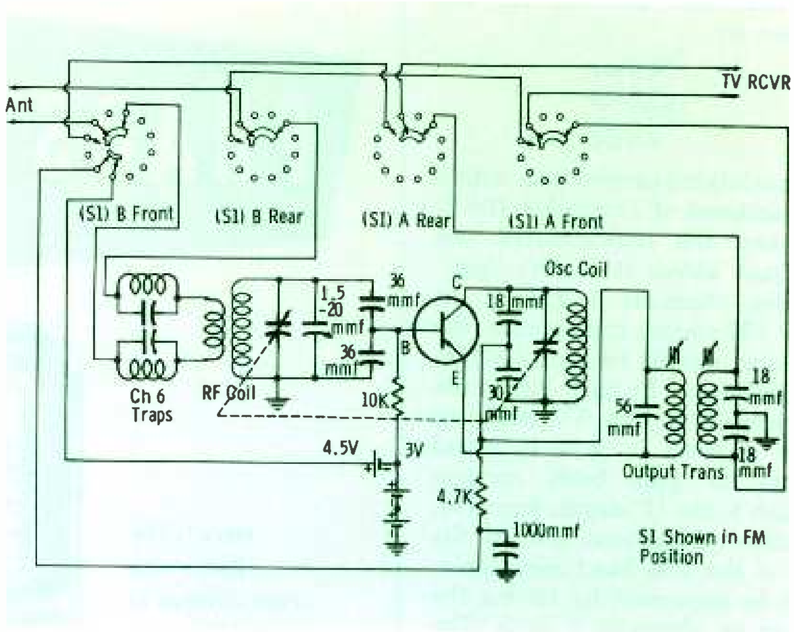


Fig. 6. "TeleVerter" contains SB transistor functioning as mixer-oscillator.

of S1B energizes the circuit in the FM position by connecting a 4.5-volt battery supply to the emitter circuit of the transistor. All other switch contacts affect the lead-in connections. In the OFF position, the TV antenna leads are connected straight through to the TV set. In the FM position, they feed signals into the RF coil of the "TeleVerter" through traps which are fixed-tuned to attenuate channel 6 TV signals; in addition, the secondary of the output transformer (a balanced 300-ohm circuit) is connected through the switches to the TV set input.

The transistor is a surface-barrier unit, a special type that can maintain stable oscillation at frequencies in the required 30-mc range and also perform adequately as a mixer in the 100-mc band. Physically, the SB transistor consists of metallic emitter and collector electrodes plated on opposite sides of an extremely thin crystal of N-type germanium. The principle of operation, different from that of ordinary junction transistors, depends on the special electrical properties of the surface of a crystal.

Note the voltages applied to the transistor. The collector is grounded through the oscillator coil and is negative with respect to the emitter, which is returned to +4.5 volts through the primary of the output coil. A moderate value of forward bias between base and emitter is provided by returning the base to a 3-volt tap on the battery supply. This arrangement is better than voltage-divider biasing in that the fixed-bias setup draws no bleeder current. Battery drain during "TeleVerter" operation is in the order of only 300 μa.

The three 1½-volt penlight batteries are mounted side by side. Due to construction of the mounting clips, the middle battery must be inserted first and removed last.

The "TeleVerter" does not generate enough heat in operation to cause objectionable frequency drift, but heat from the TV set or some other source may be troublesome. If the converter is placed on top of the TV cabinet, the coolest possible location should be selected.

" Picture's fuzzy and fulla vertical lines..."

Unusual Cascode Circuit

The RJX-109 cascode tuner found in the new General Electric "U2" TV chassis includes an extra wafer switch equipped with incremental coils that tune the interstage circuit of the cascode RF amplifier for optimum performance on every channel. Advantages of this switch are more accurate neutralization of the first triode stage, a better impedance match between the stages, and a resulting improvement in gain and noise level.

Referring to Fig. 7, note that a

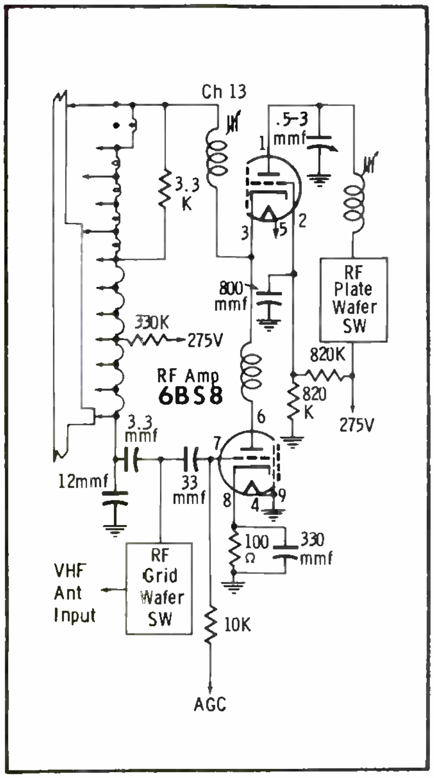


Fig. 7. New GE tuner has variable inductance between halves of RF stage.

3,300-ohm damping resistor is connected across the channel 2 to 6 coils on the switch, and a connection to the 275-volt B+ line is made through a 330K-ohm resistor for the purpose of stabilizing the cathode voltage of the second stage. The latter resistor is connected to the junction of the channel 9 and 10 coils because this is mechanically convenient.

The 6BS8 tube used in this tuner is a fairly new design which may be unfamiliar to some readers. Although very similar to the 6BQ7A and related tubes, it is a little "hotter" (with a g_m of 7,200) and differs from older tube types in several minor specifications. ▲

BY JOHN MARKUS

Editor-in-Chief, McGraw-Hill TV, Radio and Changer Servicing Course

Price Tags. In actual merchandising tests, tagged radio and TV sets in displays outsold untagged items by as much as 25 to 1. The explanation—up to 80% of today's sales are made in only 15 hours of a shop's weekly selling time because women with regular jobs have fewer hours to shop and women with young children would rather shop when husbands are available to baby sit or tag along and help with the purchasing. These hurried shoppers decide what they want to buy in an average of 20 minutes (in each store). With salesmen generally busy during these business peaks, a product must sell itself quickly and effectively by means of the price tag.

One department store found that over 350 tags were torn from merchandise by rough handling before 1 p.m. each day. This was almost the equivalent of moving those items off the sales floor. The problem was solved by putting a gummed cloth reinforcing patch around the hole of each tag. Try this if your own tags are mysteriously vanishing. Remember: no tag—fewer sales.

$ & ¢

How to Buy a Truck. When the time comes for choosing a new vehicle for your servicing business, decide on the best type for your needs before you even think of the make. Generally, there are five types available, but you can rule out the stake truck and the van unless you also expect to be handling refrigerators. This leaves the pickup, panel truck and station wagon.

Pickups are the nation's most popular delivery trucks. They are lowest in first cost, have high resale value, are easy to load, have a big capacity and will take tall bulky loads if necessary. The chief drawback, and the one which rules them out for most servicing businesses, is the fact that the load is exposed to the weather. Mounting of ladders for antenna work becomes a problem, too. Pickups come in ½, ¾ and 1-ton models, with the smallest being adequate for servicing.

The panel truck is almost as low in first cost, is ideal for servicing work because the load is protected, has high prestige value, serves nicely as a mobile repair shop, and antenna ladders can be easily mounted on the roof. Load capacity is ample for servicing in that it will take even the largest TV consoles, though too small for refrigerators. The only drawback is low resale value. If carrying ladders, get the 1-ton size; without ladders, the ½-ton size should do nicely.

Station wagons are highest in first price but also have the highest resale value. They are excellent for servicing work, have the best prestige value of all, and can also be used as the family car. The two-door, two-seat models will do your job just as well as the more expensive makes, and most of their cost can be written off on taxes as a business deduction.

$ & ¢

Dissection. A five-page article in October 14 *Time* gives recognition to the importance of the serviceman in modern living. Though tending to emphasize the rare but more newsworthy examples of unethical practice, it does so for the entire field of home repairs. Painters, plumbers, roof repairmen, furnace cleaners and auto mechanics get their full share of attention.

In TV, the siren lure of $2 service calls is exposed thusly: "Better Business Bureaus warn that, with few exceptions, any repairman who charges less than a $4 to $7 base fee for a house call is suspect; his time enroute usually comes to at least that much."

The scarcity of good TV servicemen is also pointed out, with the explanation that an apprentice graduating from a TV school gets only $1.25 an hour and often has to work six days a week. In contrast, inexperienced production-line workers in factories get up to $2 and do not have to face irate customers.

Manufacturers are given their full share of discredit for lemons. The repairman's own viewpoint is also presented with dramatic frankness, as follows:

"The repairman's biggest, loudest beef of all is directed squarely at his meal ticket—the appliance-owning U. S. public. 'The public has more chiselers and stupid jerks in it than any place else,' says an angry Pittsburgh appliance dealer. 'Everyone wants a bargain, but when the cut-rate, $100 TV set goes fizzle and the repairman's bill comes to $25, the customer refuses to pay.' "

$ & ¢

Built-ins. The trend toward the building-in of hi-fi and TV equipment in homes without first seeking professional advice has resulted in fire hazards when essential air circulation has been blocked. Approval by the Underwriters' Laboratory is conditional on mounting of a TV chassis in its own cabinet, located in an open area.

When electronic equipment is to be safely built-in, insist that there be at least two inches of air space at the sides and rear of the cabinet, and at least three inches above the top of the cabinet. Grille openings in the room wall above and below the cabinet will then allow air to flow around it.

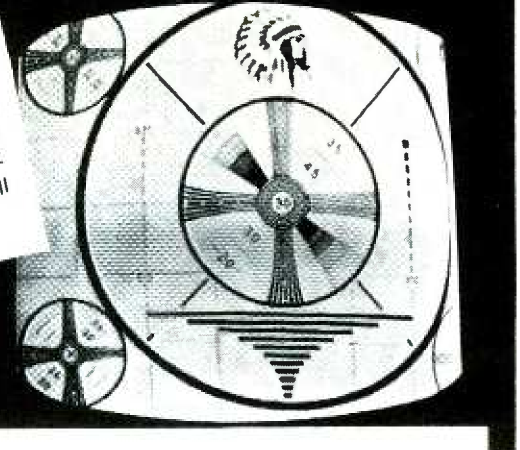
For complete safety, the enclosure for a built-in set should be constructed from heavy galvanized metal like that used in electrical terminal boxes, or other approved fireproof material such as the asbestos board used behind radiators. The power outlet box for the set should be within this enclosure. Naturally, the set mounting must be designed to permit easy one-man removal for servicing, with sufficient extra antenna length for operating the set out in the room.

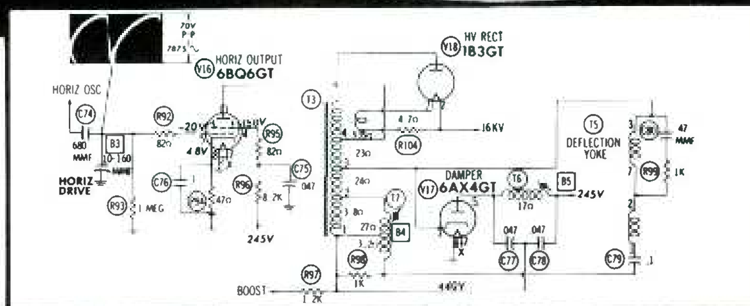
how long would it take you to solve this service problem?

PHOTOFACT

helps you lick problems like this in just minutes for only *2½¢ per model!

SYMPTOM: Horizontal Foldover affecting the right side of the screen, accompanied by an overall reduction in width





(Based on an actual case history taken from the Howard W. Sams book "TV Servicing Guide")

Let's look at this problem: When the foldover occurs at the right side of the picture, the trouble usually originates in the horizontal discharge or output circuits. Look for the following possible causes:

1. Defective tube in the flyback circuit
2. Leaky coupling capacitor (C74)
3. Misadjusted or defective drive control
4. Open or leaky capacitor (C76) in the cathode of the output stage
5. Incorrect value of the grid resistor (R93) in the horizontal output stage
6. Open or leaky screen bypass capacitor (C75) in the output stage
7. Incorrect value of the cathode resistor (R94) in horizontal output stage
8. Incorrect value of the screen resistor (R96) in horizontal output stage
9. Defective yoke or flyback transformer

With the applicable PHOTOFACT Folder at your fingertips, you'll trouble-shoot and solve this problem in just seconds. Here's how:

Using the Tube Placement Chart (you'll find it in every PHOTOFACT TV Folder) you'll quickly locate and check the tubes in the Flyback Circuit. Tubes okay?—then: A waveform analysis of the signal in the sweep section is perhaps the quickest procedure you can use to localize the trouble. Check the waveform at the junction of the two capacitors, B3 and C74. The correct waveform and peak-to-peak voltages are shown right on the PHOTOFACT Standard Notation Schematic. Waveform incorrect?—Then, using the easy-to-read resistance chart and the correct voltages shown on the schematic, check for proper resistance and voltage values to determine which part is defective. The exclusive PHOTOFACT chassis photos with "call-outs" keyed to the schematic help you locate the faulty part quickly. Important! Horizontal Foldover may result from improperly matched components in this circuit. It is *imperative* that all parts replaced duplicate the originals. You'll find the proper replacement parts for all components listed in the complete PHOTOFACT parts list.

Remember, whatever the trouble may be, you'll locate it faster and solve it easier and more profitably with a PHOTOFACT Folder by your side.

Use the servicing method you prefer—checking of waveform, voltage or resistance—you'll find all the information you need at your finger-tips in PHOTOFACT. For only *2½¢ per model, PHOTOFACT helps you solve your service problems in just minutes—helps you service more sets and earn more daily!

*Based on the average number of models covered in a single set of PHOTOFACT Folders.

MONEY BACK GUARANTEE!

Got a tough repair? Try this—at Howard W. Sams' own risk: see your Parts Distributor and buy the proper PHOTOFACT Folder Set covering the receiver. Then use it on the actual repair. If PHOTOFACT doesn't save you time, doesn't make the job easier and more profitable for you, Howard W. Sams wants you to return the complete Folder Set direct to him and he'll refund your purchase price promptly. GET THE PROOF FOR YOURSELF—TRY PHOTOFACT NOW!

FREE

FOR SERVICE TECHNICIANS ONLY

Fill out and mail coupon today for Free subscription to the Sams Photofact Index—your up-to-date guide to virtually any receiver model ever to come into your shop. Send coupon now.

HOWARD W. SAMS & CO., INC.

Howard W. Sams & Co., Inc.
2201 E. 46th St., Indianapolis 5, Ind.

☐ Put me on your mailing list to receive the Sams Photofact Index and Supplements. My (letterhead) (business card) is attached.

☐ I'm a Service Technician: ☐ full time; ☐ part time

My Distributor is: ____________

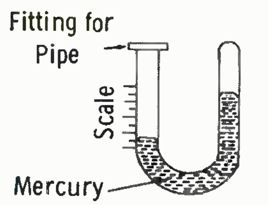
Shop Name ____________

Attn: ____________

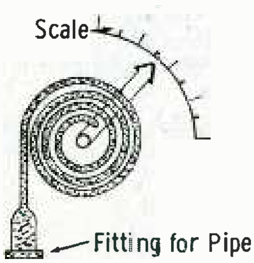
Address: ____________

City ____________ Zone ______ State ______

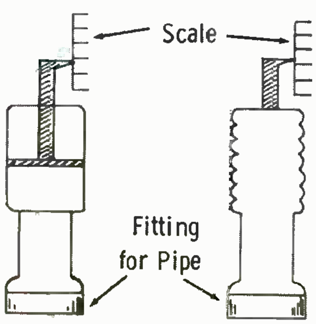
TAKING THE INDUSTRIAL PULSE



(A) Mercury manometer.



(B) Expansion tube.



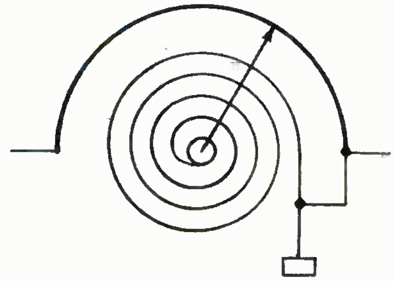
(C) Diaphragm senser.

Fig. 1. Mechanical pressure indicators.

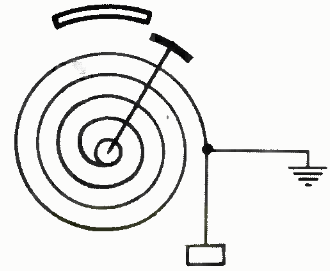
Electronic transducers in industry convert a variety of physical quantities into usable electrical signals. The electronic technician must understand the principles involved in sensers, if he is to perform a competent, speedy repair. Complete systems cannot be analyzed until all the individual units are thoroughly understood; thus, in this section, there appear detailed descriptions of sensing units. Pressure and flow sensers are described together, since they bear a mutual relationship.

In general, liquids have slow moving molecules, but a great many of them for a given volume. Gases, on the other hand, contain very fast moving molecules with only a few of them per volume. Therefore, gas pressure is attributed to molecular activity (or movement) while liquid pressure relies on molecular mass. An approximate relationship between gas and liquid pressures due to weight can be obtained by the following comparison. A 1″ square column of air 10 miles high weighs about the same as a 1″ column of water 34′ high or a 1″ column of mercury 30″ high.

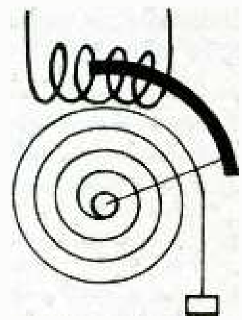
The industrial uses for pressure are quite varied; for instance, some chemical reactions take place faster when under pressure; energy can be transmitted through liquids by pressure, etc. Liquids of all types are transported from one location to another by creating a pressure difference between the two positions. The greater the pressure difference, the faster a transfer takes place. The distance moved in a given time is called the rate of flow.



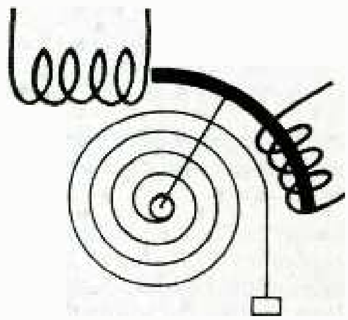
(A) Potentiometer movement.



(B) Capacitor plate movement.



(C) Variation of inductance.



(D) Change of coupling between coils.

Fig. 2. Movement of expansion tube can be used to generate an electrical signal.

Mechanical Devices

Among modern mechanical pressure devices are manometers, expansion tubes, and diaphragm displacements. Fig. 1 shows the physical shapes of the various mechanical sensers. Our only reason

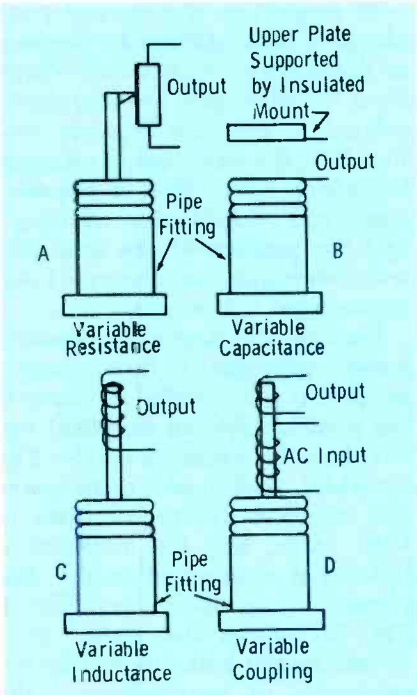


Fig. 3. Linear movement of diaphragm makes conversion more accurate.

for investigating these is to gain sufficient background for an understanding of the electronic applications which are to be described. The manometer shown in Fig. 1A is used as a calibration standard but does not offer a simple means of converting pressure into an electrical signal. Fig. 1B shows the expansion tube, which has a physical movement that could be used to actuate several types of electronic devices. The same is true of the diaphragm senser in Fig. 1C.

Several of the commonly used conversions are shown in Fig. 2. Fig. 2A indicates that as the tube expands under pressure, the slider of the potentiometer moves and causes the resistance to change. Fig. 2B shows a method of varying capacitance; when pressure changes, the position of the flag

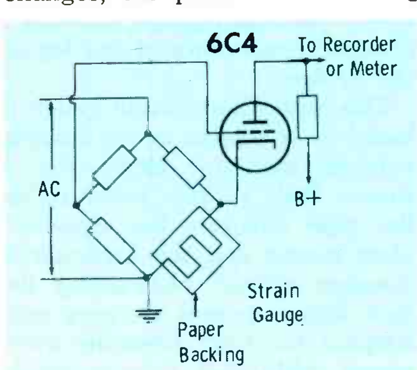


Fig. 4. The strain gauge senses pressure from deformation of pipe.

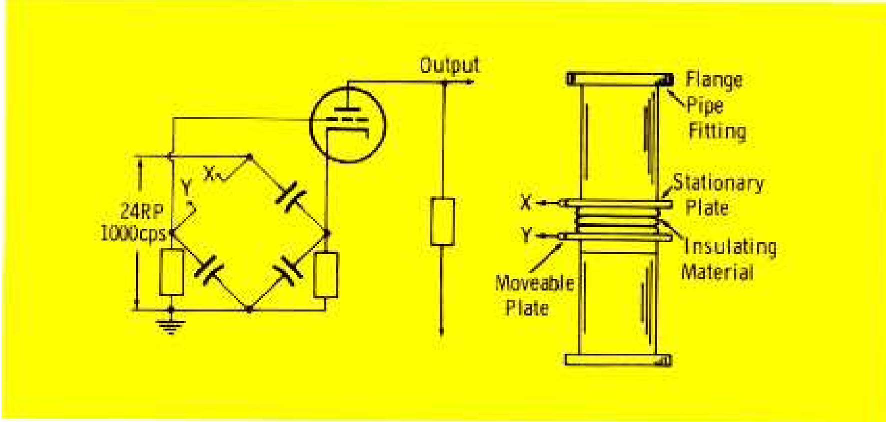


Fig. 5. Deformation of pipe causes capacitor plate separation to vary.

with respect to the curved plate changes, thus causing an increase or decrease in capacitance. Variations in inductance are also easily related to pressure changes (see Fig. 2C). If a variation in coupling is desired (Fig. 3D), a constant signal can be applied to winding 1 and the position of the iron slug will determine the amount of signal coupled into winding 2.

Because the diaphragm pressure senser provides a linear movement, it is more useful in converting pressure into an electrical signal than the expansion tube. The variables (resistance, capacitance and inductance) are the same in both cases, but the mechanical linkage is eliminated in the diaphragm senser as shown in Fig. 3. Fig. 3A shows the slider on a potentiometer being moved by the expansion or contraction of the diaphragm. In Fig. 3B, the top of the diaphragm serves as one of the plates of a capacitor. Figs. 3C and 3D show the ease of conversion using inductance as the variable.

Strain Gauges

The strain gauge is a device which senses a tension or pull on either a wire or capacitor plate. Direct conversion from a physical force to an electrical signal is possible with strain gauges, and the liquid movement is not restricted. Resistance strain gauges rely on the relationship between wire diameter and resistance. If a wire is stretched, the diameter decreases and the resistance increases. Fig. 4 shows the construction of a resistance strain gauge. The sensing wire is glued to a paper backing, and the paper is then attached to a boiler plate or pipe. Changes in pressure will deform the plate or pipe and will affect the strain gauge, causing a change in resistance of one leg on the bridge.

The capacitance strain gauge is based on a change in the spacing between capacitor plates. Fig. 5 shows that as the pressure in the pipe changes, the insulated plate moves and the capacitance changes without obstructing the flow. Strain gauges are very well adapted for high pressure work where additional fittings would mean a greater possibility of pressure break-through.

Rate of Flow

Liquid quantity and rate of flow are metered by the difference in pressure measurement across obstructions in the flow path. These obstructions may be positive displacement devices, vane type sensers, or direct converters. The actual quantity can be determined directly by displacement devices; all other flow meters respond to velocity of flow, which can be related to mass by calculation of the pipe volume and multiplying by the time velocity is maintained.

The obstructions used to obtain a difference in pressure are called orifices, nozzles and venturi tubes. When the pressure difference is determined, the reduction is accounted for by the resistance of the pipe walls, viscosity (resistance to flow of the liquid) and velocity potential or head. When the material of the pipe and the viscosity of the liquid are known, the loss of pressure due to overcoming these resistances is easily found. The remainder of the pressure difference is retained in the liquid as kinetic energy.

Fig. 6A shows the effect of placing an orifice in a pipe. The stream lines illustrate the manner in which a liquid moves when passing through the orifice. The contraction immediately following the orifice indicates an increase in velocity and the reason for a pressure difference. Sensers P1 and P2 measure the static pressures before and after the orifice. The term static pressure means potential energy due to height minus the kinetic or moving energy due to velocity.

The nozzle shown in Fig. 6B is very similar to the orifice but offers more control over the contraction. Note that both parts of Fig. 6 indicate the presence of turbulence as the liquid returns to its former velocity. As a result, some of the original pressure is lost as heat.

A method of reducing the losses caused by turbulence is to plan for a gradual increase in velocity through the constriction and a gradual return to normal pipe size. This method is shown in Fig. 7 and employs what is known as the venturi nozzle. Note the smooth reduction in size which slowly presses the stream lines

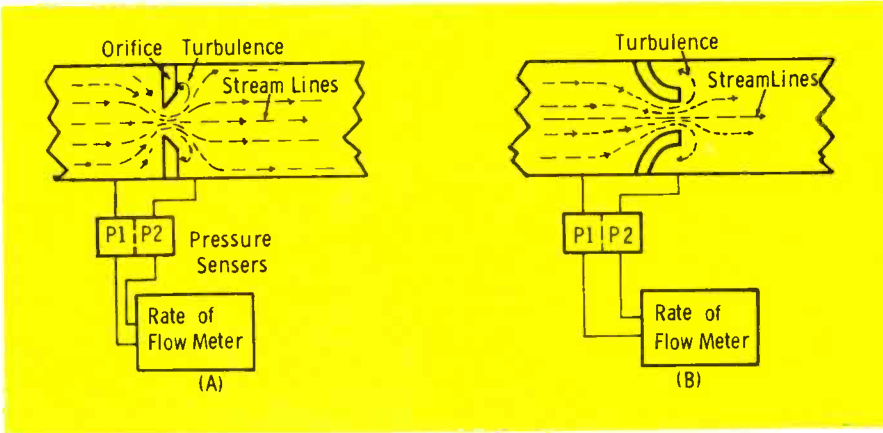


Fig. 6. Pressure difference from P1 to P2 is proportional to velocity.

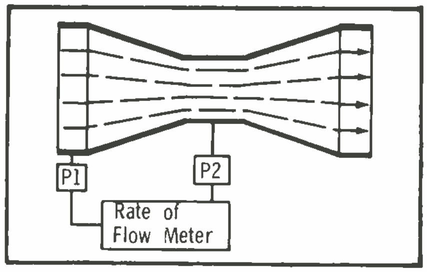


Fig. 7. Pressure loss is kept at a minimum in the venturi nozzle.

together. The loss of energy with this senser is much less than with the other orifices and nozzles described.

Positive displacement meters convert rate of flow into electrical pulses which indicate an exact quantity of liquid. These pulses can be counted by a simple counter or used in a control circuit. One type of positive displacement meter is shown in Fig. 8. The liquid is trapped between the teeth and outer casing but cannot pass through the meshed teeth. A specific amount of liquid will pass through this meter in one revolution. The rate of flow measured by displacement meters is a volumetric rate, whereas other meters determine velocity.

Vane-type meters offer less resistance to flow and yield the velocity directly. Meters of this type are used where pressure loss is important and error due to slippage is not. (Slippage is a percentage relationship which expresses the accuracy of the reading taken.) The vane anemometer shown in Fig. 9 is designed much like those used to measure wind velocity. The rotation of the wheel

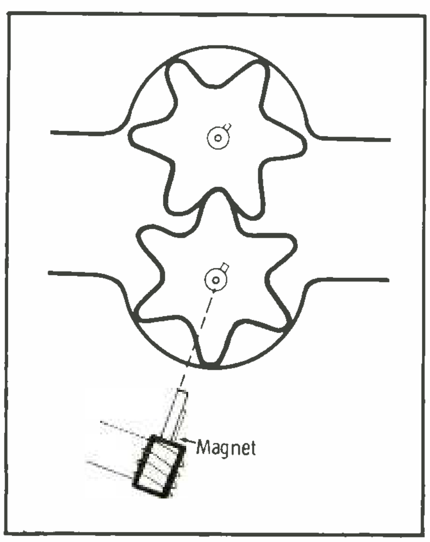


Fig. 8. Positive displacement meter offers direct quantity measurement.

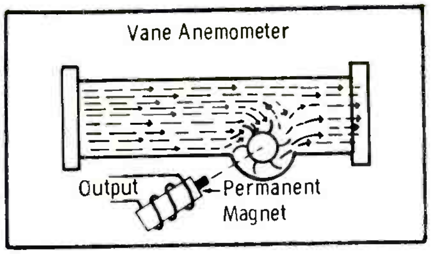


Fig. 9. With anemometer, velocity is measured without being affected by static pressure applied to system.

can be used to actuate a microswitch or generate a pulse.

An improvement over the vane-type anemometer is made by placing all the vanes directly in the flow path. The result is the turbine type flow meter. With this arrangement, signal can be developed by placing an electromagnetic pickup head in the side of the pipe so that the rotor blades will pass close to the end of the magnet or, as shown in Fig. 10, a permanent magnet is built into the rotor and a pickup coil is positioned near the rotor blade tips.

A unique feature of the turbine meter of Fig. 10 is the advantageous use of the pressure differences as a liquid passes through the turbine. At point "B" the velocity is increased; thus, the turbine rotor is literally pulled against the flow as a result of pressure recovery due to a reduction in velocity around point "C." The "floating action" of the turbine eliminates the need for a thrust bearing and allows operation in extreme cold or abrasive liquid suspensions.

Applications of this type of flow meter are engine test facilities, rocket and guided missile fuel metering, in-line blending of several liquids, telemetering, and instantaneous rate of flow measurement. Turbine-type sensers are capable of accurate measurement from gallons per hour to barrels per hour with a physical size ranging in diameter from fractions of an inch up to ten inches.

A direct-reading velocity senser which eliminates the error due to slippage is the Pitot tube. As shown in Fig. 11, this unit measures the static pressure through the sides, and the pressure due to velocity plus the static pressure through the tip. The pressure sensers are out of the line of flow, and any of the mechanical sensers described previously can be used.

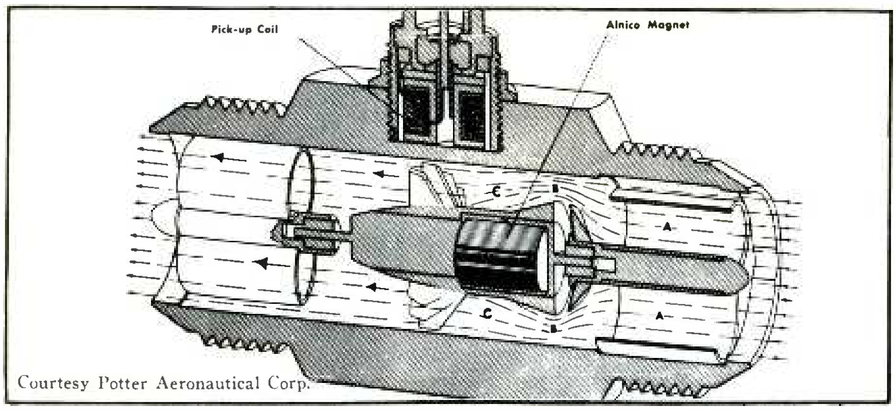


Fig. 10. Rotation of turbine causes the magnetic field to cut the pickup coil, generating an output pulse which varies with velocity.

Signal Generators

Electrical signals are generated from the mechanical movements of pressure sensers by the characteristics of resistance, capacitance, and inductance. Several types of signal generators are important enough to be described separately. The differential transformer is used to obtain signals from a great number of industrial sensing devices in addition to the pressure and rate of flow applications described here. A pressure indicating and recording instrument uses one pressure senser in one leg of the transformer while the other leg provides the motive force required to move the pen and indicator of a recorder. As shown in Fig. 12A, the leg marked IN receives a mechanical movement proportional to the pressure, and the iron core changes the inductance relationship between the upper and lower coils; thus, the voltage is divided unequally between the upper and lower coil sections. This difference in voltage causes the OUT coil to attempt a realignment of its distribution to agree with the IN coil and the iron core of the OUT coil is pushed to a new position.

The rate of flow can be determined directly with the differential transformer by using both legs of the transformer to detect pressure as shown in Fig. 12B. When P1 and P2 are across an orifice or nozzle, the difference in pressure will position the cores of the transformer legs so that each will have a different voltage division. The cathode of an amplifier is connected to one leg while the grid is

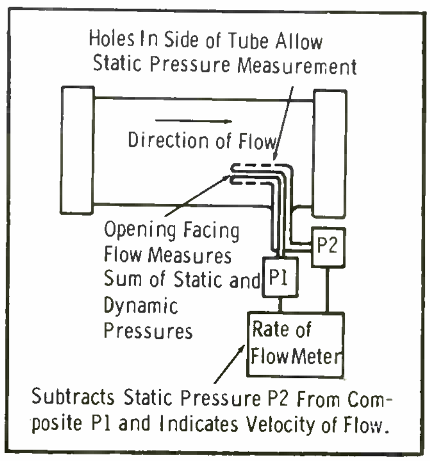


Fig. 11. The Pitot tube measures exact energy due to velocity by compensating for static pressure.

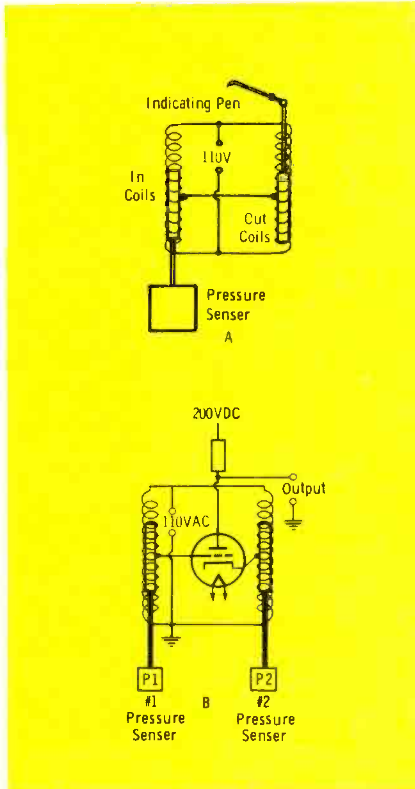


Fig. 12. Differential transformer used in pressure indicating applications.

connected to the other, and a change in position of either core will result in a change in the AC voltages applied to these two elements of the tube. Since the conduction of the tube is controlled by the grid to cathode voltage, the plate current of this amplifier will be proportional to the difference in the voltage divisions of the two legs.

A moving fluid, either gas or liquid, has a cooling effect which is proportional to the velocity. (An increase in velocity will result in a greater cooling effect.) A hot wire anemometer takes advantage of this relationship by measuring the resistance of a wire in the fluid path. A wire suspended in a section of piping or gas duct is heated by a current and measured without flow. An increase in current during fluid flow is due to a reduction in resistance which can be converted to rate of flow.

All pressure sensers create a movement which can be related to the amount of pressure. Rate of flow meters measure pressure differences or actual velocity of the liquid. The electrical signal obtained can be used to operate a recorder or a control amplifier which will maintain a predetermined pressure or rate of flow. ▲

SHOP TALK *(Continued from page 12)*

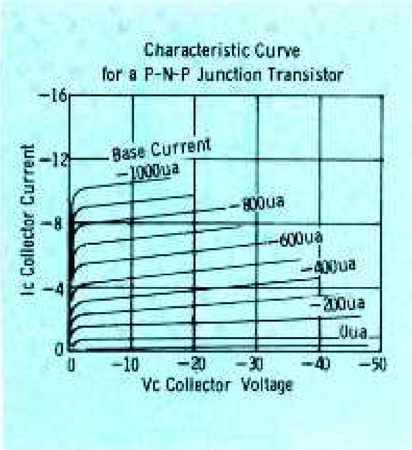


Fig. 4. Characteristic curves for a p-n-p junction transistor.

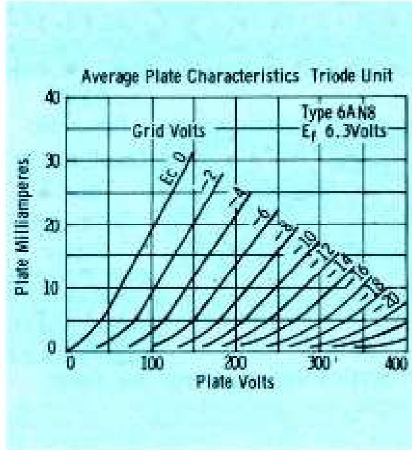


Fig. 6. Characteristic curves of the triode section of a 6AN8 tube.

this point to the ampere scale on the horizontal axis. Wherever this line strikes the axis, the scale value represents the quantity sought. In the present instance, the figure turns out to be 5 amps.

This procedure demonstrates how two variable quantities are linked together by a single curve. It is possible to tie together three variable quantities, but for this a series of curves is needed. For example, in Fig. 2 there are a number of similar straight-line curves, each representing the same series circuit but with a different value of resistance in each case. Now we have three variable quantities to deal with. First, we decide which value of resistance we wish, then we use that curve to determine the amount of current that will be obtained with various voltage values. If another circuit resistance is desired, then the curve associated with that value is selected in determining the current and voltage values.

Reference to this type of graph is a common experience for the average serviceman, since he often refers to data such as the set of pentode characteristic curves shown in Fig. 3. These curves illustrate the relationship between plate voltage and plate current for a series of different grid voltage values ranging from 0 ($EC_1 = 0$) to -6.0 volts. Since a pentode also possesses a screen grid and since the voltage on this element can influence the behavior of the tube, the screen-grid voltage must also be stated. This is done in the upper right hand corner of Fig. 3. If we wished to vary this quantity, too, then we would need a three-dimensional diagram to present all the facts. Fortunately, the screen-grid voltage generally remains fixed and it is merely necessary to give its value, as indicated.

It might be mentioned in passing that graphs of the form shown in Figs. 1, 2, and 3 serve satisfactorily for presenting the relationships between 2 and 3 vari-

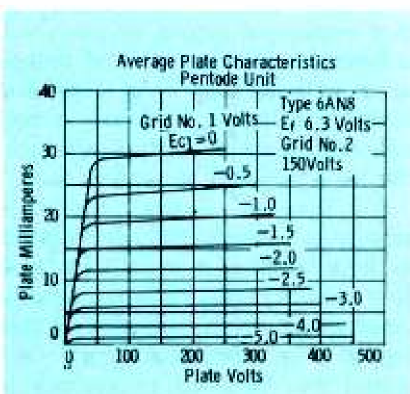


Fig. 5. Characteristic curves of the pentode section of a 6AN8 tube.

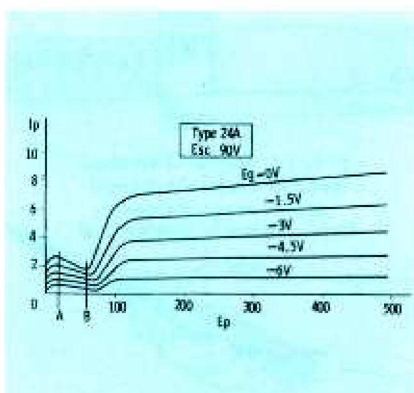


Fig. 7. In tetrode tubes, region A-B represents a negative resistance.

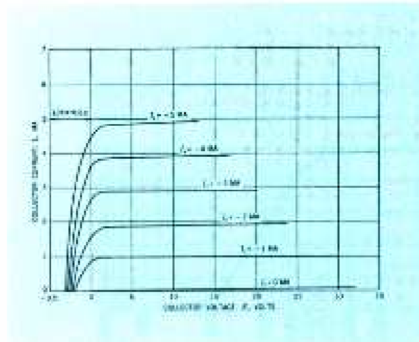


Fig. 8. In transistors, reversal of collector voltage results in current reversal.

ables. However, when the number goes beyond this, nomographs prove to be more tractable.

For transistors, the controlling quantities change, but the same basic principles apply, and surprisingly enough, the shape of the curves obtained closely resemble those for the pentode. See Fig. 4. (The latter is simply coincidental and not at all related to the discussion.) Here we have collector voltage and collector current for the two axes and base current for each of the curves. Thus, despite the fact that we are dealing with a different device, we can still employ the same type of presentation to provide information.

Aside from the obvious information which the foregoing graphs provide, there is a lot more that can be gleaned by a closer study. Referring back to Fig. 3, we see that as the grid voltage becomes more negative, the amount of plate current obtainable for a certain plate voltage decreases. Also, up to about 40 volts or so, increasing the plate voltage has a direct bearing on the plate current. This is indicated by the fact that from 0 to 40 volts, the curves rise straight up. Beyond 40 volts (actually less for high negative grid

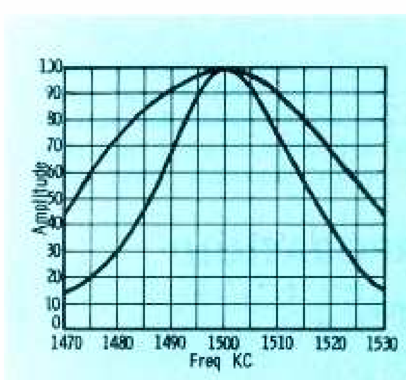


Fig. 9. Resonance curves for tuned circuits of different Q.

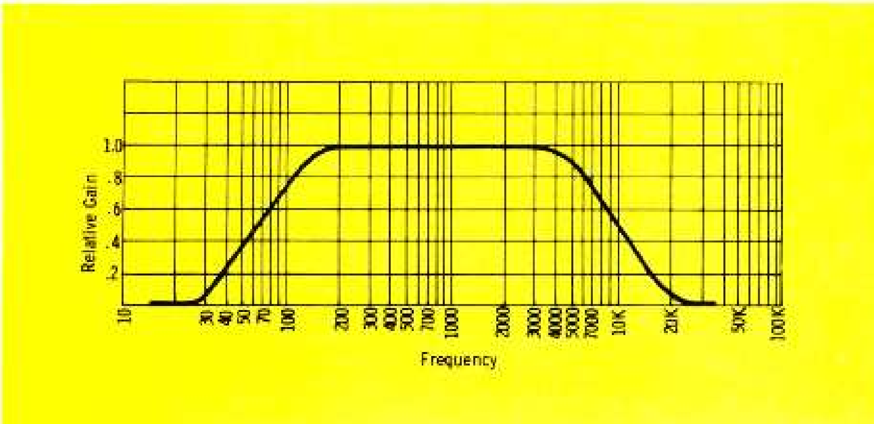


Fig. 10. Graph using logarithmic horizontal and linear vertical markings.

values), the curves tend to flatten out, rising only slightly for very large changes in plate voltage. This flattening effect means that the plate has relatively little control over plate current. It leads also to the conclusion that the plate resistance is high because it is only with a high resistance that a significant change in voltage produces only a relatively small variation in current. (This same information, of course, can be derived from the graph by dividing a change in plate voltage by the change in plate current it produces. This result is the plate resistance.)

As a comparison, consider the characteristic curves for the pentode section of a 6AN8 tube shown in Fig. 5. Note that these curves tend to be flatter than those in Fig. 3, indicating that changes in plate voltage have even less effect on the plate current. Hence, we can draw the immediate conclusion that the plate resistance of the pentode section of a 6AN8 is greater than that of a 6AU8. The tube manual confirms this conclusion because the 6AN8 pentode has a plate resistance of 300,000 ohms against a value of 150,000 ohms for the pentode portion of the 6AU8.

In a triode, the plate voltage exercises considerable control over plate current, and here the plate resistance is low. Graphically, this fact is borne out by the curves shown in Fig. 6. Note how the plate current changes with plate voltage. None of the curves tend to flatten out; instead, they extend straight up and probably continue to do so until plate current saturation is reached.

It is normal procedure to deal with positive values in characteristic curves, but this is not always the case. One of the best known

" Now we come to the high voltage section - yes, that's it--"

instances occurs in tetrode tubes where, for certain plate voltages less than 100 volts, the plate current decreases as the plate voltage increases. This effect is shown by the dip in the curves of Fig. 7. At the start, when the plate voltage is increased from zero, the plate current also rises. Then, at about 15 volts, the plate current starts decreasing with rising plate voltage and continues to do so until the plate voltage reaches a value of 65 volts or so. Beyond this point, plate current starts rising again, and its relationship to plate voltage assumes a more normal pattern.

In the region between points A and B, the resistance of the tube is said to be negative because its behavior is opposite to that encountered with normal or so-called positive resistors. Ordinarily, negative resistance is not desired, but it is highly useful in oscillator circuits.

In transistors, a situation can develop which is not possible with vacuum tubes. That is, if we reverse the voltage applied to the collector, the collector current also reverses itself and starts flowing in the opposite direction. This condition is not a desirable one since it would quickly lead to excessive current flow, with overheating and permanent damage. The reversal is brought out in Fig. 8, at the far left of the collector voltage axis. As this voltage drops below zero, the collector current decreases sharply to zero. Had the current axis been extended, it would be seen that the current also reverses.

It should be noted that the foregoing behavior of the transistor when the collector voltage is reversed does not constitute a negative resistance. This is because the current reverses too, and thus follows the lead of the voltage. Negative resistance occurs only when the voltage and current act in opposite manner.

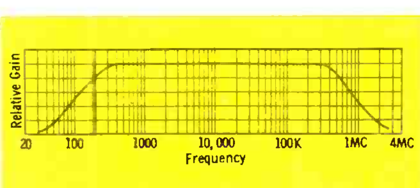


Fig. 11. Logarithmic graph containing a minimum of identifying numbers.

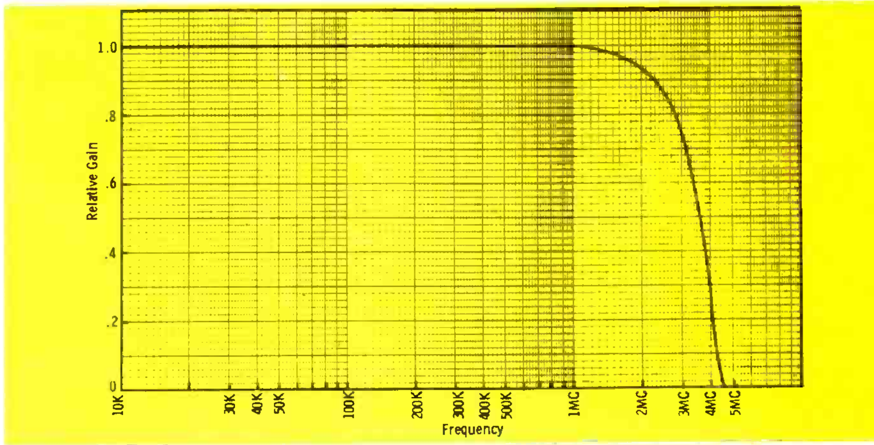
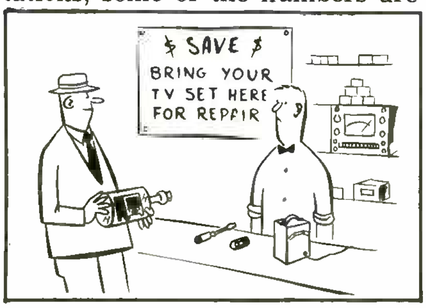


Fig. 12. Example of graph with minor divisions between major markings.

Fig. 8 also brings out another fact concerning graphs in general. That is, the axis (either one) need not start from zero. It could use whatever figures are desired to bring out that section of the curve (or curves) of interest to the person using the chart. This sort of thing is not done too often with tube or transistor charts because meaningful information is present all the way down to zero. However, in other curves, like the resonance curves shown in Fig. 9, no useful purpose is served by showing more than a small segment of the over-all graph. In Fig. 9, the resonance curves drop fairly rapidly to zero beyond the frequency limits shown (1470-1530 kc) and hence the curves end there.

Another type of graph that the technician frequently deals with is the frequency response curve. This usually concerns an amplifier, although it may be the response of a filter, tone control, or crossover network. The curves are drawn generally on semi-logarithmic paper where the horizontal or frequency axis uses logarithmic spacing while the vertical or amplitude markings are linear (see Fig. 10). The latter scale does not offer any particular difficulty insofar as reading or interpretation is concerned, but the logarithmic scale is something else again. Here, the spacing between numbers varies in cycles; that is, each group of ten major divisions follows the same pattern. The spacing between the first two numbers (10-20, 100-200, etc.) is greatest. This is then followed by progressively smaller spacing between successive numbers, reaching its lowest value between the end number of one group (90, 900, 9,000, etc.) and the initial number (100, 1,000, 10,000, etc.) of the next group.

At times, because of space limitations, some of the numbers are



ABOUT THE COVER

Traditionally, Christmas reminds us that "it is more blessed to give than to receive." Pictorial proof of this, we think you'll agree, lies in the faces of Mom and the kids, who look just as pleased as Dad over the new scope Santa brought him.

The entire PF REPORTER staff sincerely hopes that your own Christmas is as happy and peaceful as that pictured on this month's cover.

(Advertisement)

latest JACKSON tube test data

TUBE TYPE	MODEL 648 FIL.	CIRCUIT D.	CIRCUIT E.	PLATE TEST	MODEL 115/715/561 FIL.	X.	PLATE	YZ
1J3	1.4	12	9	65WY	1.4	-	50	8Q
1DN5	1.4	A14	AB267	40XZ	1.4	89	33	6JLMQ
			3	100X		89	38	5Q
6BW8	6.3	A129	678	50V	6.3		38	7JOR
		125	3	60X			30	2Q
			4	60X			30	9Q

MODEL 49

TUBE TYPE	SEC.	A.	B.	C.	D.	CATH. SHORTS	E.
1J3	D.	1.4	2X		°		100
1DN5	P	1.4	1	X	236	-	60
	D	1.4	1	-	4X.	-	90
6BW8	P	6.3	4	X	689	7	30
	D	6.3	4	-	1X.	2	62
	D	6.3	4	-	3X.	2	62

Latest Chart Form 648-18, 115/715/561-9, 49-3

omitted, although the lines they represent are included. This is true of Fig. 10, where 70 and 90 of the first group are omitted because of lack of space. A similar procedure is followed in the other groups along the frequency scale.

Because the sequence numbering and the repetitive cycling of the groups are generally understood, many such graphs actually contain only a minimum of identifying numbers, as indicated in Fig. 11. In such instances, it is necessary for the reader to mentally insert the missing values. Occasionally, the major divisions will be further divided, as shown in Fig. 12. When this occurs, it is necessary to do several things in order to determine the value of each such minor marking.

1. Count the number of minor lines between two adjacent major divisions. To this figure add 1.

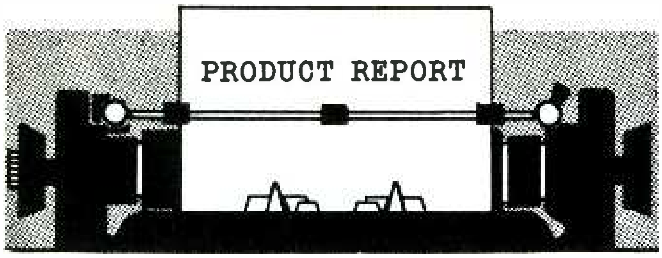
2. Divide the number thus obtained into the difference between the two major divisions which border the area covered by the minor lines.

As an example, consider the minor divisions between 100,000 and 200,000 cycles in Fig. 12. There are 9 such minor lines; adding 1 gives us 10. This 10 is then divided into the difference between 200,000 and 100,000, or

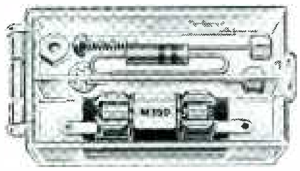
$$\frac{200{,}000-100{,}000}{10}=\frac{100{,}000}{10}=10{,}000$$

This is the value of each minor division at this point. If you continue on along the graph, say between 700,000 and 800,000 cycles, you will find that each minor division is worth 20,000. This is because there are only 5 minor divisions (produced by 4 minor lines). In the next cycle or group of numbers, 1 mc to 10 mc, the value of each minor line changes because the values of the major lines have changed. This is the big pitfall to watch out for when dealing with nonlinear scales; spacings change and so do the value of any minor dividing lines used in these sections.

In the foregoing we have barely punctured the surface of graphs; however, if you understand and can apply everything which has been stated, then you will have little difficulty with 90 per cent of the graphs that you ordinarily encounter. ▲

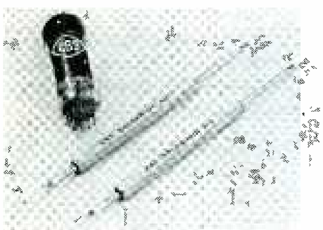


Silicon Rectifier for Radios



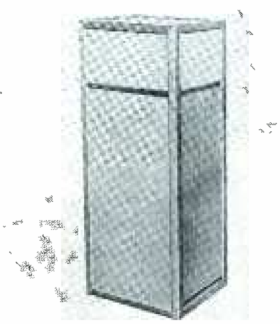
Sarkes Tarzian, Inc., Bloomington, Ind., is now making an M-150 silicon rectifier for radios and other small electronic equipment. Except for an output current rating of 150 ma, it is similar to the M-500 rectifier used in TV sets. The M-150 is supplied in a kit with clip-in holder and mounting hardware, slip-on adapters for pigtail mounting, and a 10-ohm dropping resistor which compensates for the low internal voltage drop of the M-150 and limits B+ to the specified value.

Miniature Soldering Aids



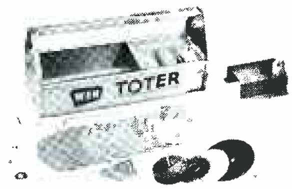
Miniaturized soldering-aid tools for servicing printed wiring boards and other compact circuitry are being offered by CBS-Hytron, Danvers, Mass. Like standard-size soldering aids, the new tools have a forked end for disconnecting leads and also a spade end for such jobs as scraping, cleaning, and removing solder from lugs and eyelets. Available are Types SH-20C with straight spade tip, and SH-20D with angled tip. Tips are of tempered tool steel, and are hard-chrome plated so they will shed solder.

Hi-Fi Speaker System



The EICO "Standard Speaker System" for high-fidelity installations is being manufactured and distributed by Electronic Instrument Co., Inc., Long Island City, N. Y., under an exclusive agreement with the designer, Hegeman Laboratories of Glen Ridge, N. J. Mid-range tones (200-2,000 cps) are produced by forward radiation from a heavy-duty 8½" driver. To the rear of this speaker, a split conical horn with a total length of 14′ supplies acoustic loading that extends bass response to 30 cps. Two tweeters, one coaxially-mounted on the main driver and the other mounted in the open above the horn mechanism box, reproduce different ranges of high frequencies up to 20,000 cps. The system, enclosed in a 36″ × 15¼″ × 11½″ cabinet of mahogany, walnut, or blond birch finish, is priced at $129.95.

Drill Accessory Kit



Wen Products, Inc., Chicago, Ill., is offering a new Model 80K35 accessory kit to users of electric drills. Contents, packed in a metal box with tray and carrying handle, include a twist drill assortment, 3″ wire brush attachment, 3″ grinding and buffing wheels, 15 sandpaper discs in three grades, paint mixer, rubber pad, lamb's-wool polishing bonnet, stand, and adapter set. Suggested list price is $9.95.

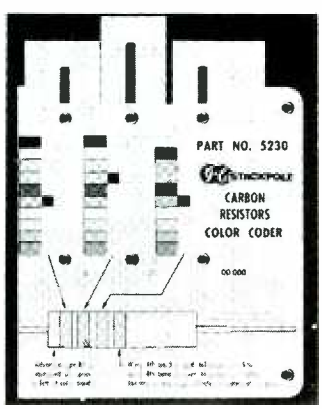
Low-Priced Ceramic Cartridges

Sonotone Corp., Elmsford, N. Y., has designed a new low-priced "5" series of ceramic cartridges with many features in common with Sonotone "2T" cartridges, but with greater compliance and wider, more even frequency response. Two models to fit any standard arm are available—"5T" turnover type for three-speed record players (shown), priced at $8.50 with sapphire needle; and "5P" single type for two-speed (45 and 33⅓ rpm) players or for 78 rpm machines, $7.50 with sapphire needle.

Subminiature Electrolytics

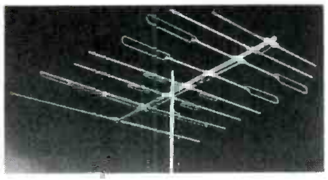
Two new types of subminiaturized electrolytic capacitors for transistor circuits and similar applications have been announced by Astron Corp., East Newark, N. J. Type EE has an epoxy end fill, and Type EM features a "spun" end with rubber bushing. The new units come in physical sizes ranging from 3/16″ × ½″ to ¼″ × ¾″ and in voltage ratings of 1, 3, 6, 8, 16, 26 and 50 volts.

Pocket Color Coder



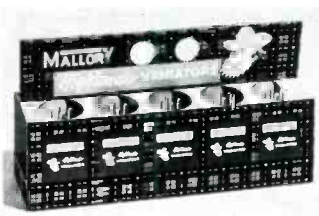
A pocket-size card containing useful information for anyone who works with carbon resistors is available from General Cement Mfg. Co., Rockford, Ill. Three scales, printed in full color on a white background, operate in slide-rule fashion to convert resistor color codes into numerical values. On the card's reverse side are charts giving EIA standard values for 10%-tolerance resistors and also Ohm's Law and parallel-resistance formulas. List price of the Color Coder card (Cat. No. 5230) is 25¢.

Gold-Colored Antennas



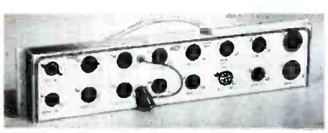
New "Golden Topliner" antennas made by Technical Appliance Corp. (TACO), Sherburne, N. Y., are put through an anodizing process which gives the elements a golden color and protects them against corrosion. An improved "paddle" design widens the bandwidth of the driven elements. Four models in the line (G2540, G2550, G2560, and G2570) are available either singly or as stacked arrays with a choice of wide or close spacing to favor low- or high-band reception.

New Vibrator Line



P. R. Mallory & Co., Inc., Indianapolis, Ind., has introduced a medium-priced "Highlander" line of replacement vibrators which feature buttonless contacts on reeds and side arms for improved smoothness and quietness of operation. The mechanism of these units is similar to that used in the premium "Gold Label" line. Some popular types in the new line include No. 4S (6-volt, 4-pin), with suggested list price of $3.60, and Nos. 3T and 4T (12-volt, 3- and 4-pin respectively), which list for $3.70 each. "Highlanders" are packed 10 to the carry-out carton.

Tube Tester Accessory Panel



B & K Mfg. Co., Chicago, Ill., is now producing a Model 510 Accessory Socket Panel for use with the Model 500 Dyna-Quik Tube Tester. The 14" × 3" panel, designed for installation in the cover of the tester, provides 16 additional sockets for testing the 6X4, 1V2, 6V3, 17H3, 12B4, 6BK5, 5CG8, 6AT8, 6CL8, 6AZ8, 6AQ7, 6BN4, 12BR7, 6CN7, 6CM7, 6BU8, 6CS7, 6AS8, and 6AH4 tube types. Net price of the accessory panel is $29.95.

Cartridge-Needle Combinations

Webster Electric Co., Racine, Wis., has brought out a new "V-8" series of plug-in combination ceramic cartridges and phono needles. All have 30-15,000 cps response, 8-10 grams tracking pressure, and up to 1 volt output. Types V-8,1 ($3.95 list) for V-M changers; V-8,2 ($4.20) for Webcor changers; and V-8,3 ($5.20) for replacing a variety of turn-under cartridges, have both 1- and 3-mil sapphire tips. A diamond tip is substituted for the 1-mil sapphire in optional types V-8,1D ($16.95); V-8,2D ($16.95); and V-8,3D ($17.95).

PF REPORTER

INDEX TO ADVERTISERS

December, 1957

PF REPORTER — CATALOG and LITERATURE SERVICE

valuable manufacturers' data available to our readers at no charge.

1L. ARGOS PRODUCTS
6 page catalog of company's products. *See ad page 36.*

2L. ASTRON
Handy pocket-sized AC4-D, Replacement Catalog and Pricing Guide for servicemen. *See ad page 4.*

3L. B & K
Bulletin 1050 tells how you can transmit video and audio to any TV set with Model 1050 Dyna-Scan. Bulletin 650 describes Model 650 Dyna-Quik portable dynamic mutual conductance tube and transistor tester. Bulletin 400-C40 describes CRT Cathode Rejuvenator Tester. *See ad page 9.*

4L. BUSSMANN
Form TVC—complete TV-fuse chart. Shows fuse to use on all TV sets and auto radios. *See ad page 23.*

5L. CBS-HYTRON
Pamphlet entitled "Independent Service and Your Future." *See ad page 29.*

6L. CHICAGO STANDARD
New 1958 Stancor TV Transformer Replacement Guide. *See ad page 11.*

7L. CIRCUIT MFG.
Catalog, instruction sheet and letter.

8L. CLAROSTAT
Sound systems controls. "T" & "L" pads—Audio Applications Form #751773. *See ad page 33.*

9L. DUMONT
Picture tube data chart. *See ad page 5.*

10L. EICO
12-page catalog shows how to save 50% on electronic test instruments and hi-fi equipment in both kit and factory-wired form. *See ad page 59.*

11L. E-Z-HOOK
A convenient reference sheet titled "How to Build the Five Most Useful Scope Probes" with schematic, mechanical component layout, etc. *See ad page 56.*

12L. ELECTRO-VOICE
Bulletin #223 with illustrations of mounting mechanism, specifications and response curves. *See ad page 25.*

13L. FINNEY
Full TV line brochure (antennas, Form #20-193) and Finco TV antenna research project request sheet. *See ad page 27.*

14L. HICKOK
8-page condensed catalog on latest test equipment.

15L. IRC
Form S-035, DLR-57 Replacement Parts Catalog. *See ad 2nd cover.*

16L. JENSEN
Wall chart J-100 and Jenselector J-92. *See ad page 64.*

17L. KEDMAN
Catalog sheet describing 4 screwdriver displays and specifications of 14 kinds of screw drivers in the company's line. *See ad page 59.*

18L. KINGSTON
"Puts Money in the Pockets of TV Servicemen," a 4-page, two-color brochure, gives details on the operation of the Kingston Absorption Analyzer. *See ads pages 28, 64.*

19L. MERIT
Form No. 700, Merit's Exact Replacement Wall Chart. *See ad page 64.*

20L. PERMA-POWER
Illustrated catalog describing Model A400 transistor power supply showing uses and applications. *See ad page 61.*

21L. PHAOSTRON
Illustrated catalog lists complete line of custom panel meters. Includes comparison chart of Phaostron instruments vs. other brands, plus dimensions and features. *See ad page 47.*

22L. SONOTONE
"Beautiful Sound by Sonotone," SA-7 catalog of high fidelity amplifiers and speaker systems. "Phonograph Modernization Manual," SAC-7 data on Sonotone ceramic cartridges and their installation. *See ad page 49.*

23L. STANDARD ELECTRICAL
22-page catalog describing complete line of "Adjust-A-Volt" transformers. Also catalog sheet on PA-1 "Adjust-A-Volt." *See ad page 48.*

24L. SYLVANIA
"Guide to Replacement" lists basic designation, tube class and various manufacturers' type nos. for over 100 tubes in industrial line.

25L. TOBE DEUTSCHMANN
Tobe service capacitor catalog 5701.

26L. TRIPLETT
Catalog on two new Triplett volt-ohm-milliammeters — models 630PL and 630APL. *See ad page 13.*

27L. WINSTON
One-page flyer on full line of equipment. *See ads pages 28, 56, 61.*

28L. XCELITE
New condensed catalog. *See ad page 42.*

NOTE: PCB Denotes Production Change Bulletin.

● Denotes Television Receiver. **S** Denotes Schematic Coverage Only.

NOTE: PCB Denotes Production Change Bulletin.
● Denotes Television Receiver. S Denotes Schematic Coverage Only.

SUPPLEMENT TO SAMS AUGUST, 1957 MASTER INDEX

Covers PHOTOFACT Set Numbers 369 through 382 Released

SEPTEMBER through DECEMBER

This Supplement is your index to new models covered by PHOTOFACT since August 1957. For model coverage prior to this date see the Sams Master Index dated August 1957. Use this Supplement with the Sams Master Index—together they are your complete Index to PHOTOFACT coverage of over 28,000 receiver models.

THIS IS YOUR LATEST INDEX SUPPLEMENT!

FOR COMPLETE PHOTOFACT LISTINGS

YOU MUST

USE IT WITH THE AUGUST 1957 MASTER INDEX!

THROW AWAY

ALL OTHER SUPPLEMENTS

Set No. Folder No.

ADMIRAL

Chassis 1B1, 1C1, 1D1 .... 381—5
Chassis 4B2 (See Photofact Servicer) 378
Chassis 4P2 .... 374—1
Chassis 4V1 (See Photofact Servicer) 378
Chassis 4Y1 (See Photofact Servicer) 376
Chassis 5A4 (See Photofact Servicer) 376
Chassis 5F3, A, B (See Photofact Servicer) 378
Chassis 5K3 (See Photofact Servicer) 376
Chassis 5S2 (See Photofact Servicer) 376
Chassis 5Z2 (See Photofact Servicer) 378
Chassis 6F1 (See Photofact Servicer) 378
Chassis 7L1 .... 375—6
Chassis 7M1 .... 369—1
Chassis 8B1 (See Photofact Servicer) 373
● Chassis 14YP3D, DK, DM .. 370—1
● Chassis 17AF1 .... 367-13-S
● Chassis 17F1 .... 367-13-S
● Chassis 19AZ4D, DF, DT, ES 377—2
● Chassis 19R2 (See Photofact Servicer) 377
● Chassis 19SY4EF, ES, LS (See Photofact Servicer) 379
● Chassis 19SZ4D, DF, DT, ES, FS, PS .... 377—2
● Chassis 20L2, Z (See Photofact Servicer) 373
● Chassis 20Z4EF, PS (Runs 10-13) (See Photofact Servicer). 377
● Chassis 20Z4EFB, FFB, PSB .... 380—2
● Chassis 22H3Z, 22J2Z (See Photofact Servicer) 380
● Chassis 23B1AZ (See Photofact Servicer) 374
● Chassis 23C1 (See Photofact Servicer) 380
● Chassis 23E1AZ, 23E1Z (See Photofact Servicer) 375
● Chassis 23F1 (See Photofact Servicer) 380
● Chassis 23F1Z (See Photofact Servicer) 374
● Chassis 23H1Z (See Photofact Servicer) 381
● C2516Z, C2517Z (Ch. 23E1AZ, Z) (See Photofact Servicer) .. 375
● CA2236A (Ch. 20L2, Z) (See Photofact Servicer) 373
● CS23A11, CS23A12, CS23A13 (Ch. 19SZ4DT) .... 377—2
● CS23A25 (Ch. 19SZ4DT) ... 377—2
● CS23A26, CS23A27 (Ch. 19SZ4ES) .... 377—2
● CS23B16C, CS23B17C (Ch. 19SZ4DF) .... 377—2
● CS323A6, CS323A7 (Ch. 19SZ4ES) .... 377—2
● CS323A16, CS323A17, CS323A19 (Ch. 19SZ4ES) .... 377—2
● CS325A6, CS325A7 (Ch. 19SZ4FS) .... 377—2
● CU2516Z, CU2517Z (Ch. 23F1Z) (See Photofact Servicer) . 374
● F2817Z (Ch. 23B1AZ) (See Photofact Servicer) 374
● FA2226 (Ch. 20L2, Z) (See Photofact Servicer) 373
● H2516Z (Ch. 23E1AZ, Z) (See Photofact Servicer) 375
● H2816Z (Ch. 23B1AZ) (See Photofact Servicer) 374
● HU2516Z (Ch. 23F1Z) (See Photofact Servicer) 374
● T18A11, T18A12, T18A13 (Ch. 17F1) 367-13-S
● T170, T171, N, T172AL, T173AL (Ch. 14YP3D) .... 370—1
● T323B1B (Ch. 20Z4EFB, FFB, PSB) .... 380—2
● T1710 (Ch. 14YP3D) .... 370—1
● TA1811, TA1812, TA1813 (Ch. 17AF1) 367-13-S
● TA2216A, TA2217A (Ch. 20L2, Z) (See Photofact Servicer) .. 373
● TS23A1, TS23A2, TS23A3 (Ch. 19SZ4D) .... 377—2
● TS23A6, TS23A7 (Ch. 19SZ4DT) .... 377—2
● TS323A1, TS323A2, BZ, TS323A3, LN (Ch. 19SZ4PS) .... 377—2

ADMIRAL—Cont.

1B11, 1C12, 1C14, 1D11, 1D12, 1E13, 1E14 (Ch. 1B1, 1C1, 1D1) .... 381—5
4B21, 4B22, 4B24, 4B28, 4B29 (Ch. 4B2) (See Photofact Servicer) 378
4P21, 4P22, 4P24, 4P28 (Ch. 4P2) .... 374—1
4V12, 4V18, 4V19 (Ch. 4V1) (See Photofact Servicer) 378
4Y11, 4Y12, 4Y18, 4Y19 (Ch. 4Y1) (See Photofact Servicer). 376
5A42, 5A43, 5A44, 5A48 (Ch. 5A4) (See Photofact Servicer). 376
5F31, A, B, 5F32, A, B, 5F33, A, B, 5F34B, 5F38, A, B (Ch. 5F3, A, B) (See Photofact Servicer) 378
5K31, 5K32, 5K34, 5K38, 5K39 (Ch. 5K3) (See Photofact Servicer) 376
5S21, 5S22, 5S23 (Ch. 5S3) (See Photofact Servicer) 376
5Z22, 5Z23 (Ch. 5Z2) (See Photofact Servicer) 378
6F10, 6F11, 6F12 (Ch. 6F1) (See Photofact Servicer) 378
7C64 (Ch. 8B1) (See Photofact Servicer) 373
7L12, 7L14, 7L16, 7L18 (Ch. 7L1) .... 375—6
7M12, 7M14, 7M16, 7M18 (Ch. 7M1) .... 369—1

AIRCASTLE

602-170144 (See Photofact Servicer) 381
610.CE-352 (See Photofact Servicer) 381
610.PM-236 (See Photofact Servicer) 381

AIRLINE

GAA-861A, GAA-862A, GAA-863A .... 369—2
GAA-864A .... 374—2
● GRX-4030A .... 379—1
● GRX-4130A .... 379—1
● GSE-4004B, GSE-4006B (See Photofact Servicer) 382
● GSE-4017B (See Photofact Servicer) 382
● GSE-5008B, GSE-5009A (See Photofact Servicer) 382
GTM-1108A .... 379—5
GTM-1653A, GTM-1654A . 376—6

AIRLINE—Cont.

● GTM-4031 .... 378—2
● GTM-4032A .... 377—3
● GTM-4131A .... 378—2
GTM-4132A .... 377—3
● WG-4021A, B, C, D, E, WG-4022A, B, C, D, E .... (PCB 340-1, 378-1) 313—2
● WG-4041A 376-20-S
● WG-4051A 376-20-S
● WG-4121A, B, C, D, WG-4122A, B, C, D .... (PCB 340-1, 378-1) 313—2
● WG-5031A, B, C, D, E, WG-5034A, B, C, D, E, WG-5036B, WG-5037B .... (PCB 340-1, 378-1) 313—2
● WG-5041A 376-20-S
● WG-5051A 376-20-S
● WG-5131A, B, C, D, WG-5134A, B, C, D, WG-5136B, WG-5137B .... (PCB 340-1, 378-1) 313—2
45XGAA-997D .... 182—2

ALLSTATE

5028 (Ch. 528.50280, 1) .. 372—1
5033 (Ch. 528.50330, 1) 372—1
Ch. 528.50280, 528.50281 372—1
Ch. 528.50330, 528.50331 372—1

ANDREA

● B2LB-VQ21 (Ch. VQ21) .... 381—1
● C-VQ21 (Ch. VQ21) .... 381—1
CP-12W (Ch. PA, P12W) .. 369—3
● E2LB-VQ21 (Ch. VQ21) ... 381—1
● F2LB-VQ21 (Ch. VQ21) .... 381—1
● LB-VQ21 (Ch. VQ21) .... 381—1
● MC-VQ21 (Ch. VQ21) .... 381—1
● T-VQ21 (Ch. VQ21) .... 381—1
W69P .... 371—1
● 2LB-VQ21 (Ch. VQ21) .... 381—1
Ch. PA .... 369—3
Ch. P12W .... 369—3
Ch. VQ21 .... 381—1

ARVIN

9574P (Ch. 1.43000) .... 377—6
9577 (Ch. 1.41700) .... 376—7
Ch. 1.41700 .... 376—7
Ch. 1.43000 .... 377—6

AUTOMATIC

CP-315B (Similar to Chassis) .... 298—4

BRAUN

HM2, HM3 .... 375—7
MM3 .... 375—7
MS3 .... 375—7
Super 99 .... 375—7
TS2 .... 375—7

BUICK

981813 .... 369—4

BULOVA

100, 110 .... 371—2
200 Series .... 382—6
220 Series .... 372—2
230 Series .... 372—2
240 Series .... 382—6
260 Series .... 376—8
270 Series .... 369—5
300 Series .... 369—6
310, 320 Series .... 370—2

CADILLAC

7268005 .... 370—3
7268035 .... 370—3

COLUMBIA RECORDS

512 .... 373—1
517, 518 .... 376—9
540 .... 373—1
572 .... 352—4

CORONADO

● TV2-9414A, B, TV2-9415A, B, TV2-9416A, B, TV2-9417A, B, TV2-9418A, B ,TV2-9419A, B, TV2-9420A, B, TV2-9421A, B, TV2-9422A, TV2-9423A, TV2-9424A, TV2-9425A .... 379—2
● TV2-9485A, TV2-9486A . 380-12-S
● TV3-9395A .... 373—2
● TV3-9401A .... 374—3
● TV3-9404A .... 361—4
● TV3-9408B, TV3-9409B, TV3-9410B, TV3-9411B .... 361—4
● TV3-9450A 382-15-S
● TV3-9455A, TV3-9456A . 382-15-S
● TV3-9460A, TV3-9461A . 382-15-S

CRAFTSMEN (Also See Radio Craftsmen)

CP-14 .... 369—7
CP-18, CP-19 .... 369—7
CTA-5 .... 369—7

CRESCENT

A-744, A-746B, E, M .... 377—7

DAVID BOGEN

DB115 376-10
D070 .... 379—6
PR100A .... 381—6
R620 .... 380—6
ST-10, ST-10G .... 378—6

DUMONT

RA-378, RA-379 .... 373—3
● RA-392, RA-393, A .... 373—4
RA-394, RA-395 .... 372—3
RA-902 .... 375—8
1210 .... 375—8
Americano .... 372—3
Balladier .... 373—3
Governor Winthrop .... 372—3
Minstrel .... 373—3

ELECTRO-VOICE

3303 .... 380—7

EMERSON

833B (Ch. 120267B) .... 381—7
840A (Ch. 120267B) .... 381—7
845B (Ch. 120321B) .... 369—8
848B (Ch. 120267B) .... 381—7
851B (Ch. 120327B) .... 372—4
852B (Ch. 120334B) .... 372—4
853B (Ch. 120335B) .... 372—4
854A, B (Ch. 120321B) .. 369—8
865B (Ch. 120243B) .... 287—7
867B (Ch. 120349B) .... 370—4
878B, 879B (Ch. 120267B). 381—7
● 1212 (Ch. 120351E) .. 365-16-S
● 1213 (Ch. 120352G) .. 365-16-S
● 1228 (Ch. 120351E) .. 365-16-S
● 1229 (Ch. 120352G) .. 365-16-S
● 1238 (Ch. 120351E) .. 365-16-S
● 1239 (Ch. 120352G) .. 365-16-S
● 1244 (Ch. 120351E) .. 365-16-S
● 1245 (Ch. 120352G) .. 365-16-S
● 1246 (Ch. 120351E) .. 365-16-S
● 1247 (Ch. 120352G) .. 365-16-S
● 1254 (Ch. 120341H) .. 365-16-S
● 1255 (Ch. 120342R) .. 365-16-S
● 1264 (Ch. 120341H) .. 365-16-S
● 1265 (Ch. 120342R) .. 365-16-S
● 1272 (Ch. 120351E) .. 365-16-S
● 1273 (Ch. 120352G) .. 365-16-S
● 1274 (Ch. 120351E) .. 365-16-S
● 1275 (Ch. 120352G) .. 365-16-S
● 2034S, 2038S (Ch. 120345E, V) 363-21-S
● 2040S, 2042S (Ch. 120346V) 363-21-S
● 2056 (Ch. 120343E) .. 363-21-S
● 2057 (Ch. 120344G) .. 363-21-S
● 2058 (Ch. 120343E) .. 363-21-S
● 2059 (Ch. 120344G) .. 363-21-S
● 2060 (Ch. 120343E) .. 363-21-S
● 2061 (Ch. 120344G) .. 363-21-S
● 2062 (Ch. 120343E) .. 363-21-S
Ch. 120243B .... 287—7
Ch. 120267B .... 381—7
Ch. 120321B .... 369—8
Ch. 120327B .... 372—4
Ch. 120334B .... 372—4
Ch. 120335B .... 372—4
Ch. 120341H 365-16-S
Ch. 120342R 365-16-S
Ch. 120343E 363-21-S
Ch. 120344G 363-21-S
Ch. 120345E, V 363-21-S
Ch. 120346V 363-21-S
Ch. 120349B .... 370—4
Ch. 120351E 365-16-S
Ch. 120352G 365-16-S

FAIRCHILD

255A .... 371—3
275 .... 381—8

FIRESTONE

4-A-145, 4-A-146 (Codes 389-5-3146, 389-5-3149, 389-6-3146A, 389-6-3149A) .... 369—9
4-A-150 (Code 364-6-445) 372—5
4-A-163 (Code 297-6-623) 370—5
● 13-G-211, 13-G-212 (Code 280-6-21T58) 369-10
● 13-G-213 (Code 280-6-21T59) 369-10
● 13-G-214, 13-G-215 (Code 280-6-21T58) 369-10
● 13-G-216, 13-G-217 (Code 280-6-21T49) 369-10
● 13-G-220, 13-G-221, 13-G-222, 13-G-223 (Codes 334-6-A62/A, 334-6-N62/A) .... 375—2
● 13-G-225, 13-G-226 (Codes 334-6-A63/A, 334-6-N63/A) .. 373—5

NOTE: PCB Denotes Production Change Bulletin. ● Denotes Television Receiver. **S** Denotes Schematic Coverage Only.

Set No. Folder No.

GENERAL ELECTRIC

C405, C406 .... 373—6
P710A, B, C, P711A, B, C .. 375—9
P725, P726 .... 378—7
T105, T106 .... 376—11
●9T001UHF, 9T002UHF ("T" Line) .... 359—7
●14P1210, 14P1211, 14P1212 ("Q2" Line) .... 381—2
●14T020 ("Q" Line) .... (PCB 328-1, 352-1) 310—4
●16C104 .... 123—4
●16T6 .... 123—4
●17P1329, 17P1330, 17P1331 ("M3" Line) 359–18–S
●17T027 ("MM" Line) .... 342—7
●21C142 ("ST" Line) .... 337—7
●21C143, 21C144 ("U" Line) .... 344—7
●21C158, 21C159 ("U" Line) .... 344—7
●21C1439 ("M3" Line) 359–18–S
●21C1449 ("M3" Line) 359–18–S
●21C1550, 21C1551 ("U2" Line) 362–17–S
●21T056, 21T057 ("U" Line) .... 344—7
●21T1540, 21T1541, 21T1542 ("U2" Line) 362–17–S
670, 671, 672, 673 .... 382—7
860, 861, 862 .... 374—5
875, 876, 877 .... 376—11
911D, 912D, 913D, 914D .. 377—8
935, 936 .... 373—6
940, 941, 942 .... 372—6

GRANCO

780 .... 350—5

GROMMES

LJ-5 .... 378—8
10PG .... 381—9
15PG .... 379—7
20PG .... 376—12
207, 207A .... 382—8
212 .... 380—8
221 .... 375—10

HALLICRAFTERS

●10TS900T, 10TS901T (Ch. A2011, B2011) .... 381—3
●17TS740B, M, 17TS760B, BJX, M, 17TS780B, M (Ch. A2007, E2007) 348–18–S
Ch. A2007 .... 348–18–S
Ch. A2011, B2011 .... 381—3
Ch. E2007 .... 348–18–S

HAMILTON ELECTRONICS

W-7 .... 375—11

HARMAN-KARDON

TA-1040 .... 380—9

HOFFMAN

●B1007 (Ch. 315) 318–15–S
●B1081, U, B1091, U, B1111, U (Ch. 321, U) .... 372—7
●B1121, U (Ch. 322, U) .... 372—7
●B1161, U (Ch. 323, U) .. 370—6
●B1191, U (Ch. 329, U) .... 377—4
●B1201, U (Ch. 329U, 330) . 377—4
●B1211, U (Ch. 3 29, U) .... 377—4
●B3061, U (Ch. 321, U) .. 372—7
●B3071, U (Ch. 322, U) .. 372—7
●B3081 (Ch. 419) 321–15–S
●B3101, U (Ch. 321, U) .. 372—7
●B3114, U (Ch. 322, U) .. 372—7
●B3151, U (Ch. 324, U) .... 373—8
●B3191, U (Ch. 420, U) .... 376—2
●B3201, U (Ch. 323, U) .. 370—6
●B3214, U (Ch. 324, U) .... 373—8
●B3234, U (Ch. 331, U) .... 380—3
●B3241, U (Ch. 329, U) .... 377—4
●B3251, U (Ch. 329U, 330) 377—4
●B3261, U (Ch. 331, U) .... 380—3
●B3271, U (Ch. 331, U) .... 380—3
●B3291, U (Ch. 421, U) .... 378—3
●B3304, U (Ch. 331, U) .... 380—3
●BG1151, U (Ch. 323, U) .. 370—6
●BT1144, U (Ch. 326, U) .. 371—4
●BW1144, U (Ch. 326, U) 371—4
●GT1144, U (Ch. 326, U) .. 371—4
●K1081, U (Ch. 321, U) .. 372—7
●K1151, U (Ch. 323, U) .. 370—6
●K1191, U (Ch. 329, U) .... 377—4
●K1211, U (Ch. 329, U) .... 377—4
●M1007 (Ch. 315) 318–15–S
●M1091, U, M1111, U (Ch. 321, U) .... 372—7
●M1121, U (Ch. 322, U) ... 372—7
●M1161, U (Ch. 323, U) .. 370—6
●M1191, U (Ch. 329, U) .... 377—4
●M1201, U (Ch. 329U, 330) . 377—4
●M1211, U (Ch. 329, U) .... 377—4
●M3061, U (Ch. 321, U) .. 372—7
●M3071, U (Ch. 322, U) .. 372—7
●M3081 (Ch. 419) 321–15–S
●M3101, U (Ch. 321, U) .. 372—7
●M3114, U (Ch. 322, U) .. 372—7
●M3151, U (Ch. 324, U) .... 373—8
●M3181, U (Ch. 420, U) .... 376—2
●M3201 (Ch. 323, U) .... 370—6
●M3214, U (Ch. 324, U) .... 373—8
●M3234, U (Ch. 331, U) .... 380—3
●M3241, U (Ch. 329, U) .... 377—4
●M3251, U (Ch. 329U, 330) . 377—4
●M3261, U (Ch. 331, U) .... 380—3
●M3271, U (Ch. 331, U) .... 380—3
●M3281, U (Ch. 421, U) .... 378—3
●M3304, U (Ch. 331, U) .... 380—3
●MG1151, U (Ch. 323, U) .. 370—6
P410 Series, P411 Series (Ch. 1109) .... 381—10
●P1007 (Ch. 315) 318–15–S
●P1121, U (Ch. 322, U) .. 372—7

HOFFMAN—Cont.

●P1151, U (Ch. 323, U) .. 370—6
●P1201, U (Ch. 329U, 330) . 377—4
●P1211, U (Ch. 329, U) .... 377—4
●P3071, U (Ch. 322, U) .. 372—7
●P3081 (Ch. 419) 321–15–S
●P3091, U (Ch. 322, U) .. 372—7
●P3101, U (Ch. 321, U) .. 372—7
●P3114, U (Ch. 322, U) .. 372—7
●P3214, U (Ch. 324, U) .... 373—8
●P3234, U (Ch. 331, U) .... 380—3
●P3241, U (Ch. 329, U) .... 377—4
●P3251, U (Ch. 329U, 330) . 377—4
●P3261, U (Ch. 331, U) .... 380—3
●P3271, U (Ch. 331, U) .... 380—3
●P3281, U (Ch. 421, U) .... 378—3
●P3304, U (Ch. 331, U) .... 380—3
●PT1144, U (Ch. 326, U) .. 371—4
●SG1144, U (Ch. 326, U) .. 371—4
●SP1161, U (Ch. 323, U) .. 370—6
●SP3061, U (Ch. 321, U) .. 372—7
●SP3151, U (Ch. 324, U) .... 373—8
●SP3161, U (Ch. 324, U) .... 373—8
●SP3181, U (Ch. 420, U) .... 376—2
●SP3201, U (Ch. 323, U) .. 370—6
●W1007 (Ch. 315) 318–15–S
●W1081, U (Ch. 321, U) .. 372—7
●W1111, U (Ch. 321, U) .. 372—7
●W1121, U (Ch. 322, U) .. 372—7
●W1161, U (Ch. 323, U) .. 370—6
●W1201, U (Ch. 329U, 330) 377—4
●W3061, U (Ch. 321, U) .. 372—7
●W3071, U (Ch. 322, U) .. 372—7
●W3081 (Ch. 419) 321–15–S
●W3101, U (Ch. 321, U) .. 372—7
●W3114, U (Ch. 322, U) .. 372—7
●W3201, U (Ch. 323, U) .. 370—6
●W3214, U (Ch. 324, U) .... 373—8
●W3251, U (Ch. 329U, 330) 377—4
●2021 (Ch. 706) 350–18–S
●4041, 4051, 4061 (Ch. 706) 350–18–S
Ch. 315 .... 318–15–S
Ch. 321, 322 .... 372—7
Ch. 323, U .... 370—6
Ch. 324, U .... 373—8
Ch. 326, U .... 371—4
Ch. 329, U, 330 .... 377—4
Ch. 331, U .... 380—3
Ch. 419 .... 321–15–S
Ch. 420, U .... 376—2
Ch. 421, U .... 378—3
Ch. 706 .... 350–18–S
Ch. 1109 .... 381—10

HOTPOINT

●9S101UHF, 9S102UHF ("T" Line) .... 363—11
●14S204, -UHF ("Q" Line) . 356—8
●21S402, 21S403 ("U" Line) .... 348—3
●21S553, 21S554 ("U" Line) .... 348—3

INTERNATIONAL TRUCK (Auto Radio)

IL7TC, IL7TC-12 .... 377—9

KNIGHT (Also see Recorder Listing)

KN-3016 (93SZ505) 375–12
KN-3032 (93SZ507) .... 378—9
KN-3060 (93SZ508) .... 379—8
KN-3061 (93SZ694) .... 377—10
KN-3116 (93SZ737) .... 375—12
KN-3132 (93SZ740) .... 378—9
KN-3160 (93SZ741) .... 379—8
93SZ505 .... 375—12
93SZ507 .... 378—9
93SZ508 .... 379—8
93SZ694 .... 377—10
93SZ737 .... 375—12
93SZ740 .... 378—9
93SZ741 .... 379—8

LINCOLN (Auto Radio)

HHK-18805-A .... 370—7
78BL (HHK-18805-A) .... 370—7

MAGNAVOX

●23 Series 344–18–S
●73 Series .... 369—12
●74 Series .... 375—3
●117 Series .... 370—8
Chassis AMP-161AA .... 373—9
Chassis AMP-162 .... 377—11
Chassis AMP-165AA .... 376—13
●Chassis CMUA487DC, ED .. 370—8
●Chassis CMUA490DC, ED, CMUA491DC, ED .... 370—8
●Chassis CMUA499DC, ED, CMUA501DC, ED .... 370—8
●Chassis CMUD495DC, ED .. 370—8
●Chassis CMUE493DC, ED .. 370—8
Chassis CR-738 .... 374—7
Chassis CR-740AA .... 375—13
Chassis CR-741 .... 370—9
Chassis CR-743 .... 369—11
●Chassis CTA487DC, ED .. 370—8
●Chassis CTA490DC, ED, CTA491DC, ED .... 370—8
●Chassis CTA499DC, ED, CTA501DC, ED .... 370—8
●Chassis CTD495DC, ED .. 370—8
●Chassis CTE493DC, ED .. 370—8
●Chassis U19-01BB, U19-02BB .... (PCB 377-1) 360—6
●Chassis U23-01AA, U23-02AA, U23-03AA 344–18–S
●Chassis U73-01AA, U73-02AA .... 369—12
●Chassis U74-01AA, U74-02AA .... 375—3
●Chassis V19-01BB, V19-02BB .... (PCB 377-1) 360—6

MAGNAVOX—Cont.

●Chassis V23-01AA, V23-02AA, V23-03AA 344–18–S
●Chassis V73-01AA, V73-02AA .... 369—12
●Chassis V74-01AA, V74-02AA .... 375—3

MERCURY (Auto Radio)

FEK-18805-C .... 372—9
FEK-18805-D .... 370—7
778M (FEK-18805-C) .... 372—9
788M (FEK-18805-D) .... 370—7

METEOR

7000 (Ch. 132.42000) .... 377—12
7047 (Ch. 528.47500) .... 379—9
7240 (Ch. 567.36008, 10) . 377—17
Ch. 132.42000 .... 377—12
Ch. 528.47500 .... 379—9
Ch. 567.36008, 10 .... 377—17

MONITORADIO (Radio Apparatus)

MR-33 .... 369—13

MOPAR

624 .... 382—9
918, 919, 919HR .... 379—10

MOTOROLA

●A21K67 Series (Ch. TS, TTS, VTS, WTS-539B) .... 357—5
CTM7X .... 372—10
OEA7X .... 373—10
VWA7 .... 374—8
●Y14P10-1, -2, Y14P11-1, -2 (Ch. TS-425Y) ... (PCB 382-4) 369—14
●Y14P10-1A, 2A, Y14P11-1A, -2A (Ch. WTS-425Y) .... (PCB 382-4) 369—14
●Y21C7BG, MG (Ch. TS-538Y) .... (PCB 375-1) 343—8
●Y21CT2B, M (Ch. TS-905Y) 371—5
●Y21K59B, M, MCH (Ch. VTS-538Y) .... (PCB 375-1) 343—8
●Y21K67B, M (Ch. TS-538Y) .... (PCB 375-1) 343—8
●Y21K70B, M (Ch. TS-542Y) .... 382—1
●Y21T33B (Ch. TS-538Y) .... (PCB 375-1) 343—8
●Y21T37B, M (Ch. TS-542Y) .... 382—1
●14P10-1, -2, 14P11-1, -2 (Ch. TS-425) .... (PCB 382-4) 369—14
●14P10-1A, -2A, 14P11-1A, -2A (Ch. WTS-425) ... (PCB 382-4) 369—14
●17P1 Series, 17P2 Series (Ch. TS-426) 373–17–S
●21CK3 Series (Ch. TS-905) 346–22–S
●21C7BG, MG (Ch. TS-538) .... (PCB 375-1) 343—8
●21CT2B, M (Ch. TS-905) .. 371—5
●21K59B, M, MCH (Ch. VTS-538) .... (PCB 375-1) 343—8
●21K67B, M (Ch. TS-538) .... (PCB 375-1) 343—8
●21K70B, M (Ch. TS-542) ... 382—1
●21T33B (Ch. TS-538) .... (PCB 375-1) 343—8
●21T37B, M (Ch. TS-542) ... 382—1
397 .... 371—6
397X 369–15
Ch. TS-425, Y (PCB 382-4) 369–14
Ch. TS-426 .... 373–17–S
Ch. TS-538, Y (PCB 375-1) 343—8
Ch. TS-542, Y .... 382—1
Ch. TS-905, Y .... 371—5
Ch. VTS-538, Y .... (PCB 375-1) 343—8
Ch. WTS-425, Y (PCB 382-4) 369–14

NEWCOMB

E-25 379–11

OLDSMOBILE

989001 369–16
989002 376–14

OLYMPIC

●1CD73, U, 1CD74, U (Ch. DH, DHU, RUNS 5 and 6) .... 382—2
●1KD81, U, 1KD82, U, 1KD83, U (Ch. DH, DHU, RUNS 5 and 6) .... 382—2
●1TD62, U (Ch. DH, DHU, RUNS 5 and 6) .... 382—2
●4KH85, U, 4KH86, U (Ch. DH, DHU, RUNS 5 and 6) .... 382—2
●14TT91, 14TT92 (Ch. GT, GTU) 378–14–S
●17TU93, 17TU94 (Ch. GU, GUU) 378–14–S
●17TZ90C, CU .... 381—4
Ch. DH, DHU, RUNS 5 and 6) .... 382—2
Ch. GT, GTU 378–14–S
Ch. GU, GUU 378–14–S

PACKARD

484652 336–13

PACKARD-BELL

4RB1 369–17
5RC1, 5RC3, 5RC4 372–11
10RP2, 11RP2 377–13
●17VT4 (Ch. V8-2) 375–18–S
●21DC5, 21DC6, 21DC7 (Ch. 98D3) 374–17–S
●21SC6, 21SC7, 21SC8 (Ch. 88S3) 379–15–S
●21SK3 (Ch. 88S3) 379–15–S
●21ST3 (Ch. 88S3) 379–15–S
●21VT2 (Ch. 88S3) 379–15–S

PACKARD-BELL—Cont.

●24DC4 (Ch. 98D3) 374–17–S
●24SC2 (Ch. 88S3) 379–15–S
●24VT1 (Ch. 88S3) 379–15–S
Ch. V8-2 .... 375–18–S
Ch. 88S3 .... 379–15–S
Ch. 98D3 .... 374–17–S

PHILCO

E976 378–11
E1356, E1357, E1358 376–15
●E3032I, R, E3034, B, SA, SS (Ch. 7H20) .... 376—3
●E4202, E4203, E4205L, M, E4206-SD (Ch. 7L40, A) .... 362—7
●E4208S (Ch. 7L70) .... 374—9
●E4601SL, SM, E4603L, M, E4606L, M, T, TL (Ch. 7L40, A, 7L41, A) .... 362—7
●E4605, C, T, E4607, L, T (Ch. 7L70, 7L71) .... 374—9
●E4614SL (Ch. 7L40, A) .... 362—7
●E6606, E6608TN, E6610L, M (Ch. 7L70, 7L71) .... 374—9
F-976 378–11
●F4210, E, L, F4212, L (Ch. 8L41) 381–17–S
●F4214STM, STN (Ch. 8L42) 381–17–S
●F4216, L (Ch. 8L71) 381–17–S
●F4620SL, SM (Ch. 8L41) . 381–17–S
●F4622, L, F4624 (Ch. 8L43) 381–17–S
●F4626, L (Ch. 8L73) 381–17–S
●F4632 (Ch. 8L43) 381–17–S
●F6206SL, SM (Ch. 8P51, A) 381–17–S
●F6620SL (Ch. 8P51, A) .. 381–17–S
●F6624T, TL (Ch. 8L72) .. 381–17–S
●UE3032I, R, UE3034, B, SA, SS (Ch. 7H20U) .... 376—3
●UE4202, UE4203, UE4205L, M, UE4206SD (Ch. 7L40U, AU) .... 362—7
●UE4208S (Ch. 7L70U) .... 374—9
●UE4602SL, SM, UE4603L, M, UE4606L, M, T, TL (Ch. 7L40U, AU, 7L41U, AU) .... 362—7
●UE4605, C, T, UE4607, L, T (Ch. 7L70U, 7L71U) .... 374—9
●UE4614SL (Ch. 7L40U, AU) 362—7
●UE4800 (Ch. 7L45U, AU) .. 362—7
●UE6606, UE6608TN, UE6610L, M (Ch. 7L70U, 7L71U) .... 374—9
●UF4210, E, L, UF4212, L (Ch. 8L41U) 381–17–S
●UF4214STM, STN (Ch. 8L42U) 381–17–S
●UF4216, L (Ch. 8L71U) .. 381–17–S
●UF4620SL, SM (Ch. 8L41U) 381–17–S
●UF4622, L, UF2624 (Ch. 8L43) 381–17–S
●UF4626, L (Ch. 8L73U) .. 381–17–S
●UF4632 (Ch. 8L43U) 381–17–S
●UF6206SL, SM (Ch. 8P51U) 381–17–S
●UF6620SL, SM (Ch. 8P51U) 381–17–S
●UF6624T, TL (Ch. 8L72U) 381–17–S
Ch. 7H20, U, 7H22 .... 376—3
Ch. 7L40, A, AU, U, 7L41, A, AU, U, 7L45, A, AU, U .... 362—7
Ch. 7L70, U, 7L71, U .... 374—9
Ch. 8E11, U, 8E13 .. 370–16–S
Ch. 8H20, U, 8H22 .. 370–16–S
Ch. 8L41, U, 8L42, U, 8L43, U 381–17–S
Ch. 8L71, U, 8L72, U ,8L73, U 381–17–S
Ch. 8P51, A, U 381–17–S

PILOT

AA-903B 377–14
AA-920B 376–16

PONTIAC

988671 372–12
988672 373–11

RCA VICTOR

SHF8, SHF9 (Ch. RS-158D, F) 346–10
2XF935 (Ch. RC-1121A) ... 209—9
6X8A, B, C (Ch. RC-1146) . 271–10
8C5D, E, F, L (Ch. RC-1179) 369–18
8C6E, J, L, M (Ch. RC-1179A) 369–18
8C51 (Ch. RC-1179) 369–18
9BT9E, H, J (Ch. RC-1164A) .... 371—7
9EMP21H, 9EMP21J, 9EMP21K (Ch. RS-153C) .... 338—9
9W51 (Ch. RC-1079D) .... 107—7
9XL1E, F, H (Ch. RC-1167A) 359–14
●17S7090, U, 17S7092, U, 17S7093, U, 17S7099, U (Ch. 5377, 5378) .... 375—4
●21CD7895, U, 21CD7897, U (Ch. CTC5N, P) (PCB 377-1) 358—9
●21CD8725, U, 21CD8727, U (Ch. CTC7A, B) 379–15–S
●21CD8775, U, 21CD8776, U, 21CD-8777, U (Ch. CTC7A, B) 379–15–S
●21CD8865, U, 21CD8866, U, 21CD-8867, U (Ch. CTC7C, D) 379–15–S
●21CD8885, U, 21CD8886, U, 21CD-8888, U (Ch. CTC7C, D) 379–15–S
●21CD8906, U, 21CD8907, U (Ch. CTC7C, D) 379–15–S

RCA VICTOR—Cont.

●21CD8926, U, 21CD8927, U (Ch. CTC7E, F) 379–15–S
●21CD8947, U (Ch. CTC7E, F) 379–15–S
●21D8281, U, 21D8282, U (Ch. KCS116A, B) 382–15–S
●21D8305, U, 21D8306, U, 21D-8307, U (Ch. KCS116A, B) 382–15–S
●21D8628, U (Ch. KCS116C, D) 382–15–S
●21RT8202 (Ch. KCS113H) 375–18–S
●21RT8425 (Ch. KCS113K) 375–18–S
●21T7385, U, 21T7386, U, 21T7387, U, 21T7388, U (Ch. KCS104A, B) 346–11
●21T8202, U, 21T8205, U, 21T8207, U (Ch. KCS113A, B) .. 375–18–S
●21T8265, U, 21T8267, U (Ch. KCS113A, B) 375–18–S
●21T8375, U, 21T8376, U, 21T8377, U (Ch. KCS113P, R) ... 375–18–S
●21T8395, U, 21T8397, U (Ch. KCS113P, R) 375–18–S
●21T8405, U, 21T8407, U (Ch. KCS113P, R) 375–18–S
21T8425, U, 21T8426, U, 21T8427, U, 21T8428, U (Ch. KCS113E, F) 375–18–S
●21T8445, U, 21T8447, U ,21T8448, U (Ch. KCS113E, F) ... 375–18–S
●21T8465, U, 21T8466, U, 21T8467, U, 21T8468, U (Ch. KCS113E, F) 375–18–S
●21T8485, U, 21T8486, U, 21T8487, U (Ch. KCS113E, F) ... 375–18–S
Ch. CTC5N, P (PCB 377-1) 358—9
Ch. CTC7A, B, C, D, E, F 379–15–S
Ch. KCS104A, B 346–11
Ch. KCS113A, B, E, F, H, K, P, R 375–18–S
Ch. KCS116A, B, C, D ... 382–15–S
Ch. RC-1079D .... 107—7
Ch. RC-1121A .... 209—9
Ch. RC-1146 271–10
Ch. RC-1164A .... 371—7
Ch. RC-1167A 359–14
Ch. RC-1179, A 369–18
Ch. RS-153C .... 338—9
Ch. RS-158D, F 346–10
Ch. 5377, 5378 .... 375—4

RAYTHEON

●C-21C1-B, -M (Ch. 21CT1C) 378—4
●M-21C0-B, -M (Ch. 21CT1C) .... 378—4
Ch. 21CT1C .... 378—4

REGENCY

TR-4 381–12

SCOTT (H. H.)

99-C 370–11
121-C 380–10
240 382–10
280 .... 373—7
310B .... 374—6

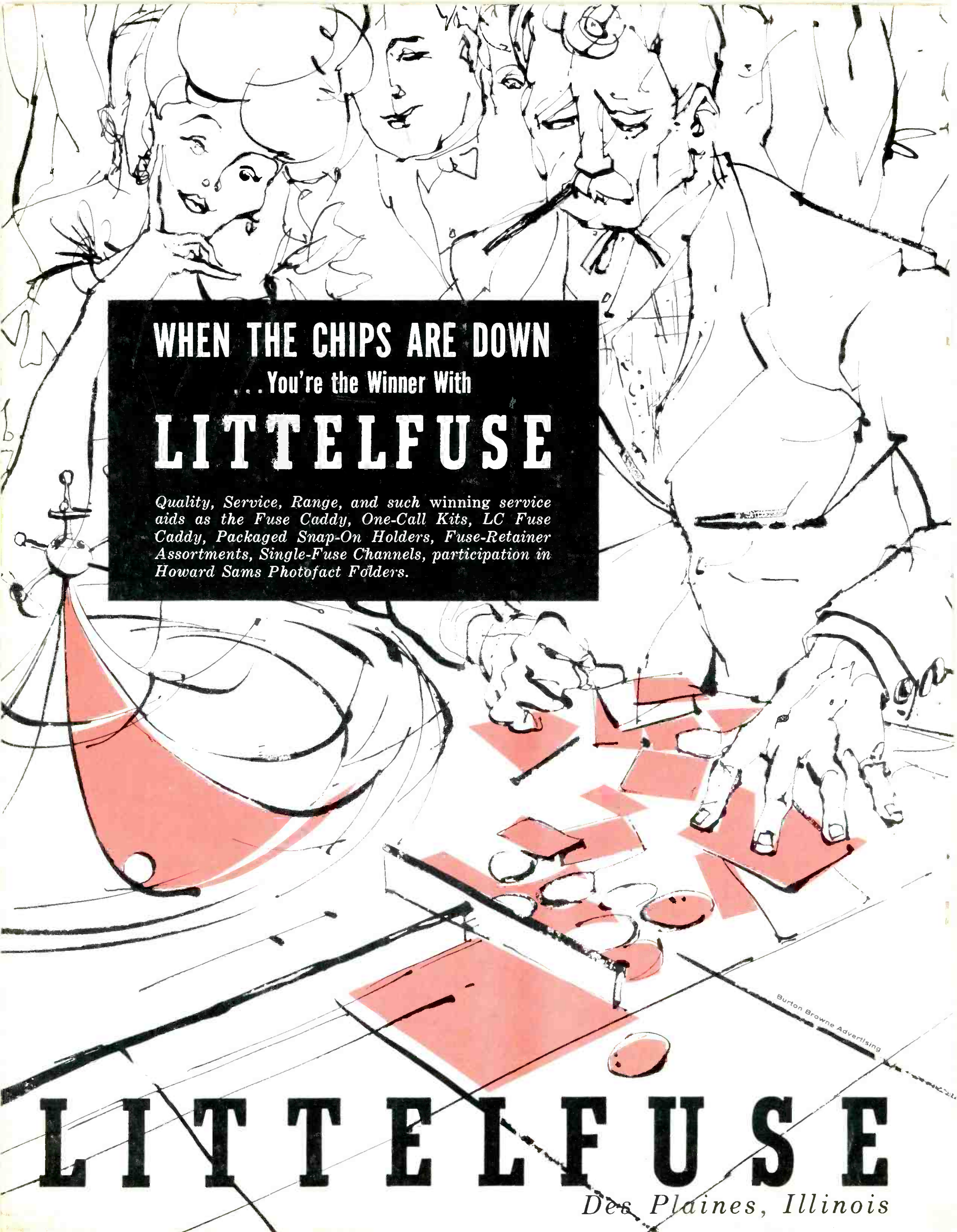
SENTINEL

●19 Series .... 371—8
Chassis AMP-140A, B, C .. 377–16
●Chassis U19-01AA, U19-02AA .... 371—8
●Chassis V19-01AA, V19-02AA .... 371—8
●Chassis V20-01AA, V20-02AA, V20-03AA .... (PCB 380-1) 367–11

SILVERTONE

●PC-7106A (Ch. 456.49201) . 378—5
●PC-7107A (Ch. 456.49211) . 378—5
●PC-7108A (Ch. 456.49201) . 378—5
●PC-7114, PC-7115, PC-7116, PC-7117 (Ch. 456.51000, 1, 10, 11, 20, 22) 368–14
●PC-7120, PC-7121, PC-7122, PC-7123 (Ch. 456.51000, 1, 10, 11, 20, 22) 368–14
●PC-7128, PC-7129, PC-7130, PC-7131 (Ch. 456.51000, 1, 10, 11, 20, 22) 368–14
●PC-7132, PC-7133, PC-7134, PC-7135 (Ch. 456.52000, 1, 10, 11) 370–12
●PC-7136 (Ch. 456.51000, 1, 20, 22) 368–14
●PC-7172, PC-7173 (Ch. 456.51000, 1, 10, 11, 20, 22) 368–14
●PC-7174, PC-7175, PC-7176, PC-7177, PC-7178, PC-7179 (Ch. 456.52000, 1, 10, 11) .. 370–12
●PC-7190, PC-7191, PC-7192 (Ch. 456.51000, 1, 10, 11, 20, 22) 368–14
4244 (Ch. 137.916, -A) .. 371—9
5245A (Ch. 567.36001) ... 377–17
6062, 6063, 6064, 6067 (Ch. 528.39900) 378–12
●6102, 6103 (Ch. 549.20040, 50) .... 380—4
6233, 6234, A, 6240 (Ch. 567.36004) 377–17
6244, 6245, 6246, 6247 (Ch. 567.33006) .... 357—7
6253F (Ch. 567.33006) .... 357—7
7038, 7040 (Ch. 528.47500, 528.48500) 375–14
7053, A, AB, B, 7054, A, AB, B (Ch. 528.47300) 374–10
●7106A (Ch. 528.49200, 201, 202) .... 378—5
●7107A (Ch. 528.49210, 211, 212) .... 378—5

NOTE: PCB Denotes Production Change Bulletin. ● Denotes Television Receiver. **S** Denotes Schematic Coverage Only.


WHEN THE CHIPS ARE DOWN
...You're the Winner With
LITTELFUSE
Quality, Service, Range, and such winning *service aids as the Fuse Caddy, One-Call Kits, LC Fuse Caddy, Packaged Snap-On Holders, Fuse-Retainer Assortments, Single-Fuse Channels, participation in Howard Sams Photofact Folders.*
Burton Browne Advertising
LITTELFUSE
Des Plaines, Illinois