RADIO — ELECTRONICS

NOVEMBER 1956

TELEVISION • SERVICING • HIGH FIDELITY

HUGO GERNSBACK, Editor

What to Do
for
Weak Video

•

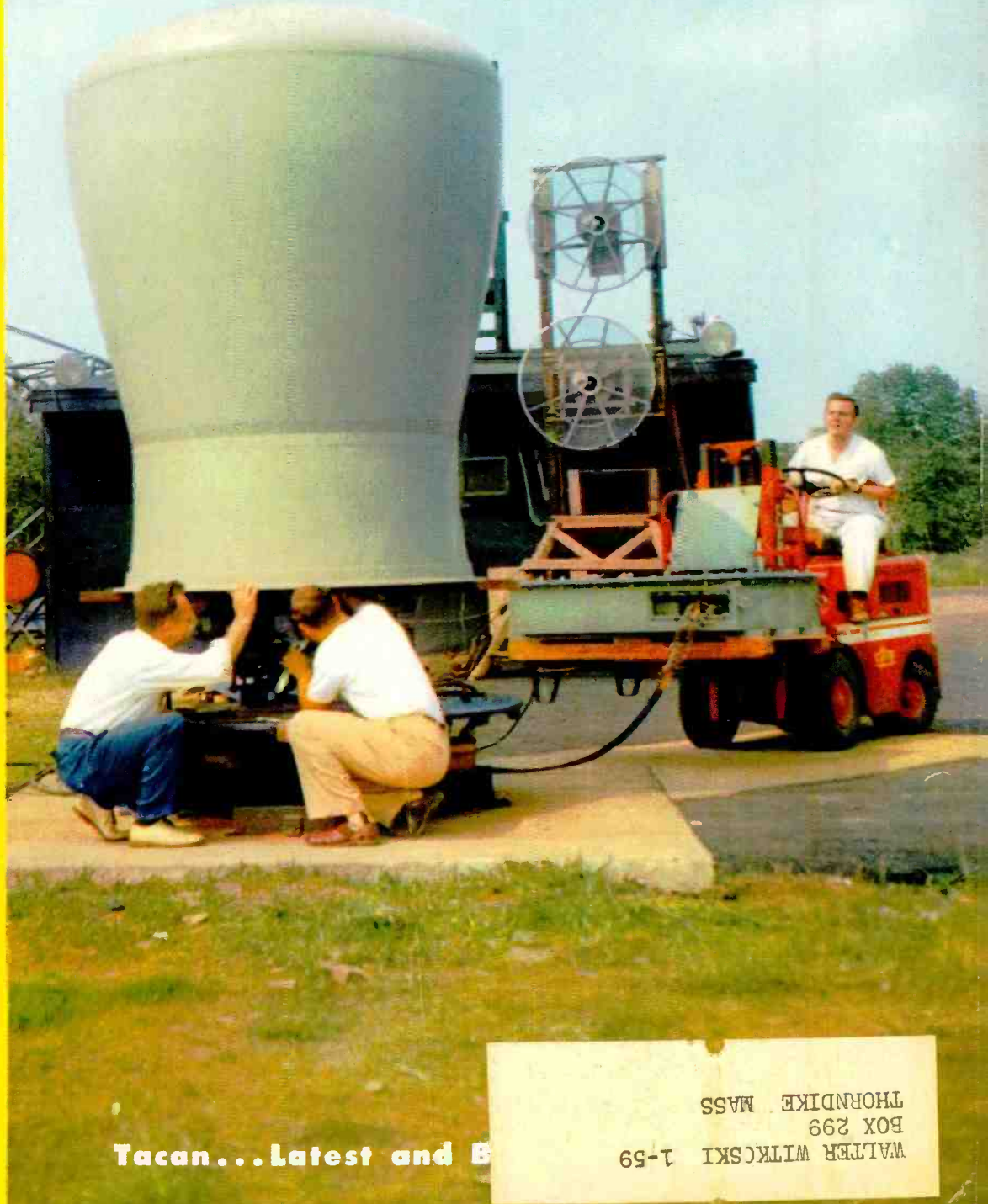
Build This
Upside-Down
Amplifier

•

Easily Built
Metronome
Is Stable

•

Hi-Fi Conversions
Are Profitable



Tacan...Latest and B

35¢
U. S. and
CANADA

YOU PUT THIS TUBE IN AND...

YAP... YAP... YAP... BLAH... BLAH... BLAH

...AND I MISSED MY FAVORITE PROGRAM

...IT'S YOUR REPUTATION!

Serviceman, at this point you are on your own! Your customer holds only **you** responsible if the picture tube goes bad because it was **your** selection. If your selection for replacement was a high quality brand, chances are your reputation for quality work wouldn't be under the gun like this.

When you use Du Mont picture tubes your reputation is backed by the pioneer commercial cathode-ray tube manufacturer of the country. The Twin-Screen Hi-Lite* aluminized picture tube is a product of the finest engineering, design, and production features assembled in 25 years of commercial manufacturing. Your confidence is definitely assured because you **know** that the guarantee on Du Mont picture tubes is good—as it has always been.

Your reputation for high quality work is established when you use high quality products. You have a reliable **partner** when you use Du Mont picture tubes.

*The ultimate in aluminized picture tubes

IT'S DEALERS CHOICE

make it...

Cathode-Ray Tube Division

ALLEN B. DU MONT LABORATORIES, Inc., 750 Bloomfield Avenue, Clifton, N. J.

NATIONAL SCHOOLS

proudly presents

FOR MEN WHO WANT TO EARN MORE

11-56 F 6.50 158

TELERAMA* • ALL 8 BRANC
TELEVISION • ELE
IN ONE DYNAMIC, MODERN S
HOME TRAINING COUR

*Registration applied for

Another great advance in **HOME STUDY TRAINING.** Let National Schools, of Los Angeles, a practical Technical Resident Trade School for over 50 years, train you at home by Shop-Method, for today's unlimited opportunities in **ALL 8 BRANCHES** of the Television, Electronics, Radio Industry.

Check all you receive in *One Master Course* at One Low Tuition

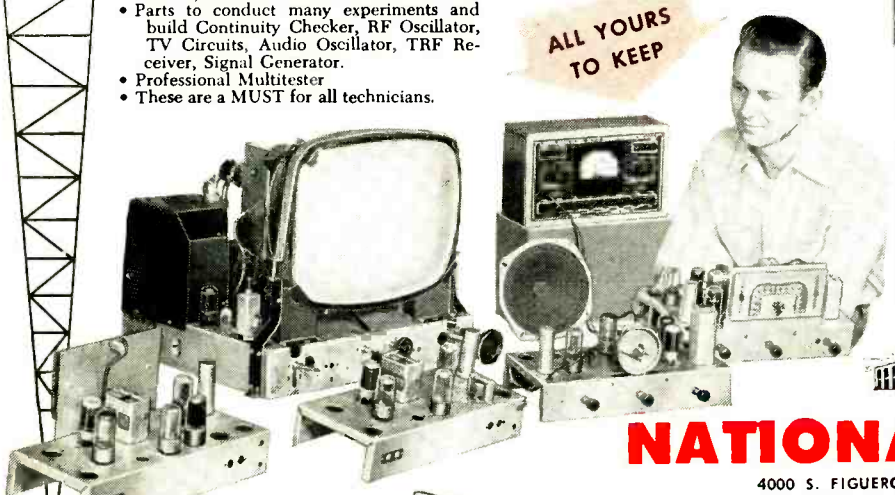
1. **Television — Including Color TV**
2. **Radio — FM and AM**
3. **Industrial Electronics**
4. **Sound Recording and Hi-Fidelity**
5. **Preparation for FCC License**
6. **Automation**
7. **Radar and Sonar**
8. **Communications**

ALL OF THIS MODERN, NEWEST, PRACTICAL EQUIPMENT IS YOURS TO KEEP!

- Parts to Build a modern TV set, including large screen Picture Tube.
- Parts to build a powerful Superhet Receiver, standard broadcast and short wave.
- Parts to conduct many experiments and build Continuity Checker, RF Oscillator, TV Circuits, Audio Oscillator, TRF Receiver, Signal Generator.
- Professional Multitester
- These are a MUST for all technicians.

YOU DO MANY PRACTICAL JOBS. You do servicing, circuit analysis and many other down-to-earth experiments. You build a modern TV set from the ground up . . . with equipment kits we give you, including a new large screen picture tube and professional Multitester, at no additional charge.

EARN AS YOU LEARN! Many of our students earn their entire tuition and more in Spare Time jobs we show them how to do while learning. YOU GET GRADUATE ADVISORY SERVICE, TOO



L. J. ROSENKRANZ
President of NATIONAL SCHOOLS

This Master-Shop-Method course is completely up-to-date. Here in Los Angeles, the TV and Electronics center of the world, we are able to keep in constant touch with the industries' latest developments. As a student, you will quickly master all phases at home . . . in your spare time. Your earning power will grow with every lesson. Just as thousands of National Schools graduates do every day, you can handle servicing, manufacturing, repairing, hundreds of other jobs, or make good money in your own business. SECURE YOUR FUTURE—NOW. SEND COUPON BELOW.

IN THESE MODERN TV STUDIOS, SHOPS AND LABORATORIES, your Shop Method Home Study Course was developed by experienced instructors and engineers. What an advantage that is to you at home — each lesson is tested, proved, easy to understand. You can master the most up-to-date projects, such as color TV set repair, printed circuits — even prepare for F.C.C. License and industrial electronics without taking a special course. TAKE YOUR FIRST STEP NOW TO A TOP-PAY JOB IN TV, ELECTRONICS, RADIO. SEND COUPON BELOW TODAY.

APPROVED FOR VETERANS AND NON-VETERANS

NATIONAL SCHOOLS

4000 S. FIGUEROA ST., LOS ANGELES 37, CALIF.
187 N. LA SALLE ST., CHICAGO 1, ILL.
IN CANADA: 811 W. Hastings St., Vancouver, B. C.

MEMBER

NATIONAL COUNCIL OF TECHNICAL SCHOOLS 1944

NATIONAL HOME STUDY COUNCIL

FREE!

Fully illustrated "CAREER" BOOK in TV, Radio, Electronics. AND actual Sample Lesson—yours at no cost, no obligation SEND COUPON NOW—TODAY!

NATIONAL SCHOOLS
TECHNICAL TRADE TRAINING SINCE 1905
Los Angeles, California

GET FAST SERVICE—MAIL NOW TO OFFICE NEAREST YOU!

NATIONAL SCHOOLS, DEPT. RG-116

4000 S. FIGUEROA ST. LOS ANGELES 37, CALIF. OR 187 N. LA SALLE ST. CHICAGO 1, ILL.

Rush free TV-Radio "Opportunity" Book and sample lesson. No salesman will call.

NAME _____ BIRTHDAY _____ 19__

ADDRESS _____

CITY _____ ZONE ____ STATE _____

VETERANS: Give Date of Discharge _____

NOVEMBER 1956, Vol. XXVII, No. 11

RADIO-ELECTRONICS

Formerly RADIO CRAFT • Incorporating SHORT WAVE CRAFT • TELEVISION NEWS • RADIO & TELEVISION

ON THE COVER

(Story on page 88)

Engineers of IT&T's Federal Telecommunication Laboratories making tests on a Tacan antenna for shipboard use, prior to shipping it to the Navy.

Color original by Dean Price

NEXT MONTH: Stability in Feedback Amplifiers • How to Lick the Intermittent

RADIO-ELECTRONICS, November, 1956. Vol. XXVII, No. 11. Published monthly at Mt. Morris, Ill., by Gernsback Publications, Inc. Second-class mail privileges authorized at Mt. Morris, Ill.
SUBSCRIPTION RATES: U. S., U. S. possessions and Canada, $3.50 for one year; $6.00 for two years; $8.00 for three years; single copies 35c. Pan-American countries $4.00 for one year; $7.00 for two years; $9.50 for three years. All other countries $4.50 a year; $8.00 for two years; $11.00 for three years.
SUBSCRIPTIONS: Address correspondence to Radio-Electronics, Subscription Dept., 404 N. Wesley Ave., Mt. Morris, Ill., or 154 West 14th St., New York 11, N. Y. When ordering a change please furnish an address stencil impression from a recent wrapper. Allow one month for change of address.
GERNSBACK PUBLICATIONS, INC. Executive, Editorial and Advertising Offices. 154 West 14th St., New York 11, N. Y. Telephone Algonquin 5-7755. **Hugo Gernsback**, Chairman of the Board; **M. Harvey Gernsback**, President; **G. Aliquo**, Secretary.
BRANCH ADVERTISING OFFICES and **FOREIGN AGENTS** listed on page 158.
POSTMASTER: If undeliverable, send Form 3578 to: RADIO-ELECTRONICS, 154 West 14th St., New York 11, N. Y.

Trademark registered U. S. Pat. Office.

G. F. Beane, W. Virginia, was a truck driver. He took the DeVry Tech Training Program, and is now tape recorder engineer at Webcor Co.

Edward Hahn, Illinois. Now an electronics technician with Televiso, Inc. DeVry Tech training helped him prepare for his present position.

Nick Barton, Illinois, a DTI grad, now has his own business and tells us he is "literally snowed with work."

George D. Crouch, California, was a retail store clerk. He took the DeVry Program, and today is in business for himself.

IF THESE MEN CAN DO IT WHY CAN'T YOU?

DeVRY TECH Will Tell You FREE How You May Prepare At Home For *the* Big-Opportunity Fields

TELEVISION
RADIO • ELECTRONICS

TIRED OF THE SAME OLD JOB?

If you're under 55, you're not too old to consider a new type of job. If you feel the need of a change and want to look ahead to the opportunities in Television-Radio-Electronics, mail the coupon below. Let DeVry Tech tell you about its industrial training program . . . about the good pay jobs open to trained men. Find out if you are qualified for DeVry Tech training.

LEARN WITH REAL EQUIPMENT

DeVry Tech puts tools and parts in your hands to build your own test equipment, loans you home training films to follow, explains problems in simple, down-to-earth language.

You need no previous technical experience to prepare at home or in our million-dollar Chicago Training Center. If you are between 17 and 55, send today for free booklet, free sample lesson and additional information.

A word of advice to Veterans and Non-Veterans from JACK DEMPSEY

"Let DeVry Tech give you an honest opinion of the great opportunities in the electronics field. This school is now in its 25th year. I've known it a long time and, believe me, it makes no idle claims. It is interested only in producing top-flight technicians. And in placing them, too. The DeVry Placement Service is in contact with some of the nation's biggest businesses . . . it serves DeVry graduates well. Why wait and wonder? Maybe your future depends on sending in the coupon below *right now!*"

Draft-Age Men . . . Be sure to get valuable information just for you.

Get these Valuable Facts . . . .

Member of National Home Study Council

"One of America's Foremost Electronics Training Centers"

MAIL TODAY FOR FREE FACTS

DeVRY TECHNICAL INSTITUTE
4141 Belmont Ave., Chicago 41, Ill., Dept. RE-11-M

Please give me free facts about the many opportunities in Television-Radio-Electronics, including the 3 publications, and how DTI may prepare me for my start in this billion-dollar field.

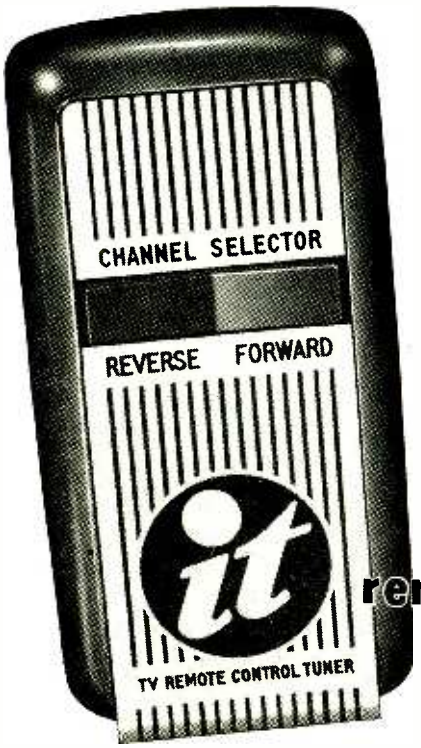
Name..... Age.....
Please Print

Street..... Apt.....

City..... Zone..... State.....

1050 **DTI's training is also available in Canada**

DeVRY TECHNICAL INSTITUTE
CHICAGO 41, ILLINOIS
FORMERLY
DeFOREST'S TRAINING, INC.



New gift idea!

. . . Terrific TV traffic-builder for Christmas!

remote CONTROL INSTANT TUNER for TV!

changes channels
from your
easy chair!

DON WILSON—RADIO AND TV'S GREATEST SALESMAN WILL BRING CUSTOMERS IN DROVES!

Don Wilson, one of America's long-time favorite radio and TV announcers, will lend his strong support to help you sell **I-T** Remote Control *Instant Tuners* on television. So place your order now for a big stock of **I-T's** and capitalize on this big advertising campaign . . . timed for Christmas.

Goes On Practically Any Set!

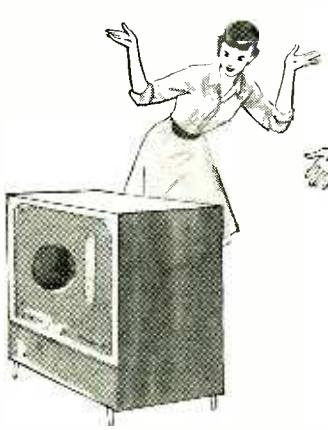
The **I-T** Remote Control Instant Tuner is engineered to go on practically *any* set—new or old. Your market is wide open!

No Installation Problems!

Customers can install **I-T** themselves in less than 3 minutes! It's easy—no tools needed—no electrical connections. And, there's no service problem!

HERE'S HOW it SELLS!

I-T sells like hot cakes! All you have to do is demonstrate it—and you'll sell **I-T's** by the bushel! Almost every TV set owner is a red hot prospect. IN ADDITION—**I-T** is the perfect gift for every occasion—Christmas, wedding, housewarming! You name it—and you'll sell **I-T**!



I-T IS SOLD AND FULLY GUARANTEED BY

THE ALLIANCE MANUFACTURING CO., INC., ALLIANCE, OHIO

(Division of Consolidated Electronic Industries Corp.)

In Canada—Alliance Motors, Schell Ave., Toronto, Ontario

WRITE, WIRE, OR CALL NOW FOR INFORMATION ON HOW YOU CAN ORDER and PROFIT with I-T Remote Control INSTANT TUNER!

the Radio month

MID-AIR COLLISION warning device has been developed by the Collins Radio Co. Approved by a special committee of the nation's airlines, two companies—American and United—are already negotiating to purchase the device.

The installation will be made in two stages. The initial setup will consist essentially of a horn or other audible unit and six lights. The lights will tell the pilot whether the dangerously close oncoming plane is ahead, behind, right, left, above or below. The distance will also be indicated. Readers will remember that this type of equipment was called for by Hugo Gernsback in his editorial "Airplane Collision Prevention" in the September issue. In it he said in part ". . . it should be possible to evolve an instrumentality whereby the pilot or navigator can read not only the exact distance between the two planes in miles, but he will see the vertical and horizontal angle of the approaching plane, too."

The final system will, in addition, provide instructions on which way to turn. A light on either the right or left side of the cockpit will indicate an abrupt turn in that direction.

The lights will be actuated by electronic computers that will consider the positions of the merging planes, relative speeds and directions of flight.

PICTURE PHONE using standard telephone line was unveiled by Bell Telephone Laboratories at a joint meeting in Los Angeles of the Institute of Radio Engineers and the West Coast Electronic Manufacturers Association. The pictures that are transmitted along with the sound vary in size from 1 x 1½ inches to 2 x 3 inches.

This picture–phone system over ordinary telephone line was made possible by slowing down the rate of transmission of picture information so that the required bandwidth can easily be handled. The raster is made up of 60 lines, each of which may have a maximum of 40 dots.

Thus, each complete frame may be considered to contain 2,400 dots. If a single frame were transmitted each second, an overall bandwidth of 1,200 cycles would be necessary. With this system one complete frame is transmitted every 2 seconds, requiring a bandwidth of only 600 cycles.

Since the 600-cycle video band contains very-low-frequency components which might be greatly attenuated during transmission over phone lines, a carrier scheme is used in which the video signal amplitude modulates a 1,200-cycle carrier. The transmitted signal is then a conventional AM double-sideband signal with a frequency range of 600 to 1,800 cycles, an optimum range for telephone–line transmission.

The picture equipment is still undergoing development and is not ready for manufacture or commercial use.

FIRST TRANSLATOR GRANTS have been made by the Federal Communications Commission. In authorizing the "inexpensive" translator stations the FCC stated that this "is part of the commission's program for bringing TV service to small communities."

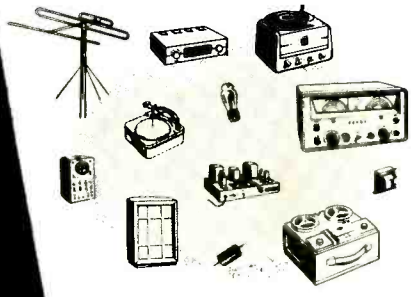
The grants were made to the Mount

free! ALLIED'S 1957 value-packed 356-page CATALOG

the only COMPLETE catalog for everything in electronics

World's Most Complete Stocks

- Latest Hi-Fi Systems and Components
- Super-Value KNIGHT-KITS
- P. A. Systems and Accessories
- Recorders and Supplies
- TV Tubes, Antennas, Accessories
- Amateur Receivers, Transmitters, Station Gear
- Test and Lab Instruments
- Specialized Industrial Electronic Equipment
- Huge Listings of Parts, Tubes, Transistors, Tools and Books...



FEATURING

SUPER-VALUE knight-kits: Finest electronic equipment in money-saving Kit form—Test Instruments, Hi-Fi kits, Hobbyist kits, Ham kits. Easiest to build and you SAVE MORE.

EVERYTHING IN HI-FI: World's largest selection of quality Hi-Fi components and complete music systems—available for immediate shipment from stock. Own the best in Hi-Fi for less!

Get ALLIED's 1957 Catalog—it's *complete*, up-to-date—356 pages packed with the world's largest selection of quality electronic equipment at lowest, money-saving prices. Get *every* buying advantage at ALLIED: fastest shipment, expert personal help, lowest prices, guaranteed satisfaction...

send for the leading electronic supply guide

free

EASY-PAY TERMS: Only 10% down, up to 18 months to pay. Available on orders over $45. Fast handling—no red tape.

ALLIED RADIO CORP., Dept. 2-L-6
100 N. Western Ave., Chicago 80, Ill.

☐ Send FREE 356-Page 1957 ALLIED Catalog

Name .....

Address .....

City ..... Zone .... State .....

Our 36th year

ALLIED RADIO

World's Largest Electronic Supply House

RADIO MONTH *(Continued)*

Grant Television Booster Service Corp., Hawthorne, Nev., to rebroadcast channel 4, KRON-TV, San Francisco, on channel 70, and to James R. Oliver, Bishop, Calif., to rebroadcast the Los Angeles signals of channel 2, KNXT, on channel 70, and channel 4, KRCA, on channel 73.

ELECTROCUTIONS caused by improper television antenna installations have prompted several North Carolina cities to consider adopting ordinances regulating these installations. While one city, Durham, has dismissed the idea as being impractical, another, Greensboro, has begun checking all sets in the city to see if they are grounded correctly.

Representative of the type of accidents occurring during antenna installations by untrained persons is a recent report from New Port Richey, Fla. A 61-year-old woman, Mrs. Aurelia M. Walrath, was killed instantly when the guy wire from a television antenna fouled a 7,200-volt high-tension wire while she was helping her husband install a TV antenna.

Calendar of Events

1956 High-Fidelity Show and Music Festival. Nov. 2–5, Palmer House, Chicago. (RADIO-ELECTRONICS will exhibit in Room 746).

New England Radio Electronics Meeting. Nov. 15–16, Hotel Bradford, Boston.

Dallas High-Fidelity Music Show, Nov. 16–18, Hotel Adolphus, Dallas, Tex.

St. Louis High-Fidelity Music Show, Nov. 23–25, Hotel Statler, Saint Louis, Mo.

Electronics Fair of Long Island, Dec. 6–8, New York State University, Farmingdale, N. Y.

1956 Eastern Joint Computer Conference, Dec. 10–12, Hotel New Yorker, New York City.

RETMA Symposium on Applied Reliability, Dec. 19–20, Bovard Hall, University of Southern California, Los Angeles, Calif.

TELESCOPE BOOSTER now being developed promises to provide a tenfold increase in the power of the world's biggest telescope on Mount Palomar. The booster, known as an image converter, consists of a vacuum tube containing a photocathode which emits electrons when exposed to starlight. The electrons are focused and passed through an opening only a few millionths of an inch thick. A photographic plate is directly behind the opening.

The efficiency of the image converter is due to the ability of light to more effectively produce electron flow from a photocathode than to create an image on a photographic plate. The image converter is placed at the focal point of the telescope and is expected to furnish pictures of stars 10 times fainter than can now be seen with the 200-inch telescope. It will also make modest telescopes the world over equal to the present power of Mount Palomar.

SOVIET TV BOOM finds large cities like Moscow and Leningrad with roofs crammed with television antennas, reports the European news director of Fairchild Publications, who was recently permitted to visit Russia. Start-

(Continued on page 14)

FREE

An FCC License can be your Guarantee of Success in Electronics

WE GUARANTEE YOUR FCC LICENSE

If you fail to pass your Commercial License exam after completing our course, we guarantee to continue your training, without additional cost of any kind, until you successfully obtain your Commercial license.

Here's proof FCC Licenses are often secured in a few hours of study with our coaching at home in spare time . . .

Name and Address	License	Time
Walter Eggers, Pacific Grove	1st	12 weeks
Paul Reichert, West Salem, Ohio	2nd	10 weeks
Harold Phipps, LaPorte, Indiana	1st	28 weeks
John H. Johnson, Boise City, Okla.	2nd	12 weeks
James Faint, Johnstown, Pa.	1st	26 weeks

WE CAN PROVIDE HUNDREDS OF NAMES IN YOUR AREA ON REQUEST

EMPLOYERS MAKE OFFERS LIKE THESE TO OUR GRADUATES EVERY MONTH!

Letter from nationally-known Airlines: "Radio Operators and Radio Mechanics are needed for our company. Periodic wage increase with opportunity for advancement. Both positions include many company benefits such as paid vacations, free flight mileage allowance and group insurance."

Letter from nationally-known manufacturer: "We have a very great need at the present time for radio-electronics technicians and would appreciate any helpful suggestions that you may be able to offer."

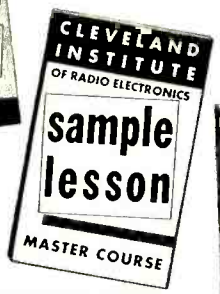
These are just a few of the examples of the job offers that come to our office periodically. Some licensed technician filled each of these jobs; it could have been you!

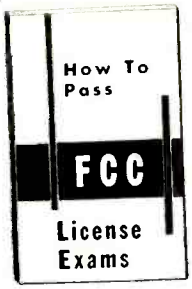
OUR TRAINEES GET JOBS LIKE THESE EVERY MONTH

CHIEF ENGINEER
"Since enrolling with Cleveland Institute I have received my 1st class license, served as a transmitter engineer and am now Chief Engineer of Station WAIN. Also have a Motorla 2-Way Service Station. Thanks to the Institute for making this possible."
Lewis M. Owens, Columbia, Ky.

TEST ENGINEER
"I am pleased to inform you that I recently secured a position as Test Engineer with Melpar, Inc. (Subsidiary of Westinghouse). A substantial salary increase was involved. My Cleveland Institute training played a major role in qualifying me for this position."
Boyd Daugherty, Falls Church, Va.

MAIL COUPON TODAY AND RECEIVE





ALL 3 BOOKLETS FREE!

CARL E. SMITH, Consulting Engineer, President
CLEVELAND INSTITUTE OF RADIO ELECTRONICS
Desk RE-97, 4900 Euclid Bldg., Cleveland 3, Ohio

Member National Home Study Council

Cleveland Institute of Radio Electronics
Desk RE-97, 4900 Euclid Ave., Cleveland 3, O.

Please send Free Booklets prepared to help me get ahead in Electronics. I have had training or experience in Electronics as indicated below:

- ☐ Military
- ☐ Radio-TV Servicing
- ☐ Manufacturing
- ☐ Amateur Radio
- ☐ Broadcasting
- ☐ Home Experimenting
- ☐ Telephone Company
- ☐ Other_____

In what kind of work are you now engaged?_____

In what branch of Electronics are you interested?_____

Name_____ Age____

Address_____

City_____ Zone____ State_____

Special Tuition Rates to Members of Armed Forces

3 OBVIOUS REASONS

why you should order a TECH-MASTER HI-FI KIT ... today!

1. **TECH-MASTER** amplifier, preamplifier, tuner and radio kits represent the ultimate in modern electronic kit design—nothing is easier or more fool-proof to assemble; nothing gives finer performance once assembled!

2. **TECH-MASTER** hi-fi kits carry the *double* guarantee of the Tech-Master Corporation, famous leaders in custom television and high fidelity since 1942, *and* of the **LOCAL** electronic parts distributor who fills your order and acts as your convenient, near-by source of expert information and advice. Ask him to demonstrate a Tech-Master kit when you are in his neighborhood — consult him again if you should ever need technical assistance, testing or service after you have purchased your kit!

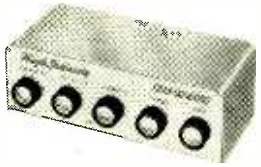
3. **TECH-MASTER** hi-fi kits now offer you the unique convenience of simplified mail order from a **LOCAL** firm combined with the extra courtesy and sales backing you expect when dealing with a reliable parts-distributor.

YOUR CHOICE OF FOUR HI-FI TECH-MASTER KITS:

TECH-MASTER TM-15A Ultra-Linear
Williamson-Type 20-Watt Power Amplifier Kit

Flat response throughout the audible frequency range as well as considerably below and above it. Vanishingly low distortion at all normal listening levels. Not more than ½% intermodulation or harmonic distortion even at 15 watts output. Smooth, crisp, transparent listening quality. Superior transient response. Hum and noise level 70 db below rated output. 1.1 volts RMS input required for 20 watts output. Specially wound high-fidelity output transformer with 4, 8 and 16 ohm output impedances. Comes with sockets, terminal strips and connectors already mounted.

Model TM-15A (dimensions 9" x 12" x 6½"; weight 27 lbs.) **$49.95**



TECH-MASTER TM-16A
De Luxe, Self-Powered Preamplifier-Equalizer Kit

Completely redesigned according to the latest techniques. Contains the most advanced features. 5-position phono equalizer (78 rpm, old 78's, RIAA, ffrr, AES). Four input channels (one low-level, high-gain input for magnetic cartridges; three high-level; high-impedance inputs for AM, FM, or TV tuner, crystal or ceramic cartridge, high-output microphone, tape recorder, etc.). Loudness compensating control. Boss and treble controls with 15 db boost or cut at 20 cps and 20 kc, respectively. Cathode follower output. Smartly styled in handsome lacquered cabinet. Comes with sockets, terminal strips and connectors already mounted. *Amazingly simple to assemble for trouble-free high-fidelity results.*

Model TM-16SP (dimensions 9⅞" x 3⅜" x 4½"; weight 4 lbs.) **$24.50**
Matching gold escutcheon **1.50**

TECH-MASTER TM-17P
Economy Preamplifier-Equalizer Kit

Same basic design as the Model TM-16SP, except for 3-position phono equalizer (78 rpm, RIAA, AES), standard true-taper volume control and provision to obtain power from the main amplifier or a similar external power supply (120 volts DC @ 6 ma, 6.3 volts AC @ 600 ma). Plug-in connection for TM-15A furnished. Cathode follower output. Gold-tone cabinet. Comes with sockets, terminal strips and connectors already mounted.

Model TM-17SP (dimensions 9⅞" x 3⅜" x 4½"; weight 4 lbs.) **$19.95**

TECH-MASTER FM-18
Hi-Fi FM Tuner Kit

Designed for optimum reception and sound quality at minimum cost. Sensitivity 4 microvolts for 20 db quieting. IF bandwidth 200 Kc. Drift-free ratio detector. Automatic frequency control (AFC) with manual front-panel cutoff. Micro-vernier tuning. Both cathode follower and high-impedance outputs provided. Self-contained power supply. Very easy to assemble.

Model FM-18 (dimensions 4½" x 8" x 6¼"; weight 6½ lbs.) **$29.95**
Model 18-C Cabinet **7.50**

ORDER NOW FROM YOUR NEAREST TECH-MASTER DISTRIBUTOR:

California, Pasadena
Dow Radio Inc.
1759 E. Colorado St.

California, San Francisco
Market Radio Supply Co.
1240 Market St.

Colorado, Denver
Fistell's Radio & Electrical Supply Co.
1081 Lincoln Street

Florida, Miami
East Coast Radio & Television Co.
1900 N.W. Miami Court

Georgia, Atlanta
Specialty Distributing Co., Inc.
425 Peachtree St. N.E.

Illinois, Chicago
J. G. Bowman and Co.
513 E. 75th Street

Indiana, South Bend
Radio Distributing Co.
432 S. Carroll St.

Maryland, Baltimore
Radio Electric Service Co.
5 North Howard Street

Massachusetts, Cambridge
Hi-Fi Lab Electronic Supply
1077 Massachusetts Ave.

Minnesota, St. Paul
Gopher Electronics Co.
370 Minnesota St.

Missouri, St. Louis
Walter Ashe Radio Co.
1125 Pine St.

New Jersey, Newark
Radio Wire Television Inc.
24 Central Ave.

New York, New York
Airex Radio Corp.
64 Cortlandt St.
Federated Purchaser Inc.
66 Dey St.

Ohio, Dayton
Stotts-Friedman Co.
135 E. Second Street

Pennsylvania, Philadelphia
Albert Steinberg and Co.
2520 N. Broad St.

Texas, Houston
Gulf Coast Electronics
1110 Winbern St.

Washington, Seattle
Seattle Radio Supply Inc.
2117 Second Ave.

West Virginia, Wheeling
James M. Black and Sons
952 Market St.

Canada, Montreal
Payette Radio Ltd.
730 St. James St., West

TECH-MASTER CORPORATION

75 Front Street, Brooklyn 1, New York

another Raytheon FIRST

100% INTERCHANGEABLE TV TUBES THAT ELIMINATE SNIVETS*

RAYTHEON

6DQ6 12DQ6 17DQ6

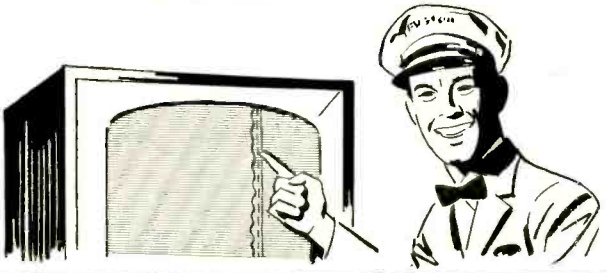
Thanks to an exclusive new Raytheon fin design, the Raytheon 6DQ6 is the first TV tube which eliminates SNIVETS that is 100% interchangeable — will work without special selection. It eliminates borderline performance, too, because its new design gives it additional and improved sweep characteristics not available in ordinary types.

Raytheon 6DQ6 tubes provide SNIVET free performance because they are individually tested for deflection operation and are given special tests under sweep amplifier conditions. Raytheon 12DQ6 and 17DQ6 Tubes incorporate this same fin construction and will provide the same superior, trouble-free performance.

An added bonus from the Raytheon 6DQ6 is that its interchangeability simplifies stocking. (It's an improved replacement for 6CU6 and 6BQ6GA series.)

Finally, the Raytheon 6DQ6 is another outstanding example of how Raytheon's superior engineering skill and production know-how have brought you still another tube that is first and finest in the field.

* *SNIVET — a vertical disturbance on the right hand area of the screen.*



RAYTHEON MANUFACTURING COMPANY

Receiving and Cathode Ray Tube Operations

Newton, Mass. • Chicago, Ill. • Atlanta, Ga. • Los Angeles, Calif.

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

(Continued from page 10)

ing virtually from scratch in 1953, at the end of 1955 there were 1 million TV sets in operation in Russia. By the end of 1956 this total will be doubled. This year most sets produced were 12- and 14-inch models, with the trend toward 14- and 17-inch units.

At the end of 1955 there were 15 state stations; by the end of this year there will be 20. In addition, there are some 60 local stations.

AIR TRAFFIC CONGESTION is to be alleviated by the use of closed-circuit TV in air traffic control. Using New York City as the test area, the Civil Aeronautics Administration announced that an experimental setup is in operation at the New York International Airport, Idlewild.

The heart of the system is a long-range radar and television arrangement in which the radar aids the control center to track planes into the New York area with blips on the radar screens. The television section relays the control center's radar images to the towers at individual airports nearby to help the planes land.

FOUR NEW TV STATIONS have gone on the air since our last report:

KAVE-TV	Carlsbad, N.M.	6
KFXJ-TV	Montrose, Colo.	10
KILT	El Paso, Tex.	13
WTVW	Evansville, Ind.	7

One station has left the air:

WHUM-TV	Reading, Pa.	61

This is the 62nd uhf station to close.

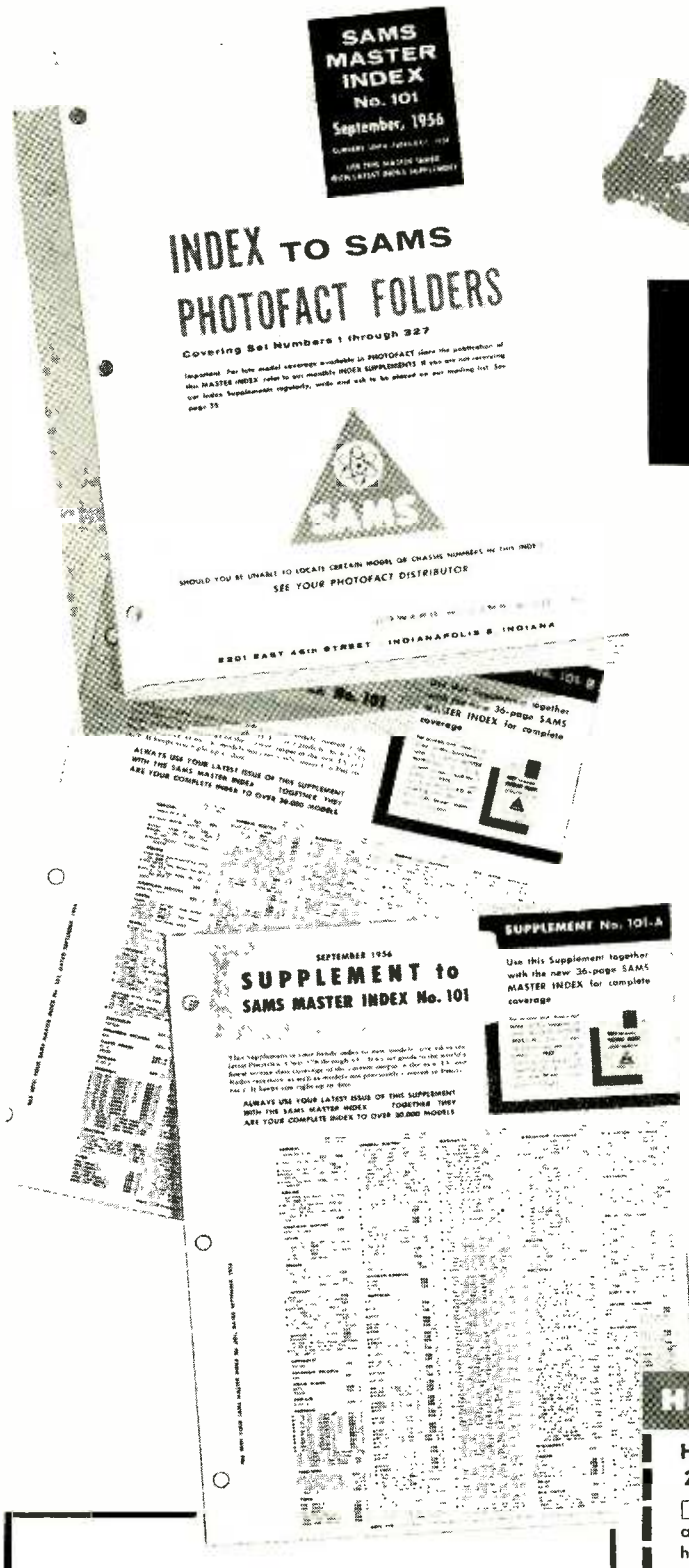
Station CBLT, Toronto, Canada, has changed channels, from 9 to 6.

The total of TV stations now operating in the U.S. and its territories is 486 (391 vhf, 95 uhf), including 22 noncommercial of which 5 are uhf ones.

FIRST PHONE CABLE across the Atlantic was put into operation this fall. Operated by AT&T, the new cable will carry 36 conversations simultaneously, free from interference which occasionally hampered the trans-Atlantic radiotelephone.

ELECTRONIC TRAILMAKER is being used by the Army to indicate a safe trail on the Greenland ice cap. Poor visibility during the polar night, snowstorms and summer "white-outs" (dense Arctic fog) make free movement over the ice cap virtually impossible. Safe trails through this area are crooked and narrow and visual markers like flags and poles are obscured by poor visibility or destroyed by the elements.

The electronic trailmarker consists of two parallel wires buried beneath the snow on either side of the trail. Alternating current is fed into the wires and a receiver mounted on a tracked vehicle detects the current in the wires. Indicators in the vehicle give the driver his position within the trail. Warning devices inform the driver when the vehicle gets out of bounds and crosses a trail wire. END



Free!

to Service Technicians Only

THE NEW SAMS INDEX TO PHOTOFACT FOLDERS

it keeps you up-to-the-minute on receiver coverage

PHOTOFACT Folders give you the world's finest Service data on TV and radio models just as soon as they hit the market. Now—with the new INDEX SYSTEM to PHOTOFACT, you locate the *latest* PHOTOFACT coverage *immediately*.

If you're a Service Technician, you can get the new Sams Index FREE. Here's how it keeps you up-to-date on receiver coverage: The Master Index (36 pages—issued twice yearly) is the complete reference to *all* PHOTOFACT Folders produced up to the date of its issue. In addition, you get an Index Supplement each month covering that month's releases of PHOTOFACT Folders. Thus, the Master Index *plus* the supplements keep you right up with current PHOTOFACT coverage. (The Index Supplements also appear each month in "PF Reporter" Magazine.)

It's easy to get your complete Index service to PHOTOFACT at NO COST TO YOU. If you're a Service Technician, just fill in the coupon and mail to us today. It will bring the Master Index direct to your shop, and monthly supplements will be mailed to you regularly thereafter. YOU'LL KEEP RIGHT UP-TO-THE-MINUTE ON PHOTOFACT COVERAGE—you'll be able to locate the data you need on over 30,000 models, as well as on CURRENT MODEL RELEASES.

Mail coupon today for your free subscription to the Sams Photofact Index

TAKE THE RIGHT STEP TO TIME-SAVING PROFIT-BUILDING BUSINESS: Sign up with your Parts Distributor to get PHOTOFACT Folder Sets automatically each month.

DO IT NOW!

HOWARD W. SAMS & CO., INC.

free! TO SERVICE TECHNICIANS

Howard W. Sams & Co., Inc.
2205 E. 46th St., Indianapolis 5, Indiana

☐ Send me your FREE Master Index to PHOTOFACT Folders (twice yearly), and put me on your mailing list to receive all Index Supplements. My letterhead and/or business card is attached.

☐ I am a Service Technician: ☐ full time; ☐ part time.

My Distributor is: _____

Shop Name _____

Attn: _____

Address _____

City _____ *Zone* _____ *State* _____

TEST 5 TUBES in 4 SECONDS EACH...ACCURATELY!

WITH THE NEW ADVANCED ENGINEERED

precise MODEL 116

Gm. & Em. ULTRAFAST TUBE & TRANSISTOR TESTER

Completely NEW!

PRECISE MODEL 116K in kit form..... **$69.95**
PRECISE MODEL 116W factory wired..... $119.95
Incl. carrying case and cover

Servicemen know the Precise Model 111 (the winner in an independent survey) easily rates "the finest tube tester in the field" at any price, BUT FOR AN ON THE JOB QUICK-TEST . . . the fastest, most accurate is the PRECISE Model 116. What's more you test tubes the foolproof method inherent in the famous Precise Model 111.

Did you ever wish you could plug in 5 of the same type tubes at once and check each one individually by rotating a switch? YOU CAN WITH THE PRECISE MODEL 116—Plug in 5 IF tubes and let them heat up at once and then check each one separately by rotating the TUBE BANK switch. ACTUALLY CHECK 5 TUBES IN 20 SECONDS, 4 SECONDS PER TUBE.

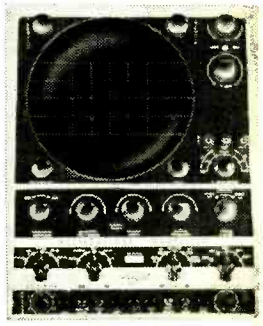
The Precise Model 111 taught the lesson that IF amplifier tubes (like the 6BC5 or 6AU6) should be tested for Gm (mutual transconductance) while the power amplifiers (like the 6L6) should be tested for Em (emission)—that's ULTRAFAST Model 116 test! It checks each section of each tube separately . . . by rotating the FUNCTION SWITCH . . . each triode of a dual triode is checked individually . . . each diode and the triode of a duo-diode-triode is separately tested and not lumped as in other testers . . . and a pentode is tested as a pentode—not a diode. TRANSISTORS, SHORTS, GAS, LIFE, Em, Gm etcetera can be tested with the PRECISE Model 116.

You can inexpensively extend the Precise Model 116 to test filament current, etc. The Model 116 gives an accurate, ultra-fast (3 basic knobs for testing) check of television tubes!

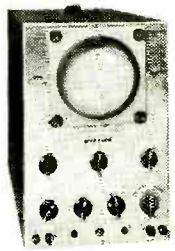
No Surplus—An etched panel—beautiful Moleskin covered wood carrying case and cover and specially simplified instructions makes the PRECISE MODEL 116 THE FINEST FAST-CHECK TUBE TESTER AND DOLLAR EARNING TRAVELING COMPANION A TV SERVICEMAN EVER HAD.

Not yet at your distributor. Order NOW to insure early delivery.
SEE YOUR LOCAL DISTRIBUTOR FOR PROOF OF WHAT WE OFFER — OR WRITE US FOR DOCUMENTARY RESULTS OF AN INDEPENDENT SCIENTIFIC SURVEY.

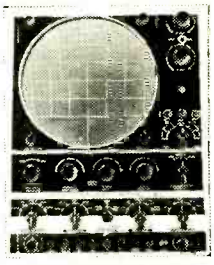
THE FAMOUS MODEL #111
111K **$79.95**
111W $139.95
Incl. Carrying Case & Cover



THE FIRST LOW PRICED 7" COLOR SCOPE
300K **$99.95**
300W $199.50



LOW PRICED 5" SCOPE
315K $49.95
315W $84.95



THE FIRST AND ONLY 8½" COLOR SCOPE
308K **$129.50**
308W $229.50

THE FINEST VOLT, REG, 7" VTVM KIT
9071K $35.95
9071W $49.95

LOW PRICED RF SIGNAL GENERATOR "BEST BUY" IN GEN. FIELD
610K $23.95
610KA pre-assembled head..... $28.95
610W $39.95

UNIV. AF, SINE, SQ, & PULSE GEN.
635K $33.50
635W $52.50

LOWEST PRICED WIRED 4½" VTVM
909K $25.98
909W **$37.50**

RF—AF—BAR GENERATOR with pre-assembled* head
630K $33.95
630KA* $38.95
630W $53.95

Prices slightly higher in the West. Prices and specifications subject to change without notice.

PTAK . $2.95
PTAW . $4.25

WRITE FOR CATALOG RE 11-6

SEE THE MANY MORE PRECISE INSTRUMENTS AND PROBES AT YOUR DISTRIBUTOR TODAY!

precise DEVELOPMENT CORP. OCEANSIDE, NEW YORK, U.S.A.

Rohn

only complete line of

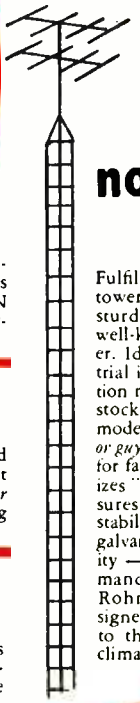
TV and COMMUNICATION TOWERS

proven in Profits *and* Customer Satisfaction

● ● ● ● HIGHLIGHTS OF THE ROHN LINE ● ● ● ●

look at these ROHN exclusives

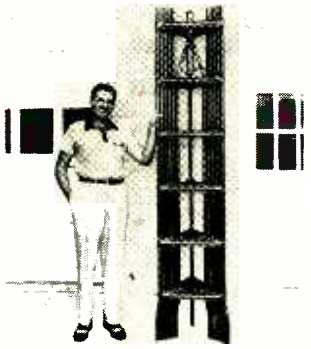
- **HOT DIPPED GALVANIZED**
  The finest, most durable finish is available for ROHN Towers and accessories . . . all done entirely on the ROHN premises under careful ROHN supervision.
- **UNEQUALLED DESIGN AND ENGINEERING**
  ROHN is the only design that has stood up over the years. ROHN has been first and foremost . . . and always the *leader* in new products to meet the changing demands.
- **MASS PRODUCTION FOR LOW COSTS**
  ROHN was the first to utilize mass production techniques to build a superior tower at the most competitive prices. This means no sacrifice in quality yet far greater profits for you.
- **UNIVERSAL CUSTOMER ACCEPTANCE**
  Thousands and thousands of installations prove the ROHN line first in customer satisfaction.
- **PIONEER MANUFACTURERS**
  Pioneers in tower manufacturing—and today one of the world's largest manufacturers of this type equipment. The ROHN Company was built on satisfaction on the part of distributor, dealer and customer alike.
- **COMPLETE LINE**
  Only ROHN offers a full line—*one* dependable one-stop source for all TV installation equipment. Save headaches, save shipping costs, save time . . . use ROHN unequalled service *exclusively*.



no. 6 tower

"All-Purpose" tower

Fulfills 75% of your general tower needs—is structurally as sturdy—yet *costs less* than the well-known Rohn No. 10 Tower. Ideal for home and industrial installations, communication requirements . . . eliminates stocking many different tower models. *Self-supporting to 50 ft. or guyed to 120 ft.!* Easy to climb for fast, efficient servicing. Utilizes "*Magic Triangle*" which insures *far* greater strength and stability. Permanent hot-dipped galvanized coating. Dependability — a feature customers demand — is assured with the Rohn No. 6 Tower., designed to "stand up" for years to the rigors of weather and climatic conditions.



Package Tower

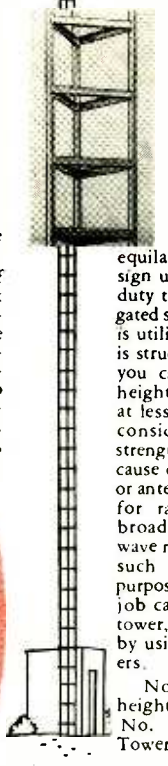
"Space Saver"— cuts storage space 300% or more!

Popular PT-48 has almost 50′ of sturdy tower within a compact 8′ x 20″ package! "Magic Triangle" design is adapted to a pyramid shape using a wide 19″ base with progressively decreasing size upward. Decreases your overhead . . . easy to transport and assemble — cuts shipping costs. Galvanized throughout. Available in heights of 24, 32, 40, 48, 56 and 64 feet!

Both Towers Feature **THE ROHN MAGIC TRIANGLE**

For structural superiority, famed wrap-around "magic triangle" design is featured in these all-steel towers. Towers have full 2½" wide corrugated cross-bracing welded to tubular steel legs. The exclusive design assures dependable strength and permanence.

COMMUNICATIONS TOWER



For extreme heights and communication purposes of all kinds, the Rohn No. 40 gives you strength and durability on which you can depend. The time tested and proven equilateral triangle design using extra heavy duty tubing and corrugated steel cross-bracing is utilized. The No. 40 is structurally sound so you can install it for heights up to 300′; or at lesser heights when considerably greater strength is required because of excessive wind or antenna loading. Use for radio telephone, broadcasting, microwave relay and all other such communication purposes. If a particular job calls for this type tower, save real money by using ROHN towers.

Note: For lesser heights, use the Rohn No. 20 or No. 30 Tower.

Telescoping Masts

Heavy-duty hot-dipped galvanized steel tubing and rigid joints give extraordinary strength. *Quick installation* . . . mast attached to base—antenna fixed, then mast hoisted quickly to desired height. Utilizes special clamp and guy ring arrangement. Flanged interior section; crimped exterior section gives mast stability that can't be beat. Complete with guy rings and necessary erection parts. In 20, 30, 40 and 50 ft. sizes. Bases and ground mounts available.

ROHN FOLD-OVER TOWERS

These unique fold-over towers are perfect for experimentation. TV service departments, amateur use, and special purposes. Uses regular ROHN tower sections with kit. Now available in standard No. 10 tower to 50′, and in ROHN No. 30 & No. 40 towers for heavy-duty use.

ALSO a full line of ROHN ACCESSORIES

Rotor posts, house brackets, eave brackets, peak and flat roof mounts, instant drive-in bases, hinged base sections, telescoping mast bases, guying brackets, UHF antenna mounts, erection fixtures, variety of mounts and supports for masts or tubing, tower installation accessories, TV service tables, mast and TV hot-dipped galvanized tubing, guy rings, "twister-anchors", rubber tower grommets, insulator sections, hinged rotor platform, accessory shelf and platform and dozens of other items. Get the complete catalog TODAY!

ROHN *Manufacturing Company*

116 LIMESTONE, BELLEVUE
PEORIA, ILLINOIS

MAIL THIS COUPON FOR FREE LITERATURE!

Rohn Manufacturing Company
116 Limestone, Bellevue
Peoria, Illinois

Gentlemen: Please rush me complete details on the full line of Rohn Towers and Accessories.

Firm_____

Name_____ Title_____

Address_____

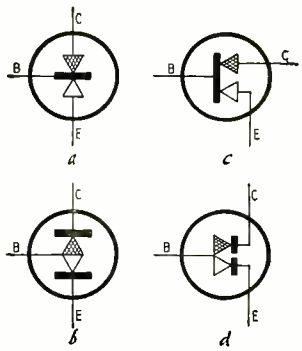
City_____ State_____

Correspondence

NEW TRANSISTOR SYMBOLS

Dear Editor:

The letter from Mr. Pugh in the August issue brought a lot of questions to my mind about the way transistors are drawn. To a man experienced in tube circuitry the transistor diagrams don't seem to contain the necessary information to make the circuit understandable at a glance. I would like to go Mr. Pugh one step further and suggest that transistors be shown logically as well as physically.



In the Gernsback Library book on transistors it states that a transistor is basically two diodes. If this is true then why not draw them as such? For instance, Fig. *a* shows a p-n-p junction transistor. The collector could be shaded and then identifying letters would be unnecessary. Or, it could just be understood that the collector is always drawn on top. An n-p-n junction type would be drawn as at *b*, with *c* representing a point-contact p-n-p, and *d* a point-contact n-p-n. [A base is of one material,, whether p or n. Mr. Lafferty's symbols would show what appears to be *two* in n-p-n transistors.—*Editor*]

With these symbols the diode action is clarified, voltage polarities and current flow become obvious. A circuit using these symbols is easy to understand and would make the transition from tubes to transistors much simpler. And the newcomer will have to be taught only diode theory to be able to understand transistors.

DON LAFFERTY
Electro Data Division of Burroughs
Pasadena, Calif.

IMPROVED LIGHT COMPUTER

Dear Editor:

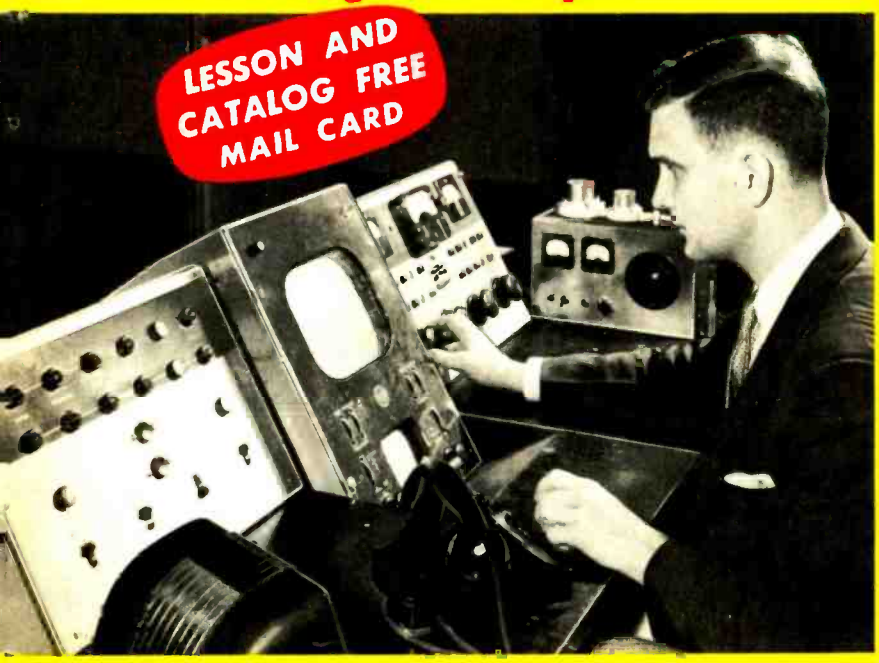
In the September issue of RADIO-ELECTRONICS we noted with great in-

(*Continued on page* 24)

You Can Train at Home for Good Pay Jobs in

RADIO-TELEVISION

Fast Growing Industry Offers Good Pay, Security, Bright Future



Training PLUS OPPORTUNITY is the ideal combination for success. Today's OPPORTUNITY field is Radio-Television. Over 125 million home Radios plus 30 million sets in cars and 40,000,000 Television sets mean big money, opportunity for trained Radio-Television Technicians. More than 4,000 Radio and TV Broadcasting stations offer interesting and important positions for technicians, operators. Color Television, portable TV sets, Hi-Fi, other developments assure future growth. Radio, Television are both growing. Need for trained technicians is increasing!

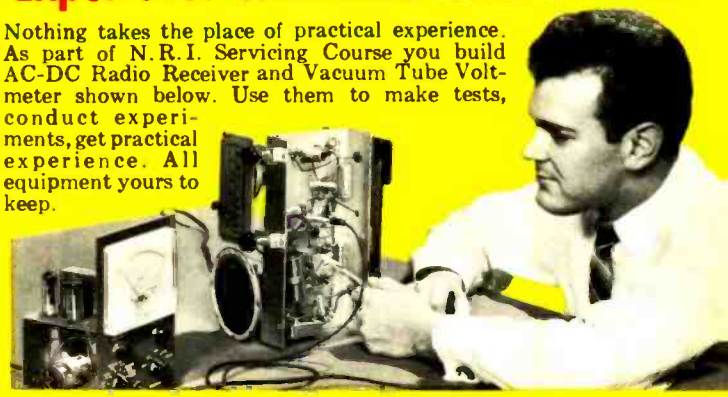
J. E. SMITH
Founder

Find Out What Oldest and Largest Home Study Radio-Television School Offers You

Since 1914—for more than 40 years—N.R.I. has been training ambitious men at home in spare time for Radio-TV. Thousands of successful graduates say N.R.I.'s 50-50 training method is a fast, easy, effective way to higher earnings, desirable jobs. Carefully planned experiments and practice with equipment supplied free of extra charge, bring basic principles, techniques to life right in your own home. Find out what dependable training can do for you.

You Learn by Doing—Get Practical Experience with Kits N.R.I. Sends

Nothing takes the place of practical experience. As part of N.R.I. Servicing Course you build AC-DC Radio Receiver and Vacuum Tube Voltmeter shown below. Use them to make tests, conduct experiments, get practical experience. All equipment yours to keep.



Add to Your Income Starting Soon

Make $10-$15 a Week Extra Fixing Sets in Your Spare Time

Soon after enrolling, many N.R.I. students start earning extra money fixing neighbors' radio sets. Many earn enough extra to pay entire cost of course and provide capital to start their own full time Radio-TV business after getting N.R.I. Diploma. If you want a job with a future, find out how you can train at home for Radio-Television. Mail Postage Free postcard for Sample Lesson. See how practical it is to learn at home. Get 64-Page Catalog, too. See equipment you get, outlines of courses, facts about opportunities in this growing field. Prices of N.R.I. Courses are low, terms easy.

See Other Side

N.R.I. Training leads to good pay jobs like these. BROADCASTING: Chief Technician, Chief Operator, Remote Control Operator. **SERVICING:** Home and Auto Radios, P. A. Systems, Television Receivers, Electronic Controls, FM Radios, Hi-Fi. **SHIP AND HARBOR RADIO:** Chief Operator, Assistant Operator, Radiotelephone Operator. **POLICE RADIO:** Transmitter Operator, Receiver Serviceman. **GOVERNMENT RADIO:** Operator in Army, Navy, Marine Corps, Coast Guard, Forestry Service Dispatcher, Airways Radio Operator. **IN RADIO PLANTS:** Design Assistant, Transmitter Design Technician . . . **AND MANY OTHERS.**

N.R.I. TRAINED THESE MEN

Thanks N.R.I. for Good Start

"Right now I am doing spare-time repairs on Radios and Television. Going into full time servicing soon." C. HIGGINS, Waltham, Mass.

Quit Job to Start Business

"I decided to quit my job and do TV work full time. I love my work and am doing all right financially." W. F. KLINE, Cincinnati, Ohio

Engineer with Station WHPE

"I operated a successful Radio repair shop. Then I got a job with WPAQ and now I am an engineer for WHPE." VAN W. WORKMAN, High Point, N. C.

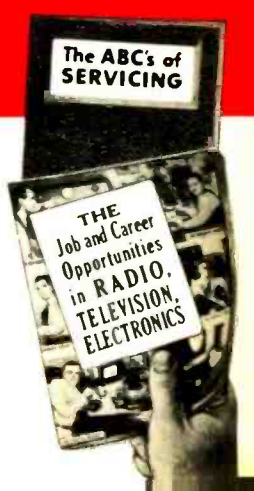
N.R.I. Started His Way up

"I was a cab driver earning $35 a week. Then I enrolled with N. R. I. Now tester with TV maker." J. H. SHEPHERD, Bloomington, Ind.

CUT OUT AND MAIL CARD NOW

SAMPLE LESSON AND CATALOG BOTH FREE

NO STAMP NEEDED!
WE PAY POSTAGE



This card entitles you to Actual Lesson on Servicing, shows how you learn Radio-Television at home. You'll also receive 64-Page Catalog.

NATIONAL RADIO INSTITUTE, Dept. F
Washington 9, D. C.

Please mail me the FREE sample lesson and 64-Page Catalog. (No Salesman will call.)

Name ..... Age .....

Address .....

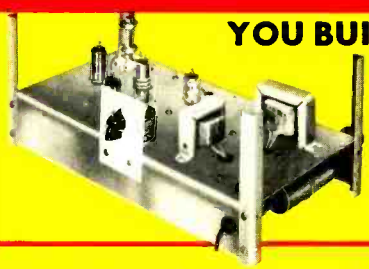
City ..... Zone ..... State .....

Approved Member, National Home Study Council

Practice Servicing-Communications with Kits of Parts N.R.I. Sends

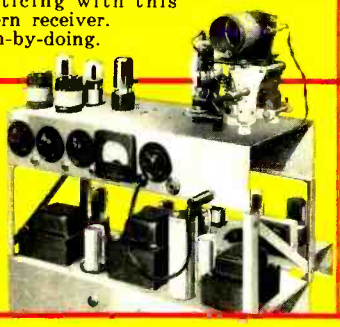
YOU BUILD AC-DC Superhet Receiver

N.R.I. Servicing Course includes all needed parts. By introducing defects you get actual servicing experience practicing with this modern receiver. Learn-by-doing.



YOU BUILD Signal Generator

You build this Signal Generator. Learn how to compensate high frequency amplifiers, practice aligning typical I.F. amplifiers in receiver circuits. Make tests, conduct experiments.



YOU BUILD Broadcasting Transmitter

As part of N.R.I. Communications Course you build this low power Transmitter, learn commercial broadcasting operators' methods, procedures. Train for your FCC Commercial Operator's License.

YOU BUILD Vacuum Tube Voltmeter

Use it to earn extra cash fixing neighbors' sets; bring to life theory you learn from N.R.I.'s easy-to-understand texts.

Radio-Television Can Give You a Good Job with a Future

N.R.I. Graduates do Important Work — Get Important Pay

Chief Engineer with Station

"I am Chief Engineer of Station KGCU in Mandan, N. D. I also have my own spare time business servicing high frequency, two-way communications systems." R. BARNETT, Bismarck, N. D.

Paid for Instruments out of Earnings

"I am doing very well in spare time TV and Radio. Sometimes have three TV jobs waiting and also fix car Radios for garages. I paid for instruments out of earnings." G. F. SEAMAN, New York, N. Y.

Has Own Radio-TV Business

"We have an appliance store with our Radio and TV servicing and get TV repairs. During my Army service, N.R.I. training helped get me a top rated job." W. M. WEIDNER, Fairfax, S. D.

See Other Side

Here is a line of work that people respect—a vocation where you can advance, win a place for yourself, earn good pay and gain much personal satisfaction in what you are able to do. And you can learn at home in your spare time. Smart fellows everywhere are using their spare time to develop new knowledge, new skills. They know it is the trained man who gets ahead, gets the better job, drives the better car, is respected for what he knows and can do.

Be a Skilled Technician

The technical man is looked up to. He should be. He does important work, gets good pay for it. Radio-Television offers that kind of work. There are more than 40 million Televisions, 150 million home and auto Radios. Millions more are sold each year. There are splendid opportunities for the man well trained in Radio-Television Servicing or Broadcasting. Micro-Wave Relay, Aviation and Police Radio, Two-Way Communications for buses, taxis, trucks, etc. are expanding—making more jobs, greater opportunity.

You Can Train in Spare Time

Keep your job until you're ready for a better one. Learn at home. N.R.I. Courses are planned for men who can study only during spare time. You get many kits to build equipment, get practical experience. You work on circuits common to both Radio and TV. Equipment you build "brings to life" things you learn in N.R.I.'s easy-to-understand texts. Experienced N.R.I. instructors, technicians, specialists devote full time to making sure you get the best and simplest Radio-TV training. Train as fast or as slow as you like.

Tested Way To Better Pay

N.R.I. Training is practical, thorough. You get the benefit of N.R.I.'s 40 years experience training men for success in Radio-Television. Most successful N.R.I. men start without any knowledge of Radio, many without a high school education. Find out what Radio-Television training can mean to you. Make a decisive move today toward becoming one of that select group—a Radio-TV Technician. Send for Actual Lesson and 64-Page Catalog, both FREE. **NATIONAL RADIO INSTITUTE, Dept. F, Washington, D.C.**

FIRST CLASS
Permit No. 20-R
(Sec. 34.9, P. L. & R.)
Washington, D. C.

BUSINESS REPLY CARD
No Postage Stamp Necessary If Mailed In The United States

POSTAGE WILL BE PAID BY

NATIONAL RADIO INSTITUTE

16th and U Sts., N. W.

Washington 9, D. C.

SAMPLE LESSON AND CATALOG BOTH FREE

CUT OUT AND MAIL POSTAGE-FREE CARD

here's how you can get more service calls ...repeat customers

Garry Moore is advertising your special "Picture Tube Clean-Up" September 14 through November 23.

When your telephone rings and you're asked for the Garry Moore "Special Picture Tube Clean-Up," grasp the opportunity. Clean the picture tube faceplate and protective glass. *Then check the set for any needed service.* But be sure you have CBS tubes in your caddy. Your customer will want them if tubes have to be replaced.

CBS Tubes, through the Garry Moore "Special Picture Tube Clean-Up," get you into new television homes where you can check sets for necessary service. What's more, CBS is building "every-six-months check-ups" for you.

NEW CBS PICTURE TUBE CLEANER

In the handy easy-to-use squeeze bottle

Just S-Q-U-I-S-H it on and wipe it off! It's the perfect cleaner for the picture tube faceplate and protective glass. Quickly dissolves accumulated grime, dust and smoke. Gets glass clean. Leaves no annoying reflective film.

Just right for your caddy . . . won't break or leak. Now available in the big 6 oz. squeeze bottle at your CBS Tube distributor's.

6 oz. squeeze bottle only 39¢ net

Ask your CBS Tube distributor for your FREE trial bottle

CBS-HYTRON
Danvers, Massachusetts

A Division of
Columbia Broadcasting System, Inc.

See Garry Moore building new business for you . . . Fridays 10:30 to 10:45 A.M., EST, over the CBS Television Network. Tie in . . . get new business and more profits.

(Continued from page 18)

terest the article *Photoelectric Light Computer*. After reading the article I checked on the spectral response of the 868 phototube, which is the type used with the computer. The 868 has an S-1 response which is more sensitive in the red and infra-red. The 1P29 phototube is electronically identical to the 868 in all respects except that it has an S-3 spectral response, mainly in the blue, green, violet region.

Since photographic paper is most sensitive to blue light, it would appear that the 1P29 phototube would make the light computer much more effective and sensitive for the purpose for which it was intended.

E. V. WEINER

Iowa City, Iowa

MORE ON SYMBOLS

Dear Editor:

Allow me to explain the "mysterious nonnafarad (n)" you mention in your editors note to a letter by Mr. Haas in the July issue. The letters nF means 10⁻⁹F. In other words, 1 nF equals 1,000 pF ($\mu\mu$f).

The reason for its use is that—in the German language area at any rate—it is customary to express capacitance below 0.1 μf in picofarads [*little* farads, or micromicrofarads.—*Editor*]. What in the Anglo-American countries is .005 μf, is 5,000 pF in the German area. As it is impractical to print so many zeros on a diagram an abbreviation was expedient. Thus, .005 μf or 5,000 pF could simply be expressed as 5 nF.

It has also become practice to simplify symbols when no ambiguity exists, i.e., M for MΩ, K for kilo-ohm and just the arithmetic figure for values below 1,000 ohms. Similarly, for capacitance the letter F is sometimes omitted from μF, nF and pF, leaving only μ, n and p.

The three-part designation (1 M 2) that you mention in connection with a Yugoslav magazine is, I believe, a more or less private code of Philips (Holland). The first figure indicates wattage rating or working volts, the letter and last figure indicate the value of the component. This code is rarely used.

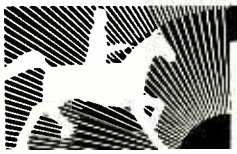
Finally, I'd like to express disagreement with Mr. Haas' criticism. Not that there weren't those differences in symbols, but they are much smaller than the differences in the languages and simply have to be translated together with the rest.

I personally find the lack of standardization of circuit symbols and layouts much more trying. For example, some French magazines print values horizontally, inductors and transformers are drawn like resistors, although these are standardized by the *ICE*.

ROBERT T. BLACH

Wimbledon, England

END



HAVE YOU READ THESE NEW RIDER BOOKS?

PICTORIAL MICROWAVE DICTIONARY
by Victor J. Young & Meredith W. Jones

With the ever increasing applications of microwaves, there has developed a need for a *ready reference* which defines and explains present day microwave terminology.
This pictorial dictionary, written by two acknowledged experts in the microwave field, presents with *rigorous accuracy* the microwave language.
Derivation, explanation, definition, and illustration are combined in such fashion as to give the reader *complete* coverage of the microwave activity. The organization of the dictionary makes it easy to use . . . and very understandable. Usable by engineers, laboratory technicians, engineering students, and all others who have a strong interest in microwave techniques.
Soft Cover, 5½ x 8½", illus.
#188.....**Only $2.95**

INTRODUCTION TO PRINTED CIRCUITS
by Robert L. Swiggett

Here is a really comprehensive text on PRINTED CIRCUITS, the recent development that has revolutionized the electronics industry. The author, who is an acknowledged expert on the subject, gives complete coverage to the various manufacturing processes used. Numerous practical applications are discussed, and the maintenance techniques peculiar to printed circuits are clearly explained.
Soft Cover, 112 pages, 5½ x 8½", illus.
#185.....**Only $2.70**

SERVICING TV AFC SYSTEMS
by John Russell, Jr.

Troubles in the AFC systems of TV receivers are difficult to diagnose and correct. This book discusses the trouble, location, and repair of the major types of AFC circuits used today . . . as well as some of the less common AFC systems the technician may encounter. The theory, waveforms, components, common faults, and their diagnosis in these systems are presented in a manner that affords the reader a *thorough* understanding of AFC circuits and their behavior. Supplemented by more than 75 illustrations, it makes it *easy* for the technician to locate and correct troubles.
Soft Cover, 128 pp., 5½ x 8½", illus.
#192.....**Only $2.70**

ARITHMETIC FOR ENGINEERS (5th Edition, Revised)
by Charles B. Clapham

An outstanding text on practical, elementary mathematics for shop machinists, shop mechanic trainees, tool and die maker trainees, mechanical engineering students at the industrial level, mechanical drafting trainees . . . and all others who want to learn the elementary mathematics of Mechanics.
Written for use in schools or home study. Ideal for industrial upgrading.
More than 390 numerical examples of solutions fully explained. More than 1,950 problem exercises, with answers.
Cloth Bound, 558 pp., 5½ x 8½", illus.
#183.....**Only $6.50**

TV TUBE LOCATION & TROUBLE GUIDE (RCA)
by Rider Lab. Staff

This book shows the tube locations for all RCA TV receivers produced between 1947 and 1956. It lists the tube complement, key voltages, and common troubles correlated with the tubes that may be responsible for them. Complete chassis and model index.
Soft Cover, 56 pp., 5½ x 8½", illus.
#194.....**Only $1.25**

BASICS OF PHOTOTUBES & PHOTOCELLS
by David Mark

Phototubes and photocells are prominently used in a great many applications of electronic devices. Science, industry, government agencies, television, and many communication facilities employ them. This book is devoted to the explanation of the principles and practices surrounding phototubes and photocells, with the utmost in visual presentation.
Soft Cover, 136 pp., 5½ x 8½", illus.
#184.....**Only $2.90**

PICTURE BOOK OF TV TROUBLES, Vol. 7 (Sound Circuits & L-V Power Supplies)
by Rider Lab. Staff

Volume 7 of this famous and extremely popular series. This volume shows the effects of faults in the Sound and L-V Power Supply circuits by examples of incorrect waveforms at specific test points. The component at fault is identified on appropriate schematics. Correct waveforms also are shown.
Soft Cover, 64 pp., 5½ x 8½", illus.
#168-7.....**Only $1.50**

AND...

IF YOU WANT THE **BEST** IN TV SERVICE INFORMATION

ON

RCA — GE
PHILCO — CROSLEY
ADMIRAL — MOTOROLA
EMERSON — ZENITH
SYLVANIA — WESTINGHOUSE

(other manufacturers later on)

...ASK YOUR JOBBER ABOUT RIDER'S NEW **SDO**

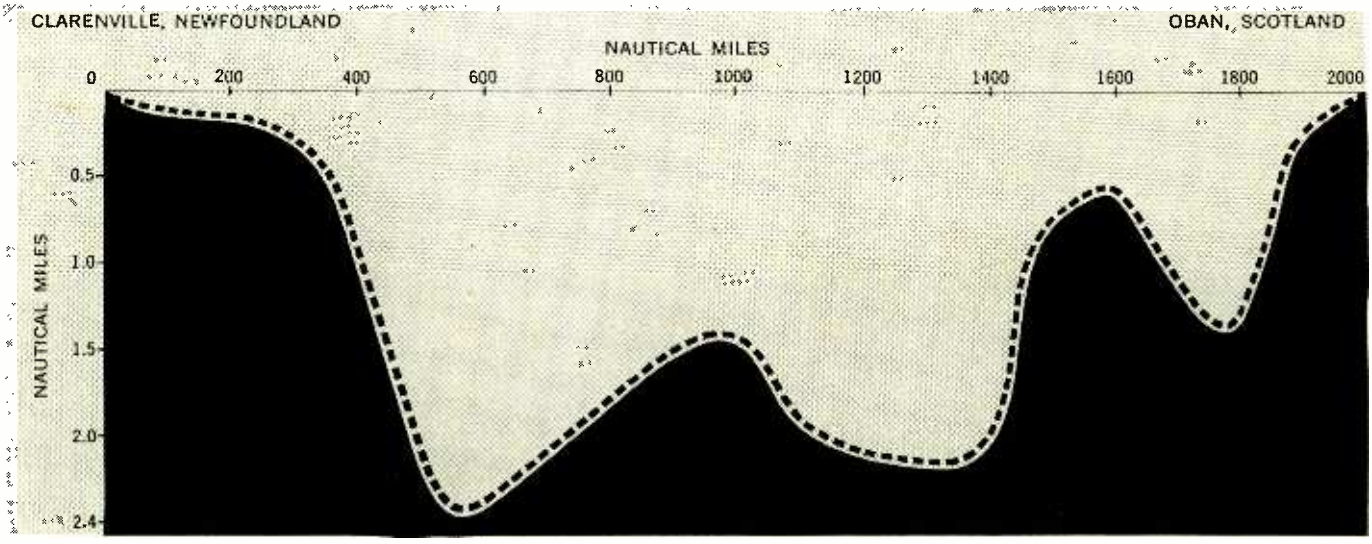
("single diagram only")

ONLY **50¢** PER CHASSIS!

JOHN F. RIDER PUBLISHER, INC.
116 West 14th Street, New York 11, N. Y.

In Canada:
Charles W. Pointon, Ltd.
6 Alcina Ave., Toronto, Ontario
In Canada, all prices approximately 5% higher.

A TRIUMPH OF TELEPHONE TECHNOLOGY



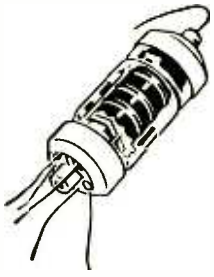
Contour of ocean bed where cable swiftly and clearly carries 36 conversations simultaneously. This is deep-sea part of system – a joint enterprise of the American Telephone and Telegraph Company, British Post Office and Canadian Overseas Telecommunications Corporation.

A great new telephone cable now links North America and Europe—the first transoceanic cable to carry voices.

To make possible this historic forward step in world communications, Bell Laboratories scientists and engineers had to solve formidable new problems never encountered with previous cables, which carry only telegraph signals.

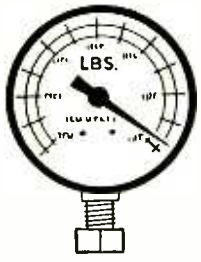
To transmit voices clearly demanded a much wider frequency band and efficient ways of overcoming huge attenuation losses over its more than 2000-mile span. The complex electronic apparatus must withstand the tremendous pressures and stresses encountered on the ocean floor, far beyond adjustment or servicing for years to come.

Here are a few of the key developments that made this unique achievement possible:

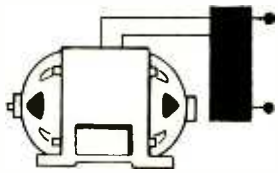


More than 300 electron tubes of unrivaled endurance operate continuously, energized by current sent from land.

Precisely designed equalizing networks and amplifiers compensate for the loss in the cable every 40 miles and produce a communication highway 144 kc. wide.



A unique triple watertight seal protects the amplifiers from pressures as high as 6500 pounds per square inch.

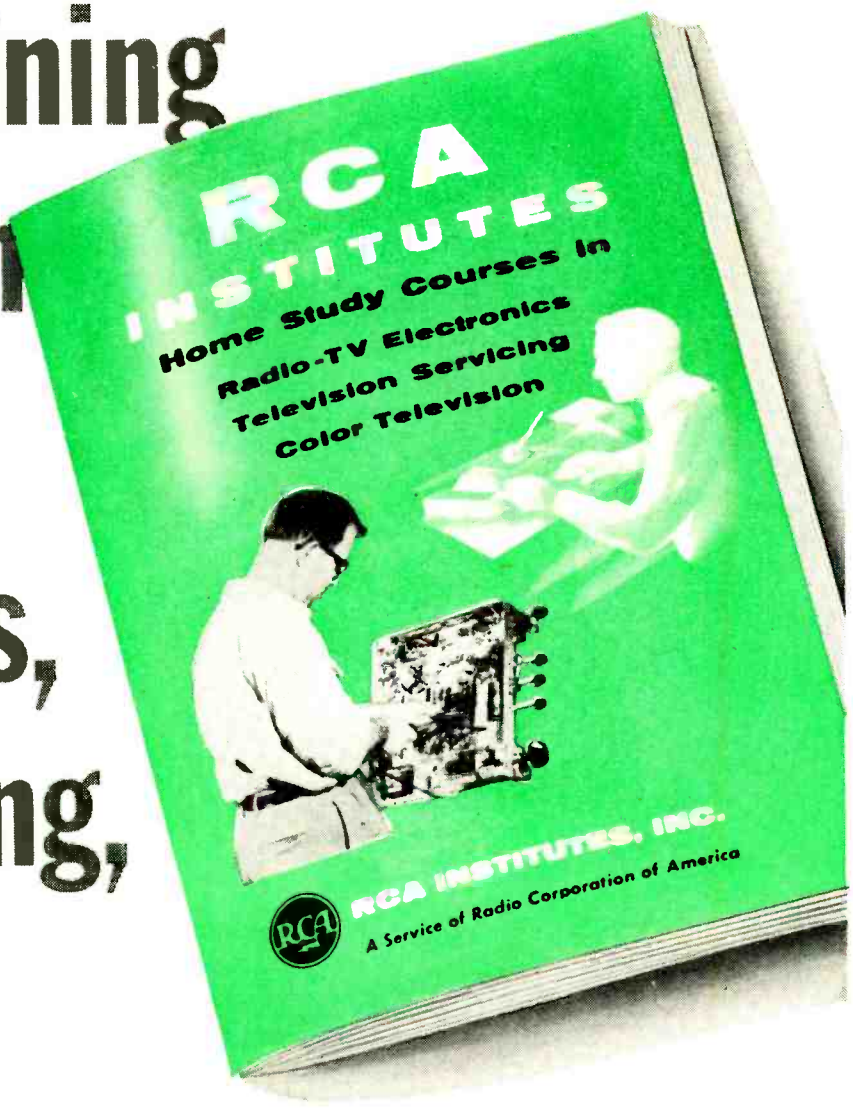


Power supplies of exceptional reliability send precisely regulated current along the same coaxial that carries your voice to energize the amplifying units.

BELL TELEPHONE LABORATORIES

World center of communications research and development

RCA offers you the finest training at home in Radio-TV electronics, TV servicing, Color TV



SEND FOR THIS FREE BOOK NOW!

The instruction you receive and equipment you get (and keep) will start you on your way. Pay-as-you-learn. You pay for only one study group at a time. This 52 page book contains complete information on Home Study Courses for the beginner and the advanced student.

RCA INSTITUTES, INC.
A SERVICE OF RADIO CORPORATION of AMERICA
350 WEST FOURTH STREET, NEW YORK 14, N.Y.

RCA Institutes, Inc., Home Study E-116,
350 West Fourth Street New York 14, N. Y.
Without obligation, send me FREE CATALOG on Home Study Courses in Radio, Television and Color TV. No salesman will call.

Name .....
Please Print
Address .....
City ..... Zone ..... State .....

VETERANS
KOREAN G-I
Check here
PL550
☐

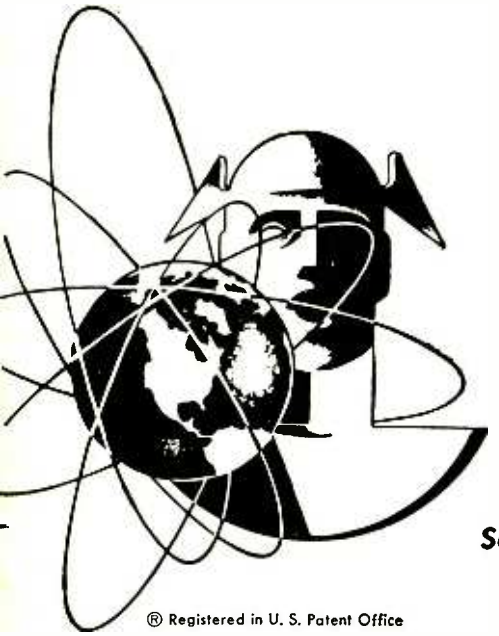
The Equation that Shook the World!

A hasty scrawl on a scrap of paper ushered in the Atomic Age. Through this equation, Dr. Albert Einstein revealed to mankind the awesome secret of atomic fission, with all of its tremendous power for good or evil.

This is the kind of a world we live in . . . a world where knowledge is power in a truer sense than ever before. It is an exciting world.

Univac® has added a new dimension to the world of science, processing data with a speed that crowds many lifetimes of research into a few hours.

Squarely in the midst of this exciting world are the engineers and scientists of Remington Rand Univac. Their potential for growth and achievement (and the rewards that go with them) is unlimited. *You can be one of them.*



® Registered in U. S. Patent Office

Immediate Openings for:

FIELD LOCATION ENGINEERS with a college degree in a scientific or engineering field and experience in electronics. Extensive electronic background may substitute for some college. Many opportunities for rapid advancement.

FIELD LOCATION TECHNICIANS with technical school background and preferably some experience in electronics. These positions can lead to full engineering responsibility.

Send complete resumé to:

Remington Rand Univac

DIVISION OF SPERRY RAND CORPORATION

Mr. Phil Wilson
Dept. SO-10
1902 W. MINNEHAHA AVENUE • ST. PAUL W4, MINNESOTA

Electronics Boom Seen

Need For Television Technicians To Rise

Industry Warned About Shortage Of Trained Men

TV SALES SET NEW RECORD

Sylvania Head Expects Huge Electronic Gains

Transistor Radios Developed

RCA HEAD PREDICTS SALES BOOM FOR COLOR TV SETS

VETERANS - - NON-VETERANS

Get Into The Field That's Making Headlines

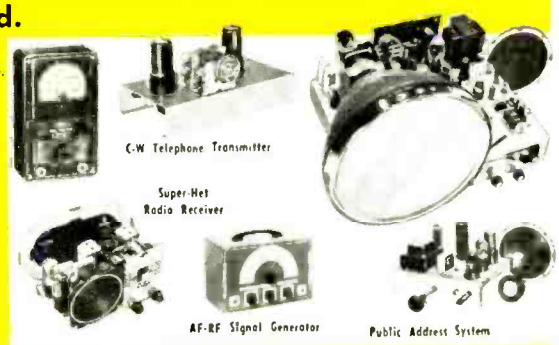
L. C. Lane, B.S., M.A.
President, Radio-Television Training Association.
Executive Director, Pierce School of Radio & Television.

All over the nation the Television-Radio-Electronics industry is making News — News that means opportunity for YOU. You can cash in on the headlines.

I WILL TRAIN YOU AT HOME FOR A TOP-PAY JOB IN TELEVISION

I will prepare you for a spot in America's fastest-growing industry. You can become a trained technician in your spare time without giving up your present job or social life. No experience needed.

LEARN BY DOING



As part of your training I give you the equipment you need to set up your own home laboratory and prepare for a top-pay job or set up your own business. You build and keep an Electromagnetic TV RECEIVER designed and engineered to take any size picture tube up to 21-inch. (10-inch tube furnished. Slight extra cost for larger sizes.) . . . also a Super-Het Radio Receiver, AF-RF Signal Generator, Combination Voltmeter-Ammeter-Ohmmeter, C-W Telephone Transmitter, Public Address System, AC-DC Power Supply. Everything supplied, including all tubes.

STUDY NEWEST DEVELOPMENTS

My training covers all the latest developments in the fast-growing Television-Radio-Electronics industry. You learn about FM — RADAR — COLOR TV — TRANSISTORS — PRINTED CIRCUITS, etc.

CHOOSE FROM THREE COMPLETE COURSES

covering all phases of Radio, FM and TV

1. Radio, FM and Television Technician Course — no previous experience needed.
2. FM-TV Technician Course — previous training or experience in radio required.
3. TV Studio Technician Course—advanced training for men with Radio or TV training or experience.

EXTRA TRAINING IN NEW YORK CITY AT NO EXTRA COST!

After you finish your home study training in Course 1 or 2 you can have two weeks, 50 hours, of intensive Lab work on modern electronic equipment at our associate resident school, Pierce School of Radio & Television. THIS EXTRA TRAINING IS YOURS AT NO EXTRA COST WHATSOEVER!

FCC COACHING COURSE

Important for BETTER-PAY JOBS requiring FCC License! You get this training AT NO EXTRA COST! Top TV jobs go to FCC-licensed technicians.

VETERANS

My School fully approved to train Veterans under new Korean G. I. Bill. Don't lose your school benefits by waiting too long. Write discharge date on coupon.

Radio-Television Training Association

52 EAST 19th STREET • NEW YORK 3, N. Y.

Licensed by the State of New York • Approved for Veteran Training

EARN WHILE YOU LEARN

Almost from the very start of your course you can earn extra money by repairing sets for friends and neighbors. Many of my students earn up to $25 a week . . . pay for their entire training with spare time earnings . . . start their own profitable service business.

FREE I'll send you my new 40-page book, "How to Make Money in Television-Radio-Electronics," a Free sample lesson, and other literature showing how and where you can get a top-pay job in Television.

MAIL THIS COUPON TODAY!

Mr. Leonard C. Lane, President
RTTA
Dept. RE-11C, 52 East 19th Street, New York 3, N. Y.

Dear Mr. Lane: Send me your NEW FREE BOOK, FREE SAMPLE LESSON, and FREE aids that will show me how I can make TOP MONEY IN TELEVISION. I understand I am under no obligation.

(PLEASE PRINT PLAINLY)

Name_____ Age____

Address_____

City_____ Zone____ State____

I AM INTERESTED IN:

- ☐ Radio-FM-TV Technician Course
- ☐ FM-TV Technician Course
- ☐ TV Studio Technician Course

VETERANS! Write discharge date

NO OBLIGATION!

NEW! COLOR and Black-&-White LAB & TV 5" OSCILLOSCOPE #460

KIT $79.95. Wired $129.50

The FINEST professional 5 mc wide-band scope value. Ideal for research, h-f & complex waves, plus Color & Monochrome TV servicing. Flat from DC to 3.58 mc ±1 db (color burst freq.), flat DC to 4.5 mc +1, −3 db. Vert. sens. 25 rms mv/in. Vert. Z 3 megs. Has the following outstanding features not found in scopes up to several times its price, kit or wired:

VERTICAL AMPLIFIER: direct-coupled (DC) thruout to eliminate l-f phase shift; **push-pull thruout** for negligible distortion; **K-follower coupling** between push-pull pentode stages for extended h-f resp. (minimizes h-f phase shift, extends useful resp. to 10 mc); full-screen undistorted vert. defl; 4-step freq-compensated decade step attenuator up to 1000:1. **SWEEP CIRCUIT:** perfectly linear sweeps, 10 cps – 100 kc (ext. cap. for down to 1 cps); **pre-set TV vert. & hor. positions** (30 & 7875 cps); automatic sync. ampl. & limiter eliminates sync amplitude adj. **PLUS:** direct or cap. coupling; bal. or unbal. inputs; edge-lit engraved lucite graph screen; dimmer; anti-glare filter; bezel fits std photo equipt. **OTHER IMPORTANT FEATURES:** High intensity trace CRT. Finest sq. wave resp. (.06 usec rise time). Push-pull hor. ampl., flat to 400 kc, sens. 0.6 rms mv/in. Built-in voltage calibration. Intensity mod. Sawtooth & 60 cps outputs. Astigmatism control. Retrace blanking. Instant, drift-free full-screen vert. positioning & 2X full-screen hor. positioning. **Bal., cal., astig. adj. externally accessible.** 5UP1 CRT, 2–6AU8, 2-6CB6, 1-12AU7A, 2-6J6, 1-6AX5, 1-1V2. Deep-etched satin aluminum panel, rugged grey wrinkle steel cabinet. Designed for easy building at home with no special equipment. 13" x 8½" x 16". 30 lbs.

SCOPE DIRECT PROBE* #PD: KIT $2.75. Wired $3.95. Eliminates stray-pick-up & signal re-radiation.

SCOPE DEMODULATOR PROBE* #PSD: KIT $3.75. Wired $5.75. Demodulates AM carriers between 150 kc and 250 mc.

SCOPE LOW CAPACITY PROBE* #PLC: KIT $3.75. Wired $5.75. For signal tracing in high frequency, high impedance & wide-band circuits (as in TV) without distortion from overloading or frequency discrimination.

150 kc to 435 mc with ONE generator!

New! RF SIGNAL GENERATOR #324

KIT $26.95. Wired $39.95

for COLOR and Monochrome TV servicing

New wide-range, stable generator – better value then generators selling at 2 or 3 times its cost! Ideal for: IF-RF alignment, signal tracing & trouble-shooting of TV, FM & AM sets; marker gen.; 400 cps audio testing; lab. work. 6 fund. ranges: **150-400 kc, 400-1200 kc, 1.2-3.5 mc, 3.5-11 mc, 11-37 mc, 37-145 mc; 1 harmonic band 111-435 mc. Freq. accurate to ±1.5%**; 6:1 vernier tuning & excellent spread at most important alignment freqs. Etched tuning dial, plexiglass windows, edge-lit hairlines. Colpitts RF osc., directly plate-modulated by K-follower for improved mod. Variable depth of int. mod. 0-50% by 400 cps Colpitts osc. Variable gain ext. mod. amplifier: only 3.0 volts needed for 30% mod. Turret-mounted coils slug-tuned for max. accuracy. Fine & Coarse (3-step) RF attenuators. RF output 100,000 uv; AF sine wave output to 10 volts. 50-ohm output Z. 5-way jack-top binding posts for AF in/out; coaxial connector & shielded cable for RF out. Tubes: 12AU7, 12AV7, selenium rectifier; xfmr-operated. Deep-etched satin aluminum panel, rugged grey wrinkle steel cabinet. 8" x 10" x 4¾". 10 lbs.

The specs are the proof... 4 NEW BEST BUYS by EICO

for COLOR and Monochrome TV servicing

New! PEAK-to-PEAK VTVM #232 & UNI-PROBE (pat. pend.)

KIT $29.95. Wired $49.95

UNI-PROBE: exclusive with EICO! Terrific time-saver! Only 1 probe performs all functions—a half-turn of probe-tip selects DC or AC-Ohms.

The new leader in professional peak-to-peak VTVMs. Latest circuitry, high sensitivity & precision, wide ranges & versatility. **Calibration without removing from cabinet.** New balanced bridge circuit. High Z input for negligible loading. 4½" meter, can't-burn-out circuit. **7 non-skip ranges on every function.** 4 functions: +DC Volts, −DC Volts, AC Volts, Ohms. Uniform 3 to 1 scale ratio for extreme wide-range accuracy. **Zero center.** One zero-adj. for all functions & ranges. **1% precision** ceramic multiplier resistors. Measure **directly** peak-to-peak voltage of complex & sine waves: 0-4, 14, 42, 140, 420, 1400, 4200. DC/RMS sine volts: 0-1.5, 5, 15, 50, 150, 500, 1500 (up to 30,000 v. with HVP probe, & 250 mc with PRF probe). Ohms: 0.2 ohms to 1000 megs. 12AU7, 6AL5, selenium rectifier; xfmr-operated. 8½" x 5" x 5". Deep-etched satin aluminum panel, rugged grey wrinkle steel cabinet. 7 lbs.

Calibration without removing from cabinet.

New! DELUXE PEAK-to-PEAK VTVM #249 with 7½" METER & UNI-PROBE (pat. pend.)

KIT $39.95. Wired $59.95

All the advanced & exclusive features of #232–PLUS the extra convenience and readability of its big 7½" meter. Your ideal bench instrument.

VTVM RF PROBES* #PRF-11 or PRF-25: KIT $3.75. Wired $4.95. Accuracy ±10%. Use with any 11 or 25 megohm VTVM.

VTVM HV PROBE #HVP-2: Wired $4.95. Complete with multiplier resistor. Measures up to 30 kv with any VTVM or 20,000 ohms/volt VOM.

*Only EICO Probes have all these features: fully shielded, rugged terminal board parts mounting; shock mounted floating construction, swivel-action color-coding, easy parts accessibility.

COMPLETE with Preamplifier, Equalizer and Control Section

New! 20-WATT Ultra-Linear Williamson-type HIGH FIDELITY AMPLIFIER #HF20

KIT $49.95. Wired $79.95

A low-cost, complete-facility amplifier of the highest quality that sets a new standard of performance at the price, kit or wired. Every detail, down to the etched, brushed solid brass control plate, is of the fine quality EICO is famous for.

Rated power output: 20 watts (34 w peak). **IM distortion (60 cps: 6 kc/4:1) at rated power:** 1.3%. **Mid-band harmonic distortion at rated power:** 0.3%. **Maximum harmonic distortion between 20 and 20,000 cps at 1 db under rated power:** approx. 1%. **Power response (20w):** ±0.5 db 20-20,000 cps; ±1.5 db 10-40,000 cps. **Frequency response (¼w):** ±0.5 db 15-35,000 cps; ±1.5 db 7-50,000 cps.

5 feedback equalizations for LP's & 78's including RIAA. Variable turnover feedback tone controls do not affect volume & permit large boosts or cuts at either end of audio spectrum with mid-freqs. unaffected. Loudness control & separate level set control on front panel. Low Z output to tape recorder. 4 hi-level switched inputs: tuner, tv, tape, auxiliary (xtal/ceramic phono or 2nd tuner); 2 low-level inputs for proper loading with all leading magnetic, FM & quality xtal cartridges. Hum bal. control. Extremely fine output transformer has interleaved windings, tight coupling, careful balancing & grain-oriented steel. 8½" x 15" x 10". 24 lbs.

These amazing EICO values are **NOW IN STOCK** at your nearest distributor. Examine them side-by-side with **ANY** competitor. You'll see for yourself why indeed EICO is your **BEST BUY.** Fill out coupon on reverse page.

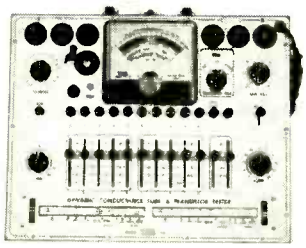
EICO®

TURN PAGE FOR MORE EICO VALUES...

84 Withers Street, Brooklyn 11, New York

Prices 5% higher on West Coast.

the specs are the test that tells who's best!

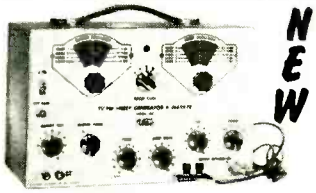


for COLOR & Monochrome TV servicing

NEW! DYNAMIC CONDUCTANCE TUBE & TRANSISTOR TESTER #666

KIT $69.95 WIRED $109.95

Unexcelled testing thoroness & accuracy. **Checks transistor collector current & Beta** using internal dc power supply. **Tests all receiving tubes** including subminiatures (& Color & Monochrome tv pic tubes with accessory adapter). **Composite indication of mutual conductance, plate conductance, & peak emission.** Simultaneous sel. of any 1 of 4 combinations of 3 plate, 3 screen, & 3 ranges of control grid voltage. Grid voltage variable over 3 ranges with 5% accurate pot. **New series-string voltages** for 600, 450 & 300 ma types. 5 ranges meter sens. with 1% precision shunts & 5% accurate pot. 10 SIX-position lever switches for free-point connection of every tube pin or cap. 10 pushbuttons for **rapid** insert of any tube element in leakage circuit & **speedy** sel. of individual tube sections. **Direct reading of inter-element leakage *in ohms.*** New gear-driven rollchart. Steel case with cover & handle. Sensitive 200 μa meter.



NEW

for COLOR & Monochrome TV servicing

TV-FM SWEEP GENERATOR & MARKER #368

KIT $69.95 WIRED $119.95

The FINEST service instrument of this type ever offered in either kit or wired form at ANY price! Outstanding ease & accuracy in FM & TV (including Color) alignment. **Entirely electronic sweep circuit** with accurately biased Increductor: **superb linearity** on both sides of selected center freq. **Newly-designed AGC circuit** automatically adjusts osc. for max. output on each band with min. amplitude variations. Sweep gen. range 3-216 mc in 5 OVERLAPPING FUND. BANDS. Sweep width continuously variable from 0-3 mc lowest max. deviation to 0-30 mc highest max. deviation. **Variable marker gen.** range from 2-75 mc in 3 FUND. BANDS plus a calibrated harmonic band (60-225 mc). Variable marker calibrated with **int. xtal marker gen. 4.5 mc xtal included.** Ext. marker provision. Double pi line filter. **Edge-lit hairlines** eliminate parallax.

Turn page for other EICO ad

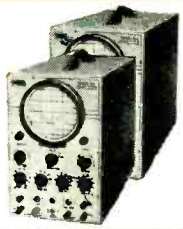
FREE 1956 EICO CATALOG!

Tells you how to SAVE 50% on your test equipment costs!

TUBE TESTER #625
KIT $34.95
Wired $49.95
• tests 600 mil series string type tubes
• illuminated roll-chart
Pix Tube Test Adapter $4.50

***New!* GEIGER COUNTER #803**
KIT $19.95 Wired $29.95

(less batteries)
Professional, all-electronic, sensitive, rugged—at lowest cost! Indicates by neon lamp & headphone clicks.



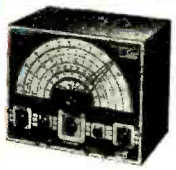
5" PUSH-PULL OSCILLOSCOPE #425
KIT $44.95
Wired $79.95
•
7" PUSH-PULL OSCILLOSCOPE #470
KIT $79.95
Wired $129.50

VACUUM TUBE VOLTMETER #221
KIT $25.95
Wired $39.95
•
DELUXE VTVM #214 (7½" METER)
KIT $34.95
Wired $54.95

RF SIGNAL GENERATOR #320
KIT $19.95
Wired $29.95
150 kc-34 mc, calibrated harmonics to 102 mc. Pure or mod. RF, & Colpitts osc. 400 cps sine outputs.

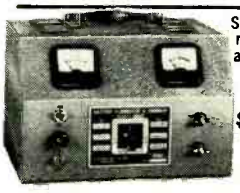
NEW!
REDI-TESTER #540
KIT $12.95
Wired $15.95
Multi-range ac/dc voltmeter, ammeter, ohmmeter, wattmeter, leakage checker for home & auto repairs.

#944 FLYBACK TRANSFORMER & YOKE TESTER
KIT $23.95
Wired $34.95
• fast check all flybacks & yokes in or out of set.
• spots even 1 shorted turn!



Range 500 kc—228 mc on fund. Cont. sweep width control, 0—30 mc.
KIT $34.95
Wired $49.95
TV/FM SWEEP GENERATOR #360
5MC-4.5MC CRYSTAL .....$3.95 ea.

1% accuracy on all 7 ranges. Range 75 kc—150 mc. Volt reg.
KIT $39.95
Wired $59.95
DELUXE RF SIGNAL GENERATOR #315



Sep. voltmeter & ammeter
KIT $29.95
Wired $38.95
6V & 12V BATTERY ELIMINATOR & CHARGER #1050

Sep. hi-gain RF & lo-gain audio inputs. Special noise locator. Calibrated wattmeter.
KIT $24.95
Wired $39.95
DELUXE MULTI-SIGNAL TRACER #147

Reads 0.5 ohms—500 megs, 10 mmfd—5000 mfd. power factor.
KIT $19.95
Wired $29.95
R-C BRIDGE & R-C-L COMPARATOR #950B

NEW!
HI-FI PREAMPLIFIER #HF-61
KIT $24.95. Wired $37.95. With Power Supply: KIT $29.95. Wired $44.95
Feedback circuitry thruout! Preamp-equalizer, tone controls, scratch & rumble filters. K-follower output.

20,000 Ohms/Volt MULTIMETER #565
KIT $24.95
Wired $29.95

1000 Ohms/Volt MULTIMETER # 536
KIT $12.90
Wired $14.90

VTVM PROBES	KIT	Wired
Peak-to-Peak	$4.95	$6.95
RF	$3.75	$4.95
High Voltage Probe-1		$6.95
High Voltage Probe-2		$4.95
SCOPE PROBES		
Demodulator	$3.75	$5.75
Direct	$2.75	$3.95
Low Capacity	$3.75	$5.75

For FREE 1956 catalog, mail coupon NOW!

EICO®

84 Withers St. • Brooklyn 11, N. Y.

Prices 5% higher on West coast and subject to change without notice. ©56

EICO, 84 Withers Street C-11
Brooklyn 11, New York

Send FREE 1956 Catalog and name of neighborhood EICO jobber.

Name.....
Home Address.....
City.....Zone.....State.....
Occupation.....

1945 to 1955: a decade of Know-How & Value Leadership in Kits & Instruments—over ½ million sold to date!

RADIO – ELECTRONICS
Hugo Gernsback, Editor

TECHNICIANLESS AGE?

. . . *Is a Self-Servicing Receiver Possible?* . . .

DURING a recent visit to Mexico City, we talked to a number of people about the progress of radio electronics and television in Mexico. As in all up-to-date countries today, Mexico is advancing rapidly from a technical viewpoint.

One of our friends, an American who has lived in Mexico for many years, deplored the fact that their technicians were far behind the times, so much so that he would not allow one to take his set off the premises "because it would surely be wrecked." We told him that no country had a patent on this situation—exactly the same thing happens in many instances in the United States and elsewhere. There are "technicians" and technicians in every country, some good, some mediocre, some bad.

At this juncture an electronic manufacturer, a native of Mexico, advanced the theory that sooner or later electronics would advance to such a state that the service technician would become obsolete. He maintained that it should not be too difficult to construct radio and television sets so that they would be "self-servicing." In other words, if a set became inoperative, you would press a special button and the set would then start to analyze itself, making all necessary corrections, rejecting useless parts and putting new ones into the circuit, until the set was restored to its original state and efficiency. He maintained that this was by no means science-fiction and that some day it would be done.

We would be the first to deny progress in this direction: indeed, on this page we have from time to time presented similar—if not quite such far-fetched—ideas. In this age of automatism, hardly anything is impossible when it comes to electronics. But it is also true that what is possible may not always be practical.

Indeed, in our most modern electronic calculating and computing machines, the so-called electronic brains, these same ideas have been used for some time. Thus, for instance, when vacuum tubes burn out or no longer render service an automatic circuit flashes a red light so the attendant can change the incapacitated tube. But incorporating expensive automatic gadgets into the average television set, while quite feasible, would run up the cost of the receiver out of all proportion. If anyone—and there are millionaires who can afford it—could spend anywhere from five to ten thousand dollars for a foolproof television set that could correct and remedy all or nearly all of its operating faults—such sets could, of course, be built. But how much of a market would there be for this type of receiver? It is conceivable that such sets could be made and sold in inaccessible locations where servicing technicians could not be had for any price, if the owner cared to spend the money.

But in spite of all the automatic regenerating features, it is doubtful that any self-servicing set could be constructed that would be absolutely foolproof under *all* circumstances. Suppose lightning hit the antenna? What then? Automation would be of no help in such a case. Suppose that there had been a flood and the set had been submerged in water. It would be hopeless to expect electronics to repair such a damaged set. Fire on the premises and other accidents, such as dropping the receiver on the floor, would all tend to make the receiver inoperative in spite of the best electronic engineering.

On the other hand, it must be admitted that, as electronics advances, manufacturers tend more and more to make sets more foolproof than were our first radio sets of the Twenties.

We have mentioned before on this page that certain parts of television and radio sets can be engineered in such a manner that by taking out a "block unit" where trouble is most apt to arise and replacing it with a new block, the set can be made operative again—but not in all instances. There remains the great problem which haunts most service technicians: the *intermittent receiver*.

An intermittent can occur in dozens of spots and locations in a receiver. It may be a loose connection or a plurality of loose connections, not only in the wiring but in the components themselves. It is true that some intermittents, due to poor connections, could be eliminated by soldering the connecting wires to the tube prongs and at all other points where plug connections are now made. Internal intermittents could be reduced by increasing quality of components, all at a cost.

These are the imponderables of servicing and no degree of automatism could eliminate such faults when and if they develop. They are the most time-consuming and vexing difficulties in servicing and so far have resisted all the ingenuity of engineers and manufacturers. There does not seem to be anything in sight—at least, not economically—to do away permanently with all intermittents in our commercial sets today.

Components for civilian electronic equipment are rated lightly as a rule. A municipal engineer who had his set in for service was startled to hear that a 600-volt capacitor would break down on a 50% overload and said that all electrical equipment for the city had to take 600% overloads for short periods and 660-volt stresses across insulation permanently, to be accepted. A TV set so made might cost two or three thousand dollars but could conceivably run for a number of years—with regular tube replacement of "reliabilized" tubes—without servicing.

While we now actually have automatic, nonhuman "service technicians,"* even these ingenious and expensive gadgets will not locate an average intermittent. Such a machine, it is true, will tell you that *there is* an intermittent or open circuit but exactly where it is, no machine will be able to indicate, at least not in the immediate future.

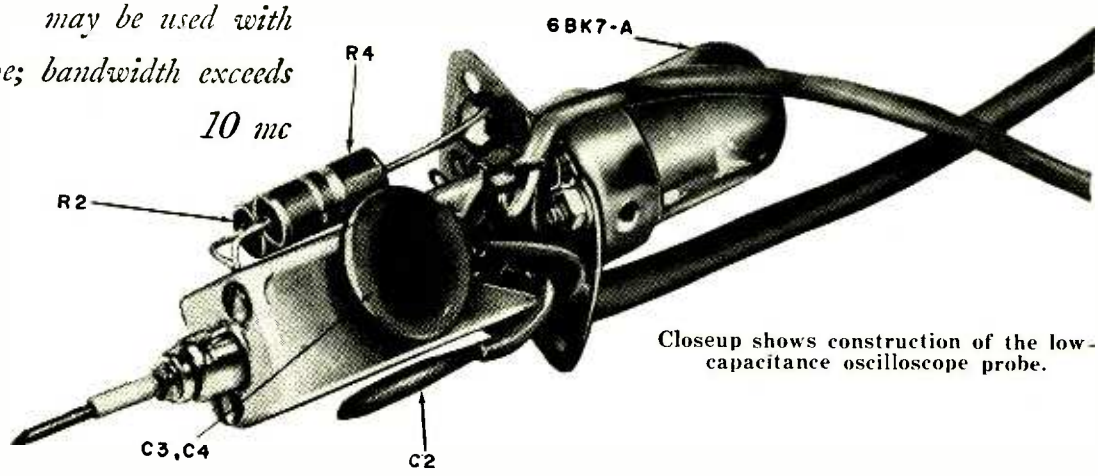
In this discussion, we have not begun to touch upon servicing color television sets, which multiplies the hazards of nonfunction almost in geometrical proportion.

We must therefore come to the inevitable conclusion that servicing technicians need not begin to despair of their profession. It is still human ingenuity, know-how and a thorough knowledge of electronics and all that goes with it that will reign in the servicing field, not only for the predictable future but for the distant future as far as it can be foreseen today. —*H.G.*

*See RADIO-ELECTRONICS for July, 1956, page 55.

AN ELECTRONIC SCOPE PROBE

Low-capacitance unit may be used with any oscilloscope; bandwidth exceeds 10 mc



Closeup shows construction of the low-capacitance oscilloscope probe.

By CHARLES W. RHODES

MANY television technicians get inaccurate and confusing results from their oscilloscope because they are not using a properly operating low-capacitance probe. These probes reduce circuit loading by the oscilloscope so that true operation may be observed.

The design of the conventional low-capacitance probe depends greatly upon the length of input cable and the input resistance and capacitance of the oscilloscope. Many scopes used in television shops are of such design that their input resistance and capacitance may vary with control adjustment, making it impossible to use such a probe. Under these conditions conventional probes attenuate the input signal greatly and low-gain scopes are not sensitive enough to make up this loss.

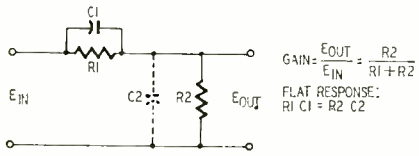


Fig. 1—Frequency-compensated voltage divider as used in low-capacitance probes.

Fig. 2—Frequency distortion on composite video waveform: a, C1 correct; b, C1 too large; c, C1 too small.

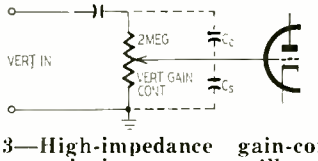


Fig. 3—High-impedance gain-control circuit used in some oscilloscopes.

The electronic low-capacitance probe overcomes these difficulties and has no circuit adjustments. It may be used with any oscilloscope. Its bandwidth extends beyond 10 mc and produces only a 5% voltage loss. Input capacitance is under 5 $\mu\mu$f and input resistance exceeds 15 megohms.

An oscilloscope with a shielded input cable may represent a circuit load of 2 megohms and 120-$\mu\mu$f shunt capacitance. The conventional low-capacitance probe uses the circuit shown in Fig. 1. The scope input resistance is R2 and its shunt capacitance, including cable, is C2. By making R1 much greater than R2, input resistance can be increased. For proper frequency response the time constant formed by R1–C1 must equal the time constant R2–C2. Normally, C1 is a small trimmer capacitor in the probe; its exact value is determined by experiment.

Fig. 2 shows the results of errors in the value of C1. In Fig. 2-a, the value is correct and the composite video waveform is undistorted. In Fig. 2-b C1 is too large and the horizontal sync is above the vertical sync, a condition known as "high peaking." In Fig. 2-c C1 is too small and the vertical sync is too high. Note the rounding off of the pulse. The value of C1 depends upon the scope input characteristics and cable length.

Some oscilloscopes use a high-impedance vertical gain control circuit as shown in Fig. 3. When the gain control is near minimum, high frequencies are fed across the control by C_c, the stray circuit capacitances. Waveform distortion as shown in Fig. 2-b results. At higher gain stray capacitance C_s bypasses the high frequencies, producing the waveform at Fig. 2-c. At full gain C_s shunts the input circuit, throwing additional capacitance across the input terminals which unbalances the low-capacitance probe.

Other scopes use a low-impedance vertical gain control, avoiding the above trouble, but use an input attenuator switch which does not always present the same input resistance and capacitance to the input terminals.

Many of these instruments can give excellent performance if this one design limitation is removed—which is what the electronic low-capacitance probe can do.

Low-capacitance probe circuit

This probe (Fig. 4) uses a 6BK7-A as a cathode follower. While this type of circuit provides no voltage gain, it does have an extremely high input impedance and a very low input capacitance. With a 6BK7-A, using one section only, a voltage "gain" (A) of 0.95 is obtained. While grid resistor R1 is shown as 820,000 ohms the action of the cathode follower is to increase this

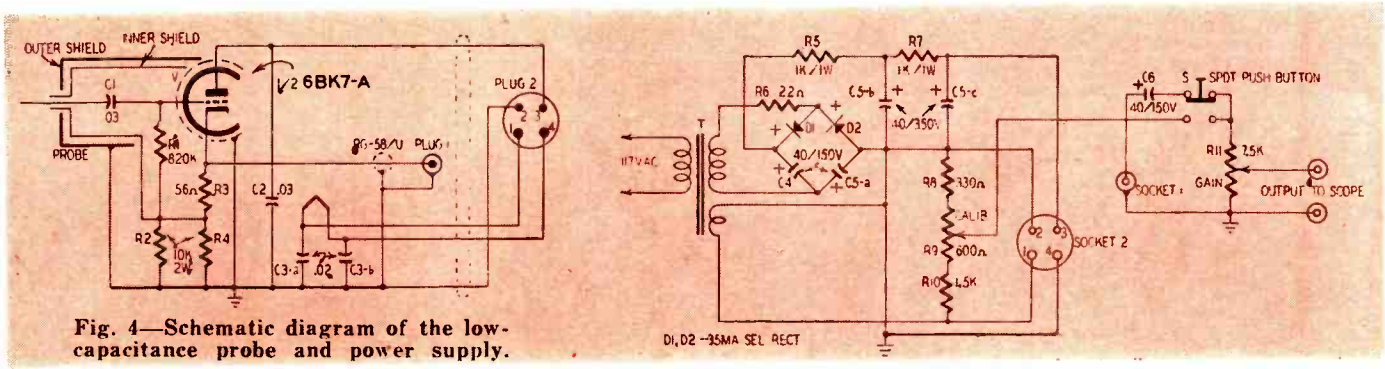


Fig. 4—Schematic diagram of the low-capacitance probe and power supply.

value by 1/(1 A) times so that it approaches 16 megohms as far as the circuit under test is concerned.

The inner shield of the probe completely shields the grid circuit from the outer shield by its coaxial construction. The inner shield is connected to the cathode of the 6BK7-A. Thus, there is virtually no grid-to-ground capacitance in this type of design. Instead, there will admittedly be a high grid–cathode capacitance. However, another property of a cathode follower is to degenerate any capacitance between its grid and cathode by (1 − A). With a gain approaching unity, this capacitance is washed out. The only other input capacitance is that of grid to plate, nearly half the total input capacitance. Therefore one section only of the 6BK7-A is used. The increased gain which would result from using both sections is marginal and would be more than offset by the increased capacitance and power supply requirements. While other triodes can be used, one section of a 6BK7-A looked best.

The output impedance of a cathode follower is extremely low. This probe has an output impedance of 100 ohms. The cable capacitance does not therefore attenuate frequencies below 12 mc. With the high input resistance afforded by the cathode-follower connection, low-frequency response is excellent.

An accessory power supply was built to furnish 240 volts at 18 ma and 6.3 volts at 450 ma. However most constructors will prefer to obtain this modest power from their oscilloscopes. It is extremely important to bypass the B-plus line with at least 40 μf. The decoupling resistor should be chosen to deliver not over 240 volts maximum to the probe.

When the probe is to be used with an instrument having a high-impedance gain control, the low-impedance gain control unit consisting of R11 and C6 should be added to the instrument. Set the high-impedance control to maximum and use only the low-impedance control. Short unshielded leads should be used to connect R11 to the instrument.

A voltage calibration feature is included on the power supply chassis. Depressing PB feeds a 60-cycle calibrating voltage into the gain control.

Parts for low-capacitance probe

R1—820,000 ohms, ½ watt
R2—10,000 ohms, 2 watts
R3—56 ohms, ½ watt
R4—10,000 ohms, 2 watts
R5—1,000 ohms, 1 watt
R6—22 ohms, ½ watt
R7—1,000 ohms, 1 watt
R8—330 ohms, ½ watt
R9—600-ohm pot. linear
R10—1,500 ohms, ½ watt
R11—7,500-ohm pot. linear
C1—.03 μf, disc ceramic
C2—.03 μf, disc ceramic
C3—.02 μf, dual disc ceramic
C4—40 μf, 150 volts
C5—40 μf, 150V, 40-40 μf, 350V
C6—40 μf, 150 volts
D1—selenium rectifier, 35 ma
D2—selenium rectifier, 35 ma
T—isolation transformer, secondary 117 volts @ 35 ma, 6.3 volts @ 1 amp
S—pushbutton switch, momentary contact
PLUG 1—miniature 4-prong cable connector (male)
PLUG 2 — single-contact coaxial connector for RG-59/U (male)
SOCKET 1—miniature 4-prong chassis connecter (female)
SOCKET 2 — single-contact coaxial connector (female chassis-type)
V—6BK7-A
Miniature socket, 9 pins
Length of RG-59/U coaxial cable
Line cord
Shield for 6BK7-A
Binding posts for power supply (2)
Length of 4-conductor cable for power supply
Shield, if type, ¾-inch square
Phono jack, RCA type
Phono plug, RCA type
Shield, if type, 1¾ inches square

Potentiometer R9 is adjusted to provide the same scope deflection as a 5-volt peak-to-peak signal at the probe input. This is 1.77 volts rms.

Construction

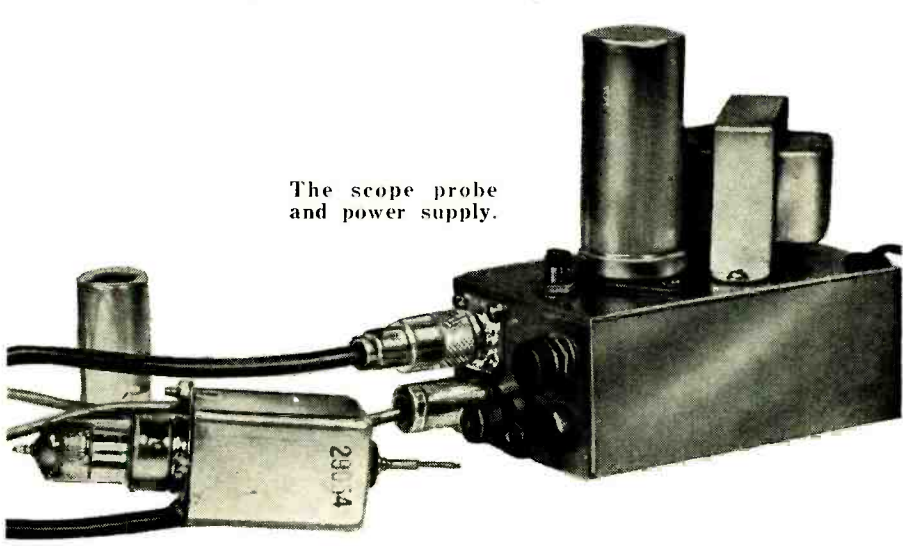
A ¾-inch-square if shield has an RCA type phono jack installed in it. It projects through a ⅜-inch hole, and flathead screws hold it in place. The prod uses an RCA phono plug with a small finishing nail soldered in it. A piece of spaghetti insulates the nail. The body of this plug should be taped as it is at cathode potential, 90 volts. Cathode load resistors R2 and R4 are soldered to the phono jack and lie outside the inner shield. Inside the shield are R1, R3 and C1. The heater bypass and plate bypass capacitors lie between the two shields. The use of these exact capacitors is recommended for space reasons.

The coaxial cable, RG59/U, is soldered to the cathode pin of the tube socket. This cable length is noncritical. A four-conductor unshielded power cable carries heater and B power to the probe. The heater should not be grounded in the probe.

The tube socket is bolted to an electrolytic capacitor mounting plate (three-tab small type) with 4-40 machine screws cut short. This particular mounting plate exactly accommodates the outer shield, another if can 1¾ inches square and 3 inches long, with spade bolts. A ½-inch hole in its end carries a grommet which will insulate and space the RCA phono jack and plug. The two cathode load resistors are soldered directly to the mounting plate and help space the inner shield.

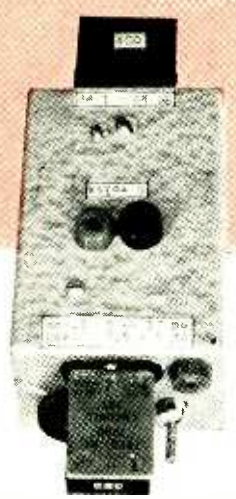
The power supply was built from material at hand. R6 was chosen to limit the voltage output.

The high sensitivity and wide bandwidth of this probe permit its use in color servicing with an oscilloscope having a wide bandwidth. END

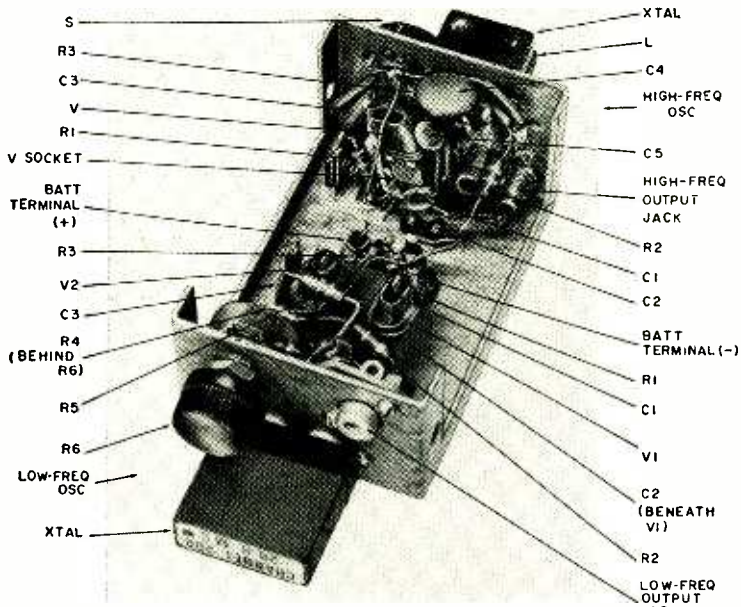


The scope probe and power supply.

Build a Dual WIDE-BAND CRYSTAL OSCILLATOR



Unit contains terminals for external power supply — batteries may be inserted.



Layout of the dual oscillator.

Highly accurate separate transistorized units on single chassis cover 3.5 to 12 mc and 80 kc to 1 mc

By I. QUEEN
EDITORIAL ASSOCIATE

A CRYSTAL oscillator is accurate. It can provide frequency check points to calibrate the dial of a signal generator, receiver, wavemeter or vfo, and is nearly free from frequency changes. Drift is negligible. Voltage variations or circuit defects result in little if any frequency change. Furthermore, crystals are available on the surplus market, often several for a dollar.

When the crystal oscillator is transistorized the instrument becomes doubly useful for we gain the additional advantages of compactness and portability. This article describes two transistorized crystal oscillators: a circuit suitable for crystal frequencies from about 3.5 to 12 mc and one for crystals ranging from 80 kc to 1 mc. Each circuit covers a very wide band of frequencies without need for retuning every time the crystal is changed. The two were built in a single 3 x 2 x 1½-inch box, but can be constructed individually if desired.

3.5-to-12-mc oscillator

Fig. 1 shows the schematic of an rf generator, using a Raytheon 2N113 transistor, a high-frequency cutoff type suitable for this purpose. The power supply may be anything from 3 to 6 volts.

This circuit oscillates when its tank is nearly resonant with that of the crystal plugged in. Surprisingly, the lock-in range is greater than 2 to 1. With C5 switched out of the circuit, L is adjusted to tune to crystal frequencies from about 5 to 12 mc. Withdrawing the coil slug raises the frequency. In my instrument L was tuned to provide crystal-controlled frequencies up to nearly 12 mc, and the low limit was then about 5 mc. When C is added it lowers the tank frequency.

Preferably, this second band should just overlap the first. In this particular instrument a value of C5 equal to 270 $\mu\mu$f provided a second band of frequencies from 3.5 to just over 5 mc, so the desired overlap is obtained. Therefore Fig. 1 can provide *continuous* coverage of crystal-controlled frequencies from about 3.5 to 12 mc. Once the desired band is chosen (by switching C5) any crystal may be plugged in without need to retune the circuit.

The output from this oscillator is the usual pure tone (when heard on a nearby receiver with beat-frequency oscillator) expected from any crystal-controlled circuit. There should be enough output to block a receiver coupled tightly to the oscillator. In most cases a loose hanging lead may be sufficient for coupling purposes.

Collector coil L is wound with 25 turns of No. 34 enameled wire on a ¼-inch-diameter slug-tuned form. Once the slug has been tuned it need not be reset thereafter.

Tuning the oscillator

Plug in the desired crystal and switch on the oscillator. Listen in on a nearby receiver with bfo, tuning it approximately to the crystal frequency. When you find the signal it should sound pure

Parts for Fig. 1 oscillator

R1—1,500 ohms, ½ watt
R2—270 ohms, ½ watt
C1—120 µµf
C2—100 µµf
C3—.005 µf
C4—.005 µf
C5—270 µµf
L—25 turns No. 34 enameled wire, ¼-inch diameter slug-tuned form, closewound
V—2N113
Xtal—see text
Batt—3–6-volt battery
S—switch, 4-position, Lafayette SP-88
Crystal socket (Mosley 500 or equivalent)
Transistor socket
Small chassis, about 3¼ x 2 x 1½ inches
Pin jack (for oscillator output)

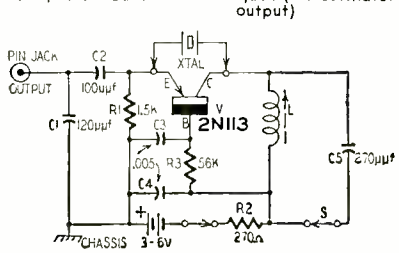


Fig. 1—High-frequency oscillator.

and clear, like a flute. The receiver antenna lead should be disconnected during this time or you may pick up considerable outside interference.

After the oscillator is found to be working correctly, adjust L as required. When a crystal frequency is outside the *upper* limit of the band, its tone (with receiver bfo switched on) may tend to sound rough. If the crystal frequency is too low for the band, its oscillations may be slow to start or it will not oscillate at all. Crystals within the band will sound clear and steady.

The reference to "12 mc" needs explanation. Surplus crystals with frequencies higher than 8 mc are not common. My own highest crystal is marked 8.775 mc. However, if a crystal of about 3.5–4.0 mc is plugged into its socket, it oscillates at its third *overtone*. This differs from a *harmonic*. An overtone is the lowest frequency available from a given crystal yet it is (nearly) an odd multiple of the crystal frequency. For example, a 3.7-mc crystal puts out a signal at nearly 11.1 mc in this circuit, and there is no trace of output at either 3.7 or 7.4 mc. The *lowest* oscillator frequency is approximately 11.1 mc. The *overtone* signal is much more powerful than if it were the third *harmonic* of the same crystal. For all intents and purposes, the crystal behaves just as if its fundamental is 11.1 mc, not 3.7.

The overtone of any crystal must always be odd. There can be no second or fourth overtone. In this circuit 80-meter crystals are effective only at their *third* overtone because the frequency comes out to about 11 mc, within the oscillator range when C5 is switched out.

Crystals with fundamentals near 3.5 mc do double duty in this oscillator. They oscillate normally at their labeled frequency when C5 is switched into the circuit, for then the band is from about 3.5 to 5.0 mc. When C5 is switched out, the output frequency is approximately three times the crystal fundamental.

If you listen to the fundamental output and then the overtone output, you will notice a much stronger signal available from the overtone; the harmonic will be weak. Also, you will note that the frequencies are not equal. For example, a 3.7-mc crystal has a third harmonic at *exactly* 11.1 mc. The overtone appeared about 15 kc lower, an error of about 0.14%. Other crystals may produce overtones a few kc above the harmonic. This error may be ignored for all practical purposes since it is so small.

The output frequency must be checked against a reliable standard before using a fundamental type crystal operating in the overtone mode or an overtone type on an overtone other than the one

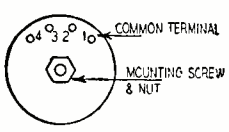


Fig. 2—Subminiature switch—rear view.

calibrated by the manufacturer. This is doubly so when the oscillator is used as a transmitter control or in a calibrating device.

Ordinarily, we might expect to need two switches for this oscillator, one to close the battery circuit, the other to switch C5. Both functions have been combined through a special four-position switch (Lafayette SP-88). This is a tiny unit, less than ½ inch deep and only ¾ inch in diameter. Fig. 2 shows a rear view of the switch terminals. When the knob is rotated fully counterclockwise (as viewed from the front), the common terminal (1) is isolated from the others. In the next position terminals 1 and 2 are shorted. In the third position terminals 1, 2 and 3 are shorted. The last position shorts all

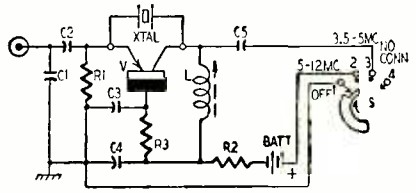


Fig. 3—Diagram of Fig. 1 circuit showing connections to switch terminals.

terminals, but this position is not used in this circuit.

Fig. 3 shows how the switch terminals connect to the oscillator. In the counterclockwise position battery power is disconnected. The next step closes the battery circuit but leaves C5 disconnected. The next step switches in C5 (through C4) for the lower-frequency band and the power remains on.

The crystal socket is Mosley No. 500 (or equivalent) for FT-243 crystals. The transistor socket is the usual five-pin in-line type. Emitter and collector pins of the transistor socket are soldered directly to the lugs of the crystal socket.

When used as an overtone generator the output is very strong even through TV bands. Thus it may be used to calibrate and align receivers and signal generators at these high frequencies. As previously stated, the overtone is not an *exact* multiple of the crystal fundamental frequency so the oscillator must be carefully calibrated before use as a test instrument.

80-kc-to-1-mc oscillator

Fig. 4 shows a transistor oscillator designed for low-frequency crystals. It is ideal for if crystals, often advertised in the radio magazines at several for a dollar. This generator uses a pair of G-E 2N170 transistors, n-p-n units that require a negative bias on emitters and positive voltage on collectors. The transistors are coupled to feed back from one collector output to the other base input. Due to this regeneration the circuit tends to oscillate when a crystal is plugged in.

The highest frequency tried in this circuit is 1 mc. The lowest is 80.86 kc, provided by a surplus type crystal purchased several years ago. It is type FM-6, manufactured by Crystal Research Labs, Hartford, Conn.

A number of low-frequency crystals have been tested successfully in the circuit. No tuning is required when changing from one crystal frequency to another. Not all these low frequencies fall within the broadcast band so they cannot be picked up directly on a broadcast receiver. However, their harmonics may be heard. For example, a 80-kc crystal has harmonics at 560 kc, 640 kc and so on and a 400-kc crystal has output at 800, 1200 and 1600 kc, in the broadcast band.

The output of a low-frequency generator such as this may be checked against a standard and then used for amplifier alignment. Thus, a variable attenuator is included. Also, the dc

Parts for Fig. 4 oscillator

R1—3,900 ohms
R2—1,800 ohms
R3—4,700 ohms
R4—15,000 ohms
R5—1,500 ohms
R6—1,000-ohm pot
All resistors ½ watt
C1—.005 µf
C2—.005 µf
C3—.005 µf
V1—2N170 transistor
V2—2N170 transistor
Xtal—see text
Crystal socket
Pin jack (for oscillator output)
Transistor sockets (2)
Common chassis and battery used for oscillators

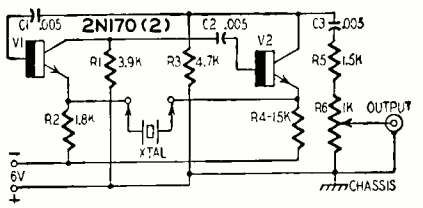


Fig. 4—Low-frequency oscillator.

component has been blocked out. The generator has a phono type jack that takes a coax lead.

Adjustments and applications

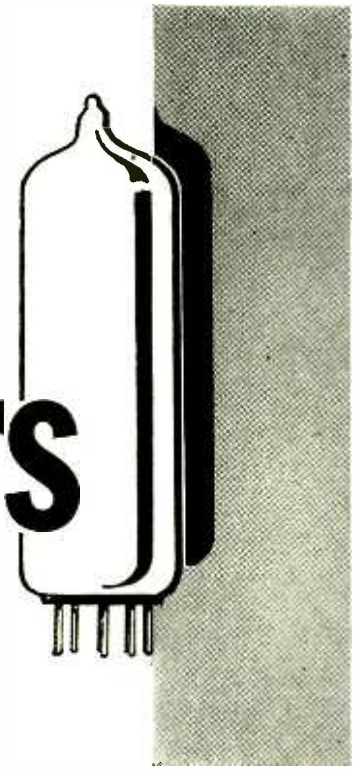
This circuit is not critical as to parts value or placement. However, try interchanging transistors for widest band coverage with least voltage input. If several transistors are available, use those that show greatest output in the band.

Among the useful applications of this circuit are: if signal generator, standard frequency source to calibrate Wien-bridge oscillators (by Lissajous patterns) and calibrating broadcast radios (by using harmonics).

For an extremely wide-band oscillator, both circuits may be included in the same instrument. The photos show such a device housed in an aluminum box 3¼ x 2 x 1½ inches. A small 6-volt battery could be placed inside since there remains plenty of room. In this particular instrument, however, an external power supply is used. Note that both oscillators are separate circuits, therefore both can oscillate at the same time, if there is any need for such operation.

The high-frequency oscillator may be shut off by its switch. The low-frequency job has no switch but its output may be reduced to zero by the attenuator. END

Tube Testers



Valuable tools when properly applied. This article tells you how

By WALTER J. SWONTEK

THE tube tester is one of the most valuable pieces of equipment a service technician can own. Since many are likely to disagree with this statement it might be advisable to change it to: A tube tester *can* be one of the most valuable pieces of equipment a service technician can own.

Practically all service shops own a tube tester of some sort. In many of these shops it is used only when a customer brings in tubes to be tested.

This article points out the many valuable uses to which tube testers can be put, and attempts to explain and overcome the prejudice in many technicians' minds against them.

Since a discussion of the merits of a tube tester is valueless when working against a heavy prejudice, let us see how this bias is produced and how entirely unfounded it is.

At the first contact with any sort of testing device, it is only human to expect a yes-or-no answer. In other words, the device is automatically expected to say: "Yes, the item is good" or "No, the item is bad." Actually, in real life, *very few things are definitely good or clearly and undeniably bad.*

Manufacturers cater to human weakness and provide a good-bad scale, clearly marked in red and green.

When such a device is offered, it is expected to be 100% accurate. In other words, the tester itself is judged on a "good-or-bad" basis. If 100% accurate, the tester is "good"; if not 100% accurate, the tester is "bad." Since nothing is absolutely perfect it is only human to judge tube testers "bad."

What usually happens is that the novice technician becomes acquainted with a tube tester and learns how to manipulate the knobs. He puts the tube tester on a pedestal as a tin god or supreme judge of all tubes. His tube worries are over! All goes well for a while, and the novice is a rabid tester of tubes. His faith is implicit. He supports the tester ardently in discussions with more experienced technicians.

Then, one fatal day, the tube tester misses a bad tube. The bad tube is reinserted in the set and troubleshooting begins. All bad parts are replaced; everything is tested. The stubborn symptoms refuse to disappear. The technician becomes a nervous wreck. Finally, the help of a more experienced friend is sought. The friend swaps tubes and presto! the trouble is cleared.

"But I checked that tube . . . ," howls the novice. His friend just laughs with that horrible, superior air. The novice's faith in testers is completely shattered.

Now that we can see that this prejudice against tube testers is founded in unreasoning emotion (all prejudices are, really) we can inspect them for their real values.

The tester as tube salesman

Let us consider this red-green scale in a realistic light. Its purpose is to sell tubes! The control settings given on the charts are calibrated so that the average new tube will read well in the green. If a tube measures an arbitrary percentage (usually 15% or 20%) below "normal," it will read in the red. This merely means that the tube is weak in emission (or transconductance on some testers) and not necessarily "bad" in the sense that it will not operate. However, the *customer* can accept the tester as a supreme judge, with the net result that we sell him a tube when his tests in the red, even though we know his old tube may work.

The function of a tube tester as a tube-selling aid is one of its most valuable uses and will, in fact, pay for its cost many times over. There need not be any sense of guilt connected with this selling. Most customers will usually buy a new tube even though they are told: "This tube will probably work, but it tests weak on the tester." The customer's logic is good. The tube tests weak, therefore it is *likely* to fail in the near future.

If the customer does not purchase a replacement for the weak tube, the technician has still gained several advantages: the customer is impressed with the technician's honesty; in case the set fails within the guarantee period, the customer is not as hostile when he brings it back. His thought is: "Maybe that weak tube went."

When the question of testing tubes for troubleshooting arises, the usual answer is: "Why bother? Swap them! That'll tell." This is true enough on the surface, and swapping tubes is a helpful maneuver. There are several disadvantages, however. If new stock is used for swapping, it soon degenerates badly. The cartons become shopworn and unusable. Unless extreme care is taken, used and defective tubes will work their way into the stock.

Many shops avoid the deterioration of their new stock by keeping a "bench stock" of tubes on the test bench for swapping. This is fine, but it represents an investment of a surprising number of dollars. In addition, the bench stock deteriorates rapidly. To prove this to yourself, take an afternoon when you are not busy and test the bench stock.

Advantages of tube testers

Tube swapping is not 100% accurate any more than a tube tester is! Swapping is accurate only when the substitute is *known good*. There can never be absolute certainty that it is.

One TV set was brought in for bench service. The outside man had (supposedly) swapped tubes. However, the bench man tested the tubes with a view of sales and found *five* defective (not just weak) tubes. This cleared all symptoms and the set required no further service. The only tube-swapping system that would have cleared the set would have been the insertion of a complete known-good set of tubes, followed by reinsertion of the old tubes, one at a time. This is time-consuming and not generally done by tube swappers. Had it not been for the tube testing, the bench man would have had a rip-snorting troubleshooting job.

A situation that arises repeatedly is the case of a circuit that contains both a defective component and a defective tube. The tube is swapped first, and, since no improvement is seen, it is reinserted. After the replacement of the defective component further troubleshooting is needed to find the bad tube. Here, the tester would most likely have caught it on the first try.

As another example, take the case of a tube with a heater–cathode short. If this tube is inserted in a set where one side of the heater and the cathode are grounded and if the short is from the cathode to the grounded side of the heater, the tube will work perfectly and be considered a known good. This may seem a long chain of circumstance, but anyone who tests many tubes will testify that it happens surprisingly often. Now, when this "known-good" (but actually defective) tube is used as a substitute, it can cause a diagnosis that leads to much fruitless troubleshooting.

Grid emission (not shown by the less expensive testers) also causes much confusion in tube swapping. If the tube is inserted in a circuit where the grid circuit resistance is very low, it may work perfectly and be considered a known good. This same tube inserted into another circuit with high resistance in the grid return will develop a positive voltage on the grid and cause many peculiar symptoms. The gas test on better tube testers catches these quickly.

The short test on tube testers is of more value to the bench technician than the emission or transconductance test. Any tube that shows an interelement short can safely be considered defective (definitely "bad") and replaced. Circuits where the tube will work even though shorted are rare and the number of tubes unnecessarily replaced is negligible. If an intermittent short is suspected, the logical step is to tap the tube gently at each position of the short test.

The noise test present on some testers is seldom needed, but it is a lifesaver when the occasion arises. Each tube can be checked for noise or microphonics separately with concrete, dependable indications.

Most of the preceding has been in favor of using the tube tester. However, this should not be taken as argument against tube swapping. The most profitable attitude a technician can take is to consider the tube tester as a valuable tool and tube swapping a valuable procedure, and use *both*.

The tube tester should be looked upon as a fact-indicating device, just as a voltmeter or ohmmeter, and not as a judge. The indications of the checker must be interpreted and judged, just as those of other test equipment.

A resistor measures 500,000 ohms. Is it bad? This reading of a resistor does not say whether it is good or bad. If it is marked 68,000 ohms, it *is* bad. Similarly, a 6K6-GT tests somewhat low on emission. Is it bad? Well, let's see—if it is used in the sound output, the slight loss in volume may be unnoticeable. It will work, so we can consider it "good" or at least satisfactory. But wait—the focus coil is in the cathode of the sound output and the symptom is poor focus! Now, the interpretation is different. A new tube clears the trouble and the weak 6K6 is now considered bad.

When the disillusioned technician is ready to return to the use of a tube checker, he should also be ready to keep in mind the failings of most testers. The following is a list of common tube-tester shortcomings obtained from bench experience.

1. When a tube tester checks a tube "bad," the tester is much more likely to be accurate than when it says the tube is "good."

2. Rectifiers will often test in the green on emission test and still produce low B-plus voltage. This is because a tube may have sufficient emission to carry the dc required to test good and yet have insufficient emission to handle the peak currents demanded in actual operation.

3. Tubes used in high-frequency oscillators, such as the 6J6, will often test good and still refuse to operate.

4. Most power tubes, such as 6K6, 25BQ6, etc., operate at a much higher temperature in the receiver. If trouble shows up only after a long warmup, the suspected tube should be tested immediately upon removal from the set, while it is still hot.

5. High-voltage tubes, 1X2, 1B3, etc., are not tested under normal operation by most tube testers. A "good" test of one of these means little.

6. Certain tube type numbers, as those used in tuners, will show a strong tendency to test good and still refuse to operate.

Ten commandments for testers

A few general rules can be set up concerning the decision as to swap or check. These are merely guides to the use of the fastest and most convenient system.

1. In customers' homes it is generally much faster to swap tubes. A complete tube check is too time consuming. If the symptom is distinct and clearly indicates trouble in one specific circuit, the two or three tubes in that circuit can be changed quickly. In addition, carrying the tube tester is excess effort while the tube kit *must* be brought along for replacements.

2. When a set is placed on the bench and has many vague symptoms, it is wise to give it a complete tube test. Although new tubes will seldom cure the trouble completely, it will usually be found that defective tubes are causing *some* of the symptoms. Replacing these clarifies the remaining symptoms and makes troubleshooting easier.

3. If a receiver on the bench has one clear symptom, tube swapping is faster and more certain. For instance, lack of width indicates changing the horizontal output tube immediately without bothering to test it.

4. When a set has a long history of recalls and general customer dissatisfaction, a complete tube test is very helpful in most cases.

5. When a stubborn symptom, definitely in one specific circuit, is met, use *both* systems. Test the old tube. Test a new tube, then swap.

6. When a technician is completely stopped on a symptom that is apparently in one specific circuit, it is wise to give the set a complete tube test. The various circuits in any TV set are usually not completely isolated from each other. Often a defective tube in a completely different section of the receiver will be found to be causing the symptom.

7. When in doubt, test *new* tubes. Only too frequently will it be found that entire "runs" of a certain tube number will develop the same defect shortly after being placed in a radio or TV receiver.

8. If a set has too simple a trouble, the profit may be too small to provide for a possible recall. A tube test here serves a dual function. It reduces the possibility of a recall, and also increases the profit to enable the technician to accept a recall on this set with better grace.

9. Sometimes a technician will gamble a new tube rather than pull the chassis, and he will replace a tube that might have been caused to go by a defective component. If the tube tester is handy and the new tube is tested *before* insertion, the technician will know if he has lost the gamble. Thus he will not wonder whether the new tube was bad in the carton.

10. When selling a tube over the counter, it is wise to test the new tube. This improves goodwill by preventing the sale of defective tubes. If the tube is of a type number that is often blown by defective components (such as a 35Z5), the customer should be warned of the possibility. This will avoid arguments over tubes burned out by the customer and should bring the set to the shop.

The tube tester is also a very valuable psychological tool. Most technicians detest having the customer look over their shoulder when they are working. If the customer insists on watching while the technician takes a look at his set, the tester gives the service technician something to do while inspecting the set for an estimate. A tube test is a much more satisfying show for the customer than the spectacle of a man probing around with a test prod, apparently aimlessly.

Thus, if the technician thoroughly understands what the tube tester actually does and how it does it, the results he obtains will not be mystifying. In addition, this knowledge will enable him to use it in original ways, developed to fit the circumstances of a particular situation. END

calibrating AC voltmeters

Cheap and accurate means of supplying calibration voltages for vtvm's

by EDWIN N. KAUFMAN

CALIBRATING the ac scales of the common analyzer, voltmeter or vacuum-tube voltmeter is a problem not only for individuals but for many small laboratories with insufficient funds for calibration equipment.

Most laboratories calibrate their ac instruments by supplying an accurate ac voltage obtained from a "standard" transformer, with taps. The input voltage to the transformer is maintained manually at a fixed, accurate value by using a precision input ac voltmeter with a "set-to-red-line" scale. A standard transformer and voltmeter with appropriate tap switches usually sell for about $750.

A transformer type calibrated ac voltage has the advantage that the impedance of the supply is very low and thus both low-impedance voltmeters or high-impedance vtvm's shunt the supply impedance very slightly and cause negligible error. If the impedance of the instrument is so low that a considerable amount of current is drawn, an error of about 1% for 100 ma will occur.

Another less common method of calibration is to use precision secondary standard voltmeters and then compare the standard to the instruments to be calibrated. This has several disadvantages: Meters (standard) are rated in percentage of full-scale accuracy which means that at any voltage less than full scale the accuracy may be much less. The standard meter must be read accurately many times to cover even a single voltage scale, as many ac meters are not linear. The standard dynamometer type of meter requires lots of power (several watts) which can be serious at times. The lowest voltage which can be indicated satisfactorily is—depending upon what you call satisfactory—from 0.3 to 3 volts. Since many vtvm's indicate as low as .001 volt ac, full scale, this means that many ranges cannot be calibrated. The cost can be as great as the standard transformer type of calibrator.

It was found impractical to calibrate ac voltmeters and analyzers (volt-ohm-meters) directly because of their low impedance and high current requirements.

It is practical to make a very inexpensive calibrator capable of supplying voltages from 1.5 mv to 80 volts (with 2% or better calibration) for vacuum-tube voltmeters.

Once a vtvm has been calibrated it can be used as a standard for checking other meters. It is not the best method, but it is inexpensive and relatively accurate. If a vtvm, after calibration, is to be used as a standard for checking other ac meters, I can very strongly recommend using a Ballantine vtvm, as it has a logarithmic scale and thus the error is the same at either end. It is also a very reliable meter.

The circuit shown uses an inexpensive ac voltmeter as a standard. This meter is rated at 2% but, as it is used at one point only on the scale, much better accuracy can be obtained if the meter is calibrated.

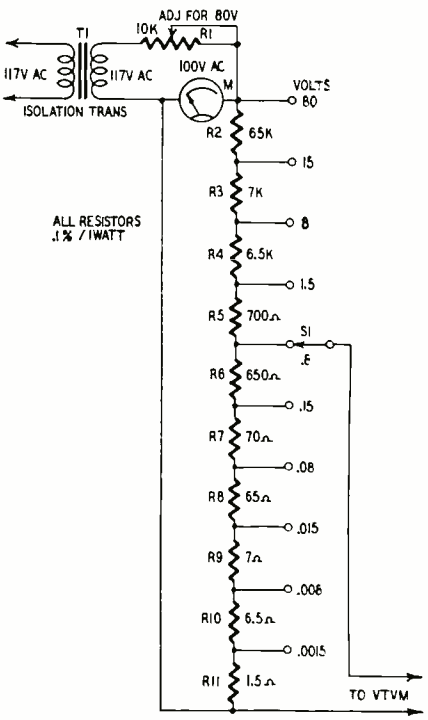
Without calibration the voltage calibrator should provide voltages within 2% or better and with calibration probably 1% or better. The resistors shown are all 0.1%, 1 watt, wirewound so that, although a string of them are used, the maximum error possible is 1%, but in actual practice all errors will average out to about 0.5%. The resistors can be obtained from the Hycor Co., 11423 Vanowen St., North Hollywood, Calif.

If economically possible, a line isolation transformer should be used in the circuit for safety; however, my personal calibrator does not use one.

The calibrating voltages were selected so that whether a vtvm indicated *high* or *low* the meter would still indicate on scale. In many cases two voltages are supplied per vtvm scale.

This circuit cannot be used on a regulated ac line but *must* be plugged into a regular power outlet as the calibration is dependent upon a pure sinusoidal waveform.

Some vtvm's are sensitive to line voltage and to waveform distortion. Therefore, on calibrating, it is advisable to calibrate under the condition the meter will normally be used. In other words, keep an eye on line voltage when calibrating or in use, unless the vtvm is stabilized by using a regulated ac power line. Remember, however, that the calibrator cannot be used on the average regulated ac line satisfactorily. END



Schematic of the ac calibrator.

Parts for Calibrator

R1—10,000-ohm potentiometer (can be 10-turn Helipot)
R2—65,000 ohms
R3—7,000 ohms
R4—6,500 ohms
R5—700 ohms
R6—650 ohms
R7—70 ohms
R8—65 ohms
R9—7 ohms
R10—6.5 ohms
R11—1.5 ohms
All resistors are 0.1%, 1 watt
T1—isolation transformer
M—0–100 volts ac meter (Weston 476 or equivalent)
S1—1-pole nonshorting 10-position switch (Mallory 3212J or equivalent)
Chassis—aluminum, approximately 5 x 4 x 3 inches
Mounting strips for resistors

TV sets with . . . remote control

By HENRY O. MAXWELL

This, the third in a series on remote-control TV, covers split-chassis models

The Radio Craftsmen C210 chassis.

In our opinion, the split-chassis type of remote control TV set is highly practical for use in custom installations where the job is planned or completed at the time that the home is being built or renovated. Interesting circuit features of five sets are discussed here. The Conrac split-chassis type and several electronic and electromagnetic remote controls were discussed in the two previous issues.

Fig. 1 shows how the video and audio circuits are divided between two chassis in the Gotham 525 and 323 receivers. The tuner and if strips are on the control or tuner chassis. After detection, the video and audio signals are each amplified in a single stage and then fed through cathode followers and interconnecting cable to the deflection chassis. The deflection chassis is turned on by a 6-volt relay excited by ac from the tuner chassis. The circuit is conventional except for the use of cathode followers. Brightness is controlled only from the deflection chassis.

Douglas Chairside

The Douglas Chairside TV receiver is a 27-inch model similar to the Conrac 800. Fig. 2 shows the keyed agc and on–off circuits and the video circuits on the remote tuner chassis. The method of feeding flyback pulses to the agc keyer is a little different from the Conrac arrangement. The flyback pulses and 6 volts ac for controlling the remote

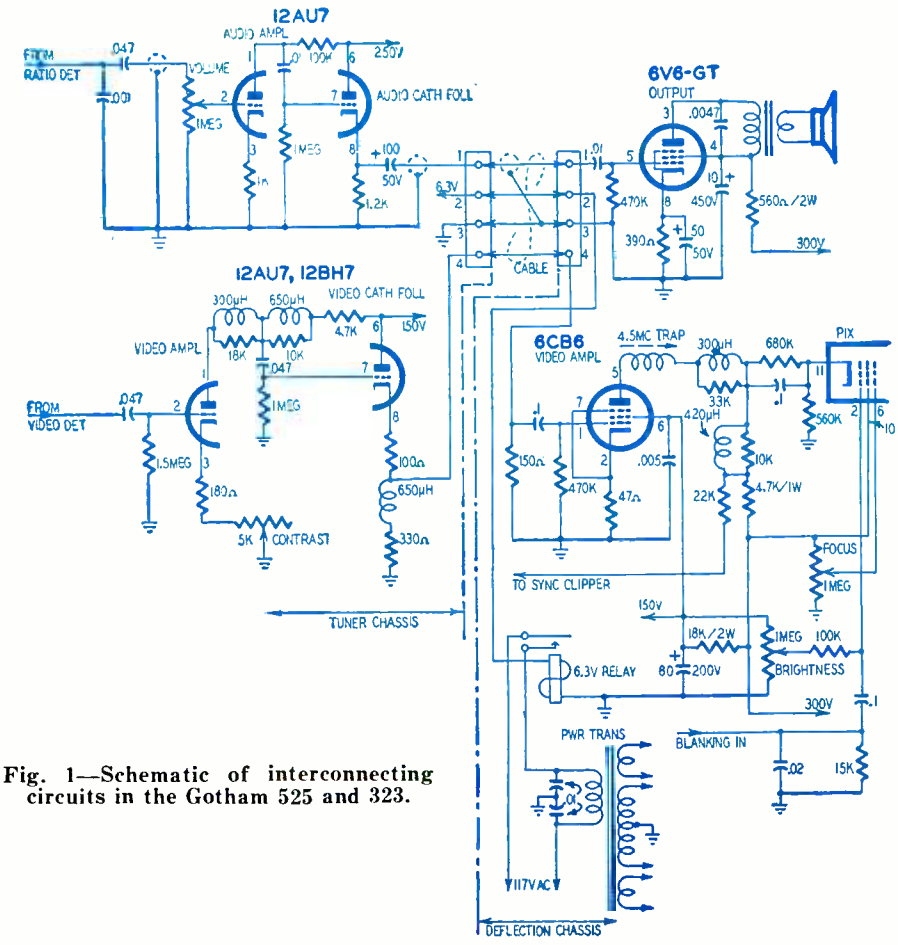
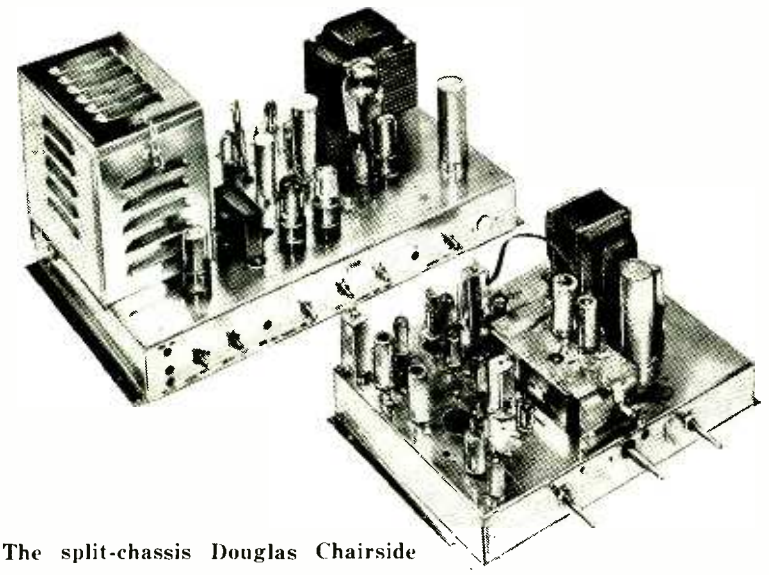
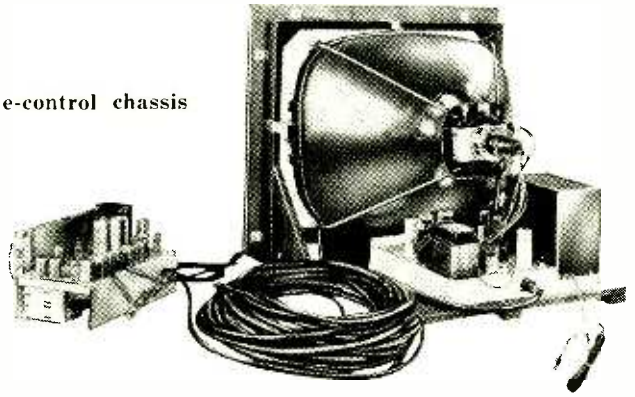


Fig. 1—Schematic of interconnecting circuits in the Gotham 525 and 323.



The split-chassis Douglas Chairside



Pilot TV-527 remote-control chassis

power relay are carried on a common pair of lines. A 5-μf capacitor prevents the interaction between the two circuits. Control voltage for the tuner is delayed and clamped by half of a 6AL5.

A 6U8 pentode-triode is the two-stage video amplifier. The pentode section is direct-coupled to the video detector. Resistance–capacitance coupling is used between the first and second video amplifiers. Contrast is controlled by a potentiometer in the grid circuit of the second stage—a cathode follower feeding the low-impedance video line of the deflection chassis. Traps in the cathode circuits of the cathode follower and the third video amplifier (on the deflection chassis) eliminate 4.5-mc beat.

Pilot TV-527

Fig. 3 shows part of the remote tuner, including cathode follower and agc circuits of this receiver. A diode rectifier is used for agc voltage. Contrast is controlled by varying a bias voltage applied to the agc line.

The video circuits on the deflection chassis are shown in Fig. 4. A cascaded 12AU7 video amplifier drives the 6CL6 video output stage. Peaking is not used in the first two stages. Adequate response is obtained by using low plate load resistors and frequency-selective feedback between the cathodes. The second half of the 12AU7 feeds the grids of the 6CL6 and a 12AT7 cathode follower, which is used when connecting additional deflection chassis as remote viewers.

Half of a 6AL5 is connected between ground and the input to the 6AU6 sync clipper. This diode conducts and charges the 0.22-μf coupling capacitor to a peak voltage equal to the level of the sync tips. The time constant of the discharge circuit is longer than the sync interval so a negative voltage of about 20 appears on the diode plate. Thus, for all normal signals, the diode conducts only enough to maintain the charge on the capacitor.

If a noise pulse exceeds the level of the sync tips, it overcomes the negative bias on the plate, causing the diode to conduct and clip noise to the point where it does not affect sync stability.

Craftsmen C210

Pertinent interchassis features of this set are shown in Fig. 5. This set is designed for use with a separate af amplifier so the usual power amplifier is not included. Jacks for tapping the output of the audio cathode follower are provided on both chassis. Direct coupling is used between the first af amplifier and the cathode follower for good fidelity.

The contrast control on the tuner chassis is in the cathode return of the 6CB6 video amplifier on the sweep chassis. The lead to the remote chassis is bypassed by a 50-μf capacitor to prevent trouble caused by stray pickup on the long lead.

The deflection-chassis power supply is controlled by a 6-volt relay. It has an extra set of contacts (normally closed)that ground the cathode of the picture tube when the set is turned off.

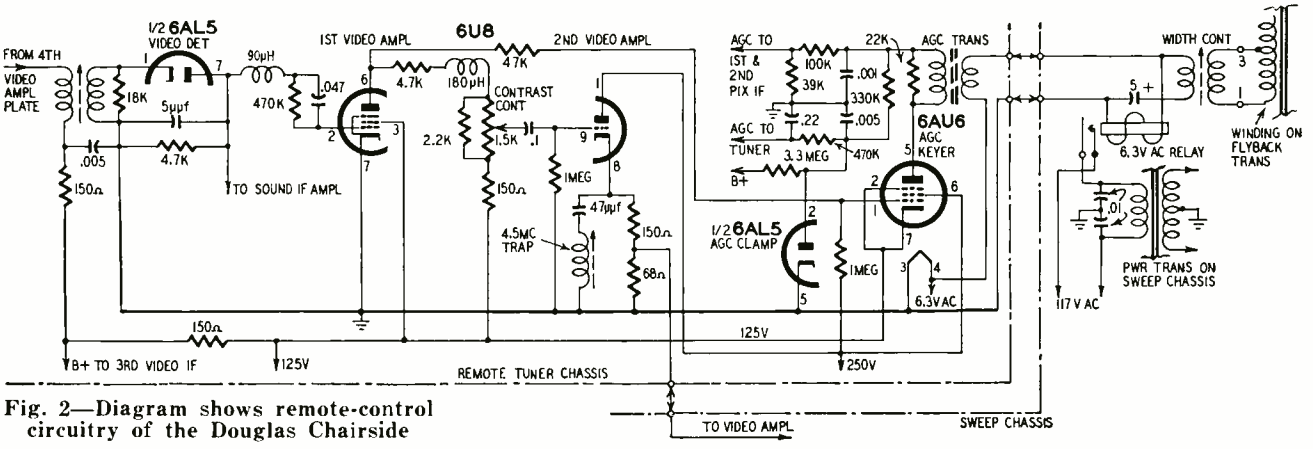


Fig. 2—Diagram shows remote-control circuitry of the Douglas Chairside

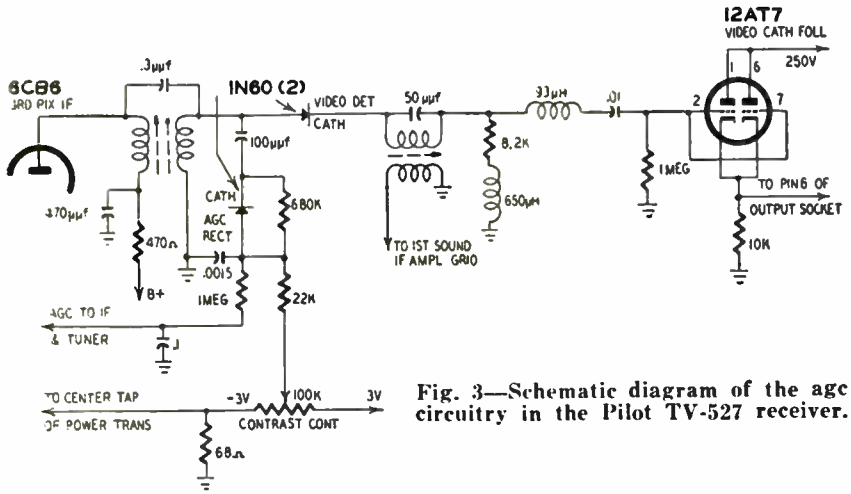


Fig. 3—Schematic diagram of the agc circuitry in the Pilot TV-527 receiver.

This discharges the B-plus filter capacitors rapidly enough to prevent a bright undeflected spot.

Sylvania circuitry

The Sylvania remote-controlled TV receiver (chassis series 1-519) is the only one reviewed here that does not have the if circuits on the tuner chassis. The if output of the tuner is fed to a 6CB6 first video if amplifier over a coaxial cable. The signal appears across a 75-ohm grid resistor in the first if amplifier.

Fig. 6 shows the brightness and volume control circuits. To avoid running long audio signal leads between the tuner and main chassis and risking loss of highs and possible hum pickup, volume is controlled by varying the screen and plate voltages on the sound if limiter. Brightness is controlled by a 2-megohm potentiometer that varies the picture tube grid voltage.

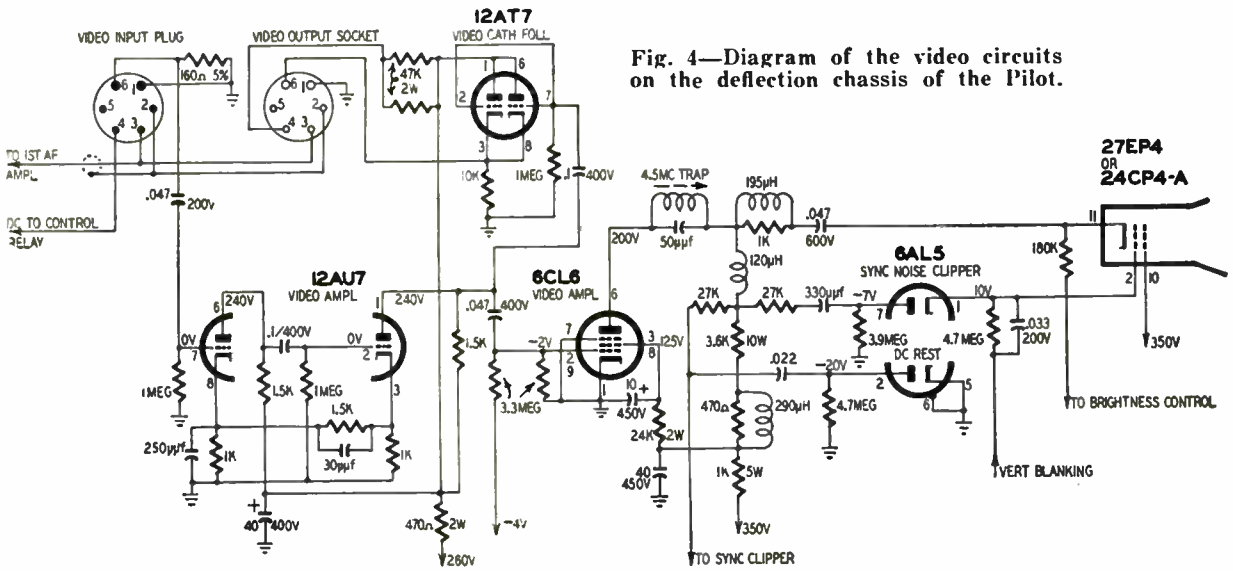


Fig. 4—Diagram of the video circuits on the deflection chassis of the Pilot.

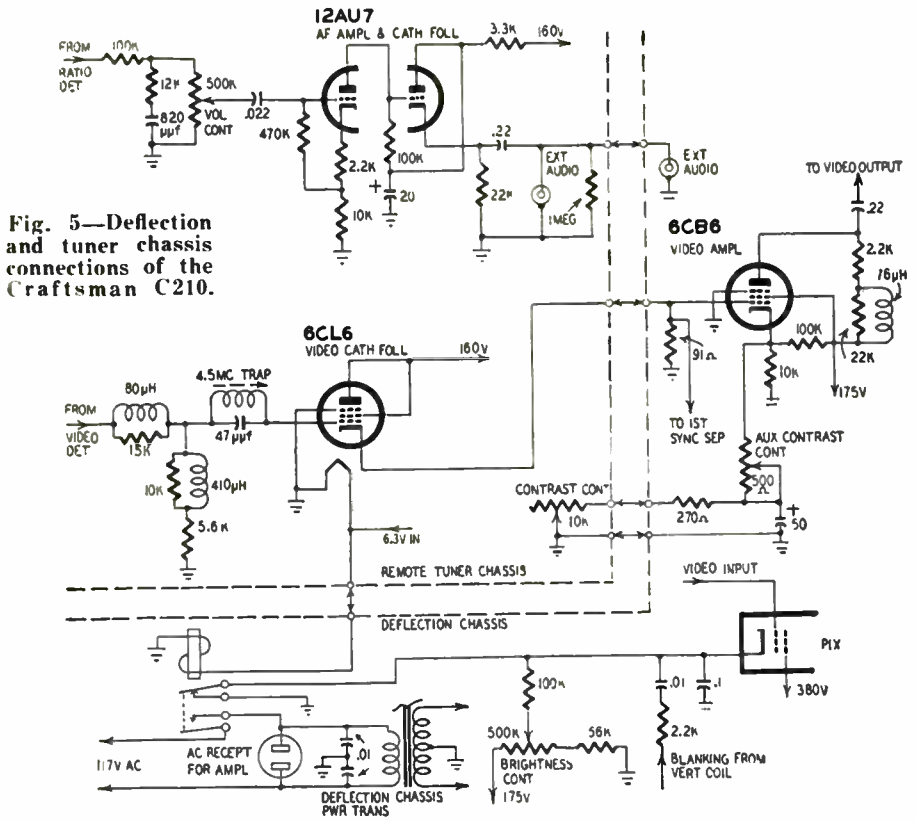


Fig. 5—Deflection and tuner chassis connections of the Craftsman C210.

As mentioned last month, the Pilot TV-527, Craftsmen C210, Douglas Chairside and Sylvania 387-388 split-chassis sets have been discontinued and are discussed here for their informational value to service technicians.

Data has just been released on Zenith's ultrasonic Space Command and Motorola's transistorized radio-controlled circuit. We hope to cover these in an early issue. END

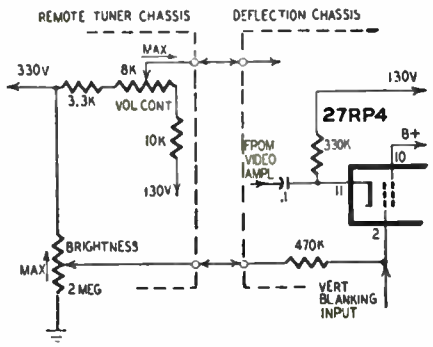


Fig. 6—The remote-control circuits in the Sylvania chassis series 1-519.

SERVICE SHOP
TIME SAVERS

Hints for improving shop efficiency

Handy rack with job cards and scratch pads increases efficiency in the shop.

By STANLEY L. KARAL

THE goal of all service shops is to trim service time to a minimum and thus reap a healthier profit. With this in mind several proven timesavers will be reviewed in the hope that they are just what you need to boost your shop efficiency.

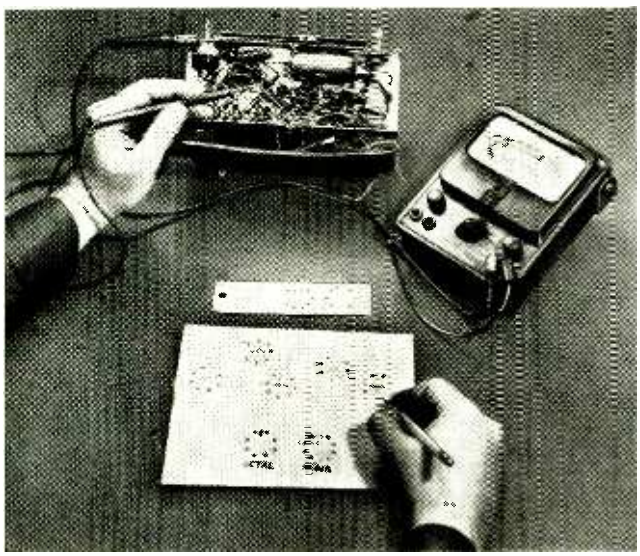
Let us start where most service jobs start, at the telephone. If yours is a small shop and phone calls are taken by the bench man, considerable time can slip by while fumbling for a pencil, looking for a scratch pad or making like Sherlock Holmes to trace the status of a service job. This wasted time can be eliminated by using a file rack (see photo).

The rack holds all the job cards in four separate divisions, labeled from left to right: *Pickups and outside jobs, jobs in the shop for service, hold for parts* and *completed jobs.* Directly under the file are two scratch pads tacked to the file. One is for listing parts needed, the other for notes.

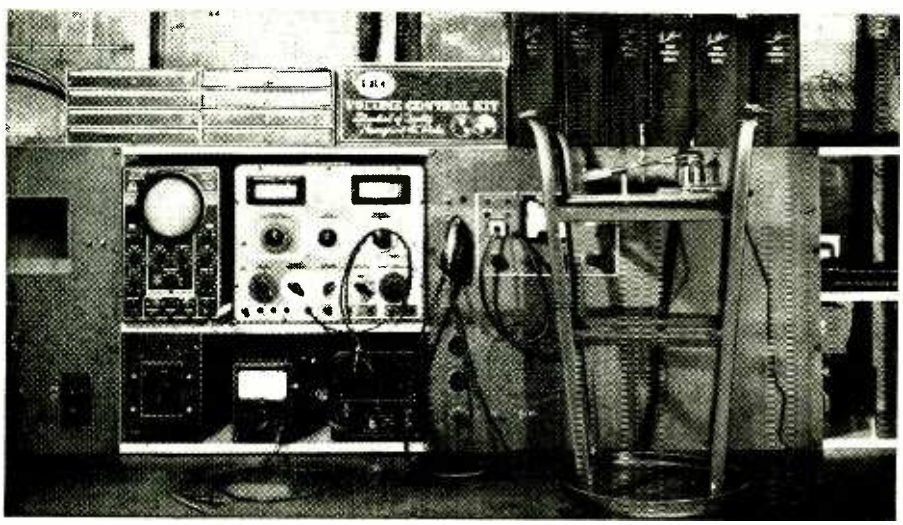
If the parts required to complete a job are not in stock, the job card is filed in the hold-for-parts file and the job number and the parts required are listed on the assigned scratch pad which serves as a continual reminder to order them. *Two* pencils are attached to the file rack with strong cord.

The rack shown is made for the usual three-piece service cards, consisting of guarantee tag, record card and claim check. Each piece is stamped with an identical number. When the job is brought into the shop—or picked up—the claim check is given to the

Service bench layout keeps test equipment, service manuals and replacement parts stock close at hand.



A simple setup for speedy and accurate voltage measurements.



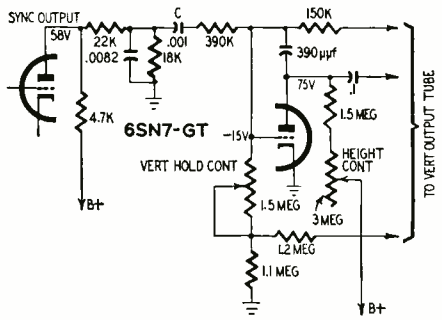


Fig. 1—Schematic diagram of the vertical oscillator in the RCA KCS82.

customer and the guarantee tag is attached to the set. The record card then goes to the back of the jobs-in-the-shop-for-service file. To work on the jobs in order, simply remove the record cards from the front of the file.

The most time-consuming place in the shop is the service bench. Keep handy a supply of screwdrivers, alignment tools, pliers and small socket wrenches. Always keep spare sets of these on hand; the time thus saved will more than pay for the tools.

Considerable time can also be saved by the general layout of the service bench. The photo shows an efficient layout for auto and home radio servicing. All test equipment is placed in an easy-to-reach cluster and all tools are removed from the work area.

The scope shown is used for tracing distortion in the audio section and it is used also to check the performance of vibrators and buffers in auto radio power supplies.

Directly under the scope is an adjustable isolation transformer which is used to isolate ac–dc chassis from the highline. It also serves to check portable radios for operation at low line voltages. To the right of the transformer is a dc supply for checking car radios. This voltage can be varied to catch slow starting vibrators, etc., by plugging the dc supply into the adjustable transformer.

The hand tools are housed in the drawers under the work surface of the bench and do not clutter the work space. The solder gun is mounted in a holster between the signal generator and the vtvm.

Another time saver is the use of a bench stool for a spare changer rack. This is especially handy when the shop is swamped with changer jobs.

For maximum efficiency every technician should establish a set service routine and use it until it becomes second nature. One such well-proven procedure is first to isolate the faulty section and test the associated tubes, by substitution or tube tester. If this does not clear the trouble, measure the B voltages in the faulty section and compare them with the schematic. In most cases this will show the trouble spot and ohmmeter checks will find the faulty component.

This is where a time saver—tube voltage guide (see photo)—comes in. The guide helps record the voltages in a readable manner. These data are then compared with the schematic and any differences investigated. The faulty component will show up quickly and without any of the false starts that usually go with hit-and-miss systems.

As an example, consider the case of Mr. B. A. Setfixer. He thumbed through the job file to find an easy one to finish off a particularly hectic day and he came to a set marked "dead vertical oscillator."

"This'll be a snap," he thought, hoisting the chassis onto the bench. He produced a schematic (Fig. 1) and laid it beside the set. As the set warmed up, a single horizontal line appeared. Delighted that the set was not intermittent, he took the voltmeter probe and "looked at" the plate voltage of the vertical oscillator tube.

"H'mmm. very little plate voltage . . . but the voltage is OK coming into the height control. The height control must be shorted to ground," his weary mind concluded.

He shut off the set and replaced the control. Another trial produced no raster and the voltage on the plate of the oscillator was still practically nil. Next our hero replaced the oscillator tube. Then anxious to see if the plate voltage had returned, he quickly touched the probe to the plate pin. It went high on the 250-volt scale.

"Doggone cheap tub-e-s . . . Hey! what gives here?" he exclaimed as the plate voltage slowly diminished to zero when the new tube heated up. Baffled, he checked voltages around the tube socket.

"What's this? 6 volts *positive* on the grid?" He finally stumbled onto the clue he needed — capacitor C was shorted.

The trouble is easy to explain now that we know the cause. The tube, with its high positive bias, looked like a direct short to ground to the high plate resistor (height control plus the the 1.5-megohm resistor). Therefore the plate voltage was near zero.

Using this hit and miss system it took our hero over half an hour to clear the trouble. Think of the time he could have saved had he used the voltage guide. The high bias would have shown itself immediately.

The guide is made from 1/16-inch Plexiglas. Two circles 1 inch in diameter are drawn on the protecting paper that comes attached to the plastic. One is divided into 8 equal parts, the other into 10. Each division mark is then pricked with a sharp center punch and holes drilled with a ⅛-inch center drill to the depth shown in Fig. 2.

Octal, loctal and 7- and 9-pin tube bases can be quickly drawn with the guide. After you use this method a while it will take less than a minute per tube to draw the tube base and pick the necessary data from the chassis.

Much time is also wasted in parading to the tube shelves, removing the tube from the carton, substituting it, returning it to the carton and then taking it back to the shelves. This time can be cut to a fraction by keeping a supply of often-used tubes right at the bench, with those that are used continually kept out of their cartons.

This can be done with the tube carrier shown in Fig. 3. It holds uncartoned tubes in all of the current sizes plus a supply of cartoned tubes on the two shelves. Several of these carriers can be made, one for ac–dc radios, one for consoles and one for each of your most popular TV brands. Each space in the carrier should be marked for a certain tube type, making it easier to identify the tube needed or the tubes missing from the carrier.

Holes in the front row (for seven-pin miniatures) are ¾ inch in diameter and 1⅛ inches deep. Those in the second row are ⅞ inch in diameter and 1⅛ inches deep for nine-pin miniatures. The two rear rows are 1⅜ inches in diameter drilled clear through the piece for glass, GT and metal tubes. The lower shelves and lips are made from ¼-inch plywood. The shelves may be set into dados as shown or fastened with brads and glue.

This by no means covers all of the time savers available to the service man, but it should be enough to orient your thoughts to time saving—and produce bigger profits. END

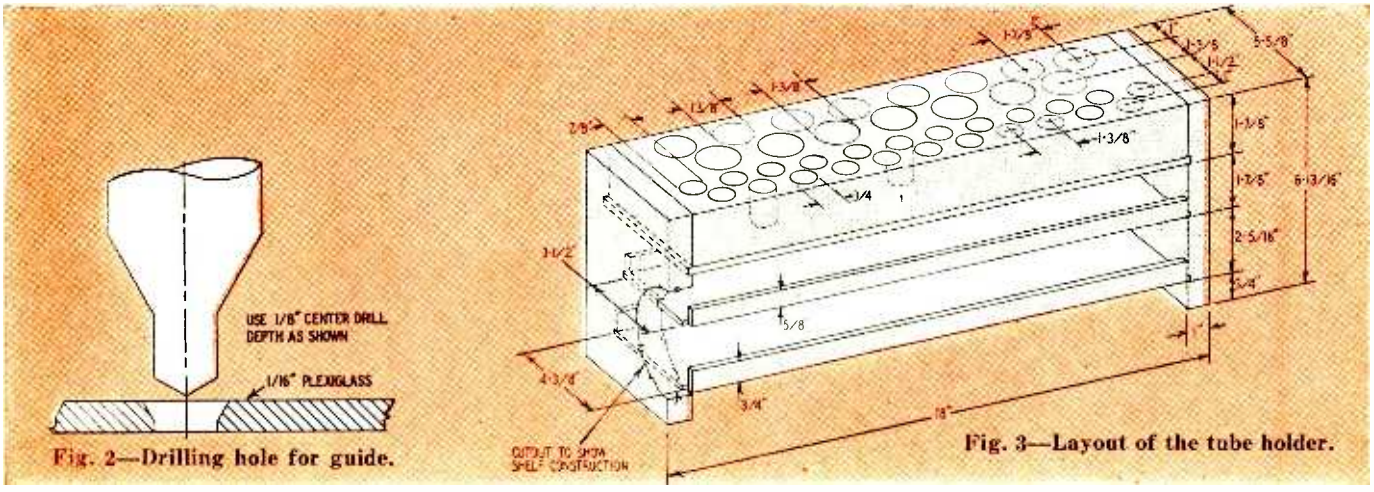
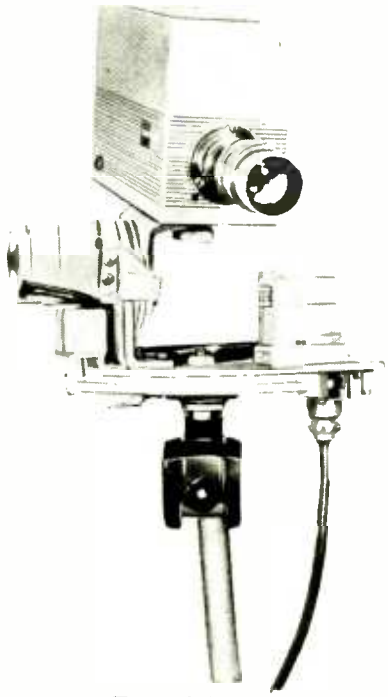


Fig. 2—Drilling hole for guide.

Fig. 3—Layout of the tube holder.

industrial TV techniques

Part IV—the camera circuitry



Typical industrial TV camera

By EDWARD M. NOLL

IN previous articles the pulse generator and its important coordination function in a closed-circuit television system were considered. This installment describes the camera arrangement of the Kay Lab industrial television system, model 1985A, taken as an example. It has three major units —camera, camera control and video monitor. The camera proper as shown at the left of the functional block diagram (Fig. 1) houses the Vidicon, a two-stage video amplifier and a cathode-follower output stage. A special protective circuit protects the Vidicon tube particularly in case of a sweep failure.

The camera control unit, which can be located at a convenient operating position hundreds of feet away, supplies all the operating voltages, pulses and deflection currents for the camera. It accepts the camera video signal, corrects it and inserts horizontal and vertical sync-blanking pulses. A composite video signal that can convey the picture information to a television monitor or viewer is thus formed in the camera control unit. The camera control unit and viewer can be adjacent to each other or separated, depending on the needs of the installation.

The camera proper

A number of signals and voltages are applied to the Vidicon camera tube, as shown in Fig. 2 (left side). Adjustable beam, target and focus operating voltages must be supplied to it. These voltages are supplied from and controlled at the camera control unit, Fig. 1. Hence camera-tube adjustments can be made remotely. Variable control grid or beam voltage is supplied directly to pin 2 of the tube. Negative vertical blanking pulses also arrive over the same line from the camera control. (You will recall from previous discussions that it is necessary to blank a camera tube in the same manner as a television picture tube is blanked, so that no spurious signals are generated during retrace intervals.)

Horizontal blanking pulses are derived by shaping properly a signal taken from the horizontal deflection coil. This horizontal blanking arrives as a positive pulse via capacitor C603 at the cathode of the Vidicon.

Adjustable dc focus voltage is supplied through a decoupling filter (resistor R605 and capacitor C604) to the focusing electrode. Adjustable target voltage is likewise applied through a decoupling filter (capacitors C602 and C601 and resistor R602) and the output load resistor R601 to the signal electrode.

Video signal origination

The video signal is released at the signal electrode of the Vidicon camera tube, developing a black-positive video signal across load resistor R601. This signal is increased in amplitude by a two-stage video amplifier and is then matched to a low-impedance coaxial cable by a cathode-follower third video stage. The two-stage amplifier is a cascode video amplifier which—as you know from TV tuner experience—has an excellent signal-to-noise ratio. Hence the very weak video signal is kept as noise-free as possible much as we minimize snow by using cascode tuners.

As you also know, a cathode follower is the impedance transformer of video circuits. The camera employs such a circuit to match the low-impedance cable (carrying video signal over a few hundred feet to the camera control unit) to the higher-impedance output of the cascode video amplifier.

Deflection

The deflection system of the camera consists of horizontal and vertical deflection coils, focus coil and two magnetized beam-centering rings. These components are assembled as a complete unit and fitted around the Vidicon tube. Horizontal deflection currents arrive via coaxial cable (pins 8 and 20). Vertical deflection energy arrives via a twisted pair and pins 6 and 18. Polarity reversing switches are provided at the deflection coils to provide mirror or inverted images when desired. Such an arrangement permits the camera to be mounted more conveniently in any position with the knowledge that an upright left-to-right image can always be obtained on the viewer.

An adjustable current arrives for the focus coil via pins 14 and 16. This coil provides an axial magnetic field along the length of the camera tube

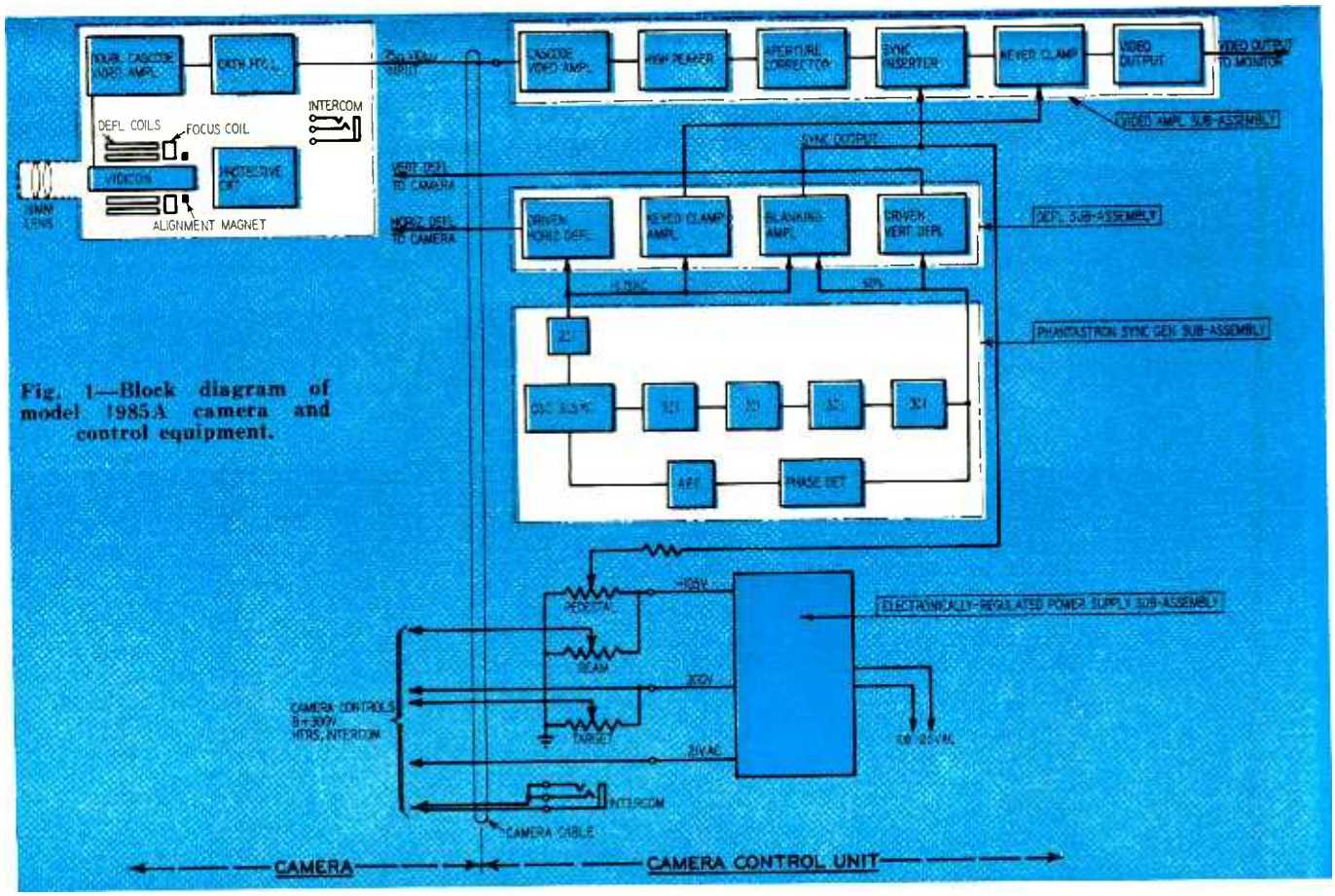


Fig. 1—Block diagram of model 1985A camera and control equipment.

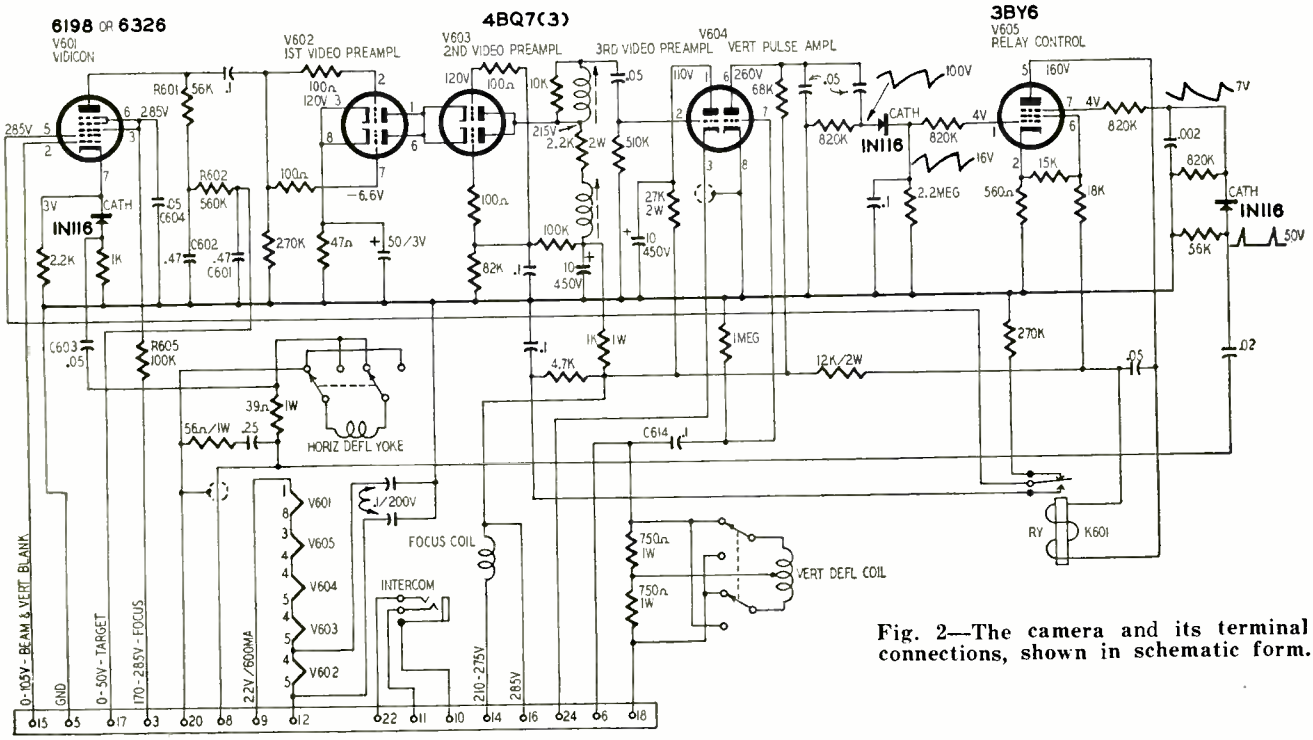


Fig. 2—The camera and its terminal connections, shown in schematic form.

to obtain true uniform focus of the beam.

A protective relay K601 makes beam current dependent on the presence of deflection currents. A pulse removed from the vertical coil is passed via capacitor C614 to the grid of V604. It is amplified, rectified and filtered to provide a positive sustaining bias at grid 1 of V605. In the same manner a similarly derived pulse develops positive bias at grid 7 of V605. The two positive biases, when present, cause tube V605 to draw sufficient plate current through the relay coil to hold it energized. In so doing the relay contacts close and apply the necessary accelerating voltage to the camera tube.

If one or both of the deflection currents fail, the positive bias is lost at the relay control tube. Hence the relay is de-energized and its contacts connect a grounded resistor to the acceleration circuit. Thus beam current is shut off and target burning by a concentrated beam of electrons focused on a small area is prevented. END

TV Service CLINIC

conducted by

JERRY KASS

HOW well a television set is functioning can be determined readily from the picture on the screen and the quality of the audio from the loudspeaker. When either of these deteriorate, the technician, by analysis, can pretty much pin the trouble down to a very few stages.

As an aid in doing this, and in those cases where the trouble is difficult to isolate, the technician can take advantage of several tell-tale clues indicating receiver operation. These clues are dc voltages available at the many test points. The voltages at these points, while varying from set to set, are nevertheless signposts of what is happening in the set up to that point. In many cases these test points have been brought out by manufacturers to the top of the chassis.

Several of these dc voltages are produced by local generators in the set and thus do not vary significantly with signal strength. In fact, they exist with the antenna terminals shorted. These include the negative grid voltage of the rf, vertical and horizontal oscillators, and horizontal output tube, the boost or bootstrap voltage and the high voltage.

With a TV signal applied, other dc test points come into play to a greater or lesser extent. These include, depending upon the receiver, the voltage developed across the video detector load, on the age bus, at the grid of the sync amplifier, at the limiter grid and across the ratio detector.

The above voltages will vary, not only with the set, but with the incoming signal strength and occasionally with control settings. Nevertheless, in most cases, a *range* can be established as representing a typical voltage. Experience with various sets will enable the technician to compress this range with different TV sets.

In considering typical voltages a signal strength equivalent to at least 6 mv from a signal generator must be applied. Preferably a stronger signal, in the order of 30 mv, should be used as a reference point.

The rf oscillator grid is an important dc check point where sound and picture are missing on all or even a single channel. If a single typical voltage had to be selected for this point it would be −6. However, a great many sets work nicely with oscillator grid voltages as low as −3 and as high as −13. Unlike the vertical and horizontal oscillators, the rf oscillator does not operate at a single frequency. Varying from about 81 mc on channel 2 (21-mc if) to about 237 mc on channel 13, the oscillator will often vary as much as from −10 on the lowest to −5 volts on the highest channel.

For the vertical oscillator the type of circuit must be considered. The most popular is the blocking oscillator which produces a negative voltage on its grid of from about −10 to −40. There is sometimes a variation in this voltage due to the grid being connected to a hold control.

Most of the multivibrator type vertical oscillators will have about −10 to −30 volts on the grid of the section feeding the vertical output tube; practically zero on the input grid. Some vertical oscillators depending upon feedback from the vertical output tube (Fig. 1) develop widely varying voltages on their grid—as much as −65 or so as little as −8 volts.

The horizontal oscillator stage is pretty much dominated by the Synchroguide and multivibrator circuits. The grid of the horizontal oscillator in the Synchroguide setup is usually highly negative, an average reading being about −60 volts. Some sets will develop as little as −25 volts at this point, others as much as −80. The multivibrator circuit, usually cathode-coupled (Fig. 2), produces a much lower voltage. The input grid is generally close to zero or a volt or so negative, with the output-section grid measuring about −12 volts.

The hard-working horizontal output tube develops a grid bias usually about one-quarter of the peak-to-peak value of the driving grid voltage. A common average for this stage is about −25 volts. The variation from here is not too great, being seldom less than −15 or more than −35 volts. This voltage can be varied by the setting of the drive control.

The boost voltage varies considerably and must be considered in relation to the B-plus voltage of the TV set. Assuming an average B-plus voltage of 275, we can assume an average boost voltage of at least 475. In older sets the boost voltage may be hardly more than 100 volts higher than B plus; in some of the newer sets it may be as much as 300 volts above.

Average high voltages cannot be listed since they will vary with the size and model of picture tube. A tube manual can be consulted for average operating high voltages for picture tubes.

Of the test points that develop a dc voltage in the presence of a signal only, the drop across the video detector load is most important as it is an excellent indication of signal strength. Most sets develop a signal of about 4 volts peak to peak at the video detector, with some as little as 2 volts and a few as much as 9. How much of this signal appears on the age bus will depend upon the point of age takeoff and the type of age circuitry used. The negative voltage in simple age circuits is usually not too much less than the voltage across the video detector load resistor. Of course, this relationship can vary considerably in keyed or amplified age circuitry. Generally, the age range from the weakest to strongest usable signal is from −0.25 to −6 volts.

The voltage developed at the limiter grid is a good indication of audio strength. With the gated-beam and ratio detectors and other new circuitry this point is becoming less reliable. However, in conventional limiter circuits a voltage of from approximately −0.5 to −2.5 can be expected.

The voltage on the grid of the input tube to the sync section will generally read something less than the peak voltage of the input signal. Thus, conventional sync amplifier or separator grid voltages are about −20. Voltages as low as −6 and as high as −30 are common.

The ratio detector is still another important test point. Fig. 3 shows a typical circuit. The voltages in parenthesis are signal-developed. The voltage across the stabilizing capacitor may vary from −5 to as much as −20.

A high-impedance voltmeter, preferably a vtvm, should be used in making these measurements. The above voltages are only typical. How efficiently these test points can be used depends upon the familiarity of the technician with a given set.

Devacuuming picture tubes

I have a window display in mind that contains a few picture tubes. It may be handled by my customers and I would like to make it as safe as possible. This means breaking the seal on the picture tube and letting air in. I have never attempted this but I heard that it could easily be done. My few experiences with broken or cracked picture tubes have left them unusable for display purposes.—R. T., Chicago, Ill.

The vacuum in a picture tube can be broken very easily and safely, but the procedure requires care and patience. Place the picture tube face down in a shipping or similar carton. Put enough soft packing material under the face so that the base of the tube extends through a small hole cut in the *closed* cover. See photo.

Now drill a ¼-inch hole in the end of the locating lug on the base. An alternative to this is to break the lug off with a sharp blow or with a pair of pliers. Use a small file or cutting pliers and make a very small hole in the exhaust tip so air enters the tube slowly. Letting air in too fast may discolor the screen or make it flake. The silvery getter deposit on the neck will change color immediately.

A few minutes after the small hole has been made, the tip can be broken off completely. From here on in caution is limited to that of handling glassware.

Capacitor breakdown

An RCA chassis KC83 came in with no vertical sweep. After some searching I found a defective capacitor connected between plate and screen of the vertical output tube. I simply replaced this capacitor and the vertical sweep was perfect. Less than two weeks later I had a callback, and it was the same trouble.

I replaced the capacitor again and and also replaced the 6K6 vertical output tube; all other components in this circuit checked good. I now have the set back with the same trouble and would like to know what the cause is. I can't face the customer on this again. —T. L., Kansas City, Mo.

In this case the trouble is very simple. The capacitor, a .001-μf unit, is rated at 1,000 volts. It shunts the vertical output transformer and is thus subjected to extremely high sweep voltages. Replace this capacitor with a good-quality .001-μf 1,600-volt unit.

15-kc whistle

Although I have noticed it on several Motorola receivers, customers have never complained of a high-pitched whistle. However, I have a Motorola now in which it is very loud and the owner objects. I have pinned it down to the horizontal output stage because it appears with the vertical oscillator out of the circuit and with the last if amplifier tube removed. It is no doubt the frequency of the horizontal oscillator. However, the best I can do is to vary the pitch slightly. I would like to know of some way to shield this interference. —P. R., Cleveland, Ohio

Unfortunately, you did not state specifically the model number of the set. However, the question is of a general nature. The whistle you refer to is no doubt the 15,750-cycle horizontal sweep frequency. Basically, it is a mechanical vibration and so cannot be shielded in the usual sense—it could be caused by a loose turn of wire or some part of the horizontal circuit that is mechanically resonant to the sweep frequency. Fortunately it is outside the hearing range of most people. When it is not, it must be damped.

The most common sources of this trouble are the horizontal output tube and the flyback transformer. The tube solution is simple—replacement. In some horizontal output transformers you can adjust the width control slightly and eliminate the whistle. A more common solution is to pour high-voltage insulating compound between the core and windings of the flyback transformer. In some horizontal output transformers that do not use the variable air-gap type of core, the sound can be eliminated by slightly loosening or tightening the core clamping screws. However, the powdered-iron core is fragile and breaks easily, so tighten gently. END

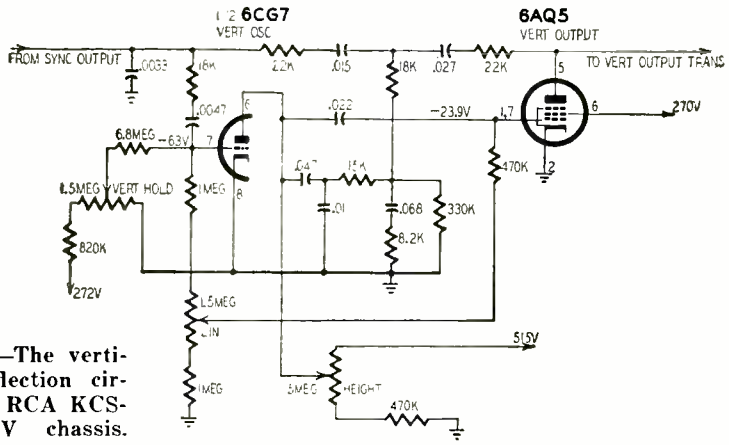


Fig. 1—The vertical deflection circuit in RCA KCS-103 TV chassis.

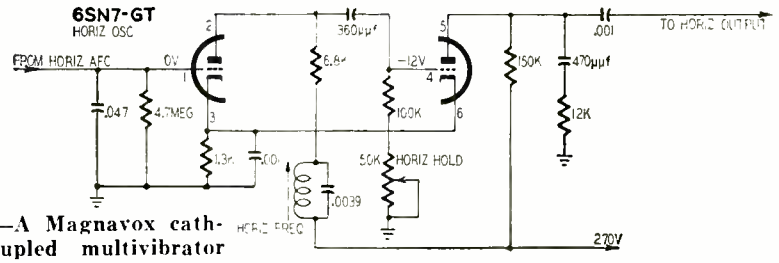
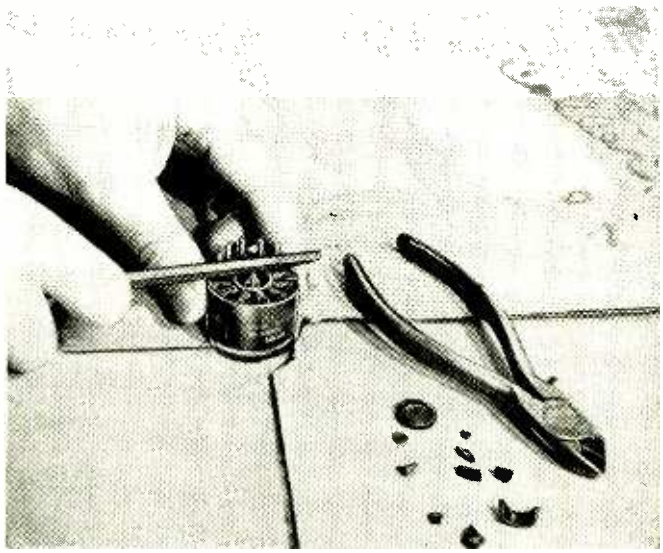


Fig. 2—A Magnavox cathode-coupled multivibrator from series 18 chassis.



Devacuuming picture tube. Tiny hole filed in exhaust tip lets air in slowly and sounds like leak in tire or a balloon.

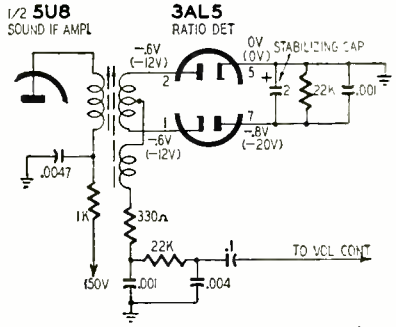


Fig. 3—Sylvania ratio-detector circuit with static and signal voltages.

Tracking down causes of insufficient signal strength in an important section of the receiver

By CYRUS GLICKSTEIN*

WEAK video—a poor, low-contrast and possibly snowy picture—is a common TV complaint. In this article it is assumed that the weak video has occurred in a set which previously worked normally.

A weak picture may result suddenly from a component breakdown or gradually because of aging components. Weak video can originate in several sections of the set and may be caused by:

1. A fault in the video signal path (Fig. 1) between the antenna and picture tube.

2. A fault in a section supplying either control or operating voltage to any of the above circuits. These voltage-supplying circuits include the agc and low- and high-voltage power supplies.

3. A fault which does not affect either the video signal path or voltage sources yet produces the effect of weak video by reducing picture contrast or brightness. Examples of such miscellaneous faults are dust on the face of the C-R tube and safety glass and a weak ion-trap magnet.

Tracking down a fault to the defective stage and component is usually done in five main steps: **a.** noting all symptoms carefully; **b.** checking the action of pertinent controls; **c.** changing tubes; **d.** making key voltage, oscilloscope and similar checks; **e.** making voltage and resistance checks around the defective stage.

a. Symptoms Note if there is an accumulation of dust on the face of the picture tube or inside the safety glass. Check the line voltage, especially if there are other symptoms in addition to weak video, such as a small raster, vertical roll, etc.

Note if there are any additional symptoms which may localize the trouble further, such as poor focus, low brightness, sweep distortion, poor sync, snow as well as weak video, etc. A weak picture with snow usually indicates a failure in the antenna, transmission line, rf amplifier or converter stage, or the agc circuit as it affects the rf amplifier. A weak picture without snow generally indicates trouble in some stage after the tuner.

b. Controls With the set tuned to an active channel, each of the following controls should be rotated through its range in approximately the order listed and the indications noted.

1. *Contrast control* There should be some variation of contrast as the control is rotated. If no variation is noticeable, check further in the contrast control circuit.

2. *Age threshold control* If rotating the agc control has little or no effect in varying the contrast, this may indicate a fault in the agc line.

3. *Brightness control* If the brightness control at maximum fails to provide normal brightness, or at minimum fails to blank out the picture tube, but volume is normal, this points to the following possibilities: defective picture tube, misadjusted ion-trap magnet, defective high-voltage circuit, defective last video amplifier tube or circuit, a defect upsetting C-R tube bias, incorrect voltage to other C-R tube pins.

4. *Volume control* Low volume together with weak video may originate in a stage common to both video and sound signals (tuner, common if stage, etc.). However, if the volume seems normal, this does not completely rule out trouble in a common video–sound stage. A fault causing a reduction in both may still leave the sound at a fairly high level with weak video.

To check the operation of the complete sound signal path, turn the channel selector to a blank channel, turn the volume control to maximum and note if the normal rushing sound is heard from the speaker. If so, the fault causing the weak video is probably in the antenna–transmission line or one of the tuner stages; if not, the fault is in a stage after the tuner.

5. *Channel selector and fine tuning* If weak pix is evident on only one channel and other channels are normal, realign the oscillator coil for the affected channel. On occasion, an antenna–transmission line fault may show up on one channel only. If the weak pix is common to all channels and the fine tuning brings in a picture only at the extreme of rotation, this points to a need for a new oscillator tube, realignment of the oscillator coils, or both.

6. *Hold controls* Check if the sync action is defective by rotating both the vertical and horizontal hold controls and noting if the hold-in range is normal. If both controls act normally the fault is probably not actually weak video but some condition which simulates this fault (such as low brightness or dust on the C-R tube face). Poor hold action indicates weak video.

c. Tube checks If control adjustments do not eliminate the trouble, tubes should be changed in all sections that may be at fault. If the set has developed a weak picture over a period of time, one or more faulty tubes may be the cause. Substitute a new set in the tuner and check the result. If oscillator tube substitution improves the picture noticeably, but throws off the alignment, vary the overall oscillator adjustment or the individual oscillator coil adjustments as required for correct alignment. If the video is improved but still weak after tuner tube changes,

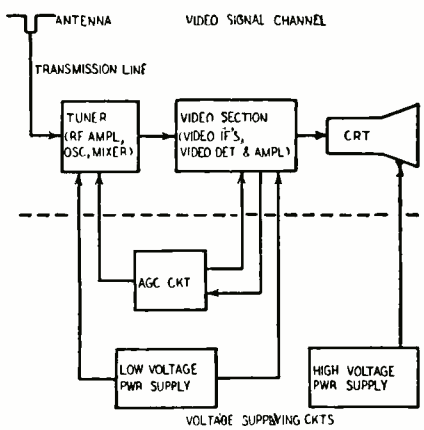


Fig. 1—The video signal path and circuits supplying voltages to it.

*Author of *Repairing Television Receivers* (John F. Rider Publisher, Inc.).

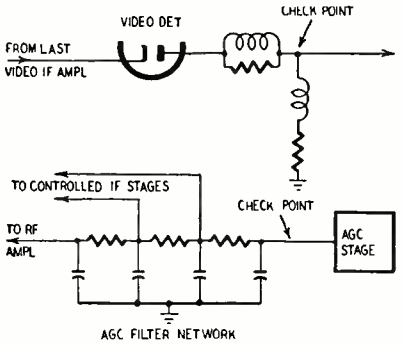


Fig. 2—Video detector and age voltage check points.

substitute new video if tubes. If necessary, try new video detector and amplifier tubes. Several new tubes in the video channel of an older set often work wonders in overcoming weak video and restoring peak performance.

To determine if any of the old tubes are usable, they may be replaced one by one and the effect on the picture noted. Old tubes which don't result in a weaker picture may be left in.

If the weak video developed suddenly, replace those tubes first which are most likely to be faulty on the basis of previous checks. If necessary, tubes should be changed in the tuner, video section (including age circuit), low-voltage rectifier and any other circuit as indicated by the symptoms and control action. If a crystal-diode video detector is used, make a preliminary resistance check across the diode, measuring front-to-back and reverse resistance before any further troubleshooting.

d. Key checks If tube changes do not cure the fault, the next step is to make quick checks at the following key points to localize the trouble further:

1. *Dc voltage checks at the video detector load and age line* Dc voltage checks should be made at the video detector load and age line (Fig. 2), first with the set tuned to an active channel, then with the set turned to an inactive channel.

With no signal applied (set turned to an inactive channel), the voltage at the video detector load should be a fraction of a volt negative. If a substantial negative voltage is measured with no signal, this points to regeneration in the video if stages and further checks are necessary in this circuit. With an incoming signal (set tuned to an active channel) the voltage at the video detector load should be −3 to −5. A reading of less than −2 volts indicates weak output between the antenna terminals and the video detector.

With no signal applied, the voltage on the age line should be practically zero. A positive voltage usually indicates a leaky coupling capacitor connected to one of the controlled if tube grids or a defective if tube.

With a normal signal the negative voltage on the if age bus should be −2 to −6, depending on signal strength. In some sets there are separate age lines to the rf amplifier and to the if stages. In such sets check both age lines.

A low age voltage (small negative reading) together with an abnormally high negative voltage at the video detector, with a signal tuned in, points to a fault in the age line which is responsible for the loss of age voltage and for the video overload. The high negative voltage at the video detector may bias the video amplifier so heavily that the video amplifier output to the picture tube is abnormally weak (Fig. 3). In the same way, low if age

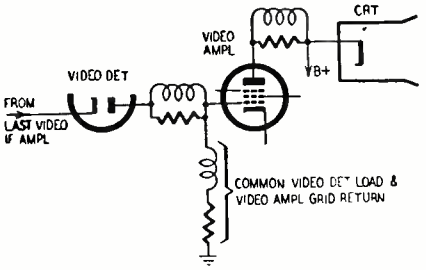


Fig. 3—A common video-detector output and amplifier-input circuit.

voltage, high rf age voltage and high video detector voltage may result not only in a weak picture but a snowy one because of the low amplification in the rf amplifier. This again points to a defect in the if age line such as a leaky or shorted age filter capacitor.

Servicing up to this point may be performed in the home. The following steps are usually taken in the shop:

2. *Signal tracing with an oscilloscope* In making bench checks for weak video, signal tracing with an oscilloscope is very effective. Check the waveform at the video detector load and measure the peak-to-peak voltage to determine if output at this point is below par (Fig. 4). Normally it is from 2.5 to 6 volts. Check the waveform at the plate of the last video amplifier, with the contrast control at the maximum clockwise position. The normal peak-to-peak voltage at this point is 40 to 60. These checks quickly determine if the trouble is before or after the video detector stage.

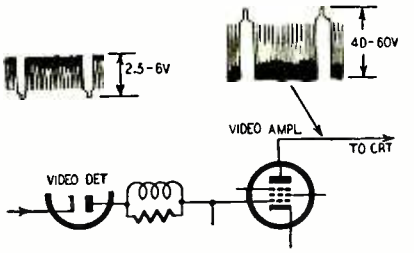


Fig. 4—Typical waveforms at the video amplifier grid and plate circuits.

3. *Gain checks with a sweep signal generator and oscilloscope* When a fault is located to the video section before the video detector, it can be further localized by gain checks with a sweep generator and oscilloscope. Turn set to a blank channel and disconnect the antenna lead-in from the antenna terminals. The scope is left at the detector load throughout the series of checks (Fig. 5).

With the sweep generator tuned to the intermediate frequency and with a 10-mc sweep, apply the output to the grid of the last video if stage. For this stage maximum generator output may be required. Set the scope at maximum vertical gain for the entire test. Note the amplitude of the signal on the scope screen. If it is large enough, turn the generator attenuator down so the least possible signal input is used.

Move the generator forward to the preceding video if grid and again note the output on the scope. A noticeable increase in waveform amplitude should be visible to indicate normal gain in the stage. A small increase or no increase indicates a defective stage. Repeat the process of turning down the generator gain and noting the amplitude before going on to the preceding grid. This prevents overloading an if stage which would result in a misleading indication of stage gain.

Then move the generator input to the preceding grid. Check each if stage this way in turn.

Check the front end, similarly, by turning the set to a given channel, again with the antenna disconnected. The sweep generator is set to the video carrier frequency of this channel. Generator output is applied to the mixer grid and antenna terminals, following the procedure described above. Performing these checks on several normal receivers will establish the usual amount of gain per stage.

Where misalignment is indicated, if and rf alignment should be checked with sweep and marker generators and oscilloscope according to manufacturer's specifications. However, most cases of weak video are not caused by misalignment. Partial or complete realignment may be required after replacing rf or if tuned-circuit components.

e. Voltage and resistance checks When previous checks have localized trouble to a particular stage, further

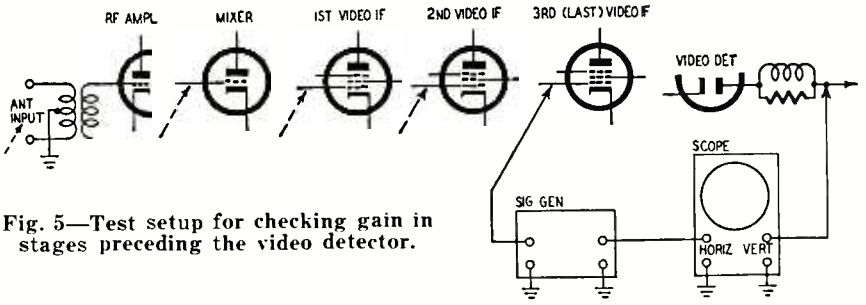


Fig. 5—Test setup for checking gain in stages preceding the video detector.

voltage and resistance checks around this stage usually show up the defective part. In some cases, such as a change in capacitor value, substitution may be necessary to isolate the faulty component.

Common causes of weak video

In practically every stage which can cause weak video the fault may be produced by a defective tube or by a drastic change of component value, such as a change in value of the plate, cathode or plate decoupling resistor or cathode,

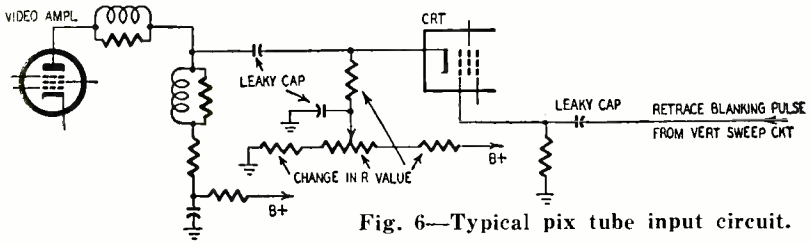


Fig. 6—Typical pix tube input circuit.

screen bypass, plate decoupling or coupling capacitor. The symptom may also arise if any capacitors are open or leaky. To avoid repetition, all trouble possibilities are not outlined for each section; only those most commonly found.

a. Antenna–transmission line Common causes of weak video resulting from antenna–transmission line troubles include: antenna rotated away from the optimum position for signal pickup; antenna partially shorting to some obstruction; corroded antenna connection terminals; partial or complete short across antenna terminals; break in transmission line; one or both transmission-line wires disconnected from the antenna or the receiver.

b. Front end Weak video may originate in any of the three front-end stages for the following reasons:

1. Low amplification in the rf amplifier stage. The signal-to-noise ratio is determined mainly by the strength of the video signal applied to the receiver input; gain of the rf amplifier; tube noise in this stage. A weak, snowy picpure results from low video input to the rf amplifier (antenna–transmission line fault or poor signal area) or from a drop in signal amplification in the rf amplifier. (The fault may be in the rf stage or in the B-plus or age line connected to this stage.) In some cases, a weak, snowy picture may result from a defective mixer with excessive tube noise.

Common rf amplifier faults include: defective tube; loose shield on rf amplifier tube; defective coupling capacitor from rf amplifier plate to mixer grid; change in value of cathode or plate resistor; faulty rf coils; detuned rf circuits requiring realignment; open or leaky bypass capacitors, especially in the screen or plate circuits; loose, dirty or corroded contacts on a turret tuner.

2. Low voltage output from the oscillator stage may be caused by: faulty oscillator tube; open grid-leak capacitor; detuned oscillator coil(s) requiring realignment; open or leaky plate bypass capacitor; defective coupling capacitor from oscillator plate to mixer grid; change in value of plate resistor.

3. Low conversion transconductance in the mixer may be caused by: defective mixer tube; change in value of plate or cathode resistor; open or leaky plate bypass capacitor; defective coupling capacitor from mixer plate to grid of first if stage.

c. Video section Weak video caused by a video section defect commonly arises from:

1. Low amplification of a video if or amplifier stage caused by: defective tube; contrast control incorrectly set or defect in contrast control or associated circuit; open or drop in value of cathode bypass capacitor resulting in degeneration; substantial increase in value of plate resistor or plate decoupling resistor; leaky screen or plate decoupling capacitor; defective if coil; open peaking coil in video amplifier.

2. Abnormally low output from the video detector caused by: defective tube or crystal diode; open peaking coil; change in value of diode load resistor.

3. Incorrect bandpass in the video section caused by: component value changes; defective if coil; detuning; change in value of grid resistor.

4. Regeneration in if or video amplifier resulting from: open bypass capacitor; faulty lead or component dress; cold-solder ground connection; if tube shields missing or making poor contact with chassis; incorrect placement of peaking coils

d. Picture tube: A number of C-R tube faults produce symptoms which give the effect of weak video. These include: defective tube (low emission causes low brightness, gassy tube causes unfocused beam and poor definition); defect in tube focusing circuit or magnet assembly; incorrect voltage applied to screen grid or focusing electrode resulting in poor contrast; weak ion trap; defect or value change in cathode or grid circuit causing either abnormally low or high brightness on the screen (Fig. 6).

e. Age circuit: Age faults which can cause weak video include: defective age rectifier amplifier tube or clamping diode; change of resistor or capacitor value in age stage or bus; shorted or leaky capacitor in the age bus; age control incorrectly set; defect in age control or associated circuit. In keyed age circuits a defective keyer pulse coil may cause loss of age (Fig. 7).

f. B-plus supply: A fault in the B-plus supply may result in incorrect voltage to one or more stages in the

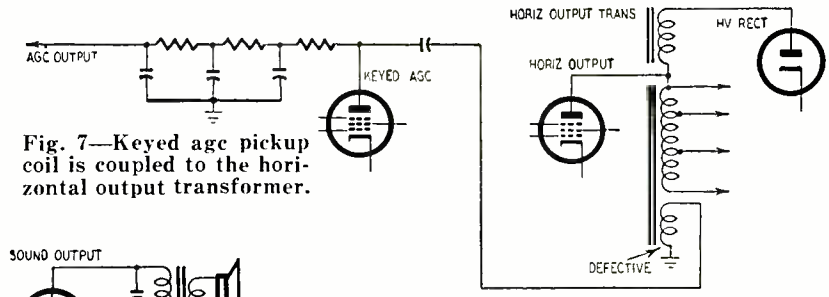


Fig. 7—Keyed age pickup coil is coupled to the horizontal output transformer.

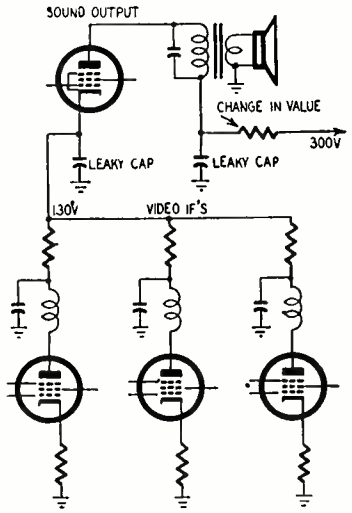


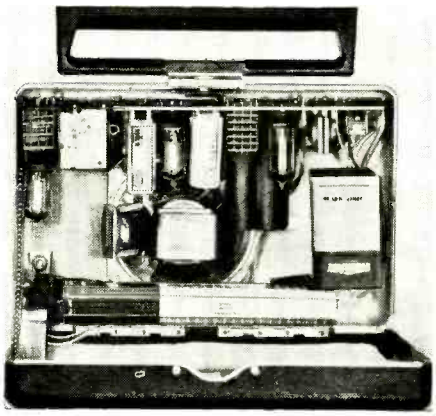
Fig. 8—B-plus path in series-tube set.

video channel and therefore cause weak video. Most common troubles are: defective low-voltage rectifier tube; defective filter capacitor; defective resistor or bypass capacitor in B-plus voltage-divider connections to the video section, front end, age stage or picture tube. In some sets, a defect in the audio output stage may cause weak video where this stage is in series (B plus) with video if stages (Fig. 8).

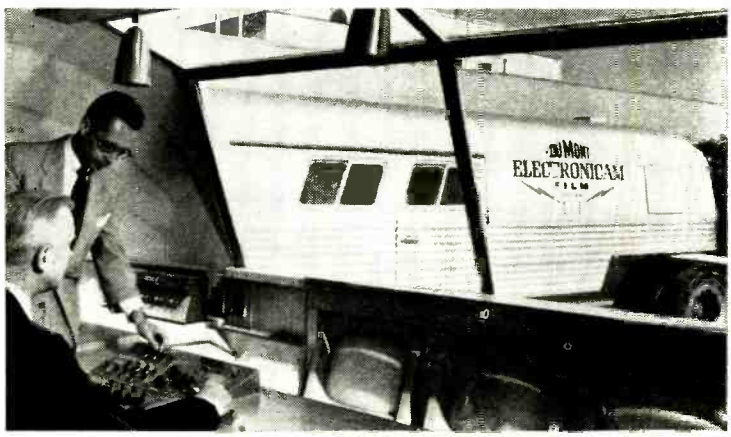
g. High-voltage supply: A faulty high-voltage system can cause reduced high voltage, thereby causing low brightness, poor focus and a weak-appearing picture. This type of defect can usually be spotted quickly because of the inability of the brightness control to provide normal brightness at the maximum clockwise position. In addition, other symptoms are often present, such as a distorted raster, blanking of the picture and raster at maximum brightness control rotation, etc. Corona or arcing in the high-voltage circuit can cause noise in the picture which looks like excessive snow in weak signal areas. END

what's new?

MODULAR CONSTRUCTION appears in home radios for the first time in the Motorola chassis HS-515, a portable. Modules have been used in television (Emerson) and test instruments (Du Mont). The components modulized in this circuit are the converter circuit, including the oscillator coil but excluding the rf output transformer, and most of the input and output components of the detector–avc–af stage. One interesting point that has puzzled technicians since modules have been announced—the list price of each of the "modulized units" is $2.85, per the service manual sheet.

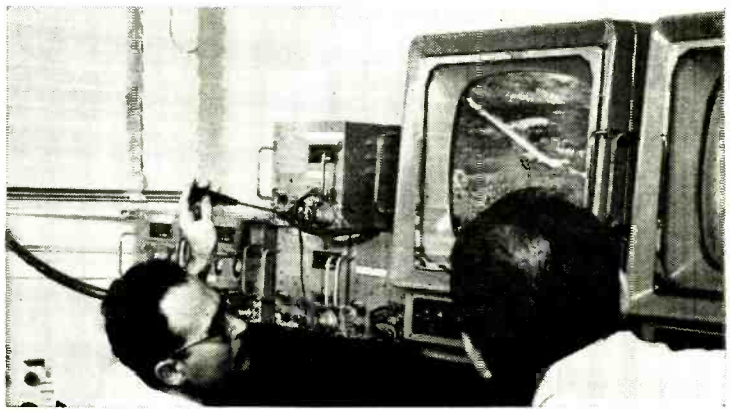


WORLD'S FIRST UNDERWATER STUDIO is this setup of WMOP, Ocala, Fla. Solely for publicity purposes, the studio was set up 15 feet below the surface of Florida's Silver Springs and broadcasts continued for over 13 hours. The "studio," only 8 x 8 feet in dimensions, contained a record player, two mikes and a line telephone. Biggest problem was getting the equipment into position without damage—solved by enclosing it in plastic bags for the trip to the "studio." The picture was taken just before signoff with the studio lighted by lamps above the tank.



MARRIAGE of electronics and Hollywood's traditional techniques was consummated with the leasing to Paramount of the Du Mont Electronicam, a picture-taking setup which comes in two trailer trucks, one of which is intended to be wheeled right onto the sound stage. Essentially a standard moving-picture camera with an electronic viewfinder and a light sharing setup, the Electronicam system records pictures on high-quality film, delivers high-resolution pictures to viewfinders and as many monitors as desired and records a kinescope film with sound and supplies signals for recording on video tape.

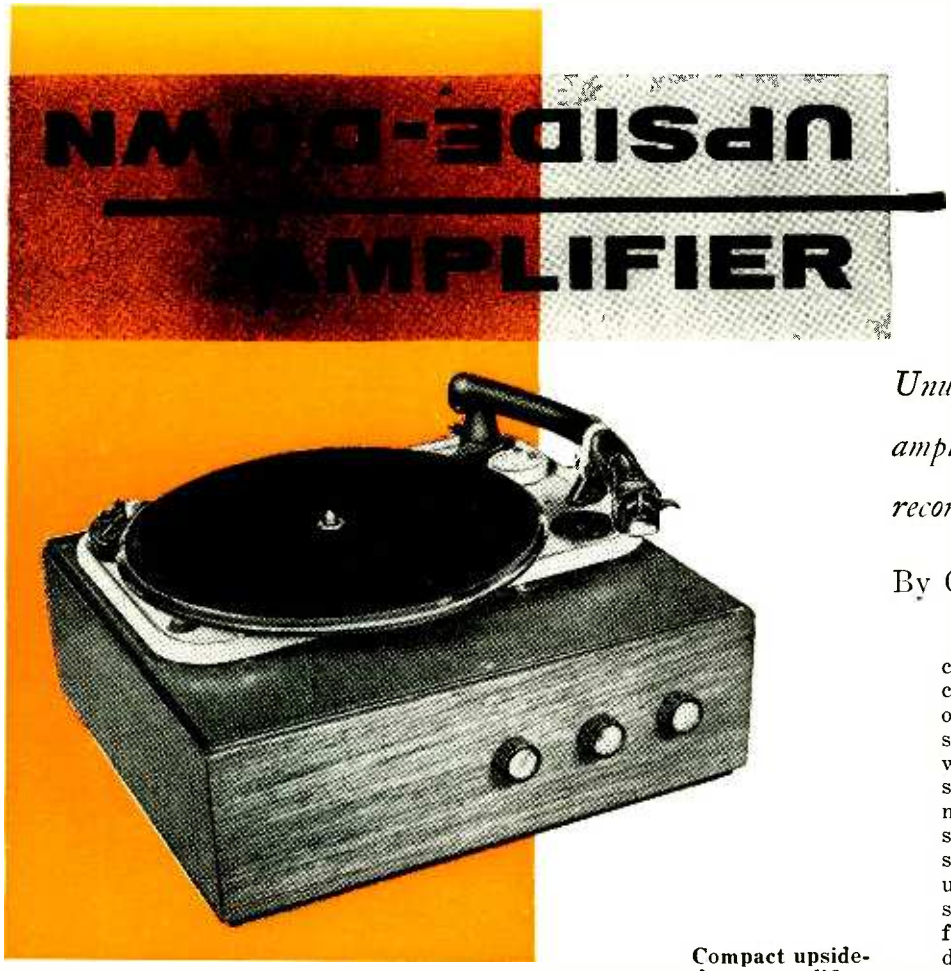
AIRBORNE TELEVISION gives viewers a clear picture of the Pennsylvania Turnpike 50 miles away from the camera. The transmitting station is a helicopter whose cabin contains an FM transmitter of 100 watts ERP, an image orthicon camera, timing generator and high-gain antenna, dropped below the helicopter. The system was developed by Philco for the Navy Department's Bureau of Ships and is intended for control of amphibious landings and possibly in jet aircraft reconnaissance and other undisclosed applications.



UPSIDE-DOWN AMPLIFIER

Unusual arrangement has amplifier built around record player

By GEORGE L. AUGSPURGER



Compact upside-down amplifier.

THIS little unit is a combination record player and hi-fi amplifier. The photos show a Garrard model T manual player and 10-watt amplifier built into a single cabinet no larger than the base used with the turntable alone.

This compactness is made possible by building the amplifier *upside down* on a standard 8 x 12 x 3-inch aluminum chassis. The turntable motorboard mounts above the chassis so that the phono motor and turntable bearing projects down into the innards of the amplifier. Components and wiring are arranged so that space is left for the mechanical assembly and the two units are then sandwiched together.

The power transformer and tube sockets are mounted on the rear of the chassis along with signal jacks and ventilating holes. Controls and preamp assembly are arranged along the front edge and the output transformer uses the remaining space available in front of the phono motor.

Obtain all components first, then *very carefully* decide exactly where the turntable assembly is to be mounted and what position the chassis will occupy with regard to the mechanical unit. Then measure precisely where mechanical parts project into the chassis and how much space they will require. When you are sure that you have allowed sufficient space in the amplifier chassis for the phonograph motor and associated parts, lay out the amplifier components and wiring to make the best use of the space left.

The unit shown uses Knight (Allied Radio) S-234 10-watt amplifier kit with the addition of a few parts. The schematic diagram (Fig. 1) indicates by large dots parts not furnished with the kit. The mixer and preamp circuits within the dashed lines are also extra parts. A few changes were made in the original amplifier circuit to increase stability and extend frequency response. The preamp and mixer sections were added to give correct equalization for a wide-range crystal phono cartridge and provide for a radio tuner without extra switching.

Because the power transformer is necessarily located close to the phono pickup, magnetic cartridges simply will not do. Unless you want to mount the power transformer at the end of a 10-foot cable, the only solution is to use one of the new wide-range crystal pickups. I selected the Ronette TO-284-P which combines the virtues of smooth frequency response with extremely low intermodulation distortion.

The Ronette is fed into a 220,000-ohm load to attenuate response below 50 cycles. The .03-μf coupling capacitor in the plate circuit of the first stage was chosen for the same purpose. If the cartridge works into a load of 1 megohm or greater, it picks up all sorts of subsonic pulses from the turntable which easily overdrive small speaker systems. Since (contrary to advertisements you may read) *no* bookshelf speaker puts out any sort of usable response below 50 cycles, it seems silly to use amplifier power just to burble the speaker cone back and forth. Such low-frequency pulses can cause considerable distortion by driving both amplifier and speaker into nonlinear operation.

The response curve of the Ronette shows a very gentle rise to about 5 kc and then a gradual slope to about 10 kc. High-frequency losses in the mixer circuit smooth out the high-frequency peak, and the .004-μf bypass capacitor in the 6SC7 cathode circuit reinforces the droop above 5,000 cycles to give a very close approximation to the RIAA curve.

Output voltage from the Ronette cartridge is enough to drive the amplifier without the 6SC7 preamplifier stage, but phono–radio isolating resistors and balance control drop the gain enough to make the extra tube desirable. It would be easier just to include a "phono–radio" switch on the front panel but the system was designed to be as simple to operate as possible: To play the phonograph turn the amplifier on and put a record on the table; to hear the radio switch on both tuner and amplifier, and there you are.

A balance control is included in the phono preamp so that radio and record player loudness can be adjusted to the same level. If a compensated loudness control (such as the Centralab C1-70-S Compentrol) is used for the main volume control, the balance control can be used to adjust the maximum level and, therefore, the amount of loudness compensation at normal listening level.

The two-channel mixing circuit attenuates high frequencies somewhat.

Parts for upside-down amplifier

R1—220,000 ohms
R2—3,300 ohms
R3—100,000 ohms
R4—33,000 ohms
R5—100,000-ohm pot
R6—100,000 ohms
R7—100,000 ohms
R8—100,000 ohms
R9—2,700 ohms
R10—270,000 ohms
R11—1-megohm pot
R12—22,000 ohms
R13—1-megohm pot
R14—1-megohm pot
R15—270,000 ohms
R16—4,700 ohms
R17—47,000 ohms
R18—1 megohm
R19—100,000 ohms
R20—1,500 ohms
R21—33,000 ohms
R22—33,000 ohms
R23—7,500 ohms
R24—220,000 ohms
R25—220,000 ohms
R26—300 ohms, 5 watts
R27—50-ohm pot, 2 watts
R28—15,000 ohms, 1 watt
R29—2,200 ohms, 2 watts
R30—250 ohms, 5 watts
All resistors ½ watt unless otherwise noted
C1—.004 µf
C2—.03 µf
C3—20-10, 50 µf, 450-450, 50 volts, electrolytic
C4—.02 µf
C5—.002 µf
C6—.02 µf
C7—250 µµf
C8—.005 µf
C9—.05 µf
C10—.001 µf
C11—.05 µf
C12—.05 µf
C13—270 µµf
C14—.01 µf
C15—40 µf, 450 volts
C16—50-80 µf, 475 volts, electrolytic
All capacitors 600 volts unless otherwise noted
V1—6SC7
V2—6SN7-GT
V3—6SN7-GT
V4—6V6-GT
V5—6V6-GT
V6—5Y3-GT
S—spst switch on volume control
T1—output transformer for push-pull 6V6's, 10,000 ohms plate-to-plate, 10 watts
T2—power transformer, 760 volts ct @ 125 ma, 6.3 volts @ 3 amps, 5 volts @ 2 amps
Octal sockets (6)
Pilot light and assembly
Input jacks (2)
Output jack
Line cord
Knobs (3)
Chassis, about 8 x 12 x 3 inches
Record player
Cabinet for record player and amplifier

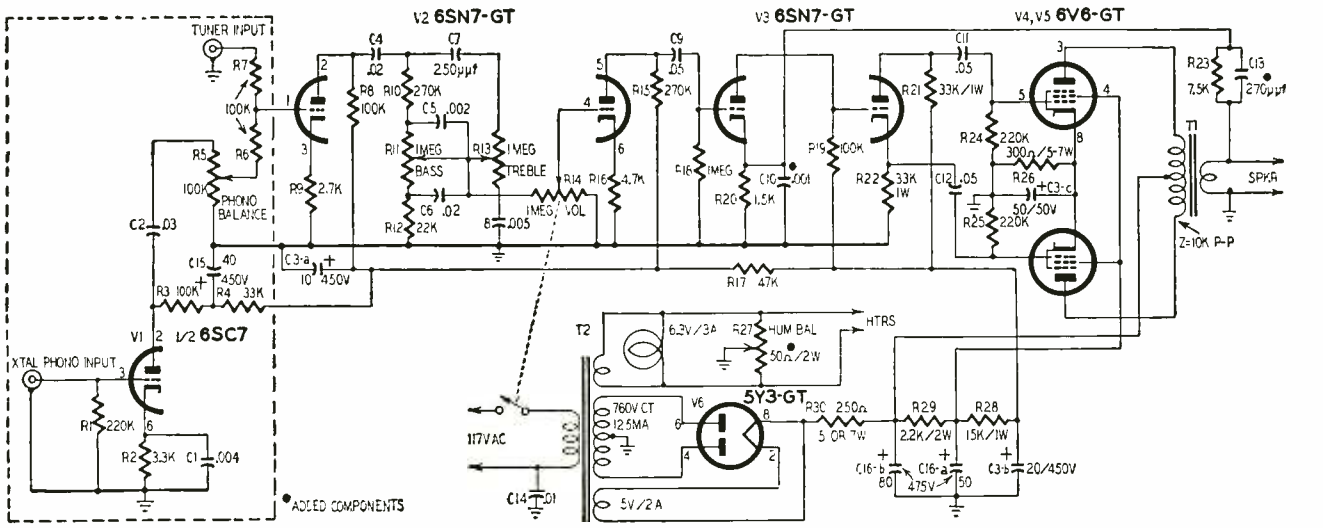
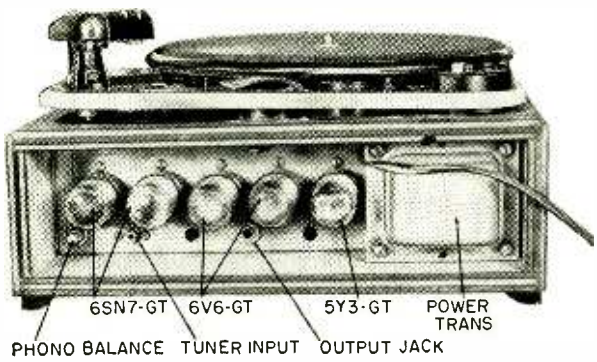
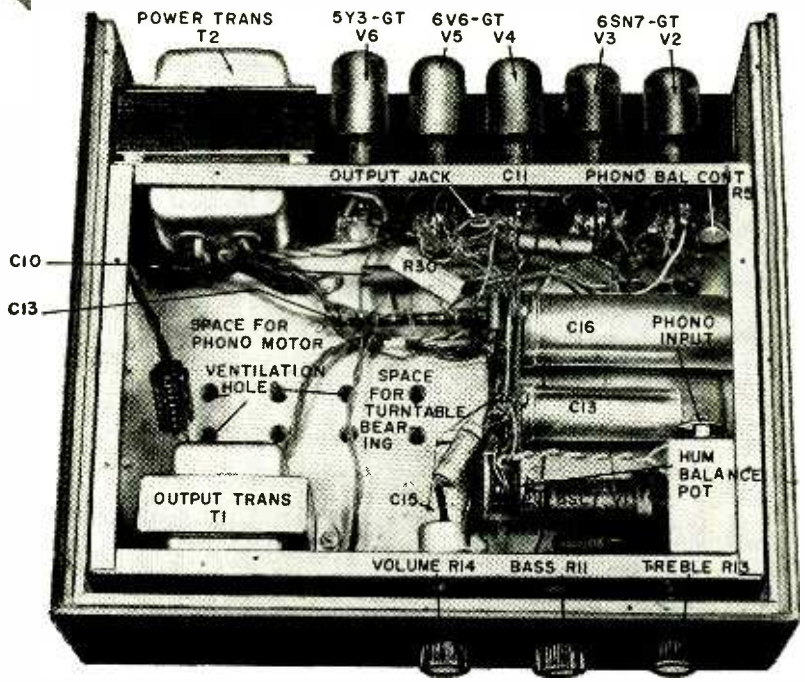


Fig. 1—Schematic diagram of the upside-down unit—fundamentally the Knight 10-watt high-fidelity amplifier.



Rear view of the amplifier.



Amplifier components are arranged to fit around underside assembly of the phonograph record player.

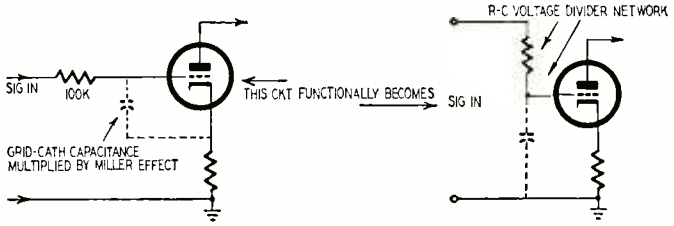


Fig. 2—How high frequencies are lost in mixer circuit.

The Miller effect increases interelectrode capacitance between the first 6SN7 grid and ground. This capacitance, together with the 100,000-ohm isolation resistors, forms a high-frequency shunt circuit (Fig. 2). Additional treble losses are introduced when the 1-megohm volume control is near mid-setting.

Fortunately, the .001-μf capacitor in the main feedback loop not only stabilizes the high-frequency response of the amplifier but compensates for the loss of highs in preceding stages. The value of this capacitor can be changed to compensate for wiring layouts, transformers variations or circuit changes. Once the response curve of the amplifier has been flattened, however, check for high-frequency instability.

All inexpensive feedback amplifiers, such as the Knight or Heathkit A-7D, have a tendency to ring when overdriven. This can be observed by running about 60 cycles into the amplifier and watching the output on a scope while the system is connected to a speaker load. Crank up the input signal until clipping is visble. If somewhere in the process a fuzzy shape (Fig. 3) appears on part of the waveform, it indicates high-frequency instability.

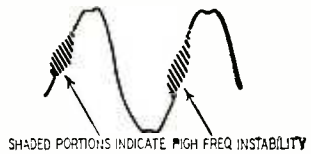


Fig. 3—Oscilloscope pattern shows ringing as amplifier is overdriven.

Changing the values of C10 and C13 will get rid of the ring but will also change the amplifier response curve. A small capacitor of 50 to 250 $\mu\mu$f across the phase-inverter plate resistor will often eliminate instability without seriously changing of characteristics.

The Knight kit, as furnished, also has a positive feedback loop to increase sensitivity, but it was impossible to retain this circuit and still keep the amplifier stable under all load conditions. Since the amplifier has plenty of gain as diagrammed, there is no reason to worry about loss of positive feedback.

Juggling capacitors and feedback loops, as mentioned, is necessary only if you are a perfectionist and have the necessary equipment. The amplifier will *sound* good if the diagram is followed exactly. Hum is a different sort of problem—it is something you can hear and consequently worth while getting rid of. The 50-ohm 2-watt hum-balancing pot and .01-μf capacitor from the ac line to chassis ground are both added to keep hum below audibility.

The balancing pot is a feature found in most commercial hi-fi amplifiers. The idea is that, by shifting the ground point of the filament system, a null can be found where hum introduced in the heater circuit cancels hum voltage picked up from other sources. Although this scheme lowers the hum level of the amplifier to insignificance if good wiring practice is followed, the input circuit is still sensitive to body capacitance unless the chassis is grounded. And most people don't have ground wires available for small record players.

Nonmetallic tone arms, such as that on the model T, provide no shielding for the pickup wires at the point where you handle the arm to put it on a record. Every time you put your fingers on the pickup head an annoying loud buzz is heard. A small capacitor from one side of the ac line to the chassis will stop this nuisance so long as the line plug is inserted the right way.

Any small amplifier circuit can easily be adapted to the upside-down type of construction. The Knight circuit described or the Heathkit mentioned are both excellent low-power amplifiers for small systems. The builder will find that one of these or a similar kit plus the additional chassis and other parts cost considerably less than purchasing individual components.

The cabinet can be made like the one shown here or designed to fit any standard manual player or record-changer assembly. Most companies furnish mounting templates with their phono units so that chassis and cabinet can be accurately laid out beforehand. If you don't have the tools or skill, any local cabinetmaker can do the job. END

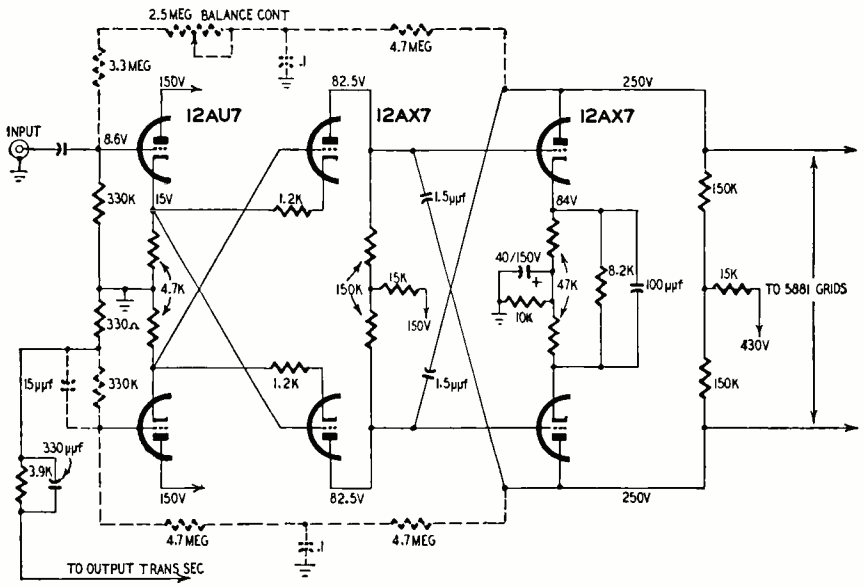
BALANCING THE GOLDEN EAR

The long-term stability of the direct-coupled front end in Mr. Marshall's Golden Ear amplifiers is poor because of the severe requirements which it places on the stability of the B-plus and heater-voltage supplies. Since the B-plus supply to the inverter stage is regulated by a voltage-regulator tube, the primary cause of balance drift is probably line-voltage variations. For a particular 12AU7 selected at random, the cathode-to-cathode voltage of the cathode-follower input stage varies about .038 volt as the line voltage is varied from 105 to 125, with plates held at 150 volts.

This modification improves the balance and minimizes drift by applying negative feedback from the driver plates to the grids of the input stage as shown in dashed lines. To maintain gain within the loop, the feedback paths are designed as low-pass networks with the 3-db point at .04 cycle. For the values shown, the feedback amounts to around 27 db. The proper balance point is reached by controlling the resistance in one of the feedback legs with a variable resistor. The 330,000-ohm grid resistor for the lower half of the 12AU7 is shunted by 15 $\mu\mu$f for 90% compensation of the grid-to-plate capacitance.

No claim is made for originality in this design, although I have not seen a comparable feedback circuit described anywhere.—*Joseph J. Conradi*

(Mr. Marshall reports that this modification works fine and produces a very stable amplifier. He adds however that it is simpler and no more expensive to add another 150-volt voltage-regulator series with the one already in the Golden Ear amplifiers and apply 300 volts regulated to the driver—*Editor*)

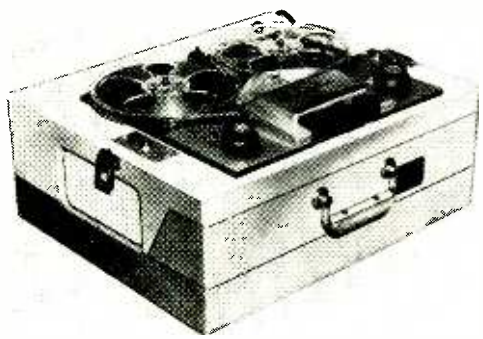


Stereo Tape Comes of Age

Theory, tape and equipment for the latest in audio realism

By HERMAN BURSTEIN

Educational Labs M-7 stereo recorder.



The portable stereo recorder made by the Amplifier Corporation of America.

IT is virtually a matter of months since tape equipment has become a significant member of the high-fidelity family. Though there are perhaps two million tape recorders in American homes, yet the vast majority have been employed as novelties rather than to record and reproduce music with anything like fidelity. But during the past year the home tape player has at last made substantial headway. Today some 30 labels of prerecorded tape offer various types of music, certainly an indication that tape is finally coming into its own.

With monaural tape just acquiring a firm foothold in the high-fidelity realm, stereophonic tape is but a step behind. So short is the step that it is hard to remember the infant of two or three years ago, to be heard only at audio fairs, a few sound salons and other select places. Although it still has a long way to go, nevertheless it may fairly be said that stereo tape has come of age. A year or so ago the audiophile who wanted to play around with stereo was thrown largely on his own resources unless he could afford one of the few and expensive pieces of equipment then available. Today he is in a position to choose from a variety of stereo tape products at prices suiting any pocketbook. Monthly his choices increase.

When we consider that much has been made of three-dimensional listening only within the last few years (outside of a few path beaters like the motion picture *Fantasia* which appeared in 1941), it is interesting to note that stereophonic reproduction goes back at least as far as 1933. At the Chicago World's Fair that year a binaural system was demonstrated which employed earphones. Later that year Bell Laboratories presented a three-channel system using speakers instead. There are even earlier reports of experiments carried on by broadcast stations on two channels, on which I can get no details at the moment. These early experiments were limited to simultaneous production and reproduction of sound because the existing media for audio recording did not permit preservation of the exact phase (time) relationship between pickup of the sound by each microphone.

The advent of tape recording provided a ready means for recording two separate sources of sound in their original phase relationship. Shortly after World War II, experiments along this line were conducted by personnel of the Armour Research Foundation. Then followed the practical adaptation of these findings first by one or two tape-recorder manufacturers and subsequently by a considerable number.

Stereo vs binaural

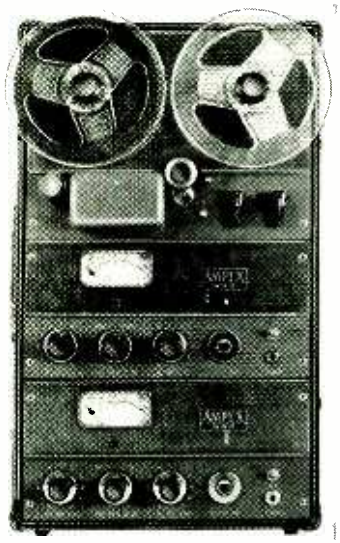
Three-dimensional sound on tape, feasible for the home, initially took the form of *binaural* reproduction, requiring earphones in playback. This system employs two microphones spaced about 8 inches apart—equivalent to the distance between a human's ears—and separated by a sound-absorbent material. The dual microphone setup is positioned in such a spot as a listener might occupy for favorable results. Sound picked up by one microphone is recorded on the lower track of the tape and sound from the other on the upper track. In playback, the signals from each track are separately amplified and fed to the listener's left and right ears. In short, the tape recorder is a time-delay device which places the listener's ears at the original performance.

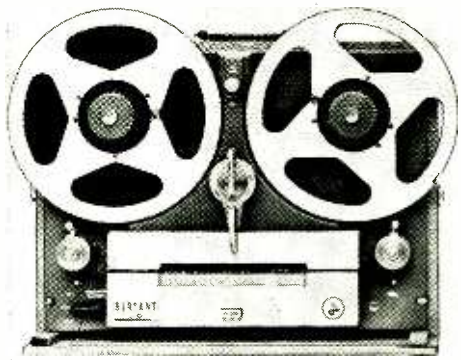
Although binaural reproduction has pronounced advantages for industrial use, such as analyzing machinery performance, it became apparent that sustained listening to music through headphones, while marvelously realistic, is a downright nuisance for most persons. Therefore the sound from binaural tape was funneled through speakers instead. But the remarkable illusion gained through headphones no longer existed when speakers were substituted.

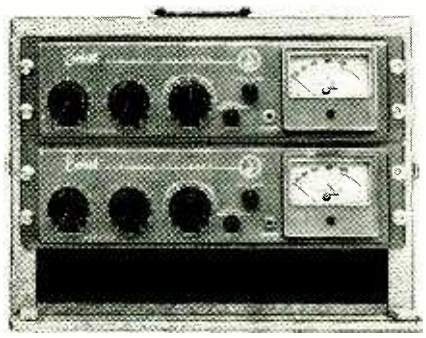
However, it was found that a good deal of the illusion could be regained by proper placement of microphones and speakers. Stereo reproduction through speakers, although still not as realistic as through headphones, has improved to the point that—weighing comfort against realism—stereo is preferable. Consequently, practically all the three-dimensional tapes made today are produced on a stereo basis; that is, the microphones are several feet rather than a few inches apart. It is to be expected that further advances in microphone technique and speaker location will continue to lessen the difference between binaural and stereophonic reproduction.

Stereo systems

Stereo reproduction (via speakers) is based on the "curtain-of-sound" theory. It assumes a soundproof curtain between the original source, say an orchestra, and the listener. This curtain is punctured—in monaural listening—by the single microphone on the stage and the single speaker in the listener's







Above, the Ampex S-5290 stereo recorder. Above right, Educational Laboratories model M-6A. Right, the Berlant-Concertone model 33-2 stereo recorder.

living room, giving rise to the so-called "hole-in-the-wall" type of reproduction. Hypothetically, for the curtain-of-sound effect, on the far side of the curtain is a line of microphones, while on the listener's side is an equal number of speakers. Each microphone is linked through an amplifier to the speaker directly opposite it. Thus each microphone–speaker combination constitutes a channel for penetrating the soundproof curtain. By inserting a tape recorder between each microphone and speaker, one introduces a time delay which permits the listener to hear the orchestra at a later time and at another site; the orchestra is brought into his own room.

While the curtain-of-sound theory does not operate perfectly because each microphone cannot be confined to an exact area, nevertheless it performs very well in practice. The number of transmission channels required to complete the stereophonic illusion ranges from four to six, depending upon the nature of the sound source. Experience has shown that a lesser number of channels can closely approach the stereophonic effect. A two-channel system is a major advance over a monaural (one speaker or two speakers fed from one channel) system. Another major step is achieved by a three-channel system, which is often considered to be optimum. Further increase in number of channels adds relatively little or nothing to the stereophonic sensation.

For economic and technical reasons, present stereo tape equipment intended for the home is two-channel although at least one company (Ampex) makes a professional three-channel machine with a price tag around $2,500. As previously indicated, however, a two-channel system can go a long way toward imparting the illusion of a three-dimensional source.

Two-channel stereo tapes require that the two microphones be spaced between 6 and 20 feet apart, depending on the sound source. Usually, the spacing is between 6 and 12 feet. The reproducing speakers should be similarly spaced if possible. It is recommended that both speakers be in line with each other so that their axes are parallel, as shown in Fig. 1-a, not turned in, as Fig. 1-b, so that their axes converge. Fig. 1-a corresponds to the curtain-of-sound principle previously described. Thus the stereophonic

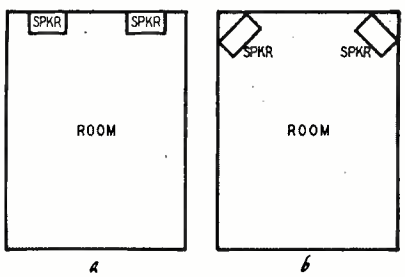


Fig. 1—Speaker placement at *a* is preferred to the toed-in arrangement at *b*.

illusion is preserved (more or less) in virtually any part of the room when the speakers are as in 1-a whereas the placement in 1-b causes the listener's position to be more critical for satisfactory results. Some authorities disagree as to the rigidity of this rule, and the listener may well experiment with speaker placement.

Although a stereo system apparently calls for doubling the audiophile's paraphernalia so far as control units, power amplifiers, speakers, etc. are concerned, this is not true when cost and space are considered. Dual preamplifier–amplifier combinations, all on one chassis, that are less than double the price of their monaural counterparts are available. If the user needs only add an additional amplifier to accommodate the second channel, he can do quite nicely with a unit of moderate power, say 10 watts, not only because the total power requirements are now divided between two channels, but also because music at a substantially lower level will provide the same sensation of sound filling the room as does a monaural system operated at high power.

So far as speakers are concerned, it has been observed that a stereophonic system makes considerably smaller demands than does a monaural system for the same degree of satisfaction. True, it would still be nice to have the best that money can buy. However, one is apt to find much less difference between relatively small and inexpensive speaker systems and their expensive brethren when using a stereo system than when reproducing monaurally. It has also been observed that stereo systems are more tolerant of limited frequency range and distortion.

On the other hand, it is felt in some quarters that ideal stereo results call for speakers with frequency response characteristics carefully matched to preserve the correct amplitude relationship between channels.

In-line vs. staggered heads

The stereo effect depends upon several acoustic phenomena, one of which is a difference in frequencies picked up by each microphone—"violins on the left, bass on the right"; another is difference in amplitude; a third is difference in phase of the same sound picked up by each microphone. Substantial importance is attributed to phase differences.

If the playback heads for each channel are not spaced exactly the same distance apart as in recording, the phase relationship between channels is altered. A number of authorities feel that it is therefore vital to preserve precisely the same spacing between heads in playback as in record. To this end the so-called *in-line* head has been developed. It consists of two individual heads constructed as a single unit so that the gap of one is vertically in line with the other. To align the two

gaps exactly is no small feat, so one in-line head at present often costs more than two equivalent single-gap heads.

In part because of cost, some manufacturers are using staggered heads, which are spaced 1.25 inches apart. Some authorities claim that gap spacing must be preserved with an accuracy on the order of .0001 inch (well-nigh impossible with staggered heads); others claim that in practice the spacing can be varied considerably before the ear detects a difference. Moreover, they believe, if a difference is detected, it does not necessarily follow that the stereophonic effect is less profound than it otherwise might have been. It is different, but not necessarily inferior.

From the viewpoint of fostering the stereophonic sensation, the battle of in-line vs staggered heads is still to be won decisively, although the trend appears to be toward in line. As a general rule, the more expensive machines use in-line heads, but some moderately priced units incorporate them as well.

In-line heads have at least two advantages apart from preservation of phase relationship. Mechanical positioning of a single in-line head with respect to the tape is simpler than alignment of two heads. A second important advantage is that editing is far simpler. Staggered heads pose the problem of cutting splices in staggered fashion to avoid detection.

On the other hand, the staggered-head system is—at least up to now—less costly and has the advantage of no cross-talk. There is mutual coupling between each section of an in-line head—each section, through induction, detects some of the signal picked up by the other section. Although the cross-coupled signal from the opposite channel is usually at least 35 to 40 db down, this nevertheless presents certain difficulties. If the head is used to play a stereo tape, some reproduction of channel A by head B and vice versa is not noticeable because, after all, both channels are reproducing the same material. However, if one section of and in-line head is to play track A of a dual-track monaural tape, then the unused section will pick up the signal from track B, transferring some of this signal to the first section. Even though the signal from track B is 40 db down, it can be quite disturbing during quiet passages of track A. Consequently, at least one of the machines with in-line heads uses an additional single-gap head for playing monaural dual-track tapes.

Commercial equipment

This section describes products already available or shortly to appear on the market and intended principally for home use in connection with recording and/or playing stereophonic tape. The author has tried to contact all tape-recorder manufacturers listed, to ascertain what stereo equipment is being made. Such omissions as may occur are therefore entirely inadvertent. Prices have been included wherever obtainable. Note that these are highly approximate and are given chiefly to show ratios of cost between one piece of equipment and another. Prices vary too greatly with time, geographical location and dealer audiophile policies to make it possible to come very close to the actual price at any given point some months after the article is written.

Stereo tape equipment presently or soon to be available offers the audiophile a great deal of choice in setting up a stereo system. He can purchase a unit which permits stereo recording as well as playback; he can purchase playback equipment only; he can purchase a complete stereo system inclusive of power amplifiers and speakers; he can purchase individual components intended for stereo use, such as tape transports, preamps, power amplifiers, heads, speakers, etc.

All the equipment discussed below is designed to operate at 7.5 inches per second. Most are designed to operate at 3.75 ips as well. Some offer the option of other speeds, such as 15 ips. In virtually all cases, the NARTB equalization characteristic is followed.

Record–playback units

Record–playback stereo machines now available include those of Ampex, Concertone, Amplifier Corporation of America and Educational Laboratories. Reference here is to an ensemble containing a transport mechanism and matched preamplifiers, with no assembly or adaptation of one unit to another required.

The Ampex stereo recorder, model S-5290 is available on special order. Except for the in-line heads, this model has the same components as the familiar monaural model 601 (formerly the 600, which had a high-impedance output). The tape transport is the same and so are the record–playback preamplifiers, two of which are used. However one of the preamplifiers contains no oscillator, means being provided for feeding bias and erase currents to both channels from the oscillator in the "master" preamplifier. Price of the S-5290 is $950 for the chassis alone and $995 in a portable case.

Ampex manufactures a companion amplifier–speaker combination, model 620, available in a portable case or in a "furniture" version at $169.50 (blond $10 additional). Model 620 contains equalization to compensate the frequency characteristics of the speaker in its enclosure so that the amplifier–speaker combination is substantially flat over an extended range. Altogether, a complete Ampex stereo system may be had at a cost of about $1,335.

Berlant-Concertone produces a stereo recorder in both its series 20 and series 30 lines. (The essential differences between the two are that the latter employs better motors in the transport and is manufactured under conditions of more rigid quality control and parts tolerances. The series 30 line costs $200 more.) Model 23 is priced at $795 and model 33 at $995; this includes transport and two preamplifiers, without enclosures. Model 33-2 is housed in two portable enclosures costing $120 additional. In the Berlant-Concertone units, each preamplifier has its own oscillator, the two being operated in synchronization to avoid beat frequencies. The company has introduced a variety of conversion kits which permit its monaural machines to be converted into stereo units either for playback only or for record as well as the playback function.

An amplifier–speaker combination is produced by Berlant-Concertone. Part No. 105250, priced at $150, is housed in a portable enclosure, and Part No. 105251, priced at $195, comes in a wood cabinet. Each cabinet also provides room for one preamplifier. Thus a complete system, including power amplifiers and speakers, would cost a minimum of $1,155 (series 20, portable enclosures) and a maximum of $1,460 (series 30, wood cabinets).

While intended for educational purposes, primarily language instruction, two machines marketed by Educational Laboratories may be used for home stereo recording and playback. Models M-6A and M-7 both employ staggered heads and are respectively priced at $269 and $295. At present the Educorder Duals, as they are called, do not offer response beyond 7,500 cycles at 7.5 ips, but a communication from Educational Laboratories states, "In the near future we will bring a companion model into production which will have improved frequency response, suitable for hi-fi recording and reproduction of stereophonic sound." The company offers two separate speakers in a split case (model EL-2S) for $48. Separate power amplifiers are not necessary as the Educorder Duals contain their own. The M-6A furnishes 1 watt per channel and the M-7 nearly 5 watts.

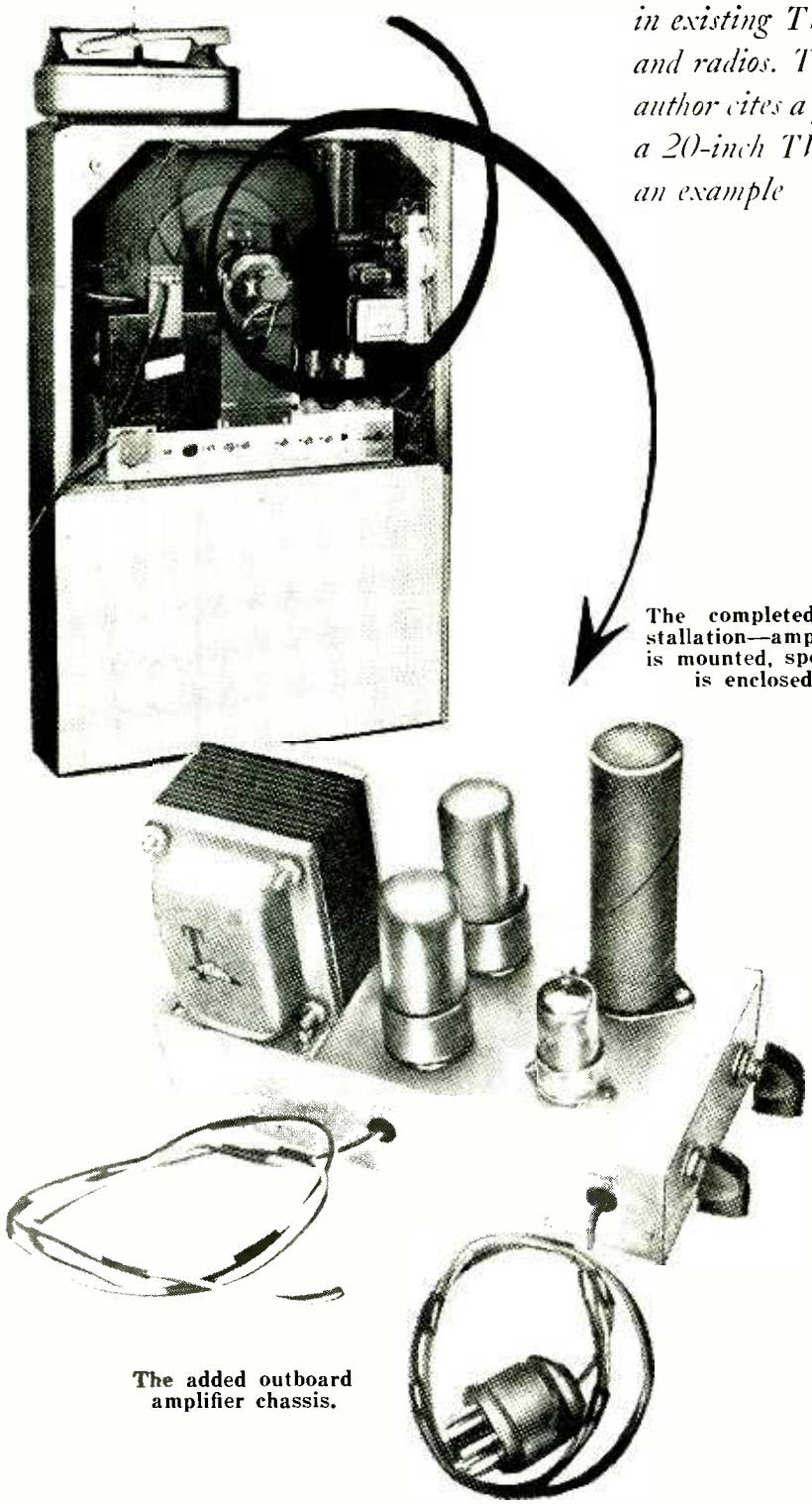
A portable battery-operated machine is manufactured by Amplifier Corporation of America. The Stereo-Magnemite uses staggered heads and has a price of $395 for the 7.5-ips model. Frequency response at this speed is 50–7,500 cycles. The transport has a spring-wound motor, which must be rewound every six minutes for the 7.5-ips model. The preamplifier is powered by batteries, which have a life of about 50 hours. The machine contains no erase head but for $13.50 additional an erasing device in the form of a permanent magnet may be obtained. Accessory stereo headphones are available (these permit playback checks in the field). Another accessory of interest is a spare-tube kit consisting of selected low-microphonic tubes. TO BE CONTINUED

The second and concluding part of this article will discuss playback units, conversion kits and other components and will contain a listing of stereo equipment available to date.

By JOSEPH CHERNOF

AUDIO CONVERSIONS are PROFITABLE

Improve the sound in existing TV's and radios. The author cites a job on a 20-inch TV as an example



The completed installation—amplifier is mounted, speaker is enclosed.

The added outboard amplifier chassis.

ONE of the service technician's more lucrative sidelines has been custom installation work. Most of these jobs are on high-fidelity audio equipment, although custom TV installations were quite popular a few years ago. The rewards in this field have been fairly high, yet few technicians have actively solicited this type of work.

Probably this is because technical ability in electronics does not necessarily qualify one as an interior decorator, cabinetmaker or carpenter. Conversely, the scarcity of technicians who can do satisfactory work in this line and the resulting high labor costs have priced custom installation beyond the reach of much of the potential market.

I have worked out what I believe a new approach to this dilemma. Here, the existing console radio–phonograph or TV set, already firmly established and accepted from a furniture standpoint, is audio-modified to give higher-fidelity performance. The modification is complete: the chassis is reworked, inferior components replaced and circuits poor in fidelity are redesigned. Even the acoustical properties of the cabinet are improved whenever possible.

Total costs are surprisingly small; most of the conversions I have worked on have been in the $50 to $75 range, yet results have been good. Best of all, the conversion of existing sets removes the appearance problem as a major factor. At the same time, you are able to present the customer with a complete, ready-made, easy-to-operate improved fidelity home sound system at a fraction of the cost of equivalent commercial sets or custom installations built from separately purchased units.

Only a few basic requirements need be met by a radio or TV set to justify its conversion: the set must be a console model, although a separate speaker enclosure plus a good speaker would do much to improve any table-model set. It should have a transformer type power supply; a push-pull audio output circuit is desirable. A reasonably substantial and attractive cabinet is just about a necessity. A built-in record changer would be convenient but not particularly important.

In the installation to be described, the original set—a Hoffman 20-inch console TV—met most of these qualifications. Its owner was an amateur musician of considerable ability. He had used the set, which was equipped with phono input jack, with an external three-speed record changer. Somewhere along the line he had heard some of his records played on a top-quality sound system and shortly thereafter asked

me to "make my equipment sound that way" in the most economical manner possible.

Approaching the problem

I examined the four main elements of his original sound system: phono cartridge, amplifier, speaker and enclosure, to determine what, if any, changes or substitutions were needed. The phono cartridge was a turnover type crystal unit. Its frequency response was quoted as being flat from 80 to 5,000 cycles, which hardly placed it within the high-fidelity class. This was replaced by an Electro-Voice type EV-47 push-pull ceramic cartridge, ideal for this application since the ceramic unit provides improved fidelity while retaining the low cost and high output voltage of a crystal unit. The relatively high output voltage makes additional preamplification unnecessary.

Using the ceramic cartridge necessitated changing R1 (Fig. 1) from 1 to 2 megohms and R2 from 500,000 ohms to 1 megohm to provide the proper 3-megohm load termination. Capacitor C1 was changed from 47 to 22 $\mu\mu$f. The speaker, an inexpensive 12-inch unit, was checked and found deficient in fidelity and power-handling ability at both ends of its range. An Electro-Voice type SP-12B, a good-performing moderately priced coaxial speaker, was substituted.

The amplifier circuit was checked and response curves taken at several levels. Fig. 2, made with an input of 1 volt from a Hewlett Packard 200D audio oscillator, is the voltage across the voice coil. The relatively poor fidelity was attributed to the inadequate output transformer, the normal limitations of a single-ended output stage without feedback and the small values of coupling capacitators used in the audio circuits. The power supply seemed adequate, but I made a note to check for a possible need for additional hum filtering in the audio B-plus supply.

Rather than making the most of the set's single-ended output, I decided to change to push-pull. To reduce the amount of modification work required in the original TV receiver chassis, an external output chassis (Fig. 3) was built. This contained phase-inverter and push-pull output tubes, an output transformer and tone controls. The output transformer was a Triad type S-31A. Power for the external chassis and the audio input signal were obtained from an adapter which plugged into the socket originally occupied by the 6K6 audio output tube.

Conventional circuits were used. A 12AX7 twin-triode drove push-pull 6V6's. The first section of the 12AX7 provided additional amplification and the second section was used as a phase splitter of the split-load or cathodyne type. Both treble and bass tone controls are in the grid circuit of the first 12AX7 section. Since the external output chassis was to be mounted in the rear of the set (see photo) adjacent to

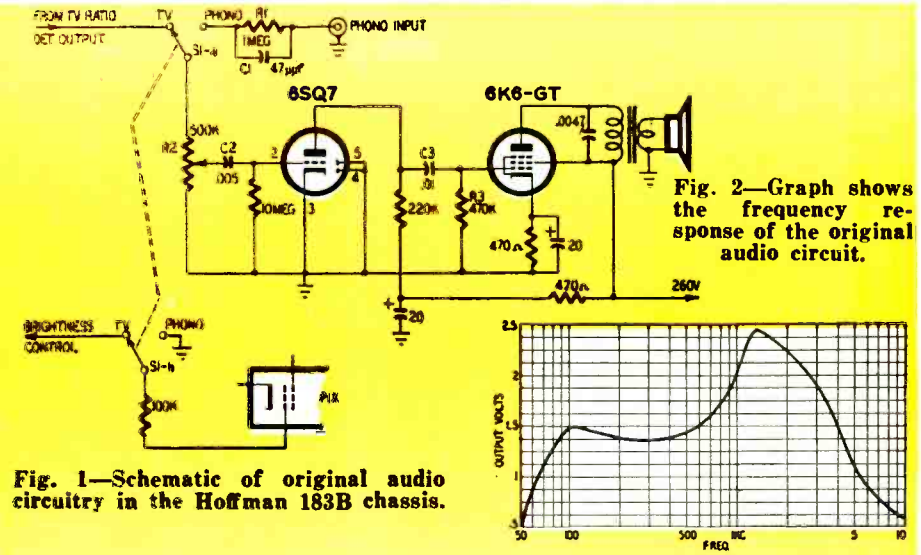


Fig. 1—Schematic of original audio circuitry in the Hoffman 183B chassis.

Fig. 2—Graph shows the frequency response of the original audio circuit.

the main chassis, these controls would not be readily accessible. However, since one of the main reasons for their use was to provide a flexible means for equalizing the various types of recording characteristics, it seemed unlikely that frequent readjustment would be necessary.

The power output stage is conventional; C1, C2, R1 and R2 are recommended by Triad engineers for use with the S-31A output transformer. The resistor and capacitor across each half of the output transformer primary winding work with the transformer leakage reactance, creating a low-pass filter to eliminate the extreme high frequencies and prevent instability. This permits substantial amounts of negative feedback with the feedback loop around all three stages of the output chassis. The speaker connections are made directly to the 8-ohm tap of the secondary winding of the output transformer.

The remaining modifications were done on the main TV chassis. The major problem here was to obtain the necessary ac and dc power for the external

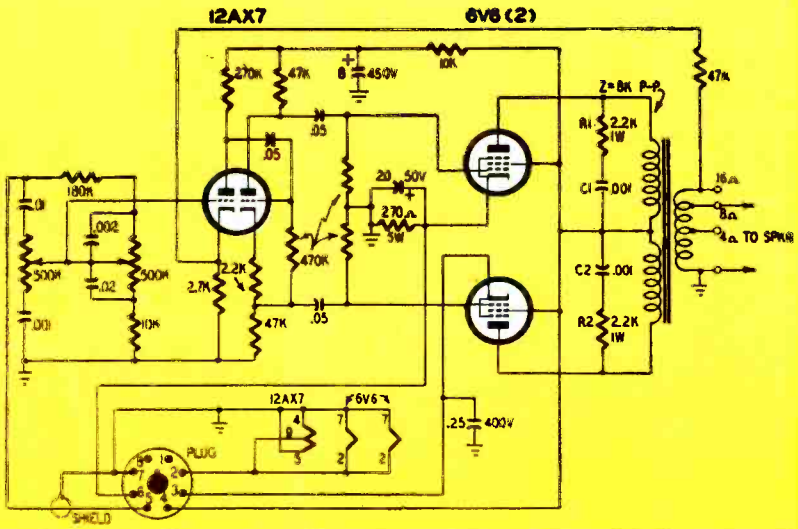


Fig. 3—Schematic diagram of the audio output amplifier fed from the TV set.

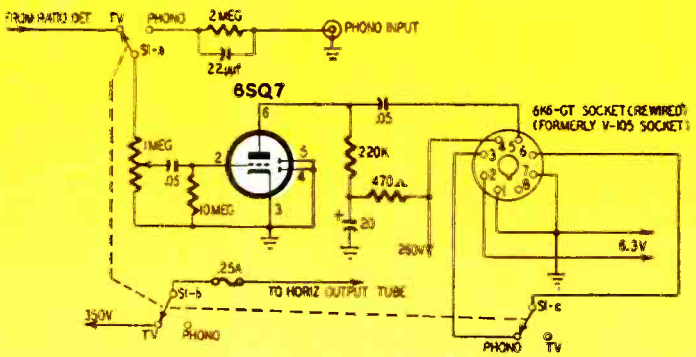


Fig. 4—Diagram shows modified circuits in the audio section of the televiser.

chassis without overloading the TV power supply. The most straightforward approach seemed to be to disable some of the high-current-drain TV circuits when the set was used solely for audio reproduction. This method, however, would not provide a means of operating the external chassis during TV reception.

The problem was solved by rewiring the TV–phono switch (Fig. 4). Originally, this switch changed the audio amplifier input from the ratio detector output to the phono input jack. It also switched the picture-tube control grid from the brightness control circuit to ground, cutting off the picture tube when the phonograph was being used.

In the revised circuit, a triple-pole double-throw switch was substituted for S1-a and S1-b (ganged sections of the original TV–phono switch). In the new circuit S1-a performs as before in switching the audio amplifier input from the ratio detector output to phono input; S1-b is in series with the ¼-amp fuse which carries the entire current of the horizontal output and damper tubes so that this supply is open in the PHONO position. The current thus obtained is ample for operation of the output chassis. Section S1-c opens the cathode return of one of the 6V6 output tubes which is run into the main chassis through the adapter. This cathode return is open for TV reception to cut down the B-plus drain of the output chassis to an amount only slightly more than that used by the original audio circuit.

Even using the single 6V6 output stage, due to the superior output transformer and speaker plus the negative feedback there is a substantial improvement in fidelity over the original TV audio circuit. Other changes made in the original TV receiver chassis are: R3 is deleted; C2 (.005 μf) and C3 (.01 μf) are both increased to .05 μf.

No provisions were made to supply the additional filament current requirements for the external output chassis. Fortunately, the original power transformer was able to handle the increased load. This was not completely a matter of chance since a uhf adapter jack at the rear of the receiver indicated that there would be spare filament current available from the power transformer. It is possible that in other modifications of this type a filament transformer might have to be added. This is a fairly low-cost item and should present no problem.

Parts for conversion amplifier

(does not include changes made in TV chassis)

Resistors: 1—2,200, 1—2,700, 1—10,000, 3—47,000, 1—180,000, 1—270,000, 3—470,000 ohms, ½ watt; 2—2,200, 1—10,000 ohms, 1 watt; 1—270 ohms, 5 watts; 2—500,000 ohms, potentiometers.

Capacitors: 3—.001, 1—.002, 1—.01, 1—.02, 3—.05, 1—0.25 μf, 400 volts; 1—8-μf 450-volt filter capacitor; 1—20-μf 50-volt filter capacitor.

Miscellaneous: 2—6V6's, 1—12AX7; 2—octal, 1—9-pin miniature socket; 1—octal adapter plug; 1—15-watt audio output transformer, good quality (Triad S-31A or equivalent) Pri: 8,000 ohms P-P, Sec: 4, 8, 16 ohms; 1—chassis; 1—3-pole 2-position switch; 2—knobs.

Reviewing the audio modifications made, an external high-quality audio output chassis was used in place of the original output tube. It was connected through an adapter to the original out put socket to pick up power–supply voltages and the audio input. The external unit provides push-pull output for phonograph playback and highly improved single-ended output for TV reception. The existing TV–phono switch on the main receiver chassis was modified to provide the additional current needed during phono operation by disabling the horizontal output circuits.

(When the amplifier in Fig. 3 is used for TV reception, there is the possibility that the potential difference between the open cathode and the grounded heater will cause leakage or shorting between these two elements. This might be minimized by using a separate transformer for the 6V6 heaters and leaving the secondary ungrounded or applying around 150 volts B plus to the center tap. A separate power supply for the audio chassis would be the ideal solution.—*Editor*)

The final step was an attempt to improve the acoustical properties of the cabinet. The physical volume available in the speaker compartment was sufficiently limited to make impractical any attempt to change it into a resonant type structure. The next best approach was to convert the enclosure into something remotely approaching an infinite baffle. This required complete suppression of any back radiation due to the speaker as well as eliminating completely any resonance effects due to the enclosure. It was necessary to line the whole interior of the speaker compartment with soundproofing material. This included covering the back and bottom of the enclosure, which were originally open (see photo). Not too much care was taken in applying and fastening the soundproofing material although nothing was left loose to vibrate at high sound-intensity levels. Additional pieces of lining were added to break up the interior of the enclosure and dampen any resonant tendencies.

This conversion job proved to be somewhat more complicated than average due to the changeover from single-ended to push-pull output. Reworking a set already featuring push-pull output would naturally be much simpler. Again, output transformer and speaker would be replaced with more adequate units.

Using a higher-quality output transformer would permit substantial amounts of inverse feedback with resulting improvement in fidelity.

There are, of course, many approaches to improving TV sound and using the TV audio amplifier for high-quality and even hi-fi reproduction. In some cases series-string filaments present new problems. This specific example shows what could be done. END

For Your Convenience . . .

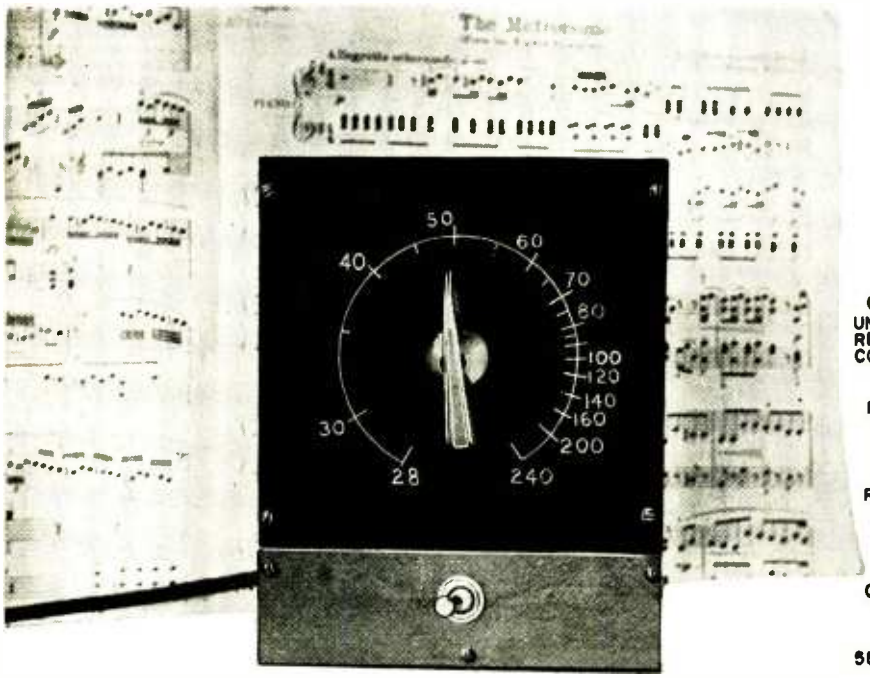
With the growing interest in construction—largely inspired by the transistor—RADIO-ELECTRONICS is including a larger number of construction articles. To make life easier for constructors (though hardly for the editors!), we are increasing the amount of information given in schematics and photographic illustrations.

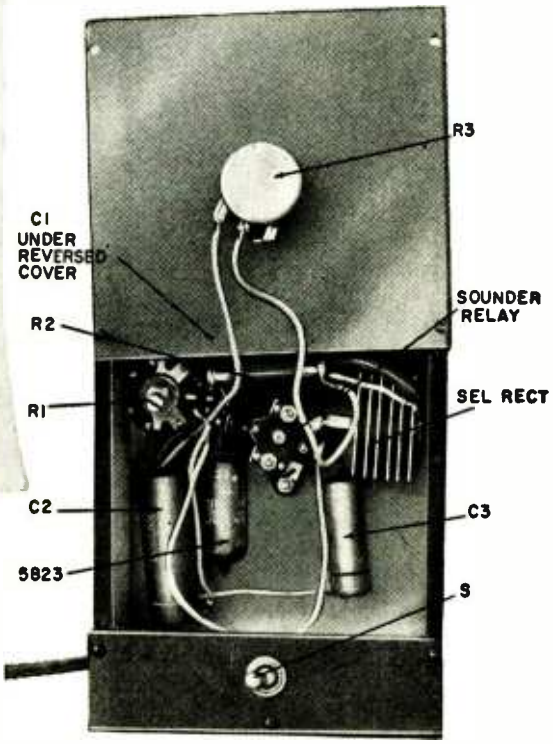
- SCHEMATICS will generally have all parts coded (R1, C2, etc.) in addition to our long-time practice of having the value noted next to the part.

- CODED PARTS LIST will also be furnished. This should settle such parts list questions as: which of the five 100 K-ohm resistors specified are ½ watt, 1 watt and 2 watt?

- PHOTOGRAPHS will have many more call-outs than in the past, to eliminate difficulties which might result from parts placement different from the original constructor's and to make parts location obvious without need for careful study.

Let us know what you think of these steps, and what others should be taken to help the reader make better use of his magazine.





Internal construction.

stable METRONOME at small cost

By TOM JASKI

MOST electronic metronomes described in recent years use either a multivibrator or some form of neon-tube oscillator. Both these oscillators are inherently unstable, particularly with variation in the supply voltage.

A cold-cathode tube is, with regard to trigger point, for all practical purposes unaffected by a reasonable variation in the supply voltage. In the metronome described here, which uses a 5823 cold-cathode relay tube, instability has been overcome to a great extent. Nevertheless, the circuit is simple and inexpensive.

The author's metronome, now in use for several years, has not yet required recalibration. It is instant starting, requiring no more warmup time than the space between beats, and produces a clear click very similar to that of the old mechanical metronomes. Visual indication could easily be added, but students should be looking at the music and not be distracted by the sight of a flashing light.

The circuit (see diagram), consists of a low-power dc supply with a 1-megohm voltage divider which charges the 0.5-μf trigger capacitor. This capacitor charges through the 470,000-ohm fixed resistor and the 5-megohm variable resistor. When the trigger voltage of the relay tube is reached it conducts for somewhat less than a half-cycle and the capacitor discharges through the arc in the tube. The conducting tube draws a fairly strong current through the sounder relay.

This relay can be almost any type with a coil dc resistance of at least 500 ohms (to limit the current in the 5823). The contacts should be removed, except in the case where the armature is returned only through contact pressure. In that case at least one contact spring should be left on. I used a small G-E relay picked up in surplus. The relay should be rigidly fastened to the back of the box. The click is produced by the armature hitting the core of the relay.

A cold-cathode relay tube can be regarded for this purpose as an all-or-nothing device. Thus, if we provide a relatively rapidly rising voltage to trigger the tube, the variation in trigger point will be very small compared to the spacing between beats. By selecting the value of the time-determining capacitor and resistors so that the charging current of the capacitor is still rising sharply, this variation is again minimized. In the circuit shown, the voltage divider is set for approximately 120 volts. The tube triggers at about 67.5 volts, when the capacitor is only half-charged.

The 0.1-μf capacitor synchronizes the triggering with the ac supply voltage, assuring that triggering always takes place at the same point on the half-cycle. In this way all beats are equally long and equally loud. The range of the metronome with the values shown is from 28 to 240 beats per minute, approximately equal to commercial metronomes.

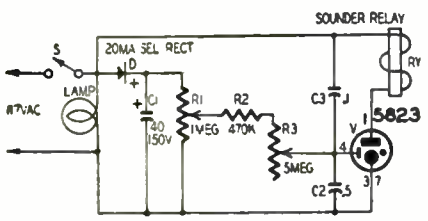
Some calibrating can be done with the voltage-divider setting. But if a calibration means is to be provided, a better way is to replace the 470,000-ohm fixed resistor with a 1-megohm variable.

The front of the metronome is a piece of transparent ruby plastic, edge-lighted by a 115-volt 3-watt G-E indicator light. The plastic is backed up with a piece of fishpaper to make it opaque to the interior. The figures are scratched onto the plastic with a sharp scriber and a lettering guide—free-hand only if you are extremely skillful at it.

A metal chassis box could be used for the enclosure, but a wooden or plastic box gave more satisfactory acoustic results. END

Parts for metronome

R1—1-megohm pot
R2—470,000 ohms, ½ watt
R3—500,000-ohm pot
C1—40-μf, 150 volts
C2—0.5 μf, 400 volts
C3—0.1 μf, 400 volts
D—20-ma selenium rectifier
V—5823
Lamp—115-volt 3-watt pilot light (G-E 3S6 or equivalent)
Ry—Relay (dc resistance at least 500 ohms—see text)
S—spst switch
Cabinet (see text)
Socket for 5823



Schematic of the metronome circuit.

New

MODEL O-11
Shpg. Wt. 21 Lbs.
$69.50

* *An improved model of what was already an outstanding instrument.*
* *Performance is unmatched in this price range.*
* *Incorporates the extra features required for color TV servicing.*

HEATHKIT ETCHED CIRCUIT, PUSH-PULL

5″ Oscilloscope Kit

COLOR TV

The previous Heathkit oscilloscope (Model O-10) which was already a most remarkable instrument, has been improved even further with the release of the Heathkit Model O-11. It incorporates all the outstanding features of the preceding model, *plus* improved vertical linearity, better sync stability, especially at low frequencies, and much-improved over-all stability of operation, including less vertical bounce with changes in level. These improvements in the Model O-11 circuit make it even more ideally suited for color TV servicing, and for critical observations in the electronic laboratory. Vertical response extends from 2 CPS to 5 MC without extra switching. Response only down 1½ DB at 3.58 MC. The 11-tube circuit features a 5UP1 cathode-ray tube. Sync circuit functions effectively from 20 CPS to better than 500 kc in five steps. Modern etched circuit boards employed in the oscilloscope circuit cut assembly time almost in half, permit a level of circuit stability never before achieved in an oscilloscope of this type, and insure against errors in assembly. Both vertical and horizontal output amplifiers are push-pull. Built-in peak-to-peak calibrating source — step-attenuated input — plastic molded capacitors and top-quality parts throughout — pre-formed and cabled wiring harness — and numerous other "extra" features. A professional instrument for the serviceshop or laboratory. Compare its specifications with those of scopes selling in much higher price brackets. You can't beat it!

Extra!

A FULL YEAR TO PAY

SEND FOR DETAILS OF HEATH TIME-PAYMENT PLAN.

1 FEWER DOLLARS BRING MORE REAL QUALITY.

- Factory-to-you sales eliminate extra profit margin.
- "Build-it-yourself" eliminates labor charge.
- Heath purchasing power cuts component costs.

2 PERSONAL SERVICE ASSURES CUSTOMER SATISFACTION.

- You deal directly with the manufacturer.
- We are interested in you before and after sale.

5 BIG REASONS WHY

Heathkits®

ARE YOUR BEST BUY...

3 PROVEN DESIGNS MEAN RELIABLE PERFORMANCE.

- Research and development efforts concentrated on kits only.
- All kits guaranteed to meet advertised specifications.

4 EVERY KIT BACKED BY WORLD-WIDE REPUTATION.

- The world's largest manufacturer of electronic equipment in kit form.
- Producer of more than a million electronic kits for the home workshop and industry.

5 EASY TIME-PAYMENT PLAN TO FIT YOUR BUDGET.

HEATH COMPANY

A SUBSIDIARY OF DAYSTROM, INC.

BENTON HARBOR 20, MICH.

GREATEST SELECTION . . .

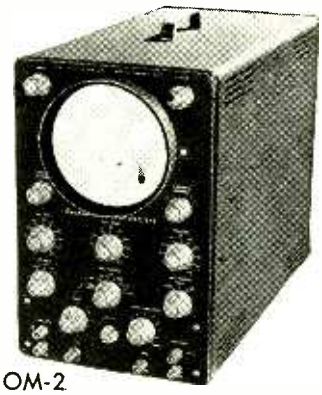
Whether your particular special interest is in servicing, ham-radio, high-fidelity, or just experimenting—there are Heathkits to fill your needs. You can equip an entire service shop or lab, buy a complete ham station or high-fidelity system, or set up a really deluxe home workshop, by choosing from the more than 70 different "do-it-yourself" electronic kits by Heath. Just glance through the kits displayed in this ad, and you will get some idea of the tremendous array of low-priced, high-quality electronic equipment available.

New **HEATHKIT ETCHED CIRCUIT**

5" Oscilloscope Kit

* *Brand new model with improved performance specifications.*
* *Full 5" scope for service work at a remarkably low price.*
* *Attractively styled front panel in charcoal gray with sharp white lettering.*
* *Easy to build from step-by-step instructions and large pictorials. Not necessary to read schematic.*

This new and improved oscilloscope retains all the outstanding features of the preceding model, but provides wider vertical frequency response, extended sweep-generator coverage, and increased stability. A new tube complement and improvements in the circuit make these new features possible. Vertical frequency response is essentially flat to over 1 mc, and down only 1½ DB at 500 kc. The sweep generator multivibrator functions reliably from 30 to 200,000 CPS, almost twice the coverage provided by the previous model. Deflection amplifiers are push-pull, and modern etched circuits are employed in critical parts of the design. A 5BP1 cathode-ray tube is used. The scope features external or internal sweep and sync, one volt peak-to-peak reference voltage, 3-position step-attenuated input, adjustable spot-shape control, and many other "extras" not expected at this price level. A calibrated grid screen is also provided for the face of the CRT, allowing more precise observation of wave shapes displayed. The new Model OM-2 is designed for general application wherever a reliable instrument with good response characteristics may be required. Complete step-by-step instructions and large pictorial diagrams assure easy assembly.



MODEL OM-2

$42.50

Shpg. Wt. 21 Lbs.

HEATHKIT LOW CAPACITY PROBE KIT

Oscilloscope investigation of high frequency, high impedance, or broad bandwidth circuits encountered in television requires the use of a low-capacity probe to prevent loss of gain, circuit loading, or waveform distortion. The Heathkit low-capacity probe may be used with your oscilloscope to eliminate these effects. It features a variable capacitor, to provide correct instrument impedance match. Also, the ratio of attenuation can be varied.

No. 342

$3.50

Shpg. Wt. 1 Lb.

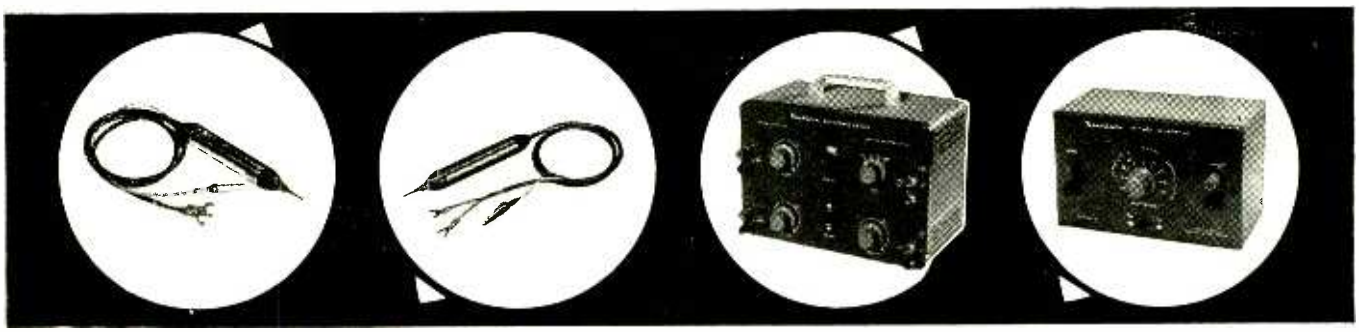
HEATHKIT ELECTRONIC SWITCH KIT

This handy device allows simultaneous oscilloscope observation of two signals by producing both signals, alternately, at its output. It features an all-electronic switching circuit, with no moving parts. Four switching rates are selected by a panel switch. Provides actual gain for input signals, and has a frequency response of ± 1 DB from 0 to 100 kc. Sync output provided to control and stabilize scope sweep. Will function at signal levels as low as 0.1 volt. This modern device finds many applications in the laboratory and service shop. It employs an entirely new circuit, and yet is priced lower than its predecessor.

MODEL S-3

$21.95

Shpg. Wt. 8 Lbs.



HEATHKIT SCOPE DEMODULATOR PROBE KIT

Extend the usefulness of your oscilloscope by employing this probe. Makes it possible to observe modulation of RF or IF carriers found in TV and radio receivers. Functions much like an AM detector to pass only modulation of signal, and not the signal itself. Among other uses, it will be helpful in alignment work, as a signal tracer, and for determining relative gain. Applied voltage limits are 30 volts (RMS) and 500 volts DC. It uses an etched circuit board to simplify assembly.

NO. 337-C

$3.50

Shpg. Wt. 1 Lb.

HEATHKIT VOLTAGE CALIBRATOR KIT

This entirely new voltage calibrator produces near-perfect square wave signals of known amplitude. Precision 1% attenuator resistors assure accurate output amplitude, and multivibrator circuit guarantees good, sharp square waves, as distinguished from clipped sine waves. Output frequency is approximately 1000 CPS. Fixed outputs selected by panel switch are; .03, 0.1, 0.3, 1.0, 3.0, 10, 30, and 100 volts peak-to-peak. Allows measurement of unknown signal amplitudes by comparing to known peak-to-peak output of VC-3 on an oscilloscope. Will also double as a square wave generator at 1000 cycles for determining gain, frequency response, or phase-shift characteristics of audio amplifiers. Equally valuable in the laboratory or in radio and TV service shops.

MODEL VC-3

$12.50

Shpg. Wt. 4 Lbs.

HEATHKIT ETCHED CIRCUIT VACUUM TUBE

$24.50

Shpg. Wt.
7 Lbs

- *Easy to build — a pleasure to use.*
- *1% precision resistors employed for high accuracy.*
- *Etched circuit board cuts assembly time in half.*

Voltmeter Kit

The fact that this instrument is the world's largest-selling VTVM says a great deal about its accuracy, reliability, and overall quality. The V-7A is equally popular in the laboratory or service shop, and represents an unbelievable test equipment bargain, without a corresponding sacrifice in quality. Its appearance reflects the performance of which it is capable. A large 4½" panel meter is used for indication, with clear, sharp calibrations for all ranges. Front panel controls consist of a rotary function switch and a rotary range selector switch, zero-adjust, and ohms-adjust controls. Precision 1% resistors are used in the voltage divider circuits and etched circuits are employed for most of the circuitry. This makes the kit much easier to build, eliminates the possibility of wiring errors, and assures duplication of laboratory instrument performance. This multi-function VTVM will measure AC voltage (rms), AC voltage (peak-to-peak), DC voltage, and resistance. There are 7 AC (rms) and DC voltage ranges of 0-1.5, 5, 15, 50, 150, 500, and 1500. In addition, there are 7 peak-to-peak AC ranges of 0-4, 14, 40, 140, 400, 1400, and 4000. 7 ohmmeter ranges provide multiplying factors of X1, X10, X100, X1000, X10K, X100K, and X1 megohm. Center-scale resistance readings are 10, 100, 1000, 10K, 100K ohms, 1 megohm, and 10 megohms. A DB scale is also provided. The precision and quality of the components used in this VTVM cannot be duplicated at this price through any other source. Model V-7A is the kind of instrument you will be proud to own and use.

HEATHKIT Etched Circuit RF PROBE KIT

This RF probe extends the frequency response of any 11-megohm VTVM so that it will measure RF up to 250 megacycles within ± 10%. Employs printed circuits for increased stability and ease of assembly. Ideal for extending service and laboratory applications of your Heathkit VTVM.

No. 309-C
$3.50
Shpg. Wt. 1 Lb.

HEATHKIT SCOPE DEMODULATOR PROBE KIT

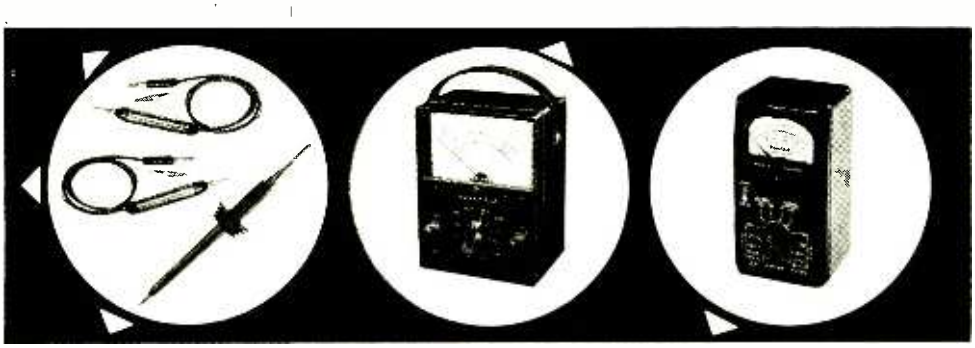
This probe functions like an AM detector to pass only modulation of signal and not signal itself. Permits observation of modulation from RF or IF carriers in TV and radio receivers. Extends usefulness of your oscilloscope. Voltage limits are 30 V. rms, and 500 V. DC. Very valuable in service or laboratory applications.

No. 337-C
$3.50
Shpg. Wt. 1 Lb.

HEATHKIT 20,000 OHMS/VOLT VOM KIT

Sensitivity of this instrument is 20,000 ohms-per-volt DC and 5,000 ohms-per-volt AC. Measuring ranges are 0-1.5, 5, 50, 150, 500, 1500, and 5000 volts for both AC and DC. Also measures current in the ranges of 0-150 microamperes, 15 ma, 150 ma, 500 ma, and 15 a. Resistance ranges provide multipliers of X1, X100, and X10,000, resulting in center scale readings of 15, 15,000, and 150,000 ohms. DB ranges cover from −10 db to −65 db. Housed in attractive black bakelite case with plastic carrying handle, this fine instrument provides a total of 25 meter ranges on its two-color scale. It employs a sensitive 50 microampere, 4½" meter and features all 1% precision multiplier resistors. Requires no external power, and is, therefore, valuable in portable applications where no AC power is available.

MODEL MM-1
$29.50
Shpg. Wt. 6 Lbs.



HEATHKIT 30,000 VOLT DC HIGH VOLTAGE PROBE KIT

This probe provides a multiplication factor of 100 on the DC ranges of the Heathkit 11-megohm VTVM. Precision multiplier resistor mounted inside the two-color plastic probe body. Plenty of insulation for completely safe operation, even at highest TV potentials. Designed especially for TV service work.

No. 336
$4.50
Shpg. Wt. 2 Lbs.

HEATHKIT HANDITESTER KIT

The Model M-1 measures AC or DC voltage at 0-10, 30, 300, 1000, and 5000 volts. Direct current ranges are 0-10 ma, and 0-100 ma. Ohmmeter ranges are 0-3000 (30 ohm center scale) and 0-300,000 ohms (3,000 ohms center scale). Uses a 400 microampere meter for sensitivity of 1000 ohms-per-volt. A very popular test device for the home experimeter, electricians, and appliance repairmen, and for use as an "extra" instrument in the service shop. Its small size and rugged construction make it perfect for any portable application. Easily slips into your tool box, glove compartment, coat pocket, or desk drawer. Top quality, precision components employed throughout.

MODEL M-1
$14.50
Shpg. Wt. 3 Lbs.

HEATH COMPANY
A Subsidiary of Daystrom, Inc.
BENTON HARBOR 20, MICH.

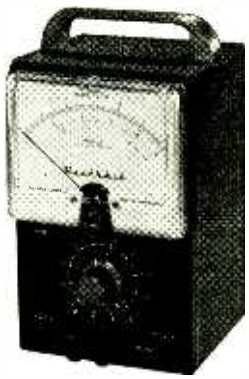
CONTROLLED QUALITY . . .

Incoming parts inspection, and inspection of material coming off of our own production line assures you of the finest "build-it-yourself" kit that money can buy. Each kit contains all the components you need for assembly—and you can have confidence in the quality of the parts themselves. In addition to this inspection procedure, an extensive proof-building program for each new kit guarantees easy-to-follow instructions and reliable performance.

HEATHKIT NEW AUDIO VACUUM TUBE

Voltmeter Kit

- *Brand new circuit for extended frequency response and added stability.*
- *Ten accurate ranges from 0-.01 to 0-300 volts.*
- *Modern, functional panel styling. "On-off" switch at both extreme ends of range switch.*



This brand new AC vacuum tube voltmeter emphasizes stability, broad frequency response, and sensitivity. It is designed especially for audio measurements, and low-level AC measurements in power supply filters, etc. Employs a cascode amplifier circuit with cathode-follower isolation between the input and the amplifier, and between the output stage and the preceeding stages. An extremely stable circuit with high input impedance (1 megohm at 1000 CPS). Response of the AV-3 is essentially flat from 10 CPS to 200 kc, and is usable for tests even beyond these frequency limits. Increased damping in the meter circuit stabilizes the meter for low frequency tests. Nylon insulating bushings at the input terminals reduce leakage, and permit the use of the 5-way Heath binding post.

The extremely wide voltage range covered by the AV-3 makes it especially valuable not only in high-fidelity and service work, but also in experimental laboratories. AC (RMS) voltage ranges are 0-.01, .03, .1, .3, 1, 3, 10, 30, 100, and 300 V. Decibel ranges cover −52 DB to +52 DB. An entirely new circuit as compared to the previous model. Employs 1% precision multiplier resistors for maximum accuracy. Handles AC measurements from a low value of one millivolt to a maximum of 300 volts.

MODEL AV-3
$29.95
Shpg. Wt. 5 Lbs.

HEATHKIT AUDIO WATTMETER KIT

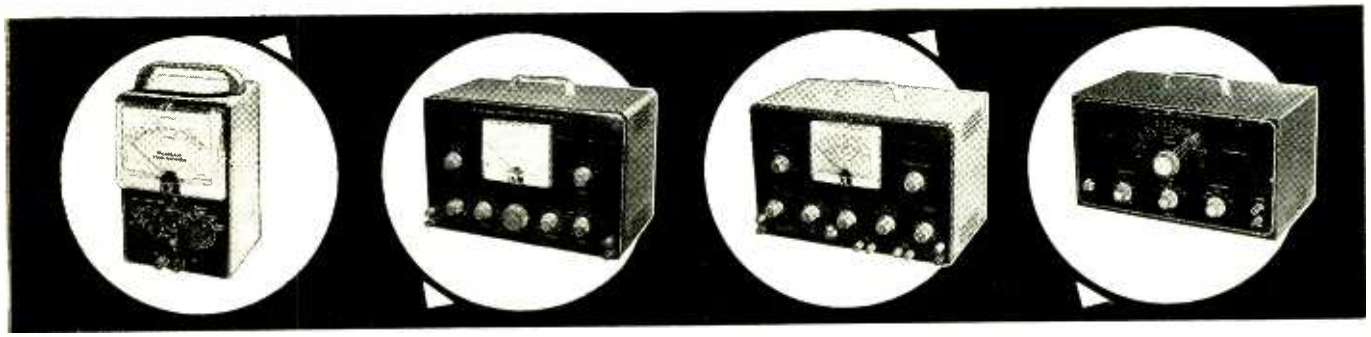
This instrument measures audio power directly at 4, 8, 16, or 600 ohms. Load resistors are built in. Covers 0-5 MW, 50 MW, 500 MW, 5 W, and 50 W full scale. Provides 5 switch-selected DB ranges covering from −10 DB to +30 DB. Large 4½" 200 microampere meter and precision multiplier resistors insure accuracy. Frequency response is ± 1 DB from 10 CPS to 250 kc. Functions from AC power line. Use in the audio laboratory or in home workshop.

MODEL AW-1
$29.50
Shpg. Wt. 6 Lbs.

HEATHKIT AUDIO ANALYZER KIT

This multi-function instrument combines an AC VTVM, an audio wattmeter, and an intermodulation analyzer into one case, with combined input and output terminals and built-in high and low frequency oscillators. The VTVM ranges are .01, .03, .1, .3, 1, 3, 10, 30, 100, and 300 volts (RMS). Wattmeter ranges are .15 MW, 1.5 MW, 15 MW, 150 MW, 1.5 W, 15 W, 150 W. IM scales are 1%, 3%, 10%, 30%, and 100%. Provides internal load resistors of 4, 8, 16, or 600 ohms. A valuable instrument for the engineer or serious audiophile.

MODEL AA-1
$49.95
Shpg. Wt. 13 Lbs.



HEATHKIT HARMONIC DISTORTION METER KIT

The HD-1 is equally valuable for the audio engineer or the serious audiophile. Used with a low-distortion audio signal generator, this instrument will measure the harmonic content of various amplifiers under a variety of conditions. Functions between 20 and 20,000 CPS, and reads distortion directly on the panel meter in ranges of 0-1, 3, 10, 30, and 100 percent full scale. Built-in VTVM for initial reference settings and final distortion readings has voltage ranges of 0-1, 3, 10, and 30 volts. 1% precision resistors employed for maximum accuracy. Features voltage regulation and other "extras". Meter calibrated in volts (RMS), percent distortion, and DB.

MODEL HD-1
$49.50
Shpg. Wt. 13 Lbs.

HEATHKIT AUDIO OSCILLATOR KIT

Producing both sine waves and square waves, the Model AO-1 covers a frequency range of 20 to 20,000 CPS in three ranges. An extra feature is thermistor regulation of output for flat response through the entire frequency range. AF output is provided at low impedance, and with low distortion. Produces good sine waves, and good, clean square waves with a rise time of only two micro-seconds for checking square wave response of audio amplifiers, etc. Designed especially for the serviceman and high-fidelity enthusiast. A real dollar value in test equipment.

MODEL AO-1
$24.50
Shpg. Wt. 10 Lbs.

HEATHKIT

Audio Generator Kit

$34.50

Shpg. Wt. 8 Lbs.

This particular audio generator is "made to order" for high fidelity applications. It provides quick and accurate selection of low-distortion signals throughout the audio range. Three rotary selector switches on the front panel allow selection of two significant figures and a multiplier for determining audio frequency. In addition, it incorporates a step-type output attenuator and a continuously variable attenuator. Output is indicated on a large 4½" panel meter calibrated in volts and in db. Attenuator system operates in steps of 10 db, corresponding with the meter calibration. Output ranges are 0-.003, .01, .03, .1, .3, 1, 3, and 10 volts rms. A "load" switch provides for the use of a built-in 600 ohm load or an external load of higher impedance when required. Output and frequency indicators accurate to within ± 5%. Distortion is less than .1 of 1% between 20 cps and 20,000 cps. Total range is 10 cps to 100 kc. New engineering details combine to provide the user with an unusually high degree of operating efficiency. Oscillator frequency selected entirely by the switch method means that accurate resetability is provided. Comparable to units costing many dollars more, and ideal for use in critical high fidelity applications. Shop and compare, and you will appreciate the genuine value of this professional instrument.

- *Less than 0.1% distortion — ideal for hi fi work.*
- *Large 4½" meter indicates output.*
- *Step-type tuning for maximum convenience.*

HEATHKIT RESISTANCE SUBSTITUTION BOX KIT

The RS-1 contains 36 10% 1-watt resistors ranging from 15 ohms to 10 megohms in standard RETMA values. All values are switch-selected for use in determining desirable resistance values in experimental circuits. Many applications in radio and TV service work.

MODEL RS-1

$5.50

Shpg. Wt. 2 Lbs.

HEATHKIT CONDENSER SUBSTITUTION BOX KIT

This kit contains 18 RETMA standard condenser values that can be selected by a rotary switch. Values range from 0.00001 mfd to 0.22 mfd. All capacitors rated at 400 volts or higher. Capacitors are either silver-mica, or plastic molded.

MODEL CS-1

$5.50

Shpg. Wt. 2 Lbs.

HEATHKIT AUDIO GENERATOR KIT

The Model AG-8 is a low cost, high performance unit for use in service shop, or home workshop. It covers the frequency range of 20 cps to 1 mc in five ranges. Output is 600 ohms, and overall distortion will be less than .4 of 1% from 100 cps through the audible range. Output is available up to 10 volts, under no load conditions, and output remains constant within ±1 db from 20 cps to 400 kc. A five-step attenuator provides control of the output. Precision resistors are employed in the frequency determining network.

MODEL AG-8

$29.50

Shpg. Wt. 11 Lbs.

HEATHKIT DECADE CONDENSER KIT

Precision, 1% silver-mica capacitors are employed in the Model DC-1 in such a way that a selection of precision capacitor values is provided ranging from 100 mmf (.0001 mfd) to 0.11 mfd (110,000 mmf) in 100 mmf steps. Extremely valuable in all types of design and development work. Switches are ceramic wafer types.

MODEL DC-1

$16.50

Shpg. Wt. 3 Lbs.

HEATHKIT DECADE RESISTANCE KIT

The Model DR-1 incorporates twenty 1% precision resistors arranged around five rugged switches so that various combinations of switch positions will provide a total range of 1 ohm to 99.999 ohms in 1-ohm steps. Switches are labeled "units," "tens," "hundreds," "thousands," and "ten thousands." Use it for ohm-meter calibration in bridge circuits as test values in multiplier circuits, etc.

MODEL DR-1

$19.50

Shpg. Wt. 4 Lbs.

HEATHKIT VARIABLE VOLTAGE REGULATED POWER SUPPLY KIT

This power supply is regulated for stability, and the amount of DC output available from the power supply can be controlled manually from zero to 500 volts. Will provide regulated output at 450 volts up to 10 ma, or up to 130 ma at 200 volts output. In addition to furnishing B-plus, the power supply provides 6 volts AC at 4 amperes for filaments. Both the B-plus output and the filament output are isolated from ground. Ideal power supply for use in experimental work in the laboratory, the home workshop, or the ham shack. Large 4½" panel meter indicates output voltage or current.

MODEL PS-3

$35.50

Shpg. Wt. 17 Lbs.

HEATH COMPANY
A Subsidiary of Daystrom, Inc.
BENTON HARBOR 20, MICH.

BONUS PERFORMANCE . . .

If a single word had to be selected to describe Heath Company advertising policy, it would be "conservative." By this we mean that the performance specifications and features are not exaggerated, and that the descriptions are accurate. We specify performance on the conservative side so you can be sure of equaling or exceeding our specifications. In almost every instance our kits will do more than we claim. Extra care in construction, and calibration against an accurate standard can extend performance well beyond advertised levels.

HEATHKIT

Signal Generator Kit

* *No calibration required with pre-aligned coils.*
* *Modulated or unmodulated RF output.*
* *110 mc to 220 mc frequency coverage.*

MODEL SG-8

$19.50 *Shpg. Wt. 8 Lbs.*

Here is an RF signal generator for alignment applications in the service shop or the home workshop. Thousands of these units are in use in service shops all over the country. Produces RF signals from 160 kc to 110 mc on fundamentals on five bands. Also covers from 110 mc to 220 mc on calibrated harmonics. RF output is in excess of 100,000 microvolts at low impedance. Output is controllable with a step-type and a continuously variable attenuator. Front panel controls provide selection of either unmodulated RF output or RF modulated at 400 cps. In addition, two to three volts of audio at approximately 400 cps are available at the output terminals for testing AF circuits. Employs a 12AU7 and a 6C4 tube. Built-in power supply uses a selenium rectifier.

One of the most outstanding features about the Model SG-8 is the fact that it can be built in just a few hours, even by one not thoroughly experienced in electronics work. Complete step-by-step instructions combined with large pictorial diagrams assure successful assembly. Pre-aligned coils make calibration from an external source unnecessary.

HEATHKIT LABORATORY GENERATOR KIT

This laboratory RF signal generator covers from 100 kc to 30 mc on fundamentals in five bands. The output signal may be pure RF, or may be modulated at 400 cycles from 0 to 50%. Provision for external modulation has been made. RF output available up to 100,000 microvolts. Output controlled by a fixed step and a variable attenuator. Output impedance is 50 ohms. Panel meter reads RF output or percentage of modulation. Incorporates voltage regulated B+ supply, double shielding of oscillator circuits, copper plated chassis, and other "extras."

MODEL LG-1

$48.95

Shpg. Wt. 16 Lbs.

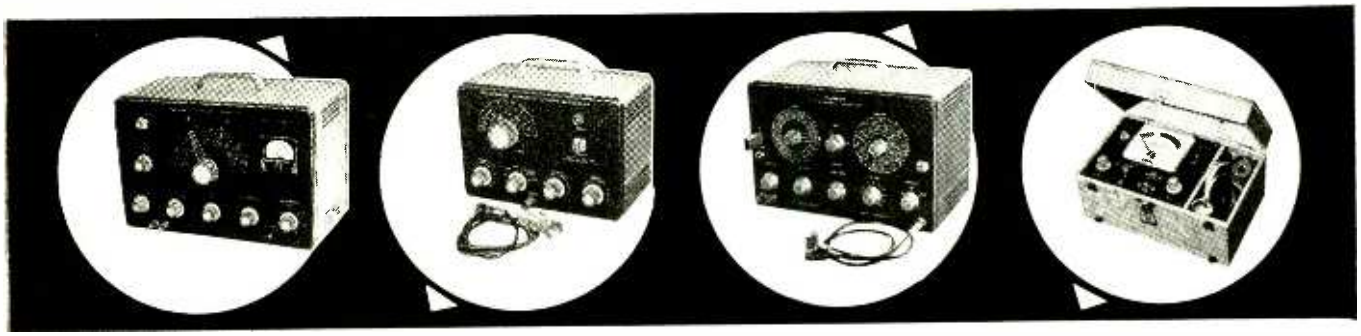
HEATHKIT TV ALIGNMENT GENERATOR KIT

This improved sweep generator model provides essential stability and flexibility for work on FM, monochrome TV, or color TV sets. Covers 3.6 mc to 220 mc in four bands. Provides usable output even on harmonics. Sweep deviation from 0-42 mc, depending on base frequency. All-electronic sweep circuit eliminates unwieldy mechanical arrangements. Includes built-in crystal marker generator providing output at 4.5 mc and multiples thereof, and variable marker covering 19 to 60 mc on fundamentals and from 57 to 180 mc on harmonics. Effective two-way blanking.

MODEL TS-4A

$49.50

Shpg. Wt. 16 Lbs.



HEATHKIT LINEARITY PATTERN GENERATOR KIT

This instrument supplies information for white dots, cross-hatch pattern, horizontal bar pattern, or vertical bar pattern. It feeds video and sync signals to the set under test, with completely controlled gain, and unusual stability. Covering channels 2 to 13, the LP-2 will produce 5 to 6 vertical bars and 4 to 5 horizontal bars. The dot pattern presentation is a *must* for the setting of color convergence controls in the color TV set. Panel provision made for external sync if desired. Use for adjustment of vertical and horizontal linearity, picture size, aspect ratio, and focus. Power supply is regulated for added stability. Essential in the up-to-date TV service shop.

MODEL LP-2

$22.50

Shpg. Wt. 7 Lbs.

HEATHKIT CATHODE RAY TUBE CHECKER KIT

This instrument checks cathode emission, beam current, shorted elements, and leakage between elements in electro-magnetic picture tube types. It eliminates all doubt for the TV serviceman, and even more important, for the customer. Features its own self-contained power supply, transformer operated to furnish normal test voltages for the CRT. Employs spring-loaded switches for maximum operator protection. Large 4½" meter indicates CRT condition on "good-bad" scale. Luggage-type portable case ideal for home service calls. Special "shadowgraph" test permits projection of light spot on screen. Also gives relative check of picture tube screen coating.

MODEL CC-1

$22.50

Shpg. Wt. 10 Lbs.

HEATHKIT

Tube Checker Kit

$29.50

Shpg. Wt. 12 Lbs.

This fine piece of test gear checks tubes for quality, emission, shorted elements, open elements, and filament continuity. Will test all tube types normally encountered in radio and TV service work. Sockets provided for 4, 5, 6, and 7-pin large, rectangular, and miniature types, octal and loctal types, the Hytron 9-pin miniatures, and pilot lamps. Condition of tubes indicated on a large 4½" meter with multi-color "good-bad" scale. An illuminated roll chart is built right in, providing test data for various tube types. This tester provides switch selection of 14 different filament voltage values from 0.75 volts to 117 volts. Individual switches control each tube element. Close tolerance resistors employed in critical test circuits for maximum accuracy. A professional instrument both in appearance and performance.

The Model TC-2 is very simple to build, even for a beginner. It employs a color-coded cable harness for neat, professional under-chassis wiring. Comes with attractive counter style cabinet, and portable cabinet is available separately. At this price, even the part-time serviceman can afford his own tube checker for maximum efficiency in service work.

- *Attractive counter-style cabinet.*
- *Wiring-harness simplifies assembly.*
- *Large 4½" meter with two-color "good-bad" scale.*
- *Separate tube element switches prevent obsolescence.*

HEATHKIT TV PICTURE TUBE TEST ADAPTER

Designed especially for use with the Model TC-2 tube checker. Use it to test TV picture tubes for emission, shorts, etc. Consists of 12-pin TV tube socket, 4 ft. cable, octal connector, and necessary technical data. Not a kit.

MODEL 355

$4.50

Shpg. Wt. 1 Lb.

HEATHKIT PORTABLE TUBE CHECKER KIT

MODEL TC-2P

This portable tube checker is identical, electrically, with the Model TC-2. However, it is housed in an attractive and practical carrying case, finished in proxylin impregnated material. The cover is detachable, and the hardware is brass plated. This rugged unit is ideal for home service calls or any portable application.

$34.50 Shpg. Wt. 15 Lbs.

HEATHKIT VISUAL-AURAL SIGNAL TRACER KIT

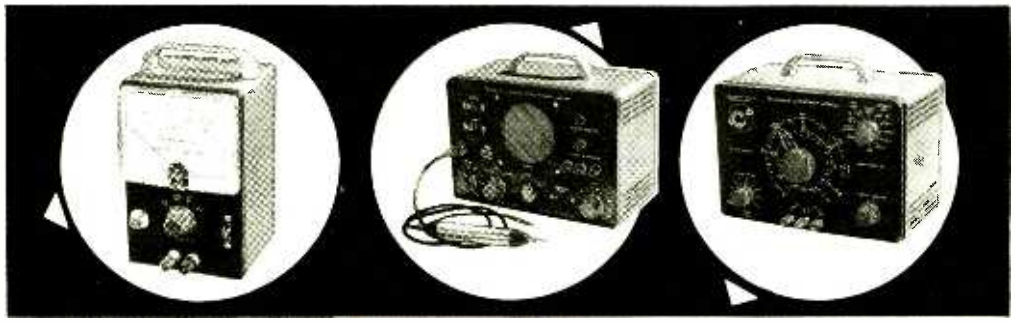
Although designed primarily for radio receiver work, this valuable instrument finds extensive application in FM and TV servicing as well. Features a high-gain channel with demodulator probe, and a low-gain channel with audio probe. Will trace signals in all sections of a radio receiver and in many sections of a FM set or TV receiver. Uses built-in speaker and electron beam eye tube for indication. Also features built-in wattmeter and a noise locater circuit. Provision for patching speaker and/or output transformer into external set.

MODEL T-3

$23.50

Shpg. Wt. 9 Lbs.

HEATHKIT DIRECT READING CAPACITY METER KIT



Operation of this instrument is simplicity itself. One has only to connect a capacitor to the terminals, select the proper range, and read the capacity value directly on the large 4½" meter calibrated in mmf and mfd. Ranges are 0 to 100 mmf, 1,000 mmf, 0.01 mfd, and 0.1 mfd full scale. Precision calibrating capacitors supplied. Not susceptible to hand capacity effects. Residual capacity less than 1 mmf. Especially valuable in production line checking, or in quality control.

MODEL CM-1

$29.50

Shpg. Wt. 7 Lbs.

HEATHKIT CONDENSER CHECKER KIT

The Model C-3 consists of an AC powered bridge for both capacitive and resistive measurements. Bridge balance is indicated on electron beam eye tube, and capacity or resistance value is indicated on front panel calibrations. Measures capacity in four ranges from .00001 mfd to .005 mfd, .001 mfd to .5 mfd, .1 mfd to 50 mfd, and 20 mfd to 1000 mfd. Measures resistance in two ranges, from 100 ohms to 50,000 ohms, and from 10,000 ohms to 5 megohms. Selection of five different polarizing voltages for checking capacitors, from 25 volts DC to 450 volts DC. Checks paper, mica, ceramic, and electrolytic capacitors. Indicates power factor of electrolytic condensers.

MODEL C-3

$19.50

Shpg. Wt. 7 Lbs.

HEATH COMPANY

A Subsidiary of Daystrom, Inc.

BENTON HARBOR 20, MICH.

PIONEER DESIGN . . .

New and unique approaches to instrument and equipment designs are a Heath Company tradition. We concentrate all our development efforts on kit projects, since this is our prime activity—and not just a sideline. This logically results in more efficient, more reliable circuit designs—and you benefit from this constant engineering progress. Buying from the undisputed leader in the electronic kit field assures you of completely modern equipment, with outstanding advanced design features.

HEATHKIT

Impedance Bridge Kit

- ½% *precision resistors and silver-mica capacitors.*
- *Battery-type tubes, no warm-up required.*
- *Built-in phase shift generator and amplifier.*

The Model IB-2 is a completely self-contained unit. It has a built-in power supply, a built-in 1000 cycle generator, and a built-in vacuum tube detector. Provision has been made on the panel for connection to an external detector, an external signal generator, or an external power supply. A 100-0-100 microampere meter on the front panel provides for null indications. Measures resistance from 0.1 ohm to 10 megohms, capacitance from 10 mmf to 100 mfd, inductance from 10 mh to 100 h, dissipation factor (D) from 0.002 to 1, and storage factor (Q) from 0.1 to 1000. ½ of 1% decade resistors employed for maximum accuracy. Typical accuracy figures are: resistance, ±3T; capacitance ±3%; inductance, ±10%; dissipation factor, ±20%; storage factor, ±20%. Employs a Wheatstone bridge, a Capacity Comparison bridge, a Maxwell bridge, and a Hay bridge. Special two-section CRL dial provides maximum convenience in operation. Use the Model IB-2 for determining values of unmarked components, checking production or design samples, etc. A real professional instrument.

MODEL IB-2

$59.50 *Shpg. Wt. 12 Lbs.*

HEATHKIT "Q" METER KIT

The Q Meter permits measurement of inductance from 1 microhenry to 10 millihenries, "W" on a scale calibrated up to 250 full scale, with multiplying factors of 1 or 2, and capacitance from 40 mmf to 450 mmf, ±3 mmf. Built-in variable oscillator permits testing components from 150 kc to 18 mc. Large 4½" panel-mounted meter is features. Very handy for checking peaking coils, chokes, etc. Use to determine values of unknown condensers, both variable and fixed. Compile data for coil winding purposes, or measure RF resistance. Distributed capacity, and Q of coils.

MODEL QM-1

$44.50

Shpg. Wt. 14 Lbs.

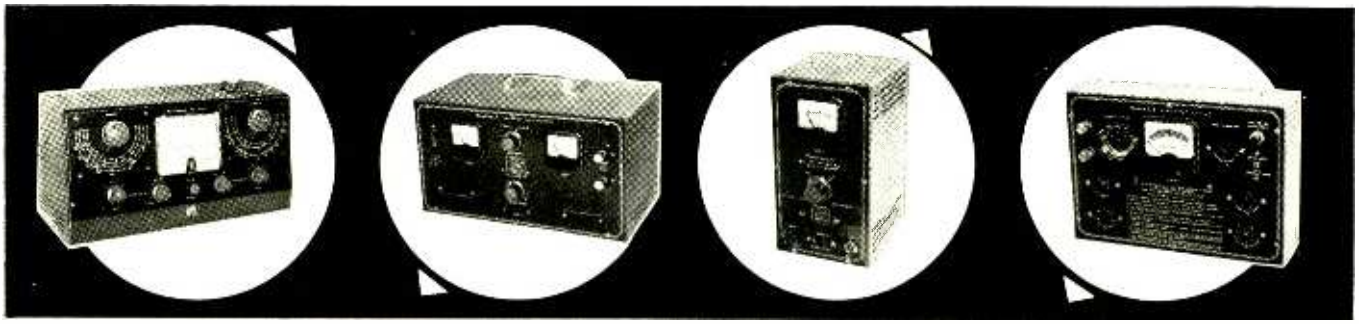
HEATHKIT ISOLATION TRANSFORMER KIT

This device isolates equipment under test from the power line. It is rated at 100 volt-amperes continously, or 200 volt-amperes intermittently. AC-DC sets may be plugged directly into the IT-1 without the chassis becoming "hot." Additionally, since the IT-1 is fused, it is ideal for use as a buffer between the power line and a questionable receiver, or a new piece of equipment. Protects main fuses. Features voltage control, allowing control of the output from 90 volts to 130 volts. Panel meter monitors output voltage. A very handy device at an extremely low price.

MODEL IT-1

$16.50

Shpg. Wt. 9 Lbs.



HEATHKIT 6-12 VOLT BATTERY ELIMINATOR KIT

This completely modern battery eliminator will supply DC output in two ranges for both 6-volt and 12-volt automobile radios. The output is variable for each range, so that operating voltage can be raised or lowered to determine how the receiver functions under adverse conditions. Range is 0-8 volts DC or 0-16 volts DC. Will supply up to 15 amperes on the 6-volt range, or up to 7 amperes on the 12-volt range. Two 10,000 microfarad output filter capacitors insure smooth DC output. Two separate panel meters indicate output voltage or output current. Makes it possible to test automobile radios inside at the workbench. Will also double as a battery charger.

MODEL BE-4

$31.50

Shpg. Wt. 17 Lbs.

HEATHKIT 6-VOLT VIBRATOR TESTER KIT

This instrument functions very much like a tube checker, to test auto radio vibrators. Vibrator condition is indicated on a simple "good-bad" scale. Tests for proper starting and overall quality of operation, of both interrupter and self-rectifier types of 6-volt vibrators. The model VT-1 is designed to operate from any battery eliminator capable of delivering continuously variable output from 4 to 6 volts DC at 4 amperes or more. It is an ideal companion unit for the Heathkit Model BE-4 battery eliminator. The construction book for the VT-1 contains vibrator test chart for popular 6-volt vibrator types. A real time saver!

MODEL VT-1

$14.50

Shpg. Wt. 6 Lbs.

HEATHKIT DX-100 PHONE AND CW

MODEL DX-100
Shpg. Wt. 107 Lbs.

$189.50

Shipped motor freight unless otherwise specified.
$50.00 deposit required on c.o.d. orders.

- *Phone or CW on 160, 80, 40, 20, 15, 11 and 10 meters.*
- *Built-in VFO, modulator, and power supplies.*
- *High quality components used throughout for reliable performance.*
- *Features 5-point TVI suppression.*

Transmitter Kit

The Heathkit DX-100 transmitter is in a class by itself in that if offers features far beyond those normally received at this price level. It takes very little listening on the bands to discover how many of these transmitters are in operation today. A truly amazing piece of amateur gear. The DX-100 features a built-in VFO and a built-in modulator. It is TVI suppressed, and uses pi network interstage coupling and output coupling. Will match antenna impedances from approximately 50 to 600 ohms. Extensive shielding is employed, and all incoming and outgoing circuits are filtered. The cabinet features interlocking seams for simplified assembly and minimum RF radiation outside of the cabinet. Provides a clean strong signal on either phone or CW, with RF output in excess of 100 watts on phone, and 120 watts on CW. Completely bandswitching from 160 through 10 meters. A pair of 1625 tubes are used in push-pull for the modulator, and the final consists of a pair of 6146 tubes in parallel. The VFO dial and meter face are illuminated, and all front panel controls are located for maximum convenience. Panel meter reads driver plate I, final grid I, final plate I, final plate voltage, and modulator current. The chassis is constructed of heavy #16 gauge copper-plated steel. Other high-quality components include potted transformers, ceramic switch and variable capacitor insulation, silver-plated or solid-silver switch terminals, etc. All coils are pre-wound, and the main wiring cable is pre-harnessed. The kit can be built by a beginner from the comprehensive step-by-step instructions supplied. It is a proven, trouble-free rig, that will insure many hours of "on-the-air" enjoyment in your ham shack.

HEATHKIT COMMUNICATIONS TYPE ALL BAND RECEIVER KIT

This receiver covers 550 kc to 30 mc in four bands, and is ideal for the short-wave listener or beginning amateur. It provides good sensitivity and selectivity, combined with good image rejection. Amateur bands clearly marked on illuminated dial scale. Employs transformer type power supply—electrical bandspread—antenna trimmer—separate RF and AF gain controls—noise limiter—headphone jacks—and automatic gain control. Has built-in VFO for CW reception.

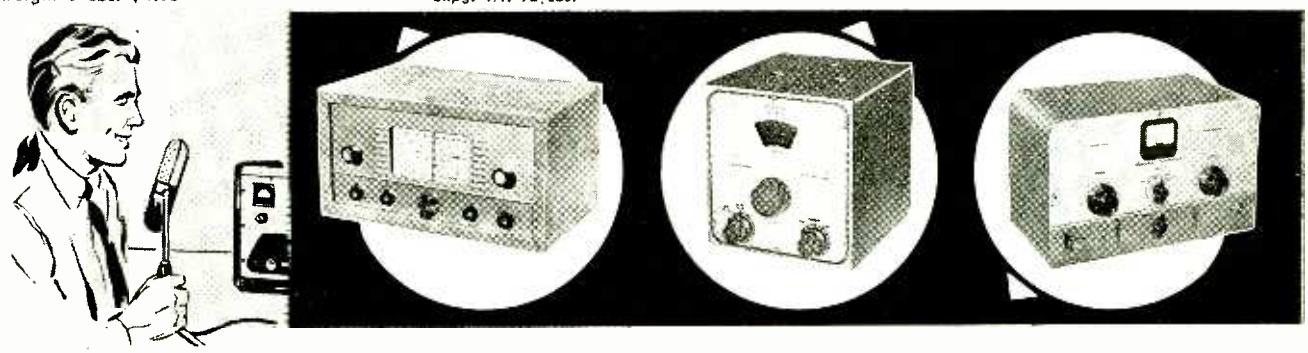
MODEL AR-3
$30.75
INCLUDING NEW EXCISE TAX‡
(Less Cabinet)
Shpg. Wt. 12 Lbs.

CABINET; Fabric covered cabinet with aluminum panel as shown. Part 91-15A. Shipping weight 5 Lbs. $4.95‡

HEATHKIT VFO KIT

You can go VFO for less than you might expect. Here is a variable frequency oscillator that covers 160, 80, 40, 20, 15, 11, and 10 meters with three basic oscillator frequencies, that sells for less than $20. Provides better than 10 volt average RF output on fundamentals. Plenty of drive for most modern transmitters. Requires a power source of only 250 VDC at 15 to 20 ma. and 6.3 VAC at 0.45A. Incorporates a regulator tube for stability. Illuminated frequency dial reads frequency directly on the band being employed. Temperature-compensated capacitors offset coil heating.

MODEL VF-1
$19.50
Shpg. Wt. 7 Lbs.



EASY ON THE BUDGET!

You can buy Heathkits on an easy time-payment plan that provides a full year to pay. Write for complete details and special order blank.

HEATH COMPANY
A Subsidiary of Daystrom, Inc.
BENTON HARBOR 20, MICH.

HEATHKIT CW TRANSMITTER KIT

This is the original low-priced Heathkit CW transmitter. Its reliable performance has been proven time and time again on the CW bands. Designed for crystal control, the Model AT-1 covers 80, 40, 20, 15, 11, and 10 meters. May be excited from external VFO. Plate power input up to 30 watts. Power supply built in. Panel meter indicates grid current or plate current for final. Incorporates pre-wound coils, copper-plated chassis, built-in line filter, profuse shielding, and top-quality parts throughout. Crystal socket and key jack on front panel. Built-in key-click filter, and single-knob bandswitching. 52-ohm coaxial output. Uses 6AG7 oscillator-multiplier, 6L6 power amplifier-doubler, and 5U4G rectifier.

MODEL AT-1
$29.50
Shpg. Wt. 25 Lbs.

DOLLAR-SAVING ECONOMY . . .

There would be no particular achievement in selling inexpensive merchandise at a low price—although it is being done every day. However, there is something to crow about when, through tremendous purchasing power and factory-to-you distribution, Heath Company can offer top quality equipment, using name-brand components, at such low prices. This is real economy, as opposed to the so-called "bargains". Needless to say, there is a big difference.

HEATHKIT PHONE AND CW

Transmitter Kit

* *6146 final amplifier for full 65-watt plate power input.*
* *Phone and CW operation on 80, 40, 20, 15, 11, and 10 meters. Pi network output coupling.*
* *Switch selection of three crystals — provision for external VFO excitation.*

MODEL DX-35

$56.95 Shpg. Wt. 24 Lbs.

The DX-35 features a 6146 final amplifier to provide 65 watts plate power input on CW, with controlled carrier modulation peaks up to 50 watts on phone. In addition, it is a most attractive transmitter. Modulator and power supplies are built-in, and the rig covers 80, 40, 20, 15, 11, and 10 meters with a single band-change switch. Pi network output coupling provided for matching various antenna impedances. A 12BY7 buffer stage provided ahead of the final amplifier for plenty of drive on all bands. 12BY7 oscillator and 12AU7 modulator. Provision for switch selection of three different crystals. Crystals reached through access door at rear. Front panel controls marked "off—CW—stand-by—phone", "final tuning", "antenna coupling", "drive level control", and "band change switch". Panel meter indicates final grid current or final plate current. A perfect low-power transmitter both for the novice, and for the more experienced operator. A remarkable power package for the price. Incidentally, the price includes tubes, and all other components necessary for assembly. As with all Heathkits, comprehensive instruction manual assures successful assembly.

HEATHKIT ANTENNA IMPEDANCE METER KIT

This instrument employs a 100 microampere panel meter and covers the impedance range of 0-600 ohms for RF tests. Functions up to 150 mc. Used in conjunction with signal source, such as the Heathkit Model GD-1B grid dip meter, the Model AM-1 will determine antenna resistance and resonance, match transmission lines for minimum standing wave ratio, determine receiver input impedance, etc. Will also double as a phone monitor. A very valuable device for many uses in the ham shack.

MODEL AM-1

$14.50

Shpg. Wt. 2 Lbs.

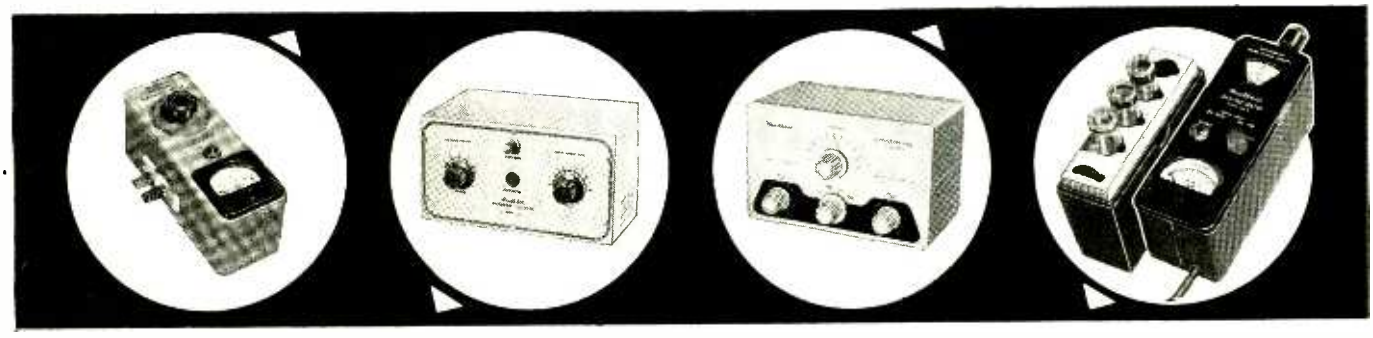
HEATHKIT "Q" MULTIPLIER KIT

The QF-1 functions with any receiver with an IF frequency between 450 and 460 kc that is not AC-DC type. Operates from the receiver power supply, requiring only 6.3 VAC at 300 ma. and 150 to 250 VDC at 2 ma. Simple to connect with cable and plugs supplied. Provides additional selectivity for separating two signals, or will reject one signal and eliminate heterodyne. A big help on crowded bands. Provides an effective Q of approximately 4,000 for Sharp "peak" or "null". Tunes to any signal within the IF bandpass of the receiver, without changing main receiver tuning dial.

MODEL QF-1

$9.95

Shpg. Wt. 3 Lbs.



HEATHKIT ANTENNA COUPLER KIT

This device is designed to match the Model AT-1 transmitter to a long-wire antenna. In addition to impedance matching, this unit incorporates an L-type filter which attenuates signals above 36 megacycles, thereby reducing TVI. Designed for 52 ohm coaxial input. Handles power up to 75 watts, 10 through 80 meters. Uses a tapped inductor and variable capacitor. Neon RF indicator on front panel. Copper-plated chassis—high quality components throughout—simple to build. Eliminates waste of valuable communications power due to improper matching. A "natural" for all AT-1 transmitter owners.

MODEL AC-1

$14.50

Shpg. Wt. 4 Lbs.

HEATHKIT GRID DIP METER KIT

The grid dip meter was originally designed for the ham shack. However, its use has been extended into the service shop and laboratory. Continuous frequency coverage from 2 mc to 250 mc with pre-wound coils. 500 microampere panel meter employed for indication. Use for locating parasitics, neutralizing, determining RF circuit resonant frequencies, etc. Coils are included with kit, as is a coil rack. Front panel controls include sensitivity control for meter, and phone jack for listening to zero-beat. Will also double as an absorbtion-type wavemeter.

MODEL GD-1B

$19.95

Shpg. Wt. 4 Lbs.

HEATHKIT BROADCAST BAND

Receiver Kit

You need no previous experience in electronics to build this table-model radio. The Model BR-2 receiver covers 550 kc to 1620 kc and features good sensitivity and selectivity over the entire band. A 5½" PM speaker is employed, along with high gain miniature tubes and a new rod-type built-in antenna. Provision has been made in the design of this receiver for its use as a phonograph amplifier. The phono jack is located on the back chassis apron. A transformer operated power supply is featured for safety of operation, as opposed to the usual AC-DC supply commonly found in "economy radio kits." Don't let the low Heathkit price deceive you. This is the kind of set you will want to show off to your family and friends after you have finished building it.

Construction of this radio kit is very simple. Giant size pictorial diagrams and detailed step-by-step instructions assure your success. The construction manual also includes an explanation of basic receiver circuit theory so you can "learn by doing" as the receiver is built. The manual even provides information on resistor and capacitor color codes, soldering techniques, use of tools, etc. If you have ever had the urge to build your own radio receiver, the outstanding features of this popular Heathkit deserve your attention.

ATTENTION BEGINNERS . . .

This kit is an ideal "first project" if you have never built a Heathkit before. A good chance to "learn by doing."

- ✻ *Miniature tubes and high-gain IF transformer.*
- ✻ *Rod-type built-in antenna. Good sensitivity and selectivity.*
- ✻ *5½-inch PM speaker.*
- ✻ *Provision for phono jack.*
- ✻ *Transformer - operated power supply.*

CABINET: Proxylin impregnated fabric covered plywood cabinet available for the BR-2 receiver as shown. Complete with aluminum panel, reinforced speaker grill, and protective rubber feet. Shipping weight 5 lbs., part No. 91-9A.....$4.95‡

HEATHKIT PROFESSIONAL RADIATION COUNTER KIT

This sensitive and reliable instrument has already found extensive application in prospecting, and also in medical and industrial laboratories. It offers outstanding performance at a reasonable price. Front-panel meter indicates radiation level, and oral indication produced by panel-mounted speaker. Meter ranges are 0-100, 600, 6,000 and 60,000 counts per minute, and 0—.02, .1, 1 and 10 milliroentgens per hour. The probe, with expansion cord, employs type 6306 bismuth counter tube, sensitive to both beta and gamma radiation. It is simple to build, even for a beginner.

MODEL RC-1
$79.95
Shpg. Wt. 8 Lbs.

HEATHKIT CRYSTAL RECEIVER KIT

The crystal radio of Dad's day is back again, but with big improvements! The Model CR-1 employs a sealed germanium diode, eliminating the critical "cat's whisker" adjustment. It is housed in a compact plastic box, and features two Hi-Q tank circuits, employing ferrite core coils and variable air tuning capacitors. The CR-1 covers the standard broadcast band from 540 kc to 1600 kc, and no external power is required for operation. Could prove valuable for emergency signal reception. This easy-to-build kit is a real "learn by doing" experience for the beginner, and makes an interesting project for all ages.

MODEL CR-1
$8.75
INCLUDING NEW EXCISE TAX‡
Shpg. Wt. 3 Lbs.

- ✻ *Amazing new circuit for high efficiency.*
- ✻ *Compact, portable and rugged.*
- ✻ *Stable circuit requires only one 67½ volt "B" battery and two 1½ volt "A" batteries.*

HEATHKIT ENLARGER TIMER KIT

The Model ET-1 is an easy-to-build device for use by amateur or professional photographers in controlling the timing cycle of an enlarger. It covers the range of 0 to 1 minute with a continuously variable, clearly calibrated scale. The timing period is pre-set, and the timing cycle is initiated by depressing the spring-return switch to the "print" position. Front panel provision is made for plugging in the enlarger and a safelight. The safelight is automatically turned "on" when the enlarger is "off". Handles up to 350 watts. The timing cycle is controlled electronically for maximum accuracy and reliability. Very simple to build in only one evening, even by a beginner.

MODEL ET-1
$11.50
Shpg. Wt. 3 Lbs.

HEATH COMPANY
A Subsidiary of Daystrom, Inc.
BENTON HARBOR 20, MICH.

COMPREHENSIVE INSTRUCTIONS . . .

The step-by-step assembly instructions provided with each Heathkit are the finest available anywhere. Each manual begins at the beginning, and assumes no previous training or experience on the part of the kit builder. This means that our kits can be built successfully by anyone who can follow instructions. As a matter of fact, new manuals are tested by having the kit built by someone in our office who has had no previous experience in electronics. This is your guarantee of complete and thorough instruction material.

HEATHKIT HIGH FIDELITY

Preamplifier Kit

- *5 switch-selected inputs, each with its own level control.*
- *Equalization for LP, RIAA, AES, and Early 78's.*
- *Separate bass and treble tone controls, and special hum control.*
- *Clean, modern lines and satin-gold enamel finish.*

Literally thousands of these preamplifiers are in use today, because the kit meets or exceeds specifications for the most rigorous high-fidelity applications, and will do justice to the finest available program sources. Provides a total of 5 inputs, each with individual level controls (three high-level and two low-level). Frequency response is within 1 DB from 25 CPS to 30,000 CPS, or within 1½ DB from 15 CPS to 35,000 CPS. Hum and noise are extremely low, with special balance control for absolute minimum hum level. Tone control provides 18 DB boost and 12 DB cut at 50 CPS, and 15 DB boost and 20 DB cut at 15,000 CPS. Cabinet measures only 12-9/16" W. x 3⅜" H. x 4⅞" D, and it is finished in beautiful satin-gold enamel. 4-position turnover and 4 position roll-off controls provide "LP," "RIAA," "AES," and "early 78" equalization, and 8, 12, 16, and 1 flat position for roll-off. Derives operating power from the main amplifier, requiring only 6.3 VAC at 1 ampere and 300 VDC at 10 MA. Easy to construct from step-by-step instructions and pictorial diagrams provided.

MODEL WA-P2 *(With Cabinet)* *Shpg. Wt. 7 Lbs.*

$19.75

HEATHKIT HIGH FIDELITY FM TUNER KIT

- *Illuminated slide-rule dial covers 88 to 108 MC.*
- *Modern circuit emphasizes sensitivity and stability.*
- *Housed in attractive satin-gold cabinet to match WA-P2 and BC-1.*

This amazing new FM tuner can provide you with real high-fidelity performance at an unbelievably low price level. Covering 88 to 108 MC, the modern circuit features a stabilized, temperature-compensated, oscillator, A.G.C., broadbanded IF circuits, and better than 10 UV sensitivity for 20 DB of quieting. A high gain, cascaded, RF amplifier is used ahead of the mixer to increase overall gain and reduce oscillator leakage. It employs a ratio detector for high efficiency without sacrifice in high-fidelity performance. IF and ratio transformers are pre-aligned, as is the front end tuning unit. This means the kit can be constructed by a beginner, without elaborate test and alignment equipment. The FM-3A is designed to match the WA-P2 preamplifier and the BC-1 AM tuner. An illuminated slide-rule dial is employed for frequency indication. Step-by-step instructions and large pictorial diagrams assure success.

MODEL FM-3A

$26.95

INCLUDING NEW EXCISE TAX‡

(With Cabinet)

Shpg. Wt. 7 Lbs.

HEATHKIT BROADBAND AM TUNER KIT

This AM tuner has been designed especially for high-fidelity applications. It incorporates a low-distortion detector, a broadband IF, and other features essential to usefulness in high-fidelity. Special voltage-doubler detector employs crystal diodes for low distortion. Sensitivity and selectivity are excellent. Audio response is ± 1 DB from 20 CPS to 2 kc, with 5 DB of pre-emphasis at 10 kc to compensate for station roll-off. Covers the standard broadcast band from 550 to 1600 kc. Incorporates a 10 kc whistle-filter and provides a 6 DB signal-to-noise ratio at 2.5 UV. RF and IF coils are pre-aligned, and power supply is built-in. Incorporates AVC, two outputs, and two antenna inputs.

MODEL BC-1

$26.95

INCLUDING NEW EXCISE TAX‡

(With Cabinet)

Shpg. Wt. 8 Lbs.

HEATHKIT ELECTRONIC CROSS-OVER KIT

This unusual device functions to separate low frequencies and high frequencies so that they may be fed to separate amplifiers and to separate speakers. This eliminates the need for conventional cross-over circuits, since the Model XO-1 does the complete job electronically. Cross-over frequencies of 100, 200, 400, 700, 1,200, 2,000 and 35,000 CPS are selectable with front panel controls on the XO-1, and a separate level control is provided for each channel. Minimizes intermodulation distortion problems. Handles unlimited power, since frequency division is accomplished ahead of the power stage. Attenuation is 12 DB per octave, with sharp "knee" at cut-off frequency.

MODEL XO-1

$18.95

Shpg. Wt. 6 Lbs.

HEATHKIT ADVANCED-DESIGN

MODEL W-5

Consists of Model W-5M *plus* Model WA-P2 preamplifier.

Shpg. Wt. 38 Lbs.
Express only.... $79.50

- *Full 25 watt output with KT-66 output tubes.*
- *All connectors brought out to front chassis apron.*
- *Protective cover over all above-chassis components.*

HIGH FIDELITY

Amplifier Kit

This 25 watt unit is our finest high-fidelity amplifier. Using a special design peerless output transformer, and KT-66 output tubes by Genalex, the Model W-5M provides performance characteristics unsurpassed at this price level. Frequency response is ± 1 DB from 5 to 160,000 CPS at 1 watt. Harmonic distortion is less than 1% at 25 watts and IM distortion is less than 1% at 20 watts (60 and 3,000 CPS, 4 to 1). Hum and noise are 99 DB below 25 watts. Damping factor is 40 to 1. Input voltage for 5 watts output is 1 volt. Tubes employed are a pair of 12AU7's, a pair of KT-66's and a 5R4GY rectifier. Measures 13-3/32" W. x 8½" D. x 8¼" H. Output impedance is 4, 8, or 16 ohms. Featured, also, is the "tweeter saver" which suppresses high frequency oscillation, and a new type balancing circuit requiring only a voltmeter for indication. This balance is easier to adjust, and results in a closer "dynamic" balance between output tubes. The Model W-5M provides improved phase shift characteristics. reduced IM and harmonic distortion, and improved frequency response. Conservatively rated high-quality components are used throughout to insure years of trouble-free operation. No technical background or training is required for assembly. Step-by-step instructions are provided for every stage of construction, and large pictorial diagrams illustrate exactly where each wire and component is to be placed. An amplifier for music lovers who can appreciate subtle differences in performance. Just ask the audiofile who owns one!

HEATHKIT DUAL-CHASSIS—WILLIAMSON TYPE HIGH FIDELITY AMPLIFIER KIT

This 20-watt high-fidelity amplifier employs the famous Acrosound Model TO-300 "ultra-linear" output transformer and uses 5881 output tubes. The power supply is built on a separate chassis, and the two chassis are inter-connected with a power cable. This provides additional flexibility in mounting. Frequency response is ± 1 DB from 6 CPS to 150 kc at 1 watt. Harmonic distortion is only 1% at 21 watts, and IM distortion is only 1.3% at 20 watts. (60 and 3,000 CPS). Output impedance is 4, 8, or 16 ohms. Hum and noise are 88 DB below 20 watts. A very popular high-fidelity unit employing top-quality components throughout.

MODEL W-3M: Shpg. Wt. 29 Lbs. Express only.....$49.75

MODEL W-3: Consists of Model W-3M *plus* Model WA-P2 preamplifier. Shpg. Wt. 37 Lbs. Express only.....$69.50

HEATHKIT SINGLE CHASSIS—WILLIAMSON TYPE HIGH FIDELITY AMPLIFIER KIT

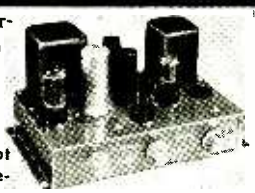
The 20-watt Model W-4AM Williamson type amplifier is a tremendous high-fidelity bargain. Combining the power supply and main amplifier on one chassis, and using a special-design output transformer by Chicago Standard brings you savings without a sacrifice in quality. Employing 5881 output tubes, the frequency response of the W-4AM is ± 1 DB from 10 CPS to 100 kc at 1 watt. Harmonic distortion is only 1.5% at 20 watts. Output impedance is 4, 8, or 16 ohms. Hum and noise are 95 DB below 20 watts.

MODEL W-4AM: Shpg. Wt. 28 Lbs. Express only.....$39.75

MODEL W-4A: Consists of Model W-4AM *plus* Model WA-P2 preamplifier. Shpg. Wt. 35 Lbs. Express only.....$59.50

HEATHKIT 7-WATT AMPLIFIER KIT

This amplifier is more limited in power than other Heathkit models, but it still qualifies as a high-fidelity unit, and its performance definitely exceeds that of many so-called "high-fidelity" phonograph amplifiers. Using a tapped-screen output transformer of new design, the Model A-7D provides a frequency response of ± 1½ DB from 20 to 20,000 CPS. Total distortion is held to a surprisingly low level. Output stage is push pull, and separate bass and treble tone controls are provided. *Shpg. Wt. 10 Lbs.*



MODEL A-7D
$18.65
INCLUDING NEW EXCISE TAX*

MODEL A-7E: Similar to the A-7D, except that a 12SL7 tube has been added for preamplification. Two inputs, RIAA compensation, and extra gain. $20.35*

HEATHKIT 20-WATT HIGH FIDELITY AMPLIFIER KIT

This high-fidelity amplifier features full 20-watt output using push pull 6L6 tubes. Built-in preamplifier provides 4 separate inputs, selected by a panel-mounted switch. It has separate bass and treble tone controls, each offering 15 DB boost and cut. Output transformer is tapped at 4, 8, 16, and 500 ohms. Designed primarily for home installations, but also used extensively for public address applications. True high-fidelity performance with frequency reponse of ± 1 DB from 20 CPS to 20,000 CPS. Total harmonic distortion only 1% (at 3 DB below rated output).

MODEL A-9B
$35.50
Shpg. Wt. 23 Lbs.

HEATH COMPANY
A Subsidiary of Daystrom, Inc.
BENTON HARBOR 20, MICH.

All prices marked with a ‡ include a 10% federal excise tax that now applies to receivers, tuners and some amplifiers, even though they may be in kit form. Since the tax is in effect as of July 5, 1956, we have no choice but to reflect it in our kit prices. This note is just to let you know we are not increasing our prices on some kits, but merely including this new tax in them.

Thank you,
HEATH COMPANY

HEATHKIT HIGH FIDELITY

Range Extending
SPEAKER SYSTEM KIT

* *High quality speakers of special design — 15" woofer and compression-type super-tweeter.*
* *Easy-to-assemble cabinet of furniture-grade plywood.*
* *Attractively styled to fit into any living room. Matches Model SS-1.*

MODEL SS-1B

$99.95

Shpg. Wt. 80 Lbs.

This range extending unit is designed especially for use with the Model SS-1 speaker system. It consists of a 15" woofer, providing output between 35 and 600 CPS, and a compression-type super-tweeter that provides output between 4,000 and 16,000 CPS. Cross-over frequencies are 600, 1,600, and 4,000 CPS. The SS-1 provides the mid-range, and the SS-1B extends the coverage at both ends of the spectrum. Together, the two speaker systems provide output from 35 to 16,000 CPS within ± 5 DB. This easy-to-assemble speaker enclosure kit is made of top-quality furniture-grade plywood. All parts are pre-cut and pre-drilled, ready for assembly and the finish of your choice. Complete step-by-step instructions are provided for quick assembly by one not necessarily experienced in woodworking. Coils and capacitors for proper cross-over network are included, as is a balance control for super-tweeter output level. The SS-1 and SS-1B can provide you with unbelievably rich audio reproduction, and yet these units are priced reasonably. The SS-1B measures 29" H. x 23" W. x 17½" D. The speakers are both special-design Jensens, and the power rating is 35 watts. Impedance is 16 ohms.

HEATHKIT HIGH FIDELITY **SPEAKER SYSTEM KIT**

MODEL SS-1

$39.95

Shpg. Wt. 30 Lbs.

* *Special design ducted-port, bass-reflex enclosure.*
* *Two separate speakers for high and low frequencies.*
* *Kit includes all parts and complete instructions for assembly.*

This speaker system is a fine reproducer in its own right, covering 50 to 12,000 CPS within ± 5 DB. However, the story does not end there. Should you desire to expand the system later, the SS-1 is designed to work with the SS-1B range extending unit — providing additional frequency coverage at both ends of the spectrum. It can fulfill your present needs, and still provide for the future. The SS-1 uses two Jensen speakers; an 8" midrange-woofer, and a compression-type tweeter. Cross-over frequency is 1,600 CPS, and the system is rated at 25 watts. Nominal impedance is 16 ohms. The cabinet is a ducted-port bass-reflex type. Attractively styled, the Model SS-1 features a broad "picture-frame" molding that will blend with any room decorating scheme. Pre-cut and pre-drilled wood parts are of furniture grade plywood. The kit is easy-to-build, and all component parts are included, along with complete step-by-step instructions for assembly. Can be built in just one evening, and will provide you with many years of listening enjoyment thereafter.

HEATH COMPANY *A Subsidiary of Daystrom, Inc.* **BENTON HARBOR 20, MICH.**

ORDER BLANK

NOTE: All prices subject to change without notice.

Enclosed find ( ) check ( ) money order for_____
Please ship C.O.D. ( ) postage enclosed for_____pounds.

On Express orders do not include transportation charges — they will be collected by the express agency at time of delivery.

ON PARCEL POST ORDERS include postage for weight shown. ORDERS FROM CANADA and APO'S must include full remittance.

Name_____

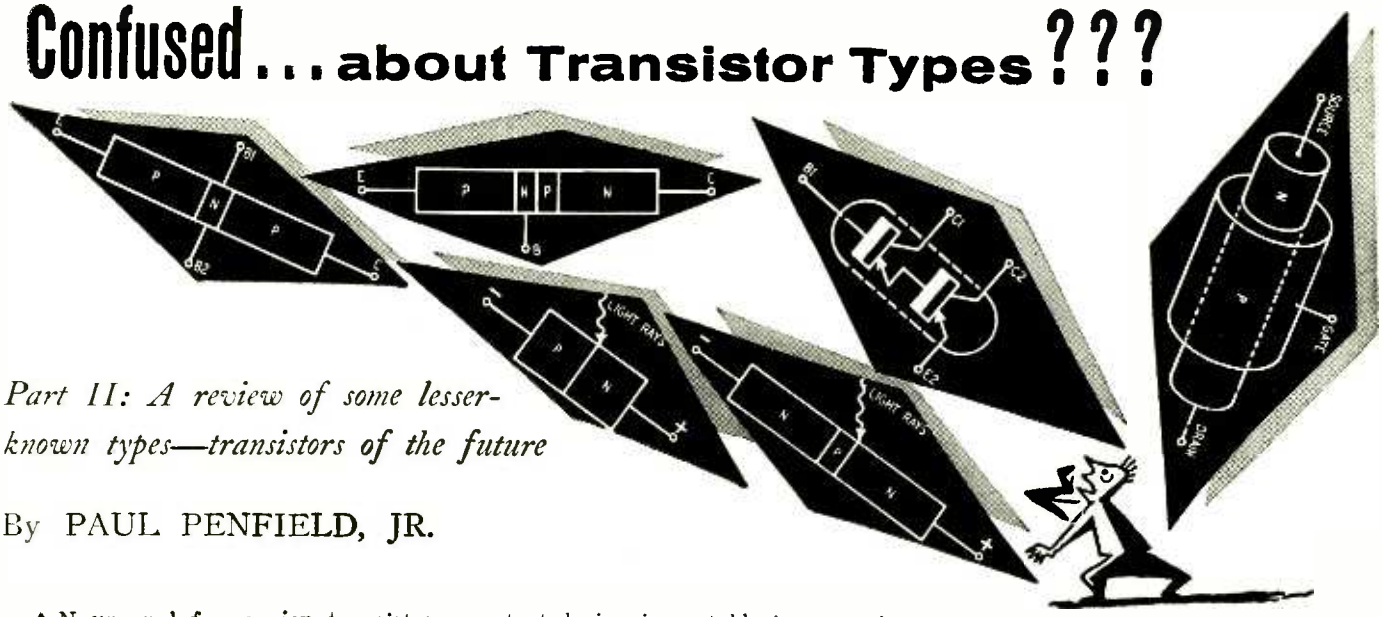
Address_____

City & Zone_____ State_____
(PLEASE PRINT)

SHIP VIA
- ☐ Parcel Post
- ☐ Express
- ☐ Freight
- ☐ Best Way

QUANTITY	ITEM	MODEL NO.	PRICE

Confused . . . about Transistor Types ? ? ?



Part II: A review of some lesser-known types—transistors of the future

By PAUL PENFIELD, JR.

AN unusual four-region transistor available now in small quantities is the *hook* transistor. This device (Fig. 1) is just like the junction transistor except for unusual construction of the collector.

Consider the right-hand three sections of the hook transistor by themselves. They form an n-p-n transistor. And the usual method of biasing the

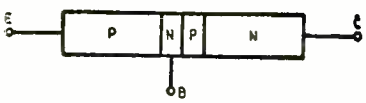


Fig. 1—Hook transistor—bias is same as for p-n-p junction transistors.

hook transistor (same as for the p-n-p junction models) is such that the n-p-n "transistor within a transistor" acts as though it had its emitter at the right, its base in the middle and its collector on the left where the hook transistor base is. Remember that a normal junction transistor, with the base left free, acts as a current multiplier for any electrons or holes at the collector junction.

With these facts in mind consider a hole which is injected from the hook transistor emitter into the base (the left-hand n-region). It suddenly sees itself in what looks like the collector of an n-p-n transistor (the right-hand three elements). And it does what every good hole does in like situations—it flows toward the base. However, at this point hook current multiplication takes place and many electrons are injected from the right. One of these fills the hole being considered, but most flow through to the hook transistor base. Thus the collector current is many times larger than the emitter current.

In this respect (having an alpha greater than 1) the hook transistor is very much like the point-contact type. And remember that one explanation for point-contact transistor current multiplication was in terms of just such a "hook multiplier" as described here.

The hook transistor, like the point-contact device, is unstable in some circuits. And like the point-contact transistor it can be made into an oscillator by simply biasing it into a normally unstable region and hanging a tuned circuit across the proper terminals. However, because of the relatively large size of the base and the hook-multiplication regions, the hook transistor is not useful to quite as high frequencies.

Field-effect transistors

The operation of the field-effect transistor is so far removed from the operation of junction units that the same names are not even used for the three elements.

In a field-effect transistor (Fig. 2) voltage at the *gate* controls the flow of current from the *source* to the *drain*.

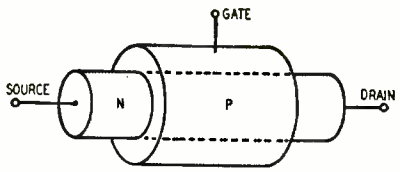


Fig. 2—Field-effect transistor—n-region extends from source to drain.

The material between the two low-resistance contacts at the source and the drain is n-type, and the gate material is p-type. The gate fits like a ring around the cylinder of n-type material.

The transistor is normally biased in such a way that the junction between the two regions is in reverse—that is, very little gate current flows.

The input gate voltage controls the current between the source and the drain. As this voltage is increased, more and more of the middle cylinder near the junction has its current carriers (excess electrons) removed by the gate voltage. This means, in effect, that less and less of the material between the source and the drain is available for current. At some gate voltage known as the "pinch-off voltage," the source-to-drain current, already low, remains constant as the gate voltage is further increased.

The device amplifies because the gate voltage input is at a relatively high impedance—that of the reversely biased junction. The output is at a lower impedance and there can be considerable voltage gain to boot, so that the power gain can be high.

The high input impedance and relatively high output impedance of the field-effect transistor mean that amplifier stages can be cascaded directly without need for a coupling transformer and without much power loss. In addition, the impedance levels are not too far removed from those of an ordinary vacuum-tube triode and many practical circuits can be lifted complete from vacuum-tube practice and used with field-effect transistors without major changes.

Tetrode transistors

The normal junction tetrode is shown in Fig. 3. It operates exactly like a junction transistor except that the extra base contact can be used to limit the effective areas of the two junctions. This makes the tetrode useful at high

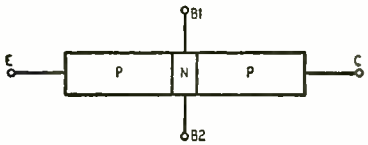


Fig. 3—Schematic of the junction tetrode, showing the two base terminals for applying a transverse voltage.

frequencies and for remote control of amplifier gain, such as in avc circuits.

Frequency range is raised in this transistor type by reducing the collector capacitance. This is done by putting a transverse voltage between the two base leads. The effect is to force all transistor action to occur at one side or the other of the transistor. In this way the effective junction area between the base and the collector is

made very small. It is possible to control the effective junction area by varying the potential between the two base terminals. If the junction area is decreased, the collector capacitance is cut down and the frequency range thereby increased.

At lower frequencies, such as for audio applications, the tetrode transistor has useful properties, too. The gain of the transistor depends on the junction area available for transistor action. By varying the potential across the base transversely, this area can be varied. Practical automatic volume controls have been made by this sort of action.

Tetrode transistors are expected to become commonplace in the next few years as their applications multiply.

Phototransistors

Phototransistors and photodiodes are two different things. A photodiode (Fig. 4) looks exactly like any other diode—either point contact or junction (a junction model is illustrated)—except

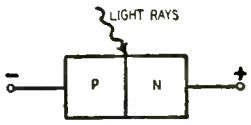


Fig. 4—Diagram of the photodiode.

that a window is provided in the case to let light reach the junction. The diode is normally biased in reverse so that little current flows. When light strikes the junction it creates electron-hole pairs. These flow apart and constitute current. Efficiencies very close to 100% have been observed for well-made photodiodes.

A phototransistor (Fig. 5) is merely a photodiode with a built-in hook amplifier. It is made just like an ordinary junction transistor (either p-n-p or n-p-n) and operated with the base lead disconnected. The reversely biased collector junction is illuminated and hook multiplication (which all junction tran-

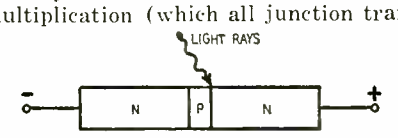


Fig. 5—The phototransistor—a photodiode with built-in hook multiplier.

sistors show with a base floating) results in far greater sensitivity than possible with merely a photodiode.

Some time ago the photodiode was called a phototransistor, and some writers still use the terms wrong—do not be confused.

Tandem transistors

Just as two vacuum-tube sections are often put in the same envelope (such as the 6SN7), so it is possible to put two transistors in the same case. One interesting application of this idea is the tandem transistor. Two transistors are put in the same case and connected electrically inside. Fig. 6 tells the story. The first half is a smaller transistor than the second—both in size and rating. The first stage, which acts as a

common-collector amplifier, supplies the entire base current—bias and signal—for the second stage. The second stage may be operated either as a common-collector or—more likely—a common-emitter stage.

Tandem transistors offer no advantage over using two normal junction transistors, except for the unique space-saving package.

The particular combination in Fig. 6 is not the only one and it may be profitable in the future for manufacturers to make several styles of tandem transistors (that is, internally connected) as well as dual transistors (two units not internally connected together). Twin units (matched transistors of the same or opposite polarity) will also undoubtedly become popular.

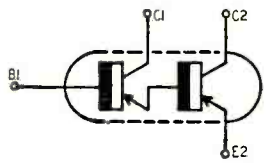


Fig. 6—The basic tandem transistor.

Miscellaneous types

Various other transistor types, too numerous to mention, have been either tried or dreamed up. Three of the most promising are the symmetrical transistor, the fieldistor and the point-junction transistor.

The symmetrical transistor is just like a junction transistor except that either end may be used as the collector and either as the emitter. This is quite unlike normal junction transistors in which connecting "backward" is not recommended. The symmetrical transistor is made by making the collector and emitter junctions exactly the same; this is not done for several reasons in normal junction transistors.

A fieldistor (do not confuse with the field-effect transistor) is made by placing a metal electrode close to a reversely biased junction—close to but not touching. The field produced by this control element affects the amount of reverse current flowing. Since the input terminal does not actually touch the germanium elements, very high input impedances are possible—as high as possible with a tube grid. And moderately high output impedances are also possible although the power gain is low. Whether this device—not yet fully developed—will ever become popular remains to be seen.

Point-junction transistors are possible in which the emitter is a junction and the collector a point-contact. Some properties of such a device are interesting for computer applications, although these devices are also not yet fully developed.

The author hopes that some of the confusion so commonplace because of the many types of devices using the name "transistor" has been settled by this article, and that the reader has gained some valuable perspective. END

ELECTRONICS

ABBREVIATIONS and Symbols

By CHARLES S. KIMBALL

THE rapidly expanding fields of science bring with them a language very often all their own. Many of the words used are not words in the usual sense, but are fabricated from a group of words, ie, *radar* (radio direction and ranging). With these comes a vast array of engineering shorthand consisting of technical abbreviations, prefixes, symbols and letter designations, all designed to speed up the transmission of technical meaning.

This list is a compendium of those used in electronics and allied fields of science. It is based on current general usage within the electronics industry and is compiled from accepted reference sources such as *Reference Data For Radio Engineers, Radiotron Designers Handbook, Webster's New World Dictionary, Radar Systems Fundamentals,* etc.

This list differs considerably from the RADIO-ELECTRONICS abbreviations (January, 1956, page 138; March, 1956, page 108) in that it covers a broad field. RADIO-ELECTRONICS style is geared primarily for the general subject matter appearing in the magazine and in many cases abbreviations are used only in artwork.

This list is printed to give a broader coverage and for the benefit of the person who has looked up an abbreviation in the RADIO-ELECTRONICS list, only to find that obviously some other definition than the one given was intended. For instance, the letter B in our abbreviations stands for base (of a transistor) whereas this list has no less than eight definitions.

ABBREVIATION*	DEFINITIONS
	—A—
A	—Ampere. —Area. —Battery or other supply source of vacuum-tube filament power. —Class of vacuum-tube operation in which plate current flows continuously during the entire cycle. —In rf transmitter emissions, designation for amplitude modulation. —In radar, an indicator that presents target range data only. —In vacuum-tube equations, the voltage gain of a stage. —A class of broadcasting station which services primarily to communities other than the principal city of the area. A maximum effective rated power of 1 kw and an antenna height of 250 feet are permitted. —U. S. Navy prefix for airborne equipment.

* Abbreviations are used to indicate either singular or plural; either as a noun or as an adjective.

Standardization is lacking in the use of capital letters and periods as used with abbreviations. Thus the term *Automatic Volume Control* is expressed as *AVC, A.V.C., a.v.c.* or *a.v.c.*

In the use of Greek letters a lower case letter is used except where a capital is indicated.

ELECTRONICS

ABBREVIATION*	DEFINITIONS
A+	—Point of positive filament voltage connection in a vacuum-tube circuit; the positive terminal of such a voltage source.
A—	—Point of negative filament voltage connection in a vacuum tube circuit; the negative terminal of such a voltage source.
Å	—Angstrom unit.
A_o	—In vacuum-tube equations, the voltage gain of a stage at midfrequency.
AA	—Antiaircraft.
AAC	—Automatic amplitude control (radar).
AAM	—Air-to-air missile.
AAVC	—Audio avc.
AB	—Class of vacuum-tube push-pull operation in which plate current flows for appreciably more than half but less than the entire input cycle.
AB_1	—Class AB1 same as AB. Grid current does not flow during any part of the cycle.
AB_2	—Class AB_2 same as AB. Grid current flows for at least a part of the cycle.
Ab	—Prefix used in the names of the electromagnetic units.
Abac	—British term for nomograph.
abc	—Automatic brightness control (TV).
	—Automatic bias control.
	—Automatic bass compensation.
ac	—Alternating current.
A/C	—Aircraft.
ACC	—Automatic chroma control.
ac–dc	—Alternating or direct current.
adf	—Automatic direction finder (or finding).
ADJ	—Adjacent.
	—Adjustable.
af	—Audio frequency.
afc	—Automatic fire control (radar).
	—Automatic frequency control.
AFT	—Audio-frequency transformer.
agc	—Automatic gain control
AGCA	—Automatic ground control approach (radar).
AGL	—Aircraft gun laying.
AGOS	—Air–ground operations system.
AJ	—Anti-jamming.
Alpha (A, α)	Greek letter symbol for:
	—Absorption factor.
	—Attenuation constant.
	—Angles and coefficients.
	—Transistor current amplification factor (emitter to collector).
AM	—Amplitude modulation.
amp	—Ampere.
AMPL	—Amplifier.
A–N	—Army–Navy.
ANL	—Automatic noise limiter.
ANT	—Antenna.
apc	—Automatic phase control (color TV).
	—Automatic picture control (TV).
ASM	—Air-to-surface missile.
ASR	—Airport surveillance radar.
ASV	—Air-to-surface vessel (radar).
AT	—Type of piezoelectric crystal extensively used between 500 kc and 10 mc; designation for the axis on which such a crystal is cut.
atc	—Automatic temporal control (radar).
	—Automatic tracking control (radar).
ATL	—Artificial transmission line (radar and other).
ATR	—Anti-TR tube (radar).
ATTEN	—Attenuator.
AU	—Angstrom unit; also Å.
AUM	—Air-to-underwater missile.
AUTO	—Automatic.
AUTOTRANS	—Autotransformer.
Av	—Average.
avc	—Automatic volume control.
ave	—Automatic volume expansion.
AWG	—American wire gauge. Same as B&S wire gauge.
Az-El	—Azimuth elevation (radar indicator).
	—B—
B	—Flux density.
	—Susceptance.
	—Battery or other supply source of vacuum-tube plate voltage.
	—U. S. Navy prefix to designate identification equipment. Examples: ABK, BK, etc.
	—Class of vacuum-tube push-pull operation in which the tubes are biased almost to the point of cutoff. Plate current flows approximately half the input cycle.
	—In radar, the letter designation for the type of indicator that presents target azimuth and range data, a type not in general use.
	—A class of broadcasting station serving primarily a metropolitan district or principal city and its surrounding area, or primarily rural areas.
b	—Base (of transistor).
B+	—Point of positive plate voltage connection in a vacuum tube circuit; positive terminal of such a voltage source.
B—	—Point of negative plate voltage connection in a vacuum tube circuit; negative

ABBREVIATION*	DEFINITIONS
	terminal of such a voltage source.
B_1	—Class B_1. Same as Class B. No grid current is permitted to flow during any part of the cycle. Also known as quiescent push-pull.
B_2	—Class of vacuum-tube push-pull operation: the same as class B. Grid current flows during part of cycle.
BATT	—Battery.
BC	—Broadcast (frequency band).
BCI	—Broadcast interference.
Beta (β)	—Greek letter symbol for:
	—Phase constant.
	—Coefficients.
	—Angles.
	—Transistor current amplification (base to collector).
bfo	—Beat frequency oscillator.
B-H	—B-H Curve: A graph of the relationship between the magnetic flux (B) and the magnetic force (H); also known as a permeability curve.
BMNT	—Beginning, morning nautical twilight (navigation).
BO	—Barkhausen oscillation.
bo	—Beat oscillator.
BRL	—Bomb release line (radar navigation).
B&SWG	—Brown & Sharpe wire gauge; same as AWG.
BT	—Letter designation or a type of piezoelectric crystal extensively used between 4500 kc and 10 mc; also the axis about which such a crystal is cut
BTO	—Blocking tube oscillator.
	—Bombing through overcast (radar).
BTU	—British thermal unit.
BWG	—Birmingham wire gauge.
BWO	—Backward wave oscillator (radar).
	—C—
C	—Capacitance.
	—Cathode of a vacuum tube. The symbol generally used is K.
	—Class of vacuum-tube push-pull operation in which plate current flows for appreciably less than one-half of the input cycle.
	—In radar, the letter designation for the type of indicator that presents target azimuth and elevation data.
	—Battery or other supply source of bias voltage in a vacuum tube circuit.
	—Collector (of transistor).
C+	—Point of positive bias voltage connection of a vacuum-tube circuit; also the positive terminal of such a voltage.
C−	—Point of negative bias voltage connection of a vacuum tube circuit; the negative terminal of such a voltage.
CALIB	—Calibrate.
CATH	—Cathode.
CATH FOLL	—Cathode follower.
CCA	—Carrier-controlled approach.
CCW	—Counterclockwise.
cemf	—Counterelectromotive force.
centi	—1/100 of any given unit.
CGS	—Centimeter–gram–second system of units.
CH	—Choke.
CHAN	—Channel.
CHG	—Charge.
Chi (χ)	Greek letter symbol for:
	—Electric susceptibility.
CIC	—Combat information center. U. S. Navy designation for the compartment aboard ship in which all radar information is screened and disseminated; corresponds to U. S. Army filter center.
CKT	—Circuit.
CKT BRKR	—Circuit breaker.
cm	—Centimeter.
CMR	—Counter mortar radar.
co	—Crystal oscillator.
co	—Cutoff (vacuum tubes).
COAX	—Coaxial.
Coho	—Coherent oscillator (radar).
COM	—Common.
COMCM	—Communications counter measures.
COND	—Conductor.
CONELRAD	—Control of electromagnetic radiation.
CONN	—Connection.
CONT	—Control.
CONV	—Convergence.
CONVTR	—Converter.
cp	—Candle power.
CPS	—Cycles per second.
C-R	—Cathode-ray (tube, etc.).
CRO	—Cathode-ray oscilloscope.
CRTI	—Cathode-ray tube indicator (radar).
CVG	—Composite video generator (radar).
CW	—Clockwise.
	—Continuous wave.
cycles	—Cycles per second.
	In vacuum-tube terminology:
C_g	—Grid capacitance.
C_{gh}	—Grid–heater capacitance.
C_{gk}	—Grid–cathode capacitance.
C_{gp}	—Grid–plate capacitance.
C_k	—Cathode capacitance.
C_p	—Plate capacitance.
C_{ph}	—Plate–heater capacitance.
C_{pk}	—Plate–cathode capacitance.

TO BE CONTINUED

Superior's New Model 770-A

The FIRST Pocket-Sized VOLT-OHM MILLIAMMETER

USING THE NEW "FULL-VIEW" METER

71% MORE SCALE AREA

Yes, although our new FULL-VIEW D'Arsonval type meter occupies exactly the same space used by the older standard 2½" Meters, it provides 71% more scale area. As a result, all calibrations are printed in large easy-to-read type and for the first time it is now possible to obtain *measurements instead of approximations* on a popular priced pocket-sized V.O.M.

● Compact — measures 3⅛" x 5⅞" x 2¼". ● Uses "Full View" 2% accurate, 850 Microampere D'Arsonval type meter. ● Housed in round-cornered, molded case. ● Beautiful black etched panel. Depressed letters filled with permanent white, insures long-life even with constant use.

Specifications

5 A.C. VOLTAGE RANGES: 0-15/30/150/300/1500/3000 Volts. 6 D.C. VOLTAGE RANGES: 0-7.5/15/75/150/750/1500 Volts. 2 RESISTANCE RANGES: 0-10,000 Ohms, 0-1 Megohm. 3 D.C. CURRENT RANGES: 0-15/150 Ma., 0-1.5 Amps. 3 DECIBEL RANGES: —6 db to + 18 db, + 14 db to + 38 db, + 34 db to + 58 db.

The Model 770-A comes complete with self-contained batteries, test leads and all operating instructions.

$15.85 NET

Superior's New Model 670-A

SUPER-METER

A COMBINATION VOLT-OHM MILLIAMMETER PLUS CAPACITY REACTANCE INDUCTANCE AND DECIBEL MEASUREMENTS.

D.C. VOLTS: 0 to 7.5/15/75/150/750/1,500/7,500 Volts. A.C. VOLTS: 0 to 15/30/150/300/1,500/3,000 Volts. OUTPUT VOLTS: 0 to 15/30/150/300/1,500/3,000 V. D.C. CURRENT: 0 to 1.5/15/150 Ma. 0 to 1.5/15 Amperes. RESISTANCE: 0 to 1,000/100,000 Ohms 0 to 10 Megohms. CAPACITY: .001 to 1 Mfd. 1 to 50 Mfd. (Good-Bad Scale for checking quality of electrolytic condensers). REACTANCE: 50 to 2,500 Ohms, 2,500 Ohms to 2.5 Megohms. INDUCTANCE: .15 to 7 Henries 7 to 7,000 Henries. DECIBELS: —6 to +18, +14 to +38, +34 to +58.

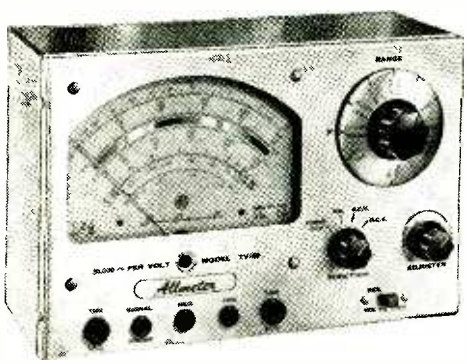
ADDED FEATURE:

Built-in ISOLATION TRANSFORMER reduces possibility of burning out meter through misuse.

The Model 670-A comes housed in a rugged crackle-finished steel cabinet complete with test leads and operating instructions.

$28.40 NET

Superior's New Model TV-60



20,000 OHMS PER VOLT

ALLMETER

Includes services never before provided by an instrument of this type.

Read and compare features and specifications below!

FEATURES

- A sensitive, accurate Volt-Ohm-Milliammeter with giant meter and *mirrored* scale.
- An accurate direct-reading Capacity meter.
- A Kilovoltmeter.
- An R.F. Signal Tracer.
- An Audio Signal Tracer.
- Giant recessed 6½ inch 40 Microampere meter with *mirrored* scale assures accuracy and easy-reading. All calibrations are printed in large easy-to-read type. Fractional divisions are easily read with the aid of the mirrored scale.
- The line cord, used only when making Capacity measurements, need be plugged in only when using that service. It is out of the way, stored in its pliofilm compartment at all other times.
- A built-in Isolation Transformer automatically isolates the Model TV-60 from the power line when the capacity service is in use.
- Selected, 1% zero temperature coefficient metallized resistors are used as multipliers assuring *unchanging* accurate readings on all ranges.
- Use of the latest type of *printed circuit* guarantees maintenance of top quality standard in the production runs of this precise instrument.
- A new *improved* type of high-voltage probe is used for the measurement of high voltages up to 30,000 Volts. This service will be required when servicing color TV receivers.
- Simply plug-in the R.F. probe and convert the Model TV-60 into an efficient R.F. SIGNAL TRACER permitting the measurement of stage-gain and cause of trouble in the R.F. and I.F. circuits of A.M., F.M., and TV receivers.
- Plug in the Audio probe and convert the Model TV-60 into an efficient AUDIO SIGNAL TRACER. Measure the signal levels and comparative efficiency of hearing-aids, public-address systems, the amplifier sections of Radio & TV receivers, etc.

SPECIFICATIONS

8 D.C. VOLTAGE RANGES: (At a sensitivity of 20,000 Ohms per Volt) 0 to 15/75/150/300/750/1500/7500/30,000 Volts.

7 A.C. VOLTAGE RANGES: (At a sensitivity of 5,000 Ohms per Volt) 0 to 15/75/150/300/750/1500/7500 Volts.

3 RESISTANCE RANGES: 0 to 2,000/200,000 Ohms, 0-20 Megohms.

2 CAPACITY RANGES: .0002S Mfd. to 30 Mfd.

5 D.C. CURRENT RANGES: : 0-75 Microamperes, 0 to 7.5/75/750 Milliamperes, 0 to 15 Amperes.

3 DECIBEL RANGES: — 6 db to + 58 db.

R. F. SIGNAL TRACER SERVICE:

Enables following the R.F. signal from the antenna to speaker of any radio or TV receiver and using that signal as a basis of measurement to first isolate the faulty stage and finally the component or circuit condition causing the trouble.

AUDIO SIGNAL TRACER SERVICE:

Functions in the same manner as the R.F. Signal Tracing service specified above except that it is used for the location of cause of trouble in all audio and amplifier systems.

Model TV-60 comes complete with book of instructions; pair of standard test leads; high-voltage probe; detachable line cord; R. F. Signal Tracer Probe and Audio Signal Tracer Probe, Pliofilm bag for all above accessories is also included. Price complete. Nothing else to buy. Only

$52.50 NET

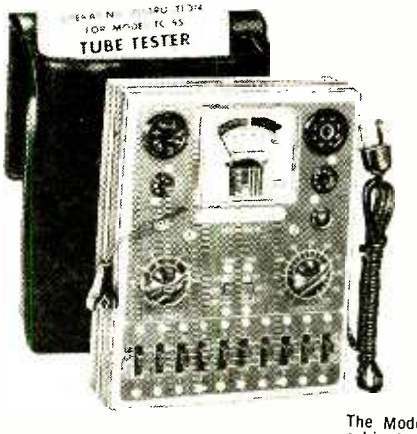
SHIPPED ON APPROVAL

NO MONEY WITH ORDER — NO C. O. D.

Try for 10 days before you buy! If completely satisfied, send down payment after trial and pay balance at indicated monthly rate — NO INTEREST OR FINANCE CHARGES ADDED. If not completely satisfied, return to us, no explanation necessary. (See approval form on page 87 for complete details.)

Superior's New Model TC-55

TUBE TESTER



FOR { **The Experimenter or Part-time Serviceman,** who has delayed purchasing a higher priced Tube Tester.
The Professional Serviceman, who needs an extra Tube Tester for outside calls.
The busy TV Service Organization, which needs extra Tube Testers for its field men.

Speedy, yet efficient operation is accomplished by:

1. Simplification of all switching and controls.
2. Elimination of old style sockets used for testing obsolete tubes (26, 27, 57, 59, etc.) and providing sockets and circuits for efficiently testing the new Noval and Sub-Minar types.

You can't insert a tube in wrong socket
It is impossible to insert the tube in the wrong socket when using the new Model TC-55. Separate sockets are used, one for each type of tube base. If the tube fits in the socket it can be tested.

"Free-point" element switching system
The Model TC-55 incorporates a newly designed element selector switch system which reduces the possibility of obsolescence to an absolute minimum. Any pin may be used as a filament pin and the voltage applied between that pin and any other pin, or even the "top-cap"

Checks for shorts and leakages between all elements
The Model TC-55 provides a super sensitive method of checking for shorts and leakages up to 5 Megohms between any and all of the terminals. Continuity between various sections is individually indicated. This is important, especially in the case of an element terminating at more than one pin. In such cases the element or internal connection often completes a circuit.

Elemental switches are numbered in strict accordance with R.M.A. specification.
One of the most important improvements, we believe, is the fact that the 4 position fast-action snap switches are all numbered in exact accordance with the standard R.M.A. numbering system. Thus, if the element terminating in pin No. 7 of a tube is under test, button No. 7 is used for that test.

The Model TC-55 comes complete with operating instructions and charts. Housed in rugged steel cabinet. Use it on the bench — use it for field calls. A streamlined carrying case, included at no extra charge, accommodates the tester and book of instructions.

$26.95 NET

Superior's New Model TV-11

TUBE TESTER

SPECIFICATIONS:

★ Tests all tubes including 4, 5, 6, 7, Octal, Lock-in, Peanut, Bantam, Hearing Aid, Thyratron Miniatures, Sub-miniatures, Novals, Sub-minars, Proximity fuse types, etc.

★ Uses the new self-cleaning Lever Action Switches for individual element testing. Because *all elements are numbered according to pin-number in the RMA base numbering system,* the user can instantly identify which element is under test; Tubes having tapped filaments and tubes with filaments terminating in more than one pin are truly tested with the Model TV-11 as any of the pins may be placed in the neutral position when necessary.

★ The Model TV-11 does not use any combination type sockets. Instead individual sockets are used for each type of tube. Thus *it is impossible to damage a tube by inserting it in the wrong socket.*

★ Free-moving built-in roll chart provides complete data for all tubes.

★ Newly designed Line Voltage Control compensates for variation of any Line Voltage between 105 Volts and 130 Volts.

★ NOISE TEST: Phono-jack on front panel for plugging in either phones or external amplifier will detect microphonic tubes or noise due to faulty elements and loose internal connections.

EXTRA SERVICE — The Model TV-11 may be used as an extremely sensitive Condenser Leakage Checker. A relaxation type oscillator incorporated in this model will detect leakages even when the frequency is one per minute.

The model TV-11 operates on 105-130 Volt 60 Cycles A.C. Comes housed in a beautiful hand-rubbed oak cabinet complete with portable cover

$47.50 NET

Superior's New Model TV-12

TRANS-CONDUCTANCE TUBE TESTER

ALSO TESTS TRANSISTORS!

TESTING TUBES

★ **Employs improved TRANS-CONDUCTANCE circuit.** An in-phase signal is impressed on the input section of a tube and the resultant plate current change is measured. This provides the most suitable method of simulating the manner in which tubes actually operate in Radio & TV receivers, amplifiers and other circuits. Amplification factor, plate resistance and cathode emission are all correlated in one meter reading.

★ **NEW LINE VOLTAGE ADJUSTING SYSTEM.** A tapped transformer makes it possible to compensate for line voltage variations to a tolerance of better than 2%.

★ **SAFETY BUTTON**—protects both the tube under test and the instrument meter against damage due to overload or other form of improper switching.

★ **NEWLY DESIGNED FIVE POSITION LEVER SWITCH ASSEMBLY.** Permits application of separate voltages as required for both plate and grid of tube under test, resulting in improved Trans-Conductance circuit.

TESTING TRANSISTORS

A transistor can be safely and adequately tested only under dynamic conditions. The Model TV-12 will test all transistors in that approved manner, and quality is read directly on a special "transistor only" meter scale.

The Model TV-12 will accommodate all transistors including NPN's, PNP's, Photo and Tetrodes, whether made of Germanium or Silicon, either point contact or junction contact types.

Model TV-12 housed in handsome rugged portable cabinet sells for only

$72.50 NET

SHIPPED ON APPROVAL

NO MONEY WITH ORDER — NO C.O.D.

Try for 10 days before you buy! If completely satisfied, send down payment *after* trial and pay balance at indicated monthly rate — NO INTEREST OR FINANCE CHARGES ADDED. If not completely satisfied, return to us, no explanation necessary. (See approval form on page 87 for complete details.)

About Testing Picture-Tubes . . .

Of course you can buy an "adapter" which theoretically will convert your standard Tube Tester into a picture - tube tester. Sounds fine - but - it simply doesn't work out that way!

We do not make nor do we recommend use of C.R.T adapters because a Cathode Ray Tube is a very complex device and to properly test it, you need an instrument designed exclusively to test C. R. Tubes and nothing else. As compared to a make-shift adapter, which sells for about five dollars, our Model TV-40 C.R.T. Tube Tester sells for $15.85 But, if you believe that Television is here to stay, then you must agree that the difference in price is more than justified by the many years of valuable service you will get out of this indispensible instrument. Incidentally, the Model TV-40 is the only low-priced C.R.T Tube Tester, which includes a real meter Neons are fine for gadgets and electric-line testers, but there is no substitute for a meter with an honest-to-goodness emission reading scale.

Superior's New Model TV-40

PICTURE TUBE TESTER

A complete picture tube tester for little more than the price of a "make-shift" adapter!!

The Model TV-40 is absolutely complete! Self-contained, including built-in power supply, it tests picture tubes in the only practical way to efficiently test such tubes; that is by the use of a separate instrument which is designed exclusively to test the ever increasing number of picture tubes!

EASY TO USE:

Simply insert line cord into any 110 volt A.C. outlet, then attach tester socket to tube base (Ion trap need not be on tube). Throw switch up for quality test...read direct on Good-Bad scale. Throw switch down for all leakage tests.

Tests all magnetically deflected tubes . . in the set - out of the set . . . in the carton!!

SPECIFICATIONS:

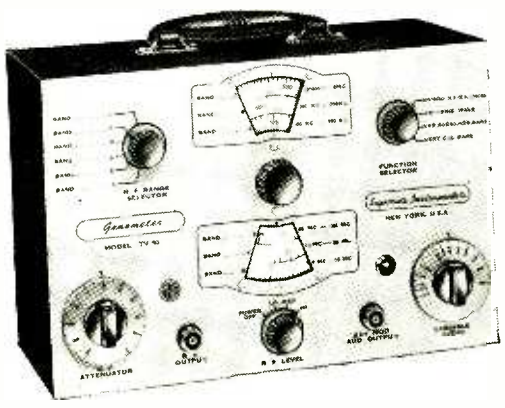
- Tests all magnetically deflected picture tubes from 7 inch to 30 inch types.
- Tests for quality by the well established emission method. All readings on "Good-Bad" scale.
- Tests for inter-element shorts and leakages up to 5 megohms.
- Test for open elements.

Model TV-40 C.R.T. Tube Tester comes absolutely complete—nothing else to buy Housed in round cornered, molded bakelite case. Only

$15.85 NET

Superior's New Model TV-50

GENOMETER



A versatile all-inclusive GENERATOR which provides ALL the outputs for servicing:

A.M. Radio • F.M. Radio • Amplifiers • Black and White TV • Color TV

7 Signal Generators in One!

- ✓ R.F. Signal Generator for A.M.
- ✓ R.F. Signal Generator for F.M.
- ✓ Audio Frequency Generator
- ✓ Bar Generator
- ✓ Cross Hatch Generator
- ✓ Color Dot Pattern Generator
- ✓ Marker Generator

R. F. SIGNAL GENERATOR: The Model TV-50 Genometer provides complete coverage for A.M. and F.M. alignment. Generates Radio Frequencies from 100 Kilocycles to 60 Megacycles on fundamentals and from 60 Megacycles to 180 Megacycles on powerful harmonics.

VARIABLE AUDIO FREQUENCY GENERATOR: In addition to a fixed 400 cycle sine-wave audio, the Model TV-50 Genometer provides a variable 300 cycle to 20,000 cycle peaked wave audio signal.

BAR GENERATOR: The Model TV-50 projects an actual Bar Pattern on any TV Receiver Screen. Pattern will consist of 4 to 16 horizontal bars or 7 to 20 vertical bars.

CROSS HATCH GENERATOR: The Model TV-50 Genometer will project a cross-hatch pattern on any TV picture tube. The pattern will consist of non-shifting horizontal and vertical lines interlaced to provide a stable cross-hatch effect.

DOT PATTERN GENERATOR (FOR COLOR TV): Although you will be able to use most of your regular standard equipment for servicing Color TV, the one addition which is a "must" is a Dot Pattern Generator. The Dot Pattern projected on any color TV Receiver tube by the Model TV-50 will enable you to adjust for proper color convergence.

MARKER GENERATOR: The Model TV-50 includes all the most frequently needed marker points. The following markers are provided: 189 Kc., 262.5 Kc., 456 Kc., 600 Kc., 1000 Kc., 1400 Kc., 1600 Kc., 2000 Kc., 2500 Kc., 3579 Kc., 4.5 Mc., 5 Mc., 10.7 Mc. (3579 Kc. is the color burst frequency.)

THE MODEL TV-50 comes absolutely complete with shielded leads and operating instructions.

Only .....

$47.50 NET

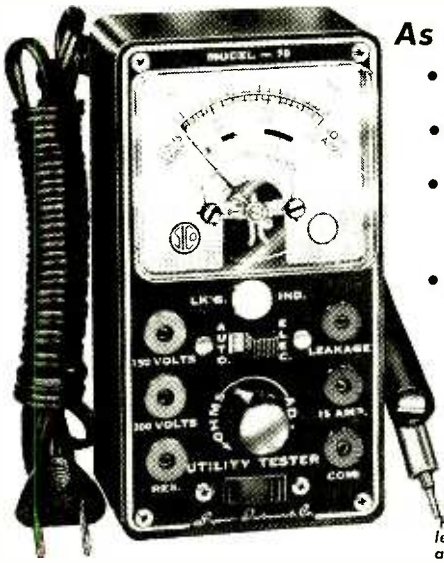
SHIPPED ON APPROVAL

NO MONEY WITH ORDER — NO C.O.D.

Try for 10 days before you buy! If completely satisfied, send down payment *after* trial and pay balance at indicated monthly rate — NO INTEREST OR FINANCE CHARGES ADDED. If not completely satisfied, return to us, no explanation necessary. (See approval form on page 87 for complete details.)

Superior's New Model 70 UTILITY TESTER®

FOR TESTING AND REPAIRING ALL ELECTRICAL APPLIANCES AUTOMOTIVE EQUIPMENT—TV TUBES



As an electrical trouble shooter the Model 70:

- Measures A.C. and D.C. Voltages, A.C. and D.C. Current, Resistances, Leakage, etc.
- Will measure current consumptian *while the appliance under test is in operatian.*
- Incarporates a sensitive direct-reading resistance range which will measure all resistances commonly used in electrical appliances, matars, etc.
- Leakage detecting circuit will indicate cantinuity from zera ahms ta 5 megahms (5,000,000 ohms).
- Will test Toasters, Irons, Broilers, Heating Pads, Clocks, Fans, Vacuum Cleaners, Refrigerators, Lamps, Fluorescents, Fans, Switches, Thermostats, etc.
- Will test *all* TV tubes for apen filaments, interelement shorts, burned aut tubes, etc. (Will nat test TV tubes for *quality*. An emission type tester such as the models TC-55, TV-11, TV-12, etc., described an preceding pages is required to test tubes for *quality*.)

As an Automotive Tester the Model 70 will test:

• Both 6 Volt and 12 Volt Storage Batteries • Generators • Starters • Distributors • Ignition Cails • Regulators • Relays • Circuit Breakers • Cigarette Lighters • Stop Lights • Condensers • Directional Signal Systems • All Lamps and Bulbs • Fuses • Heating Systems • Horns • Also will locate poor grounds, breaks in wiring, paor connections, etc.

Handsome round-cornered molded bakelite case, 3⅛"x5⅞"x2¼". Complete with all test leads. Also included is a 64 page book giving detailed instructions, for testing all electrical appliances, automotive equipment, TV tubes, etc.

Only **$15.85 NET**

READ THIS!! READ THIS!! READ THIS!!

You don't pay for the Tester you select until AFTER you have examined it in the privacy of your home! All models

SHIPPED ON APPROVAL

NO MONEY WITH ORDER — NO C.O.D.

Yes, when you send in the coupon (below) you are merely giving us permission to submit the item(s) you select for your approval. If, after trying it you decide to keep it, then and only then do you send us the down payment and pay the balance at the monthly indicated rate with not *one penny added for interest or finance charges!* If not completely satisfied (we can't please everyone) you simply return the unit to us; no explanation necessary.

MOSS ELECTRONIC DISTRIBUTING CO., INC.
Dept. D-296, 3849 Tenth Ave., New York 34, N. Y.

Please send me the units checked. I agree to pay down payment within 10 days and to pay the monthly balance as shown. It is understood there will be no finance or interest charges added. It is further understood that should I fail to make payment when due, the full unpaid balance shall become immediately due and payable.

Name.....

Address.....

City.....Zone....State.....

☐ Model 670-A . Total Price $28.40 $7.40 within 10 days. Balance $3.50 monthly for 6 months.

☐ Model TV-11 Total Price $47.50 $11.50 within 10 days. Balance $6.00 monthly for 6 months.

☐ Model TV-40 . . Total Price $15.85 $3.85 within 10 days. Balance $4.00 monthly for 3 months.

☐ Model TV-50 Total Price $47.50 $11.50 within 10 days. Balance $6.00 monthly for 6 months.

☐ Model TC-55 . . . Total Price $26.95 $6.95 within 10 days. Balance $5.00 monthly for 4 months.

☐ Model TV-12 . Total Price $72.50 $22.50 within 10 days. Balance $10.00 monthly for 5 months.

☐ Model 770-A Total Price $15.85 $3.85 within 10 days. Balance $4.00 monthly for 3 months.

☐ Model TV-60 Total Price $52.50 $12.50 within 10 days. Balance $8.00 monthly for 5 months.

☐ Model TV-70 Total Price $15.85 $3.85 within 10 days. Balance $4.00 monthly for 3 months.

All Prices net, F.O.B., N.Y.C.

COVER FEATURE

TACAN

New aerial navigation system combines the features of two older types to pin-point planes' position

By J. WHALEN

SINCE man started to fly he has searched for more precise methods of finding his way from one place to another. To get where he wants to go, a pilot needs to know his distance and direction (range and bearing) from a fixed point on Earth. Modern aviation relies mainly on electronics for this chore. Radio and radar signals, cutting through clouds, fog, rain, snow and darkness, permit aircraft to follow their routes over an unseen Earth.

Till recently, systems that gave bearing only have been satisfactory. The pilot could take his bearings on more than one station, find his position at the intersection of the bearing lines and measure his distance from that point to his destination. But planes are getting faster—and there are a lot more of them than a few years ago. Pilots—especially in jets—haven't the time to take bearings and compute distances.

The most modern aerial navigation system in general use, the visual omnirange (VOR) tells the pilot his bearing relative to a fixed point on the ground. (VOR was described in RADIO-ELECTRONICS, February, 1951.) A more recent unit, DME (distance measuring equipment), which tells the pilot his distance from the VOR–DME station, is not so generally used. But a new and more precise navigational system, called Tacan (TACtical Air Navigation) worked out by the Navy in conjunction with Federal Telecommunications Laboratories, may supersede this entirely practical setup, simply because of greater accuracy and adaptability.

Unlike VOR–DME, Tacan gives both distance and bearing with one composite signal, with five times the bearing accuracy of the old system (and equal distance accuracy).

How Tacan operates

The system works in the 1000-mc portion of the spectrum. Transmitters and receivers are required for both ground and aircraft stations (see Fig. 1). Each ground station transmits on a fixed frequency between 962 and 1024 or 1151 and 1213 mc. Channels are spaced 1 mc apart. The airborne equipment receives on any one of 126 selectable channels in the spectrum used by the ground stations and transmits on any one of the 126 selectable channels between the frequencies of 1025 and 1150 mc.

The 1000-mc signals are broken up into pulses, or rather pulse pairs, each pulse 3.2 microseconds wide and separated from its neighbor by 12 microseconds. Every second 3,600 of these pairs are transmitted.

How distance is measured

The airborne transmitter initiates the action by sending out interrogation pulses at a specific repetition rate. Spacing between pairs is made purposely random—no two airborne transmitters have the same spacing and the control circuits have a certain amount of built-in instability to permit the rate to *jitter* slightly. These pulses trigger the ground transmitter into replying to the airborne interrogator. The reply is received by the aircraft's equipment, which measures the time it took to reach the ground station and return, allows for the fixed delays in the equipment and shows the distance in nautical miles on an indicator.

Theoretically, the ground transmitter need not operate except in answer to interrogations. To transmit bearing information, however, and to keep the receiver up to top sensitivity, it has been found better to maintain a "constant-duty cycle" in which the same number of pulses are sent out whether interrogations are received or not. The gain of the receiver is such that when

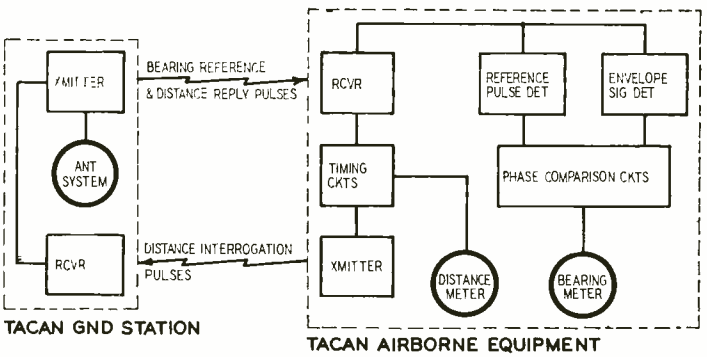
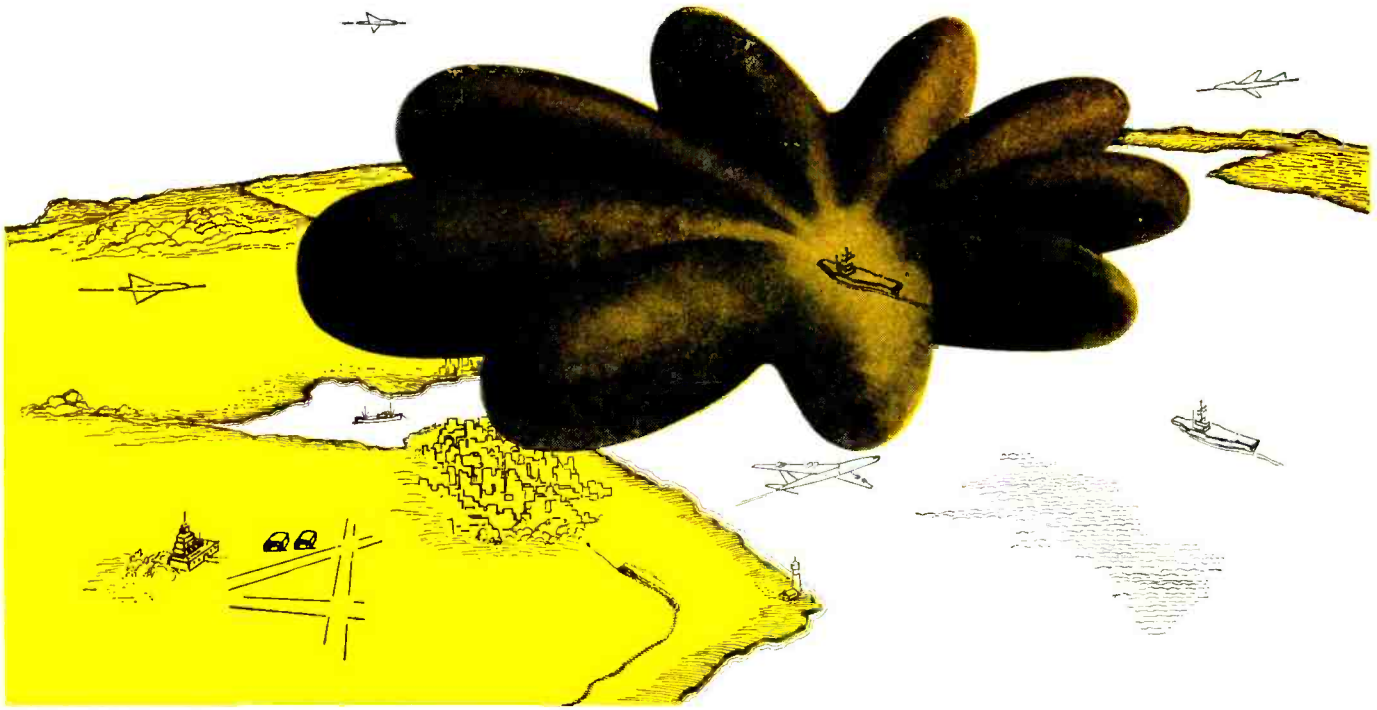


Fig. 1—Diagram shows Tacan airborne and ground equipment and operation.



Idealized 3-D model of nine-lobed cardioid radiation pattern. Transmitter is aboard ship at focus of cardioid.

Illustrations courtesy Federal Telecommunications Laboratories

no interrogations are received random noise triggers the transmitter. As interrogations are received, an automatic gain control reduces sensitivity slightly so that the transmitter is triggered partly by receiver noise and partly by aircraft interrogations. If 100 interrogations are received, all the 2,700 pulse pairs used for distance measurement are triggered by plane-to-ground signals. (The remaining 900 pulse pairs are used for bearing information.)

Pulse pairs sent out in answer to interrogations have the same spacing as those sent by the interrogating aircraft. Noise-triggered pairs have random spacing. This is why the aircraft can recognize the reply to its own query. Only the reply meant for it will follow the spacing of the interrogating transmitter. Obviously, only the replies meant for the aircraft would give the right distance and bearing information.

How bearing is measured

Picture a lighthouse whose narrow beam rotates at some fixed rate. Assume that every time the beam passed north it triggered off a red light that could be seen equally well in all directions. Let's say you are out at sea in a boat somewhere within visual range of the light.

To gauge your bearing relative to north you would need only a stopwatch. You would simply measure the time between the instant the red light flashed (north) and the instant the rotating beam swept past your position. Knowing the rpm of the beam you could easily calculate your bearing.

For instance, say the light rotated clockwise at 1 rpm and you measure 15 seconds between the red flash and the instant the beam swept past your position. Your bearing relative to the lighthouse would be 90° (east).

This is actually what any omnirange (including Tacan) does by electronic techniques. In Tacan, bearing information is contained in audio signals with which the pulse-modulated rf carrier is amplitude-modulated. The AM is imposed by a rotating antenna system; the strength of the signal at the output of the transmitter remains constant at all times.

Heart of the Tacan system is the ground antenna, Fig. 2. Our cover shows a photograph of the antenna, covered with its protective dome. The central element is a 3-inch diameter stationary array of seven biconical dipoles stacked vertically. The central element is the only excited one.

Surrounding this element are two Fiberglas cylinders, one 5 inches and the other 33 inches in diameter. Both are rotated at 15 rps (900 rpm) around the central element. The inner cylinder carries a single parasitic element—the outer nine elements.

With just the one parasite (inner rotating cylinder) the circular pattern of the vertical array is transformed into the cardioid pattern of Fig. 3-a. This cardioid pattern rotates at 15 revolutions per second. To a receiver at a fixed point (or a plane whose position changes little in 1/15 second) the strength of the signal rises to a maximum, drops to a minimum and returns to the starting point 15 times a second—in other words the signal

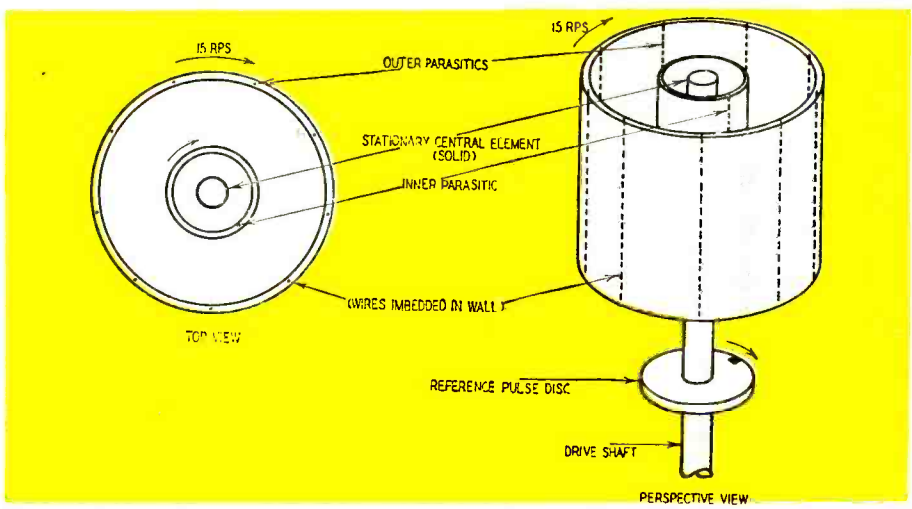


Fig. 2—Plan and perspective views of the antenna—"heart of the Tacan system."

is amplitude-modulated at a 15-cycle rate. Since the amplitude goes through a 360° cycle for every revolution, the *phase* of the modulation (number of degrees from maximum amplitude or other recognizable point in the signal) is equivalent to the number of compass degrees from the same point.

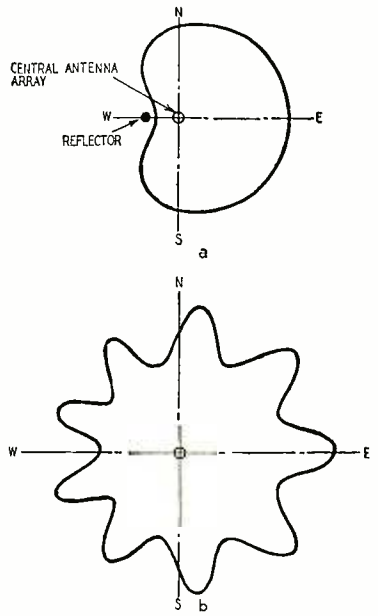


Fig. 3—The 15-cycle modulated pattern (*a*) and the 135-cycle one (*b*).

But so far we have no such point —nothing to take the place of the flash of our optical phare every time the beam pointed north. Actually, at the instant the maximum radiation of the ground-to-air Tacan signal is due east, a closely spaced group of pulses, easily recognized by the airborne receiver, is sent out as a reference signal. The airborne equipment measures the phase difference between this reference signal and the 15-cycle *coarse* variable signal to obtain the coarse bearing.

The *fine* modulating signal is produced by the outer cylinder with its nine parasitic elements. These superimpose a 135-cycle amplitude modulation on the 15-cycle pattern already being transmitted, since the cylinder, sweeping around at the same 15-cycle rate as the inner one, adds its nine lobes or ripples (Fig. 3-b) to the cardioid pattern as received at any distant station. The coarse system identifies the bearing sector within 20°; the fine system pinpoints it to within 1° within this sector.

Receiving circuits

To the airborne receiver, the cardioid pattern produces a 15-cycle sine

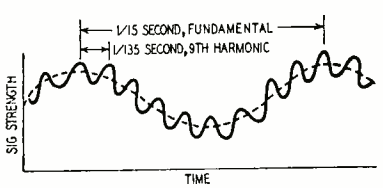
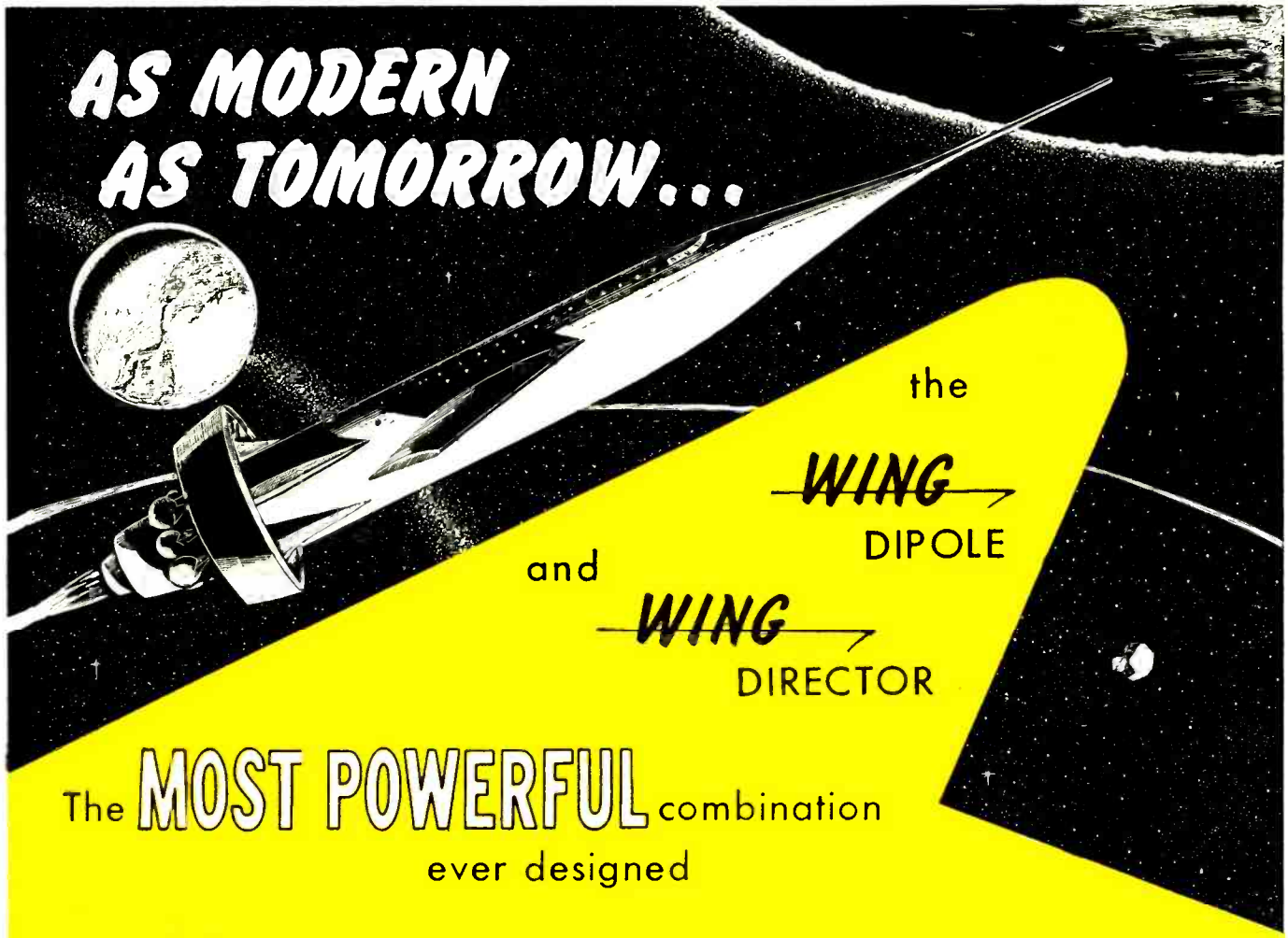


Fig. 4—How the 15-plus-135-cycle signal appears to the airborne receiver.



the
WING
DIPOLE
and
WING
DIRECTOR

The MOST POWERFUL combination
ever designed

FOUND ONLY IN THE TRIO ZEPHYR LINE

ZEPHYR MITE
POWER PACKED PAIR
FOR DISTANCE

Zephyr
POWER PACKED THREESOME
FOR EXTREME DISTANCE

ZEPHYR ROYAL
POWER PACKED FOURSOME
FOR THE MAXIMUM

Trio's Zephyr and Zephyr Royal, the leaders of the 1956 season, are brought to you in the 1957 models improved and perfected, and destined to remain the champions. This famous antenna family is expanded by the Zephyr-Mite, newest addition to the Zephyr family. Trio's Zephyr family features the "Wing" dipole—the composite dipole that brought the power of the Yagi to every channel! Add to this the "Wing" director, the revolutionory new director specifically designed to enhance the power and sensitivity of the "Wing" dipole—and you have a combination that is unequalled in the TV antenna field today for the maximum in performance. The "Wing" dipole and "Wing" director are exclusive features of the Trio Zephyrs—features that make Trio "the choice antenna line."

Trio's recognized quality construction features the internationally famous Insta-Lok clamps—the clamps that 'protect' the element!

TRIO®
Manufacturing Company
GRIGGSVILLE, ILLINOIS

 EXPORT SALES DIV., SCHEEL INTERNATIONAL INC., 4237 N. Lincoln Ave., Chicago, U.S.A. Cable Address: HARSCHEEL

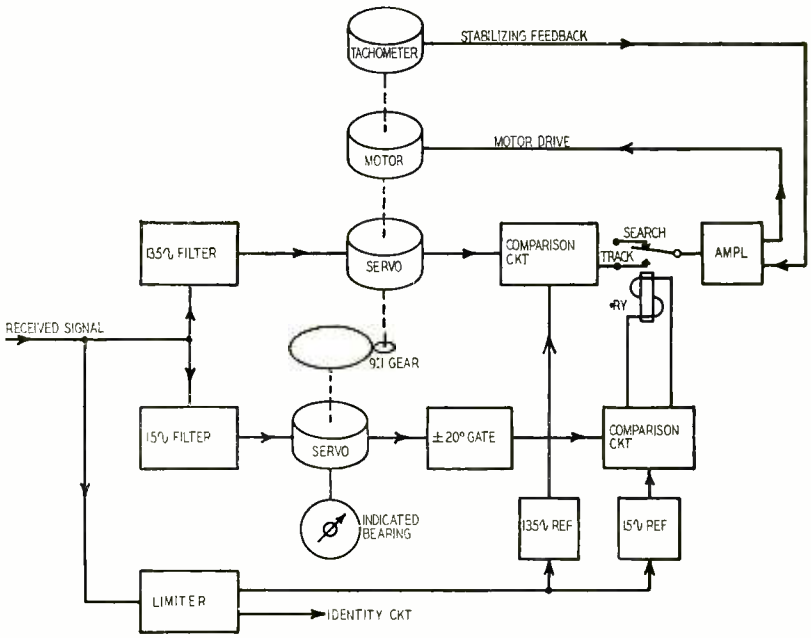


Fig. 5—Diagram of bearing circuits. (Peak rider and decoder circuits omitted.)

wave as shown in the dashed line of Fig. 4. The bearing circuits thus only have to measure the phase of the wave received at the instant the reference signal is received. The bearing circuits of an aircraft receiver are shown in simplified form in Fig. 5. After passing through a decoder in the earlier stages of the receiver, to eliminate all but properly spaced pairs, the signal is split, one portion going to reference burst decoders and the other through separate 15- and 135-cycle channels of a coarse–fine computing electromechanical servo.

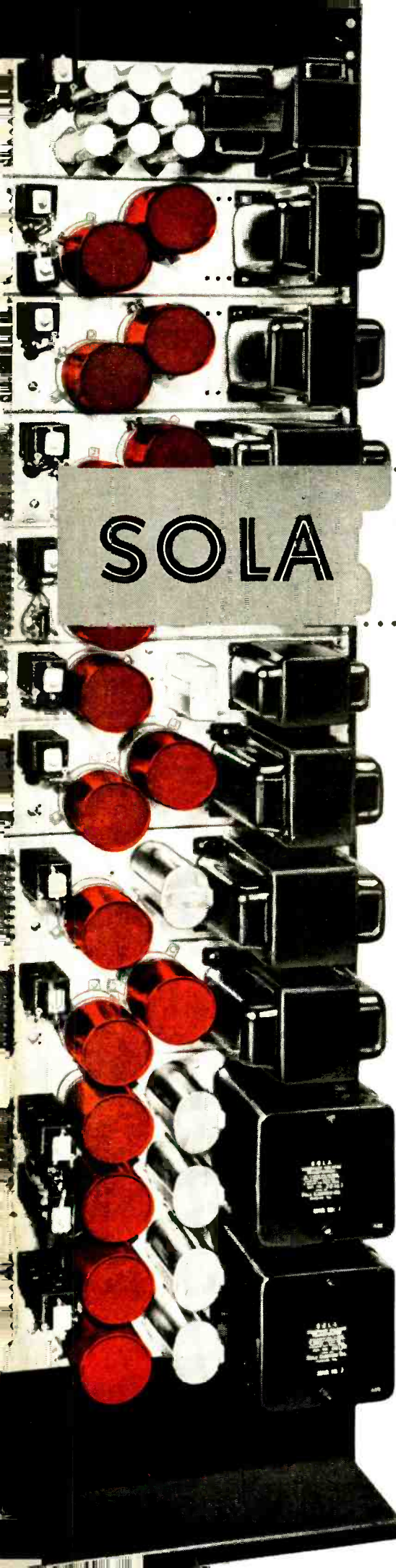
As previously stated, the reference signal is transmitted when the maximum lobe is due east. But the reference signal is not at the maximum (which to the receiver is the rather broad peak of a sine wave) but 90° ahead of it. (A sine wave crosses the zero axis 90° beyond its peak and at that point is changing most rapidly in instantaneous value.)

The sine wave received from the 15-cycle filter is applied to the servo and is made to produce a "gate" at the reference frequency. If the aircraft is due south of the beacon, this reference frequency will fall inside the gate. The indicator will indicate 0°, or north, and a relay is closed to switch the equipment from *search* to *track*. If the plane is not due south, the gate must be shifted in phase till the gate and reference signal coincide. This is done by a phase shifter which rotates at 4 rpm. As soon as the gate has been moved the requisite number of degrees, gate and reference signal will coincide, the meter indicates the difference from north, the relay closes and the 135-cycle circuits take over. These have their own reference pulse bursts and the process is repeated, with the rotation of the phase shifter being transmitted to the indicator through a 9-to-1 reduction gear. It is this that makes the bearing indications of the system so much more accurate than older methods.

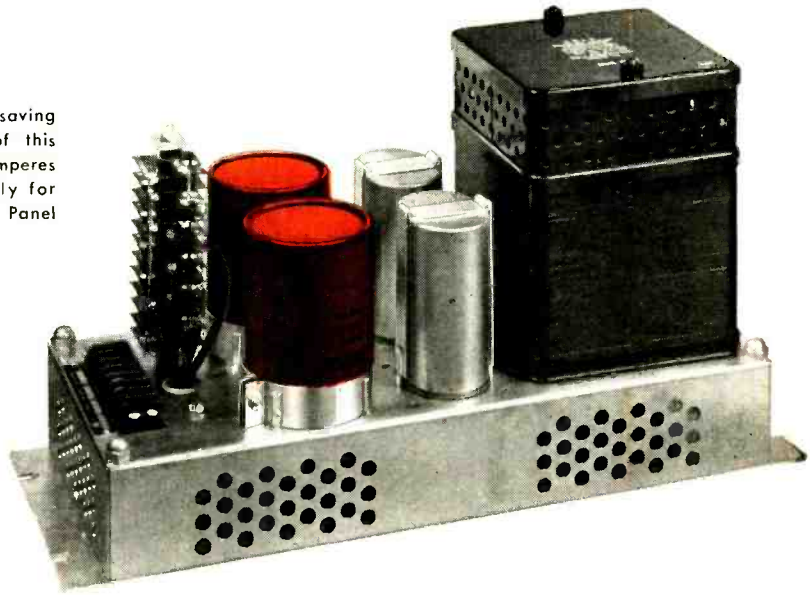
When the gate is in exact coincidence with the reference burst, the comparison circuit supplies no voltage to keep the phase shifter in rotation and the indicator remains fixed till some slight change in the course of the plane may activate the tracking circuits. The circuits then operate to indicate the changed bearing.

A somewhat analogous method is used in the distance-measuring equipment, with a pair of gates varying to tie in with signals having the same spacing as those sent from the plane. There is also a search and tracking mode, with a much lower interrogation pulse rate (approximately 24 per second) while tracking than during the search period when about 150 pulses per second are sent out. Circuit refinements in both the bearing and distance equipment add a "memory" to the circuits so that temporary interruptions of the signal, as by static, interference or the reference burst or identification signals do not return the equipment from the tracking to the search mode.

Tacan is regarded by experts to be the most refined system for furnishing range and bearing and is applicable to use on shipboard and in mobile applications where VOR–DME is not practical. Already in use in Air Force and Navy aircraft, the system met with some objection from civil aircraft authorities because it would make expensive and satisfactory VOR–DME equipment useless. However, a compromise has recently been worked out in which the bearing equipment of the older system may be retained—at least for a time. The compromise system, Vortac, has already been accepted by the Government's Air Coordinating Committee and will be put into effect systematically over the next several years. END



Note the space-saving compact design of this 150 volt DC 5 amperes Sola power supply for computer circuits. Panel height is only 7".



SOLA chooses Sangamo Capacitors for Germanium Power Supplies

Space-saving compactness and light weight . . . features assured by the exacting demands of Sola engineers . . . are among the many advantages of Sola Constant Voltage DC Power Supplies for intermittent, variable, pulse or high current loads. That's why they specify Sangamo Type DCM Electrolytic Capacitors for the high-capacitance filter section of these power supplies.

Besides contributing to the space-saving, weight-reducing design of the "Sola CV DC," Sangamo Capacitors minimize ripple voltage and insure steady, stable DC voltage. No further need for heavy, bulky choke components with their substantial and often-varying load voltage drops.

Just as Sangamo Capacitors meet the exacting specifications of Sola design engineers, they can meet yours . . . no matter how demanding —regardless of how specialized.

Sangamo DCM Electrolytic Capacitors provide excellent capacity stability with long life . . . exceptionally low equivalent series resistance . . . extremely high capacity for case size in low voltage ranges. Special design permits high ripple current without overheating. Can be supplied in maximum energy content rating of 80-watt seconds with maximum voltage rating of 450 VDC. Maximum capacity value of 33,000 mfds. can be supplied at 15 WVDC.

The Sangamo DCM Electrolytic Capacitor is housed in a seamless, drawn aluminum container with gasket-sealed molded alkyd resin base thermosetting plastic cover. Detail of cover construction insures minimum contact resistance in current carrying members and provides an adequate safety vent in case of heavy overload.

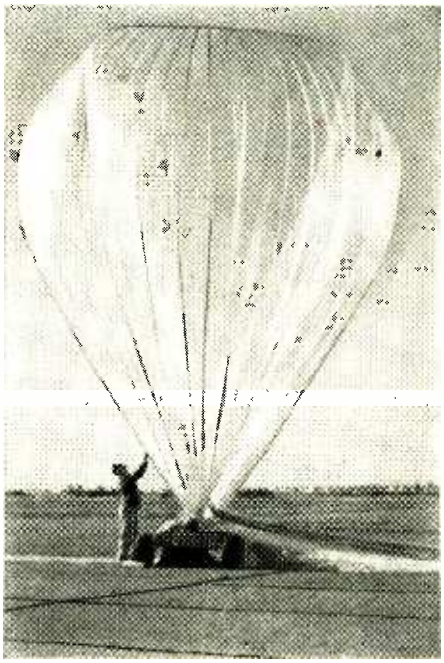
SANGAMO ELECTRIC COMPANY

CAPACITOR DIVISION • SPRINGFIELD, ILLINOIS

SC56-5

RADIO

SOLAR CELL FOR SATELLITES



Possibly one of the most unique uses for the recently developed silicon solar cell will be to supply electrical power to future man-made satellites. With the announcement that the first such satellite will be launched in 1957–58, Dr. John Pierce, research head of Bell Labs, suggested this application for their solar cell.

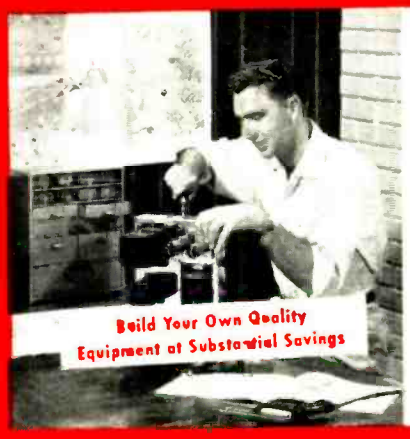
Several months ago the solar cell made its first high-altitude balloon flight. An automatic recorder showed that the solar cell had actually doubled its output at a mere 40,000 feet. Light is much more intense outside the filtering effect of the atmosphere, and cold increases the cell's efficiency. Data, as yet unreleased, from more recent flights at higher altitudes are sure to disclose unbelievable solar-cell performance.

See page 10 for additional articles scheduled for future issues

you get the **most** for your money in

ALLIED'S own knight-kits

THE FINEST ELECTRONIC EQUIPMENT IN MONEY-SAVING KIT FORM



Buy With Confidence From the Pioneers in Electronic Kits

LOWEST COST—our huge buying power means biggest savings for you. You do the easy assembly and your finished instrument is equal in performance and appearance to equipment selling for several times the remarkably low KNIGHT-KIT price.

ADVANCED DESIGN—months of research, development and field-testing go into each KNIGHT-KIT to bring you the latest advances in quality design. And to assure top performance, premium quality parts are supplied in each kit.

EASIEST TO ASSEMBLE—all chassis and panels are punched; all parts are clearly identified—resistors are mounted on cards and values are shown. Instruction manuals are a marvel of clarity, featuring "Step-and-Chek" assembly, "King-Size" diagrams and "Spotlight" pictorials. All you need are soldering iron, pliers and screwdriver.

ALLIED stakes its 36-year reputation in the Electronics field on your complete success and fullest satisfaction with KNIGHT-KITS.

TEST EQUIPMENT • HAM GEAR • HOBBYIST KITS • HI-FI KITS

LATEST PRINTED CIRCUIT

NEW knight-kit LOW COST GENERAL-PURPOSE 5" OSCILLOSCOPE KIT

Model F-146

$49.50

Outstanding value in an all-new, highly versatile 5" oscilloscope kit. Perfect for visual display of all commonly encountered waveforms. Excellent for AM, FM and TV servicing, plus other high-frequency applications. An easy-to-build, easy-to-use, dependable performer that matches or beats commercially wired 'scopes selling at several times more. Up-to-the-minute kit design features printed circuit, laced wiring harness, and pre-cut wires for quick and easy assembly. Has 4 sweep ranges, 15-150,000 cps. High vertical sensitivity: 25 rms millivolts/inch; input impedance, 3.3 megs and 45 mmf; response down only 3 db at 700 kc. Horizontal sensitivity, 70 rms mv/inch; response, down only 3 db at 200 kc; input impedance, 2.2 megs and 30 mmf. Deluxe features include DC positioning controls for fast trace positioning; blanking circuit on all ranges to eliminate retrace lines; graph scope screen and internal, regulated calibrating voltage for highly accurate signal measurements; frequency-compensated vertical attenuator; provision for internal or external, positive or negative synchronization; Phantastron linear sweep generator; high 2nd anode voltage for high-intensity trace. Kit is complete with 5" CRT and all tubes—ready for assembly. Blue steel case with "disappearing" handle. Handsome panel in contrasting gray. Size, 14½ x 9½ x 16" deep. Shpg. wt., 40 lbs.

Model F-146. Complete 5" Oscilloscope Kit. Net only **$49.50**
F-148. RF Demodulator Probe Kit. Net only **$3.45**
F-147. Low-Capacity Probe Kit **$3.45**

Model F-123

NEW knight-kit TV-FM SWEEP GENERATOR KIT

$44.75

Guaranteed Linearity • Fool-proof Calibration
Wide-Range Coverage • Electronic Blanking

All-new; precision-designed for lab use, TV and FM servicing, production line testing. Covers 300 kc to 250 mc continuous on 4 bands (all fundamentals). Center frequencies of VHF TV channels appear on scales. Exclusive KNIGHT-KIT sweep circuit assures almost perfect linearity—RF sweep output in excess of 0.15 volts, *flat within 1 db*, is available on all bands. Sweep width continuously variable, 0-13 mc. Crystal-controlled marker oscillator with dual crystal socket and selector switch. Phase control provides blanking shift, 0 to 180°. Step-type and continuous output controls; separate marker amplitude control. Filter connected to 0-50 mc output jack provides 20 db attenuation of frequencies above 50 mc. to assure pure, fundamental output. 5-volt horizontal sweep voltage (for scope) available from front panel. Professional-looking blue-finish steel case with gray panel. Has "disappearing" handle. 8½ x 12 x 7½". With all parts, tubes, test cable, solder and multi-color pre-cut wire. Less crystal. Shpg. wt., 13½ lbs.

Model F-123. TV-FM Sweep Generator Kit. Net only **$44.75**
P-286. 4.5 mc Crystal (.005%). Net **$4.80**
P-143. 5.0 mc Crystal (.02%). Net **$3.95**
P-145. 10.7 mc Crystal (.02%). Net **$3.95**

EASY PAYMENT TERMS

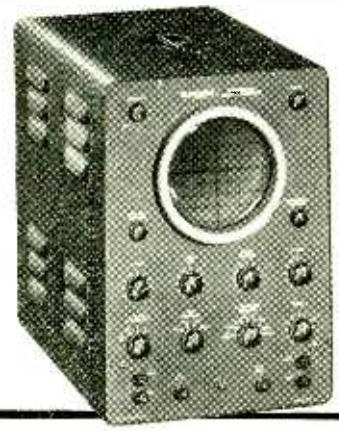
If your total KNIGHT-KIT order is over $45, take advantage of our liberal Time Payment Plan—only 10% down. Write for application form.

ALL PRICES NET F.O.B. CHICAGO

order from **ALLIED RADIO**
100 N. WESTERN AVE., CHICAGO 80, ILLINOIS

SEE FOLLOWING PAGES

ALLIED'S *own* knight-kits... *better by far*



knight-kit 5" ALL-PURPOSE WIDE-BAND OSCILLOSCOPE KIT

2 Printed Circuit Boards • 5 Mc Width for Color TV

Model F-144

$69.00

Wide-band, 5" Oscilloscope; equals or betters the performance of commercially-wired 'scopes costing several times the price. Two printed circuit boards and laced wiring harness assure wiring accuracy and reduce assembly time. Ideal for lab use, color TV servicing and high frequency applications. Provides unusually wide sweep range—*from 15 to 600,000 cps*. Locks in at frequencies as high as 9 mc. Vertical response, 5 cycles to 5 mc. Response, down only 1 db at 3.58 mc color burst frequency; down only 3 db at 5 mc. High vertical sensitivity of 25 mv/inch. Input capacity 20 mmf and 3.5 megs. Outstanding features: cathode-follower vertical and horizontal inputs; 2nd anode provides 1400 volts high-intensity trace; push-pull vertical and horizontal amplifiers; positive and negative locking; faithful square wave response; frequency-compensated attenuator; Z-axis input for intensity modulation; one volt P-P calibrating voltage; astigmatism control; blanking circuit to eliminate retrace lines; DC positioning control. Complete with CRT, all tubes and parts. Handsome, professional, blue-finished steel case with "disappearing" handles. 14½ x 9½ x 16". Shpg. wt., 40 lbs.

Model F-144. Wide-Band 5" Oscilloscope Kit. Net only..... **$69.00**

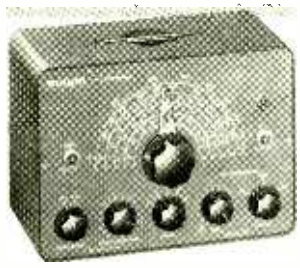
F-148. Demodulator Probe. Net..**$3.45.** **F-147.** Low Capacity Probe. 12 mmf. Net....**$3.45**

NEW knight-kit VOLTAGE CALIBRATOR KIT

Model F-136 **$12.75**

Permits the use of any scope as a precision peak-to-peak AC voltmeter. Provides a true square-wave voltage on scope screen. Range switch and calibrated potentiometer permit selecting any voltage between .01 and 100 volts, in 4 ranges. Fifth position of switch feeds external signal to scope for comparison. Constant output on line volt. variation from 80-135 v, ±6% on all ranges. Shunt capacitance only 15 mmf. Use any 20,000 ohms/volt VOM or a VTVM for initial calibration. Direct coupling of output provides ground reference for DC scopes. Portable case, 7¾ x 5¼ x 4⅜". Ready to build. Shpg. wt., 5 lbs.

Model F-136. Voltage Calibrator Kit. Net.... **$12.75**



knight-kit LOW COST RF SIGNAL GENERATOR KIT

Model F-145 **$19.75**

Build this wide-range extremely stable RF signal generator and save two-thirds the cost of a comparable wired instrument. Ideal for alignment of RF and IF stages in radio and TV sets, and for trouble-shooting audio equipment. Delivers output on fundamentals from 160 kc all the way out to 110 mc; useful harmonics to 220 mc. Has built-in 400-cycle sine-wave audio oscillator for modulating RF; audio is also available externally. Features high-stability Colpitts circuit with precision-wound coils—no calibration necessary. Has input for external modulator. Maximum audio output, 10 volts. RF output, over 100,000 micro-volts. Step and continuous-type output attenuators. With all parts, tubes, wire and solder. Portable case, 7 x 10 x 5". Shpg. wt., 10 lbs.

Model F-145. RF Signal Generator Kit. Net only..... **$19.75**

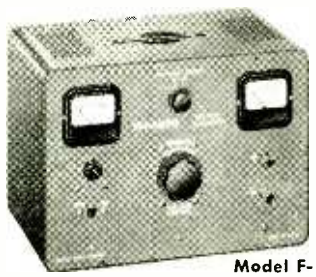
Model F-135

$26.50

knight-kit VISUAL-AURAL SIGNAL TRACER KIT

A remarkable value in an instrument which permits visual and aural signal tracing of RF, IF, video and audio circuits—*has highest gain in its price class*. Traces the signal from the antenna to the speaker. Reproduces signal at plate or grid connection of any stage. Identifies and isolates "dead" stages. Features: usable gain of 91,000; "magic eye" with calibrated attenuators for signal presence indication and stage-by-stage gain measurements; built-in 4" PM speaker; single probe with plug-in head gives instant choice of RF or audio tracing. Provides noise test; built-in watt meter calibrated from 25 to *1000 watts;* provision for external scope or VTVM. Blue-finish steel case. Shpg. wt., 13 lbs.

Model F-135. Signal Tracer Kit. Net only..... **$26.50**



Model F-129

$37.95

NEW knight-kit 6-12 VOLT BATTERY ELIMINATOR KIT

A valuable new unit for servicing auto radios, mobile gear, etc. Delivers continuously variable filtered DC output from 0 to 15 volts. Provides DC output at 0-8 volts or 0-15 volts. Continuous current rating: 12.5 amps at 6 volts, 10 amps at 12 volts. Can also be used as battery charger. Oversize rectifiers and transformer for better regulation and long life. Two meters provide simultaneous current and voltage readings; ranges: 0-15 volts DC; 0-20 amps DC. Doubly protected: fused primary and automatic-reset overload relay for secondary. Heavy-duty binding posts. Blue-finish steel case with "disappearing" handle. With all parts, solder and pre-cut wire. 9 x 12⅛ x 7¾". Shpg. wt., 20 lbs.

Model F-129. Power Supply Kit. Net only..... **$37.95**

knight-kit AUDIO GENERATOR KIT

Model F-137 **$37.50**

An ideal audio frequency source for checking audio circuits and speaker response. Covers: 20 cps to 1 mc in 5 ranges. Output voltage: 10 volts into 600 ohms impedance. *Offers the flat response of a lab standard*—±1 db to 1 meg. Generator imp., 600 ohms. Less than .25% distortion from 100 cps through the audible range; less than .5% when driving 600 ohm load at maximum output. Cont. var. step-attenuated output. 17 lbs.

Model F-137. Audio Generator Kit. Net only....**$37.50**

knight-kit RESISTANCE SUBSTITUTION BOX KIT

Model F-139 **$5.95**

Simplifies determination of resistor values needed in a circuit. 36 standard 1 watt resistance values between 15 ohms and 10 megohms with an accuracy of 10%. 18-position switch; also slide switch for multiplying values by 1000. Extra switch wafer serves as tie points, eliminating buss bar. 5 x 3 x 2". Complete with test leads and clips. 2 lbs.

Model F-139. Resis. Sub. Box Kit. Net..**$5.95**

knight-kit CAPACITANCE SUBSTITUTION BOX KIT

Model F-138 **$5.95**

Makes it easy to find capacitor values needed in a circuit. Provides 18 standard capacitor values from .0001 mfd. to .22 mfd., ±20%. Values are 600 volts, except .15 and .22 which are 400 volt. 18-position switch selects all values quickly and easily. In bakelite case, 5 x 3 x 2". Complete with all parts, test leads and clips. 2 lbs.

Model F-138. Cap. Sub. Box Kit. Net..**$5.95**

QUALITY ELECTRONIC TEST EQUIPMENT IN MONEY-SAVING KIT FORM

...easiest to build...you get more...YOU SAVE MORE

4½" Meter

Model F-128 **$16.95**

knight-kit

1000 OHMS/VOLT VOM KIT

Exceptional accuracy and versatility at amazing low cost. Ideal for service shop, lab and Amateur use. Uses 4½" meter (400 microamp movement) with separate scales for AC voltage and current, DC voltage and current, decibels and resistance. 38 ranges include: AC, DC and output volts, 0-1-5-10-50-100-500-5000 (1000 ohms/volt sensitivity); Resistance, 0-1000-100,000 ohms and 0-1 meg.; Current, AC or DC, 0-1-10-100 ma and 0-1 amps; Decibels, —20 to +69 in 6 ranges. *Uses 1% precision resistors.* 3-position function switch and 12-position range switch. Complete kit with bakelite case, (6¾ x 5¼ x 3¾"), battery, pre-cut wire, solder and test leads. Shpg. wt., 2½ lbs.

Model F-128. 1,000 ohms/volt VOM Kit. Net only. **$16.95**

Model F-140 **$29.50**

knight-kit

20,000 OHMS/VOLT VOM KIT

Outstanding quality and performance at extremely low cost. Features 32 ranges; full vision 4½" meter; accuracy ±2% of full scale; 50 microampere sensitivity for 20,000 ohms/volt input resistance on DC; front panel "zero adjust" Single switch selects function and range. Range: AC, DC and output volts, 0-2.5, 10-50-250-1000-5000; Resistance, 0-2000-200,000 ohms and 0-20 meg.; DC ma, 0-1-10-100; DC amps, 0-1-10; Decibels, —30 to +63 in 6 ranges. Uses precision 1% multipliers. Moisture-resistant film-type resistors. Complete kit with bakelite case (6¾ x 5¼ x 3¾"), batteries, pre-cut wire, solder and test leads. Shpg. wt., 5 lbs.

Model F-140. 20,000 ohms/volt VOM Kit. Net only..... **$29.50**

knight-kit VTVM KIT with Printed Circuit Board

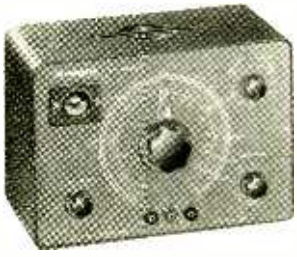
Model F-125 **$24.95** An extremely stable, and highly accurate VTVM. Greatly simplified wiring—entire chassis is a printed circuit board. Maximum convenience in arrangement of scales; 3X AC and DC scale design permits utilization of best portion of each scale for most accurate readings. Also measures peak-to-peak for FM and TV work. Ranges: AC P-P volts, 0-4-14-40-140-400-1400-4000; AC rms volts and DC volts, 0-1.5-5-15-50-150-500-1500; resistance, 0-1000-10K-100K ohms and 0-1-10-100-1000 megohms; db scale, —10 to +5. AC response, 30 cycles to 3 mc. Low-leakage switches and 1% precision resistors. Balanced-bridge circuit. 4½" meter, 200 microamp movement. Polarity reversing switch. Input res., 11 megs. Shpg. wt., 6 lbs.

Model F-125 Printed Circuit VTVM Kit. Net only.. **$24.95**

F-126. Hi-Voltage Probe; extends DC to 50,000 Volts **$4.75**

F-127. Hi-Frequency Probe; extends AC to 250 mc.. **$3.45**

PORTABLE MODEL



knight-kit RESISTOR-CAPACITOR TESTER KIT

Model F-124 **$19.50** Measures capacitance and resistance by accurate bridge method; checks for opens and shorts in paper, mica and ceramic capacitors; shows power factor of electrolytics. Large dial shows capacitance and resistance at a glance; balanced-bridge circuit with "magic eye" null indicator measures power factor from 0-50%. Tests capacitors with rated voltages applied. 5 test voltages: 50, 150, 250, 350, 450. Capacity ranges: 10 mmf to 1000 mfd in 5 ranges. Resistance ranges: 100 to 50,000 ohms and 10,000 ohms to 5 megs. Accuracy, ±10%. Automatic discharge feature prevents after-test shock. Blue-finished steel case, 5 x 3 x 2". With tubes and all parts. Shpg. wt., 8 lbs.

Model F-124. Resistor-Capacitor Tester Kit. Net only..... **$19.50**

Model F-143 **$29.75**

knight-kit LOW-COST TUBE TESTER KIT

Offers high accuracy, top versatility and convenience at lowest cost. Tests 4, 5, 6 and 7-pin large, regular and miniature types, octals, loctals, 9-pin miniatures and pilot lamps. *Features test for new 600 ma series string tubes.* Tests for open, short, leakage, heater continuity and quality (by amount of cathode emission). 4½" square meter with clear "GOOD-?-REPLACE" scale. With line-voltage indicator and line-adjust control. Choice of 14 filament voltages from .63 to 117 volts. Blank socket for future type tubes. Universal-type selector switches for any combination of pin connections. *Single-unit, 10-lever function switch.* Entire switch assembly is installed as a single unit—saves time and greatly simplifies construction. Illuminated roll chart lists over 600 tube types. Shpg. wt., 14 lbs.

Model F-143. Counter Model Tube Tester Kit. Net only... **$29.75**

Model F-142. Portable Model Tube Tester Kit. Net only.... **$34.75**

F-141. TV Picture Tube Adapter for above. Net only..... **$3.75**

NEW knight-kit TRANSISTOR & DIODE CHECKER KIT

Model F-149 **$8.50** Checks leakage-to-gain ratio and noise level of all junction, point contact and barrier transistors. Also checks diodes, forward and reverse current conduction of selenium rectifiers; useful for continuity and short checks. Easy-to-read meter. Features: spring-return leakage gain switch; calibration control; separate sockets for PNP and NPN transistors. Headphones or signal tracer may be used with checker for noise measurements. Case, 5 x 3 x 2". With 22½ volt battery. 2½ lbs.

Model F-149. Transistor Checker Kit. Net. **$8.50**

Model F-119 **$12.50**

knight-kit LOW-COST "IN-CIRCUIT" CAPACITOR CHECKER KIT

Tests capacitors while they are still wired in the circuit! Saves time and bother; an essential instrument for the service technician. Just press a button and the "magic eye" instantly shows opens and shorts (not leakage). Tests opens and shorts on any capacitor of 20 mmf or greater capacity, even if it is in parallel with a resistance as low as 50 ohms. Tests for shorts may be made on any capacitor even when it is shunted by as low as 20 ohms. Blue-finish steel case, 7¾ x 5¼ x 5". With tubes, all parts, wire and solder. Easy to assemble. Shpg. wt., 5 lbs.

Model F-119. Cap. Checker Kit.... **$12.50**

EASY PAYMENT TERMS: If your total KNIGHT-KIT order is over $45, take advantage of our liberal Time Payment Plan —only 10% down. Write for application blank.

ALL PRICES NET F.O.B. CHICAGO

ALLIED'S own MONEY-SAVING knight-kits

FAMOUS knight-kits FOR HOBBYISTS & EXPERIMENTERS...FASCINATING, INSTRUCTIVE...

knight-kit
"SPACE SPANNER" BAND SWITCHING RECEIVER KIT

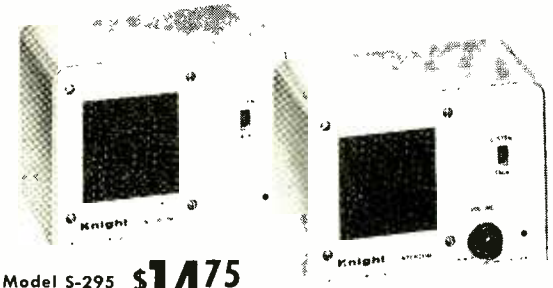
Model S-243 **$15.95**

Thrilling Short Wave and Broadcast

Famous 2-band AC-DC receiver in easy-to-build kit form at a very low price. Pulls in thrilling short-wave (6 to 17 mc) and standard broadcast. It's fun listening to amateur, aircraft, police and marine radio. Features highly sensitive regenerative circuit. Bandswitch selects broadcast or short wave. Has 4" PM speaker and beam-power output tube for plenty of volume; headphone connectors for weak signal listening; slide switch cuts out speaker. Uses 12AT7 regenerative detector and audio amplifier, 50C5 power output, 35W4 rectifier. Six controls: Bandspread; Main Tuning; Antenna Trimmer; Bandswitch; Regeneration; Audio Gain. Includes tubes and all parts. 7 x 10½ x 6". Shpg. wt. 4½ lbs.

Model S-243. "Space Spanner" Receiver Kit. Net only..... **$15.95**

S-247. Matching Cabinet for above. 2 lbs. Net..... **$2.90**

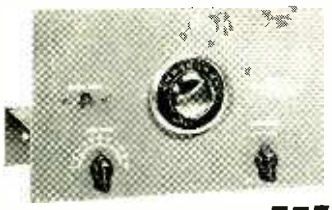


Model S-295 **$14.75**

NEW knight-kit TWO-WAY INTERCOM KIT

New low-cost, easy to build intercom system kit. Ideal for use in home or office. Consists of Master unit and Remote unit, each with press-to-talk switch. Remote unit may be left "open" for answering calls from a distance, for "baby-sitting", etc. Remote may also be connected for "private" operation—cannot be "listened-in" on, but it can be called and can originate calls. Master unit includes high-gain 2-stage amplifier; each unit has 4" PM dynamic speaker. Complete with Antique White cabinets (4¾ x 6½ x 4⅜"), all parts, tubes and 50 feet of cable (up to 200 feet of cable can be added). For AC or DC. Shpg. wt., 7 lbs.

Model S-295. Two-Way Intercom Kit. Net only.. **$14.75**



Model S-740 **$11.75**

knight-kit
"OCEAN HOPPER" RECEIVER KIT

Tops for exciting broadcast, long wave and short wave reception. Highly sensitive regenerative-type circuit. Excellent headphone reception; can be used with 3-4 ohm PM speaker on strong broadcast band stations. Supplied with plug-in coil for standard broadcast; covers long wave and popular short wave bands with coils below. Pulls in thrilling foreign broadcasts, police, amateurs and aircraft. Controls: Main Tuning, Bandspread, Antenna Tuning. Off-On-Regeneration. With all parts and tubes (less extra coils and headset). AC or DC. Shpg. wt., 5 lbs.

Model S-740. "Ocean Hopper" Kit..... **$11.75**

EXTRA PLUG-IN COILS

S-741. Long Wave, 155-470 kc. Net..... **79¢**
S-742. Short Wave, 1.65-470 kc.
S-743. Short Wave, 2.9-7.3 mc. } Net each..... **65¢**
S-745. Short Wave, 7-17.5 mc.
S-744. Short Wave, 15.5-35 mc.

Model S-735 **$17.25**

knight-kit
"RANGER II" SUPERHET RADIO KIT

Thousands have built and enjoyed the "Ranger" Broadcast Band Receiver. Carefully engineered for easy construction and powerful, sensitive performance. Latest Superhet circuit; tunes 540 to 1680 kc; covers entire broadcast band and exciting police calls. Features automatic volume control, built-in preformed loop antenna, ball-bearing tuning condenser. Develops excellent tone quality from Alnico V PM dynamic speaker. Supplied with following tubes: 12SA7GT converter; 12SK7GT IF amp.; 12SQ7GT det.-AVC-audio; 50L6GT audio output; 35Z5GT rect. Complete with handsome brown plastic cabinet (6 x 9 x 5) tubes, speaker, all parts, and instruction manual. AC or DC operation. Shpg. wt., 8 lbs.

Model S-735. "Ranger II" Superhet Radio Kit. Net only..... **$17.25**

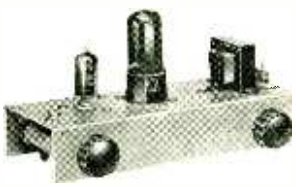
Model S-730 **$19.95**

knight-kit
3-WAY PORTABLE RADIO KIT

A low-cost portable radio covering the full standard broadcast band from 535 kc to 1650 kc. Delivers excellent reception on AC or DC current or from self-contained batteries. Sensitive Superhet circuit features automatic volume control, economical operation. Includes powerful 5" Alnico PM dynamic speaker, efficient ferrite loop-stick antenna. Supplied with following tubes: 1R5 converter; 1U4 IF amplifier; 1U5 detector-AVC-audio; 3V4 audio output. Complete with attractive portable case (7⅝ x 10 x 5¼"), tubes, speaker, all parts and instruction manual. Shpg. wt., 6 lbs.

Model S-730. 3-Way Portable Radio Kit (less batteries). Net. **$19.95**

J-651. Battery Kit for above..... **$2.50**



knight-kit LOW COST PHONO AMPLIFIER KIT

Model S-790 **$8.95**

It's easy to build this fine-performing, low-cost compact phono amplifier. Ideal for use in a portable phonograph—simply add any record player and a 3 to 4-ohm speaker. Amplifier works with crystal or ceramic cartridges. Inverse feedback circuit for rich, clean tone quality. Delivers full 1½-watt output with less than .25 volt input. Includes efficient tone control; has AC outlet, controlled from amplifier switch. Complete with tubes and all parts. Size only 4½ x 7 x 4"—fits into almost any portable phono case. Shpg. wt., 3 lbs.

Model S-790. Phono Amplifier Kit. Net only..... **$8.95**

FAMOUS knight-kit CRYSTAL SET KIT

Model S-261 **$2.15**

Thousands of beginners have started in radio and electronics by building the KNIGHT-KIT crystal set. This feature-packed set delivers loud, clear reception of local broadcast stations. A germanium crystal diode detector assures high sensitivity and simple operation—no crystal adjustment required. "Hi-Q" coil boosts sensitivity. Ball-bearing variable capacitor for easy tuning. With all parts and simple-to-follow instructions. Shpg. wt., 1 lb.

Model S-261. Crystal Set Kit. Net only..... **$2.15**

S-267. Accessory Kit. 2000-ohm headphones and all parts for outdoor antenna..... **$2.95**

Buy with confidence from ALLIED—America's Pioneer in Electronic Kits

finest quality electronic equipment in lowest-cost kit form

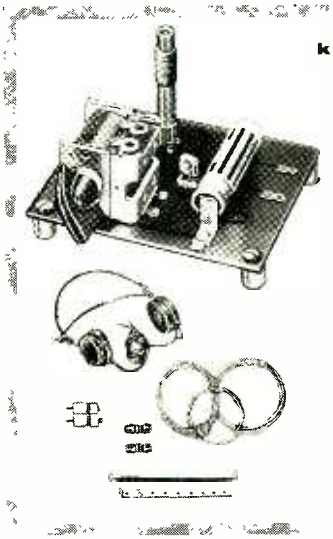
EASY-TO-BUILD HIGH PERFORMANCE KITS • WIDELY USED BY MANY LEADING TRAINING SCHOOLS

NEW knight-kit ELECTRONIC PHOTOFLASH KIT

Model S-244 **$28.50**

New feature-packed photoflash kit—designed for top quality dependability—available at a money-saving low price. Ideal for black and white or color photography. Xenon-filled reflector-bulb assembly gives over 10,000 flashes at less than ½¢ each! 1/700-second flash freezes the fastest action. Has 50 watt-second output. Provides light approximating daylight in spectral quality; permits the use of outdoor-type film indoors. Film guide number for color (ASA10) is 45. Designed for "X" or "O" shutters only. Requires sync cable (available from any photo supply dealer) and either battery or AC supply listed below. Complete outfit with battery weighs only 3½ lbs. Kit includes all parts, carrying case and easy-to-follow instructions. Shpg. wt., 3 lbs.

Model S-244. Electronic Photoflash Kit. Net.... **$28.50**
S-246. AC Power Supply Kit. Easy to assemble.... **$3.75**
J-626. Battery for above (Burgess U-200)..... **$8.47**



knight-kit TRANSISTOR RADIO KIT

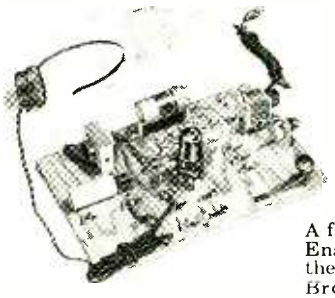
Printed Wiring • Works from Penlight Cell

Model S-765 **$4.35** **Smooth Variable Capacitor Tuning**

Experiment with the marvel of transistors! Printed circuit requires no wiring—just assemble with a few solder connections and enjoy excellent reception over the full AM broadcast band. No tubes to burn out—no crystal. Compact—fits in the palm of your hand—operates for months from a single penlight cell. Transistor provides plenty of power for strong headphone reception. Complete with all parts, transistor and penlight cell. Shpg. wt., 8 oz.

Model S-765. Transistor Radio Kit **$4.35**
S-266. Accessory Kit. 4000-ohm headphones and all parts for outdoor antenna..... **$3.15**

FAMOUS knight-kit LAB KITS



6-IN-1 RADIO LAB KIT

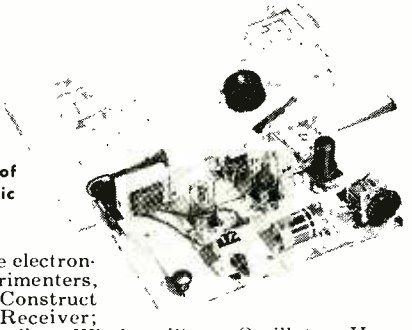
Model S-770 **$7.95** **Build Any of 6 Electronic Projects**

A fascinating and instructive kit. Enables you to build any one of the following projects: Standard Broadcast Receiver; Wireless "Home Broadcaster"; Code Practice Oscillator; Code Practice Broadcaster; Signal Tracer; Sine Wave Generator. Perfect for beginners. Once basic wiring is completed, circuits may be changed without soldering. Safe to build and operate; only tools needed are screwdriver, pliers and soldering iron. The ideal kit for students and beginners in electronics. Kit includes mounting board, tube, all parts and easy-to-follow instruction manual. Less headphone (also serves as mike). Shpg. wt., 6 lbs.

Model S-770. "6-in-1" Lab Kit. Net only..... **$7.95**
J-112. Single 1000-ohm headphone for above..... **$1.05**
C-100. Antenna kit for above..... **$1.05**

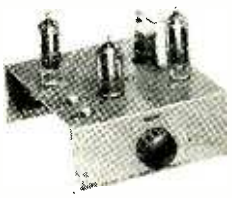
10-IN-1 LAB KIT

Model S-265 **$12.65** **Build Any of 10 Electronic Projects**



A wonderfully instructive electronics kit. Ideal for experimenters, beginners—fun to build. Construct a sensitive Broadcast Receiver; Amplifier (for phono or mike); Wireless Phono Oscillator; Home "Broadcast Station"; Code Practice Oscillator; Capacity-Operated Relay, or any one of *four* other fascinating projects. Low voltages; safe to build and operate. Only tools needed are soldering iron, screwdriver and pliers. Perfect for self-instruction in circuit fundamentals, and packed with practical applications. Kit includes mounting board, tubes, all parts, hardware, microphone, and 12-page builders' manual. Shpg. wt., 10 lbs.

Model S-265. "10-in-1" Lab Kit. Net only..... **$12.65**
J-112. Single 1000-ohm headphone for above..... **$1.05**
C-100. Antenna Kit for above..... **$1.05**



knight-kit WIRELESS BROADCASTER KIT

Model S-705 **$9.50**

This fascinating unit makes it possible to "broadcast" with phonograph or microphone through any standard radio receiver up to 50 feet away—without any connection to the set. May be used with crystal or magnetic cartridge, or with microphone. Broadcasts a clear, full-toned signal. High-gain stage permits using magnetic cartridge without need for external preamp. Complete with all parts, tubes, wire and solder (less microphone). 4½ x 5 x 6". Easy to assemble. Shpg. wt., 3 lbs.

Model S-705. Wireless Broadcaster Kit. Net only..... **$9.50**
S-556. Microphone for above with 5-ft. cable..... **$3.95**

knight-kit PHONO OSCILLATOR KIT

Model S-760 **$5.85**

This low-cost phono oscillator may be used with any crystal phonograph for "broadcasting" recorded music through any standard radio receiver up to 50 feet away. Requires no direct connection to radio set. Operates on any frequency between 600 and 800 kc. Has controls for adjustment of modulation level and selection of clear frequency on radio receiver. Uses 50L6GT tube and 35Z5GT rectifier. Complete with all parts, tubes and instructions. 4¼ x 4¼ x 4½". Shpg. wt., 1 lb.

Model S-760. Phono Oscillator Kit. Net only..... **$5.85**

ALL PRICES NET F.O.B. CHICAGO

knight-kit CODE PRACTICE OSCILLATOR KIT

Model S-239 **$3.95** **Transistor Circuit—Powered by Penlight Cell**

An ideal code practice oscillator. Uses transistor circuit. Extremely low current consumption—powered by single penlight battery. Provides crisp, clear tone (400 to 600 cps). Has input jack for earphone; screw-type terminal strip for key. In compact bakelite case (2⅜ x 3¾ x 1½") with anodized aluminum panel. Complete with all parts, transistor, battery and easy-to-follow instructions. Shpg. wt., 1 lb.

Model S-239. Code Practice Kit.... **$3.95**

See Next Page for Amateur Kits

ALLIED'S own knight-kits give you the most for your money

BUILD YOUR OWN QUALITY HI-FI AMPLIFIER!

knight-kit

BASIC 25-WATT LINEAR-DELUXE HI-FI AMPLIFIER KIT

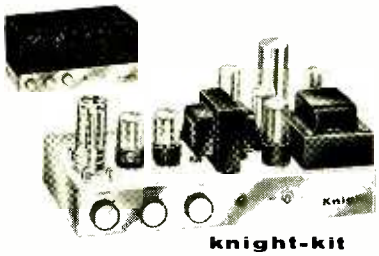
Model S-755

$44.50

Williamson-Type Circuit
Printed Circuit Board
Chrome-Plated Chassis

This super-quality hi-fi basic amplifier is designed to satisfy the most critical listener. Intended for use with tuners incorporating built-in preamp or with separate preamp. Incorporates latest Williamson-type circuit and has potted matched transformers. Delivers maximum output of 45 watts. Frequency response is: ±0.5 db, 10 cps to 120 kc, *measured at 20 watts*. Harmonic distortion is only .15% right up to 30 watts. Intermodulation distortion is only .27% at 10 watts and only .4% at 20 watts, using 60 cps and 7 kc, 1:4 ratio. Hum level is —85 db below full rated output. Output impedance, 4, 8, 16 ohms. Input voltage for 25-watt output is 1.8 volts. Uses two 12AU7's, two 5881's, and a 5V4. Etched circuit is utilized in voltage amplifier and phase inverter stages to speed assembly. Has output tube balancing control, variable damping control, and on-off switch. Handsome chrome-plated chassis, 14 x 9 x 2". Overall height, 7". A deluxe true hi-fi amplifier equal in performance to amplifiers selling at over twice the price. Complete with all parts and tubes. Easy to assemble. Shpg. wt., 27 lbs.

Model S-755. Basic 25 Watt Hi-Fi Amplifier Kit. Net only..... **$44.50**
S-759. Metal enclosure for above; black finish. 3 lbs. Net..... **$4.25**



knight-kit

10-WATT HI-FI AMPLIFIER KIT

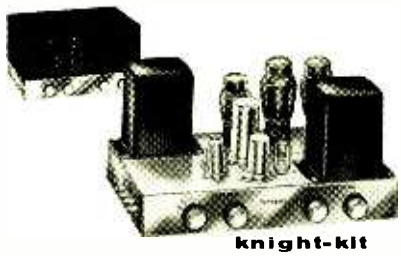
Model S-753

$23.50

Chrome-Plated Chassis

Famous for wide response and smooth reproduction at low cost. Only 0.5 volt drives amplifier to full output. Frequency response: ±1 db, 30-20,000 cps at 10 watts. Harmonic distortion less than 0.5% at 10 watts. Intermod. distortion less than 1.5% at full output. Controls: on-off-volume, bass, treble. Input for crystal phono or tuner. Chromed chassis; punched to accommodate magnetic cartridge preamp. Matches 8 ohm speakers. Shpg. wt., 14 lbs.

Model S-753. Amplifier Kit. Net... **$23.50**
Model S-235. Preamp Kit for above ... **$3.10**
S-757. Metal Enclosure. 3 lbs..... **$3.95**



knight-kit

20-WATT HI-FI AMPLIFIER KIT

Model S-750

$35.75

Chrome-Plated Chassis

True hi-fi for less! Frequency response, ±1 db, 20-20,000 cps at 20 watts. Distortion, 1% at 20 watts. Hum and noise level: tuner input, 90 db below 20 watts; phono 72 db below 20 watts. 4 inputs: magnetic phono, microphone, crystal phono or recorder, and tuner. Controls: Bass, Treble, Volume, Selector. With compensation positions for 78 and LP records. Built-in Preamp. Outputs: 4, 8, 16 and 500 ohms. 23 lbs.

Model S-750. 20-Watt Kit. Net **$35.75**
S-758. Metal Enclosure. 3 lbs. **$4.15**
S-752. Chrome-plated escutcheon for cabinet installation of amplifier. Net..... **$1.40**

LOW-COST TOP QUALITY KITS FOR THE HAM

knight-kit

Model S-255

$43.75

50-WATT CW TRANSMITTER KIT

Built-in Pi-Type Antenna Coupler

Check the features packed into this new transmitter kit and you'll see why it's one of the greatest Amateur values ever offered. Compact and versatile, it is the perfect low-power rig for the beginning Novice or seasoned veteran. Features: 50 watts input to 807 final; high-efficiency 6AG7 modified-Pierce oscillator takes crystal or VFO without circuit changes; bandswitching coverage of 80, 40, 20, 15, 11-10 meters; pi-section antenna output matches line impedances from 50 to 1200 ohms —permits use with any type of antenna; no separate antenna tuner required. Crisp, clean, cathode keying of oscillator and final. Power take-off plug supplies filament and B-plus voltages for other equipment. Copper-finished chassis and cabinet interior, filtering, shielding, bypassing, and coaxial SO-239 antenna connector provide excellent TVI suppression. Meter reads either plate or grid current of final. Jacks for VFO, crystal and key. Supplied with all parts and tubes. Less crystal and key. 8⅜ x 11⅜ x 8¾". Shpg. wt., 18 lbs.

Model S-255. 50-Watt Transmitter Kit. Net... **$43.75**

knight-kit

SELF-POWERED VFO KIT

Model S-725

$28.50

Complete with built-in power supply! Careful design and voltage regulation assure high stability. Excellent oscillator keying characteristics for fast break-in without clicks or chirps. Full TVI suppression. Has plenty of bandspread: separate calibrated scales for 80, 40, 20, 15, 11 and 10 meters; vernier drive mechanism. 2-chassis construction keeps heat from frequency determining circuits. Output cable plugs into crystal socket of transmitter. Output on 80 and 40 meters. With Spot-Off-Transmit switch for "no swish" tuning. Extra switch contacts for operating relays and other equipment. With all parts and tubes. 8 lbs.

Model S-725. Self-Powered VFO Kit. Net..... **$28.50**

NEW knight-kit AMATEUR RF "Z" BRIDGE KIT

Model S-253

$5.85

Measures standing wave ratio (SWR) and impedance of antenna systems; also for adjusting antenna networks for optimum results. Any VOM may be used for null indicator. High accuracy with 20,000 ohm/v VOM. Correction factor info supplied for other VOM's. With coax input and output connectors. Meters both input and bridge voltage. Calibrated dial gives direct impedance reading; includes 1% precision resistor for precise calibration adjustment. With all parts and handy plasticized SWR chart. 1½ lbs.

Model S-253. "Z" Bridge Kit. Net only **$5.85**

ALLIED RADIO

100 N. WESTERN AVE., CHICAGO 80, ILL.

Our 36th year

ALLIED RADIO CORP., Dept. 02-L-6, 100 N. Western Ave., Chicago 80, Ill.

Ship me the following KNIGHT-KITS:

Quantity	Description	Model No.	Price

$_____ enclosed. For parcel post include postage (express is shipped collect).

Name _____

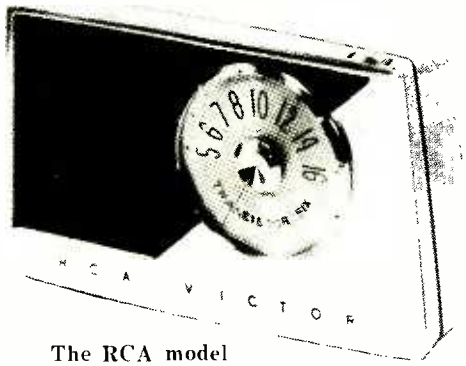
Address _____

City _____ Zone _____ State _____

← order Today

TRANSISTOR **RADIOS**

Part VI—Interesting recent offerings by RCA, Westinghouse, Emerson, Philco and Bulova



The RCA model 7-BT-9J

By I. QUEEN
EDITORIAL ASSOCIATE

THE latest n-p-n grown junction transistors are being made with very low internal collector capacitance. Furthermore, these units can be made nearly identical so far as capacitance is concerned. A typical value is 2 $\mu\mu$f. Because of this extremely low capacitance, neutralization can be dispensed with. Of course, the circuit wiring and parts placement must be designed to eliminate all external feedback from output to input. This feedback balance must not be disturbed through any changes in wiring or parts placement when being serviced. Replacement of transistors with different types may upset either the gain or capacitance balance, causing either regeneration or degeneration and affecting the optimum performance of the set. With the exception of the Philco and Bulova, the sets below do not require neutralization.

RCA 7-BT-9J

This receiver (Fig. 1) uses six transistors, three n-p-n types in the high-frequency circuits and three p-n-p units for audio. The set measures 3 7/16 x 5 13/16 x 1 9/16 inches and weighs 1 pound with battery. Output is 65 mw undistorted, with a maximum of 100 mw. It has a printed circuit, and the cabinet is made of nonbreakable Impaq plastic.

The signal and local oscillator frequencies are mixed by connecting in series the secondaries of the oscillator transformer and the antenna loop. It is desirable to stabilize the bias for a converter. This is often done by a voltage divider. Here, the V1 base is returned to a point of fixed positive voltage, the emitter of V2. Minus the small drop in R1, it provides a low bias for the converter.

As usual, the signal is impressed across the emitter-base circuit of each if stage (through a capacitor). However, the collector circuits are not conventional. Ordinarily, these return (through a capacitor) to the emitters. This receiver returns them to a *center tap* on the transformer secondary. This means that the if amplifiers function more like *common-base* stages which are highly degenerative and require no neutralization. Since the center taps are between emitter and base in each case, each stage is actually a compromise between common emitter and common base. There is sufficient degeneration to make neutralization unnecessary, yet ample gain remains.

The detector diode generates a negative potential across the volume control. This is filtered and fed back to the base of V2. A strong signal reduces the if gain for proper avc action.

The push-pull class-B stage includes a thermistor whose resistance is 270 ohms at normal room temperature. When the set is operated in a warm location, the transistors are more conductive and pass greater current. At the same time, the thermistor resistance goes down (due to the higher temperature) and lowers the potential between base and emitter. One effect offsets the other, so the class-B current remains nearly constant regardless of temperature variation.

The no-signal current to this receiver is 6 ma, at 50-mw output, it rises to 14 ma.

Westinghouse "Seven Transistor"

This set has a 6 x 3⅛ x 1⅝-inch unbreakable case (choice of three colors) that fits a lady's handbag or a man's suit pocket. It features a printed-board circuit and class-B output driving a 2¾-inch speaker (Fig. 2), weight is 15½ ounces. Conelrad frequencies are identified. An earphone jack is included for personal listening. Power supply is a 9-volt battery, drain on which is only 5 ma at low volume.

The high-frequency circuits use n-p-n transistors; the audio stages are p-n-p. The converter is the usual autodyne which combines oscillation and mixing. Oscillation results from inductive coupling between the converter's emitter and collector circuits.

The if stages do not provide for neutralization but the following must be observed: Both stages may use a 2N146 transistor type *or* the first may use a 2N145 and the second a 2N147. Otherwise, gain or feedback balance may be upset. Each transformer is untapped and the bases are biased from a fixed resistor network. The detector is a class-B stage that amplifies as well as rectifies.

The avc system deserves special comment. The detector passes more current as the signal strength increases. This current must flow through R6 (in the first if stage). Thus, as the current rises with greater signal, R6 biases its if amplifier for less gain. A large capacitor is used across R6 to filter the variations so that gain will not be controlled from one instant to the next but, rather, smoothly over an extended interval.

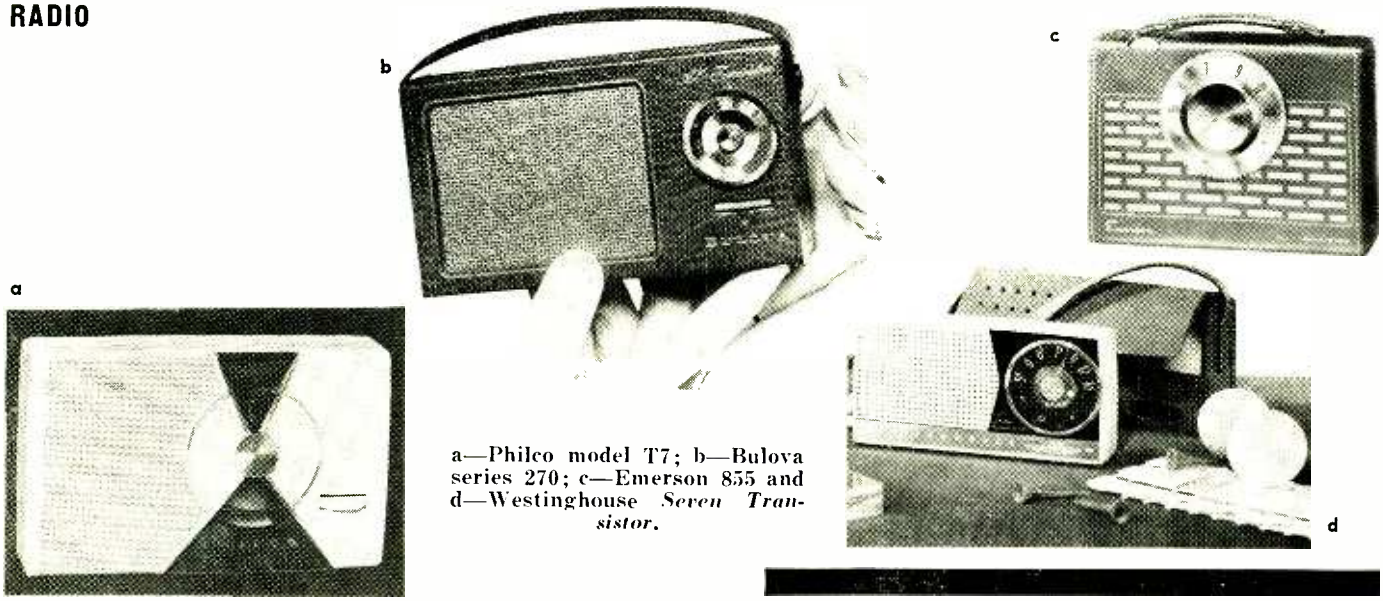
The volume control is a potentiometer that determines the fraction of output transferred to the driver. When its arm—connected to the detector output—is set at the low end of the control, *no* audio is transferred. At the high end, *all* audio is fed to the driver.

When an earpiece is plugged into the jack (driver stage), the class-B stage is disconnected from the driver. Note, however, that its power is not cut off. A class-B stage consumes power in proportion to its signal input. Naturally there is no signal input when the earpiece is plugged in. Thus the stage idles and consumes negligible power. The output stage requires a matched pair of transistors and is fixed-biased. The speaker impedance is 12 ohms.

Emerson model 855

This receiver measures 9⅜ x 7 x 3 5/16 inches and weighs 5 pounds with batteries. Leather cabinets (choice of five colors) are available for it. The set is powered by a pair of 9-volt batteries in parallel (Eveready 276 or equivalent). These will operate the receiver up to *1,500 hours*, that is, 2 to 5 years of normal playing. Operating cost is actually *less* than that of an ac radio.

Fig. 3 shows the schematic and the voltages at transistor elements with respect to chassis. The converter is conventional. It feeds into a pair of if stages that require no neutralization. These stages are peaked at 455 kc as usual. Each transistor may be a 2N146 *or* the first stage may be 2N145 and the second 2N147. Each base and collector is properly bypassed as shown.



a—Philco model T7; b—Bulova series 270; c—Emerson 855 and d—Westinghouse *Seven Transistor*.

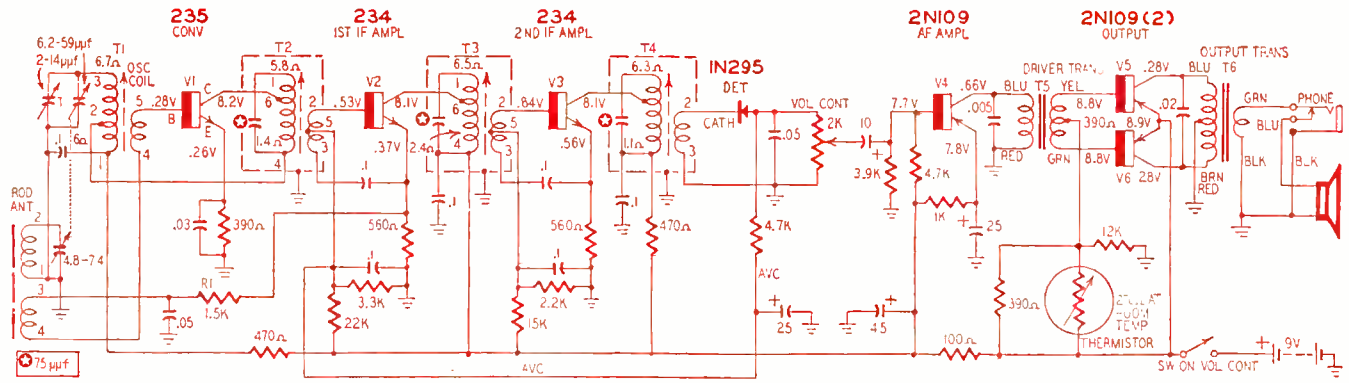


Fig. 1—The RCA 7-BT-9J. Some interesting if circuit features are to be found in this six-transistor, one-diode radio.

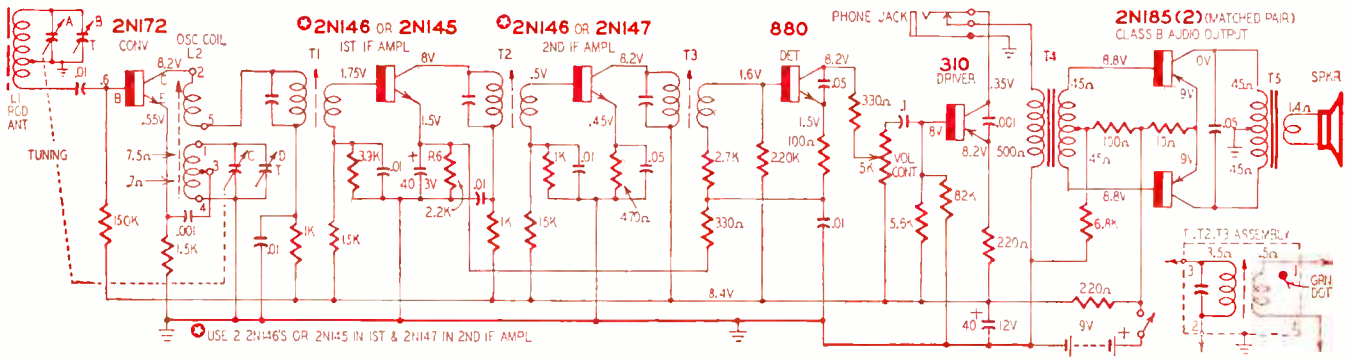


Fig. 2.—The Westinghouse *Seven Transistor* receiver uses n-p-n transistors in the rf circuits, p-n-p's in the audio stages.

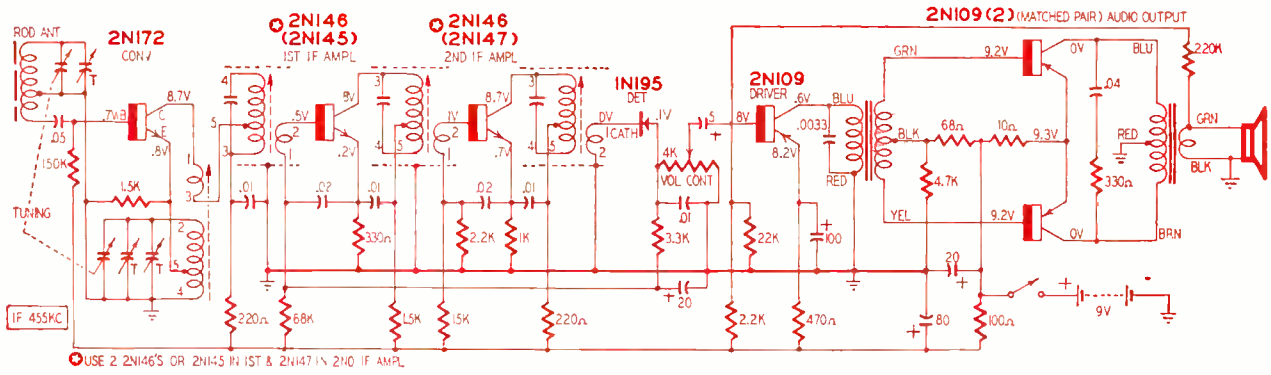


Fig. 3—The Emerson model 855, another six-transistor-plus-diode receiver has a pair of 9-volt batteries in parallel.

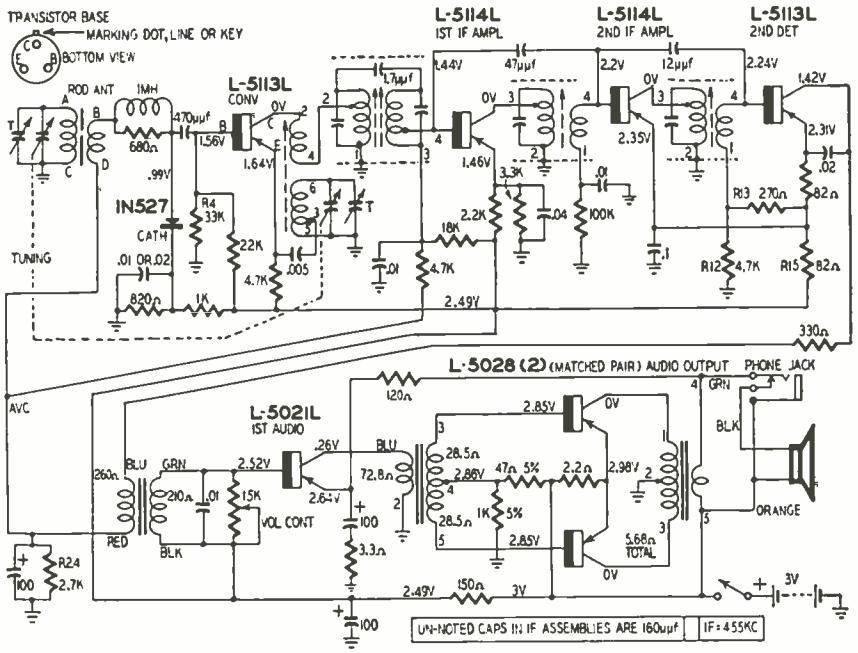


Fig. 4—The Philco Cordless T is a seven-transistor set that operates from only 3 volts. It uses neutralization.

Unbypassed emitters provide a small amount of degeneration for stability.

The detector is a crystal diode. It supplies a negative voltage to the volume control. The ac component is fed through a 5-μf capacitor to the driver. The dc component (across the volume control) is filtered and fed back to the base of the first if. This constitutes the avc action. A stronger signal will generate a greater dc voltage at the volume control. This negative potential will bias the if stage to lower gain.

The driver is fixed-bias. It feeds an also fixed-bias class-B stage. This output stage is fed *directly* from the battery, all previous transistors being supplied through a filter resistor (100 ohms). Tone from this set is enhanced by a degenerative network that couples the speaker to the base of the driver. Also, a tone network is included across the primary of the output transformer.

Philco Cordless T7

This receiver measures 7 x 4½ x 2 inches. Its nonbreakable cabinet is made of high-impact plastic. Components are mounted on a printed-wire panel.

The Philco is very unusual in that its power supply consists of just a pair of size-D flashlight cells. These cost about 25c and can power the set for approximately 250 hours. This extended life is made possible through the use of surface-barrier transistors in the high-frequency stages. Surface-barrier units require very low current and voltage yet are highly efficient at high frequencies. The audio stages use alloy junction transistors which require (and deliver) higher power than the barrier types. (See Fig. 4.)

The unconventional input stage utilizes a crystal diode to aid avc action. The avc supply is in series with the secondary of the loop antenna. As avc voltage goes more positive due to stronger signals, it biases the diode to greater conduction. Thus the diode partially "shorts" the signal and reduces its amplitude. An impedance network consisting of a 680-ohm resistor and a 1-millihenry coil in parallel helps to maintain constant response over the entire band.

The first if transformer is double-tuned to obtain a better flat-top response. The first if stage is biased from the avc lead. As the avc goes more positive with increasing signal, it reduces the if gain. Both if stages are neutralized.

The detector is biased to *cutoff* by R12, R13. Therefore its collector current increases in proportion to signal. This current flows through the primary of the first audio transformer and through R24. A large capacitor filters this current, and delivers the drop across R24 as avc voltage to the converter and first if.

With zero signal, the detector must remain near cutoff but this optimum bias may change due to temperature variations. To guard against this, R15 is connected to pass currents of both the second if and the detector emitters. Assume a temperature rise so that both emitter currents tend to increase. Now the greater current of the second if amplifier will produce a drop across R15. This tends to reduce (and thus cancel) the original rise in detector current due to temperature. Note that the second if is not supplied by avc so its emitter current is essentially constant, except for temperature effects.

The audio stages are transformer-coupled. The volume control shunts the first transformer and controls the input to the first stage. Emitter bias for this transistor is supplied through the output transformer (see diagram). This network also supplies degenerative feedback to the first audio stage for tone quality. The output class-B stage is biased by 5% resistors.

Bulova series 270

These receivers measure 3⅜ x 6⅛ x 1¾ inches and weigh 22 ounces. Cabinet is available in choice of two colors: mahogany alligator (model 270) and sun-tan alligator (model 277). Both are unbreakable. The set has its own leather type handle and does not need a carrying case. A single 9-volt battery provides 950 hours of playing time. The radio is guaranteed for a year, the transistors for life.

Using only four transistors and a diode detector, model 270 gives excellent results. The mixer–oscillator feeds into a single if stage. A 10-μμf capacitor neutralizes the stage by feeding back energy in opposite phase to that which passes directly through the transistor.

The detector generates a positive voltage which is filtered and applied to the if stage as avc. A transformer couples the audio stages. The output is single-ended as shown in Fig. 5.

Bulova also manufactures a deluxe portable using six transistors and a diode. Model 267 has a 4-inch speaker, provides 500 hours of playing time from a single 9-volt battery, is 5⅝ x 6½ x 2⅝ inches.

TO BE CONTINUED

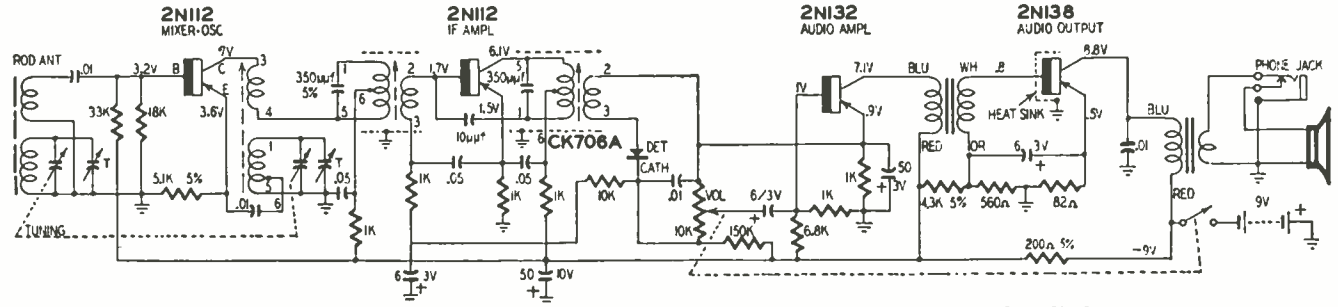
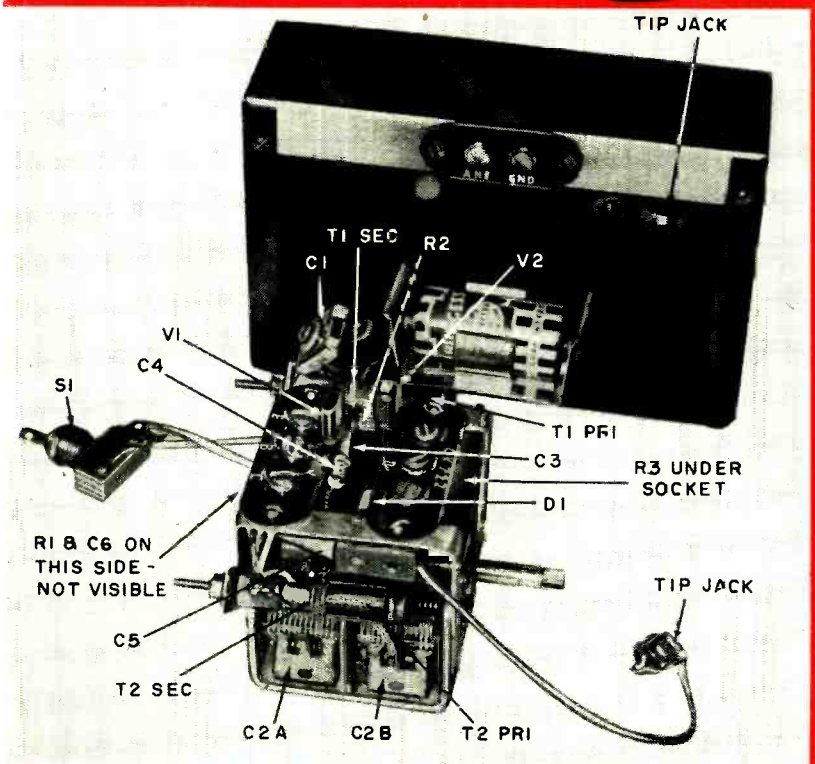


Fig. 5—Complement of the little Bulova is only four transistors and a diode.

TRANSISTORIZED RADIO HAS RF STAGE

By J. E. PUGH, JR.



Chassis view. Components are mounted on strips bolted to the capacitor.

A SINGLE-STAGE transistorized trf amplifier ahead of the now-popular radios consisting of a crystal detector and a transistorized audio amplifier will improve both sensitivity and selectivity at a small cost.

Such an amplifier is made practical by the high alpha cutoff-frequency transistors now available at prices attractive to the experimenter. Several such rf transistors can be obtained but the Raytheon CK760 (2N112) was selected for the receiver to be described. This transistor has an alpha cutoff frequency of 5 mc with a theoretical maximum gain of 20 db at 2 mc, which is adequate for good results over the entire broadcast band.

The antenna is coupled to T1–C2-a (Fig. 1), the first resonant circuit, through C1, the antenna trimmer capacitor. This capacitor is adjustable from 45 to 380 $\mu\mu$f and permits the receiver to be used with a wide range of antenna lengths. Both T1 and T2 are high-Q inductors with adjustable ferrite cores. An extra coil is wound on each inductor on T1 to match the low input impedance of V1 to the high impedance of T1–C2-a; on T2 to provide neutralization voltage through C4 for the rf amplifier stage. Capacitor C2 is a 10–365-$\mu\mu$f two-gang variable capacitor and has just enough capacitance variation to cover the broadcast band from 550 to 1500 kc.

Transistor V1 is connected in a grounded-emitter circuit with R2 being used to give a slight increase in input impedance. Resistor R1 is of such a value as to limit V1 collector current to below 1 milliampere.

The signal is rectified in the crystal diode detector D1 and the audio component is amplified by transistor V2. The load for this amplifier is a pair of 24,000-ohm magnetic headphones, which is well suited to this purpose as the majority of grounded-emitter amplifiers require a load impedance of 20,000 to 30,000 ohms.

A single 1.5-volt flashlight cell supplies operating voltage. This voltage can be increased if desired but it should not be greater than 6 volts, as this is the absolute maximum collector-voltage

rating for the type CK760 transistor.

The rf amplifier is designed to give a good balance between maximum selectivity and maximum sensitivity, and the overall result is very satisfactory for a receiver of this type. The selectivity is sufficient to give good separation in all cases except very close locals which may spread out enough to cover some weak distant stations. The sensitivity is great enough to make daytime reception of a station 250 miles away possible, and at night a station 1,100 miles away is received with good volume using a 10-foot antenna.

The output is great enough to drive a transistorized class-B amplifier if it is desirable to use a speaker instead of the headphones. Such an amplifier was described on page 59 of the March, 1956, issue of RADIO-ELECTRONICS and, if it is used, a volume control should be added between D1 and V2.

Construction details

A 4 x 4¼ x 6-inch sloping-panel metal cabinet is used to house the receiver. It is fairly large to keep the losses in the high-Q inductors, T1 and T2, at a minimum. If a nonmetallic cabinet is used, it can be much smaller.

The two three-lug screw type terminal strips used for transistor sockets are mounted on an aluminum strip framework screwed to the front and back surfaces of the tuning capacitor frame. The holes for mounting these strips and for fastening the capacitor to the cabinet are tapped so the 6-32 mounting screws do not project beyond the inner surface of the capacitor frame. Since most of the small parts are mounted on the underside of the terminal strips, ample space must be allowed for clearance between them and the opened rotor plates on the tuning capacitor.

Transformers T1 and T2 are Grayburne Vari-Loopsticks. This type coil is adjustable with a screw-actuated core and is supplied with an 18-inch length of wire attached to one terminal. This length of wire is used for the secondary and is closewound in either direction for 17 or 18 turns with a spacing of ⅜ inch below the bottom of L1. The L2 secondary is closewound snugly against the bottom of and in the same direction as the primary for 17 or 18 turns. When wound in the correct direction, this secondary will appear as a continuation of the primary winding with the ground tap at their junction. It can be fastened with coil dope after it is wound. The T1 secondary should not be cemented at this time as it may need a slight adjustment during the alignment procedure. After the secondaries are wound the mounting brackets supplied with these coils can be cut off, drilled and mounted on the capacitor.

The antenna trimmer C1 is soldered directly to the "hot" lug of T1 and is connected to the antenna terminal with a short length of No. 16 wire, which provides a rigid support for C1. It is first soldered to the antenna terminal and is then soldered to C1 after the receiver assembly is mounted inside the cabinet.

Rubber feet (⅜-inch od) can be mounted on the bottom of the cabinet to improve the appearance and to prevent scratching the furniture.

Alignment

The first step in the alignment procedure is to put the calibration marks on the panel, using the template in Fig. 2. These lines can be made by scratching through the paint carefully with a sharp pointed tool such as a machinist's scriber, or decals can be used for both the calibration lines and numerals.

After the dial marking is completed, a few preliminary adjustments can be made. First adjust both T1 and T2 until the top of the core is about even with the top of the primary winding. Next back the antenna trimmer off about 1 turn from maximum capacitance and then back off the trimmers on both sections of C2 about 1½ turns. After the above adjustments have been made, the receiver can be mounted in the cabinet. At this time it should be possible to receive stations but the following adjustments must be made for peak performance:

1. Connect a modulated signal gen-

Parts list for trf-stage receiver

B1—1.5-volt flashlight cell—type C
C1—45-380 μμf, mica, trimmer
C2—10-365 μμf, 2-gang, variable, with trimmers—Miller 2112 or equivalent
C3—1,000 μμf, ceramic
C4—33 μμf, ceramic
C5, C6—.01 μf, molded plastic
D1—1N34 crystal diode
T1, T2—Grayburne Vari-Loopstick (see text)
Phones—Headphones, Trimm 24,000-ohm Featherweight
R1—47,000 ohms
R2—100 ohms
R3—220,000 ohms
All resistors ½ watt
S—spst toggle switch
V1—CK760 (2N112) transistor
V2—CK722 transistor
3-screw terminal strips (2)
2-screw terminal strip
2-1/16-inch-diameter skirted knob
4 x 4¼ x 6-inch sloping-panel cabinet—Bud C-1580 or equivalent
Battery box—Austin Craft 1-C or Acme No. 9
1-terminal tie-point lug
Phone jack or tip jacks
Miscellaneous screws, nuts, washers, etc.

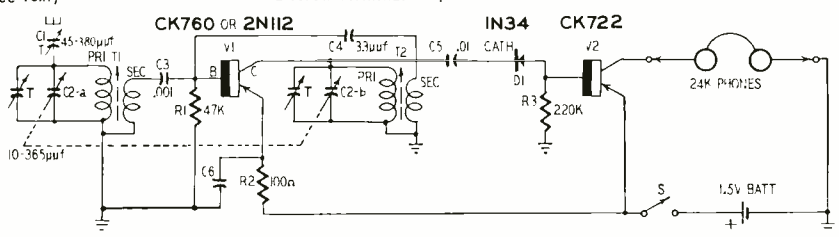


Fig. 1—The receiver uses two transistors plus a crystal diode detector.

erator to the input terminals of the receiver and an oscilloscope or ac voltmeter across the headphones.

2. Set the generator and the receiver dial to 600 kc.
3. Adjust core of T1 for maximum output.
4. Adjust core of T2 for maximum output.
5. Set the generator and the receiver dial to 1400 kc.
6. Adjust C2-a trimmer for maximum output.
7. Adjust C2-b trimmer for maximum output.
8. Repeat steps 2 to 7 until the output is peaked at 600 and 1400 kc. Since there is some interaction between the input and output circuits of V1, these adjustments will need to be repeated several times before best tracking is obtained. If there is any tendency to oscillate during alignment, back L2 off from T1 slightly.

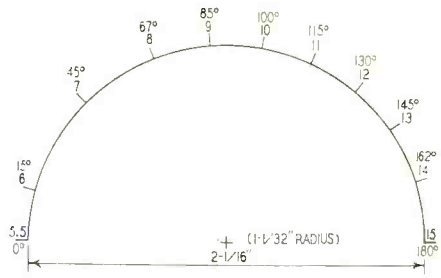


Fig. 2—Template for the dial layout

9. Disconnect the signal generator and connect the antenna and ground to the receiver. A 1400-kc signal is now induced into the antenna by attaching a short antenna to the signal generator. Now adjust the antenna trimmer for maximum output at a dial setting of 1400 kc and the receiver is ready to use.

If a signal generator is not available, make the alignment as follows:

1. First make the preliminary alignment as described above and then determine the exact frequency of two nearby broadcast stations. One should be between 550 to 750 kc and the other between 1200 and 1500 kc.
2. Connect the antenna and ground leads to the receiver.
3. Set the dial to read the same frequency as lower-frequency station.
4. Adjust T1 and then T2 for maximum output.
5. Set the dial to read the same as the higher-frequency station.
6. Adjust the antenna trimmer and then the C2-b trimmer for maximum output.
7. Repeat steps 3, 4, 5 and 6 until both stations are loudest at the correct dial readings.

If the antenna length is ever changed, readjust the antenna trimmer for maximum output with the receiver dial set at 1400 kc. This can be done without the signal generator if a station of known frequency between 1200 to 1500 kc is available. Simply set the receiver dial to read the same as the transmitter frequency and adjust the C2-a trimmer for maximum output. END

a Weller soldering tool

bright-idea Christmas Gift to give or receive

low-cost soldering set only $7.95 list

Here's the gift of 101 do-it-yourself uses for those homecrafters, hobbyists, and hi-fi fans high on your Christmas gift list.

A Weller Soldering Kit or Gun is *the* gift for year-round fun in doing relaxing home and hobby jobs. A most-wanted and appreciated gift, too . . . because of its talents for getting things done—*right!*

Weller Soldering Kit contains everything needed for first-class soldering . . . even by beginners. Contains:

- **Latest type Weller Gun**—Over 100 watts • Heats in 5 seconds • Triggermatic heat control • 2 pre-focused spotlights.
- **Soldering Brush**—for cleaning connections.
- **Soldering Aid**—for twisting wires and opening old joints.
- **Famous Kester Solder**—ample supply for scores of jobs.

other Weller soldering tools

PROFESSIONAL MODELS—Heavy-Duty Soldering Guns, up to 275 watts capacity. Dual spotlights. Heat in 5 seconds. $13.50 list and up.

MODEL 8250AK—Weller metal kit includes Heavy-Duty Gun; Accessory Tips for cutting and smoothing jobs; Tip Wrench; Kester Solder. $14.95 list.

order from your electronic parts distributor

Weller ELECTRIC CORPORATION • EASTON, PA.
601 Stone's Crossing Road

RADIO

Improving Sensitivity in AC–DC Radios

By CHARLES GARRETT

MANY of the small ac-dc radios brought to repair shops have poor sensitivity at the low-frequency end of the dial (550-800 kc). But because these radios usually have only an oscillator trimmer, and rarely a padder, the service technician generally is helpless to improve their low-end response. The following suggestions will improve the majority of such radios.

On radios with the conventional flat-loop type antenna, try this: Tune to a station around 1400 kc and peak the antenna trimmer (it is usually mounted along with the oscillator trimmer on the side of the tuning gang). Then tune to a weak station near 600 kc and adjust the oscillator trimmer in and out for peak reception while rocking the tuning gang back and forth to hold in the station.

Recheck the antenna trimmer again at 1400 kc and then for best results repeat the procedure at least once.

The dial pointer may now indicate slightly off the received station but due to the vague dial markings on most of today's radios, this is not always important. If it is necessary to set the dial pointer accurately on any particular radio, move the *pointer* and do not adjust the oscillator trimmer again or the low-end response will suffer. In some extreme cases, a compromise between accurate dial settings and low-end sensitivity may become a necessity.

Radios using small pencil-shaped antennas (a powdered-iron core with a few loose turns of wire wound on it) can be peaked at both low and high ends without affecting dial accuracy in any way by using the following methods:

First, only a small percentage of these types of antennas provide for adjusting the core for peak low-end response. On these few adjust the antenna *trimmer* at about 1400 kc and the *core* at about 600 kc. Repeat the procedure at least once.

Of those that are not adjustable, two types are available. One is short,

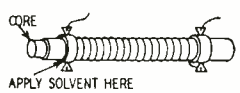


Fig. 1—The core is loosened and slipped in and out for peak results at 600 kc.

MR. ELECTRONICS MAN:

If you're willing to lose your job tomorrow to a technically-trained man,

don't read this!

But, if you're interested in an honest-to-goodness career in the vigorous young electronics industry, here's how you can step ahead of competition, move up to a better job, earn more money, and be sure of holding your technical job even if the brass is firing instead of hiring.

The "how" is CREI training in radio-television-electronics. You don't have to be a college graduate. You *do* have to be willing to study—at home. You can do it while holding down a full-time job. Thousands have. However, you must have some prior electronic experience, either in military service, professional employment, experimenting, or ham operating. Since 1927 CREI has provided alert young men with the technical knowledge that leads to more responsibility, more job security, more money. More than a quarter century of experience qualifies CREI to train you.

What qualifies *you* for CREI? If you have a high school education, you're off to a good start. If you have a knack for math, so much the better. If you are currently working in some phase of the electronics industry, you'll get going faster. But remember this: CREI starts with fundamentals and takes you along at your own speed. You are not held back by a class, not pushed to keep up with others who have more experience or education. You set your own pace. Your CREI instructors guide you through the lesson material and *grade* your written work personally. You master the fundamentals, then get into more advanced phases of electronics engineering principles and practice. Finally you may elect training at career level in highly specialized applications of radio or television engineering or aeronautical radio.

How good is CREI training? Here are a few ways to judge. Ask an electronics engineer, if you know one. Ask a high-school or college physics teacher. Ask a radio station engineer. Check up on our professional reputation: CREI home study courses are accredited by the Engineers' Council for Professional Development; CREI is an approved member of the National Council of Technical Schools. Ask personnel managers how they regard a man with a CREI "ticket." Look at this partial listing of organizations *that pay CREI* to train their own personnel: United Air Lines, Canadian Broadcasting Corp., Trans-Canada Airlines, Douglas Aircraft Co., Glenn L. Martin Co., Columbia Broadcasting System, All-American Cables and Radio, Inc., Gates Radio Co., Canadair Ltd., Federal Electric Corp. and U. S. Information Agency (Voice of America). Finally, ask a CREI graduate to tell you about our Placement Bureau, which currently has on file more requests for trained men than we can fill.

What's the next step? The logical one is to get more information than we can cram into one page. The coupon below, properly filled out, will bring you a fact-packed booklet called "Your Future in the New World of Electronics." It includes outlines of courses offered, a resume of career opportunities, full details about the school, and tuition details. It's free.

MAIL THIS POSTAGE-FREE POSTCARD TODAY

CAPITOL RADIO ENGINEERING INSTITUTE

Accredited Technical Institute Curricula

Dept. 1411-C, 3224 16th St., N.W., Washington 10, D. C.

Please send me your course outline and **FREE** Illustrated Booklet "Your Future in the New World of Electronics" . . . describing opportunities and CREI home study courses in Practical Electronics Engineering.

CHECK FIELD OF GREATEST INTEREST

- ☐ Practical Radio Electronic Engineering
- ☐ Broadcast Radio Engineering (AM, FM, TV)
- ☐ Practical Television Engineering
- ☐ Practical Aeronautical Electronic Engineering

IC

Name _____ Age _____

Street _____

City _____ Zone _____ State _____

Check: ☐ Home Study ☐ Residence School ☐ Korean Veteran

To help us answer your request intelligently, please give the following information:

EMPLOYED BY _____

TYPE OF PRESENT WORK _____

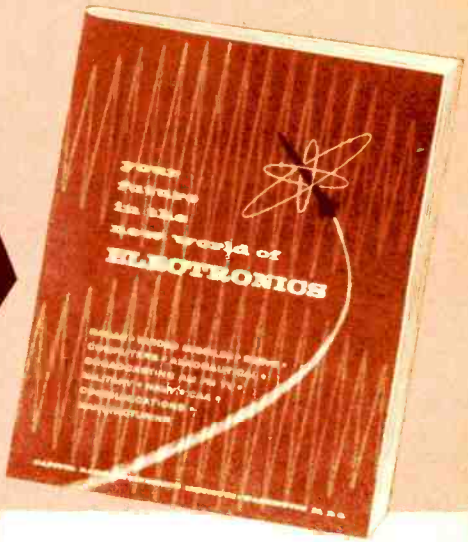
SCHOOL BACKGROUND _____

ELECTRONICS EXPERIENCE _____

IN WHAT BRANCH OF ELECTRONICS ARE YOU MOST INTERESTED? _____

Get this FREE Booklet Today!

Loaded with career-building facts—it can lead you to a bigger job, better pay, security and success in radio—TV—electronics



"YOUR FUTURE IN THE NEW WORLD OF ELECTRONICS"—
Contains a proved plan for your successful career in:

★ RADAR ★ GUIDED MISSILES ★ SERVO
★ COMPUTERS ★ AERONAUTICAL
★ BROADCASTING AM FM TV ★ MILITARY ★ NAVY
★ CAA ★ COMMUNICATIONS ★ MANUFACTURING

A PROVED CAREER-PREPARATION PLAN THAT WORKS!

This free book has brought success home to thousands of men just like you! They are now enjoying responsible jobs, good pay and the good things of life. So can you! In less time than you think! We tell you how you can carve out a bigger better-paying job. Our proved career-preparation plan works because it was written by authorities who know exactly what the varied electronic industries want, need and expect from you!

ELECTRONICS' FUTURE CAN BE YOUR FUTURE

You can't keep up with the tremendous changes in the electronic industries. What's predicted for next year becomes outdated in a few months! All phases of the electronic industries are experiencing phenomenal growth. There are thousands of career openings, big ones. Industry can't find *enough* trained manpower to fill them—in manufacturing, testing, servicing, broadcasting and telecasting.

TAKE TV FOR EXAMPLE!

Four hundred and six stations are on the air! Many more are building or in the plans stage; 38,000,000 sets are in use. Color TV is just starting to really come alive! This same phenomenal growth picture is repeated in every phase of business employing electronics—crime prevention, aeronautics, fire-fighting, communications, to name but a few. CREI has the plan to keep you moving upward, to help you assume your rightful place!

CREI GRADS ARE IN DEMAND!

The big companies know CREI men have what it takes! CREI grads are at work in America's biggest corporations, in positions ranging from technicians to engineers to top management. Companies such as Canadian Broadcasting Corp., Douglas Aircraft Co., Glenn L. Martin Co., All-American Cables and Radio, Inc., Federal Electric Corp., U.S. Information Agency (Voice of America), and United Air Lines, are now paying for CREI training for their own technical staffs. Our placement bureau has more requests for CREI-trained men than we can presently supply.

Act Now!

TAKE THAT FIRST BIG STEP! NO OBLIGATION

Fill out and mail the coupon. When you do, you'll be on the way to higher pay, a better job and complete career security. Act right away. Send for your *free* book today.

CREI GRADS EASILY PASS FCC EXAMS!

You start feeling the benefits of CREI training right away, either with your present connection, or with a future employer. You'll have all the training you need to secure your FCC commercial license.

THOUSANDS LIKE YOU HAVE SUCCEEDED WITH CREI'S PLAN! "CREI TRAINING IS BEST"

"—I chose CREI training upon recommendation of two top engineers. Before I had completed the course I became transmitter chief of a 5 KW station. I am now employed as a technician at a 100 KW TV station, and in spare time have a good TV sales and service business. Anyone interested in his electronic future should have CREI training." . . . —Arlie D. Patton, San Antonio, Texas.

"—I know of no case in which a man who applied himself and completed the CREI course failed to better himself through promotion and increase in salary." . . . —Wendell L. Fraser, San Diego, Calif.

"—CREI has raised me to professional status as a radioman. Thanks to your instructors who always gave me needed help."—Victor Mentzer, Wilmington, Del.

"—I have been in radio and electronics for 24 years. I fully recommend CREI as the best school I have seen."—L. McManus, Montreal, Canada.

1st Class
Permit No. 288-R
Sec. 34.9 P.L.R.
Washington, D. C.

BUSINESS REPLY CARD
No Postage Stamp Necessary If Mailed in United States

3c Postage Will Be Paid By

CAPITOL RADIO ENGINEERING INSTITUTE

3224 16th Street, N.W.

Washington 10, D. C.

MAIL THIS POSTAGE-FREE POSTCARD TODAY

about 3 inches, and its coil is wound on a paper coil form with the powdered-iron core cemented inside the form. To align this type, first free the core (Fig. 1) by applying G-C Service Solvent or a similar solvent to the cemented areas. Set the dial on a weak station around 600 kc and move the core in or out of the coil form to the point of peak reception. Adjust the antenna trimmer at the 1400-kc end, repeat the procedure at least once and then cement the core in place.

The other type of rod antenna is about 6 inches long and 0.5 inch across. Its coil is cemented or waxed directly on the core in loosely separated turns except at one end where the coil bunches.

Loosen the bunched section of the coil (Fig. 2) with service solvent, if

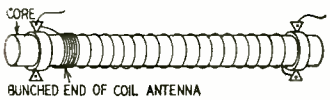


Fig. 2—Bunched end of antenna coil is slid back and forth for peak reception at the low end of the band—600 kc.

necessary, and with the set tuned to a station near 600 kc gently slide that part of the coil back and forth for peak reception. Trim on the high end as usual and repeat the procedure for best results.

Be sure—before starting to work on the receiver—that it is already working at its highest sensitivity. Test all the tubes and make sure that the set is properly aligned.

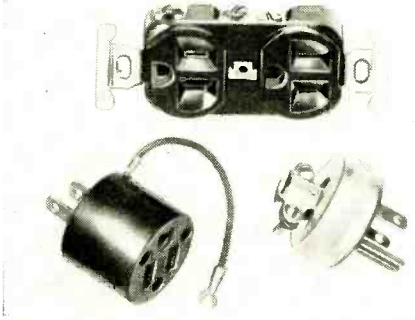
There is one more problem concerning receiver sensitivity. Occasionally poor sensitivity in a particular receiver is caused by the necessity of mistuning the if transformers to prevent oscillating or squealing. In a case like this try reversing the leads attached to the terminals of either the primary or secondary of either, or both, of the if transformers. Then realign. The resulting improvement in low-end response should be most gratifying. END

"Whoever in the world told you this fellow was a top-notch service technician?!?"

MISCELLANY

The 3-Wire Line Plug

PURCHASERS of new portable electric drills, sanders, saws, impact hammers and similar tools will probably find them fitted with a 3-prong power plug that will not fit into a standard receptacle. This third prong replaces the seldom-used pigtail ground lead formerly supplied on portable electrical equipment. The pigtail did not make grounding mandatory so the use of a 3-wire line and 3-prong plug was recommended by Underwriters Laboratories and adopted by most manufacturers of portable electric tools. This trend is expected gradually to extend to household appliances.



New 3-wire duplex receptacle with adapter and matching plug below

The reason for grounding such tools and equipment is a sound one. If the hot side of the power line should short to the motor frame or metal shell of the equipment, the operator is likely to receive a fatal shock. On the other hand, if the frame of the equipment is grounded, a fuse will blow.

To use these tools, you will either have to replace the conventional convenience outlet with a new 3-wire parallel-slot grounding type receptacle or use an adapter between the 2-prong receptacle and the 3-prong plug. (See photo.) The adapter has a grounding pigtail with a lug for fastening to a screw on the receptacle's wall plate or cover. The 3-prong adapter and receptacle will also accommodate regular and polarized plugs used on equipment that does not require grounding.

Either an adapter or a 3-wire parallel-blade grounding receptacle should be installed permanently at all outlets where new power tools are likely to be used. An adapter and a 3-wire extension cord with grounding type male and female connectors should always be carried along with the tool on jobs outside the shop because matching convenience receptacles are not likely to be available.

Tools equipped with pigtail grounding leads can be readily converted by clipping off the molded rubber plug and replacing it with a 3-wire parallel-blade type. Older tools not equipped for grounding can be made much safer to use by replacing the line cords with a 3-wire line with the same size conductors. The third conductor should be firmly connected to the ground lug in the plug at one end and to the frame of the motor at the other. END

MOST ACCEPTABLE

FROM DELCO RADIO

come the transformers with high acceptability. You trust them... so do your customers!

Universal vibrator transformers, produced through the combined electronic skills of Delco Radio and General Motors, meet the requirements of nearly every model of auto radio. Each is designed for easy installation and complete customer satisfaction. Laminated core inserts are stamped out of low-loss silicon steel and heat treated to maintain correct magnetic properties. Coils are precision-wound on special machines. All models have ample leads. Your UMS-Delco Electronic Parts Distributor can supply you with all models. Call him today. Remember, the Delco Wonder Bar Radio is being nationally advertised in leading consumer publications . . . so you are tuned in on a constantly increasing service.

Uncased Models 6055, 6065, 6067 do not include filter network

Cased Models 6060, 6064 and 6066 are made with "A" line filter network consisting of an "A" choke and .5 mfd. capacitor. Easy-mount drilling template, plus three self-tapping screws are included for your convenience.

DELCO

WONDER BAR

RADIO

DIVISION OF GENERAL MOTORS, KOKOMO, INDIANA

GM PARTS SALES

A GENERAL MOTORS PRODUCT — A UNITED MOTORS LINE

Distributed by Delco Electronics Parts Distributors

A complete line of original equipment service parts from the

WORLD LEADER IN AUTO RADIO

new Records

MONITOR

Note: Records below are 12-inch LP and play back with RIAA curve unless otherwise indicated.

Boston Pops Picnic
Arthur Fiedler conducting the Boston Pops Orchestra
RCA Victor IM-1985

This sounds very much as if RCA engineers have been listening to the Vanguard recordings of the Vienna State Opera Orchestra playing Strauss. Forgiving one or two slight lapses in monitoring which result in just a touch of distortion in a couple of spots and which place it just a shade under the above Capitol recording, this is in very much the same class and well worth the investment.

Mason's *Pops Polka* (band 1, side 1) has a brass-band flavor and sharpness with a lovely low dull drum and fine high highs. In fact, the drum takes its place beside that of the Vienna State Opera as a test of very fine speaker systems—on the best of them it has a lovely thud. The music, which should be a real picnic for the average hi-fi listener, includes the *Waltzing Cat, Jealousy, Danube Waves Waltz, Malaguena, Village Swallows Waltz* (complete with water whistle), *In a Persian Garden* and *Poet and Peasant*. The last is a very spectacular showoff with several really fortissimo peaks. Fiedler and the Pops play it with charming picniclike good humor and sprightliness.

This apparently was recorded at least 10 db below the standard peak level. In fact, tape recorder noise is audible in spots; thus there is only a second or two of overcutting distortion. The sound is impressive throughout and the balance is the best RCA has managed for this orchestra.

STRAUSS, JOHANN, JR.: *Le Beau Danube* (Ballet)
Orchestra of the Paris Opera conducted by Manuel Rosenthal
Capitol P-18006

The Paris Opera Orchestra seems to get better with each recording. This has an especially gorgeous sound with a nice dull bass—very big in spots—and bright high highs in execellent balance. The bass is not exaggerated, the high highs are always in proper perspective. Fortissimo in spots, but pianissimo in others, there is an excellent measure of both ends of the dynamic range. Apparently, every pops orchestra is now buying a big bass drum or digging one out of the attic; this one ranks with the Vienna State Opera's and the Boston Pops'. The music is a long medley of Strauss tunes strung together into a ballet and everybody but those who can no longer stand the *Blue Danube* should like it.

MOZART: *Violin Concertos Nos. 4 and 5*
Yehudi Menuhin, violin
Philharmonic Orchestra conducted by John Pritchard
RCA Victor IM-1961

If, of the current anniversary flood of Mozart recordings, I were to recommend one as the most certain to please the most people, I think this would be it. The music is entirely delightful and Menuhin does it complete justice (though his own cadenzas are just a trifle too modern) in a very natural fiddle tone, round in the high end and nicely gutting in the low end. There are some good examples of plucking, fingering and bowing transients (especially in No. 5). The orchestra contributes an excellent background with a nice bass. The second movement of No. 4 is one of the loveliest of violin solos.

SIBELIUS: *Masterpieces*
Arthur Winegrad String Orchestra
London Symphony Orchestra
Royal Opera House Orchestra (Covent Garden)
MGM E-3332

Except for a few seconds of overcut distortion, this is another very fine example of excellent modern sound. It presents most of the popular Sibelius short pieces: *Finlandia, The Swan of Tuonela, Valse Triste, Festive, Romance in C Major* and *Rakastava*, in performances which seem adequate and with considerable material for testing and demonstration. Those who would like to add a potpourri of Sibelius will find this fills the bill pleasantly.

RACHMANINOFF: *The Bells Symphony*
Rome Symphony and Chorus, plus soloists, conducted by Jacques Rachmilevich
Supervised by Rachmaninoff Society
MGM E-3246

This was Rachmaninoff's *magnum opus*, and it puts soloists, chorus and orchestra through a lot of paces. It's considerable Rachmaninoff to take at one sitting, but if you go for him this is an adequate performance both musically and in sound.

SCHUMAN: *Davidsbundler Dances Symphonic Etudes*
Capitol P-8337

These solo piano works are just enough out of the way to please those who are a little surfeited with the standard repertoire but not up to anything really esoteric. Pleasant and interesting music well played and again recorded just below the top for piano quality.

SHOSTAKOVICH: *Six Preludes and Fugues*
Shostakovich, pianist
Capitol P-18013

The Russians may be catching up with us in atomic science and planes but they've got a long way to go in recording, though I admit I've heard worse recordings with strictly American labels and very recently released ones. This is definitely for those who are interested in technical aspects of music or who need the very esoteric to relieve their boredom. It is supposed to be Shostakovich's attempt to approach in a modern idiom the job Bach did with the *Well-Tempered Clavichord*. If anyone has had any doubts about how the USSR's fair-haired boy of music stacks up to the old masters, this ought to dispel them. For my money he could just about hold the candle for a half-awake Bach improvising at a 4 o'clock mass. Still, this is a pretty fair effort and with considerable in-

BUILD 16 RADIO

circuits at home with the New Improved Progressive Radio "EDU-KIT"

A Practical Home Radio Course

Now Includes
TESTER, SOLDERING IRON, HIGH FIDELITY, SIGNAL TRACER, CODE OSCILLATOR, PRINTED CIRCUIT SIGNAL INJECTOR

- **No Knowledge of Radio Necessary**
- **No Additional Parts or Tools Needed**
- **Excellent Background for TV**

only **$19.95**

NOW! FREE TOOLS WITH "EDU-KIT"

WHAT THE "EDU-KIT" OFFERS YOU

The "Edu-Kit" offers you an outstanding PRACTICAL HOME RADIO COURSE at a rock-bottom price. Our Kit is designed to train Radio & Electronics Technicians, making use of the most modern methods of home training. You will learn radio theory, construction practices and servicing.

You will learn how to build radios, using regular schematics; how to wire and solder in a professional manner; how to service and trouble-shoot radios. You will work with the standard type of punched metal chassis as well as the latest development of Printed Circuit chassis.

You will learn the basic principles of radio. You will construct, study and work with RF and AF amplifiers and oscillators, detectors, rectifiers, test equipment. You will learn and practice code, using the Progressive Code Oscillator. You will learn and practice trouble-shooting, using the Progressive Signal Tracer, the Progressive Signal Injector, the Progressive Dynamic Radio & Electronics Tester and the accompanying instructional material.

You will receive training for the Novice, Technician and General Classes of F.C.C. Radio Amateur Licenses. You will build 16 Receiver, Transmitter, Code Oscillator, Signal Tracer and Signal Injector circuits, and learn how to operate them. You will receive an excellent background for Television.

Absolutely no previous knowledge of radio or science is required. The "Edu-Kit" is the product of many years of teaching and engineering experience. The "Edu-Kit" will provide you with a basic education in Electronics and Radio, worth many times the complete price of $19.95. The Signal Tracer alone is worth more than the price of the entire Kit.

THE KIT FOR EVERYONE

You do not need the slightest background in radio or science. Whether you are interested in Radio & Electronics because you want an interesting hobby, a well paying business or a job with a future, you will find the "Edu-Kit" a worth-while investment.

Here is an excerpt from a letter that we received from Loren DePriest, 1496 4th St., Mansfield, Ohio: "I have spent many pleasant hours in constructing the radios from the schematics in your book, and have learned a great deal from them. Being as I am interested in Radio, I consider the money spent for your course as a wise investment. I have learned more from your course by actually doing than I did from an expensive course."

Many thousands of individuals of all ages and backgrounds have successfully used the "Edu-Kit" in more than 79 countries of the world. The "Edu-Kit" has been carefully designed, step by step, so that you cannot make a mistake. The "Edu-Kit" allows you to teach yourself at your own rate. No instructor is necessary.

The "Edu-Kit" is also used for courses of study, extra-curricular activities, industrial personnel training and rehabilitation. The "Edu-Kit" is used by Jr. High Schools, High Schools, Technical Schools, Jr. Colleges, Colleges, Universities, Industrial firms, Rehabilitation Hospitals, Boards of Education, U.S. Govt. agencies, United Nations Educational, Scientific and Cultural Organizations (UNESCO), Veterans Administration, and numerous adult, radio and young peoples' groups and clubs. The "Edu-Kit" is also popular with servicemen throughout this country and abroad.

Designed for universal use, the "Edu-Kit" operates on any voltage from 105 to 125 volts, AC and DC. For use in countries employing higher line voltages, a 210-250 Volt AC/DC model is available.

PROGRESSIVE TEACHING METHOD

The Progressive Radio "Edu-Kit" is the foremost educational radio kit in the world, and is universally accepted as the standard in the field of electronics training. The "Edu-Kit" uses the modern educational principle of "Learn by Doing." Therefore you construct, learn schematics, study theory, practice trouble-shooting—all in a closely integrated program designed to provide an easily-learned, thorough and interesting background in radio.

You begin by examining the various radio parts of the "Edu-Kit." You then learn the function, theory and wiring of these parts. Then you build a simple radio. With this first set you will enjoy listening to regular broadcast stations, learn theory, practice testing and trouble-shooting. Then you build a more advanced radio, learn more advanced theory and techniques. Gradually, in a progressive manner, and at your own rate, you will find yourself constructing more advanced multi-tube radio circuits, and doing work like a professional Radio Technician.

THE "EDU-KIT" IS COMPLETE

You will receive all parts and instructions necessary to build 16 different radio and electronics circuits, each guaranteed to operate. Our kits contain tubes, tube sockets, variable, electrolytic and paper dielectric condensers, resistors, tie strips, coils, hardware, tubing, punched metal chassis, Instruction Manuals, etc.

In addition, you receive Printed Circuit materials, including Printed Circuit chassis, special tube sockets, hardware and instructions. You also receive a useful set of tools, a professional electric soldering iron, and a self-powered Dynamic Radio & Electronics Tester. The "Edu-Kit" also includes Code Instructions and the Progressive Code Oscillator, in addition to F.C.C.-type Questions and Answers for Radio Amateur License training. You will also receive lessons for servicing with the Progressive Signal Tracer and the Progressive Signal Injector, a High Fidelity Guide and a Quiz Book. You receive all parts, tools, instructions, etc. Everything is yours to keep.

FREE
Hi-Fi, Radio & TV Servicing Manuals on request
(see coupon below)

SERVICING LESSONS

You will learn trouble-shooting and servicing in a progressive manner. You will practice repairs on the sets that you construct. You will learn symptoms and causes of troubles in home, portable and car radios. You will learn how to use the professional Signal Tracer, the unique Signal Injector and the dynamic Radio & Electronics Tester. While you are learning in this practical way, you will be able to do many a repair job for your friends and neighbors, and charge fees which will far exceed the price of the "Edu-Kit." Our Consultation Service will help you with any technical problems you may have.

J. Stataitis, of 25 Poplar Pl., Waterbury, Conn., writes: "I have repaired several sets for my friends, and made money. The 'Edu-Kit' paid for itself. I was ready to spend $240 for a Course, but I found your ad and sent for your Kit."

FROM OUR MAIL BAG

Ben Valerio, P. O. Box 21, Magna, Utah: "The 'Edu-Kits' are wonderful. Here I am sending you the questions and also the answers for them. I have been in Radio for the last seven years, but like to work with Radio Kits, and like to build Radio Testing Equipment. I enjoyed every minute I worked with the different kits; the Signal Tracer works fine. Also like to let you know that I feel proud of becoming a member of your Radio-TV Club."

Robert L. Shuff, 1534 Monroe Ave., Huntington, W. Va.: "Thought I would drop you a few lines to say that I received my "Edu-Kit," and was really amazed that such a bargain can be had at such a low price. I have already started repairing radios and phonographs. My friends were really surprised to see me get into the swing of it so quickly. The Troubleshooting Tester that comes with the Kit is really swell, and finds the trouble if there is any to be found."

PRINTED CIRCUITRY

At no increase in price, the "Edu-Kit" now includes Printed Circuitry. You build a Printed Circuit Signal Injector, a unique servicing instrument that can detect many Radio and TV troubles. This revolutionary new technique of radio construction is now becoming popular in commercial radio and TV sets.

A Printed Circuit is a special insulated chassis on which has been deposited a conducting material, which takes the place of wiring. The various parts are merely plugged in and soldered to terminals.

FREE EXTRAS

• SET OF TOOLS • RADIO & ELECTRONICS TESTER • ELECTRIC SOLDERING IRON • TESTER INSTRUCTION MANUAL • HIGH FIDELITY GUIDE • QUIZZES • TELEVISION BOOK • MEMBERSHIP IN RADIO-TV CLUB • CONSULTATION SERVICE

UNCONDITIONAL MONEY-BACK GUARANTEE

ORDER DIRECT FROM AD
RECEIVE FREE BONUS RESISTOR KIT WORTH $5

☐ Send "Edu-Kit" Postpaid. I enclose full payment of $19.95.
☐ Send "Edu-Kit" C.O.D. I will pay $19.95 plus postage.
☐ Send me FREE additional information describing "Edu-Kit." Include FREE valuable Hi-Fi, Radio and TV Servicing Literature.

(Outside U.S.A.—No C.O.D.'s. Send check on U.S. bank or Intern't'l M.O. "Edu-Kit" for 105-125 V. AC/DC $20.95; 210-250 V. AC/DC $23.45.)

Name .....

Address .....

.....

PROGRESSIVE "EDU-KITS" INC.
497 Union Ave., Room 122-G, Brooklyn 11, N. Y.

terest. Those who like to have versions played or conducted by the composers themselves should latch onto a copy of it.

RESPIGHI: *Roman Festivals*
KODALY: *Háry János Suite*
Toscanini conducting the NBC Symphony Orchestra
RCA Victor LM-1973

It is unfortunate that one of the world's most phenomenal conductors will be heard by posterity in recordings which do neither him nor the art of recording even token justice. Offhand I can think only of his recording of Moursorgski's *Pictures at an Exhibition* as worthy of inclusion among the best examples of high-fidelity recordings. This recording shows what I mean. It is strictly for Toscanini adorers (and then to be played on a system that cuts off at about 5,000 cycles).

I was especially disappointed because Toscanini was perhaps the best interpreter of Respighi's music, and *Roman Festivals* is one of the most sensational sound-effect creations of that remarkable composer. You'd never know it from this recording, however. It is not ony full of distortion, but with the most execrable balance of tone and so lacking in definition that it might almost be equally well played on a two-manual organ.

Háry János is among the most delightful of "modern" music, but this recording of a broadcast of 1947 is no better than a prewar shellac. Therefore, unless you collect Toscanini and your ears can overlook some frightful sound, you'll find versions by lesser conductors under other labels a far better buy. To do RCA Victor justice, I imagine they look upon this as a sort of archivistic recording, intended for collectors of Toscanini.

PAGANINI: *Violin Concerto No. 1*
Fistoulari conducting the London Symphony
SIBELIUS: *Violin Concerto in D Minor*
Boult conducting the London Philharmonic
Yehudi Menuhin, violinist
RCA Victor LM-1946

Menuhin is a violinist no record library can possibly overlook and this is a particularly happy example of his style. The Paganini is possibly the most suitable of all violin concertos for show-off and demonstration because—aside from some of the most brilliant fiddling fireworks—the accompanying orchestra, when giving the soloist a chance to wipe his brow or retune his fiddle, has some fine bass and cymbal high highs. The fiddle part calls for real virtuosity and is most melodic. The Sibelius presents an excellent contrast in orchestration and violin as well. It has some good kettle drums and basses and some very notable peaks and sharp brasses. Menuhin is very fine though he seems a little more bored with the Paganini that he was when Victor first recorded him in this before the war.

STRAUSS, Richard: *Metamorphoses*
Four Last Songs
***(Chirstel Goltz,* soprano)**
Hollreiser and Pro Musica Orchestra of Vienna
Vox PL-9400

If you have a hi-fi Golden Ear snob in the neighborhood who claims to hear all sorts of things you don't, try this on him. The *Metamorphoses* is a rather dull work which gives each of 10 violins, 5 violas, 5 cellos and 3 double basses an opportunity to play the lead or solo. Theoretically, all the instruments should be slightly different and on a good enough hi-fi system a good enough Golden Ear should be able to identify them by their slight differences. The music and record are otherwise interesting only to the guy who wants his Strauss complete. The songs are no great shakes and the soprano is overrecorded in spots with an unhappy effect on a not-too-good voice.

The Three Ravens
Songs of Elizabethan England
Alfred Deller, counter-tenor; guitar and lute accompaniment
Vanguard VRS-479

The description above may not appeal to you, but it is possible that in failing to buy it you

might miss something you would enjoy very much. The Deller voice (a male alto) is one of the most remarkable voices you'll ever hear and it is recorded here with great purity, and indeed with enough leeway so that even an only fair system should not spoil its beautiful round tones. The songs are more interesting than you might expect and include such old favorites as Barbara Allen and Greensleeves. There are in addition two delightful lute solos. You can probably get your money back betting your friends that they can't guess whether it's a male or female voice.

MOZART:
Serenade No. 12 (K388)
Divertimento No. 15 (K287)
Arthur Fiedler and His Sinfonietta
RCA Victor LM-1936

This is a Mozart anniversary and all the companies are putting out new Mozart recordings. This is a particularly pleasant one. The *Serenade* is for double woodwinds and horns and presents a lovely woodwind tone, beautifully recorded with excellent presence. The *Divertimento* is one of a considerable number for strings and horns. This particular one is especially pleasant and shares the excellent recording.

Divertimento No. 17 (K334)
Eine Kleine Nachtmusic (K525)
Reiner and Chicago Symphony Orchestra
RCA Victor LM-1966

Another very pleasant *Divertimento* and the ever-popular *Eine Kleine* in a bigger orchestral version, also well recorded and with excellent presence.

Symphonies No. 36, 39, 40 and 41
Reiner and Chicago Symphony
RCA Victor LM-6035
(two 12-inch records)

An anniversary album of the four greatest Mozart symphonies in performances and recordings which do them complete justice. The polyphonic style provides excellent material for testing or demonstrating definition. The strings are loud enough in some places to overtax some pickups.

Quartet in G Major (K387)
Quartet in D Minor (K421)
Barchet Quartet
Vox PL-9480

If you prefer intimate chamber music, this will provide excellent presence. Two of the best of Mozart's quartets with some of his most touching melodies. Excellent recording quality.

Moritat
Dick Hyman Trio
MGM K-12149

This one slipped past me when it first came. If you can find a copy, by all means buy it. One of the best and most engaging demonstration and showoff records I know of. Some really extraordinary piano effects nicely and cleanly recorded, with a good bass and good trap highs.

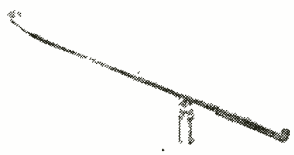
IBERT: *Les Amours de Jupiter*
Escales
Composer conducting Orchestra of Paris Opera
Capitol P-18004

Two more examples to prove, if proof is needed, that modernism is neither all dissonance nor all alike. *Escales* (Ports of Call) is an impressionistic travalogue which causes no pain at all. The kettle drums are especially good in the second movement and there are sharp castanets in the third. The amusingly satirical *Jupiter* shares the same outstanding kettle drums, has some fine horns, a complex orchestration which needs good definition and a brilliant sound throughout. The jaded ear should enjoy this thoroughly. END

Name and address of any manufacturer of records mentioned in this column may be obtained by writing Records, RADIO-ELECTRONICS, *154 West 14th St., New York 11, N.Y.*

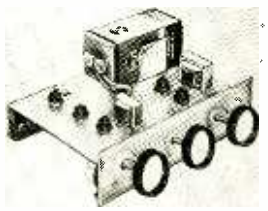
new Devices

HI-FI ARM. Designed for LP records in 3 lengths—16, 18 and 21 inches. Nylon shaft in nylon post, rides on polished steel ball. Nonrattling pivots, hardened cone point setscrews that need no lubrication turn into nylon shaft. Micrometer type counterbalance section travels 2½ inches, adjusts stylus force and can be calibrated for any pickup by stylus pressure gauge. Height adjustment from 1½ to 3 inches. Pickup mount-



ings are standard ½-inch centered studs, tapped for 3/48 threads. Built-in calibration mark for overhang adjustment. Arm lifts off base for inspection and cleaning. Can be disconnected for safety. ¼-inch hole needed for mounting. Polished aluminum finish.—**Volpar,** 4404 W. 2nd St., Panama City, Fla.

TRANSISTORIZED AUDIO AMPLIFIER in kit form, *KT-104* for 3.2-ohm and *KT-105* for 8-ohm voice coils. Output 0.75 watt. Response 30 to 10,000 cps. Class-B push-pull output. Inverse feedback for reduction of linear and nonlinear distortion.



Crystal, magnetic and tuner inputs. Separate bass and treble controls. Transformer-coupled driver and output stages. All parts. Prepunched chassis, knobs, transformers, etc. Diagrams. Instructions.—**Lafayette Radio.** 100 6th Ave. N. Y. 13, N. Y.

FOUR-SPEED HI-FI RECORD CHANGER, *SRC-62.* For plug-in use in home-assembled systems. Plays 7-, 10- and 12-inch records, intermixes 10- and 12-inch discs of same speed, stops all last records automatically. Single rotatable selector switch. Removable slip-on spindle holds 14 7-inch discs. Permanent standard spindle loads 12 10-inch and 10 12-inch records. Heavy-duty 4-pole, 4-coil motor. Muting switch. Click filter. 2 rotatable styli in tone arm for 45-rpm and other speeds. Smooth-ground, weighted turntable. Single-switch start-stop and reject controls. 8 3/8 x 13 7/16 x 11 15/16 inches. 15 lbs. 6-foot ac cable, 4-foot audio cable and plug.—**RCA,** 30 Rockefeller Plaza, N. Y. 20, N. Y.

SPEAKER ENCLOSURE SYSTEM, *Synfonette.* Flat frequency response from 90–12,000 cycles. 8 x 14 x 9 inches. Can be used singly, in horizontal or vertical positions, mounted on

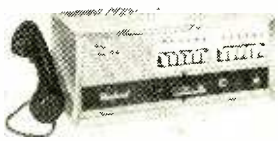
wall or ceiling, and in pairs for added realism. Blond, walnut, mahogany or ebony finish.—**National Co.,** 61 Shennan St., Malden 48, Mass.

RECORD CLOTH. Impregnated with Lubri-Stat — silicone base formulation that removes static electricity — cleans dust from record grooves and leaves a lubricating film on plastic type records. Individually packaged in a polyethylene envelope.—**Permo, Inc.,** 6415 No. Ravenswood Ave., Chicago 26, Ill.

RADIO AND INTERCOMMUNICATION SYSTEM, *Music-*

Monitor. Built-in. 6-room radio broadcast reception. 2-way intercommunication between master and 5 remote stations.—**David Bogen Co., Inc.,** Paramus, N. J.

INTERCOMMUNICATION SYSTEM, *Amplicall.* Sharonart steel finished in two-tone "office gray" simulated, embossed leather. (Illustrated) *4400* with universal master, station signal lights, chime signals, registered and identified calls during absence; facilities up to 30 buttons and lights. *5400* has universal master with up to 24 buttons giving any combination intercom service. *5300* for industrial intercom and paging, made with rack and panel equipment



in RP100 centralized system. *2500,* high-power paging. Economy systems include *6400 series* universal ac–dc system with up to 12 buttons, *5104* master 4-station system, and *5101* master 2-station system. — **Rauland-Borg Corp.,** 3515 W. Addison St., Chicago 18, Ill.

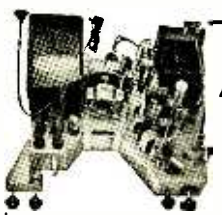
TUBULAR CONDENSERS—85° C ... TOP QUALITY—Equally as good for TV or Radio Work

.1—200v, .25—200v, .47—200v, .002—400v, .004—400v, .006—400v, .02—400v.....2c ea.
.047—400v, .1—400v, .25—400v, .5—400v, .002—600v, .01—600v, .02—600v .....5c ea.
.047—600v, .1—600v, .25—600v, .001—1000v, .01—1000v, .035—1000v, .05—1000v.....6c ea.
.1—1000v, .005—1700v, .02—1700v, .05—1600, .05—2500v, .0005—7500v.....12c ea.
100—50v, 50/30—150v, 10—450v, 40—450v, 50—450v, 80—450v, 1000—6v.....34c ea.

CARBON RESISTORS Regular factory stock in, Stackpole, I.R.C., Speer, etc.

½ WATT 10% 20, 68, 82, 100, 150, 270, 330, 390, 470, 560, 680, 1K, 1800, 2700, 3900Ω.....2c ea.
½ WATT 10% 3.3, 20, 39, 68, 82, 100, 150, 270, 330, 390, 470, 560, 680, 1KΩ .....2c ea.
½ WATT 10% 1800, 3900, 4700, 5600, 6800, 8200, 10K, 15K, 18K, 22K, 33K, 44KΩ.....2c ea.
½ WATT 10% 50K, 120K, 150K, 180K, 330K, 470KΩ 1, 3.9, 6.8, 10, 15 MEG .....2c ea.
1 WATT 10% 2.2, 3.3, 5, 15, 220, 390, 470, 1K, 1800, 2700, 3300, 3900, 4700KΩ .....2c ea.
1 WATT 10% 10K, 15K, 18K, 22K, 27K, 39K, 47K, 56K, 82K, 100K, 120K, 150K, 470KΩ .....3c ea.
2 WATT 10% 3.3, 39, 100, 270, 470, 560, 1K, 1500, 22K, 27K, 39K, 100K, 470KΩ.....4c ea.

WIREWOUND RESISTORS 1K-5W, 5K-5W, 100-5W, 10K-5W, 500-10W, 8500-10W, 670-20W.....16c ea.
CERAMIC CONDENSERS 1, 2, 3, 5, 6, 10, 25, 47, 50, 56, 68, 82, 100, 120, 200mmf.....3c ea.
CERAMIC CONDENSERS 220, 270, 330, 470, 1000, 1200, 1500, 2500, 5000, 6800mmf.....3c ea.
MICA CONDENSERS 5, 25, 30, 50, 60, 68, 75, 100, 120, 150, 220, 250, 270mmf.....3c ea.
MICA CONDENSERS 330, 470, 510, 560, 680, 820, 1K, 1500, 2K, 3K, 4K, 8K, 10Kmmf.....3c ea.
UHF STRIPS FOR STANDARD TUNER list price, $11.90. Your Price $1, the following numbers available—22R, 33F, 38F, 45Q, 45F, 45K, 46F, 46Q, 48F, 48K, 49F, 51Q, 54F, 54K, 54Q, 55F, 55K, 55Q, 56K, 57K, 61K, 66Q, 67F, 69Q, 71F, 73F.....Your choice any or all...$1 ea.
PM SPEAKERS 3"—$1, 4"—$1, 5"—$1, 6"—$1.29, 8"—$1.99, 10"—$2.68, 12"—$2.99
AUDIO OUTPUT TRANSFORMERS 50L6—39c, 6K6—39c, 6V6—39c, Pushpull 6K6—59c
SELENIUM RECTIFIERS 75ma—46c, 150ma—68c, 250ma—89c, 300ma—99c, 500ma—$1.29
TV CARTWHEEL CONDENSERS $1.75 10KV only 5c, 20KV—39c, 90KV—59c
TV FOCUS COILS 247Ω, 360Ω, 470Ω, 1000Ω, 4000Ω, or latest Focalizer only .....$1.97 ea.
TV UNIVERSAL PICTURE TUBE MOUNTING BRACKETS for any CRT up to 21".....Set $4.97
$3 PICTURE TUBE BOOSTER brightens and adds life to picture tube .....only $1
$25 SUPER HET TUNER RADIO incl. tubes, for use with TV, Phono or Amplifier.....$6.99
$75 MARKEL 78RPM RECORD CHANGER with pickup, plays both sides of record, only $15
$25 3-SPEED PORTABLE PHONOGRAPH complete ready to play, only $13
$15 AC-DC PHONO AMPLIFIER, incl. 3 tubes, beam output, volume & tone control.....$5
3-SPEED PHONO MOTOR including turntable and all accessories $4
ASTATIC PICKUP ARM including L-71 cartridge and three speed needle, list price $8.75.....only $2.59
PHONO MOTOR 78RPM including turntable and all accessories $1.78
$2.50 SAPPHIRE PHONOGRAPH NEEDLE good for over 4000 playings .....59c ea.
ASTATIC CRYSTAL ±L-82 .....$1.59 **$25 DIAMOND NEEDLE** for all 33/45 cartridges $9.84
ANTENNA LOOPS oval type ....29c **LOOPSTICK ANTENNAS** hi-gain, ferrite, adjustable ....39c ea.
$7.95 UNIVERSAL AUTO ANTENNAS 3 section chromium brass, complete for any car .....$2 ea.
ROSIN CORE SOLDER economy type .....49c lb. Finest quality 40/60.....79c
$1 HEX NUT WRENCH handiest tool ever made, 10 sizes ¼" to 19/32" only .....19c ea.
ONE PENNY BUYS A STANDARD 1 AMP FUSE size ¼" x 1¼" regular price 8c, only .....1c ea.



Build your own

SUPER DE LUXE 31-TUBE #630 TV CHASSIS

±630 SUPER DELUXE 31-TUBE TV KIT

OPERATES 16" to 21" PICTURE TUBES • Engineered in strict adherence to the genuine RCA ±630 plus added features • FULL 4MC BANDWIDTH • CASCODE TUNER • COSINE DEFLECTION YOKE • LARGER POWER TRANSFORMER • KEYED AGC • 12" SPEAKER • CONDENSERS and RESISTORS at rated capacities and tolerances. You receive a COMPLETE SET of PARTS and TUBES, everything needed is included (less CRT & wire). All I.F. Coils and Transformers are factory pre-aligned and tuned. You will enjoy building it with "LIFE-SIZE easy to follow step-by-step ASSEMBLING INSTRUCTIONS" included with each KIT.

Slashed to **$99.99**

Similar KIT for 24" or 27" CRT slashed to **$110.39**

21" TV CONVERSION KIT

NOW . . . Anyone with even a limited knowledge of TV—can Convert any Size, any Make TV RECEIVER *to operate* 21" *or any* 70° *Picture Tube.*

COMPLETE SET OF ESSENTIAL PARTS includes matched set of Todd 70° COSINE DEFLECTION YOKE and TODD HV FLYBACK TRANSFORMER, FOCALIZER, 20KV FILTER, DRIVE TRIMMER, LINEARITY COIL, CONDENSERS, RESISTORS.

Your Price.... **$13.97** List Price $33.50

Incl. CONVERSION MANUAL with Step-by-Step Instructions & Diagrams.

Similar Kit for 24", 27" or any 90° CRT **$15.98**

PULSE KEYED AGC KIT

Finest, most accurate and the easiest Kit to install in any make TV RECEIVER including the No. 630. Improves performance and insures a steady picture on all channels.

COMPLETE SET OF PARTS Including 6AU6 tube & Instructions **$2.99**

#630 BY TECHMASTER

COMPLETE 1957 LINE AT SPECIAL PRICES

Excitingly New

Video Theatre TV . . . Hi-Fi Kits

Catalog mailed on request

CBS PICTURE TUBES

17" 70° ±17BP4A $22.66 | 21" 70° ±21EP4B $32.21
90° ±17AVP4A | 90° ±21ALP4A

24" 90° ±24CP4A Aluminized $48.99 | 27" 90° ±27EP4A Aluminized $74.31

STANDARD CASCODE TUNER

For better all around performance
Complete with tubes and Brooks CASCODE MANUAL with step-by-step instructions and all extra parts needed. **$15.97**

FLYBACK TRANSFORMER

Latest single 1B3 type, for the 21" and all 70° Picture Tubes. It is similar to the popular No. X-053 and goes up as high as 16KV. With it you receive easy-to-follow instructions and schematic diagrams that apply to build, convert or improve practically all makes of TV Receivers **$4.86**

COSINE DEFLECTION YOKE

The latest achievement in the 70° type, with complete wired network. Will add new life to any TV Set, in brilliance, clarity and sweep. This is the same type we supply with our Kits, with it you receive easy-to-follow instructions and diagrams **$4.92**

18KV FLYBACK TRANSF.

This new Flyback Transformer now makes 90° conversions easy on any make TV Set. Customers report excellence on 24" and 27" TV sets built or converted with this Transformer. Instructions and schematic diagrams included **$5.24**

COSINE DEFLECTION YOKE

NEW 90° TYPE, with complete wired network. It solves all problems formerly sought for, in 90° Yokes, for undistorted clear pictures and ease of overall sweep. Instructions and schematic diagrams included for building, replacing and converting **$5.98**

"ONE DOLLAR" buys

As much as $15 worth — Everything Brand New and sold to you with a money back guarantee.

20 – 10KV CARTWHEEL COND. total list $35 ...$1
100 – ASSORTED ½ WATT RESISTORS.....$1
100 – FUSES 1 AMP standard size 1¼" x ¼".....$1
100 – TUBULAR CONDENSERS .02—100v. $1
100 – ASSORTED WHITE TUBE CARTONS.....$1
300 – TV STANDARD CORONA BUTTONS.....$1
100 – TV STANDARD CORONA RINGS.....$1
300 – TV DIAL ESCUTCHEON SPRINGS.....$1
100' – FINEST NYLON DIAL CORD.....$1
300 – SELF TAPPING SCREWS ±8/32 x 5/8" ...$1
400 – ASST. SCREWS, NUTS, WASH, RIVETS..$1
50 – ASST. TUBULAR CONDENSERS 85°.....$1
70 – ASST. 1 WATT RESISTORS.....$1
35 – ASST. 2 WATT RESISTORS.....$1
35 – ASST. RADIO KNOBS screw and push-on $1
100 – KNOB SPRINGS standard size 3/8" x ½".....$1
50 – ASST. SOCKETS octal and miniature $1
50 – ASST. MICA CONDENSERS some in 5% ...$1
50 – ASST. CERAMIC CONDENSERS.....$1
10 – ASST. VOLUME CONTROLS less switch $1
5 – ASST. VOLUME CONTROLS with switch $1
20 – ASST. PILOT LIGHTS ±44, 46, 47, 51 ....$1
10 – PILOT LIGHT SKTS. bayonet type, wired....$1
50 – ASST. TERMINAL STRIPS 1, 2, 3, 4 lug ...$1
10 – ASST. RADIO ELECTRO. CONDENSERS...$1
5 – ASST. TV ELECTROLYTIC CONDENSERS...$1
10 – ASST. TV COILS sync, peaking, width, etc....$1
10 – 6 FT. ELEC. LINE CORDS with plug.....$1
5 – TV CHEATER CORDS with both plugs $1
10 – ASST. WIREWOUND RES. 5, 10, 20 watts ..$1
200' – HOOK-UP WIRE & SOLDER KIT.....$1
100' – TWIN LEAD-IN WR. 300Ω, heavy duty ...$1
50' – FLAT 4-CONDUCT. WIRE, many purposes ..$1
10 – AC-DC ANTENNA HANKS each 20 feet $1
25 – ASST. MICA TRIMMER CONDENSERS....$1
50 – TUBULAR CONDENSERS .1-200v $1
50 – TUBULAR CONDENSERS .02-400v $1
50 – TUBULAR CONDENSERS .001-600v $1
25 – TUBULAR CONDENSERS .01-600v $1
20 – TUBULAR CONDENSERS .25-600v $1
20 – TUBULAR CONDENSERS .047-600v $1
20 – TUBULAR CONDENSERS .001-1000v.....$1
20 – TUBULAR CONDENSERS .01-1000v $1
20 – TUBULAR CONDENSERS .039-1000v $1
20 – TUBULAR CONDENSERS .05-1000v $1
20 – TUBULAR CONDENSERS .05-1600v $1
20 – TUBULAR CONDENSERS .02-1700v $1
3 – ELECTROLYTIC COND. 50/30 - 150v $1
5 – ELECTROLYTIC COND. 100/50 - 50/25v $1
3 – ELECTROLYTIC COND. 80/50 - 450v $1
3 – ELECTROLYTIC COND. 40/10/10 - 450v $1
3 – ELECTROLYTIC COND. 40/40 - 450v $1
5 – ELECTROLYTIC COND. 250/1000 - 10/6v ...$1
35 – MICA COND. 20-30 mmf and 15-100 mmf ...$1
35 – MICA COND. 20-470 mmf and 15-1000 mmf..$1
35 – MICA COND. 20-3000 mmf and 15-10K mmf..$1
35 – CERAMIC COND. 20-1 mmf and 15-47 mmf ..$1
35 – CERAMIC COND. 20-68 mmf and 15-1500 mmf .$1
35 – CERAMIC COND. 20-2500 mmf and 15-680 mmf $1
50 – 100 OHM ½ WATT RESISTORS 5%.....$1
75 – 680 OHM ½ WATT RESISTORS 10%.....$1
75 – 470K OHM ½ WATT RESISTORS 10%...$1
50 – 3.3 OHM 1 WATT RESISTORS 10%.....$1
50 – 3900 OHM 1 WATT RESISTORS 10%.....$1
50 – 15K OHM 1 WATT RESISTORS 10%.....$1
50 – 27K OHM 1 WATT RESISTORS 10%.....$1
50 – 120K OHM 1 WATT RESISTORS 10%....$1
50 – 150K OHM 1 WATT RESISTORS 5%.....$1
50 – 470K OHM 1 WATT RESISTORS 10%....$1
50 – 2.2 MEG OHM 1 WATT RESIST. 10%...$1
25 – 2.2 OHM 2 WATT RESISTORS 5%.....$1
25 – 3.3 OHM 2 WATT RESISTORS 5%.....$1
25 – 5.6 OHM 2 WATT RESISTORS 10%.....$1
25 – 270 OHM 2 WATT RESISTORS 10%.....$1
25 – 470 OHM 2 WATT RESISTORS 10%.....$1
25 – 100K OHM 2 WATT RESISTORS 10%.....$1
3 – AUDIO OUTPUT TRANSFORMERS 50L6 type .$1
3 – AUDIO OUTPUT TRANS. 6K6 or 6V6 type $1
3 – I.F. COIL TRANSFORMERS 456kc.....$1
3 – I.F. COIL TRANSFORMERS 10.7 mc FM $1
4 – OVAL LOOP ANTENNAS ass't, hi-gain types. .$1
3 – LOOPSTICK ANT. new ferrite, adjustable $1
12 – RADIO OSCILLATOR COILS 456kc $1
3 – 2 GANG VARIABLE COND. 420/162mc $1
3 – ½ MEG VOLUME CONTROLS with switch ...$1
1 – BEST 4" PM SPK. 1.47 oz. alnico ±5 magnet ..$1
1 – 5" PM SPEAKER alnico ±5 magnet $1
2 – $2.50 SAPPHIRE NEEDLES 4000 playings $1
2 – SELENIUM RECTIFIERS 1-65ma. 1-100ma. ...$1
5 – DIODE CRYSTALS 2IN21, 2-IN23 1-IN64 ....$1
1 – $6 INDOOR TV ANTENNA hi-gain 3 sec. $1
1 – 21" TV OPEN MASK soft gray color $1
1 – TV SAFETY GLASS 13⅜" x 16½".....$1
1 – TV UNIV. FOCALIZER adjusts for any ohmage .$1
1 – TV VERT. OUTPUT TRANS. 10 to 1 ratio $1
5 – TV CRT. SOCKETS with 18" leads $1
5 – HI-VOLT. ANODE LEADS with 18" leads $1
5 – ASST. CASCODE ANTENNA STRIPS.....$1
2 – TV 1ST & 2ND SND. I.F. COILS ±201K1 ..$1
1 – TV RATIO DETECTOR TRANS. 4.5mc $1

HANDY WAY TO ORDER—Simply tear out advertisement and pencil-mark items wanted, enclose with Money Order or check. No letter needed, envelope address is sufficient.

You will receive a new copy of this ad for re-orders. ON SMALL ORDERS—Please include stamps for postage, excess will be refunded. Larger orders will be shipped express collect.

BROOKS RADIO & TV CORP., 84 Vesey St., Dept. A, New York 7, N.Y. TELEPHONE COrtland 7-2359

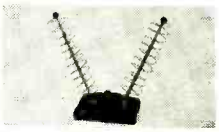
NEW DEVICES

(Continued)

ANTENNAS. *Zephyr Royal* (see photo) with Wing director. Stagger tuning gives flat frequency response in color reception. Rejector phasing elimi-

nates side pickup. *Trio Zephyr* has Wing director and 2 Wing dipoles. Greater bandwidth due to complementary spacing on low and high bands. *Trio Zephyr Mite* for flat response, good impedance and single-lobe pattern. Portion of stub employed as channel-13 dipole. Integrated reflectors add 2-db gain on channel 7, 1-db on channel 13. Gain on channels 2–6 1 db; on 7–13, 0.5 db.—**Trio Mfg. Co.,** Griggsville, Ill.

ANTENNAS, *models 404* and *505.* Cover channels 2 to 83. Telescoping dipoles. Swivel on ball and socket in any direction. Gold spirals, plastic base, gold



uprights.—**Hi-Lo TV Antenna Corp.,** 3540 No. Ravenswood Ave., Chicago, Ill.

COMMUNITY-TV ANTENNA-SYSTEM CABLES. Flat to obviate reduction of signals on high or low TV channels. Minimize line radiation. Double-shielded and jacketed. *Trade No.*

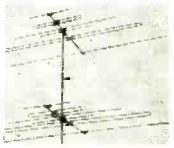
8232 for tap-off lead-ins and *Trade No. 8233* for secondary leads. Sweep-tested before shipment.—**Belden Mfg. Co.,** 4647 W. Van Buren St., Chicago, Ill.

INDOOR ANTENNA. *Showman.* Wide range of color combinations. 19 inches. No extendible rods. Does not protrude over TV set. 12-channel variable inductance operating on same

principle as TV set. Bandwidth characteristics of single-channel Yagi when tuned to specific channel. Separate high- and low-band dipoles.—**Channel Master Corp.,** Ellenville, N. Y.

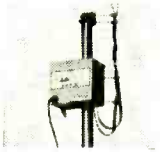
TV ANTENNA, *Bandmaster.* Vswr uniformly less than 1.6-to-1 on all channels. 10-element all-channel Yagi. No joints in straight-through elements at high-current points. Preassembled.—**Davis Electronics,** 4002 W. Burbank Blvd., Burbank, Calif.

TV ANTENNA, *303.* All-channel vhf (2–13). Crimped element ends. Plugged booms. High-impact polystyrene insulators. 300-ohm driven element. Aluminum construction. Metal phasing lines. 8½ lbs. City,



single bay; country, double bay. —**Winegard Co.,** 3000 Scotten Blvd., Burlington, Iowa.

BROADBAND MAST BOOSTER, *model Super-20.* Noise figure 5.5 db low band, 7 db high



band, gain 20 db. Separate high- or low-band inputs at 300 ohms. 75- or 300-ohm output through built-in ferrite-core transformer. Automatic or continuous operation. 3 6BZ7's in modified cascode circuit.—**Benco TV Associates, Ltd.,** 278 Bridgeland Ave., Downsview P.O., Toronto, Canada.

PHONE AND CW TRANSMITTER KIT. *Heathkit DX-35.* Phone and CW operation on 80, 40, 20, 15, 11 and 10 meters. Plate power input 65 watts on CW, controlled-carrier modulation peaks to 50 watts on phone. Two-stage 12AX7 speech amplifier, 12AU7 modulator, 12BY7 oscillator, 12BY7 buffer and 6146 final. Pi-network output coupling. Front-panel controls: function switch with positions

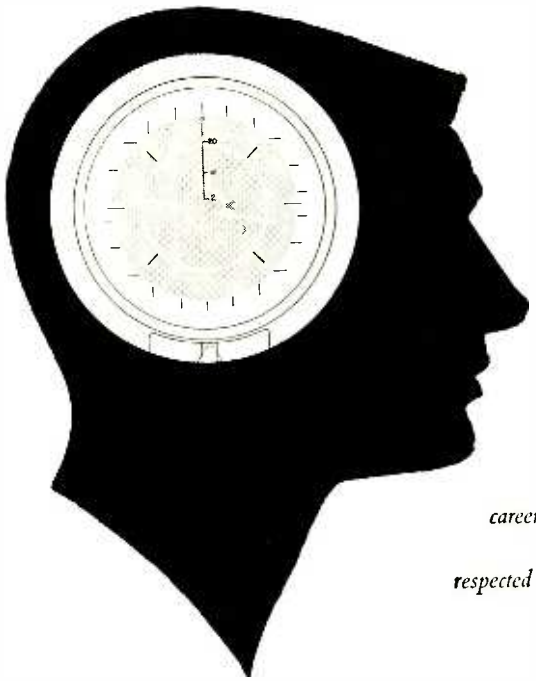
OFF—CW—STANDBY—PHONE, final tuning, antenna coupling, drive level control, band change switch. Meter indicates final grid or plate current.—**Heath Co.,** 305 Territorial Road, Benton Harbor, Mich.

RADIO KIT, modular. 2 modules do work of 16 separate electrical parts. Prefabricated printed circuits, tubes, loud-

speaker. Ivory-colored plastic cabinet. — **R&D Electronics Labs., Inc.,** Long Island City. N. Y.

TRANSISTOR RADIO KIT. 6 transistors, crystal diode and

Systems Career: a laboratory for learning



. . . an exciting and rewarding career awaits the E.E. or Physics graduate who joins this highly respected Engineering team.

As a Field Engineer at Hughes, through training and assignment you will become familiar with the entire systems involved, including the most advanced electronic computers. With this knowledge you will be ideally situated to broaden your experience and learning for future application in either the military or commercial field.

The national respect which Hughes commands in the field of advanced electronics is in no small part due to the technical support provided by the Field Engineers. Other contributors to the success of the Field Service and Support Division are the Technical Manuals Engineer, Training School Engineers, Technical Liaison Engineers, and Field Modification Engineers.

This Hughes activity is a highly trained organization of expert engineers, giving support to the armed services and airframe manufacturers using the company's equipment. Locations are in Southern California, continental U.S., overseas. We invite you to join this team. For further information write us at the address below.

HUGHES

Some extra advantages for Field Engineers include:

Training at full salary for 3 months before assignment.

Generous moving and travel allowance between present location and Southern California (Culver City).

Additional compensation plus complete travel and moving on assignments away from Culver City.

Ideal living conditions in the unsurpassed climate of Southern California.

Reimbursement for after-hours courses at UCLA, USC, or other local universities.

Employee group and health insurance paid by company, retirement plan, sick leave, and paid vacations.

Scientific Staff Relations
RESEARCH AND DEVELOPMENT LABORATORIES
HUGHES AIRCRAFT COMPANY
Culver City, California

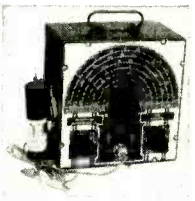
SELLING OUT!

COMPLETE STOCK OF NATIONALLY ADVERTISED RADIO & TELEVISION TESTING INSTRUMENTS, PARTS AND ELECTRICAL APPLIANCES TO BE SOLD

REGARDLESS OF COST.
Prices Reduced Up to 80%

This is the opportunity of a lifetime!

Below mentioned units are not kits, but all factory wired and brand new. Some models have been discontinued by the manufacturer, but every one is factory sealed and carries a one year factory guarantee. Satisfaction or money refunded within 10 days.



Model 999 Combination F.M., A.M. and Television

SIGNAL GENERATOR *and* SIGNAL TRACER

A.C. operated, generates R.F. frequencies from 150 k.c. to 50 m.c. Positive action attenuator provides effective output control at all times. R.F. is obtainable separately or modulated by the Audio Frequency. Signal Tracer uses the new Sylvania Germanium Crystal Diode, which combined with a resistance-capacity network provides a frequency range of 300 cycles to 50 Megocycles.

Complete with signal tracer probe, test leads and full instructions

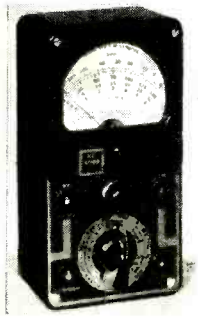
Regular $39.50 — *net only* **$19.50**

TEST CRAFT

Model TC-10 Quality Multitester

AC and DC Voltage Ranges: 0-5/15/150/-1500/3000 Volts. DC Current Ranges: 0-5/50 ma. 0-1.5 Amps. Resistance Ranges: 0-100 ohms. 0-100 K. Complete with batteries, instructions: Size: 6"x3½"x2"

Reg. $16.85 — *now only* **$9.85**



SUPREME

Model 543-S

Multimeter

1% WIRE WOUND PRECISION RESISTORS

D.C. Volt Ranges: 0-150-300 D.C. Ma: 0-60-120-300-600. AC Volt Ranges: 0-150-300. Ohm Ranges: 0-1000/100,900. Complete with instructions.

Reg. $24.50 — *now only* **$9.95**

TEST CRAFT

Model TC-75

Combination Test Speaker and Signal Tracer

plus resistor tester
plus condenser tester
plus output indicator
plus speaker substitution
plus field substitutor
plus voice coil substitution

Complete with full instructions

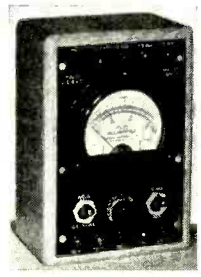
Reg. $39.50 — *now only* **$24.50**

Famous-Make

OHMETER

Has a double range of 0-10 and 0-1000 ohms for accurate measurement of low resistance. Widely used for production testing, armature and field resistances of small motors, relay and coil testing transformer winding tests, etc. Complete with test leads, instructions, leather case.

Reg. $36.50 *now only* **$14.95**



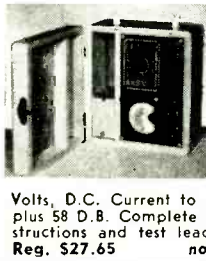
SUPERIOR

Model 1553

Volt-Ohm-Milliammeter

Meets U.S. Army requirements for accuracy and durability. Measures AC Voltages: 0-7.5/15/150/-750. D.C. Voltages: 0 to 2.5/15/150/750. D.C. Current: 0 to 7.5/75 ma. Resistance: 0 to 5,000/500,-000 Ohms. Complete with leather case, instructions.

Reg. $29.25 — *now only* **$14.50**



SUPERIOR

5,000 ohms per Volt,

Volt-Ohm-Milliammeter

D.C. Voltages to 1500 Volts. A.C. Voltages to 1500 Volts. Resistance to 2 Megohms. Output Volts to 1500 Volts, D.C. Current to 150 Ma., Decibels to plus 58 D.B. Complete with instructions and test leads.

Reg. $27.65 — *now only* **$14.50**

TEST CRAFT

Model TC-50

TUBE AND SET TESTER

Test all tubes up to date, incl. 4, 5, 6, 7L, octals, loctals, television, magic eye, thyrators single ended floating filament, mercury vapor, new miniatures, etc. Multimeter Specifications: AC and DC Voltage Ranges: 0-1-100-1000-5000. DC Current Ranges: 0-10-100-1 Amp. Low Res. Range: 0-10,000 Ohms. Medium Res. Range: 0-100,000 Ohms. High Res. Range: 0-1 megohm. Complete with test leads and instructions.

Reg. $49.50 *now only* **$29.50**

		Dealers Net Price	Selling-Out Price
METROPOLITAN	Model 111 Quality Multitester	21.50	9.95
GENERAL ELECTRONICS	" 200, AM-FM & Television Signal Generator, AC operated	39.50	24.50
REINER ELECTRONICS	" 333, DC Volt-Ohm-Milliammeter	26.95	9.95
SUPERIOR INSTRUMENT CO.	" Model TV-11 Tube Tester	47.50	38.00
SHALLCROSS	" 630 Wheatstone Resistance Bridge	145.00	75.00
GRUEN	2½" DC, D'Arsonval Type, 1 Milliammeter, Meter	9.95	2.95
WESTON	Model 507, F.S. 1, 2 Milliam. Meter	12.95	3.95
TRIPLETT	331-JP 30 Amperes, Meter	12.95	4.95
MARION	3" D'Arsonval Type, 1 Milliam. with calibrated Volt-Ohm Current Scale, Meter	12.95	3.95
ACRO	Radio & Phonograph Chassis Cradles	6.95	2.95
GRAF-O-TONE	8" Glass Recording Discs, sold only in cartons of 24 discs	.75 each	.15
MELODISC	12" Metal Recording Discs, sold only in cartons of 50 discs	1.50 each	.30
HOLYOKE	180 Ohm resistance line cord, 6 foot with plug	1.25 each	.35
"	Electrical Iron Cords, 6 foot with plug	.95 each	.25
"	Extension line cords, 9 foot with plug	.75 each	.30
"	Extension line cords, 12 foot with plug	.95 each	.40
"	No. 22, stranded, tinned, copper push-back wire, on 500" spools	5.75 ea. spool	2.50
DUOSONIC	MODEL CAPRI, 3 speed recordplayers, with life time needle, plastic case, speaker and amplifier	Reduced to	16.95 each
MAGUIRE	Automatic Recordchanger	Reduced to	9.95 each
TELE-TONE	Table Radio	Reduced to	9.95 each
MOTOROLA	Table Radio, 5 tubes	Reduced to	12.95 each
"	Clock Radios	Reduced to	18.95 each
PHILCO	Table Radios, 5 tubes	Reduced to	17.95 each
GENERAL ELECTRIC	Portable Radios, 3 Way 5 tubes	Reduced to	24.95 each
ADMIRAL	Portable Radios, 3 Way 5 tubes	Reduced to	24.95 each
PHILCO	Portable Radios, 3 Way 5 tubes	Reduced to	24.95 each
GENERAL ELECTRIC	Clock Radios, 5 tubes	Reduced to	24.95 each
ADMIRAL	Clock Radios, 5 tubes	Reduced to	24.95 each
REVERE	Whistling Tea Kettles	Reduced to	2.95 each
GENERAL ELECTRIC	Automatic Irons	Reduced to	7.95 each
ROLAND	Table Radios, 5 tubes	Reduced to	12.95 each
CUCKOO CLOCK	Genuine, imported Black Forest, hand-carved, cuckoos every 15 minutes	Reduced to	4.95 each
GLO	Electronic, oscillating massager with infra-red heat combined	Reduced to	3.95 each
ROTO BROIL 400	Fully automatic rotisserie and broiler combination, 7 way, with time clock, 3 heat element, double powered	Reduced to	24.50 each
CAPITOL	Infra-red heat, automatic broiler	Reduced to	9.95 each

All prices are f.o.b. New York, 20% deposit with order, balance C.O.D., or full remittance with order.

QUANTITIES ARE LIMITED. WRITE, PHONE OR WIRE FOR IMMEDIATE DELIVERY.

METROPOLITAN ELECTRONICS & INSTRUMENT CO.

106 Fifth Ave., New York 11, N.Y. Telephone: Oregon 5-1707 Cable Address: METRONICS

(Continued)

40-page manual. Can be used, also, for amplifiers, oscillators, broadcast receivers, ham radio components, test instruments, etc.—**Sylvania Electric Prods., Inc.,** 1740 Broadway, N. Y. 19, N. Y.

VHF RECEIVER. *Air-O-Ear.* Picks up aircraft broadcasts for 200 miles. Built-in antenna. Portable. Plugs into any 115-volt wall socket. 6-tube superhet circuit. Noise squelch control. Selenium rectifier. Automatic

volume control. Coaxial tuning. Drift compensation. 6-inch oval speaker in ebony case. 7½ x 5 x 4½ inches. White dial calibrations from 108 to 130 mc. 5 lbs. —**Nova-Tech, Inc.,** 1721 Sepulveda Blvd., Manhattan Beach, Calif.

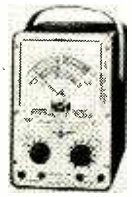
PICTURE-TUBE REJUVENATOR, *Zipt.* Burns off grid and cathode shorts without chassis pulling.—**General Cement Mfg.**

Co., 400 So. Wyman St., Rockford, Ill.

COLOR CONVERGANCE AND LINEARITY GENERATOR. *Win-Tronix model 250.* Optimum

white dot pattern, white line crosshatch and horizontal or vertical bars. Jitter free—afc locked to power line. Standard 15,750-cycle horizontal sync pulse and 60-cycle vertical sync pulse. 525-line interlaced raster with retrace blanking for use as laboratory test pattern and sync generator. Only 2 controls—output attenuator and pattern selector. — **Winston Electronics, Inc.,** 4312 Main St., Philadelphia 27, Pa.

FLYBACKER PLUS, *model 124.* Tests all TV flybacks, yokes and capacitors without disconnecting them from the circuit. Shows up leakage in mica capacitors. 5 reading scales with separate one for yokes and capacitors. Illuminated meter. Picture-frame type steel case with etched aluminum panel. 8 pounds. 10 x 6 x 5 inches. Tube, leads and instructions.—**Radio City Prods. Co.,**

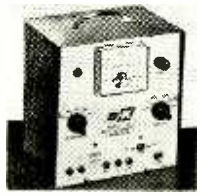


Inc., Centre & Glendale Sts., Easton, Pa.

PORTABLE SERVICE INSTRUMENT, *model 8500,* for black-and-white, color receiver chassis and cathode-ray tubes. For receiver troubleshooting, connected between receiver output cable and cathode-ray tube without removal of either from cabinet, thus permitting video drive, K-G1 and K-G2 voltage and cathode current measurement. In 3-gun, shadow-mask type color receiver, each gun gives information. Tests and checks emission, grid control, gas and

leakage of cathode-ray tube. Test prods so that meter measures dc voltages up to 1,000, up to 30,000 volts with high-voltage probe. Built-in power supply for ohmmeter function. Rejuvenates picture-tube cathodes.— **Philco Corp.,** Tioga & C Sts., Phila., Pa.

TEST EQUIPMENT CALIBRATOR. *model 750.* Calibrates vom, vtvm and other meters, signal, sweep and marker generators, oscilloscopes. 2, 5, 25, 100 and 300 volts dc; 5, 25, 100 and 300 volts ac to check voltage ranges. 10, 100, 1,000, 10,000 and 100,000 ohms and 10 megohms for resistance ranges. Crystal oscillator generates harmonic frequencies over 300 mc with 0.1% accuracy. Crystal oscillator and pentode amplifier converts into audio oscillator to signal-trace trouble in audio



amplifiers in FM and TV receivers and high-fidelity equipment. Measures peak-to-peak voltages of any waveform. Null-indicator meter, function and range switches. 5-mc crystal. 8¾ x 8 x 5½ inches. 6¾ lbs. **B&K Mfg. Co.,** 3731 No. Southport Ave., Chicago 13, Ill.

SHORTED-TURNS INDICATOR. Tests shorted and open

INDEPENDENCE 3-7400

CHICAGO STANDARD TRANSFORMER CORPORATION
3501 W. ADDISON ST. • CHICAGO 18, ILLINOIS

SPECIAL NOTICE

TO OUR MANY ASSOCIATES AND FRIENDS
IN THE RADIO, TELEVISION AND ELECTRONICS INDUSTRY

We have been told that there is a rumor being circulated by competitors or others that the Chicago Standard Transformer Corporation has planned, or is planning to sell its assets to outside interests.

Such a rumor is utterly false and unfounded, but has reached us from too many sources to be ignored.

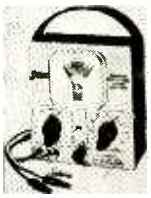
We, therefore, feel compelled to make this public declaration in order to rectify any misconceptions that may have been bred as a result of this misinformation and to "set the record straight."

The Chicago Standard Transformer Corporation is now, and will remain, as it has since 1928, ready and able to serve this dynamic industry with the finest of transformers, coils, and electronic components. We will continue to develop . . . to engineer . . . and to produce the same top quality products that have earned national respect, and accounted for our continued leadership.

CHICAGO STANDARD TRANSFORMER CORPORATION

circuits in one operation. Vacuum-tube voltmeter indicating device. Built-in safeguards against overload and meter burnout. Plastic sleeve protects test rod. Test rods for special coils. 14 x 8 x 8 inches. ⅜-inch standard test rod.—**B&K Mfg. Co.**, 3731 No. Southport Ave., Chicago 13, Ill.

TRANSISTOR CHECKER. *Model TDC 22.* Tests transistors and crystal diodes without removal from circuit. Gain control varies 6-volt battery voltage for different gain transistors. Setup chart in removable booklet mounted in plastic folder on rear of unit. Checks p-n-p and

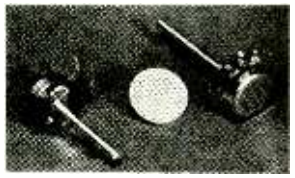


n-p-n transistors for current gain, leakage, opens and shorts; crystal diodes for forward-to-backward resistance ratio. Uhf diodes protected by reduced voltage. Clear plastic meter. 2-tone steel demagnetized case. —**Service Instruments Co.**, 171 Official Rd., Addison, Ill.

TRANSISTOR TESTER KIT, TT-2. 4⅝-inch 2% meter. 1% components. Ranges cover current gain beta 0–100 and 0–300 expanded alpha scale 0.50 to 0.99 and leak $I_{b_{co}}$. Measures p-n-p and n-p-n transistors and crystal diodes. Self-contained and

calibrating. Uses inexpensive flashlight batteries. Punched, lettered and finished panel. 17-page instruction manual.—**Kit-Tronics**, 2315 Hendola Dr. N. E., Albuquerque, N. M.

MINIATURIZED CONTROL, *series 44.* For hearing aids, pocket radios, portable radios, TV sets, portable test equipment and printed circuits. 21/32 inch diameter; 5/16 inch deep. 200 mw at 40° C. Linear resistance range 200 ohms to 5 megohms; tapered, 1,500 ohms to 2.5 megohms. Resistance tolerances 20%, 30% above 100,000 ohms. 300° mechanical and electrical rotation. Bushing and tab mounting. Spst or dpst switches

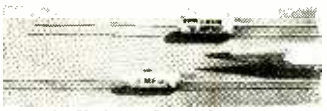


with 0.5 amp 25-volt dc rating. —**Clarostat Mfg. Co., Inc.**, Dover, N. H.

TRANSISTOR MAGNETIC POWER SUPPLY, *Hycon-Verter,* fits in palm of hand. Replaces small vibrators, inverters or dynamotors. Weighs 1½ lbs.; 2 x 2½ x 3 inches. Input 24 volts dc; output 115 volts, 400-cycle ac and 150 volts dc with 25-watt load rating. Supplies ac power for gyroscopes, servomotors, magnetic amplifiers, synchros, microsyns, etc., and high-voltage dc for walkie-talkies; vehicular,

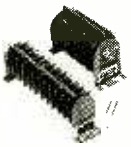
aircraft and marine communications and allied electronic equipment. 90% efficiency minimizes heat dissipation. Hermetic seal makes it explosion-proof. Almost total absence of radio and acoustic noises.—**Hycon Mfg. Co.**, 2961 E. Colorado St., Pasadena, Calif.

ELECTROLYTIC CAPACITORS, *Littl-Lytics.* Small. Hermetically sealed. Aluminum. For replacements in transistor radios, hearing aids, pocket-sized wire recorders and all miniature electronic units using small electrolytics. From 3/16 inch diameter by 9/16 inch long to ⅜-inch diameter by ⅞ inch long. Values from 1 to 200 μf in voltages from 1 to 50 volts dc.—**Sprague Products Co.**, 81



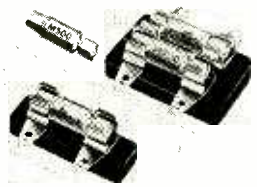
Marshall St., No. Adams, Mass.

45-VOLT SELENIUM RECTIFIERS. Standard sizes from



11/16 to 2 inches square. types. High stability. Low reverse or leakage current.—**Components Div., Federal Telephone & Radio Co.**, 100 Kingsland Rd., Clifton, N. J.

FUSE TYPE SILICON RECTIFIER. 400 volts reverse at 50(ma. ¼-inch diameter, approximately 1 inch long. Fits int(standard fuse holder. Re juvenates old TV sets by giv-



ing approximately 20 volts more on B plus.—**Sarkes Tarzian Rectifier Div.**, Bloomington, Ind. END

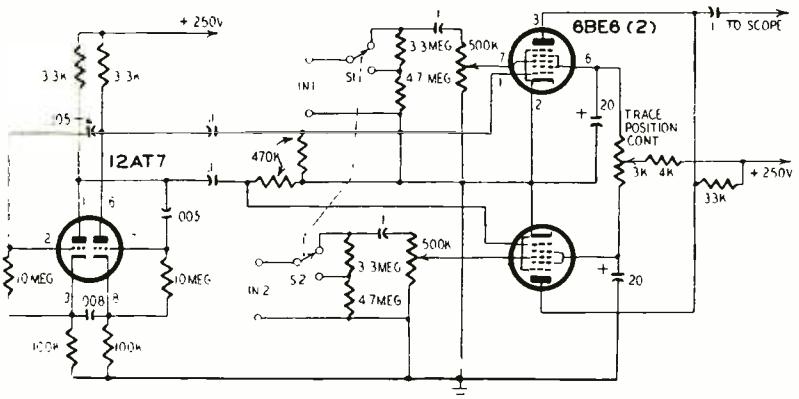
All specifications given are from manufacturers' data.

radio-electronic Circuits

ELECTRONIC SWITCH

When a single-beam oscilloscope is used to compare related waveforms, it is necessary to switch the scope input from one source to the other. This makes it almost impossible to detect minor differences in waveshapes. Waveform studies can be simplified by using an electronic switch to connect the two sources alternately to the scope.

The twin-channel electronic switch shown in the diagram is reprinted from *Radioamater*, a Yugoslavian amateur radio magazine. The 12AT7 is a multivibrator type square-wave generator. The square-wave pulses on its plates are 180° out of phase and are fed to the oscillator grids of the 6BE6 signal amplifiers. Signals from source 1 and source 2 are fed to grid 3 of the 6BE6's through variable attenuators. The square waves on the oscillator grids alternately block and unblock the 6BE6's so the signals applied to the signal grids are alternately amplified and fed to the input of the oscilloscope. The amplitudes of the two input signals are varied simultaneously by the ganged two-step attenuators and separately by the 500,000-ohm potentiometers in the input circuits. The 3,000-ohm control between the 6BE6 screens varies the separation between the two traces.



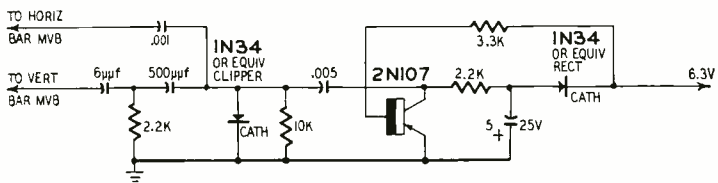
IMPROVING THE LP-1 DOT–BAR GENERATOR

An unstable pattern is particularly annoying when using a dot-bar generator to adjust convergence in a color TV set. This trouble is common to most low-priced units. The Heathkit LP-1—as well as several others—is troublesome because it is very difficult to keep the horizontal bars locked in with the power line. This causes the pattern to jitter at a rate determined by the difference between the power-line frequency and the frequency at which the set's vertical oscillator tends to lock.

Prompted by the article "Transistorized Scope Calibrator" (RADIO-ELECTRONICS, February, 1956) describing a square-wave generator as a voltage-reference source, I developed a practical circuit for syncing the dot–bar generator to the power-line frequency. Briefly, the 60-cycle line signal is squared, differentiated and then clipped to provide a sync signal for the horizontal-bar multivibrator in the LP-1. The sync circuit is shown in the diagram.

A 6-volt 60-cycle signal is tapped off the power supply and rectified by a 1N34 or similar germanium diode to supply operating voltage for the transistor. A part of the ac signal is fed through the 3,300-ohm resistor to the transistor base. The transistor acts like an on–off switch opened and closed at a 60-cycle rate.

A square-wave signal is taken from

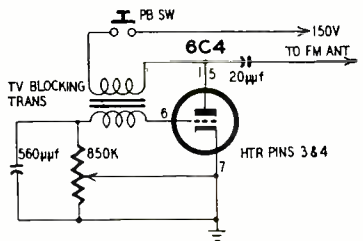


the collector and differentiated by the .005-μf capacitor and 10,000-ohm resistor. A diode clipper shunts this resistor and clips the signal so only the negative-going spike is left. This spike (about 2 volts peak to peak) is tapped off and fed through a .001-μf capacitor to pin 1 of the horizontal-bar multivibrator to lock it effectively in at any multiple of 60 cycles within the range of its control. Simultaneously the spike is passed through another differentiator (a 500-$\mu\mu$f capacitor and 2,200-ohm resistor) and fed to the vertical-bar multivibrator to improve its frequency stability.

This circuit is easy to add to the LP-1 and similar equipment. A 7-point terminal strip for mounting the new parts was fastened to the rear skirt of the LP-1 chassis. The .001-μf capacitor connects between a terminal on the strip and pin 1 on the 6J6 horizontal-bar multivibrator socket. A lead runs from the free end of the 500-$\mu\mu$f capacitor on the strip to an unused terminal on a strip near the vertical-bar multivibrator. A 2,200-ohm resistor is connected from this point to ground and the 6-$\mu\mu$f capacitor goes to pin 5 on the vertical-bar multivibrator socket. The 3,300-ohm resistor and rectifier diode connect to one heater pin on the 6X4 rectifier socket.—*John A. Wheaton*

FM TUNING AID

A simple blocking oscillator using an old two-winding TV blocking transformer makes an excellent tuning aid for FM receivers, especially those using a gated-beam (6BN6) detector where an electron-ray type tuning indicator will not work. The blocking oscillator



shown in the diagram generates a rather short pulse with a fairly fast rise time throughout the region of the FM band, and the fundamental frequency of the oscillator, since it lies within the audio spectrum, lends an audible tone to the pulse. To tune in a station "on the nose," press the push-button and tune the receiver in the usual manner to a noise null. Power requirements of the oscillator are comparatively small and in most cases may be obtained directly from the receiver power supply. The output of the oscillator is loosely coupled to the FM antenna input by wrapping a few turns of wire around the lead-in.

Where an appreciable amount of FM servicing is done this unit can be built into a small box using a selenium rectifier supply and small heater transformer.—*Warren J. Smith* END

Technicians' News

NATESA CONVENES

Most important action of the convention of the National Alliance of TV & Electronic Service Associations at its annual convention in September was a declaration of war on "captive service."

To avoid any confusion as to the meaning of the term, captive service was defined as "Services offered to consumers on a fee or no-charge basis by a TV or radio receiver manufacturer, their subsidiaries, agents or segment of a receiver distribution other than the retail merchandiser." No definite plans or campaign tactics were made public, but it was understood that this as well as other "growing industry problems" was one of the causes for the streamlining of the organization that was voted. A 12-man executive council was elected to replace the previous 56-member board of directors, which was too widely scattered and unwieldly for the most effective action.

First act of the new executive council was the appointment of Mr. Frank Moch as executive director. Mr. Moch will devote the larger part of his time to this new post, handling his TV–radio service business largely through subordinates. Mr. Moch's appointment is for a period of two years, with a salary of $12,500 per year, plus expenses. He will be a member of the executive board.

Albert C. W. Saunders of the Saunders School of Television (Boston, Mass.) was reappointed educational director of the organization.

Robert Hester of Kansas City was elected president of the Alliance for the forthcoming year, after a spirited campaign at which the runner-up was Vincent Lutz of St. Louis. F. B. Koepnick of Houston was elected secretary general; C. Nelson Burns of Memphis, treasurer. Regional vice presidents are Robert Kidd, Norfolk, Eastern; Russ Harmon, Cincinnati, East Central; H. O. Eales, Oklahoma City, West Central; Winston Haines, Burlingame, (Calif.). Western. Secretaries are Pascal P. Pratt, Buffalo, Eastern; Joe Driscoll, St. Paul, West Central; Harold Stein, Denver, Western.

A new comprehensive insurance plan was adopted. Essentially a group insurance and indemnity plan, it will protect members and their employees when the need for payment of hospital and surgical expenses arises. The plan also provides for such future protection as retirement income and life insurance. It was specifically tailored for NATESA by insurance consultants in Cincinnati.

Friends of Service Management awards were voted on a continuing basis to Howard Sams, P. R. Mallory, Sylvania Electric Products, Sprague Products and *Technician* Magazine. First-time winners were *Service Dealer* magazine and the CBS tube division. Due to "the present unsettled conditions" regarding service business, no award was voted in the TV set manufacturing division, according to the executive council of the service organization.

T.E.A. CONVENES

The Texas Electronics Association held its fourth annual clinic and fair Aug. 24, 25 and 26. Over 500 service technicians attended the sessions, which were held in the Rice Hotel at Houston. The interest shown was indicated by the fact that some of the sessions commenced at 8 am (after a 7:10 am breakfast) with a coffee break from 9 to 9:45, after which the session reopened till 11:15. Subjects discussed ranged from color and hi-fi through transistors and modules to automation. Some of the best speakers ever to appear before a state service technicians' convention addressed the meetings. Among them were Dr. Allen B. Du Mont, John Rider, Dorman Israel of Emerson, James Lansing of James Lansing Sound and W. L. Parkinson of General Electric. It was at this meeting that Parkinson announced General Electric's plans to go into the TV service field. Past President Forrest Baker also reported on the newly formed American Electronics Council.

The program was so arranged that exhibits and lectures did not find themselves in competition, as has unfortunately been the case in some service conferences. In addition, a special program offered the ladies interesting activities for part of each of the three days of the convention.

AEC APPOINTS SECRETARY

The American Electronic Council has set up its national office at 822 Central Building, Wichita, Kans., reports its president, Forrest Baker.

C. D. (Jack) Hughes was appointed executive secretary. Mr. Hughes has served as executive secretary for the Wichita Appliance Dealers Association and the Kansas Appliance Dealers Association for the past four years, is the author of the recently published

book *How to Organize and Operate a Small Association* and has been active in the promotion of the National Appliance, Radio & TV Dealers Association.

G-E's SERVICE PLAN

Further information on the General Electric factory service scheme was revealed by Wm. L. Parkinson of the G-E appliance and TV receiver division, in an interview about two weeks after the initial announcement at the Houston convention of the Texas Electronic Association.

Mr. Parkinson, as reported by *Television Digest*, believed that G-E would be able to start factory servicing in three test cities by Nov. 1. "Ideally," he stated, "we would then like to wait about six months before entering other markets. However . . . we are getting cross-pressures. Independent servicemen are trying to get us to hold off; our own independent distributors are urging us to move quickly in their markets."

Parkinson also pointed out that G-E intended to franchise independent service organizations as factory service stations wherever advisable. "I did not mention that in my Texas speech," he stated, "so it hasn't been reported, but just because we're setting up factory service branches in some markets doesn't mean we're sending out a crew from the factory. Where we can find a strong independent, we'll franchise him as our branch. . . . We don't want to replace any independent serviceman or take any business away from him. We're out to lend stability to the service business, to cut down on complaints we've been getting about servicing—and believe me, they are enormous! Frankly, we have a great deal of respect for the competence of the average serviceman—but we also must face the fact that a very high percentage of them are unqualified. They, and only they, figure to be hurt by our program."

NEW SERVICE PAPER

We have received Vol. 1, No. 1 of *The Raster*, a publication of the Electronic Service Council of the Ozarks. ESCO is composed of three organizations in southern Missouri, TESA of Southwest Missouri, TESA of the Ozarks and TESA–South Central Missouri. *The Raster* will be published monthly and sent to all electronic technicians in southern Missouri.

The 10-page paper is larger than the usual run of service publications and is *printed* on excellent glossy stock. Contents include editorial matter and local advertising. A technical article (on a slave substitution unit) appears as well as a number of short kinks. The news includes the TESA–MO state meeting and a new association in southeast Missouri, a column of personals and two letters to the editor. The new paper seems to be off to a good start and well on the way to becoming a strong influence in four states. END

new Tubes Transistors

Returning to normalcy after several months of heavy output in new tube and transistor releases, this month's announcements include a new beam power tube, an interesting plug-in selenium rectifier, a damper for series heater strings, an audio output transistor for auto radios and an ingenious *Wamoscope*.

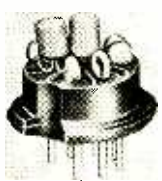
6DG6

A beam power tube of the glass octal type, the 6DG6, announced by RCA, is designed primarily for use as an output tube in audio amplifiers. The tube has a 6.3-volt 1.2-ampere heater and a maximum peak heater–cathode voltage of ± 90 volts, but otherwise is like the 25L6-GT. It has high power sensitivity and high efficiency at relatively low plate and grid-2 voltages.

In typical operation as a class-A_1 amplifier, plate voltage is 200; grid-2 voltage, 125; cathode resistor, 180 ohms; peak af grid-1 voltage, 8.5; zero-signal plate current, 46 ma; maximum-signal plate current, 47 ma; zero-signal grid-2 current, 2.2 ma; maximum-signal grid-2 current, 8.5 ma; plate resistance (approximately), 28,000 ohms; transconductance, 8,000 μmhos; load resistance, 4,000 ohms; total harmonic distortion, 10%; maximum-signal power output, 3.8 watts. Maximum plate dissipation is 10 watts; maximum grid-2 input is 1.25 watts.

Selenium plug-in diode

A small, compact plug-in selenium rectifier, the 60-7788 has been especially designed by International Rectifier Corp. to replace the 6AL5 tube in many TV sync discriminator circuits. These subminiature units offer advantages



over the 6AL5 tube since they are much smaller. They also do not require any heater power, thereby offering a higher reliability factor than the conventional vacuum tube.

This unit (see photo) consists of two

International 1U1 selenium diodes, mounted and soldered to a plug that fits a seven-pin miniature tube socket. Each diode is designed to deliver 20 volts dc at 1.5 ma for an rms voltage input of 26 maximum and may be operated through an ambient temperature range of − 50°C to 100°C. The diodes are completely encapsulated within a thermosetting plastic to protect them from moisture, corrosive atmosphere and fungi.

In addition to their application as horizontal sync phase discriminators in television receivers, these diodes are ideal components for bias supplies, power supplies for sensitive relays, in computors and in many other circuits.

19AU4

Another RCA announcement is the 19AU4, a half-wave vacuum rectifier tube of the glass octal type. It is particularly suited for use as a damper diode in the horizontal deflection circuits of black-and-white television receivers using series heater strings.

Rated to withstand a maximum peak inverse plate voltage of 4,500, the 19AU4 can supply a maximum peak plate current of 1,050 ma and a maximum dc plate current of 175 ma. Designed with insulation between heater and cathode to withstand negative peak pulses between them of as much as 4,500 volts with a dc component up to 900 volts, the 19AU4 permits flexibility in choice of deflection circuits.

The heater requirements of the 19AU4 are 18.9 volts and 600 ma. Maximum seated length is 3¼ inches and base connections are the same as the 6AU4GT. Maximum plate dissipation is 6 watts.

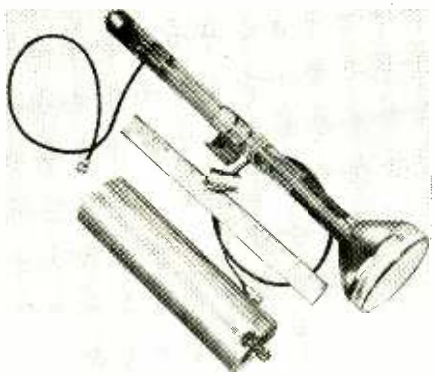
2N242

A hermetically sealed power transistor for automobile radios has been announced by Sylvania. Designated as type 2N242, the unit is a p-n-p alloy junction germanium transistor designed for the audio output stage and other applications. In mounting, the collector is grounded to the chassis.

Maximum ratings for the 2N242 at 25°C are: collector-to-base voltage, − 45; collector-to-emitter voltage, − 45; collector current, steady state, − 2 amps. Operating at 12 volts, the 2N242 provides 2.5 watts of class-A output with less than 5% harmonic distortion.

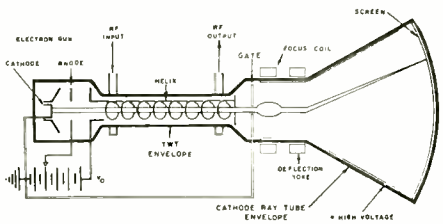
6762 Wamoscope

A radically new type of cathode-ray tube for radar, microwave television and other electronic display applications has been announced by Sylvania. Developed in cooperation with the Naval Research Laboratory, the 6762, dubbed the Wamoscope (wave-modulated oscilloscope), combines the essential functions of a microwave receiving set in a single tube envelope, eliminating many of the tubes and components



required by conventional microwave receivers. (See photo and drawing.)

Microwave signals go directly from the antenna into the tube, where they are amplified, detected and displayed on the tube's fluorescent screen. The 6762 is about 20 inches long and has a 5-inch diameter screen. The solenoid



shown fits over the traveling-wave tube section to focus it and over the tube's rf transducers Operation is in the frequency range of 2000-4000 mc. END

Thirty-Five Years Ago

In Gernsback Publications

HUGO GERNSBACK, *Founder*

Modern Electric	1908
Wireless Association of America	1908
Electrical Experimenter	1913
Radio News	1919
Science & Invention	1920
Television	1927
Radio-Craft	1929
Short-Wave Craft	1930
Television News	1931

Some larger libraries still have copies of ELECTRICAL EXPERIMENTER on file for interested readers.

In November, 1922, *Science and Invention* (formerly *Electrical Experimenter*)

World-Time Clock for Radio Stations, by Dr. Alfred Gradenwitz.
The Simplest Radio Outfit Contest, by E. S. Gunn. Sixth Prize Winner.
Glass Bottle Regenerative Receiver, by T. H. Halstead.
Radio Aerial Pole, by Henry Frey.
Practical Data on Radio-Frequency Amplification, by Robert E. Lacault.

Question Box

5-STATION INTERCOM SET

Kindly publish a diagram of a master intercom unit with four remote stations. The remote stations should be able to call the master but not each other. Please show a switching arrangement which will permit the master to make simultaneous announcements to all of the remote stations.—C. T., Denton, Md.

The diagram at *a* is the schematic of a suitable master amplifier for an intercom system. You can substitute almost any equivalent audio amplifier circuit. Naturally, the output transformer should match the power amplifier tube (s) to the 4-8-ohm speaker. T1 may be a special intercom input transformer designed to match a voice coil to a grid or it may be a small output transformer with its primary connected to the grid of the input stage.

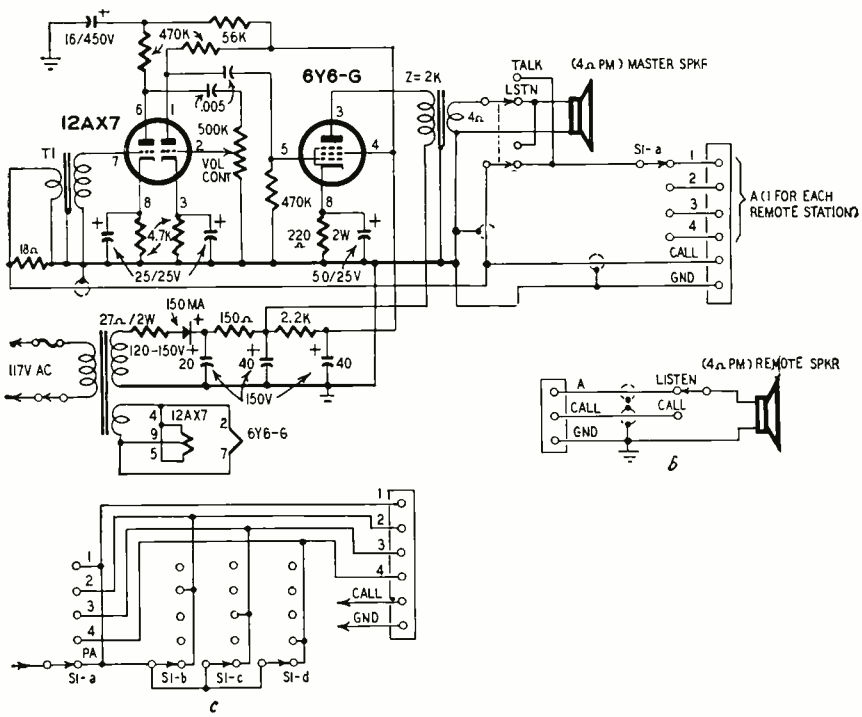
The diagram at *b* shows the wiring of each of the remote stations. The master is designed for four remotes. You can use as many as you want as long as the selector switch S1-a has one position for each remote. The TALK-LISTEN switch on the master is a spring-return type dpdt lever switch wired so it is normally in the LISTEN position. Single-pole double-throw lever switches are used on each remote. These switches are spring-return types wired so they return to the LISTEN position.

To use the master as a PA unit to call all stations, the selector switch must have *one more* position than there are remote stations. In addition, it should have the same number of circuits (decks or wafers) as there are remotes.

The drawing at *c* shows the wiring of the selector switch with the PA position added. S1-a is the same in diagrams *a* and *c*.

The necessity for shielding depends on the gain of the amplifier and on the layout of parts. It may be necessary to use shielded leads in the CALL and LISTEN circuits, but it is not advisable to install shielded cables until tests show it to be necessary.

Speakers with voice coils of around 4 ohms are satisfactory for many installations. But, we recommend 45-ohm types with matching input and output transformers if the average distance from the master to remote is more than 75 feet or so. This minimizes power loss.



SPEAKER BAFFLE LINERS

I'm constructing a speaker enclosure. The instructions recommend lining the inside with Kimsul, Ozite or Fiberglas bats. Please describe these materials and tell me where they can be purchased.—N. J. S., Blowing Rock, N. C.

Ozite is the trade name of a material used as cushioning for rugs and carpets. It is generally available at rug and carpet dealers.

Fiberglas bats are widely used for insulating hot-cold food containers, hot-air heating ducts, as weatherstripping and for inserting under automobile hoods to minimize engine noise. It is easily glued, stapled or tacked to most surfaces and is readily available in thicknesses of 1 and 2 inches. You can get it at hardware stores, building supply houses and auto accessory stores. Mail-order houses such as Sears Roebuck sell rolls of 1-inch thick Fiberglas insulation 3 feet wide and 8 feet long for less than $2.

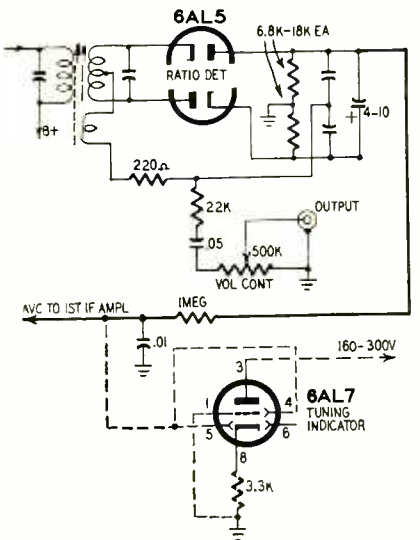
Kimsul is an insulation widely used in the building trades. It consists of a 1-, 1½- or 2-inch-thick blanket of many thin layers of cellulose fiber stitched to a soft fiberboard binder. It comes in rolls 16 and 24 inches wide, containing 100 and 200 square feet. Cost is less than 10 cents per square foot at most building supply houses.

Ozite and Fiberglas bats are preferable because they can be obtained in smaller quantities.

FM TUNING INDICATOR

I have a Meissner model 8C FM tuner. Please show how a tuning indicator can be added to it.—R. P., Mountain Lakes, N. J.

The diagram shows how a 6AL7 tuning indicator can be connected to the tuner. The avc system (shown in heavy lines) is used as a source of control voltage for the tuning indicator.



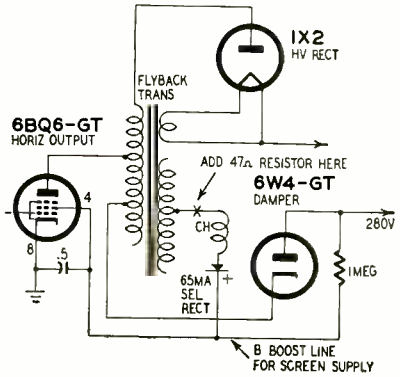
Automatic volume control is not used in all 8C tuners. If yours lacks this feature, you can add it at the same time that the indicator is being installed. Simply lift the first if amplifier grid return from ground and connect it to the avc line. The dashed lines show the connections for the tuning indicator.

The Question Box of the February, 1956, issue describes two vtvm type circuits with neon lamps used as indicators. END

Technotes

SETCHELL CARLSON 151

Double trouble developed in the novel screen supply to this receiver. The circuit (see diagram) uses a selenium rectifier in a simple B-boost circuit to increase the voltage to the screen of the horizontal output tube.



A vertical dark space, that could be varied both in width and darkness by the drive control, was the first symptom that developed. It occupied the middle third of the screen and had the appearance of a vertical hum bar, with smaller vertical bars within it.

Measurements indicated the high voltage and the output tube screen voltage were low. Replacing the horizontal oscillator and output tubes did not help. Finally, bridging the screen bypass capacitor with a similar unit increased screen brightness and provided normal performance.

A month later I had a callback with a complaint of insufficient brightness. Again the output tube screen voltage measured low; replacing the selenium rectifier cured the trouble. A month later the trouble recurred and again the rectifier was defective. This time terminal 5 of the flyback was opened and a 47-ohm 2-watt resistor inserted to limit surge current through the rectifier. The choke apparently did not do too good a job of surge limiting since it was supplanted by a resistor in later models.—*Alfred Roberts*

ZENITH 5L42 RADIO

After the second set of tubes went bad within a few days, the customer was understandably irate. The trouble was due to a partially shorted .001-μf capacitor acting as a tone compensator in the plate circuit of the audio output tube, a 3V4. The leak permitted B plus to flow through the output transformer to this capacitor, through it to the A-plus side of the series tube filament string and thence to A minus, mostly

by way of the tube filaments, overheating these tubes. Such filament type tubes are very sensitive to overvoltage and only a small amount of excess voltage will do them in very quickly. Not enough of a short was present in the capacitor to kill the sound, but enough leakage was present to kill the tubes!—*Eugene Rollins*

WIDTH INCREASE

Increased capacitance from the plate of the horizontal output tube to the chassis or B minus will increase the width of the raster.

The maximum that may be obtained by this method is about 2 inches on a 21-inch tube—often sufficient. The more added capacitance, the more the width, running about ¾ inch for 10 $\mu\mu$f with a maximum of 25 $\mu\mu$f. More than this value will lower the high voltage, and the integrating action will prolong the retrace period (horizontal) so that it may not occur within the blanking time.

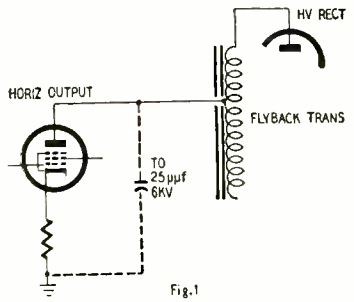


Fig. 1

Fig. 1 shows the idea. The capacitor is connected from the cap of the output tube to chassis or B minus (to whichever the cathode resistor returns). The capacitor must have a rating of at least 5 kv and preferably more. It may be connected across the lower half of the flyback in some cases, making it unnecessary to remove the chassis.

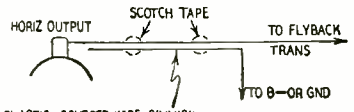


Fig. 2

Fig. 2 shows how the width may be stretched about ½ inch. A piece of insulated wire is taped (with Scotch tape) to the high-voltage wire (plate lead) running to the cap of the horizontal output tube. The free end of the wire goes to chassis or B minus as before. The insulation forms the dielectric of the capacitor. Or the wire may be coiled around the lead to the tube cap. —*James A. McRoberts*

PORTABLE RADIOS

The line plugs used on some RCA and other three-way portables are polarized so one side of the line cord completes a circuit to one side of the on-off switch when the set is used on batteries.

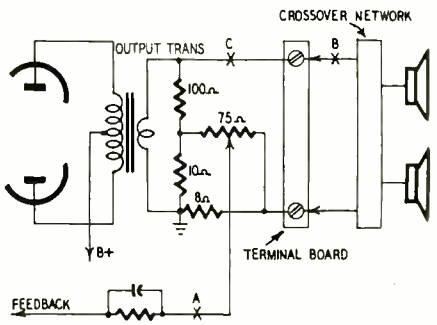
If the set does not work on batteries, check the line plug. I have found several instances where the original plugs have been replaced or reconnected incorrectly.—*J. V. Cavasenno*

ZENITH 6C05 RADIO

Complaints of this receiver overloading on strong stations were traced to the dial pointer rubbing against the dial, shorting out the ave line. After several callbacks the trouble was cured by placing a layer of Scotch tape between the dial and pointer. The dial is cardboard, but the metal paint used is a very good conductor.—*G. P. Oberto*

VARIABLE DAMPING DETECTION

Recently I have seen two amplifiers (one of them my own) turn into radio receivers after the addition of variable damping circuits in the output. This puts various resistances in series-parallel with the crossover network, as well as with the feedback, which can result in some very queer reactances and may cause detector action. In both



cases, the speakers were mounted at some distance from the amplifiers: one with shielded, one with unshielded wire.

When a background of radio programs was heard constantly, even though the tuner was switched off, checking demonstrated that unplugging the speakers also killed the unwanted radio programs.

This suggested the very simple remedy: a small (about 2.5-mh) rf choke was put in the speaker leads and everything returned to normal. I prefer inserting at A but points B and C are effective.—*R. C. Sandison*

VIDEO OVERLOAD

The symptoms on a Stewart Warner model 9120 were poor contrast and unstable sync. Checking from the front end showed everything OK up to the grid of the first video amplifier. Here there was a very high—nearly cutoff—bias. Since direct coupling is used between this grid and the video detector, I checked for an excessive if signal being rectified. The reason for the high if was insufficient age voltage.

I checked the keyed age circuit and replaced the if tubes before I discovered that the feedback pulse to the keyer plate measured a little low—300 volts as compared to a normal 450. All tubes in the horizontal circuit were tested and the drive varied. I finally noted a 6-megohm leakage between the tightly coupled pickup coil and width coil. Replacing this unit restored age action and improved the picture.—*Charles G. Buscombe*

END

Patents

ANIMATED ELECTRIC TOY
Patent No. 2,752,730

George R. Bellett, Venice, and Donald C. Porter, Bakersfield, Calif. (Assigned to Donald C. Porter, Arcadia, Calif.)

Powered by a voltaic cell using the acid of a lemon, grapefruit or apple, this animated toy can wag a tail, wiggle ears, etc. Fig. 1 shows a toy dog designed to hold a lemon "power supply." Its tail wags until the fruit acid is used up, possibly several days.

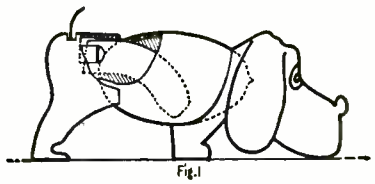


Fig. 1

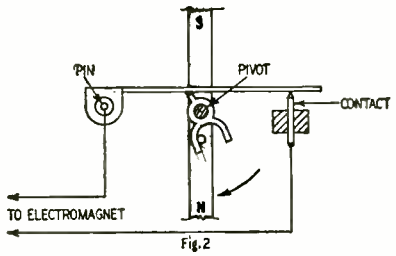


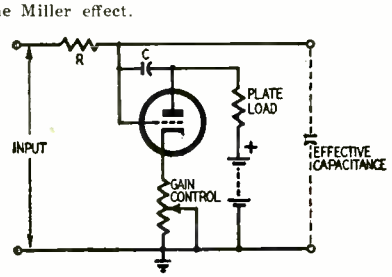
Fig. 2

The lemon is slit so that blotting paper draws up the acid. The paper is placed between zinc and copper electrodes to form an electrical cell sufficiently powerful to energize an electromagnet. Also, a flat bar magnet (Fig. 2) is camouflaged and decorated to make its upper end look like a tail. When the electromagnet is de-energized, the bar magnet remains vertical, as shown. When voltage is applied from the acid cell, the N pole is repelled to the left, as shown by the arrow. This lifts a silver leaf spring to break a contact and interrupt current to the electromagnet. Therefore the magnet swings back and the contact is remade.

TIME-CONSTANT AMPLIFIER
Patent No. 2,743,358

Neil E. Handel, Wrentham, Mass. (Assigned to Foxboro Co., Foxboro, Mass.)

The time constant of an R-C network (its product in ohms and farads) equals the time (in seconds) required for the network to charge to 63% of its final value. A large time constant, say 10 minutes, is difficult to attain because of the very large capacitor and resistor that must be used. However, it is easily accomplished by the Miller effect.



When a tube operates as an amplifier its effective input capacitance is greater than its actual capacitance when the tube is cold. The increase varies with gain. Approximately, the effective capacitance equals the gain multiplied

by the plate–grid capacitance. This is the Miller effect.

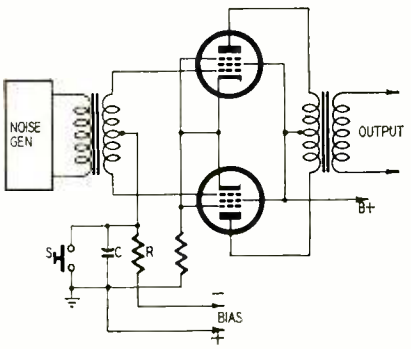
A recommended circuit is shown. If C is 12 μf and stage gain is 30, the effective input capacitance (dashed lines) will equal 360 μf. If R is 10 megohms, the time constant is 1 hour (3,600 seconds).

SOUND EFFECTS DEVICE

Patent No. 2,751,585

Jarrett L. Hathaway, Manhasset, N. Y.; Raymond E. Lafferty, Fairlawn, N. J. (Assigned to RCA)

Noises like thunder, gunshots and the crashing of waves contain a confused mixture of frequencies over a wide band. Except for their duration and rate of decay, there is not too much difference between them. This device utilizes a noise generator to simulate many sounds. The noise is gated (as to duration and decay) to produce required sounds.



The figure shows an amplifier normally blocked by a negative bias supply. When the pushbutton switch S is depressed, the grids are grounded through the transformer center tap. The amplifier now transmits the noise signal. When S is released, the bias supply charges C through R. The noise gradually dies out. Eventually the capacitor charge blocks the tubes completely.

(Continued)

This amplifier may be controlled to produce realistic gunshot sounds, for example. Blank cartridges are not reliable for this purpose because their sound output is not uniform. Here the sound of the blank cartridge is picked up and amplified. It triggers an electronic switch (instead of S). A realistic gun noise requires closure of the switch circuit for about 10 milliseconds. The decay time (controlled by R and C) should be about ¼ second, after which the amplifier should block again.

TRANS-ATLANTIC RADIO RELAY

Patent No. 2,748,266

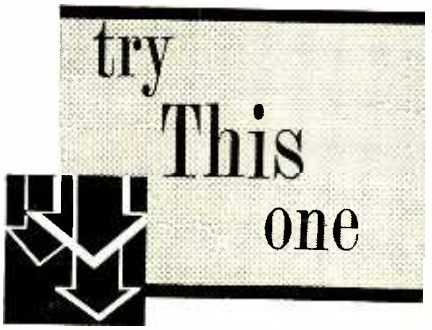
Richard C. Royd, Summit, N. J. (Assigned to Bell Telephone Labs., Inc.)

This calls for hourly flights of Stratocruisers flying at 11,000 feet. They would carry a pay load of up to 5 tons in addition to the necessary microwave relay equipment. Flying at intervals of 200 miles along the route between New York and London, they could relay TV and telephone signals on a carrier of approximately 6000 mc.

Each plane would receive signals on one frequency and transmit them on another (both near 6000 mc) to eliminate possibility of interference. However, the first and last plane in each relay line would utilize one of two special "shore" frequencies when within 200 miles from shore. This is done to prevent the need for each terminal station to change frequency every hour as a plane enters or leaves the relay line.

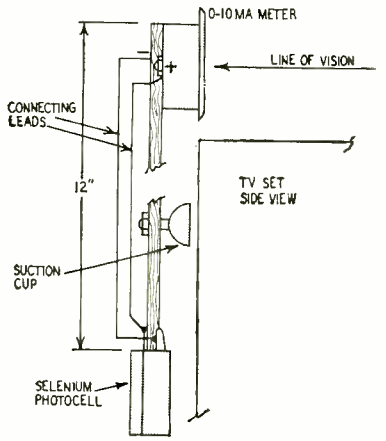
Should any plane develop trouble that requires it to leave the line, it would signal the planes ahead and behind it. These planes would immediately change speed so as to maintain a distance of 267 miles, rather than 200 miles. This closes the gap, with four planes covering the distance normally requiring five planes. This would create a problem of frequency, with two planes sending and receiving on the same single frequency. To avoid this, the planes filling the gap would switch to one of the "shore" frequencies to link them.

END



TV SERVICING AID

I find a self-generating photocell and a 10-ma meter make a useful aid when adjusting ion-trap magnets (beam benders) without pulling TV chassis. The meter and photocell are mounted on opposite ends of a 12-inch supporting rod or strip with a suction cup to hold the assembly so the meter projects above the cabinet and the photocell is in front of the picture tube as shown in the drawing. The meter and cell are wired in series and polarized so the meter reading increases as the raster gets brighter. I used an International Rectifier Corp. type A-15 selenium cell but any similar type with high output will do.—*Robert P. Kraig*



TIMING TAPE RECORDERS

Maintaining correct speed of tape machines is a point often overlooked by home recordists. The oversight is justified, however, because the recordist seldom—if ever—has occasion to play his tapes on any machine except his own. Hence, no variation in pitch or tempo is detectable. If he buys a new recorder or makes tapes for use on other machines, he is likely to be dismayed to find the original tapes either too fast or too slow. The same applies in the reproduction of commercial prerecorded tapes.

Here is a simple method of determining the actual operating speed of a recorder: Use a piece of blank tape carefully measured and cut to a length five times the rated speed of your recorder, adding an extra ¼ inch for splicing purposes. (For instance, a 7½-ips recorder requires a total length of 37¾ inches.) Make sure both ends are square. Overlap the ends of this strip ¼ inch, make a diagonal cut and splice in the usual manner.

TRY THIS ONE *(Continued)*

Thread this loop into the recorder so that it can run continuously without obstruction. Switch to MICROPHONE–RECORD, turn recording gain about half open and thump the microphone once with your finger. Stop the recorder immediately so that this thump will not be erased when the loop begins to repeat its run.

Now set the recorder in playback position. Synchronize a stop watch or the second hand of your wrist watch with the first thump and count the total number occurring within a 120-second interval. This count, divided by a factor X (shown in table) gives the actual operating speed of your recorder.

$$\text{Actual speed} = \frac{\text{Thumps in 120 sec}}{X}$$

X	Rated speed of recorder (ips)
1.6	15
3.2	7.5
6.4	3.75
12.8	1.875

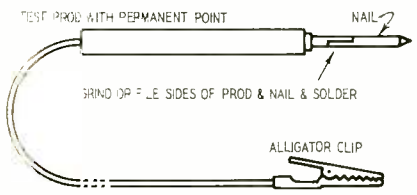
If the recorder is running true, you should count 24 thumps. Assuming a rated speed of 7.5 ips, a count of 23 would indicate an actual speed of 7.19 ips. A count of 25 would indicate 7.81 ips. Both these figures represent an approximate 5% deviation from the ideal—which means that musical pitch is raised or lowered by less than a half tone. To many people this is hardly detectable, if reproduction is from a prerecorded tape. However a critical listener might be disturbed by this slight change of pitch and tempo. If your recorder deviates as much as 2 counts per 120 seconds, this represents an approximate 10% error, which is serious.

If a timing loop isn't long enough to clear all obstructions on the recorder, it may be made twice the ordinary length (but do *not* double the extra ¼ inch added for splicing). In this case divide the factor X by 2 for determining actual speed.—*Norman V. Becker*

(If you are interested only in measuring 15- and 7½-ips tapes, the tape may be made 60 inches long. Then a 15-ips tape will give 30 thumps and a 7½-inch one 15 thumps each 120-second period. X then is equal to 2 in each case.—*Editor*)

HIGH-VOLTAGE DISCHARGER

An efficient device for discharging the stored-up potential from the high-voltage section of a television set can be made from an old test prod, a nail and an alligator clip.



If the test prod is of the replaceable-tip type, it is a simple matter to replace the original tip with a 1½- or 2-inch

TRY THIS ONE *(Continued)*

nail (with head removed, of course). If the tip is not removable, simply solder a nail to it. See drawing. An alligator clip is attached to the other end to complete the device.

The discharger is simple to use. First, fasten the alligator clip to any point on the TV chassis as in the photo. Then, with the test prod, ground the high-voltage lead at the point where it fastens to the picture tube. The length of nail may be pushed under the rubber cup (if present), thus contacting the picture-tube button. If the set uses a voltage-doubler circuit, discharge both capacitors as an added precaution. —*Carleton A. Phillips*

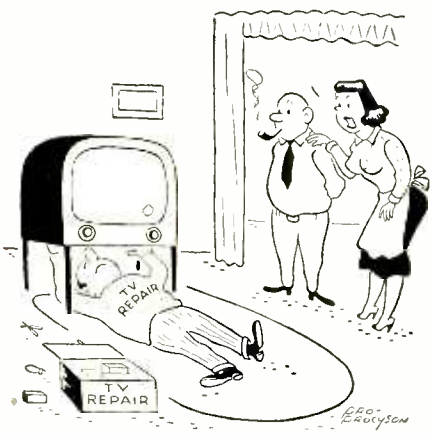
MERCHANDISING IDEA

Each time we receive a premium for a volume purchase of tubes, parts or appliances, we put it to work as a merchandising tool instead of appropriating it for our personal use.

For example, if we receive an extra electric iron with a quantity purchase, a sheet of paper is numbered with the total number of irons purchased in the lot. Each customer purchasing a major appliance or traffic item around the cost of the iron has his name and address entered opposite one of the numbers. When all numbers are taken, a non-competing customer draws the winning number from a box.

Winners are notified by mail and, if we have more than one premium, the contest is repeated. Thus, we boost sales and service at no cost to us.—*Henry Josephs*

END



"Of course he's reliable—he was an auto mechanic for 20 years!"

People

Wilfred L. Larson (top left photo), Switchcraft, was elected president of the newly renamed Electronic Industry Show Corp. at its annual meeting in the Virgin Islands. Jerome Kirshbaum (top right), Precision Apparatus Co., was elected vice president; William J. Moreland (bottom left), Conrac, Inc., was

elected secretary and J. A. Milling (bottom right), Howard W. Sams & Co., Inc., treasurer. The corporation, formerly known as Radio Parts and Electronic Equipment Shows, Inc., manages the annual Electronic Parts Distributors Show in Chicago in May.

Norman L. Harvey, chief engineer of the Sylvania Radio & TV Division, was appointed operations manager–tubes for the tube activities of Sylvania's Electronics Division at Woburn, Mass.

Herman J. Schorle joined Pyramid Electric Co., North Bergen, N. J., as director of manufacturing. He comes to the company from Micamold Electronics Manufacturing Corp.

Harold C. Mattes was elected vice president in charge of the Private Label Division of Hallicrafters, Chicago, following the purchase of the Raytheon Co., TV and radio tools, dies and other equipment, from Admiral Corp. Mattes, a pioneer in the manufacture of consumer radio, was a co-founder of Belmont

Radio Corp. in 1928 and served as its first president. He became vice president and then president of the Raytheon Radio & TV Division when it absorbed Belmont. **L. C. Obrien, Allen Henry, Richard Marholz** and **Melvin Moore,** also former Raytheon executives, join Mattes in the move to Hallicrafters.

John M. Spooner, manager of the RCA TV picture tube servicing plant in Sellersville, Pa., was named manager of the Findlay, Ohio, plant of the Components Division.

Neal W. Turner, chief audio engineer of the Heath Co., Benton Harbor, Mich., was promoted to merchandising manager. He will handle merchandising for the complete Heathkit line of electronic kits for home and industry.

William G. Tuscany will head sales of the newly created Semiconductor Section of Centralab, a division of Globe-Union, Milwaukee, Wis. **Earl Clemick,** who has been with the company for the last four years, succeeds him as head of packaged electronic circuits sales.

Thomas O. Moore joined the ORRadio Industries, Opelika, Ala., as chief electronic engineer after a tour of duty in Washington, D.C. working on the Navy's new atomic submarines.

Obituary

Col. Herbert H. Frost, a pioneer in the radio equipment manufacturing industry, recently, in Washington, D. C., after a long illness. Colonel Frost was first president of RMA (now RETMA). Colonel Frost was probably best known to experimenters for the famous Frost phones and to the trade as West Coast manager of E. T. Cunningham, whose tubes were one of the two standard brands of the 'Twenties.

Personnel Notes

. . . **Peter Weil** was promoted to assistant manager of the Technical Products Division of Allen B. Du Mont Labs., Clifton, N. J. He had been assistant to the division manager.

Correction

The name of **Mike Remund,** recently appointed vice president in charge of sales of Jensen Industries, Forest Park, Ill., was incorrectly spelled "Redmund" in October's RADIO ELECTRONICS. END

Business

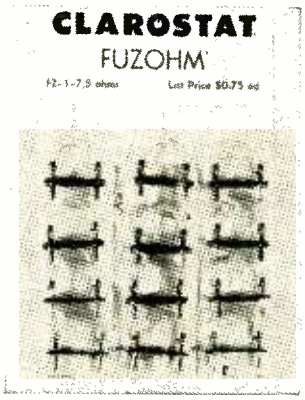
Merchandising and Promotion

Raytheon Manufacturing Co., Receiving and Cathode-Ray Tube Operations, Newton, Mass., launched a new promotion campaign to back up its Bonded Dealer program. The campaign includes a group of specially designed items, window display cards, streamers,

and the new Bonded Dealer Creed display. National advertising will also be used to support the program. The photo shows E. I. Montague (right), advertising and promotion manager of Raytheon's distributor tube sales staff, explaining the new material to Edward Fisher, Brookline, Mass., service technician.

Sylvania Electric Products, New York, has released a new film strip "Make Way for Color" to aid distributors and dealers in selling and servicing color TV.

Clarostat Manufacturing Co., Dover, N. H., is marketing its Fuzohm fuse-



type resistors on a wall display card which accommodates 12 units.

ORRadio Industries, Opelika, Ala., has scheduled the biggest advertising program in its history this fall and winter to promote its Irish Brand magnetic recording tape. Consumer and

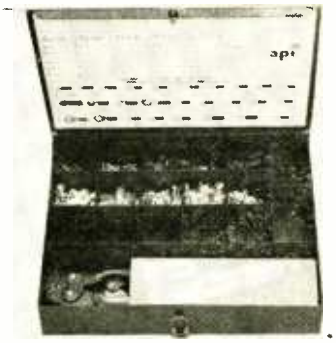
trade publications and, for the first time, FM radio, will be used. The campaign will feature F. R. O'Sheen, the Irish leprechaun used as a trademark.

Dynamics - Electronics - New York, Forest Hills, N. Y., is merchandising its complete line of 60 service aids, accessories, components, etc., on a self-service counter or wall rack on which

any 12 of these items may be displayed.

Rockbar Corp., Mamaroneck, N. Y., is pushing an advertising campaign to sell its English-made Collaro record changers to the mass market as opposed to concentrating on the hi-fi field. Class consumer magazines will be used.

American Pancor, Inc., Havertown, Pa., designed a new portable, metal, partitioned repair kit for its A-MP terminals, connectors and its Champ or Super Champ hand tool for crimping, cutting, stripping, etc.



Electro-Voice, Inc., Buchanan, Mich., is putting its promotion show "on the road." The Electro-Voice motor caravan is taking five tons of hi-fi equipment valued at $20,000 on a nation-wide tour which will end next May in Detroit. The "road show," in addition to participating in 23 hi-fi shows, will present the Electro-Voice story to as many as 150 people at a time with a maximum turnout of a thousand per day expected.

Winegard Co., Burlington, Iowa, is under way on a large national advertising campaign to introduce its 1957 line of outdoor antennas featuring Umbrella-Ease installation. The antennas are aluminum anodized in colors. The

color theme is carried through to the cartons which may be used for point-of-sale merchandising and promotion.

Merit Coil & Transformer Corp., Chicago, is planning a stepped-up advertising and promotion campaign for the coming year. A new 20-page catalog and 128-page *All-Industry TV Repl Guide* are included. Photo shows Arnold

Litteken (left), Merit sales manager, explaining the company's manufacturing facilities and techniques to Jim Cody of Cody Advertising, the company's newly appointed advertising agency, which is handling the campaign.

Federal Electronics Sales, Rockville Centre, N. Y., is merchandising its new hi-fi record-conditioning cloth treated with K-400 Kayonite antistatic chem-

ical, in a new display carton containing 12 cloths individually packed in a black-and-gold polystyrene case. END

technical Literature

PARTS

The 1956 spring and summer issue of *Pocket Control Guide (No. 4)*, a 96-page cross-reference guide of radio, television and audio replacement controls, is 3¾ x 8½ inches for easy use in pocket or repair kit.

Centralab Distributors, or Centralab, Div. of Globe Union, Inc., 900 E. Keefe Ave., Milwaukee 1, Wis. 20c.

RADIO–TV SERVICE AIDS

Catalog 157 offers 80 pages of radio–television service aids, among them new products such as G-C Klipzon self-holding prods and connectors, printed-circuit repair kits and phono drive kits.

Parts distributors, or General Cement Mfg. Co. (Div. of Textron, Inc.), 919 Taylor Ave., Rockford, Ill.

TV PICTURE TUBES

A new edition of Quick Selection Guide for Television Picture Tubes *(ETD-1001C)* aids the designer in his selection of the proper tube from the large number of types on the market. 211 tubes are classified by size, bulb structure and deflection angle. Whether a tube is aluminized, external conductive coating capacitance, type of ion-trap magnet, face, style of anode terminal and dimensions are indicated.

G-E Tube Sales, 1 River Road Schenectady 5, N. Y.

SERVICE AIDS

A 1955 catalog, *ETR-589C*, of promotional and service aids to the TV and radio service dealer describes such items as business identification signs, advertising material, package promotion, business aids, service aids and technical publications.

General Electric Tube Distributors.

CAPACITOR MANUAL

The *Sprague TV Replacement Capacitor Manual K-102*, combines in a new format information previously published in separate electrolytic and ceramic manuals. It covers 6,589 TV sets made by 88 companies.

The electrolytic section alphabetically lists each manufacturer. In addition, Sprague replacement capacitors are fully described and cross-referenced to original part numbers.

The ceramic section differs in that, while it contains an alphabetical listing of sets by make, it groups Sprague replacements according to the section in the TV set in which they are used.

Sprague Distributors, or Sprague

OPPORTUNITY ADLETS

Rates—15c per word (including name, address and initials) Minimum ad 10 words. Cash must accompany all ads except those placed by accredited agencies. Discount, 10% for 12 consecutive issues. Misleading or objectionable ads not accepted. Copy for Jan. issue must reach us before Nov. 15, 1956.

RADIO-ELECTRONICS,
154 West 14 St., New York 11, N. Y.

COMPLETE YOUR HIGH SCHOOL at home in spare time with 59-year-old school. Texts furnished. No classes. Diploma. Information booklet free. AMERICAN SCHOOL, Dept. X89, Drexel at 58th, Chicago 37, Ill.

HIGH-FIDELITY SPEAKERS REPAIRED. Amprite Speaker Service, 70 Vesey St., New York 7, N.Y. BA 7-2580.

BUY Surplus transmitters, receivers, radar, electronic equipment. Direct from Government. List $1. Box 1842BS, Hartford 1, Conn.

SPECIAL! New Tripplet 4½ 0-50 Microammeters! Wholesale $14.70, SPECIAL $7.95. 2½-3" PM. speakers $1. Output transformers 35c. FREE LIST. BOX 144, Sweet Home, Oregon.

FOR SALE—Government Surplus Electronics; Radios; Radio Telephones; Supplies—Direct from U. S. Government Depots—List & Procedure $1. BRODY, Box 8-REA, Sunnyside 4, N. Y.

OFFICE AUTOMATION: Prepare for the future with the only home study course instructing application of electronic computers to business clerical operations. Free Information. BUSINESS ELECTRONICS, Programming Branch, Box 3330 Rincon Annex, San Francisco 19, Calif.

WANTED: Electronics men to qualify for Engineering Degrees by comprehensive examination. No courses. Excellent employment opportunities waiting. CRAMWELL INSTITUTE, RE-7, Adams, Mass.

FREE Catalog Business, Personal, Printing. D. M. PRESS, Sebastopol, Calif.

TELEVISION Tuner Repairs. DAN'S TELEVISION LABORATORY, 606 Sunrise Highway, Babylon, N. Y.

RULE OTHERS WITH THOUGHTS. Incredible power. (Details—10c). DELMAR WISDOM, 846-850 Sunnyside Ave., Chicago 40, Ill.

DIAGRAMS FOR REPAIRING RADIOS $1.00. Television $2.00. Give Make, Model. Diagram Service, Box 672-RE, Hartford 1, Conn.

TRANSISTORIZED F-M KIT $9.95 less transistor. EKERADIO, 646 North Fair Oaks, Pasadena, Calif.

WELDERS 110 volts, ⅛" metal $6.95 plus 50c postage. ¼" metal welder $21.95 FOB. Complete, ready to use. ESSAY MFG. CO., Dept. A, Quincy 69, Mass.

TUBES—TV, RADIO, TRANSMITTING, AND SPECIAL PURPOSE TYPES BOUGHT, SOLD AND EXCHANGED. Send details to R. E. Gensler W2LN1. 512 Broadway, N.Y. 12, N.Y.

RUBBER STAMPS, for every purpose, professional one day service, 25c per word, HAWTHORNE CO., Otsego, Mich.

ALL MAKES OF ELECTRICAL INSTRUMENTS AND TESTING equipment repaired. Hazelton Instrument Co., 128 Liberty Street, New York, N.Y.

REPAIR orders printed. Tags, statements, letterheads, envelopes, Samples, prices Free. HOWPRINT, 723-R Eunice, Webster Groves, Mo.

"HYPNOTIZE -with one word -one finger-snap!" (Details—stamp.) HYPNOMASTER, 846-H5 Sunnyside, Chicago 40, Ill.

COMPLETE Television Sets $11.95. JONES TV, 1115 Rambler, Pottstown, Pa.

RECORDERS, Hi-Fi, Tapes, Wholesale prices. Catalogue. KARSTAN, 215 East 88th St., New York 28, N.Y.

DIAL-A-MATIC adding machine. Adds (up to 99,999). Subtracts! $2 Postpaid. M-LEES, Box 6792 (R), San Antonio, Texas.

WANTED: AN/APR 4, other, "APR.", "TS-", "IE", ARC-1, ARC-3, ART-13, BC-348, etc. Microwave Equipment. Everything Surplus. Special tubes. Tec Manuals. Lab Quality Equipment, Meters. Fast Action, Fair Treatment. Top Dollar! Littell, Fairhills Box 26, Dayton 9, Ohio.

PROFESSIONAL Electronic Projects—Organs, Timers, Intercoms, Moisturometers, Counters, etc., $1 each. List Free. PARKS, 101 S.E. 57th, Portland 15, Oregon.

WANT a VERY LOW RESONANCE SPEAKER? Ask your dealer to demonstrate the RACON "hi-compliance", floating cone, foam-suspension loudspeaker, or write for literature and prices to RACON ELECTRIC CO., 1261 Broadway, New York 1, N. Y.

FOR SALE: Used Altec-Lansing 604B 15" duplex hi-fi speaker with crossover net plus 8 cu. ft. ¾" plywood utility reflex enclosure. Excellent condition. $75. Owned by one of RADIO-ELECTRONICS' editors. Convenient buy for someone in N.Y.C.-N.J. area. Box RA-11, RADIO-ELECTRONICS, 154 West 14th Street, New York 11, N. Y.

LONG Playing Records 20 to 50% Discount. Brand-New Factory Fresh Unplayed—All Labels—Send 20c for catalogue to RECORD SALES, 1110 Winbern, Houston 4, Tex.

LEARN WHILE ASLEEP! Details, complete instructions $2. Satisfaction guaranteed. RESEARCH ASSOCIATION, Box 610-H, Omaha, Nebr.

SELL YOUR WAY TO WEALTH!

WANTED—Surplus Military and Commercial Aircraft Electronics: BC-788 . . . I-152 . . . ARN-7 . . . ARC-1 . . . ARC-3 . . . BC-221 . . . RTA-1B . . . ART-13 . . . DY-21 . . . APN-9 . . . transmitters . . . receivers . . . test equipment . . . etc.! WANTED—Electronic Broadcast . . . transmitting . . . receiving . . . Magnetrons Tubes; Broadcast . . . transmitting . . . receiving . . . Magnetrons . . . Klystrons . . . miniature . . . sub-miniature . . . ruggedized . . . etc.! TOP Prices Paid! For Fatest Checks—Sell to Rex! Write or phone description for immediate action. R. L. SANETT, W6REX, 1524 S. Edris Drive, Los Angeles 35, Calif. Phones: REpublic 5-0215 . . . CRestview 1-3856.

MONEY made servicing television sets when using special Build-It-Yourself Trouble shooting tester from old television set. $2. STERLING, 129 West Long Ave., New Castle, Pa.

TAPE RECORDED CODE COURSES. None comparable. Free literature. TAPEDCODE, Box 31, Langhorne, Pa.

DIAGRAMS! Repair Information! Radios—Amplifiers—recorders $1. Televisions $1.50. Give make, model, chassis.—Norelco-Philips & Amperex tubes in stock! TV MILTIE, Box 101EA, Hicksville, N.Y.

TECHNICAL LITERATURE *(Continued)*

Products Co., 81 Marshall St., North Adams, Mass. 10c each.

SAFETY BOOKLET

Conceived for children but of interest to adults, *The Adventures of Grandpa Champ* dramatizes the dangers in home electrical wiring when approached improperly. A Safety Rule List is appended and A-MP's solderless, crimp-attached terminals are mentioned.

Aircraft-Marine Prods., Inc., Harrisburg, Pa.

TRANSISTOR APPLICATION NOTES

A package of brochures, *GP-71*, offers complete specifications on G-E's 17 standard high-performance entertainment type transistors and application notes on transistor audio amplifiers.

Notes are accompanied by design charts for specifying transformers for class-A and -B output stages and many other helpful curves.

Semiconductor Products Dept., General Electric Co., Electronics Park, Syracuse, N. Y.

THERMISTORS

Information on the historical background, operating characteristics, typical applications and engineering data on Veco thermistors and a section on Veco varistors with graphs showing typical curves, are contained in a new edition of *Veco Thermistor Data Book.*

Victory Engineering Corp., Union, N. J. ($1. Free if requested on company letterhead.)

CAPACITORS

Information on subminiature paper capacitors in hermetically sealed tubular metal cans—their performance and applications, MIL-C types cross-referenced with the comparable commercial unit and dimensional drawings—are reported on in *Sangamo Engineering Catalog TS-105A.*

Sangamo Electric Co., Electronics Components Div., Springfield, Ill. END

Books

ELECTRONS, WAVES AND MESSAGES—The Art and Science of Modern Electronics, by John R. Pierce. Hanover House, Garden City, N. Y. 5½ x 8½ inches, 318 pages. $5.

Two things about this book immediately impress the reviewer. First—and most important—the author attempts sincerely and successfully to write for the reader who is interested in electronics but has had no scientific training. Despite a few slips, the job has been done better than in any other work this reviewer has yet seen.

The second salient point is the unheard-of modernity of the book. Practically all authors of "popular" works have started out by reading earlier books on the same subject and have to some extent been trapped by their emphasis and organization. Pierce has struck out on his own trail, and sometimes finds himself 180° out of phase with earlier writers. The second chapter of the book is on the laws of motion and the sixth is titled "Maxwell's Wonderful Equations." The author—probably more familiar with traveling-wave tubes than any other types—considers these and klystrons as important as the popular book writer's time-honored triode and gives them equal or greater space. Microwaves appear more often in explanations and illustration than broadcast-band frequencies.

There are places where the author may take a little too much for granted. The explanation of an oscillator circuit (page 124) is very brief for a neophyte, for example. Yet the weakest parts of this book compare very favorably with the strongest parts of almost any earlier work written with the same purpose and directed at the same audience.—*FS*

ULTRASONIC ENGINEERING—WITH PARTICULAR REFERENCE TO HIGH-POWER APPLICATIONS, by Alan E. Crawford. Butterworths Scientific Publications, London, England. Distributed in U. S. by Academic Press, New York. 344 pages. $8.

A useful correlation of data and material on applications and effects of ultrasonic waves and on methods of applying them to load. Photographs and basic drawings of experimental and practical ultrasonic devices.

THE GENERATION OF ELECTRICITY BY WIND POWER, by E. W. Golding. Philosophical Library, 15 E. 40 St., New York 16, N. Y. 6 x 9 inches, 318 pages. $12

The wind is a fairly common source of power for small electrical generators, especially thoses used to charge a 6-volt battery for radio use. In some Caribbean islands, practically every isolated home has its own wind generator for that purpose and often to supply lighting as well. They are also fairly common on our western plains.

This book devotes three chapters to wind-driven generators and plants, one to the testing of such generators and another to their relative economy. Other chapters discuss the wind's character-

istics, distribution, measurement and other factors pertinent to its utilization. Large wind-driven generators for power, and their utilization in combination with other power sources, are also considered.—*FS*

MAINTAINING HI-FI EQUIPMENT, by Joseph Marshall. Gernsback Library, Inc., New York, N. Y. 5½ x 8½ inches, 223 pages. Hard cover, $5; paper cover, $2.90.

Hi-fi equipment requires specialized and more exacting maintenance than does ordinary audio equipment. That is the reason for this book, written by an authority in the field. This text can aid the hi-fi owner who wishes to do his own servicing as well as the professional technician. It is written in easily understood language and includes many diagrams and scope test patterns.

The book begins with a description of audio test equipment and a review of typical tone circuits, crossovers, inverters and other networks. After a chapter on preliminary diagnosis, the author continues to typical defects and how to locate them. There are three chapters on distortion alone. The reader is shown how to check for balance, ringing, clipping, parasitics and other defects. One feature is that each chapter is complete in itself and requires no cross-reference. This makes it easy to locate information on a specific problem.

As expected, the oscilloscope receives much attention as a test instrument for hi-fi equipment.—*IQ*

INDUSTRIAL ELECTRONICS IN QUESTIONS AND ANSWERS, by Edward J. Buckstein. Frederick Ungar Publishing Co., New York. 197 pages. $3.95.

Prepared for students, radio service technicians and experimenters, questions and answers form an introduction to industrial electronics. Starting with resistance welding, the author progresses smoothly through photoelectricity, thyratrons, time-delay circuits, counters, scalers and test instruments. Basic diagrams and graphs are used wherever necessary.

RADIO PHILATELIA, by Herbert Rosen. Audio Master Corp., New York. 46 pages. $2.

Prepared for experienced philatelists as well as the neophyte and layman, here's a new approach to stamp collecting. It lists over 500 stamps and several hundred postmarks and slogans dedicated to various phases of radio, TV, electronics, telegraphy and telephony. Approximately 225 stamps and 50 postmarks and slogans are illustrated in black-and-white in their original size.

MULTIVIBRATORS, edited by Dr. Alexander Schure. John F. Rider Publisher, New York. 52 pages. 90c.

This introduction to the basic principles of the multivibrator with analysis of typical free-running, one-shot (flip-flop) and bistable (flopover) types is a useful aid to understanding more advanced treatments of the subject.

DIRECTORY

COLOR TELEVISION

Home Study For Technicians

Now Available the MOST COMPLETE, COMPREHENSIVE COLOR TV HOME STUDY COURSE illustrated with BLOCK-A-MATICS

This new seven-lesson HOME STUDY COURSE in COLOR TELEVISION was compiled by Albert C. W. Saunders, internationally noted author-lecturer on Radio and TV Servicing, and is the best course available today. It is just off the press with the latest technical information. Lessons are fully illustrated with simplified diagrams including BLOCK-A-MATICS —*The New Look In Schematics.* Also Color Illustrations.

COMPLETE COURSE—ONLY $25

ALSO AVAILABLE:

Practical Transistor Course for Radio and Electronics Technician by Albert C. W. Saunders. Three lessons *only* *$10*

For Particulars Write

Saunders Electronics Correspondence School

Dept. CT **137 Federal Street, Boston 10, MASS.**

wanted career men

Train for a career instead of a job. Demand for our graduates exceeds supply. *Effective placement.* Modest costs. Small classes. Well-equipped labs. Beautiful campus. *Approved for Vets.* Enter Jan., March, June, Sept.

BACH. SCI. DEGREE IN 27 MONTHS

Complete Radio Eng. courses . . . TV, UHF, FM, Electronics. Also Mech., Civil, Elec., Chem., Aero. Eng. *36-month B.S. in Bus. Adm.* (Gen. Bus., Accig., Motor Transport Mgt.) . . . capable students faster. Prep courses. *Write Jean McCarthy, Director of Admissions, for catalog and "Your Career in Engineering & Commerce."*

TRI-STATE COLLEGE

2416 College Avenue, Angola, Indiana

TOP-FLIGHT

ELECTRONICS

Train for tech. rep., field engineer, electronic specialist on missiles, computers, radar, automation radio, color-TV. Basic and advanced theory and laboratory. Mathematics. Major firms select our graduates. Dormitories-campus. 21 months' program. High school grad. or equivalent. G. I. approved. Start Jan., April, July, Sept. Write for catalog.

VALPARAISO TECHNICAL INSTITUTE

Dept. C Valparaiso, Indiana

TELEVISION

PREPARE FOR A GOOD JOB!

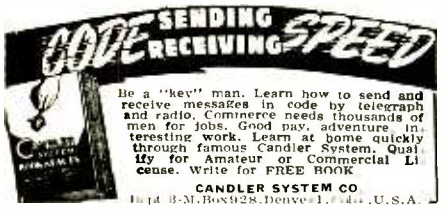
BROADCAST ENGINEER
ELECTRONICS
RADIO SERVICING

Television Servicing

(Approved for Veterans)
BUILDING AIRCONDITIONED
SEND FOR FREE LITERATURE

BALTIMORE TECHNICAL INSTITUTE

1425 EUTAW PLACE. BALTIMORE 17, MD.



Be a "key" man. Learn how to send and receive messages in code by telegraph and radio. Commerce needs thousands of men for jobs. Good pay, adventure, interesting work. Learn at home quickly through famous Candler System. Qualify for Amateur or Commercial License. Write for FREE BOOK

CANDLER SYSTEM CO.

Dept. B-M, Box 928, Denver 1, Colo., U.S.A.

FINISH HIGH SCHOOL AT HOME!

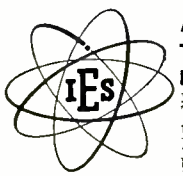
No classes to attend. Easy spare-time training covers big choice of subjects. Friendly instructors; standard texts. Full credit for previous schooling. Diploma awarded. Write now for FREE catalog!

WAYNE SCHOOL Catalog HKE-9

2527 Sheffield Ave., Chicago 14, Illinois

ELECTRONIC TECHNICIANS

ARE IN DEMAND



TRAINED MEN ARE NEEDED NOW! In just 18 months, you can complete Electronic Technicians training to enter this ever-growing industry. Day or evening classes. Opportunity for employment in local industry. Approved for Korean Veterans. Terms beginning Jan., April, July, September. Write for Catalog 111 TODAY.

INDIANAPOLIS ELECTRONIC SCHOOL

312 E. Washington St. Indianapolis 4, Indiana

ENGINEERING DEGREES

(Under and Postgraduate)

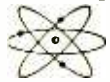
E.E. Major in Electronics,
Earned Through Home Study.

AMERICAN COLLEGE OF ENGINEERING

Residential Courses also Available

Box 27724(M), HOLLYWOOD 27, CALIF.

ELECTRONICS



Prepare for unlimited opportunities in electronics! B.S. degree in 27 months. Intensive, specialized courses. Math, electrical engineering, TV, advanced radio theory & design. Mod. labs. Low tuition. Self-help. Also Aero., Chemical, Civil, Electrical, Mechanical Engineering. B.S. degree in 36 mo. in Math., Chem., Physics. Prep. courses. G.I. appr. Enter Dec., March, June, Sept. Catalog.

Engineering Degree IN 27 MONTHS.

INDIANA TECHNICAL COLLEGE

1511 E. Washington Blvd., Fort Wayne 2, Ind.

LEARN TV SERVICING
UHF—COLOR—VHF

Master the latest, up-to-the-minute TV and Color TV developments.

You can Earn to $5,000-$10,000 a year in TV servicing after a few short months. Education or age is no barrier. Find out how you can EARN WHILE YOU LEARN in our big Shops and Laboratories. You work with the latest equipment. Waste no time with Non-Essentials, Math or Design Theory. Complete information in our new FREE booklet. Address Dept. E-956. Approved for veterans. Free Placement Service.

WESTERN TELEVISION INSTITUTE

341 W. 18th St. Los Angeles, Calif.

Dept. E-11-56
Mail me information about training.
Name .....
Address .....

Your choice of school is highly important to your career in

INDUSTRIAL ELECTRONICS

RADIO-TELEVISION

ELECTRONICS COMMUNICATIONS

Become an
ELECTRICAL ENGINEER
or an
ENGINEERING TECHNICIAN
at

MSOE *in Milwaukee*

Choose from courses in:

ELECTRICAL ENGINEERING
Bachelor of Science degree in 36 months. Communications option (radio-tv) Power option.

ENGINEERING TECHNICIAN
Assoc. in Applied Science degree — 18 months.
Electronics Communications
Electrical Power.

MSOE — located in Milwaukee, one of America's largest industrial centers — is a national leader in electronics instruction — with complete facilities, including the latest laboratory equipment, visual aid theater, amateur radio transmitter — offers 93 subjects in electrical engineering, electronics, radio, television, electrical power, and electricity.

Advisory committee of leading industrialists. Courses approved for veterans. Over 50,000 former students. Excellent placement record.

TERMS OPEN JANUARY, APRIL, JULY, SEPTEMBER

Choose wisely — your future depends on it. Write for more information today!

MILWAUKEE
SCHOOL OF ENGINEERING

Dept. RE-1156, 1025 N. Milwaukee Street
Milwaukee 1, Wisconsin

Send FREE career booklet.

I am interested in ..... (Name of course)
Name ..... Age .....
Address .....
City ..... Zone ..... State .....
If veteran, give discharge date .....

MS-57

LAFAYETTE SENSATIONAL VALUES! IN COMPLETELY WIRED TEST EQUIPMENT at LESS than the PRICE of KITS!

LAFAYETTE SIGNAL GENERATOR

NEVER BEFORE HAS A COMPLETELY WIRED AND TESTED INSTRUMENT OF SUCH ACCURACY AND QUALITY BEEN OFFERED AT SUCH A PRICE!

- **FREQUENCY 120 KC TO 260 MC**
- **120 KC TO 130 MC ON FUNDAMENTALS**
- **LABORATORY ACCURACY AND QUALITY**

22.50

A completely wired and tested instrument not to be confused with units sold in kit form at almost the same price, but with a quality and accuracy of instruments 3 to 4 times its price. Six overlapping ranges generate signals of 120KC — 320KC, 320KC—1000KC, 1MC—3.2MC—11MC, 11MC—38MC and 37MC—130MC all on fundamentals with calibrated harmonics from 120MC to 260MC. Selector switch gives instant choice of ranges. Switch gives choice of internal modulation of 400 CPS or use of any external source at other frequencies. For audio testing the 400 cycle signal can be used separately. Outputs are unmodulated RF, modulated RF and 400 CPS audio. RF output is in excess of 100,000 microvolts and jacks are provided for choice of either high or low RF output. Stability is insured by special circuit design. Has a fine adjustment RF control. AF output is 2-3 volts. AF input is 4 volts across 1 megohm. Large clear 5 inch etched dial plate and pointer are protected by transparent plastic bezel. Common AF terminals for EXT-MOD input and INT-AF for audio tests eliminate need for special AF output connectors. Machine engraved panel lettering. Handsome gray metal case with carrying handle. Measures 6½" x 10" x 4½". Comes complete with pair of leads. AC line cord and plug. Operates on 105-125V 50-60 cycle AC. Shpg. wt., 8 lbs.

LAFAYETTE LSG-10 SIGNAL GENERATOR **22.50**

NEW POCKET AC-DC VOM MULTITESTER

2,000 ohm per volt Sensitivity on both DC and AC

160 ua 3" METER
1% PRECISION RESISTORS
SILVER CONTACT SELECTOR SWITCH

FULL SCALE RANGES

***DC Volts:* 0-10; 0-50; 0-500; 0-1000 Volts — *AC Volts:* 0-10; 0-50; 0-500; 0-1000 Volts—*DC Current:* 500 ua and 500 ma — *Resistance:* 0-10K; 0-1 Meg — *Decibels:* —20 to +22; +20 to 36 db (0 db — 0.775 V)—*Capacity:* 250 mmfd to .2 mfd—.005 mfd to 1 mfd—*Output Ranges:* 0-10; 0-50; 0-500; 0-1000 volts**

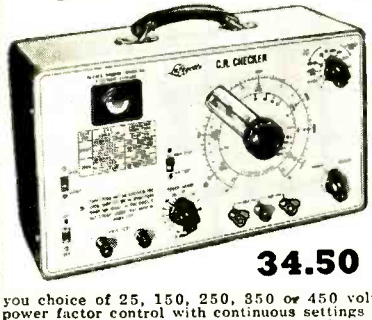
8.95

Best Buy in America! A very accurate and sensitive VOM. This Multitester is a complete instrument (not a kit) with high quality and sensitive 160 microamp meter; 2000 ohm per volt on both AC and DC. Single selector switch, 1% precision resistors, 3" meter. Features extreme versatility, accuracy and ruggedness. In attractive plastic front panel, with metal bottom for ruggedness and shielding. First capacity range requires 50 volt AC source. Second capacity range requires 10 volt AC source. Size 4¼"x3½"x1⅝". Complete with test leads and batteries. Shipping weight 4 lbs.

RW-27A ..... Complete **8.95**

NEW! LAFAYETTE CAPACITANCE-RESISTANCE TESTER WITH "IN-SET QUICK CHECK"

COMPLETELY WIRED AND TESTED



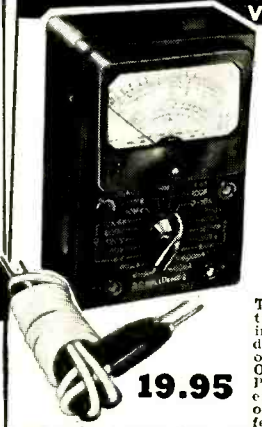
- **TWO INSTRUMENTS IN ONE**
- **CHECKS ELECTROLYTIC, PAPER, MICA AND CERAMIC CONDENSERS**
- **4 DIRECT READING CAPACITY SCALES FROM .00001 MFD TO 1000 MFD**
- **CHECK FOR OPEN SHORTS, LEAKAGE AND INTERMITTENTS**
- **2 RESISTANCE RANGES FROM 100 TO 5 MEGOHM**

34.50

Here is a "must" for servicemen and lab technicians. A completely self-contained AC operated capacitance and resistance bridge, plus a quick check for in the set testing. Large 5 direct reading scale has 4 ranges of .00001-.005 MFD, .001-.5 MFD, .1-50 MFD and 20-1000 MFD. Resistance ranges are 100-50,000 OHMS and 10,000 to 5 megohm. Quick check feature enables you to check capacitors for shorts, open or intermittent while in circuit—no need to remove them from the set till you're sure they need replacement. Leakage test switch gives you choice of 25, 150, 250, 350 or 450 volts for checking leakage under correct potential. Separate power factor control with continuous settings from 0 to 50%. Operation is simple and accurate, using a magic-eye tube as the null detector. Attractively finished steel case with etched panel and rounded corners, measures 14½"L x 8¼"H x 5"D. Shpg wt. 19 lbs.

MODEL LC-4 ..... NET **34.50**

HIGH SENSITIVITY 20,000 OHM PER VOLT DC 10,000 OHM PER VOLT AC MULTITESTER



LOOK AT THESE FULL SCALE RANGES!

***D.C. Volts:* 0-6; 0-30; 0-120; 0-600; 0-1200; 0-6000 Volts — *A.C. VOLTS:* 0-6; 0-30; 0-120; 0-600; 0-1200 Volts — *RESISTANCE:* 0-10K; 0-100K; 0-1 Meg; 0-10 Megohms — *D.C. CURRENT:* 0-60 Microamp; 0-6; 0-60; 0-600 Milliamps — *DECIBEL:* —20 to +17 db (0 db—0.774V) — *CAPACITY:* .0001-.01; .005-.15 mfd — *INDUCTANCE:* 20-2000 millihenry —*OUTPUT RANGES:* 0-6; 0-30; 0-120; 0-600; 0-1200 Volts**

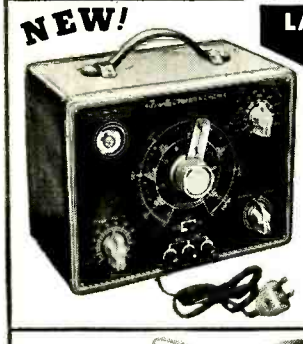
19.95

The new Lafayette high sensitivity Multitester is a complete instrument (not a kit). In addition to its unusual sensitivity of 20,000 PER VOLT ON D.C. AND 10,000 OHMS PER VOLT ON A.C., and the extraordinary number and scope of its ranges, it is packed with features that would make it cost at least twice as much if made in this country. Uses 1% precision resistors, silver contacts on selector switch, 35 ua 3" meter. Dependable, rugged and accurate. Even the test leads are heavy duty with high voltage insulation. Voltage source required for low capacity range is 120V A.C., for high range capacity and inductance scale is 6V A.C. Attractive plastic front with metal bottom. Size 6¼"x4¼"x2½". Complete with batteries and leads. Shipping weight 4½ lbs.

RW-30A ..... Singly, Each **19.95**
In lots of 3, Each **19.25**

NEW! LAFAYETTE CAPACITOR-RESISTANCE TESTER

COMPLETELY WIRED AND TESTED



21.50

COMPLETELY WIRED AND TESTED

- **CHECKS ALL TYPES OF CONDENSERS FOR CAPACITY, LEAKAGE, OPEN SHORTS OR INTERMITTENT CONDITION**
- **DIRECT READING SCALES FROM .00001 TO 1000 MFD AND 100 TO 5 MEGOHMS**

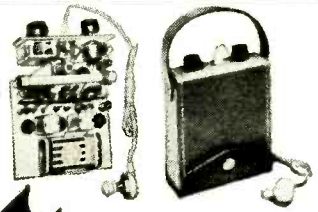
A stable and accurate bridge type circuit measures capacitance in 4 ranges of .00001-.005 MFD, .001 to .5 MFD, .1 to 50 MFD and 20 to 1000 MFD. Two resistance ranges of 100-50,000 and 10,000 to 5 megohms. Check leakage under actual load with choice of 25, 150, 250, 350 or 450 volts available by selector switch. Power factor control from 0 to 50%. Checks for leakage, open, short, or intermittent operation. All readings taken directly off scales after setting magic eye to maximum. Completely self-contained power supply. Attractively finished steel case with rounded corners and etched panel. Operates from 110V AC. Size 9⅜"L x 7⅛"H x 5¼"D. Shpg. wt. 10 lbs.

MODEL LC-15 ..... NET **21.50**

4 AND 6 TRANSISTOR SUPERHET KITS POCKET AND HOME RADIOS FOR SPEAKER AND EARPHONE OPERATION

POCKET SIZE: 4"L x 3-5/16"W x 1"D BUILT-IN ANTENNA! REQUIRES NO EXTERNAL ANTENNA OR GROUND!

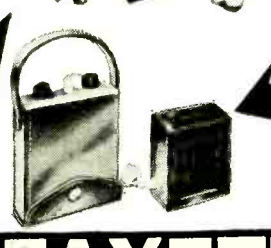
FIRST BUILD THIS



Lafayette engineers have designed this fascinating 4-transistor superhet receiver kit in a unique and interesting form. It is, by itself, a completely self-contained, pocket sized personal portable set which operates a miniature earpiece so only you can hear; by plugging into the KT-96 kit listed below, it is instantly converted to a full 6-transistor home radio, complete with speaker for the entire family to enjoy. Circuit features use of 4 transistors (2 high frequency and 2 audio type) plus a germanium diode, 2 I.F. stages and built-in high gain ferrite core and antenna. The result is a sensitive, stable and selective set covering the entire broadcast band. Requires no outside antenna or ground connection. The kit is furnished complete with transistors and all parts, including battery and chassis already drilled and punched. The earpiece and carrying case are accessory items, not supplied. All necessary pictorial and circuit diagrams are furnished with simple, easy-to-follow instructions.

KT-94 —Kit, shpg. wt., 2 lbs. ..... Net **19.95**
MS-311—Leather Carrying Case. ..... Net **1.95**
MS-260—Super power dynamic earpiece. ..... Net **3.95**

THEN BUILD THIS



2-TRANSISTOR PUSH-PULL OUTPUT KIT WITH SPEAKER SELF-CONTAINED IN BEAUTIFUL PLASTIC CASE.

- **CONVERTS 4-TRANSISTOR KIT INTO A 6-TRANSISTOR HOME RADIO WITH SPEAKER**

Add a completely transistorized push-pull audio stage to your 4 transistor receiver. Complete stage including speaker and case measures only 3" H x 2⅜" W x 1⅜" D. Plugs right into 4 transistor kit above. Converts your 4 transistor set to a 6 transistor plus diodes superhet receiver. Performance equal or superior to commercially wired sets selling at more than twice the price. Kit includes 2 transistors, 2 transformers, 2½" PM speaker, pre-punched chassis, speaker case to hold entire stage, battery, hardware, instructions and diagrams.

KT-96—Shpg. wt., 1 lb. ..... Net **11.50**

LAFAYETTE RADIO DEPT JK-1

JAMAICA 33; N.Y. 165-08 Liberty Ave. Write for FREE Bargain Packed Catalog!

100 SIXTH AVE., NEW YORK, N. Y.
BOSTON, MASS., 110 Federal St.
PLAINFIELD, N. J., 139 West 2nd St.
NEWARK, N. J., 24 Central Ave.
BRONX, N. Y., 542 E. Fordham Rd.

FREE! LAFAYETTE CATALOG

ELECTRONIC CATALOG PACKED WITH MONEY SAVERS

Packed with the largest selection of Electronic, Radio and T.V. Parts, and equipment, PA, Hi-Fi systems, tubes, antennas, Transistor Kits, parts and components, Test Equipment, new build your own kits, tools, books, Microscope, drafting equipment, Binoculars, Telescopes, All Radio, TV and Ham supplies — ALL AT GREAT SAVINGS — For the economy minded servicemen, dealer, engineer and technician. CHUCK FULL OF BUYS! SEND FOR YOUR FREE COPY TO-DAY.

35 WATT HI-FI AMPLIFIER KIT WITH METERED OUTPUT AND 4 PUSH-PULL PARALLEL NEW EL84 TUBES

New Lafayette high power amplifier kit with a host of features not in any other single amplifier. Calibrated output meter permits use as either a recording or reproducing amplifier. EL84 power pentodes provide high peak power and low distortion required for better audio quality. Features exceptional control versatility and ample inputs for all associated custom hi-fi equipment. DC operated preamp filaments and balancing adjustment to minimize hum. Meter can be switched to indicate either recording voltage or output level of amplifier. Features rumble filter, loudness control, separate bass and treble controls, silencing switch, speaker selector switch, output balancing adjustment and monitoring jack.

SPECIFICATIONS

FREQUENCY RESPONSE: ± 1 db 20-40,000 cps. **HUM:** 85 db below rated output. **POWER OUTPUT:** 35 watts with 4% total distortion at full rated output. **INPUTS:** TV Sound, Radio, Magnetic Phono, Crystal Phono, Tape. **OUTPUT IMPEDANCE:** 4, 8 and 16 ohms; high impedance for tape recorder. **TUBE COMPLEMENT:** 3-12AX7, 1-12AU7, 4-EL84, 1-5U4. **FEEDBACK:** Negative feedback loops virtually eliminate distortion. **POWER:** 117V, 60 cps, 80/150 watts with auxiliary power receptacles. Removable escutcheon. Size 12⅛" L x 9¾" D x 4⅛" H.
A combination of high power, high fidelity, gleaming beauty and advanced engineering features unmatched at even twice the price. Supplied in complete kit form with simplified easy-to-follow instruction sheets. Shpg. w., 25 lbs.

KT-115—Complete kit, ... Net **59.50**

LAFAYETTE'S FM-AM TUNER KIT

- SIMPLIFIED DETAILED INSTRUCTION MANUAL
- MEETS FCC REQUIREMENTS FOR RADIATION
- GROUNDED GRID TRIODE AMPLIFIER
- ARMSTRONG FM CIRCUIT WITH FOSTER-SEELEY DISCRIMINATOR
- AFC DEFEAT CIRCUIT WITH FRONT PANEL CONTROL

The excellence of its design and the quality of its components combine to provide this compact high-fidelity FM-AM tuner with superb characteristics normally found in units costing several times as much, and with performance unbelievable at this low price. Features Armstrong FM circuit with limiter and Foster-Seeley discriminator. Simplified tuning with slide-rule dial and flywheel counterweighted mechanism. AFC defeat circuit combined with tuning control. Attractive etched copper-plated and lacquered finish.

SPECIFICATIONS

FREQUENCY RANGE: FM, 88-108 MC; AM, 530-1650 KC. **ANTENNA INPUT:** FM, 300 ohms; AM, Ferrite loopstick and high impedance external antenna. **CONTROLS:** 2—a function control for AM, FM, PHONO, TV and a tuning/AFC defeat control. **DISTORTION:** Less than 1% rated output. **FREQUENCY RESPONSE:** FM, ± .5 db 20 to 20,000 cps; AM, ± 3 db 20 to 5000 cps. **SENSITIVITY:** FM, 5 μv for 30 db quieting; AM, Loop sensitivity 80 μv/meter. **SELECTIVITY:** FM, 200 KC bandwidth, 6 db down — 375 KC FM discriminator peak to peak separation; AM, 8 KC bandwith, 6 db down. **IMAGE REJECTION:** 30 db minimum. **HUM LEVEL:** 60 db below 100% modulation. **TUBE COMPLEMENT:** 2-12AT7, 1-6BA6, 1-6BE6, 2-6AU6, 1-6AL5 plus 1-6X4 rectifier. **SIZE:** 5¼" high x 9⅝" wide x 9½" deep (excluding knobs). **CONSUMPTION:** 30 watts. For 110-120V 60 cycles AC. Less metal case. Shpg. wt., 9 lbs.

KT-100 Complete kit, less cage. ..... Net **34.95**
LT-10 —Completely wired..... Less metal case. ..... Net **52.50**
ML-100—Metal cage for above, shpg. wt., 3 lbs. ..... Net **5.00**

New! HIGH FREQUENCY TWEETER WITH ACOUSTIC LENS

DIRECT IMPORTATION MAKES THIS PRICE POSSIBLE!

14.95

- FREQUENCY RESPONSE FROM 2000 CPS TO BEYOND AUDIBILITY
- LOUVERED ACOUSTIC LENS FOR UNIFORM SOUND DISPERSION
- HANDLES 25 WATTS OF POWER
- PRICED EXCEPTIONALLY LOW

New high frequency tweeter featuring a louvered acoustic lens for uniform sound dispersion and capable of handling up to 25 watts of distortion-free power. The directional tendency of high frequency notes is overcome by the natural wide dispersion angle of the short horn and the acoustic lens which disperses and radiates the high notes smoothly throughout the entire listening area. The lens is detachable for panel mounting, with a separate base for the tweeter furnished for external mounting where desired. Aluminum voice coil has 16 ohms impedance. Size: 4¼" long x 3" diameter, lens extends 2½". Requires a crossover network, preferably one with a level control, such as the LN-2. With full instructions. Shpg. wt., 5 lbs.

HW-7 ..... Net **14.95**

METAL-CASED CONE TYPE HI-FI TWEETER

FREQUENCY RESPONSE 2000-16,000 CPS • HANDLES 20 WATTS OF POWER

5.95 Net

Highest quality cone type high frequency tweeter having a range from 2000 to 16,000 cycles. Especially efficient at higher end of audio spectrum where other cone type tweeters tend to lose clarity and volume. Entirely closed in a metal case with a base so that it can stand by itself or be mounted on a flat surface with mounting bracket supplied. Rated to handle 20 watts of power. A crossover network is required; the Lafayette LN-2 is ideal. Voice coil impedance 8-16 ohms. Size: 3⅛" x 2⅛" x 3" Diam. Shpg. wt., 3 lbs.

HK-3 ..... Net **5.95**

CROSSOVER NETWORK

- CAPACITIVE-INDUCTIVE NETWORK WITH CROSSOVER AT 2000 CPS
- BUILT-IN LEVEL BRILLIANCE CONTROL

8.75

The frequencies above 2000 cycles are channeled to the high frequency tweeter by means of the high-Q inductance and capacitance comprising this efficient crossover network. The highs and lows are brought into acoustic balance by means of a continuously variable level-brilliance control. Control has a 2½ ft. long cable for remote mounting. Network matches 8-16 ohm speakers with insertion loss reduced to a minimum. Enclosed in metal case 6" L x 2⅝" H x 2⅝" D. With full instructions. Shpg. wt., 5 lbs.

LN-2 ..... Net **8.75**

2 WAY SPEAKER SYSTEM 40-16,000 CYCLES

This 2-way speaker system is another excellent buy for the moderate purse. It is basically the same as the SY-85 system described at the top of the page, but incorporates the deluxe SK-68 speaker with 21.5 oz. Alnico V magnet. This results in more efficient reproduction and extension of the lower register. Complete system includes the SK-68 12" 25 watt woofer, HK-3 cone type tweeter and LN-2 crossover network with lever-brilliance control. Range of system 35-16,000 cycles. Shpg. wt., 18 lbs.

SY-87—Complete System..... Net **27.50**
SY-86—Complete System, same as above except the HW-7 Tweeter with acoustical lens is supplied instead of HK-3. Shpg. wt., 20 lbs..... Net **36.50**

New! LAFAYETTE Mail Order Center

Lafayette Radio

DEPT JK-2

165-08 Liberty Ave. JAMAICA 33; N. Y.

NAME _____

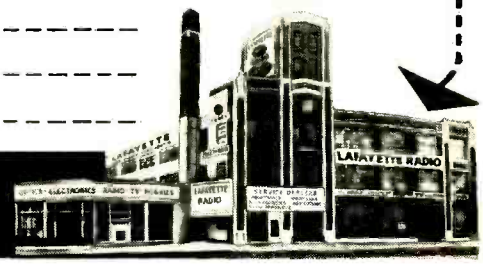
ADDRESS _____

CITY _____

ZONE _____

STATE _____

SEND FREE LAFAYETTE CATALOG



CUT OUT AND MAIL TODAY!

ADVERTISING INDEX

Radio-Electronics does not assume responsibility for any errors appearing in the index below.

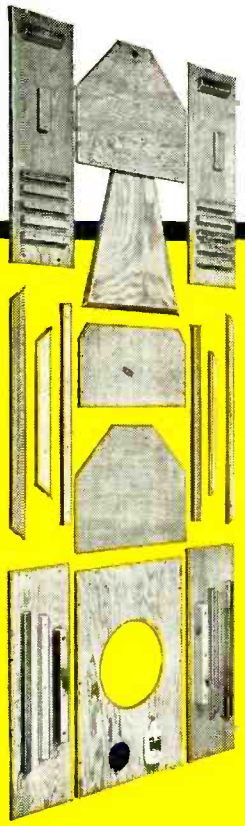
SCHOOL DIRECTORY PAGE 154-155

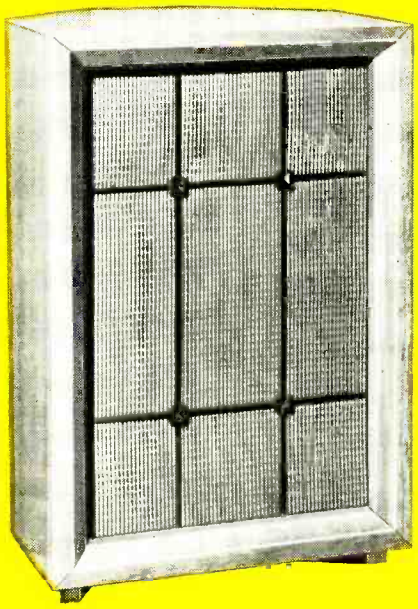
BRANCH ADVERTISING OFFICES: Chicago: 1413 Howard St. Tel ROgers Park 4-8000. **Los Angeles:** Ralph W. Harker and Associates, 600 South New Hampshire. Tel. DUnkirk 7-2328. **San Francisco:** Ralph W. Harker and Associates, 582 Market St., Tel., GArfield 1-2481.

FOREIGN AGENTS: Great Britain: Atlas Publishing and Distributing Co., Ltd., London E.C. 4. **Australia:** McGill's Agency, Melbourne. **France:** Brentano's, Paris 2e. **Belgium:** Agence et Messageries de la Presse, Brussels. **Holland:** Trilectron-Heemstede. **Greece:** International Book & News Agency, Athens. **So. Africa:** Central News Agency, Ltd., Johannesburg, Capetown, Durban, Natal; Universal Book Agency, Johannesburg. **Middle East:** Steinmatz Middle East Agency, Jerusalem. **India:** Broadway News Centre, Dadar, Bombay #14. **Pakistan:** Paradise Book Stall, Karachi 3.

DO IT YOURSELF!

BUILD AN AUTHENTIC Electro-Voice SPEAKER ENCLOSURE





THE ARISTOCRAT KIT

ELECTRO-VOICE KD KITS let you build any of 7 authentic research-engineered Electro-Voice speaker housings at half the cost of comparable factory-built models.

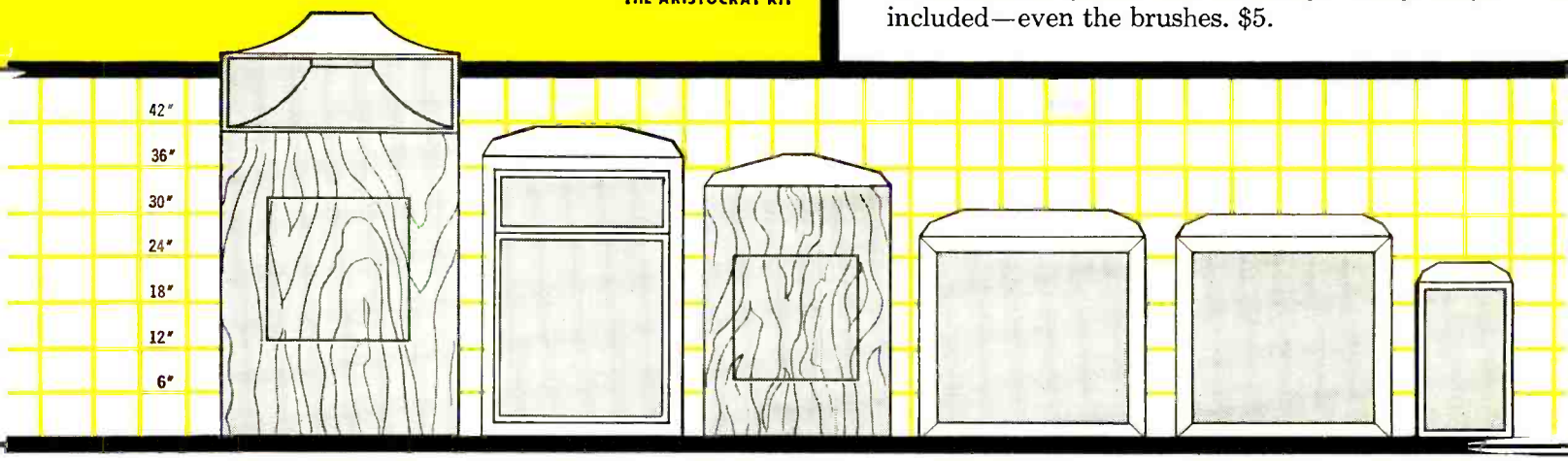
Electro-Voice building block plan lets you expand from a single speaker to a multi-speaker high-fidelity system one economical step at a time.

TWO WAYS TO DO IT

Get the kit—pre-cut, shaped, drilled and marked parts and hardware plus illustrated, step-by-step instruction book.

Buy the book only, order supplies from your lumber dealer. Priced from 75c (the Baronet Kit) to $1.50 (the Patrician Kit).

Electro-Voice Finishing kits add the professional touch to your enclosure. Walnut, mahogany, fruitwood, cherry, golden oak or ebony. Everything's included—even the brushes. $5.



THE PATRICIAN IV KIT | THE CENTURION KIT | THE GEORGIAN KIT | THE REGENCY KIT | THE EMPIRE KIT | THE BARONET KIT

THE PATRICIAN IV KIT. The interior working horn assembly kit for those desiring the finest. This augmented design of the corner folded-horn bass section for 18-inch, 4-way speaker systems delivers widest bass response of any loudspeaker system. Designed for use with E-V Model 103C Patrician IV four-way driver components. For built-in installations or to be decorated as you choose. Finished size: 57½ in. high, 34½ in. wide, 26⅞ in. deep. Shpg. wt. 150 lbs.
Model KD-1 ..... Net, $118.00

THE GEORGIAN KIT. The interior working horn assembly kit that creates authentic indirect radiator type corner folded-horn bass section for 15 in. 4-way speaker system. Exceeded in range only by the Patrician IV. For use with deluxe E-V Model 105 or standard Model 117 package of 4-way driver components. For built-in installations or to be decorated as you choose. Finished size: 38½ in. high, 26¼ in. wide, 22½ in. deep. Shpg. wt. 88 lbs.
Model KD-2 ..... Net, $65.00

THE CENTURION KIT. Four-way system folded-horn, corner enclosure. Uses exclusive E-V "W" type single-path indirect radiator for propagation of extended bass. Sealed cavity behind 15 in. low-frequency driver cone promotes superlative transient response, subdues cone excursions, lowers distortion. For use with E-V Model 105 or Model 117 package of driver components. Finished size: 42⅛ in. high, 29 in. wide, 22½ in. deep. Shpg. wt. 75 lbs.
Model KD-3 ..... Net, $87.00

THE REGENCY KIT. Most popular low-boy style folded-horn enclosure that can be used in corner or flat against one wall. Improves the bass range and response of any 15-in. speaker. Makes an outstandingly efficient reproducer when used with E-V SP15 coaxial speaker, 15TRX triaxial reproducer or 114A 2-way or 114B 3-way system. Finished size: 29⅜ in. high, 33½ in. wide, 19 in. deep. Shpg. wt. 70 lbs.
Model KD-4 ..... Net, $73.00

THE EMPIRE KIT. Economical enclosure for use in a corner or flat against one wall. Designed for 15-in. speakers and separate 2- and 3-way systems. Particularly effective when used with SP15B coaxial speaker, 15TRXB triaxial reproducer, or 116 2-way or 116A 3-way system. Recommended components for Regency kit may also be employed. Finished size: 29⅜ in. high, 32 in. wide, 16 in. deep. Shpg. wt. 45 lbs.
Model KD-5 ..... Net, $51.00

THE ARISTOCRAT KIT. Folded-horn corner enclosure designed for 12-in. speakers and separate 2- and 3-way systems. For use with Electro-Voice SP12 or SP12B coaxial speakers, 12TRX or 12TRXB triaxial reproducers, and 108, 111 2-way and 108A, 111A 3-way systems. Smooth reproduction down to 35 cps, with remarkable purity and efficiency. Finished size: 29⅜ in. high, 19 in. wide, 15¼ in. deep. Shpg. wt. 37 lbs.
Model KD-6 ..... Net, $39.00

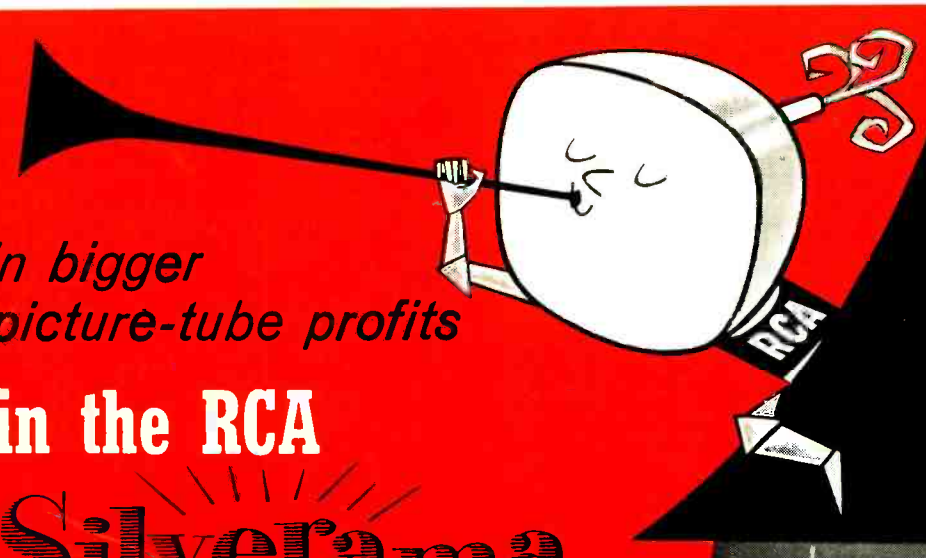
THE BARONET KIT. Phenomenal reproducer in very small size. This folded-horn corner enclosure is designed for use with E-V Model SP8B 8-in. Radax speaker. E-V T35 or T35B Super Sonax UHF driver can be added for a 3-way system. Finished size: 23 in. high, 14 in. wide, 13 in. deep. Shpg. wt. 24 lbs.
Model KD-7 ..... Net, $26.00

Electro-Voice®

ELECTRO-VOICE, INC.
BUCHANAN, MICHIGAN

EXPORT: 13 EAST 40TH STREET, NEW YORK 16, U. S. A. CABLES: ARLAB

Send for Bulletin No. 211-W611. Folders describing Electro-Voice high-fidelity speakers, systems and components, amplifiers, tuners and cartridges available on request from your Electro-Voice distributor or write.



Win bigger picture-tube profits

Join the RCA Silverama CRUSADE FOR PROFITS

The top picture-tube line on the market . . . Compelling national advertising . . . The most forceful promotional material in picture-tube history . . . These join forces now to spearhead your CRUSADE FOR PROFITS in RCA's newest selling campaign for Silverama Super-Aluminized Picture Tubes.

RCA paves the way with a barrage of national advertising in *Life*, *TV Guide*, the *Saturday Evening Post*, and on the N.B.C. TV and Radio Networks.

And, to help you cash-in on this CRUSADE FOR PROFITS, your RCA Distributor is ready now with a winning array of RCA Silverama sales promotion material—window displays, decals, streamers, local spot commercials by Vaughn Monroe, direct-mailers, and consumer give-away items.

So, join the Crusade now. There's a selling-season of profits waiting to be won over by you. See your RCA Distributor immediately.

RCA **PICTURE TUBES**

RADIO CORPORATION OF AMERICA, HARRISON, N. J.