Lower-Noise
TV Booster

Servicing Transistor
Local Oscillators

Loudspeakers
of the Future

Transistorized and
Hybrid Auto Radios

New Amplifying
Devices
(See page 32)

35¢
U.S. and Canada
A positive fact about Du Mont Positive Quality . . .

Du Mont Picture Tubes cut callbacks due to tube failure by 40%. Consider what this means to you—fewer callbacks, greater profits.

Ask your distributor about Du Mont Positive Quality Picture Tubes and Electronic Tubes.

*Send name and address for your free copy of the Du Mont Replacement Tube Chart.*

*Based on actual engineering figures.*

**Du Mont**

Television Tube Division

Allen B. Du Mont Laboratories, Inc., Clifton, N. J.
Learn to Service TV Sets—any make or model—Quickly

NRI ALL PRACTICE Method trains you at home to become a Professional TV Serviceman

You learn the time saving techniques, methods used by top TV Servicemen

This is 100% learn-by-doing, practical training. NRI supplies all necessary equipment, all tubes, including a 17-inch picture tube; and comprehensive manuals covering a thoroughly planned program of practice. You learn how experts diagnose TV receiver defects quickly—audio and video—and how to fix them accurately.

You get actual experience aligning TV receivers, isolating complaints from scope patterns, eliminating interference, using germanium crystals to rectify the TV picture signal, adjusting the ion trap and hundreds of other valuable Professional techniques.

You Get COLOR TV Books

Early — Learn-by-Doing

The day you enroll, NRI sends you special Color-TV textbooks to speed your knowledge of this fast growing phase. Many full color pictures, diagrams. To cash in on Color TV you need the kind of training NRI supplies. We supply all components to build Oscilloscope, Probe, Signal Generator, TV Set, show you how to conduct experiments, practice TV repairs.

OLDEST, LARGEST Radio-TV Home Study Training

This is professional training, not for beginners. If you have some knowledge of Radio-TV or have had some Radio Shop experience this course is for YOU. Conveni- ent monthly terms. Mail Coupon for Cat- alog FREE. National Radio Institute, Dept. 7MFT, Washington 16, D.C.

MAIL NOW

NATIONAL RADIO INSTITUTE
Dept. 7MFT, Washington 16, D.C.

Please send my FREE copy of "How to Reach the Top in TV Servicing." I understand no salesman will call.

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

Address.................................................

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

ACCREDITED MEMBER NATIONAL HOME STUDY COUNCIL
NOVEMBER, 1957

Radio-Electronics
Formerly RADIO-CRAFT • incorporating SHORT WAVE CRAFT • TELEVISION NEWS • RADIO & TELEVISION

EDITORIAL
31 Tactile Electronics—Hugo Gernsback

ELECTRONICS
32 Two New Approaches to Amplification—Eric Leslie
35 More About Transistor Types—Paul Penfield, Jr.
37 Transistor Circuit Breakers—A. H. Taylor
38 Multiple Sun Battery—Rufus F. Turner

AUDIO—HIGH FIDELITY
39 High Fidelity at Low Cost With Twin-Coupled Amplifier—Norman H. Croughurst
44 Loudspeakers of the Future—Gerald Shirley
47 Tube Data and Amplifier Design—Herbert Ravenswood
49 True or False Quiz for Audiophiles—Herman Burstein
50 Deluxe Remote Baby Sitter—Edwin N. Kaufman
122 New Records—Monitor

TELEVISION
52 Low-Noise TV Booster—J. R. Lange, K9ARA
55 TV Dx—Robert B. Cooper, Jr.
56 TV Service Clinic—Conducted by Robert G. Middleton
58 Tips from a TV Dx'er's Notebook—Robert B. Cooper, Jr.
60 A Tale from Cuba—L. F. Fenton
61 Practical Color TV Installation, Part III—Robert G. Middleton
79 Hot Coil—G. N. Carter
82 Positive Grid—Robert A. Hillkemper

RADIO
84 7-Transistor Pocket Radio—Howard Granoff
88 Transistor and Hybrid Auto Radios, Part I—Jack Darr
103 Servicing Transistor Radios—James A. McRoberts

TEST INSTRUMENTS
110 Time-Base Marker Generator—James G. Arnold
114 Two-Transistor Signal Generator—Joseph Chernof
118 Phase-Shift Comparator Measures Frequency Ratios, Modulation—J. E. Pugh, Jr.

158 Books
150 Business and People
160 Corrections
16 Correspondence
127 New Devices
6 News Briefs
137 New Tubes and Semiconductors
153 Patents
141 Radio-Electronic Circuits
155 Technical Literature
134 Technicians' News
147 Technotes
144 Try This One
157 35 Years Ago

NEXT MONTH: PHONOGRAPH PICKUP ARMS
• CARE AND MAINTENANCE OF THE VTVM

ON THE COVER
(Story on page 32)

The unusual-looking device is a Specator, a new type of semiconductor, expected to operate at frequencies higher than 1,000 mc. The package of pins at the left gives an idea of the unit's size.
Color original by Raytheon Manufacturing Company.

Hugo Gernsback
Editor and Publisher
M. Harvey Gernsback
Editorial Director
Fred Shuman
Managing Editor
Robert F. Scott
Technical Editor
Larry Steckler
Assistant Editor
I. Queen
Editorial Associate
Robert G. Middleton
Television Consultant
Elizabeth Stalcup
Production Manager
Cathy Coccozza
Advertising Production
Wm. Lynn McLaughlin
Art Director
Soi Ehrlich
Fred Nelms
Staff Artist
Lee Robinson
General Manager
John J. Lasuen
Sales Manager
G. Aliquo
Circulation Manager
Adam J. Smith
Director, Newsstand Sales
Robert Fallaith
Promotion Manager

Average Paid Circulation
Over 195,000

Associate Member Institute of High Fidelity Mfrs., Inc.


SUBSCRIPTION RATES: U. S., U. S. possessions and Canada, $4.00 for one year; $8.00 for two years; $9.00 for three years; single copies 50c. Pan-American copyright countries $4.50 for one year; $9.00 for two years; $10.50 for three years. Subscriptions in all other countries $5.00 a year; $10.00 for two years; $12.00 for three years. Subscriptions in all other countries must be made payable to Radio-Electronics, Inc., 684 N. Wacker Ave., Mt. Morris, Ill., or 154 West 14th St., New York 11, N. Y. When returning a change of address, please furnish an address label from a recent issue. Allow one month for change of address.

Gernsback Publications, Inc., Executive Editor and Advertising Office, 134 West 14th St., New York 11, N. Y. Telephone Alfonse 5-7755. Hugo Gernsback, Chairman of the Board; M. Harvey Gernsback, President; G. Aliquo, Secretary.

Branch Advertising Offices and Foreign Agents listed on page 26.

Postmaster: Mail is accepted at Mt. Morris, Ill., as second-class matter.

Printed in U. S. A. on Recyclable Paper

www.americanradiohistory.com
Get into TELEVISION RADIO-ELECTRONICS

Let National Schools of Los Angeles, a practical Resident Technical School for over 50 years, train you at home by Shop-Method for unlimited opportunities in all phases of TV, Electronics, Radio.

LEARN ALL 8 PHASES BY SHOP METHOD
1. Television... including Color TV
2. Radio... AM, FM
3. Industrial Electronics
4. Communications
5. Sound Recording & Hi-Fidelity
6. Automation
7. FCC License
8. Radar & Micro Waves

We give you parts to build a modern TV set... all tubes plus large screen Picture Tube... and a Superhet Receiver. You also receive a Professional Multitester.

You get 19 Big Kits... all this newest, practical equipment.

GOOD JOBS... MORE MONEY SECURITY... ALL CAN BE YOURS!
You are needed in the great modern Television-Electronics industry. Trained technicians are in growing demand, at excellent pay, in sales and service, manufacturing, broadcasting, telecasting, communications, research, and many other important branches of the field. National Schools Master Shop-Method Training, with newly added lessons and equipment prepares you in your spare time, right in your own home, for these fascinating opportunities.

YOU EARN WHILE YOU LEARN
Many students pay for their entire training—with spare time earning. We'll show you how you can, too! You receive material that shows you how to earn extra money servicing TV and Radio receivers, appliances, and doing many other profitable jobs.

YOU GET EVERYTHING YOU NEED
Clear, profusely illustrated lessons, shop-tested manuals, modern circuit diagrams, practical job projects—consultation privilege with our qualified staff.

Don't delay your future another day. Send coupon for full information TODAY.

MAIL POSTAGE-FREE COUPON... NOW!
1. Fill out coupon in Ink.
2. Cut along dotted line and fold coupon.
3. Staple, paste, glue, or tape ends together.
4. Mail today! No postage necessary.

FREE! Career-Spin in TV-Radio-Electronics, PLUS actual SAMPLE LESSON. No obligation, no salesman will call.

Name
Address
City Zone State
Check if interested ONLY in Resident Training in Los Angeles
VETERANS: Give date of discharge

NATIONAL SCHOOLS
4000 South Figueroa Street
Los Angeles 37, California

NOVEMBER, 1957

POSTAGE WILL BE PAID BY
NATIONAL SCHOOLS
4000 South Figueroa Street
Los Angeles 37, California

RG-117

www.americanradiohistory.com
RETMA CHANGES NAME. The Radio-Electronics - Television Manufacturers Association has changed its name to Electronic Industries Association (EIA). This is hoped to be the end of a series of changes, by which the Radio Manufacturers Association (RMA) successively became RTMA and then RETMA before adopting its present title.

2 TV PROGRAMS TO A CHANNEL, making it possible for one to be used for pay-TV and the other for free viewing, has been proposed to the FCC by Blonder-Tongue Labs. Though exact technical details are not yet available, it was revealed that two pairs of signals are to be transmitted by the TV station, one pair for program A and the other for program B. Program A consists of two positive units (see Fig. 1-a) which combine to produce a show on the viewer's screen. However, program B is made up of one positive and one negative signal. (see Fig. 1-b). These signals cancel each other and do not appear.

When you wish to see program B, a Bi-Tran decoding signal is fed to the receiver. The decoding signal reverses the negative image in the B program to positive and the B program is received (see Fig. 2-b). Simultaneously, one of the positive signals for the A program is reversed to negative and the A program is cancelled out (see Fig. 2-a). As applied to pay TV, the normal (free) program would come through on the A channel and the pay program on the B channel. To watch the pay program, the set would be switched to the B channel. This would bring decoding signals—carried on the regular telephone line—to the receiver, and at the same time would transmit information as to the program selected back to the telephone office. The payment could be included in the viewer's monthly phone bill.

Modification of both receiving and transmitting equipment would, of course, be necessary.

In military uses the Bi-Tran system could allow transmission of classified information as only persons who knew the proper decoding signals could decipher the signal.

Doubling the number of TV channels would also permit educational programs and public service information as required by police and fire departments and hospitals to be transmitted without disturbing any existing programs.

Calendar of Events
1957: Toronto High-Fidelity Exposition, Oct. 30-Nov. 2, Park Plaza Hotel, Toronto, Canada.
High Fidelity Music Show, Nov. 1-3, Hotel Mcinnosh, Portland, Ore.
International Congress and Exhibition of Measuring Instrumentation and Automation, (Interkama 1957), Nov. 9-16, Dusseldorf, Germany.
Third IRE Aeronautical-Communications Symposium, Nov. 6-8, Hotel Utica, Utica. N. Y.
Puerto Rico Hi-Fi show, Nov. 8-10, Norman
die Hotel, San Juan, P. R.
High-Fidelity Music Show, Nov. 8-10, New
Washington Hotel, Seattle, Wash.
Third Annual IRE Instrumentation Conference, Nov. 11-13, Baltimore Hotel, Atlanta, Ga.
IRE (RETMA) Radio Fall Meeting, Nov. 11-
13, King Edward Hotel, Toronto, Canada.
High Fidelity Music Show, Nov. 22-24, Stat-
ley Hotel, St. Louis, Mo.
RETMA Conference on Maintainability of Electronic Equipment, Dec. 18-19, University of Southern California, Los Angeles, Calif.

NEW BATTERY makes electricity direct from gases, by feeding oxygen and hydrogen through its electrodes. The simplified diagram shows the basic operation of this new battery, called a fuel cell. Hydrogen and oxygen enter the cell through specially treated, low, porous carbon electrodes. When the gases diffuse to the electrodes' surfaces, they come into contact with the electrolyte, a solution of potassium hydroxide. At the hydrogen electrode, the electrochemical reaction releases an electron which flows through the external circuit and is accepted at the oxygen electrode. This flow of electrons is the current that powers electrical

(Continued on page 10)
DEVRY TECH CAN PREPARE YOU IN SPARE TIME AT HOME AS AN

ELECTRONICS TECHNICIAN!

No Previous Technical Experience or Advanced Education Needed!

Laborers and bookkeepers, store clerks, farmers, salesmen — men of nearly every calling — have taken the DeVry program and today have good jobs or service shops of their own in Electronics.

Here’s proof positive that it can be done — done by men like yourself — men who had no previous technical experience, no advanced education.

If you are 17 to 55, we will tell you free how you may prepare for exciting, interesting jobs in Automation Electronics, Radar, Guided Missiles, Communications, Industrial Electronics and many others shown at right. Here is a chance of a lifetime to prepare to cash in on one of today’s fastest growing fields. Mail the coupon for details.

DeVry Tech’s amazingly practical home method enables you to spend minimum time to get maximum knowledge. In fact, you get exactly the same type of basic training equipment used in our Chicago and Toronto training laboratories — among the finest!

Send coupon for free facts NOW!

Live-Wire Employment Service

DeVry Tech’s Placement Department is in contact with some of the best-known employers in the Electronics field. The service is free to all graduates—and DeVry Tech’s record in helping to place men has been outstanding.

Draft Age?

We have valuable information for every man of draft age, so if you are subject to military service, be sure to check the coupon.

What a DeVry Tech Diploma Meant to These Men!

G. F. Beane, W. Virginia, was a truck driver. He took the DeVry Tech Training Program, and is now a technical electronics sales representative.

Edward Hahn, Illinois. Was a laborer, now an electronics project engineer with Televiso, Inc. DeVry Tech training helped him prepare for his present position.

Nick Barton, Illinois, came directly from high school to DeVry Tech. Now he has his own service shop 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 the servicing field for himself.

"One of North America’s Foremost Electronics Training Centers"

DeVRY TECHNICAL INSTITUTE

CHICAGO 41, ILLINOIS

DeFORSIT’S TRAINING, INC.

MAIL COUPON TODAY!

DeVry Technical Institute
4141 Belmont Ave., Chicago 41, Ill., Dept. RE-11-N

Please give me FREE Sample Lesson and your booklet, "Electronics and YOU," and tell me how I may prepare to enter one or more branches of Electronics as listed above.

Name_________________________Age__________

Street__________________________Please Print__________Apt__________

City__________________________Zone______State____

☐ Check here if subject to military training.

DeVry Tech’s Canadian Training Center is located at 626 Roselawn Avenue, Toronto 12, Ontario.

www.americanradiohistory.com
BOGEN FLEX-PAK®
MAKES EVERY PA JOB AN EASY ONE

portable . . . or permanent

BOGEN'S FLEX-PAK LINE has the flexibility you need to meet virtually every PA installation problem. Flex-Pak units are light, compact, portable, and can be used separately or grouped together. The amplifiers are available in every popular price range and power output . . . 13 models in all. That's why, with Flex-Pak, you can tailor the sound system to fit the job, with none of the fuss and bother of custom installations.

And remember—you can look to Bogen for all your sound equipment needs . . . speakers, microphones, turntables, tuners, and accessories. See your Bogen distributor today.

EASY SERVICE . . . EASY INSTALLATION

Loosen 4 thumbscrews and the lid's off for fast, easy servicing. Folds back when not in use in easy-sliding accessory record player mount. 4 thumbscrews attach easily erased write-in's on gain controls mark level settings.

MAIL COUPON TODAY

NAME_________________________
FIRM_________________________
CITY_________________________
STATE_________________________

BOGEN'S FLEX-PAK LINE has the flexibility you need to meet virtually every PA installation problem. Flex-Pak units are light, compact, portable, and can be used separately or grouped together. The amplifiers are available in every popular price range and power output . . . 13 models in all. That's why, with Flex-Pak, you can tailor the sound system to fit the job, with none of the fuss and bother of custom installations.

And remember—you can look to Bogen for all your sound equipment needs . . . speakers, microphones, turntables, tuners, and accessories. See your Bogen distributor today.

EASY SERVICE . . . EASY INSTALLATION

Loosen 4 thumbscrews and the lid's off for fast, easy servicing. Folds back when not in use in easy-sliding accessory record player mount. 4 thumbscrews attach easily erased write-in's on gain controls mark level settings.

MAIL COUPON TODAY

NAME_________________________
FIRM_________________________
CITY_________________________
STATE_________________________

BOGEN'S FLEX-PAK LINE has the flexibility you need to meet virtually every PA installation problem. Flex-Pak units are light, compact, portable, and can be used separately or grouped together. The amplifiers are available in every popular price range and power output . . . 13 models in all. That's why, with Flex-Pak, you can tailor the sound system to fit the job, with none of the fuss and bother of custom installations.

And remember—you can look to Bogen for all your sound equipment needs . . . speakers, microphones, turntables, tuners, and accessories. See your Bogen distributor today.

EASY SERVICE . . . EASY INSTALLATION

Loosen 4 thumbscrews and the lid's off for fast, easy servicing. Folds back when not in use in easy-sliding accessory record player mount. 4 thumbscrews attach easily erased write-in's on gain controls mark level settings.

MAIL COUPON TODAY

NAME_________________________
FIRM_________________________
CITY_________________________
STATE_________________________
WHERE WILL YOU BE IN

Electronics

6 MONTHS FROM TODAY?

add technical training to your practical experience

Get These Valuable Booklets FREE . . .

learn how

We guarantee
to train you until you receive

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.

learn how

Our Amazingly Effective Job-Finding Service Helps Cleveland Institute Trainees Get Better Jobs . . . Here are some recent examples:

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. I also have a Motorola 2-Way Service Station. Thanks to the Institute for making this possible." Lewis M. Owen, Columbia, Ky.

Airlines—In a year and a half, he received his first class FCC License. He is continuing his training with Cleveland Institute. His goal is much higher than his present position with Eastern Airlines, so he is adding technical "know-how" to his practical experience.

Bob Thompson, Nashville 14, Tennessee

Test Engineer—"I am pleased to inform you that I recently secured a position as Test Engineer with Melper, 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 Daugherly, Falls Church, Va.

CLEVELAND INSTITUTE OF RADIO ELECTRONICS
Desk RE-11, 4900 Euclid Bldg. Cleveland 6, Ohio

November, 1957
ELECTRONICALLY OPERATED
HIGH FIDELITY TURNTABLE SYSTEM
ACHIEVES UNPRECEDENTED PERFORMANCE

NEW
FAIRCHILD

electronically controlled
and speed-regulated

Exciting, brilliantly engineered, the new Fairchild E/D brings to the turntable—a traditionally mechanical device—all the precision and accuracy of modern electronics.

Gone are the intricate couplings—the step-pulleys, cams, rubber wheels, etc. And gone with them are the principle causes of turntable distortion.

The new Fairchild E/D achieves a quality of performance beyond anything we have ever known. Rumble, wow and flutter become academic questions.

And gone with them is the new E/D's performance is entirely unaffected by variations in power line voltage and frequency.

PERFORMANCE SURPASSES ALL INDUSTRY STANDARDS

| RUMBLE CONTENT | 100% better than NARTB standards |
| FLUTTER CONTENT | specified for primary professional recording equipment |
| SPEED REGULATION |  |

HOW IT WORKS

In the new Fairchild E/D turntable speed is changed by changing the speed of the hysteresis-synchronous motor. The speed of the motor is changed by altering the frequency of the current used to drive it.

This current is furnished by a variable-frequency oscillator-amplifier, called the Electronic Control-Regulator. Four frequencies are available which operate the turntable at 162½, 33⅓, 45 and 78 rpm respectively. Individual controls also permit the user to adjust each speed ±5%.

The Fairchild E/D can be operated from any AC power line supplying 85 to 135 volts. It can be operated with DC, using a converter—or with storage batteries and a vibrator-inverter. No matter which source is used, the quality and accuracy of turntable performance remain the same.

The Turntable Unit, which incorporates the turntable, hysteresis motor and 2-belt drive, can be purchased without the Electronic Control-Regulator (ECR) and used as a high quality single-speed 33⅓ rpm turntable from a 60-cycle power line. The ECR can be obtained at a later date, and easily mounted in the unitized turntable enclosure.

PRICES ARE: Fairchild E/D complete, $186.50; Turntable Unit (less ECR), $99.50; Electronic Control-Regulator (ECR) $94.00; Hardwood Base (shock-mounted) in walnut, mahogany or korina, $51.50.

See your Fairchild dealer for a demonstration. Literature on request. FAIRCHILD Recording Equipment Co., 10-40 49th Avenue, L. I. C. 1, N. Y.
ALLIED'S 1958 CATALOG

404 value-packed PAGES

the only COMPLETE catalog for everything in electronics

Get ALLIED's 1958 Catalog—it's complete, up-to-date—404 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...

WORLD'S LARGEST STOCKS

- Latest Hi-Fi Systems and Components
- Money-Saving, Build-Your-Own KNIGHT-KITS
- Recorders and Supplies
- Public Address Systems and Accessories
- TV Tubes, Antennas and Accessories
- Amateur Receivers, Transmitters, Station Gear
- Test & Lab Instruments
- Specialized Industrial Electronic Equipment
- Huge Listings of Parts, Tubes, Transistors, Tools, Books

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

featuring:
ALLIED'S money-saving knight-kits:
Finest electronic equipment in money-saving kit form. Over 50 quality kits available—Hi-Fi amplifier, tuner and speaker kits, Hobby kits, Test Instruments, Ham kits (see our KNIGHT-KIT values elsewhere in this publication). ALLIED KNIGHT-KITS are easiest to build and they SAVE YOU MORE.

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

ALLIED RADIO
World's Largest Electronic Supply House

NOVEMBER, 1957

send for the leading electronic supply guide

ALLIED RADIO CORP., Dept. 2-L7
100 N. Western Ave., Chicago 80, Ill.

☐ Send FREE 404-Page 1958 ALLIED Catalog

Name______________________________
Address______________________________
City__________________________Zone____State____

www.americanradiohistory.com
the finest... from every point of view...

THE REK-O-KUT TURNTABLE ARM

Most superbly styled of all arms — this is also the one turntable arm that offers best compliance, lowest resonance, optimum tracking... to give you better sound! That is why it is the one arm invariably sold with every turntable — outselling all other turntable arms combined! Write for catalog and free Strobe disc. $26.95 12" Arm, $29.95 16" Arm.

EXCLUSIVE FEATURES! • Patented sealed Versa-Twin bearing pivot provides superior horizontal compliance. • For free vertical motion, arm pivots are mounted in chrome steel ball-bearing races. • Micrometer gram weight adjustment gives correct stylus pressure without need for stylus gauge. • Has easy arm-height adjustment. Takes all popular cartridges.

REK-O-KUT
HIGH FIDELITY TURNTABLES-TURNTABLE ARMS
36-19 108th St., Corona 68, N.Y.
Cast your ballot for a successful future!

256 I.C.S. COURSES

Whether you stand at a machine or sit at a desk...whether you're making $75 a week or $75 hundred a year...whether your interest is Power Plants or Paper Pulp, Advertising or Electronics...chances are I.C.S. has exactly the course you need to get ahead.

I.C.S. is not only the oldest and largest correspondence school. It also offers the most courses. 256 in all. Each one success-proved by graduates who rose to top technical and administrative positions. Chief engineers, Superintendents, Foremen, Managers. Executive assistants.

I.C.S. Courses cover bedrock facts and theory plus practical, on-the-job applications. No skipping. Texts are prepared by leading business and industrial authorities working with I.C.S. editors and educators. They are constantly being reviewed and revised in line with current developments.

As an I.C.S. student, you study in your spare time, set your own pace. No time lost getting to class or waiting for slower students to catch up. If you wish, I.C.S. will make progress reports to your employer. You win recognition as a "comer," one who is ready to move ahead. Thousands of students report pay increases and promotions within a few months of enrollment. All graduates win the coveted, approved I.C.S. diploma.

3 FREE BOOKS! Check the subject that interests you in the coupon below. I.C.S. will rush you (1) a special book outlining your opportunities in this field, (2) the 32-page gold mine of career tips, "How to Succeed," (3) a sample I.C.S. lesson (Math.) demonstrating the famous "I.C.S. Method." "X" MARKS OPPORTUNITY.


---

### INTERNATIONAL CORRESPONDENCE SCHOOLS

**BOX 23910K, SCRANTON 15, PENNA.**

Without cost or obligation, send me "HOW TO SUCCEED" and the opportunity booklet about the field BEFORE which I have marked X (plus sample lesson):

**ARCHITECTURE and BUILDING CONSTRUCTION**
- Air Conditioning
- Architecture
- Arch Drawing and Designing
- Building Contractor
- Building Estimator
- Carpentry and Millwork
- Carpenter Foreman
- Heating
- Interior Decoration
- Painting Contractor
- Planning
- Reading Arch. Blueprints

**ART**
- Commercial Art
- Magazine & Book Illus.
- Show Card and Sign Lettering
- Sketching and Painting

**AUTOMOTIVE**
- Automobiles
- Auto Body Rebuilding and Refinishing
- Auto Engine Tuneup
- Auto Technician

**AVIATION**
- Aero-Engineering Technology
- Aircraft & Engine Mechanic

**BUSINESS**
- Accounting
- Advertising
- Business Administration
- Business Management
- Cost Accounting
- Creative Salesmanship
- Managing a Small Business
- Professional Secretary
- Public Accounting
- Purchasing Agent
- Salesmanship
- Salesmanship and Management
- Traffic Management

**CHEMICAL**
- Analytical Chemistry
- Chemical Engineering
- Chem. Lab. Technician
- Elements of Nuclear Energy
- General Chemistry
- Natural Gas Prod. and Trans.
- Petroleum Prod. and Eng.
- Professional Engineer (Chem)
- Pulp and Paper Making

**CIVIL ENGINEERING**
- Civil Engineering
- Construction Engineering
- Highway Engineering
- Professional Engineer (Civil)
- Reading Struc. Blueprints
- Structural Engineering
- Surveying and Mapping

**DRAFTING**
- Aircraft Drafting
- Architectural Drafting
- Drafting Machine Design
- Electrical Drafting
- Mechanical Drafting
- Sheet Metal Drafting
- Structural Drafting

**ELECTRICAL**
- Electrical Engineering
- Elec. Engr. Technician
- Elec. Light and Power
- Practical Electrician
- Practical Lineman
- Professional Engineer (Elec)

**HIGH SCHOOL**
- High School Diploma

**MECHANICAL and SHOP**
- Diesel Engines
- Gas-Elec. Welding
- Industrial Engineering
- Industrial Instrumentation
- Industrial Metallurgy
- Industrial Safety
- Machine Design
- Machine Shop Practice
- Mechanical Engineering
- Professional Engineer (Mech)
- Quality Control
- Reading Shop Blueprints
- Refrigeration and Air Conditioning
- Tool Design
- Tool Making

**RADIO, TELEVISION**
- General Electronics Tech.
- Good English
- High School Mathematics
- Short Story Writing

**LEADERSHIP**
- Industrial Foremanship
- Industrial Supervision
- Personnel-Labor Relations

**RAILROAD**
- Car Inspector and Air Brake
- Diesel Electrician
- Diesel Engr. and Fireman
- Diesel Locomotive

**STEAM and DIESEL POWER**
- Combustion Engineering
- Power Plant Engineer
- Stationary Diesel Eng.
- Stationary Fireman

**TEXTILE**
- Carding and Spinning
- Cotton Manufacture
- Cotton Warping and Weaving
- Loom Fixing Technician
- Textile Designing
- Textile Finishing & Dyeing
- Throwing
- Warping and Weaving
- Worsted Manufacturing

---

**Name**

**Age**

**Home Address**

**City**

**Zone**

**State**

**Working Hours**

**A.M. to P.M.**

**Occupation**

---

Canadian residents send coupon to International Correspondence Schools, Canadian, Ltd., Montreal, Canada... Special tuition rates to members of the U.S. Armed Forces.

---

NOVEMBER, 1957

---

13
OUTSTANDING FEATURES

1. Four speeds, each with ±3½% speed adjustment. Built-in illuminated strobe disk for all speeds. Built-in level bubble and leveling screws.
2. Precision 4-pole motor, extra-compliant belt-drive and idler system plus exclusive Thorens Roto-Drive principle, providing complete vibration isolation, absolutely constant speed.
3. Provision for easily changing arms without leaving unsightly permanent marks—just replace low-cost arm mounting board, available for 12'' or 16'' arms in various finishes. Easy to mount, the TD-124 requires only 2½'' clearance below mounting board. Furnished with attached line cord, shielded cable and solder plate.

Gyro-like Roto-Drive gives new Thorens TD-124 absolute speed uniformity. Heavier than 16-inch turntables, yet it starts, stops in less than 2/3 turn!

How to get the heaviest possible turntable for smooth, absolutely quiet operation without sacrificing fast starts and stops.

That's the problem Thorens engineers faced when they set out to build the best four-speed, 12-inch, hi-fi turntable money can buy. You'll be amazed at the simplicity of their solution.

The new TD-124 really has two turntables in one: (1) a heavy 10-lb. rim-concentrated, cast-iron flywheel (outweighs 16'' aluminum turntables) (2) a light aluminum cover, or turntable proper. An exclusive, Thorens-originated clutch couples or decouples the light aluminum table to the heavy flywheel for instant starts and stops. What's more, the Thorens double turntable system gives you the weight of a cast-iron table (3 times as heavy as aluminum) without danger of attracting any pickup magnet. And with this unique construction, your pickup gets magnetic shielding from motor or transformer hum fields by the iron turntable.

Ask your hi-fi dealer to show you the Thorens TD-124. Better yet, arrange to hear one of those critical, slow piano records on the TD-124. If you don't know who your dealer is, write Thorens Company, Dept. E117, New Hyde Park, N.Y. 79
GET IN ON THE TV BOOM!

TRAIN FOR A TOP-PAY JOB AS A TELEVISION TECHNICIAN

NO PREVIOUS EXPERIENCE NEEDED – study AT HOME in your SPARE TIME

Next to the atom and hydrogen bombs, the biggest noise being made today is by the booming radio-television-electronics industry.

Now, while the boom is on in full force, is the time for you to think about how you can share in the high pay and good job security that this ever-expanding field offers to trained technicians.

Just figure it out for yourself. There are more than 400 television broadcasting stations operating right now and hundreds more to be built; more than 34 million sets in the country and sales increasing daily. Soon moderately priced color television sets will be on the market and the color stampede will be on.

All these facts mean that good jobs will be looking for good men. You can be one of those men if you take advantage of my training now — the same training that has already prepared hundreds of men for successful careers in the radio-television-electronics field.

Ne experience necessary! You learn by practicing with professional equipment I send you. Many of my graduates who now hold down good paying technician jobs started with only grammar school training.

If you have previous Armed Forces or civilian radio experience you can finish your training several months earlier by taking my FM-TV Technician Course. Train at home with kits or parts, plus equipment to build YOUR OWN TV RECEIVER. ALL FURNISHED AT NO EXTRA COST!

After you finish your home study training in the Radio-FM-TV Technician Course or the FM-TV Technician Course you get two weeks, 50 hours, of intensive laboratory work on modern electronic equipment at our associate school in New York City, Pierce School of Radio & Television.

COLOR TV TECHNICIAN COURSE—All new! Learn the latest. Be prepared for those Color TV servicing profits ahead! Contains the most up-to-date servicing data, procedures and circuits. For men with radio or TV training or experience.

VETERANS! You get these free!

As part of your training I give you the equipment you need to set up your own home laboratory and prepare for a BETTER-PAY TV JOB. You build and keep an Electromagnetic TV RECEPTOR 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-Rf 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.

EARN WHILE YOU LEARN Almost from the very start you can earn extra money while learning by repairing radio-TV sets for friends and neighbors. Many of my students earn enough each week to pay for their entire training from spare time earnings . . . start there own profitable service business.

FCC COACHING COURSE Qualifies you for Higher Pay! Given to all my students AT NO EXTRA COST. Helps you qualify for the TOP JOBS in Radio-TV that demand an FCC license! Full training and preparation at home for your FCC license.

MAIL THIS COUPON TODAY!

Mr. Leonard C. Lane, President
Radio-Television Training Association
Dept. RE-11D, 52 East 19th Street, New York 3, N.Y.

[Name and Address]

[PLEASE PRINT CLEARLY]

[Signature]

[Color TV Technician Course]
[FM-TV Technician Course]
[TV Strobe Technician Course]

[Your discharge date]
Seeing Double?

SURE ... THEY LOOK ALIKE BECAUSE THEY ARE EXACTLY ALIKE

Each Merit product of the same type is exactly the same as another—both in construction and appearance.

COMPARE IT WITH MERIT

Take a Merit product off the shelf. Compare it with any other similar product on the market. You'll find Merit is superior!

COMPARE IT WITH MERIT

Only Merit live tests its products to insure uniform quality.

MERIT

MERIT COIL AND TRANSFORMER CORP.
4427 North Clark Street - Chicago 40, Illinois

Correspondence

BETTER BASS—CORRECTION

In my article "Better Bass Response," published in the September issue, I stated (page 34) that the flare cutoff of the Klipschorn is about 50 cycles. I was mistaken — the K-horn uses a 40-cycle flare.

One other statement in the article may be misleading to some readers. The sentence reads, "Below its cutoff frequency, a horn acts as a mass coupled to the driver cone." This is quite true — it acts as a mass coupled to the cone as well as retaining to some degree the resistive characteristic of horn loading. In other words, a finite horn of fairly large throat area does not abruptly unload its driver at cutoff frequency. The transition is more gradual than graphs based on theoretically infinite horns indicate. Moreover, the throat impedance of such a horn never reaches zero, but approaches a small finite value.

I should perhaps have made this point more emphatically in the article. Unfortunately, to go into an explanation of the various factors involved in the performance of various commercial horn designs below theoretical flare cutoff would require a separate article.

GEORGE L. AUGSPURGER
Los Angeles, Calif.

HORN CUTOFF

Dear Editor:

This concerns Mr. Augspurger’s article in the September issue and his letter of correction.

I'd like to point out that the horn has a property of unloading gradually, rather than abruptly at the so-called cutoff point. My paper "A Note on Acoustic Horns" (Proceedings of the IRE, Vol. 33, No. 17, pages 447-49, July, 1945) shows the actual throat impedance, both resistive and reactive components, to be continuous and finite through the point of cutoff.

Actually, the useful impedance of a horn can be made available down to about 80% of the cutoff frequency. Thus in our Klipschorn, referred to by Mr. Augspurger, the design cutoff due to taper is 40.5 cycles, calculated on the shortest length of a string stretched from throat to mouth. Taking the mean path, the taper cutoff calculates to about 37 cycles. The response is down 10 db at 32 cycles (relative to 100 cycles) so 32 cycles is taken as the practical cutoff, though wave propagation and sound pressure are still being produced to below 30 cycles.

I hope that you can use this authentic data. It seems to me rather to be
RCA offers you the finest training at home in Radio-TV electronics, TV servicing, Color TV

SEND FOR THIS FREE BOOK NOW!

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

In Canada—RCA Victor Company, Ltd.,
5001 Cote de Liesse Rd., Montreal 9, Que.

Pay-as-you-learn. You need pay for only one study group at a time. Practical work with very first lesson. All text material and equipment is yours to keep. Courses for the beginner and advanced student.

RCA INSTITUTES, INC.
A Service of Radio Corporation of America

RCA INSTITUTES, INC.
Home Study Courses in
Radio-TV Electronics
Television Servicing
Color Television

RCA INSTITUTES, INC.
A Service of Radio Corporation of America

RCA INSTITUTES, INC.
Home Study Dept.
RE-117
350 West Fourth Street, New York 14, N.Y.
Without obligation, send me FREE 52 page CATALOG on Home Study Courses in Radio, Television and Color TV. No Salesman will call.

Name: ________________________________

Address: ________________________________

City: ___________________________ Zone: __________ State: ________

KOREAN VETS! Enter discharge date __________________

To save time, paste coupon on postcard

NOVEMBER, 1957
Versatile as a one-man band

(Our apologies, Mr. Petrillo!)

Centralab Model B Control

Try a Model B just once and you'll see why we blow our horn about this 15/16" control that adapts readily to virtually any application.

Universal, fluted, knurled-type shaft fits all knobs — split knurl, shallow flat, deep flat, half-round, round.

KB-Fastatch switches snap on, to convert control to switch-type unit.

Sound like music to your ears? It does to other servicemen! That's why Centralab distributors are selling Model B's to beat the band. Order your supply now.

Centralab A DIVISION OF GLOBE-UNION INC. 123K EAST KEEFE AVENUE • MILWAUKEE 1, WISCONSIN Y-1458

CORRESPONDENCE (Continued)

regretted that such a large mass of the published material is derived from hearsay instead of from authentic sources. This is not by way of criticizing Mr. Augspurger, whom I admire, nor his papers which have been more factual than most, but I feel these things should be checked before rather than after publication. For this, I'd be inclined to pin the responsibility on the publisher. You undoubtedly realize how many people feel a printed item is true, just because it is printed. This really puts a terrific moral responsibility on the publisher to try and keep his articles factual.

Hope, Ark.

PAUL W. KLEPSCH

(The publishers of this magazine — and of most other responsible technical magazines, we hope — make every effort to be certain that the articles printed are correct and factual. In some fields, however, the authorities themselves differ as to what constitutes the facts, and nowhere is this so true as in the field of loudspeakers and their associated equipment. We could find authorities to check our articles, of course, but who could we find to check the authorities? — Editor)

WANTS CARTOONS

Dear Editor:

I am beginning to miss the cartoons in your magazine. Once upon a time you had anywhere from 5 to 10 cartoons in my favorite magazine. Now I can hardly find them. Not only that, but they seem to be shrinking in size, too. How come?

St. Louis, Mo.

FRANK ALLBRO

... ELIMINATED

Dear Editor:

I have noted your cartoons for some years now and to me they are getting worse all the time. Maybe there is something wrong with my sense of humor, but I wish you would cut them out and give us live reading matter instead.

How about it?

Chicago, Illinois

HAROLD DICKENS

(More cartoons? No cartoons? What do our readers want? Drop us a postcard with your vote.—Editor)

HIGH PERVEANCE?

Dear Editor:

In the February, 1957, issue (page 119), under the heading of 2SC66-GB I note you use the term high-perveance. I have checked and can find no definition of perveance. I would appreciate it, if you would enlighten me as to the meaning of this word.

Niles, Ohio

JACK RICHARDS

The term "perveance" is an attempt to get a factor somewhat resembling that of straight dc ohmic resistance. (Plate resistance, as you know, refers to ac resistance as measured by small voltage changes near the operating point.) Thus, the perveance of a tube is a function (in a diode, where the term was first used) of the area of the
Learn TELEVISION-RADIO
Servicing or Communications
by Practicing at Home
in Spare Time

WITHOUT EXTRA CHARGE
you get special NRI kits developed
to give actual experience with TV-
Radio equipment. You build, test,
experiment with receiver or broad-
casting circuits. All
equipment yours to
keep.

Have the High Pay, Prestige, Good
Future of a Skilled TV-Radio Technician
People look up to and depend on the Technician, more than
ever before. Offices, plants, homes everywhere are obliged to
buy his knowledge and services. His opportunities are great
and are increasing. Become a TV-Radio Technician. At home,
and in your spare time, you can learn to do this interesting,
satisfying work—qualify for important pay. To ambitious men
everywhere here in the fast growing Television-Radio field is
rich promise of fascinating jobs, satisfaction and prestige as
well as increasing personal prosperity.

Increased Opportunities in Growing Field
A steady stream of new Electronic products is increasing the
job and promotion opportunities for Television-Radio Tech-
nicians. Right now, a solid, proven field of opportunity for
good pay is servicing the tens of millions of Television and
Radio sets now in use. The hundreds of TV and Radio Stations
on the air offering interesting jobs for Operators and Technicians.

More Money Soon—Make $10 to $15 a
Week Extra Fixing Sets in Spare Time

NRI students find it easy and profitable to start
fixing sets for friends and neighbors a few months
after enrolling. Picking up $10, $15 and more a
week gives substantial extra spending money.
Many who start in spare time soon build full time
TV-Radio sales and service businesses.

Act Now—See What
NRI Can Do for You
NRI has devoted over 40
years to developing sim-
plified practical training
methods. You train at
home. Get practical experi-
ences, learn-by-doing. Ad-
dress: NATIONAL RADIO IN-
STITUTE, Washington 16, D. C.

Studio Eng., Station KATV
"I am now Studio Engineer at Television Station
KATV. Before en-
rolling for the NRI
Course, I was held back
by limitation of a sixth
grade education." BILLY
SANCHEZ, Fine Bluff, Ark.

NRI Has Trained Thousands for
Successful Careers in TV-Radio

Has All the Work You Can Do
"Quite early in my train-
ing I started servicing sets. Now have com-
pletely equipped shop. My NRI training is the
backbone of my pro-
gress." E. A. BREDA,
Tacoma, Wash.

The Tested Way
To Better Pay
See Other Side

SAMPLE LESSON
AND CATALOG
BOTH FREE

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

NATIONAL RADIO INSTITUTE, Dept. A
Washington 16, D. C.

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

Name
Address
City Zone State

ACCREDITED MEMBER, NATIONAL HOME STUDY COUNCIL

NO STAMP NEEDED!
WE PAY POSTAGE
For Higher Pay, Better Jobs
Be a Television-Radio Technician

Broadcasting Offers Satisfying Careers

4000 TV and Radio stations offer interesting positions. Gov't Radio, Aviation, Police, Two-Way Communications are growing fields. Trained Radio-TV Operators have a bright future.

Servicing Needs More Trained Men
Portable TV, Hi-Fi, Transistor Radios, Color TV are making new demands for trained Technicians. Good opportunities for spare time earnings or a business of your own.

Train at Home the NRI Way Famous for Over 40 Years
NRI is America's oldest and largest home study Television-Radio school. The more than 40 years' experience training men for success, the outstanding record and reputation of this school—benefits you in many ways. NRI methods are tested, proven. Successful graduates are everywhere, from coast to coast, in small towns and big cities. You train in your own home, keep your present job while learning. Many successful NRI men did not finish high school. Let us send you an actual lesson, judge for yourself how easy it is to learn.

No Experience Necessary—NRI Sends Many Kits for Practical Experience
You don't have to know anything about electricity or Radio to understand and succeed with NRI Courses. Clearly written, well-illustrated NRI lessons teach TV-Radio-Electronic principles. You get NRI kits for actual experience. All equipment is yours to keep. You learn-by-doing. Mailing the postage-free card may be one of the most important acts of your life. Do it now. Reasonable tuition. Low monthly payments available.

Address: NATIONAL RADIO INSTITUTE, Washington 16, D. C.

Business Reply Card
No Postage Stamp Necessary if Mailed in the United States

First Class Permit No. 20-R
Sec. 34.9, P. L. & R.
Washington, D. C.

New Quality Control Chief
"Had no other training in Radio before enrolling, obtained job working on TV amplifiers before finishing course. New Quality Control Chief."—R. Fava, Lboro, Norwich, N. Y.

NRI Course Easy to Understand
"I opened my own shop before receiving my diploma. I have had to hire extra help. I am independent in my own business."—D. P. Carmody, Stockton, Cal.

Works on Color-TV
"NRI changed my whole life. If I had not taken the course, probably would still be a fireman, struggling along. Now Control Supervisor at WOCA-TV."—J. F. Meline, New York, N. Y.

See Other Side for more information on the Tested Way to Better Pay

Sample Lesson
64-page Catalog both FREE

Technical “KNOW-HOW” Can Give You Interesting, Important Work
LEARN-BY-DOING with Kits NRI Sends at No Extra Charge

YOU BUILD AC-DC Superhet Receiver
NRI 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 L.F. amplifiers in receiver circuits. Make tests, conduct experiments.

YOU BUILD Vacuum Tube Voltmeter
Use it to earn extra cash fixing neighbors' sets; bring to life theory you learn from NRI's easy-to-understand texts.

YOU BUILD Broadcasting Transmitter
As part of NRI Communications Course you build this low power Transmitter, learn commercial broadcasting operators' methods, procedures. Train for your FCC Commercial Operator's License.
CORRESPONDENCE (Continued)

cathode and the distance between it
and the anode. In a triode tube, the
grid enters the picture and the perveance
is a function of the product of the
grid—cathode—plate spacing and
the cathode—plate spacing, as well as
of the element areas. With other factors
constant, perveance increases with
cathode area and with less spacing be-
tween cathode and the first element
outside the cathode.

A standard formula for perveance
for a tube is:

\[ G = \frac{i}{e^{2/3}} \]

where \( i \) is the cathode cur-
rent and \( e^{2/3} \) is the 3/2 power of the
plate voltage.

(The current in a tube tends to rise
not linearly with the voltage but in
proportion to the 3/2 power of the
voltage.) That is the reason for the
peculiar expression.—Editor

AGAINST LICENSING AND
PAY TV

Dear Editor:

I agree with Mr. Henry (“Licensing
Not the Answer,” page 21, September
issue). Licensing will just mean an
extra expense for the technician. I am
a part-time technician myself and do
not believe this business needs a li-
enced technician. I suggest that all
who oppose licensing write and let no
such move go through. Licensed tech-
nicians can pull underhanded deals too.
If no complaint is lodged, they get
away with it too.

I am also opposed to pay television.
The enjoyment of television is the
convenience of having the program
brought into your own livingroom,
without cost. If I have to pay to see
a movie, I might as well go to the
theater. The airways are free. What’s
wrong with the present method of spon-
soring programs? I say those who op-
pose pay TV better speak up now and
not permit any such move to go through.

BRIAN CHIN KING
New York, N. Y.

RED AND FUZZBALL

Dear Editor:

I wish to report that I thoroughly
enjoyed the article “Practical Color TV
Installation” by Bob Middleton. I am
looking forward to Part II. Part I was
clear and very well received. Give us
more.

D. WADE PITTMAN
Fountain Head, Tenn.

Dear Editor:

You can bet our boots I enjoyed the
article titled “Practical Color TV In-
stallation.”

Sure would like to see more written
like that. The fact that Bob Middleton
tells where the adjustments are and
what they look like helps me a lot. I
mean the things around the picture
tube (color), beam positioning mag-
nets, etc.

PETE KOWALCHIK
Kingston, Penn.

(And more in the same vein. No op-
posing votes yet.—Editor.)

NOVEMBER, 1957
Photofact helps you lick problems like this in just minutes for only $2.50 per model!

Let's take a look at this problem: This trouble symptom is present when there is no driving signal to the vertical deflection coils and when the horizontal scanning is normal. Look for the following possible causes:

1. Defective multivibrator or output tubes
2. Open coupling capacitors C71 or C69
3. Open linearity control R6 or cathode resistor R79
4. Open size control R5
5. Open output transformer T3

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

Using the Tube Placement chart (you'll find it in every Photofact TV Folder) you can quickly locate and check the multivibrator and output tubes.

Tubes okay?—then: Check waveform at grid of vertical output tube (W10). Wave shapes and peak-to-peak values appear right on the Photofact Standard Notation schematic. Waveform correct?—then: Check for open R6, or R79 or for faulty components in the output plate circuit. The DC resistance of the vertical output transformer and the lead colors are also shown right on the schematic.

Waveform incorrect?—then: Check voltages at the pins of the multivibrator tube. They're right on the exclusive Standard Notation schematic.

Whatever the trouble, you'll locate it faster and easier with a Photofact Folder by your side. Be sure to use the complete Replacement Parts List to select the proper replacement for the repair.

Use the servicing method you prefer—checking of waveform, voltage or resistance—you'll find all the information you need at your fingertips in Photofact.

For only $2.50 per model, Photofact helps you solve your service problems in just minutes—helps you service more sets and earn more daily!

Money Back Guarantee!

Got a tough repair? Try this—at Howard W. Sams' own risk: see your Parts Distributor and buy the proper Photofact Folder Set covering the receiver. Then use it on the actual repair. If Photofact doesn't save you time, doesn't make the job easier and more profitable for you, Howard W. Sams wants you to return the complete Folder Set direct to him and he'll refund your purchase price promptly. Get the Proof for Yourself—try Photofact now!
Rohn Towers are the only complete line of towers... from the No. 6 "all purpose" tower which is most suitable for TV installations, to the giant No. 40 communications tower. Hot-dipped galvanized finish is featured in the entire line.

No. 6 Tower is ideal for heights 50-120'. Features Magic Triangle construction that assures great strength, stability and durability. Stocking Rohn No. 6 Towers means you can fulfill practically all tower needs!

Both the No. 6 and No. 40 Towers are in 10" sections and are easily installed without special equipment. Also available: No. 30 Towers and a unique space-saver PACKAGED TOWER, the latter available in heights from 24' to 64'.

Send coupon today!

“World’s Largest Exclusive Manufacturer of TV-Communications Towers”

Rohn Manufacturing Co.
116 Limestone, Bellevue
Peoria, Illinois  Phone 4-9156

November, 1957
at no added cost

GROUP LIFE INSURANCE

(Administered and Underwritten by New England Mutual Life Insurance Co.)

for Registered Raytheon Bonded Electronic Technicians

who by preference use Raytheon Receiving Tubes

Now, Registered Bonded Dealers can gain personal security for themselves and their families — automatically increase their life insurance coverage, through their regular purchases of Raytheon Receiving Tubes. The amount of coverage is determined by the quantity of Receiving Tubes the dealer buys.

The New England Mutual Life Insurance Company has created a Group Life Insurance Plan for Raytheon Bonded Electronic Technicians — a plan offered exclusively by Raytheon Distributors who sponsor the Bonded Dealer Program. Any such Distributor who meets the necessary requirements for setting up a Group Life Insurance Plan for Bonded Dealers may give them this valuable protection without the necessity of a physical examination. Check with your Raytheon Sponsoring Distributor and see if he has it available to you.

If you’re not at present a Raytheon Bonded Dealer, better see your Sponsoring Distributor as to whether you can qualify. You’ll find being a Raytheon Bonded Dealer a real asset to you. You’ll find using Raytheon quality receiving tubes is a big help, too.

*Only Registered Raytheon Bonded Dealers who own their businesses and have the necessary shop facilities and equipment to qualify for Bonding, are eligible for Group Insurance under this plan.
What Does F.C.C. Mean To You?

What is the F.C.C.?

F.C.C. stands for Federal Communications Commission. This is an agency of the Federal Government and it consists of F.C.C. Element IV. It is mostly technical covering advanced radiotelephone theory and basic television theory. The examination covers generally the same subject matter as the second class examination, but the questions are more difficult and involve more mathematics.

What is an F.C.C. Operator License?
The F.C.C. requires that only qualified persons be allowed to install, maintain, and operate electronic communications equipment, including radio and television broadcast transmitters. To determine if an applicant is qualified, the F.C.C. gives technical examinations. Operator licenses are awarded to those who pass these examinations. There are different types and classes of operator licenses, based on the type and difficulty of the examination passed.

What are the Different Types of Operator Licenses?
The F.C.C. grants three different types of operator licenses—commercial radiotelephone, commercial radiotelegraph, and amateur.

COMMERCIAL RADIOTELEPHONE operator licenses are those required of technicians and engineers responsible for the proper operation of electronic equipment involved in the transmission of voice, music, or pictures. For example, a person who installs or maintains two-way mobile radio equipment must have a radiotelephone license. (A knowledge of Morse code is NOT required.) A COMMERCIAL RADIOTELEGRAPH license is required of persons who install, maintain, and operate automatic telegraph equipment. (A knowledge of Morse code is required.) An AMATEUR RADIOTELEPHONE license is granted to persons who install, maintain, and operate two-way radio equipment for recreational purposes only. (A knowledge of Morse code is required to be a "ham").

What are the Different Classes of RadiotelePHONE licenses?
Each type (or group) of license is divided into different classes of radiotelephone licenses, as follows:

(1) First Class Radiotelephone License. No previous license or on-the-job experience is required to qualify for this license. The examination consists of F.C.C. Elements I and II covering radio laws, F.C.C. regulations, and basic operating practices.

(2) Second Class Radiotelephone License. No on-the-job experience is required for this examination. However, the applicant must have attained a high school education. The examination consists of F.C.C. Elements I and II. The second class radiotelephone examination covers the broadcast equipment. It is mostly technical and covers basic radiotelephone theory (including electrical calculations), vacuum tubes, transistors, oscillators, power supplies, amplitude modulation, frequency modulation, measuring instruments, transmitters, receivers, and antennas and transmission lines, etc.

(3) Third Class Radiotelephone License. There is no on-the-job experience is required for this license. The examination gives the applicant the necessary idea that he must have already passed examination Elements I, II, and III. (If the applicant wishes, he may take all four elements at the same sitting, but this is not the general practice.) The first class radiotelephone examination consists of F.C.C. Elements I, II, and III. The second class radiotelephone examination consists of elements IV, V, and VI. The examination is divided into two parts, the first part covers the broadcast equipment, the second part covers radio and television broadcasting equipment. The examination is divided into different classes, each type and class having a different number of questions. The examination is divided into different classes, each type and class having a different number of questions. The examination is divided into different classes, each type and class having a different number of questions. The examination is divided into different classes, each type and class having a different number of questions.

Which License Qualifies for Which Jobs?
The THIRDD class radiotelephone license is of value primarily in that it qualifies you to take the second class examination. The scope of authority covered by a third class license is extremely small.

The SECOND Class radiotelephone license qualifies you to install, maintain, and operate all radiotelephone equipment except commercial broadcast station equipment.

The FIRST Class radiotelephone license qualifies you to install, maintain, and operate every type of radiotelephone equipment (except amateur, of course) including all radio and television stations in the United States, and in its Territories and possessions. This is the highest class of radiotelephone license available.

How Long Does It Take to Prepare for F.C.C. Exams?
The time required to prepare for F.C.C. examinations naturally varies with the individual, depending on his background and aptitude. Grantham training prepares the student to pass F.C.C. exams in a minimum of time.

In the Grantham Resident Course, the average beginner with no previous experience or training in electronics should obtain his second class radiotelephone license after from 200 to 300 hours of study. Some students should then prepare for his first class FCC license, to approximately 100 additional hours of study.

In the Grantham Resident Course, the time required to complete the course and get your second class license (under normal circumstances) is as follows:

- The DAY course (5 days a week) should get your second class license at the end of the first 9 weeks of classes, and your first class license at the end of the 3 additional weeks of classes.
- The EVENING course (2 nights a week) should get your second class license at the end of the 22nd week of classes and your first class license at the end of the 26th week of classes.
- The course is a total of approximately 6 months.

Here's how F.C.C. licensees pass the first F.C.C. exam:
- The first F.C.C. exam is divided into two parts, the first part covers the broadcast equipment, the second part covers radio and television broadcasting equipment. The examination is divided into different classes, each type and class having a different number of questions.
- The first F.C.C. exam is divided into two parts, the first part covers the broadcast equipment, the second part covers radio and television broadcasting equipment. The examination is divided into different classes, each type and class having a different number of questions.
- The first F.C.C. exam is divided into two parts, the first part covers the broadcast equipment, the second part covers radio and television broadcasting equipment. The examination is divided into different classes, each type and class having a different number of questions.
- The first F.C.C. exam is divided into two parts, the first part covers the broadcast equipment, the second part covers radio and television broadcasting equipment. The examination is divided into different classes, each type and class having a different number of questions.
- The first F.C.C. exam is divided into two parts, the first part covers the broadcast equipment, the second part covers radio and television broadcasting equipment. The examination is divided into different classes, each type and class having a different number of questions.

The Grantham Course a "Memory Course"?
- Some schools and individuals offer a "coaching service" in FCC license preparation. The weakness of the "coaching service" method is that it promotes the student already has a knowledge of technical radio and approaches the subject on a "question and answer" basis. On the other hand, the Grantham course begins at the beginning and progresses in logical order from the fundamentals of radio to the doctrine of radio. In every lesson, the student is presented with the facts and principles of radio. In every lesson, the student is presented with the facts and principles of radio. In every lesson, the student is presented with the facts and principles of radio. In every lesson, the student is presented with the facts and principles of radio. In every lesson, the student is presented with the facts and principles of radio.

- Grantham training prepares the student for the FCC examinations. The emphasis is on making the subject easy to understand. With each lesson, you receive an FCC-type test, so you can discover daily just which points you do not understand and clear them up as you go along.

- Grantham training prepares the student for the FCC examinations. The emphasis is on making the subject easy to understand. With each lesson, you receive an FCC-type test, so you can discover daily just which points you do not understand and clear them up as you go along.

- Grantham training prepares the student for the FCC examinations. The emphasis is on making the subject easy to understand. With each lesson, you receive an FCC-type test, so you can discover daily just which points you do not understand and clear them up as you go along.

- Grantham training prepares the student for the FCC examinations. The emphasis is on making the subject easy to understand. With each lesson, you receive an FCC-type test, so you can discover daily just which points you do not understand and clear them up as you go along.
5-star feature...

1. the best color TV picture
   the growth of color TV means an ever greater demand for CDR Rotors for pin-point accuracy of antenna direction.

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

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

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

5. the complete line
   a model for every need... for every application. CDR Rotors make it possible for you to give your customer exactly what is needed... the right CDR Rotor for the right job.
Learn PRACTICAL RADIO-TV with 25 BIG KITS of equipment I send you while you train with me... for valuable shop bench experience...

"I Will Train You at Home in RADIO-TELEVISION On Liberal No Obligation Plan!"

New Equipment! New Lessons! Enlarged Course! The true facts are yours in my big new catalog... YOURS FREE...

JUST MAIL COUPON!

I can train and prepare you in as little as 10 months to step into the big opportunity Radio-Television service field. Train without signing a binding contract... without obligating yourself to pay any regular monthly amounts. You train entirely at home in spare hours... you train as fast or as slowly as you wish. You'll have your choice of THREE SPRAYBERRY TRAINING PLANS... planned for both beginners as well as the more experienced man. Get the true facts about the finest most modern Radio-Training available today... just mail the coupon for my big new 56 page fact-filled catalog plus sample lesson—both FREE.

Train the Practical Way—with Actual Radio-Television Equipment

My students do better because I train both the mind and the hands. Sprayberry Training is offered in 25 individual training units, each includes a practice giving kit of parts and equipment... all yours to keep. You will gain priceless practical experience building the specially engineered Sprayberry Television Training Receiver, Two-Band Radio Set, Signal Generator, Audio Tester and the new Sprayberry 18 range Multi-Tester, plus other test units. You will have a complete set of Radio-TV test equipment to start your own shop. My lessons are regularly revised and every important new development is covered. My students are completely trained Radio-Television Service Technicians.

See for Yourself... Make Your Own Decision... Mail Coupon Today!

The coupon below brings you my big new catalog plus an actual sample Sprayberry Lesson. I invite you to read the facts... to see that I actually illustrate every item I include in my training. With the facts in your hands, you will be able to decide. No salesman will call on you. The coupon places you under no obligation. Mail it now, today, and get ready for your place in Radio-Television.

SPRAYBERRY ACADEMY OF RADIO-TELEVISION
1512 Jarvis Avenue, Dept. 20-U, Chicago 26, Illinois

Mail This Coupon For Free Facts and Sample Lesson

SPRAYBERRY ACADEMY OF RADIO-TELEVISION
1512 Jarvis AVE., Dept. 20-U, Chicago 26, Ill.
Please rush all information on your ALL-NEW Radio-Television Training Plan. I understand this does not obligate me and that no salesman will call upon me. Include New Catalog and Sample Lesson FREE.

Name ___________________________ Age __________
Address __________________________
City ______________________ Zone ______ State _________

Average cost per lesson
ONLY $3.42
Including Kits and Equipment
A GREAT AMPLIFIER TUBE IS PERFECTED FOR TELEPHONY

A new transcontinental microwave system capable of carrying four times as much information as any previous microwave system is under development at Bell Laboratories. A master key to this development is a new traveling-wave tube of large frequency bandwidth.

The traveling-wave amplifying principle was discovered in England by Dr. Rudolf Kompfner, who is now at Bell Laboratories; the fundamental theory was largely developed by Labs scientist Dr. John Pierce. Subsequently the tube has been utilized in various ways both here and abroad. At the Laboratories it has been perfected to meet the exacting performance standards of long distance telephony. And now for the first time a traveling-wave tube will go into large-scale production for use in our nation's telephone systems.

The new amplifier's tremendous bandwidth greatly simplifies the practical problem of operating and maintaining microwave communications. For example, in the proposed transcontinental system, as many as 16 different one-way radio channels will be used to transmit a capacity load of more than 11,000 conversations or 12 television programs and 2500 conversations. Formerly it would have been necessary to tune several amplifier tubes to match each channel. In contrast, a single traveling-wave tube can supply all the amplification needed for a channel. Tubes can be interchanged with only very minor adjustments.

The new amplifier is another example of how Bell Laboratories research creates new devices and new systems for telephony.

Left: A traveling-wave tube. Right: Tube being placed in position between the permanent magnets which focus the electron beam. The tube supplies uniform and distortionless amplification of FM signals over a 500 Mc band. It will be used to deliver an output of five watts.
NEW! 12-WATT Williamson-type HIGH FIDELITY INTEGRATED AMPLIFIER HF12 with Preamplifier, Equalizer & Control Section KIT $69  WIREd $79

Compact, beautifully packaged & styled. Provides complete control of the finest fidelity amplifier network. Direct tape head & magnetic phonos inputs with NARTB (tape) & RIAA (phone) feedback equalizations. 6-tube circuit, dual voltage for variable turnover base & truble-free feedback-type tone controls. Output Power: 12 w cont. 25 w pk. IM Dist. (60 & 6000 wps @ 4/1): 1.5% @ 25 w; 0.5% @ 60 w. Freq. Resp. @1.5 or 2.5 w: 20 kc to 25 kc. 3 TRU®; 2 TRU®; 1 TRU®; 0.5 TRU®. @0.5 or 0.1 w: 20 kc to 20 kc. 3 TRU®; 2 TRU®; 1 TRU®; 0.5 TRU®. @2000 cps: 20 kc to 20 kc. 3 TRU®; 2 TRU®; 1 TRU®; 0.5 TRU®. @20 kc: 40 kc to 20 kc. 3 TRU®; 2 TRU®; 1 TRU®; 0.5 TRU®.

Like the HF50 below shown, the HF12 offers virtually absolute stability, flawless transient response under either reactive or reactive (speaker) load, & is unaffected by feedback conditions. Extremely high quality output transformer with external form wound coils for 4, 8, 16 ohm speaker connections, grain-oriented steel, & fully partitioned in seamless steel case. Excellent balanced output coupling (100 w pk. IM Dist. @ 6000 wps @ 4/1: 0.5% @ 60 w, 0.3% @ 20 kc within 1 db of rated power. Freq. Resp. @ 100 w pk. 6/0.5 or 0.2 db @ 25 kc. @ 40 kc: 3 TRU®; 2 TRU®; 1 TRU®; 0.5 TRU®. @2000 cps: 2 TRU®; 1 TRU®; 0.5 TRU®. @20 kc: 2 TRU®; 1 TRU®; 0.5 TRU®.

Will not add distortion or detract from the wide-band or transient response of the finest fidelity amplifiers at any control setting. High quality feedback circuitry throughout the complete control & switching facilities. Heavy-gauge solid brushed brass panel, concentric controls, one-piece brown enamel cabinet for lasting attractive appearance. Feedback-type, sharp cut-off (12 dB/octave) scratch & random filters. Low-distortion feedback equalization. Most common recording curves for LP's & 78's, including RIAA. Low-distortion feedback tone controls: provide large boost or cut in bass or treble with mid-freqs & volume unaffected. Centralab printed-circuit Senior components; hardwired output with concentric load resistor. 4 level switch inputs (tuner, tv, tape, aux). 3 level volume inputs (separate front panel low-level input selector permits common use of changer & turntable). Proper pick-up loading & attenuation provided for all quality cartridges. Hum bal. control. DC super-imposed on filament supply. 4 convenience outlets. Extremely flat wideband freq. resp. @ 1 db 6-100,000 wps. @0.5 db 12-50,000 wps. Extremely sensitive. Nighthawk hum, noise, room, speaker, & IM distortion. Size: 4 "x 3/16" x 11/16" x 8/16. 15 lbs.

NEW! 50-WATT Ultra-Linear HIGH FIDELITY POWER AMPLIFIER HF50 KIT $157 WIREd $187

Like the HF50 shown below, the HF50 offers virtually absolute stability, flawless transient response under either reactive or reactive (speaker) load, & is unaffected by feedback conditions. Extremely high quality output transformer with external form wound coils for 4, 8, 16 ohm speaker connections, grain-oriented steel, & fully partitioned in seamless steel case. Excellent balanced output coupling (100 w pk. IM Dist. @ 6000 wps @ 4/1: 0.5% @ 60 w, 0.3% @ 20 kc within 1 db of rated power. Freq. Resp. @ 100 w pk. 6/0.5 or 0.2 db @ 25 kc. @ 40 kc: 3 TRU®; 2 TRU®; 1 TRU®; 0.5 TRU®. @2000 cps: 2 TRU®; 1 TRU®; 0.5 TRU®. @20 kc: 2 TRU®; 1 TRU®; 0.5 TRU®.

Will not add distortion or detract from the wide-band or transient response of the finest fidelity amplifiers at any control setting. High quality feedback circuitry throughout the complete control & switching facilities. Heavy-gauge solid brushed brass panel, concentric controls, one-piece brown enamel cabinet for lasting attractive appearance. Feedback-type, sharp cut-off (12 dB/octave) scratch & random filters. Low-distortion feedback equalization. Most common recording curves for LP's & 78's, including RIAA. Low-distortion feedback tone controls: provide large boost or cut in bass or treble with mid-freqs & volume unaffected. Centralab printed-circuit Senior components; hardwired output with concentric load resistor. 4 level switch inputs (tuner, tv, tape, aux). 3 level volume inputs (separate front panel low-level input selector permits common use of changer & turntable). Proper pick-up loading & attenuation provided for all quality cartridges. Hum bal. control. DC super-imposed on filament supply. 4 convenience outlets. Extremely flat wideband freq. resp. @ 1 db 6-100,000 wps. @0.5 db 12-50,000 wps. Extremely sensitive. Nighthawk hum, noise, room, speaker, & IM distortion. Size: 4 "x 3/16" x 11/16" x 8/16. 15 lbs.
New! Dynamic Conductance Tube & Transistor Tester #666
KIT $69.95
WIRE $109.95

New! TV-FM Sweep Generator & Marker #368
Kit $39.95
Wired $119.95

Eco!: for Color & Monochrome TV servicing
FREE CATALOG shows you HOW TO SAVE 50% on 50 models of top quality professional test equipment.
MAIL COUPON NOW!

New! RF Signal Generator #324
Kit $26.95
Wired $59.95

Complete with steel cover and handle.
Speed, ease, unexcelled accuracy & thoroughness. Tests all reading tubes (old picture tubes with adapter). Complete information of Gm, Gm & peak density; Simultaneous set of any of 4 combinations of 5 plate voltages, 5 screen voltages, 3 ranges of continuously variable grid voltage (with 5% accuracy max). New sweep voltages for 600, 450, 300 mua types. Sensitivity 200, 600, 1200 mua. 5 ranges, meter sensitivity (5% shunts & 5% pot). 10 SIX-position lever switches: freepoint connection of each tube pin. 10 pushbuttons rapid insert of any tube element in leakage test circuit & speed aset of individual sections of multi-section tubes in reject tests. Direct-reading of inter-element leakage in ohms. New gear-driven ratchett. Checks m, p, & p/2 transistor; separate meters readings of collector leakage current & Beta using internal dc power supply. Deep-etched satin aluminum panel; rugged gray metal-steel cabinet.

New! Color and Monochrome DC to 5 MC LAB & TV 5" Oscilloscope #460
KIT $99.95
Wired $129.95
• Features DC Amplifiers!
Flat from DC-4.5 kc, usable to 10 mc. VERT. Amplifier: full wave rectified r.f.; input to 3 meg; direct-coupled & push-pull thurh; k-follower coupling b. stages; 3-step freq-compensated attenuator (up to 1000). SWEET: perfectly linear; 10 cps-100 kc (exc. cap. for range to 1 cps); pre-set TV & V.H. positions; auto. sync. amp in. PLUS: direct or cap. coupling; b. or unbal. inputs; edge-lit engraved lucite graph screen; dimmers; filter; bezel fixed at photo equip. High intensity trace CRT. 0.66 inc rise time. Push-pull thurh; amp. flat dc to 400 kc, sem. 0.6 ms rms at 3. Built-in vol. calib. 2 axis mod. Sawtooth & 60 cps output. Antig. control. Interface blanking. Phasing control.

New! Peak-to-Peak VTVM #232 & Uni-Probe (pot. pend.)
KIT $49.95
Wired $149.95

Latest circuitry, high sensitivity & precision, wide range. Excellent with or without removing from cabinet. New balanced bridge circuit. High 2 input for negligible frequency bridging. 45° phase, can't burn-out circuit. 7 non-skip ranges on every function. 4 functions: +SC VOLTS, -DC VOLTS, DC Volt. Ohms. Uniform 3 to 1 scale ratio for extreme wide-range accuracy. Zero center. One zero-adj. for all functions. Wide range, 5% precision ceramic multiplier resistors. Measure direct peak-to-peak voltage of complex & unbalanced waves: 0.4, 14, 42, 140, 420, 1400, 4200. DC/RMS sine volts: 0.4. 15, 50, 150, 550, 1500, 3000, 10,000 (with 15V probe & 250 mc with PRF probe). Ohms: 0.2 ohms to 1000 meg. 11A/B, 6AL5, selenium rectifier; x-fmr. operated. Deep-etched satin aluminum panel; rugged gray metal-steel cabinet.

Send for FREE CATALOG now

EICO 30-00 Northern Blvd., Long Island City 1, N.Y.

RADIO-ELECTRONICS

Turn page for more EICO values

EICO® Prices 5% higher on West Coast.

C-11 Show me HOW TO SAVE 50% on Test Equipment and Hi-Fi. Send me a FREE Catalog and name of neighborhood distributor.

Name ____________________________
Address ___________________________
City _____ Zone _____ State ______

www.americanradiohistory.com
**TACTILE ELECTRONICS**

... The Sense of Touch Can Be Conveyed From Afar...

The direct extension of the first human sense—hearing—over appreciable distances began with the telephone in 1876. In 1929, John Logie Baird of London, England, added the second sense—sight—when television made its debut.\(^*\)

Remote perception of the third sense—touch—by *teleactivity*—feeling at a distance—has been partly within our grasp for some time. It is possible that Eliasha Gray was the first to approach it with his *teletypewriter* (1888), which is still in use today. By means of the teletypewriter you can write at a distance, instantaneously, in your own handwriting. True, this is not transmitting actual touch at a distance, but it comes close to it. Some of the teletypewriter features may be used in future teletactile apparatus.

To understand the better the problem of teleactivity and its enormous future technical applications, we should first analyze its essentials. The tactile sense of touch or feeling means coming in contact with something—a sensation conveyed through the tactile nerves. These sensitive nerves are highly susceptible to pressure, variations of surface from polished to rough unevenness such as velvety, sticky, soft or hard, etc. In addition, the tactile nerves are sensitive to temperature. While no single instrument—let us call it a Teletac—yet in existence can successfully feel at a distance, there is no reason in the world why it cannot be developed in the future. We have practically all the means at hand to bring it to life soon.

Indeed, for many years industry has had (and used) parts of the future Teletac. Let us cite a few. In paper manufacturing, electronic instruments continuously feel and check the thickness, smoothness (coating) of the paper in process of manufacture. The instruments alert the attendants if the paper runs uneven, or stop the machine automatically. For thin (tissue) papers, electronic contacting devices guard against small holes in the sheet. Similar instruments are used in the manufacture of rolled metal sheeting, such as nickel, copper, brass, tin foils, etc. Devices of the same kind are used in the textile industry to control weaving machinery for smoothness in finishes, density, thickness (weight), etc., of the final cloth product.

In the printing industry, where high-speed presses require extra-fast output, the metal rollers are heated or other heating means are used to dry the inks rapidly on the running paper sheet as it issues from the press. Thermo-electronic devices maintain an exact optimum temperature while the press runs.

In rubber manufacture, special electronically rigged rollers check the correct softness or hardness of rubber stock. Here, too, the electronic sensing device stops the machinery if the end product is too hard or too soft.

A recent sensing device, called the *proximity limit switch*, uses a special transducer. The entire instrument, less than 2 x 6 inches, is actuated, by the presence of magnetic materials, over a wide range of shapes, sizes, weights, roughness, whether at rest or speeding. The sensing head requires no physical contact and is effective up to a 1-inch distance. It has no moving parts and has many industrial uses.

The *Physiophon* of the author, first demonstrated in 1929 at the New York Institute for the Deaf, transformed sound waves into high-frequency electric waves. These were then conveyed via hand electrodes to the deaf. The sound was felt as pleasant, slight tingling shocks. By holding hands a group of totally deaf persons could simultaneously "hear" music, speeches, etc.

Nikiskow also was a later electric instrument called *telefactor* used by the deaf. It converts sound waves into vibrations which are detected by the finger tips.

But let us now consider the comprehensive Teletac, a future instrument with which you can actually feel at a distance. The complex transmitter—not necessarily large—could then be plugged into any telephone which by then will also be color-television equipped. You could then see, feel and order a suit or a bolt of cloth or any other merchandise across the continent. Fantastic? Yes, but not impossible. The sales clerk upon request would run his Teletac over the goods and you could actually feel the texture at a distance. Your Teletac receiver, an integral part of your own phone, requires that you merely insert your finger into its opening. Instantly you will feel the fabric and you will distinguish between silk, velvet, wool or linen. A doctor, too, can in this manner feel a patient's pulse, take his temperature, etc.

How can this be done? At the transmitter we have a metallic sensing "brush." Its smooth, round "bristles" are of nickel, short bristles, very close together, are mounted on a sort of telephone diaphragm with an electromagnet under the diaphragm making the device act similarly to a telephone. Moving the bristles over a rough texture vibrates the diaphragm more than a smooth surface. By amplification the receiver diaphragm is displaced exactly as the one at the transmitter. The receiver has a similar diaphragm with bristles on which your finger rests. You now have the illusion of feeling the exact consistency of the texture at the far transmitter. Your finger is at rest, but the bristles have the motion, acting as if you moved the finger over the distant material—which is what actually occurs. This is of course only one way to accomplish teleactivity. There are many other and more refined ways.

At the transmitter a thermistor surrounds the bristles at the same level as their tops but does not touch the bristles. When the ring touches any material—or the human body, for instance—the thermistor transmits an electric impulse over the line. At the receiver this impulse—amplified—heats a similarly shaped heater rim. Hence your finger senses the same degree of heat as that existing at the transmitter. A doctor can thus place a thermometer in the Teletac receiver and read the patient's temperature, providing the patient had a Teletac transmitter.

This is only a very sketchy and incomplete description of such a device without future refinements. For the immediate future and for industrial purposes, the problem is much simpler.

For oil-well drilling, for instance, the sensing organ can be quite rugged to tell the men instantly in what type of strata the drill head is biting. Pyrometers for heat interpretation at a distance are already on the market.

One interesting, noncommercial Teletac could easily be adapted for the blind. Braille books, using elevated dots for tactile reading are expensive. In the future, one monitoring person could guide a transmitter over the pages of a single book. Innumerable blind individuals could then simultaneously feel—read such a braille broadcast at small cost.

Industry has thousands of uses for various electronic teletacs. Few will be alike, as every manufacturing plant has its own special conditions. Yet one thing is certain: electronics will be able to supply any type of Teletac required to feel and sense efficiently at a distance.

---

\(^*\) Paul Nikiskow in Berlin was first with the invention of the scanning disk, in 1884, but no fast, light-sensitive photoelectric cells were then in existence. Hence he never achieved true television.

NOVEMBER, 1957

31

Radio-Electronics

Hugo Gernsback, Editor

www.americanradiohistory.com
Two new approaches to Amplification

Within the past few months two new amplifying devices have appeared in the field where for so many years de Forest's electron tube ruled alone, moving aside a little only in the past decade to permit the transistor to do some of its jobs.

One of the new devices, Raytheon's Spacistor (Radio-Electronics, September, 1957, page 8) looks like a member of the transistor family. The other, the Naval Ordnance Laboratory's Solion (rhymes with Napoleon) ("Electrochemical Units," Radio-Electronics, August, 1957, page 12), is like nothing else in this world. A flat cylindrical cell, which may be less than 2 inches across, divided or partly divided into two sections and filled with an electrolyte, it is a closer relative to the old wet cells that used to operate doorbells than to anything now used in the electric-electronic field. Yet it can measure pressures, flows, accelerations, and performs other functions which would otherwise require expensive, complex and bulky equipment. Operating on just under 1 volt, it runs for such long periods of time on an electric cell (battery XA-10B) specially constructed for it as to make even the transistor look like a current hog.

Neither of these devices has reached the commercial market, and it is still too early to predict what part they will play in an electronic world where the tube and transistor have already proved themselves practical and versatile amplifiers. The Spacistor is expected to find its most useful applications in the uhf field; the Solion is limited to a top of 400 cycles at present, but can operate from there down to dc. It can also be used as a transducer to turn electric into mechanical energy.

The very name of the Spacistor puts it in the solid-state amplifier family, whose best known member is the transistor. But this semiconductor device acts in many ways more like a vacuum tube than a transistor. (See Fig. 1.)

New semiconductor and electrolytic devices may push ultra-high-frequency limits upward; far outdo transistors in circuitry simplification and compactness

By Eric Leslie

The Spacistor operates at 100 volts; transistors are commonly low-voltage devices. Transistor output and input impedances are low; those of the Spacistor are high, even higher than for vacuum tubes. Transistor input capacitances, conversely, are high; the Spacistor's lower than those of vacuum tubes.

The transistor's most serious limitation has been frequency. Readers remember when commonly available ones would work well over only a little more than the audio range. The frequency limit has been pushed steadily upward since that time, but is still well below that of vacuum tubes.

One reason for the frequency limitations of the transistor is the slow

Fig. 1—Two amplifiers compared. Spacistor—High voltage is applied between collector and base in direction to produce strong electric field and practically no current. Electrons injected into this field flow very rapidly to collector. Flow is modulated by signal applied between base and modulator, which acts like vacuum-tube grid. Transistor—Similar but lower voltage is applied between collector and base. Since emitter (in n-p-n transistor) is more negative than base area near it, it injects electrons, which flow to positive collector (at lower speed than in the Spacistor, because of lower collector voltage). Signal to be amplified is applied between base and emitter, current from which increases and decreases as it becomes more or less negative with respect to base. Action is same in p-n-p transistor, with reversal of voltages and current flow.

www.americanradiohistory.com
bias voltage on the modulator also makes it act something like the screen grid in a vacuum tube. The field due to this voltage is felt through the whole space-charge region and has a greater effect on the no-signal current from the injector than does the voltage from BATT 3, across the whole Spacistor. Thus it tends to prevent the injector current from being affected by changes in the voltage between base and collector. This keeps the output impedance reasonably high—in excess of 30 megohms for an injected current of 30 ma. (The input impedance is likewise high—about 30 megohms.)

The Spacistor is still in the early experimental stages and has not yet been tested to the limits of its capabilities. No checks at very- or ultra-high frequencies have been run, and the full amplifying power of the device is still unknown. Low-frequency power gains of 70 db and voltage gains of 3,000 have already been obtained from experimental units. Transconductance of present Spacistors is considerably below that of good vacuum tubes, but is comparable to that of dry-cell types. The Spacistor's output capacitance is extremely low—values of less than 1 µf are entirely feasible—and it is expected that amplifiers can be built to operate at frequencies higher than 1,000 mc. Another advantage of the Spacistor is the isolation of input and output circuits by the modulator's screening action, a valuable feature in multistage circuits. It is further expected that it will be possible to construct Spacistors from much higher-temperature materials than transistors.

The Ionization cell

Many of us were given some idea of ionic action in our student days. In practical life, the flow of electrons has so far overshadowed that of ions that we may have forgotten that ions can carry current as well as electrons. Yet the ion still does play its part in our everyday life. It does useful work in gas tubes, rectifiers, thyristors and voltage regulators, and is even more common in electrolytic capacitors, where ions actually form one of the plates. A more conspicuous (but less useful!) form of ionic activity is corona discharge, ever more familiar with increasing voltages on TV tubes. Ionization is the breaking down of atoms under electric stress. An atom so broken down may lose an electron, and be dissociated into a negative electron and a positive ion. Or it may gain an electron and become a negative ion. An ion, then, is a charged particle of matter—an atom that has gained or lost one or more electrons.

Ions may be made by collision. In a mercury-vapor rectifier or thyatron, electrons on their way from cathode to anode knock electrons out of the gas atoms they run into on the way. These electrons accompany the first ones to the plate, increasing the tube's current output.

Ions may also be made chemically. Electrolytes are chemical solutions whose constituents may be ionized. A very common example of such ionization is the electric primary cell (a flashlight battery is the most common example). Chemical action dissolves zinc atoms out of the can. They leave in the form of positive ions, leaving electrons behind them and moving with negative ions of chlorine to form zinc chloride. Energy is released by this chemical reaction; electrons piled up in the zinc electrode (the can) constitute a negative voltage and can be made to do work on their way back to the positive (carbon) electrode.

In some types of electrolytic cells we may put an external source of electricity across the electrodes instead of expecting energy from the cell itself. (The electrolytic capacitor again immediately to mind.) A cell with two electrodes of the same metal and an electrolyte composed of a salt of that metal can be used in electroplating. Atoms go into solution as positive ions at the positive electrode, each atom leaving an electron behind. These ions drift toward the negative electrode, where each one picks up its missing electron and again becomes an atom of the metal. (If the negative electrode is not of the same metal as the positive one, it will be plated with metal from it.)

The Solon

A third type of electrolytic cell—the one used in the Solon—is one in which the electrodes take no part in the action. A typical Solon uses platinum electrodes and a mixture of iodine molecules and potassium iodide in solution. The potassium iodide breaks up into positive potassium and negative iodide ions. The iodine molecules, drifting to the negative electrode at a rate virtually independent of the low voltage which is applied to the Solon, acquire electrons and become negative iodide ions. These ions move to the positive electrode, give up their electrons, and once again become iodine molecules.

The quantity of electric current that will flow is controlled by the rate at which iodine molecules are broken down into iodide ions at the cathode.
Fig. 4—Response of cell of Fig. 3 as signal is increased (negative electrode) rather than by their re-formation into iodine molecules at the positive electrode. Hence the current flow is independent of voltage and depends on factors such as stirring (movement of solution past the cathode).

Thus we can use mechanical energy (stirring) to regulate electrical energy or convert mechanical energy to electrical energy. The first application of such an effect that comes to mind is a flow meter, and the Solion can be used for that purpose.

Fig. 5 is an example of a flow meter. This is a typical Solion used as an acoustic detector (in other words, as a sort of microphone).

At the orifice cathode, iodine is changed to iodine ions. At the gauge anodes, iodide ions are reconverted to iodine molecules. The number of iodine molecules coming into contact with the orifice cathode controls the flow of electric current in the solution.

When there is a flow of electrolyte through the orifice cathode, the number of iodine molecules coming into contact with the cathode is greater than when the liquid is still. Sound waves striking the diaphragm at the left (Fig. 3) exert pressure on the liquid, causing it to flow back and forth through the orifice in proportion to the intensity of the sound. The meter indicates current changes accordingly.

The peculiar shape of the cathode is due to the response desired. A cathode so constructed will have roughly a logarithmic response, as indicated by Fig. 4. A cell of the type shown in Fig. 3 may pass a current of less than 20 μA with no flow of liquid through the cathode orifice. At 0.01 cubic centimeter (cc) per second the current increases to more than 40 μA, an easily measurable difference. At 1.0 cc per second, current is more than 300 μA.

The same type of cell may be used to indicate and measure low-frequency changes of pressure that would not be called sound waves. Results are particularly good between 2 and 10 cycles, though the cell can be designed to increase response at a desired frequency (resonate) and is useful up to a top limit of about 400 cycles with present designs.

The "separated detector"

The Solion principle may be used in a variety of modified designs for special jobs. An example of a slightly different type of Solion is that in Fig. 5. It is adapted to the measurement of unidirectional flows and pressures. The hookup resembles that of Fig. 3, except that one of the outside electrodes is at the same voltage as the cathode, which in this cell is a piece of closely woven platinum gauze. (Its response is linear rather than logarithmic.) The ions tend to drift toward the left (positive) electrode (anode) where they become iodine molecules. In time, practically all the iodine ions find themselves, under the attraction of the anode, on the left side of the cathode (separator electrode). Now, if there is a movement of liquid toward the right, due to pressure on the left diaphragm, new ions are brought into contact with the cathode, and increased current flow is indicated on the meter. If flow is from right to left, there is no action — there are practically no iodine ions in the liquid in the cell's right section.

The electro-osmotic cell

The Solion is a two-way transducer—it can act as a flow meter which converts mechanical energy to electrical energy, and as a pump which converts electrical energy to mechanical energy. This pump can be made without moving parts by using electro-osmosis.

An electro-osmotic pump is shown in Fig. 6. It has long been known that when a liquid of low conductivity is placed in a tube of—for instance—glass, the inside surface of the tube takes on an excess negative charge. The solution close to this surface has an excess positive charge, its atoms having lost electrons to the glass. The great majority of these positive ions are tightly bound to the surface and are not free to move. Further out, they are free to move, though they are also less numerous.

If a voltage is applied to electrodes at the ends of the tubes, as shown in Fig. 6, these ions start to move to the left, taking other molecules with them.

The solution is literally "dragged by its skin" through the tube. The rate of flow can be varied by varying the voltage applied across the ends of the tube.

In the "pump" used in some Solion devices, the narrow tube is replaced by a porous disc which is essentially an arrangement of thousands of extremely small tubes. The electrodes are placed on the flat surfaces of the disc and thus liquid is forced from one side of it to the other.

An example of an electro-osmotic cell is shown in Fig. 7. It uses distilled water as a low-conductivity fluid, and the flow of liquid can be made linear with the applied voltage.

Such a cell may be combined with the separated detector of Fig. 5 to form an amplifier. A typical example is an electro-osmotic cell with 1 volt applied across it. The current can be held to about 30 μA, a power input of 30 microwatts. A linear separated detector hydraulically coupled to the electro-osmotic cell can be designed to give an output of 10 ma across 100 ohms. This is 10 milliwatts out for 30 microwatts in, a power gain of 330.

Fig. 6—How an electro-osmotic flow is produced.

Fig. 7—Voltage applied to electro-osmotic cell produces liquid flow.

The possibilities of the Solion are by no means limited to the types described above. Other designs for special purposes or for obtaining outputs bearing a special mathematical relation to the input have been designed. But even those already described seem to have a wider range of applications than can at present be predicted or imagined. They are expected to be particularly useful in airplane instrumentation. Three of them coupled together, according to the Naval Ordnance Laboratory, can be used to show directional changes in the three dimensions through which an airplane flies, replacing hundreds of pounds of bulky equipment with three extremely simple, compact units whose weight is measured in ounces. The same compactness and simplicity are likely to open up many applications in industrial and other fields.
...more about transistor types...

Part I—How drift and Unijunction transistors work and a discussion on the manufacture of alloy and diffusion transistors

By PAUL PENFIELD, JR.

In October and November, 1956, I attempted to clarify some of the confusion which was inevitable as a result of the barrage of numerous types of transistors, many with very strange-sounding names. Within the past year some new transistor types have appeared, specifically RCA's Drift transistor and G-E's Unijunction. In addition, there has been some recent confusion about the effects of various manufacturing methods on transistor properties. Therefore, it seems appropriate to go over this question.

Drift transistors

The major limit on high-frequency response of junction transistors is the time it takes holes (for p-n-p transistors) to wander or diffuse across the base. Inside the base region there is no electric field, and the only reason why the holes travel across at all is that there are more of them near the emitter and they tend to spread out evenly.

There are three main ways to get around this effect. One is to make the base extremely thin (as in surface-barrier or micro-alloy transistors). Another is to devise a structure which does not have any current carriers diffusing, and restricts the flow of carriers directly instead (the field-effect transistor). A third way is to build an electric field in the base of an ordinary junction transistor to make the holes travel across faster. When holes are acted on by an electric field they drift much faster than they would otherwise diffuse. The p-n-i-p transistor ("Confused About Transistor Types, Part 1," RADIO-ELECTRONICS, October, 1956) has such a built-in electric field, but it is not as efficient as the one in the drift transistor.

The built-in electric field is produced by having a difference in the number of donor atoms distributed in various parts of the base. Near the emitter there are more than near the collector. The "why" is not obvious but, if properly done, this graded-impurity base...
Transistor differences

The drift transistor is also called a diffused-base transistor because this describes the way the impurities are placed in the base. However, in operation, drift by electric field, not diffusion, is the method used for getting the holes out of the base. Do not be confused by these terms.

This arrangement also leads to a small collector capacitance and a low base resistance—both desirable effects for high-frequency operation. Because of these factors the drift transistor can operate in the tens of megacycles.

The Unijunction

Formerly known as the double-base diode, this device (shown in Fig. 1) has only one junction but two base contacts. (See "Using the Unijunction" RADIO-ELECTRONICS, July, 1957.) If it has an additional collector region on the right, it would just be like a tetrode transistor.

In operation, a steady current is passed between the two base electrodes, and the point where the emitter is located is at some voltage above base 2. As the emitter junction's potential is raised, nothing much happens until it reaches the potential of the base region directly opposite it. At this point the junction at the emitter becomes forward biased, and the current flows in.

The interesting thing is that as soon as the emitter junction passes current, the effective base-to-base resistance drops considerably because of the holes which the emitter passes into the base. Once this happens, the point in the base near the emitter junction will drop in voltage, causing the emitter to be even more forward biased, causing more emitter current, etc. This is an unstable condition, and the current would run away if it were not limited by external resistors. The device is now in a low-voltage-high-current condition and is effectively on whereas before it was off.

The Unijunction transistor is not useful as an amplifier, but is good for switching circuits, multivibrators, etc. It has been compared to the thyatron because its firing action is similar.

Transistor differences

Two transistors may be different, and therefore be given different names, for a number of reasons. They may be different types or they may be made from different materials—germanium, silicon or some other semiconductor.

Generally speaking, silicon is better at higher power levels and germanium at higher frequencies. In the future, one of the dozens of uninvestigated semi-conductors may turn out to be better transistor material than either germanium or silicon.

But an important third difference may be the method of manufacture. Junction transistors, for example, can be made many ways, and the transistor's characteristics depend on the method used.

In making transistors the idea is to make two p-n junctions close together. Remember that a p-region is formed wherever the acceptor density is greater than the number of donor impurities, and n-type material has more donors than acceptors. Methods of making transistors depend on schemes to move impurity atoms about and change their density.

Four such schemes are important. One is crystal-growing with controlled amounts of impurities. Another is melting a piece of germanium and letting it refreeze (recrystallize). The third is a diffusion operation conducted at moderately high temperatures, and last comes the very important alloy technique. Many manufacturing methods use more than one of these four techniques.

Alloy transistors* are by far the most common, especially for everyday applications and for power transistors. Here we start off with, say, an n-type chip of germanium (see Fig. 2) and place a small alloy dot of silicon or germanium alloy on it. Upon heating, this alloy melts and dissolves some of the germanium. When the temperature is lowered, the germanium nearest the n-type germanium refreezes to form a single crystal, but heavily doped with gallium, which is an acceptor. Thus this region will be p-type.

In practice, two dots are placed on the chip of germanium simultaneously, one to the collector and one to the emitter. Fig. 3 is a microphotograph of a cross-section view of a completed structure. Special techniques were used to make the p-type regions, emitter and collector, appear white. Contact is made by soldering a wire onto the two dots and making an ohmic contact to the base region.

This method is simple and cheap and gives nearly 100% yield when done with care. Unfortunately it is not easy to control the base width accurately, so alloy transistors are not too good for high frequencies.

Silicon p-n-p and n-p-n alloy transistors are possible, as are germanium n-p-n models, but in each of these cases there are still unsolved problems.

Diffusion types

Impurity atoms such as donors and acceptors can diffuse through solid germanium at moderately high temperatures just as a drop of ink will slowly diffuse through a glass of still water. The rate at which they diffuse depends on the temperature and also on the material.

Diffusion can take place from plated electrodes made of the diffusing material or from a vapor of the material.

If doped material is heated in a vacuum, impurities will diffuse out from the surfaces.

Diffusion is a very versatile technique for moving impurities to form junctions, although not enough information is yet available about it. The temperature applied is moderate so the germanium does not melt, and the time required is measured in minutes so the process can be controlled fairly accurately.

Often, diffusion will occur in making other types of transistors, and it is not really known what role diffusion has in making alloy transistors. Because it is not easy to tell which mechanism is at work, alloy transistors used to be called diffusion transistors. A diffused-emitter-collector (or diffused-E-C) transistor is made by diffusing in acceptor impurities on two sides of a silicon n-type material (see Fig. 4) to form two junctions. The device looks much like an alloy transistor.

An additional step is required to make contact to the p-regions, raising the cost slightly, but an advantage is that the power type alloy transistor can be much closer to the collector junction. This type of construction is best suited for silicon and germanium power transistors. Both p-n-p and n-p-n transistors can be made.

An alloy-diffused (or diffused-base) transistor is made by diffusing an n-type layer on the surface of a p-type crystal. This n-layer becomes the base (as shown in Fig. 5) and the original crystal the collector. A p-type emitter is alloyed in on the top surface.

This technique is rather easy with germanium and gives a donor distribution in the base which makes the completed unit a drift transistor, not a normal junction transistor.

Alternatively, the original material could be intrinsic or slightly n-type, and both the emitter and the collector could be alloyed after the diffusion process. Fig. 6 shows the construction, which is used in commercial drift transistors.

Double-diffused transistors, still not commercially available, are quite practical for silicon. Here two diffusions are used, in the order indicated in Fig. 7. First a p-layer is diffused as the base and then on top of this, at a lower temperature, an n-layer is diffused on as the emitter.

There are several undesirable features about the double-diffused transistor, such as the necessity to drill a hole through the emitter region to make connection to the collector base. However, at present this technique is one of the most promising for high-frequency silicon transistors.

Next month we will continue with this discussion of manufacturing methods. Bonded, micro-alloy, grown-junction, grown-base, gated, and melt-back transistors will be covered.

* Also known as alloy-junction, alloyed, fused-junction, diffusion-junction, fusion-junction, fused-alloy, and formerly known as diffused-junction, alloy-diffused, diffusion transistors. Do not be confused because of the many names, some of which are close to or the same as names for different manufacturing methods.
TRANSISTORS need protection against mistakes in any circuit, but especially in class-B amplifiers. Fuses are simplest but their cost tempts you to fuse too heavily and their resistance makes trouble in low-impedance circuits.

You can make a circuit breaker that has lower resistance than a fuse from a transistor and a relay. It will soon pay for itself. The principle is very simple and is also good for using cheap, high-resistance meters in circuits which will not tolerate their resistance. Place a low resistance (R1) in series with the load and apply the drop across it to the emitter and base of a transistor as in Fig. 1. Put the relay coil (or meter) in series between the collector and the battery.

It makes no difference whether the battery returns to the base as in Figs. 1-a and -b or to the emitter as in Fig. 1-c, if the resistance of R1 is much lower than the common-base input resistance of the transistor. Very high alpha is no advantage but a low-current relay and a transistor with low input resistance make a circuit breaker with lower series resistance. Coil resistance up to about 10,000 ohms has no effect but to require a higher voltage. The battery supply (Ea) must be a volt or two more than the relay requires (operating current times coil resistance) but less than the transistor's maximum rating. Keep it as low as possible.

Voltage can be lowest in Fig. 1-a because the polarized relay has less resistance for the same operating current. The unbiased tongue remains tripped without battery drain and is reset by hand or reverse current. Capacitor C makes the breaker trip instead of just buzzing and can be larger if a delay is wanted.

Circuits in Figs. 1-b and 1-c use ordinary plate-circuit relays which operate with a few ma in coils of 2,500-10,000 ohms and are connected to hold on after tripping until reset. They do not need capacitor C if they make before-break contacts switch S1 is needed in Fig. 1-b to protect the transistor during switching. A large value for capacitor C delays tripping.

Three-terminal breaker

The breakers of Fig. 1 have only two terminals and can be used anywhere like a fuse. Fig. 2 shows the circuit of a compact three-terminal breaker which uses the battery of the protected circuit. It requires a p-n-p transistor if it breaks the positive lead and a n-p-n transistor and reversed electrolytes if it breaks the negative lead. The photos show construction details of the unit.

The sensitive relay in this breaker keys a huskier one with better contacts. There should be several contacts, but the relay that fits the box doesn't have them. Besides, it is better to use independent breakers with circuits that have more than two battery leads.

TRANSMIT

CIRCUIT BREAKERS

By A. H. TAYLOR

Protect your transistors with circuit breakers

NOVEMBER, 1957
MULTIPLE SUN BATTERY

By RUFUS P. TURNER

The dc output of an inexpensive sun battery is too low for most amateur and experimental applications such as supplying the bias for transistor circuits. However, more current or voltage can be obtained by connecting several of these cells in parallel or series.

Completed sun battery.

Readers have several times expressed curiosity as to the performance of a battery of these cells and we decided to make a test to determine the output characteristics. First, it was figured that three cells would be about the largest number the average experimenter would buy. So three International Rectifier Corp. type B2M cells were mounted and connected as shown in the photo and Fig. 1.

Fig. 1—Pictorial of wiring.

Fig. 2—Output of multiple sun battery.

Fig. 2 shows the dc output characteristic of this three-cell sun battery when exposed to direct sunlight. Note from this curve that the output varies from 1.2 volts at 1.2-µa load (external resistance R = 1 megohm) to 0.2 volt at 400 µa (R = 500 ohms). The dc output will be proportionately lower in dimmer light. In the 100—400-µa region, in which most transistor operation probably will occur, there is a variation from 0.2 to 0.97 volt.

END
SINCE I have written so many articles showing why different amplifiers cause different kinds of distortion and getting straight the way in which different circuits function, I have received a number of calls asking why don't I design a really good amplifier circuit using the best principles discussed. The reason is obvious—I have been too busy investigating and writing. However, it is time for the best principles to be put together into one amplifier. And—in response to popular demand—here it is.

Based on some of the popular misconceptions I have been bucking, some things this amplifier does will be described by those who have been doing other things. So right here it will be well to explain just why the circuit is arranged the way it is:

Investigating different ways of coupling output tubes shows that using push-pull triodes gives the best chance of getting high quality with low distortion. But the output is rather inefficient, unless we go to transmitting triodes and get an output in the region of 100 to 200 watts by working in class B; in which case it is possible to achieve an efficiency comparable to, if not higher than, that obtained at lower powers with pentodes.

Using simple push-pull pentode operation, the circuit is extremely critical of correct matching, which no practical loudspeaker achieves. The circuit is much more efficient in that the tubes give a much bigger output for lower cost, but the stability tolerances of an overall feedback arrangement can become very critical, especially of practical (speaker) loads. Many low-cost "high-fidelity" amplifiers do use push-pull pentodes with some degree of feedback in the output. But they cause their designers numerous headaches in getting distortion down to a satisfactory figure (working into a resistance load), juggling the circuit so it remains stable (if in fact it does) into the variety of possible practical loudspeaker loads and also adjusting the circuit so it sounds reasonably good.

The third alternative is Ultra-Linear. This splits the difference between triode and pentode operation and, in most tubes, also splits the difference in efficiency. As far as the tubes are concerned, it is often the best method of operation as regards linearity, but this is not the end of the story. You need a very good output transformer designed specifically for this purpose or other kinds of distortion will show up that the patent specification didn't tell you about.

Unity-coupled

While Ultra-Linear operation makes pentode tubes much more tolerant of different loading, there is another fact about practical operation that allows us to use pentode operation, provided we do it the right way. This is the relationship between a speaker's impedance characteristic and power demand.

At the low-frequency end, where resonance causes a speaker's impedance characteristic to rise, resonance improves its electromechanical efficiency. What is needed is virtually constant voltage drive, rather than constant power drive. Less power is required if the speaker is matched to the amplifier in the region where its impedance is substantially resistive (see Fig. 1-a). This means that, although pentodes normally produce more distortion working into a higher load, we can utilize this impedance drive to reduce distortion by a greater ratio than the rise in impedance. The reduction in power demand from the output then results in a satisfactory distortion figure.

Reactive components in a speaker's impedance characteristic at the high-frequency end have a similar factor to help them. A speaker works best when fed by a constant voltage or high-damping-factor amplifier and, in most
program material, there is very little power at the extreme high frequencies. An amplifier using pentode output and a feedback arrangement that readjusts the tube operation to compensate for this (Fig. 1-b) and that delivers full power into a nominal resistance load over the entire audio-frequency range, will perform at least as well as the Ultra-Linear. It will be more efficient because pentode operation is still more efficient than Ultra-Linear, especially with class-B operation.

This is the philosophy behind two popular circuits, the unity-coupled by McIntosh and the Cirlotron by Electro-Voice. The unity-coupled circuit uses a special output transformer, a vital feature of which is the bifilar winding of the primary. None of the transformer manufacturers produces a transformer for unity coupling, with a bifilar-wound primary. If they did, its cost would put unity coupling off the map for most amplifier builders. McIntosh can produce a competitive amplifier with this circuit only because they make their own transformers on a production line, integral with the manufacture of the amplifier itself.

The Cirlotron is a circuit that is also specially adapted to production by a manufacturer who specializes in this type. The output transformer is not unusual (beyond having an unusual ratio), but the power transformer has to be because the circuit requires two separate high-voltage supplies.

Twin-coupled circuit

In the circuit I use, which I propose to call the twin-coupled circuit, instead of using two separate high-voltage supplies, or a very special bifilar-wound output transformer, I use a conventional power supply with two conventionally wound output transformers of moderate cost. The cost of these output transformers is such that two of them can be obtained for less than the one found in more conventional high-quality amplifiers.

This is made possible by the use of a circuit which does not require output transformers to respond to frequencies far beyond the actual audible frequency range required, merely to satisfy stability criteria of the feedback circuit. It has always seemed to be a waste to require an output transformer that maintains response flat to somewhere between 100 kc and 1 me to amplify satisfactorily frequencies that go up to only 20 kc.

The next question is how big are we going to make this amplifier? For the first model we decided to use a couple of EL84's to deliver a maximum output of 10–15 watts. This amplifier will deliver about 10 watts rms continuous sine wave. In practical audio program material it delivers the equivalent of 15 watts rms undistorted and 30 watts peak with slightly less than 1 volt input. This is because, when a continuous maximum output is passed, the B-plus voltage drops off a little and reduces the available power. So for performance comparison purposes this can be called a 15-watt amplifier.

The reason so small an output proves satisfactory is that it does not run into sudden kinds of distortion when the output is exceeded on momentary peaks. Careful observation and tests with various amplifiers of different power ratings have shown some interesting facts. Many circuits designed to deliver 50 watts or more probably deliver their rated output with very low distortion. But try to get 51 watts from a 50-watt amplifier and you will suddenly find you are getting only about 35 watts of distorted output.

This explains a fact that many have already noticed: that some lower power-output rated amplifiers give apparently cleaner and better output than those with a bigger rating according to specification. Suppose we have an audio program run at an average level of, say, 5 watts, with peaks extending up to what should require 60 watts.

Using a 15-watt amplifier of good design, the average level will be pure and undistorted at 5 watts. The 60-watt peak will be slightly distorted, but clipped down to about 20 watts instead of 60. The overall result does not sound too bad.

At the same apparent level from the 50-watt amplifier will sound considerably worse. The average 5-watt output, by itself, would sound the same as from the 15-watt amplifier. But the 60-watt peak drives the 50-watt amplifier into very severe distortion, so as to give only about 35 watts extremely distorted output. Not only this, but the distortion hangs over into the 5-watt level that immediately follows the 60-watt peak. Consequently even the average 5-watt level is much more distorted than it sounds in the well designed 15-watt amplifier.

To make the 50-watt amplifier sound as clean as the 15-watt amplifier we have to turn the gain control down so the peaks stay well below 50 watts, which means we shall no longer have the average operating level of 5 watts. Consequently the output will not sound as loud as it does from the 15-watt amplifier.

Based on this experience, the twin-coupled amplifier eliminates the causes of sudden-overload distortion and, surprisingly enough, gives performance that compares with many 50-watt amplifiers very favorably, although it is capable of delivering only 30 watts peak undistorted and 10 watts rms.
The circuit, but, for the purpose of this amplifier, as class-AB operation gives the same output as class B, the simpler method (and the cheaper one) is to switch to cathode bias and use class AB. Fig. 2 is the amplifier schematic.

The next point involves the choice of phase inversion. One idea considered was to use the 12AX7 with one half operating as a split-load phase inverter. This would enable single-ended feedback to be used, which was one reason for abandoning it. As we shall see, there are advantages to the use of entirely push-pull feedback in this circuit. The other reason is that the split-load phase inverter comes immediately before the 12A7 driver (V2), which has boot-strap coupling in the plate circuit to get enough swing to drive the output tubes. This means that the input grid swing to the 12A7 on each half is just about the maximum possible by the time you reach maximum output from the EL84's. Under this condition a split-load phase inverter introduces a rather curious distortion and one which overall feedback tends to exaggerate rather than minimize.

When the grid of the 12A7 coupled to the cathode of the split-load phase inverter begins to conduct, as it will if output is even slightly exceeded, it clips the waveform, the same as with any other grid current in an R-C coupled circuit. But, as well as clipping the waveform of the drive stage coupled to the cathode, it produces a very sharp peak in the waveform fed to the other half of the 12A7. This is because the cathode half of the split load is virtually bypassed by zero impedance as soon as grid current begins to flow in the tube it drives. This means that the tube begins to operate into the plate half of the load as a full amplifier, instead of a split-load inverter. Consequently a sudden, very sharp pointed peak, in a negative direction, appears in the plate circuit (Fig. 3). All of this begins to happen at about the same time other circuits reach overload points. The effect of feedback is to exaggerate this sharp peak. It takes a variety of forms at different frequencies. Some places appearing as a notch, at other places it begins to look like a damped parasitic oscillation on the waveform. This is shown by Fig. 4.

This defect can be avoided by using push-pull operation throughout, which is the circuit I finally adopted. A further advantage of using push-pull operation throughout is that it allows entirely push-pull feedback. This means the output transformers can be removed from the feedback loop. Some will immediately object that this means the

Fig. 2—Circuit of the twin-coupled amplifier.

Undercathode view shows the relatively uncluttered wiring.
feedback does not cancel distortion "produced by" the output transformer. This is not true, as I have shown in previous articles.

Output transformers cause distortion in two ways: by the direct effect of the magnetizing current at low frequencies or due to their internal reactance at very high frequencies. Usually the latter effect is produced, only because to the method of operating the tube or due to overall feedback. Consequently, removing the transformers from the overall feedback loop, rather than allowing them to produce distortion at the high-frequency end, frees them from the liability of doing so and also makes it possible to use a transformer that does not have to respond up to 100 kc or higher to produce satisfactory performance up to 20 kc.

At the low-frequency end, feedback from the primary is as effective in reducing distortion due to transformer magnetizing current as feedback from the secondary. So, by using overall feedback from the output tubes back to the input 12AX7, we avoid the need for unnecessarily high-quality output transformers and produce an amplifier which is inherently more stable than any kind of circuit with output transformers in the feedback loop.

In this circuit it is important to have close tolerance values for feedback resistors R2 and R3 in the cathodes of the 12AX7 and R4 and R5 from the cathodes of the EL84's. These resistors should be 5% tolerance or better.

The phase-inversion circuit is somewhat new, although it looks like a straight paraphase. It is different because the overall feedback operation is included in phase inversion. If the inversion provided by resistors R9 and R10 is not exact, overall feedback will correct for this.

The use of a paraphase inversion is still liable to produce an effect similar to that described with the split-load phase inverter. The presence of overall feedback in push-pull minimizes the effect, but it will still increase the distortion a little before the clipping point is reached, due to the fact that 12AU7's do not start to conduct grid current suddenly.

The remedy for this is to insert resistors R12 and R14 in series with the 12AU7's grids. This prevents the slight grid current commencement at pin 7 of the 12AU7 from being reflected into the 12AX7 grid at pin 2 and producing an asymmetrical signal through the amplifier. Instead the signal fed to pin 2 of the 12AX7 is a true inversion of that at the input, pin 7. The slight droop at maximum signal, due to the very small commencement of grid current through R12 and R14, is symmetrical and readily compensated for by the feedback arrangement, until clipping occurs on the output tubes.

Checks with the indicated values for R9 and R10, used for phase inversion, show that close tolerance is not critical. The closely controlled push-pull feedback takes care of slight fluctuations at this point. Serious deviation from the correct values, such as using 47,000 or 100,000 ohms in place of 68,000 ohms, will result in unbalance in the drive to the 12AU7 and consequent unbalance in the drive to the EL84's. These resistors, therefore, should be as close to the indicated values for R9 and R10, as well as close to tolerance feedback resistors. If you want to incorporate a refinement to be sure of obtaining absolutely the best performance from this amplifier (and some people always like to have a BALANCE control in a push-pull amplifier) use a 50,000-ohm potentiometer in conjunction with a 47,000-ohm resistor in the phase-inverter circuit. This circuit is shown in Fig. 5. Adjust the BALANCE control for equal voltages on the grids of the 12AU7, at a 1,000-cycle input signal.

Another comparatively minor advantage of this amplifier circuit is that it readily lends itself to modification to push-pull input. This has some advantages if you wish to operate the amplifier with a computer, expand or coded controls, using variable-gain stages ahead of it. These circuits work with much less distortion if the variable-gain tubes are used in push-pull so as to give a push-pull output. In using this amplifier, it is then possible to use push-pull coupling throughout. All that is necessary to make the change is to remove the phase-inversion components, put another 270,000-ohm unit in the grid circuit to pin 2 of the 12AX7 and bring out another input lead. This is shown in Fig. 6.

How it works

Now come the points that everyone wants to know—how this amplifier really works. It uses two output transformers, the primary of one being in the cathode circuit while the primary of the other is in the plate and screen circuits, with these cross-coupled. The secondaries are connected in parallel, not only at the ends but at each tap. This means that whichever secondary tap is used, half the output current will be delivered by each transformer.

On the primary the same resultant current flows through both transformer windings because they are virtually in series. The high voltage goes in at the center tap of one, through the tubes and out through the center tap of the other from the cathodes. So half the audio voltage is developed on each output transformer's primary.

For the extremely low frequencies, magnetic coupling from one primary to the other by the parallel-connected secondaries is sufficient to insure that screen voltage is always in phase with cathode voltage and that plate voltage is equal but in opposite phase on each tube. To take care of the middle and higher frequencies, where the leakage inductance of the transformer would loosen off this coupling, the simple expedient of placing a 0.5-mf capacitor between screen and cathode of each tube is used. This means that good coupling...
in the tube is maintained out to a frequency far beyond that possible in an output circuit of this type where the correct maintenance of voltage between screen and cathode depends on transformer coupling.

Here many will ask, "Why, if you are using a low-cost transformer of conventional design, do you have to get one specially made?" This was something I hoped to avoid. But everything I could find listed had to be rejected for one of two reasons.

Single-ratio transformers in this power rating (7.5 watts per transformer, since each delivers half the total) do not have the right impedances. As we have explained, the primary of each transformer presents half the normal plate-to-plate load for these tubes. Also the nominal secondary impedance needs to be twice that of the speaker system to which the two are connected, as they supply the total power in parallel, between them.

Some of the so-called "universal-output" transformers might include the correct impedance ratios. But these types are invariably intended for even poorer frequency range than we can tolerate. While complicated design, to get an unnecessary high end response, can be avoided, we still need iron to get the low end. Most of the universal type list a weight of less than 1 pound, which means they could never give power below 60 cycles—if they go that far.

For this reason, I designed a suitable transformer for the job (although two transformers are used, they are identical) and had them made up. Having proved that the amplifier works up to expectations, a number of well-known transformer manufacturers have agreed to cooperate with readers of this magazine by making this type available and the suitable new type numbers are listed in the parts list.

If you should have a couple of old transformers lying around that you would like to try in this circuit, remember that the plate-to-plate load must be half the normal value for the tubes, and the secondary rating for impedance must be double the speaker impedance with which you will use it.

As feedback is taken directly from the cathode, which is only at a low voltage above ground, it is unnecessary to use blocking capacitors in series with feedback resistors R4 and R5. This eliminates a potential cause of low-frequency instability.

Cathode degeneration, due to half the power being taken from the cathode circuits of the EL84's, reduces the effective voltage gain of these tubes as output tubes by about 12 db, operating into correctly matched load. (Operating open circuit, this would be a reduction of about 36 db.) This means damping factor, before any output feedback is applied at all, is equal to approximately 3 or 4.

The boot-strap circuit has the effect of increasing the dynamic load line for V2 by a corresponding factor of 4 times due to the 12-db degeneration in the output stage. This more than doubles the available swing from the 12AU7, but it does not have the effect of degenerating the distortion-reducing effects of negative feedback by the same factor.

This is because V2's gain is not boosted by the same amount as its available swing. Working with the 39,000-ohm plate resistor, V2's gain, with a plate resistance of about 7,000 ohms, comes out to 39/46 times the amplification factor of the tube, which is 17. This figures to about 14.4. Using the dynamic load of 4 times 39,000 ohms, or approximately 160,000 ohms, the gain of the tube rises to 160/167 times the amplification factor of 17, or about 16.3. So the change in gain, due to the bootstrap effect, is from 14.4 to 16.3, which is little more than 1 db.

Another comment on this circuit may refer to the absence of cathode-bypass capacitors, on either the 12AU7 or EL84 bias connections. In both instances, the use of a cathode-bypass capacitor not only increases the distortion produced by the pair of tubes, but also reduces the available swing as compared with the unbypassed condition. Thus leaving out the bypass capacitors is not a matter of economy, it produces better performance.

With the 12AU7 boot-strap drive circuit, the damping factor of this amplifier is still in the region between 3 and 4 (a little nearer to 3 than to 4). The overall feedback provided by the 150,000- and 1,500-ohm resistors is around 14 db, which boosts the basic damping factor of the amplifier by 5 times, to about 15. Winding losses in the output transformers reduce this, at the output terminals, to between 8 and 10, according to the tape used. As the winding losses in the transformer are still only a small fraction of the speaker's voice coil resistance, this cannot be regarded as a serious deterioration in damping.

From the feedback viewpoint, the overall feedback loop contains three rolloffs at the low-frequency end of the response. The reactances contributing to this rolloff are C2, C3, C4, and C5 and the primary inductance of the output transformers, the latter being the limiting factor. The other values are optimized to minimize possible bounce effects with any practical load reactance possibilities. This produces level response down to 20 cycles.

At the high-frequency end, cathode degeneration of the EL84's prevents either plate or cathode circuits from introducing any effective rolloff up to a much higher limit than that produced in the other circuits. The effective rolloffs are due to the V2 grids as a capacitance loading on the plate circuits of V1 with the 47,000-ohm resistors in series, and due to the EL84 grids as a capacitance loading on the plate circuit of the 12AU7. Without any compensation, the overall response of the amplifier is level up to well above 20 kc, although there is a loss of about 1 db between 15 and 20 kc.

(Continued bottom page 44)
LOUDSPEAKERS

By GERALD SHIRLEY

In the field of transducers which convert electrical energy into acoustical energy, the long-held supremacy of the cone type speaker is being challenged by new types of loudspeakers. Principally these are electrostatic, Ionophone and Corona Wind.

Strictly speaking, electrostatic speakers are not new; their theory was well understood long ago; in fact there were one or more commercial versions as far back as the Nineteen Thirties—Kylectron, manufactured by United Reproducers. These early models suffered from arc-over, dielectric breakdown and limited performance due to a lack of suitable materials in those days. As a result they dropped out of competition.

In recent years the development of myriad new materials and plastics has made possible the successful revival of the electrostatics. In their push-pull, high-frequency versions—notably JansZen and Pickering—they have already won many adherents among audiophiles.

The Ionophone was first demonstrated by Sigfried Klein, the French scientist, several years ago. This tweeter was probably the first sound-producing transducer having no moving parts. Commercial versions of the Ionophone have been in use in France for several years, principally in theaters, and production in Germany and England by licensees is reported to have begun last year. In the United States the rights to the Ionophone were acquired by the DuKane Corp., and, after a year of intensive research under the direction of their chief engineer, William Torn, working with the inventor himself, the company has announced an improved model. Electro-Voice Co. will distribute the home hi-fi version for DuKane; its price is about $150. The American version of the Ionophone has been renamed the Ionovac (see Fig. 1) and is made by Electro-Voice. (The etymology of this rechristening appears somewhat obscure since the suffix vac usually connotes the word vacuum.) How well the Ionovac tweeter will be received by the Golden-Ear crowd remains to be seen, although it seems reasonable to expect that the quality of reproduction should be excellent.

Corona Wind loudspeaker

The newest development in the speaker field is the Corona Wind loudspeaker (CWLS). Like the Ionophone it has no moving parts. However, it has the additional advantage of being inherently a wide-range transducer, with response right down to zero cycles. The CWLS is the invention of a New Zealand-born engineer, Dr. David M. Tombs, who began his work on the speaker several years ago while senior lecturer in tele-

 HI-FI TWIN-COUPLED AMPLIFIER

(Continued)

Use of resistor R6 and capacitor C1 between Vi's cathodes levels off the response to 20 kc, working into a resistance load or open circuit.

The circuit as shown will work well into any dynamic speaker combination. But for a system with an electrostatic tweeter it will produce from 6-8-db boost at about 20 kc. This can be reduced to about 2 db, which will sound quite smooth, by omitting R6 and C1. Distortion characteristic and frequency response are shown in Figs. 7 and 8. The 2 db can be eliminated by inserting a resistance about half the value of the nominal impedance (8 ohms on the 16-ohm output) in series with the tweeter feed. This will affect only the 20-kc response.

Construction kinks

C6 and C7 should be arranged to get as direct a coupling as possible between cathode and screen. This is achieved by spacing the tube sockets so the capacitors may be wired directly and snugly into this position. The output transformers are then oriented to keep all primary leads short. These are the only precautions necessary in chassis layout to insure stability.

In this amplifier circuit, ground returns are no problem at all as regards stability. But careless ground returns can result in slight hum induction. This conforms with the general pattern of precautions for power amplifier wiring. C8 may have its case directly grounded to the chassis, in which case the input ground should be isolated from chassis and a return taken to the point where the supply goes to ground at the electrolytic capacitor. Alternatively the electrolytic capacitor may be isolated from ground by using the bakelite wafer that comes with it, in which case the input socket can be solidly grounded and a return taken from the supply ground back to the input. All other amplifier grounds should then be taken to the supply ground rather than the input ground, to avoid internal ripple coupling back to the input. These precautions are necessary only if you are aiming to get a hum level in the region of 90 db or even better.

This is the first constructor amplifier utilizing the new twin-coupled output circuit. The circuit is not, of course, restricted to application to EL84 tubes. For bigger outputs class-B operation could be utilized with suitable transformers for the purpose and a method of coupling between the drive and the output stage that obviates the sudden overload characteristic of class-B unity-coupled operation. If interest in a high-output twin-coupled amplifier warrants it, we will pursue the matter and publish later a design for a further circuit with bigger output.

www.americanradiohistory.com
found that by adjusting its position and voltage it could be made to behave very much like the grid of a vacuum-tube triode. As shown schematically in Fig. 3-a, this is actually an embryonic loudspeaker. Note that the collector electrode or anode is blunt—that is, it has a smooth, broad surface. With this type of electrode structure the ac sound could be passed on to a steady, unidirectional wind; the electrical analogue would be modulated dc or ac with a dc component. To eliminate this background wind, which serves no useful purpose and would probably be distracting if audible, Dr. Tombs next tried using a corona discharge for the anode. This produced its own wind which opposed the wind from the cathode and it was found possible, by adjusting the voltage and position of the grid, to achieve a state of no wind (zero current). (See Fig. 3-b.)

This is the form which has been utilized in making small prototype speakers for laboratory studies and demonstrations of the device. It can be seen from Figs. 4 and 5 that a great many pairs of needles are used; the reason for this is simply that the amount of sound produced by a single pair is very faint. It has been estimated that for the average living room a needle field having an area of between 2 and 4 square feet will be required.

The Corona Wind loudspeaker appears to possess several significant virtues. Most of these arise from the fact that there are no moving parts, hence no resonances or nonlinear suspension problems such as are encountered in conventional cone and diaphragm speakers and drivers. The frequency response goes right down to zero and extends well up into the ultrasonic region at the upper end. The corona-exposed electrodes of early experimental models are not yet absolutely flat but it is expected that, since flat response is theoretically possible, further research and development should make it a reality.

Speaker comparison

It is interesting to compare the Corona Wind loudspeaker with the Ionophone and electrostatic types, since there are both common characteristics and differences between them. Taking the Ionophone first, the most conspicuous similarity is, of course, the absence of moving parts. Both types require a high voltage. The Ionophone is powered and driven by an rf, amplitude-modulated transmitter. The CWLS is powered by a high-voltage dc power supply and driven by an audio signal of high peak-to-peak voltage, but no audio watts are required. The Ionophone is a point source of sound and could be used to supply output to the room air load. The CWLS is an area device and requires no coupling mechanism or transformer. However, when it is to be used as a full-range reproducer, it will require suitable baffle just like any woofer to preserve the low-frequency response—to prevent cancellation effects between front and back waves. (Either an infinite baffle or a bass-reflex enclosure should work properly with the CWLS.)

The Ionophone appears to be inherently a single-ended transducer. According to published graphs, its distortion varies inversely with frequency and this is perhaps the most important reason why its use is limited to tweeter applications. (The other reason, of course, is the horn problem.) The CWLS in its single-ended forms, as shown in Figs. 3-a and 3-b, is subject to square-law distortion in much the same manner as single-ended electrostatic speakers. Fortunately it is very easy to recast the CWLS in push-pull form (see Fig. 3-c), significantly reducing distortion.

The Ionophone is said to generate considerable internal heat, which may necessitate occasional replacement of the quartz cell. The CWLS, on the other hand, generates ozone which is corrosive to many metals. It would probably be desirable in a commercial CWLS to have the electrodes and grids made of a corrosion-resistant material such as stainless steel.

Lastly, the Ionophone appears to operate as a power diode whereas the CWLS operates as a power triode. This would seem to imply greater efficiency for the CWLS.

Turning now to electrostatic speakers (Pickering makes one called the Iso-phase, see Fig. 6), the first point of similarity to the CWLS is that both are area devices rather than point sources of sound. This particular characteristic of sound-producing transducers appears to be taking on more importance recently. This may have something to do with the increasing interest in and growth of stereo (and pseudo-stereo) reproduction. All other things being equal in a high-fidelity

![Fig. 2—Physics experiment shows effect of corona wind. The wheel spins exactly as if air were jetting out of each point.](www.americanradiohistory.com)

![Fig. 3—Basic circuit of the Corona Wind loudspeaker.](www.americanradiohistory.com)
single-channel system, if the middle and upper-middle frequencies are generated by a large area reproducer, the reproduction just seems to sound better than when the source is small.

The electrostatic speaker utilizes a high voltage, too, but its characteristics and function are quite different from the other two types. In the electrostatic the voltage used for polarizing the field, the potential is kept below that which would cause ionization and very little current is drawn. The power to drive the electrostatic speaker must be in the form of actual audio watts. (This creates something of a problem for some amplifiers since the load seen by the output tubes is almost pure capacitance.)

The lightweight diaphragm of the electrostatic speaker comes fairly close to the no-moving-parts ideal of the CWLS and Ionophone, but still imposes certain limitations on the speaker's performance. At the high end this limitation is not immediately apparent since fairly flat response to 20,000 cycles or higher has been achieved. The significant fact here, though, is that different makes of electrostatic speakers do sound different from each other and this is evidence that the diaphragms are somewhat coloring the output, no matter how slightly. As long as this is so, it is hard to see how the claim—made in certain quarters—that the output is absolutely indistinguishable from the original sound can be sustained. The current push-pull electrostatics represent a marked advance in the art and to many listeners are an improvement over cone and compression type tweeters. But until the Ionovac and CWLS have also been heard from, no speaker should be accorded the title of ultimate.

At the low end of the frequency spectrum, the limited amplitude of excursion of its diaphragm makes it difficult for the electrostatic to perform effectively—to move a lot of air. The limits on diaphragm excursion are dictated by the necessary methods of suspension and even more so by the close proximity of the polarizing plates. The only out for the electrostatic that wants to woof is to grow bigger, but obviously there are limits here too. Since the CWLS does not have a diaphragm, it is apparently not as severely limited in this respect and should be able to move considerably more air at low frequencies than an electrostatic of the same overall area. Several wide-range electrostatics have been developed and demonstrated. I have heard two models so far and they are not in the same league with Klipschorns, AR's or even a good bass-reflex job. If you want that frightening whomp from a bass drum (with the volume turned up a little, of course) or that semi-earthquake feeling which a 32-cycle (or lower) organ pedal tone can generate, you'll stick with your old-fashioned cone type woofer for the time being.

Time will tell whether with further improvements the electrostatics can equal these older types, and whether the Corona Wind loudspeaker too can equal and perhaps even surpass them. So much for comparisons. It must be pointed out in closing that, while the electrostatic and Ionophone types are already available, the CWLS is still in the experimental stage and considerable research and development will be necessary to bring it out of the laboratory and into the home. The research will have to start at a very elementary level since little is known about this aspect of corona—the associated wind. The effects of all the variable parameters—shapes and sizes of electrodes and grids, spacing, positioning, voltages, etc.—have to be studied individually and then in combination to find the optimum design centers. (Some of this research has already been started in various universities.) Since at the present time there is no timetable on the CWLS, you are advised not to put off assembling your dream system until you can obtain one. It will probably be several years at least before they are available.

END

---

**LOOK**... what Radio-Electronics has in store for you in the months ahead...

- Direct-Reading Audio Frequency Meter
- Servicing New Auto Radios
- New Amplifier with KT-68 Tubes
- Tricky Circuits in TV
- Common Fallacies in Color TV Servicing

The December issue of RADIO-ELECTRONICS goes on sale November 26 at all better parts distributors and newsstands.

**SUBSCRIPTION RATES**

- One year $6.00
- Two years $7.00
- Three years $9.00

154 West 14th Street, New York 11, N.Y.
DESpite manufacturers' efforts in preparing tube manuals, we sometimes need data that is not there. This article shows how to make the best of what is given.

The variety of circuits in which tubes are used and the ever-enlarging range of tube types make presenting adequate information about their performance in different circuits quite a problem for the tube manufacturers. In spite of the ever-growing variety, and the good job done in supplying data, we sometimes find it hard to locate a tube with just the right combination of characteristics to suit the purpose we have in mind. When we find a tube that looks about right, often the manual we are using does not present the information in an easy form to apply to our problem.

I have no less than a dozen tube manuals, of which more than half are the type maintained as a service in a loose-leaf binder. Even with this comprehensive data, I sometimes have to interpolate and figure out what I want by "inspired guesswork." But before proceeding with "how to make good guesses," some readers will want to know what is the best tube manual.

Some tube manuals

Probably the best buy, value for money, is the RCA Receiving Tube Manual, at 60c. The current edition includes 20 tabular charts of information about R-C-coupled amplifiers, covering 56 tube types, pentodes and triodes. These charts give all the essential data for three B-supply voltages, with three plate-coupling resistor values for each. A selection of three grid resistor values for the following stage with each coupling resistor is also provided. This means a total of 27 sets of operating conditions for each chart. Each lists values for the remaining resistors in the circuit, the voltage gain achieved and the maximum output available, together with capacitor values for a rolloff at 100 cycles.

From this information the design of an R-C stage can easily be completed, according to the circuit's requirements. If the desired low-frequency rolloff is 20 cycles, just multiply all capacitor values by 5 and take the next larger stock value. For example, if the cathode bypass capacitor is given as 3.7 µf, a minimum of 18.75 µf, is needed for a 20-cycle rolloff, so a 25-µf capacitor will be adequate.

The maximum available output is based on the clipping point for the operating condition given. No information about distortion is given in these tables.

Another easily obtained manual is published by Sylvania. This costs $2 and includes service. It, too, has a tabulated section for R-C amplifier design, with 22 tables covering 73 tube types. In general, these are the same types as those covered in the RCA manual, but each has some of the others misses. Also the information listed differs. The Sylvania tabulation does not give some of the capacitor values but does include information on distortion at two different operating levels, giving gain, volts in and out for each level.

For completeness of tube type coverage, Tung-Sol service is probably best, giving you two large loose-leaf binders for the purpose. They do not include a convenient listing for R-C design like RCA and Sylvania. The Tung-Sol service includes tube types other than those manufactured by them, for the sake of completeness, but even this service does not list every type, although it is probably the most comprehensive manual available in that direction.

For completeness of data on tubes covered, the Brimar application report service seems about the best (available from Standard Telephones & Cables, Valve Dept., Footscray, Kent, England). Unfortunately, in the few years that this service has been operating, they have covered little more than a couple of dozen tube types. The Mullard Data service, also very comprehensive in detail, only covers Mullard tubes and is not readily applicable to American types—especially as Mullard uses their own tube numbering system. I will not go on and list the merits and demerits of every tube manual available and I hope that no manufacturers will feel slighted because they have not been mentioned. All probably list something that the others miss, although much of the coverage is almost identical. But with all this information, we may still fail to find the data that would be most helpful for a particular job.

Pentode circuits

As an example, I recently had an application for which the tubes listed in the R-C-coupled section were not suitable. A number of channels with an input never exceeding 1 volt required maximum amplification in a single tube with minimum current drain, and the output had to be at an impedance not much lower than 100,000 ohms. A job for a sharp-cutoff pentode. Thumbing through the available types, the 6AG5 looked most likely, but neither of the manuals has it in the R-C section because its usual application is in if or rf circuits.

The available data is listed below:

<table>
<thead>
<tr>
<th>Plate (volts)</th>
<th>Grid No. 2 (screen) (volts)</th>
<th>Cathode resistor (ohms)</th>
<th>Plate (ma)</th>
<th>Grid No. 2 (ma)</th>
<th>Transconductance (µhos)</th>
<th>Plate resistance (megohms)</th>
<th>Grid No. 1 (volts for I₀ = 10 µa)</th>
</tr>
</thead>
<tbody>
<tr>
<td>100</td>
<td>125</td>
<td>250</td>
<td>4.5</td>
<td>7.2</td>
<td>9.5</td>
<td>0.6</td>
<td>-5</td>
</tr>
<tr>
<td>125</td>
<td>135</td>
<td>150</td>
<td>1.4</td>
<td>2.1</td>
<td>2.0</td>
<td>0.5</td>
<td>-6</td>
</tr>
<tr>
<td>150</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>5.0</td>
<td>-8</td>
</tr>
</tbody>
</table>

This information is found in several manuals. The only difference is that the items are in a different order. Where do we go from here? The following procedure has been found fairly reliable and produced a good answer to this problem. We have specified that the plate coupling resistor must be 100,000 ohms. For maximum swing, using a B plus of 250 volts, we
should have about 150 volts on the plate, or 100 volts drop across the 100,000-ohm resistor, placing the operating point near the center of the available swing. This represents a plate current of 1 ma. In each case the screen current is a little less than one-third the plate current. The screen voltage should be a little lower than the plate voltage to assure stability, so a screen feed resistor more than three times the plate resistor value should be used. A 390,000-ohm unit was tried and found successful. The total cathode current will be about 1.25 ma. Now, we need a cathode resistor to supply about 1.5 volts bias, so the tube will handle 1 volt rms safely. A resistor of 1,200 ohms seems to be needed. Let's see how this compares with the middle column of data, the nearest to this operating condition.

The specified 100-ohm cathode resistor, with a total current of 7.2 - 2.1 = 9.3 ma, will produce a bias of 0.03 volt. If we assume the plate voltage is kept the same and the bias increased to 1.5, it is obvious that the current will get reduced to a little less than two-thirds or between 5 and 6 ma, instead of the 1.25 ma we assumed. So with a 1,200-ohm bias resistor, the current would be more than 1.25 ma, and the plate and screen voltages would be lower than prescribed, probably below 100 volts. We need more bias to handle the plate current and voltage.

Different values were tried, with 1,800 ohms giving the best result. Voltages measured with a vtm were: grid bias (cathode to ground), 3.5; plate volts, 150; screen, 140. As the tube is operated fairly well into its curvature (approaching the plate bend cutoff) there is an appreciable second harmonic, but it did not matter in this application. We would guess that transconductance at this point is about a third of the quoted value as the plate current is about one-sixth the quoted value. This guess is arrived at by taking an average between the ratio and its square root: 6 is halfway between 3 and its square, 9. We would expect a change in plate current of 6 to 1 to be accompanied with a change of transconductance of 3 to 1, if the screen is changed in the same proportion. This turned out to be a good guess. The stage's gain measured 170, with a 100,000-ohm plate coupling resistor. This means the transconductance is 1,700, just one-third the quoted value of 5,100.

We could have figured this gain from the characteristic curves for the 6AG5, using a 100,000-ohm load line (see Fig. 1). For a 1-volt change in grid potential, from -3 to -4, the plate voltage changes from 40 to 210, representing a gain of 170.

The grid-resistor coupling to the following stage will cut down the gain. The grid resistor had been fixed by previous design figures at 560,000 ohms, so gain will be reduced by the effect of paralleling 560,000 ohms with 100,000 ohms in the plate circuit. As plate resistance is quoted 500,000 ohms, and is probably much higher than this at the chosen operating point, we can for convenience ignore its effect. Placing 560,000 ohms in parallel with 100,000 ohms gives an ac load resistance of 85,000 ohms. Gain is reduced, 0.85 × 170 = 145.

To figure the low-frequency response, which must go down to 20 cycles, first we consider the coupling capacitor, which will introduce a 3-db loss when its reactance is equal to 100,000 ohms and 560,000 ohms in series, 660,000 ohms. A .02-
f capacitor has a reactance of 390,000 ohms at 20 cycles, which will cause a loss of about 2 db.
TRUE or FALSE Quiz for Audiophiles

By HERMAN BURSTEIN

1. If a power amplifier rated at 100 watts produces 12.5 watts for an input of 0.5 volt, it will produce 25 watts for an input of 1 volt.
False—It will produce 50 watts, because power varies with the square of the voltage.

2. It is more important for phonograph turntable to rotate at a steady speed than at an accurate speed.
True because most human ears can tolerate deviations from correct speed —for example, 34 instead of 33 1/3 revolutions per minute—of as much as 1%, 2% or even 3% without these deviations being perceptible or annoying. However, extremely small departures from steady rotation (wow and flutter)—well below 0.5%—are perceptible and annoying to most persons.

3. Single-cone speakers are often superior to coaxial and two-way systems in the same price class.
True—Mere division of the audio spectrum does not mean more speakers is not sufficient for reproduction that is smooth, low in distortion and adequate in range. There are several single-cone speakers on the market which in these respects outperform multiple speaker systems at comparable total price. On the other hand, the ultimate in audio today is obtained by multiple-speaker systems that use specially designed units for each portion of the audio spectrum.

4. Many AM broadcast stations meet high-fidelity requirements so far as frequency range is concerned.
True—AM stations are not required to cut off above 5,000 cycles, as is often supposed. Many maintain flat response to 12,000 or even 15,000 cycles. However, most AM tuners cut off sharply above 5,000 cycles or thereabouts for design reasons and to minimize interstation whistles. Some high-fidelity AM tuners do maintain response well above 5,000 cycles, but unless the signal is a relatively strong one, noise and adjacent-channel interference may become unpleasant.

5. Since A.F. (automatic frequency control) increases distortion, it is best to operate an FM tuner with A.F. off, if this is optional.
False because, if anything, A.F. decreases distortion. The disadvantages of A.F. are a slight loss in sensitivity—in most cases much too small to be of importance—and difficulty in separating a weak station from a nearby strong one; that is, with A.F. on, the tuner tends to capture the strong signal rather than the weak one if the two are close to each other on the dial.

6. The principal difference between professional and home tape recorders operating at 7.5 ips is in their high-frequency response.
False. Many home recorders have high-frequency response extending as far as 20,000 cycles, while the professional machine is limited to about 10,000 cycles.

N O V E M B E R, 1957
The problem of how to get out evenings without the added expense of a baby sitter arises in every family with children. Some folks use a member of the family or a neighbor as a sitter; this is not always a happy solution. This article will describe a remote baby-sitting system which permits a neighbor to baby sit for you without leaving her home.

When you visit your nearby neighbors, you will be able to sit back and enjoy the evening without running back and forth to check the children. When possible, a direct line to a neighbor, an audio amplifier, microphone and speaker can't be beat, but in most cases the neighbor who will baby-sit for you is several houses away.

The solution is to use a carrier-current system. Although these systems have been discussed before, I do not consider existing circuits satisfactory for baby sitting. One reason is the possibility of the carrier shifting frequency over a period of several hours, causing a partial or complete loss of the signal at the receiving end. Second, a separate receiving unit must be built.

My circuit circumvents these problems by being crystal-controlled and operating in the broadcast band. It can be tuned in on almost any broadcast receiver.

The main defect of a carrier system is that reception is limited to houses on the same common side of the house.
Miller type 43-A antenna coil, is to cut off the mounting lug and solder the coil directly to the lugs on the trimmer capacitor. To determine proper trimmer adjustment, place a dc voltmeter across the 5,000-ohm resistor R3. About 100 volts will be indicated. Screw the trimmer in and out; a broad point will be found where the voltage falls to below 50. The circuit is now properly loaded. Plug in a radio and turn to 1,000 on the dial (allow 15 minutes warmup for stability). The system is now in operation.

**Optional receiver**

For those who would rather not use a radio as part of their system a carrier-current receiver circuit is shown in Fig. 2. The three-tube circuit eliminates receiver drift, and provides considerable gain. More gain can be obtained by adding a 10-µf 25-volt electrolytic capacitor across the 6SJ7 cathode resistor R3. Removing or decreasing the value of C4, the tone control capacitor, will also increase gain.

Observe proper polarity with the germanium diodes. The bypass diode increases amplifier gain and decreases noise and hash to a large extent.

The receiver's frequency range is about 380–1,700 kc. To receive frequencies below 430 kc add a 50–100-µf capacitor across C3. If the receiver will not tune to a high enough frequency, replace C3 with a trimmer of lower capacitance.

The transmitter will operate satisfactorily at 530–540 kc if trimmer C4 is changed to an Arco 304M (320 µf) and a 100-µf mica is wired across it.

The receiver is very quiet without any appreciable 60-cycle hum. Compared to some broadcast receivers it seems to have better quality with excellent music reproduction.
LOW-NOISE TV BOOSTER

This 4-channel unit brings in that color program. Helps to end weak color and confetti

By J. R. Lange, K9ARA

The growing use of color TV sets has created new interest in improving fringe area reception. The fringe for good color reception seems to be closer to the TV transmitter than for black and white. We recently purchased a color TV set before local uhf stations were equipped to originate or relay color programs. Nearly snow-free black-and-white reception was obtained from Milwaukee and Chicago vhf channels 4 and 5 but very little color and lots of confetti was present during color broadcasts. Little could be done to the antenna so several boosters were tried using 6J6 and 6BZ7 tubes. Some improvement, but not enough to be really significant, was obtained on channel 5 using a hot 6BZ7.

The noise figure or snow contribution of a booster or TV tuner rf stage is mainly determined by the tubes. The higher the tubes' transconductance, the lower the noise figure. Common tubes, such as the 6G7, 6B7-A, 6G7-A, 6BZ7, 6B38, etc., now used for TV tuners, boosters and distribution amplifiers, have transconductances of 6,000 to 9,000 µhos. Some miniature tubes such as the 6AJ4, 6Am4 and 6RC4 are rated at about 10,000 µhos. Since the first or grounded-cathode stage of a vhf cascade rf stage contributes most to the noise figure, a more expensive (88 to 815) tube can be used for the first stage and a less expensive one for the grounded-grid stage.

I built a channel-5 cascade TV booster with a Western Electric WE 417-A/5842 followed by a G-E type 6AJ4. The 417-A has been popular with amateurs on the vhf bands and has a low noise figure because of its 20,000-25,000-µho transconductance. The color picture improvement was surprising. Color confetti was reduced. Color sync and saturation were improved. The booster also improved all black-and-white sets it was tried with.

The requirements of wide-band microwave rf and video amplifiers have led to the development of high-performance pentodes such as the WE 404-A/5847 and Amperex and Mullard E180F/6688. They feature a close-spaced grid and cathode structure similar to that of the 417-A. When triode-connected, with screen tied to plate, a grounded-cathode stage with a transconductance of 20,000 µhos can be obtained. Noise figures are nearly as low as with the 417-A.

Our four-channel vhf booster was built with triode-connected 404-A's and E180-F's in the input stages of channels 4, 5, 9, and 12, and 6AJ4's in the grounded-grid stages using a series dc cascode circuit. The 6AJ4 is a good grounded-grid amplifier and has a heater-to-cathode voltage rating sufficient for use in the series dc or direct-coupled cascade circuits. It is moderately priced and can handle the plate current required for proper operation of the first stage. The presence of the suppressor grid in a pentode input tube causes little increase in noise, but does cause some loss of gain when the 404-A is used on channels 7 to 13. This is probably due to the internal connection of the suppressor to cathode and the common-cathode lead inductance. The E180F suppressor can be separately grounded and the two cathode leads doubly bypassed to give better high-band gain.

If a booster is to be constructed, decide what input tube type is to be used and what form the booster will take.
for best utility and appearance. For high-band channels the 417-A, E180F, and 404-A (in the order named) are best for gain. The gain with the 401-A is still high enough so that noise figures of all three tubes are comparable and around 4.5 db. Low-band gains are nearly the same, and noise figures of about 3 db can be obtained. These tubes are usually not sold locally but are obtainable from several mail-order surplus dealers. Make sure tubes are new; not used or rebushed. E180F's are obtainable from Amperex Electronic Corp., Hicksville, N.Y., and from Amperex or Mullard distributors. The 404-A and 417-A/5842 are also obtainable from Ericsson (State Labs, 649 Broadway, New York, N.Y.) at list prices. Special-purpose tubes may often be obtained from dealers who do not list them in their catalogs. Be sure to specify the 417-A/5842 completely to avoid getting a WA147-A surplus klystron.

Building the unit

The booster shown in the photographs was built for use on top of or alongside the TV set. It was built into a 2 1/4 x 10 x 4-inch Channel Lock aluminum box and has a self-contained power supply. Fig. 1 shows the circuit for a single channel. Four of these are combined to form a four-channel booster. The power supply is as in Fig. 1. Plate and heater power can be switched to any of the four peaked single-channel amplifiers. Input and output leads are quickly connected using clothespin type antenna clips. A straight-through connection is provided for local vhf or uhf converter output.

The inside of the booster (see photos) shows the suggested circuit layout. Sockets are oriented with plate leads toward the output. A sheet-aluminum shield is placed across the 6AJ4 socket (passing between pins 3 and 4 and 8 and 9) to prevent oscillation. Lead lengths of the input tube anode and bypass and the 6AJ4 grid bypass capacitors should be as short and direct to a chassis ground as possible. The input and neutralizing coils are insulated from the chassis.

The tubes should be shielded from each other to keep the grounded-grid stage stable. The ordinary JAN type shield causes high bulb temperatures and for longest tube life should be avoided. The four-channel amplifier has heat-conducting shields on the 6AJ4's. (We used IERC military B type shields made by IERC, 145 Magnolia Boulevard, Burbank, Calif.) It is recommended that they be used on both tubes.

Besides the input tube the input coil has an important effect on the booster's noise figure. The coil-winding data table gives coils that are overcoupled past the point of maximum gain so as to present to the tube the impedance giving lowest noise figure. The four-channel booster uses 3/4-inch-diameter coil forms from a microwave or radar if strip. Commercial 3/4-inch-diameter forms such as the Cambridge Thermionic Corp. LS-6 or the James Millen 69048 are equivalent. High-frequency powdered-iron cores coded white should be used. Lower-frequency cores will lower the coil Q and may increase the noise figure.

The low-band input, neutralizing and output coils are wound tightly with No. 28 enameled wire. Adhesive tape cut into 3/4-inch strips will help to hold the ends while winding. Bend the first inch of wire at a right angle to the direction of winding and lay on the form parallel to the axis. Wrap a small length of tape several times around the form and the lead near the bend. Wind the coil, keeping the turns tight. After the last turn, bend the wire at right angles to the windings and parallel to the axis of the form. Tape down like the starting end. Leave 1-inch leads. Coat the winding and tape with a good coil dope such as Q Max or polystyrene cement. Model-airplane type cements should not be used. They reduce coil Q.

The input coil and output windings L1 and L6 are similarly tightly wound, in a reverse direction, over the grid and plate windings after they are dry. When halfway through the input winding, scrape 2 inches of the wire bare, fold over, twist and tin with solder so that a 1-inch twisted lead for the center tap sticks out. Finish winding, tape the end and apply another coat of coil cement. Check with an ohmmeter to make sure the two windings are not shorted.

Coils for channels 7 to 13 are wound with No. 24 enameled wire. This is easily done after the forms are mounted on the chassis. The heater and interstage rf chokes are tightly wound over a 3/16-inch-diameter rod or drill shank. By scraping the enamel off, tinning with solder and bending the leads before sliding out the rod, the choke will not be distorted when ready to solder in the circuit. The interstage choke for channels 7 to 13 is wound using the leads of capacitor C4, spreading turns apart one turn width.

If space is a problem or if a booster for only one channel is needed it can be built into a 2 x 2 x 4-inch aluminum box with power taken from the TV set. It could then be easily concealed. An antenna-top version can be enclosed in a 3 x 4 x 5-inch weatherproof box and power can be sent up externally. The bandwidth of a single-channel unit can be widened to cover channels 7 to 13, or several low-band channels such as 2, 3, 4 or 5. A sweep generator and oscilloscope should be used to check adjustment. Single-channel boosters can be peaked using a TV set and station signal if the coil winding data given for the desired channel is followed.

Booster alignment

The booster's tuning can be checked best by using a sweep generator, oscilloscope and 300-ohm balanced detector...
When the booster is complete, final adjustments can be made using the TV signal and TV set. Pick a time when the signal is weak, but not fading, and external interference is at a minimum. Connect the booster between the antenna and TV set and make sure the input leads, output leads and power cord are separated from each other.

Data on the noise figure of the four-channel and other boosters measured over a 1.5-mc bandwidth is shown in Fig. 3 along with the test hookup. A 1-db reduction in noise figure gives a noticeable reduction of snow. A 2-3-db reduction in noise figure, possible with this type of booster in front of the average cascode tuner, gives a snow reduction equivalent to stacking the receiving antenna or doubling the TV transmitter power.

If the booster gives little or no picture improvement, check all operating voltages. The plate current should be at least 20 ma with a 40-A or 417-A input tube and 10 ma with a E180F. Currents much higher than 20 ma will shorten the life of the 6AJ4. Also disconnect the input-winding center tap from ground and check for a short between L1 and L2.

Switching inputs and outputs in addition to plate and filament power is possible as long as the input and output leads and switch contacts are physically separated. A three-gang six-pole non-shorting two-or-more-position steatite insulated rotary switch would be satisfactory. (These switches are made by Mallory and Centralab.) The middle gang can be used for plate and heater switching and to separate the input and output gangs. This kind of switch takes up a lot of room and will leave room for three channels only.

**Coil-Winding Data Table**

<table>
<thead>
<tr>
<th>TV Channels</th>
<th>L1 Turns Wire</th>
<th>L2 Turns Wire</th>
<th>L3 Turns Wire</th>
<th>L4 Turns Wire</th>
<th>L5 Turns Wire</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>7 1/2</td>
<td>No. 28</td>
<td>11 No. 28</td>
<td>21 No. 28</td>
<td>20 No. 24</td>
</tr>
<tr>
<td>3, 4</td>
<td>6 1/2</td>
<td>No. 28</td>
<td>8 No. 28</td>
<td>17 No. 28</td>
<td>12 No. 24</td>
</tr>
<tr>
<td>5, 6</td>
<td>4 1/2</td>
<td>No. 28</td>
<td>6 No. 28</td>
<td>13 No. 28</td>
<td>12 No. 24</td>
</tr>
<tr>
<td>7, 8</td>
<td>3 1/2 No. 24</td>
<td>3 No. 24</td>
<td>45 1/2 No. 24</td>
<td>45 1/2 No. 24</td>
<td>3 No. 24</td>
</tr>
<tr>
<td>9, 10</td>
<td>3 No. 24</td>
<td>2 1/2 No. 24</td>
<td>4 No. 24</td>
<td>4 1/2 No. 24</td>
<td>3 No. 24</td>
</tr>
<tr>
<td>11, 12, 13</td>
<td>2 1/2 No. 24</td>
<td>2 No. 24</td>
<td>35 1/2 No. 24</td>
<td>4 1/2 No. 24</td>
<td>35 1/2 No. 24</td>
</tr>
</tbody>
</table>

All coils use enamelled wire except coil L4, channels 7-13, which uses the leads of C4.

1. L2, L3 and L5 are tightly wound on 1/4-inch-diameter slug-tuned coil forms such as James Millen 60848-6 with No. 19 mm core (coded white) or Cambridge Thermionic Corp. LS 6 with 20063-D core (coded white).
2. L1, center-tapped, and L6 are reverse-wound tightly over L2 and L5, respectively.
3. L4 is 3/16-inch-diameter air-core, tightly wound choke on channels 2 to 6 and is wound 3/16-inch diameter, with leads of C4 spaced 1 turn, on channels 7 to 13.
BY ROBERT B. COOPER, JR.

B y now, almost everyone has read or heard something about the International Geophysical Year (IGY). The IGY is an 18-month period during which 65 nations will study the actions of the earth and solar system. This period is being used to gather facts more than to study the earth—huge storehouses of facts which scientists will be able to study for generations to come.

One of the fact-gathering programs (there are all) now being investigated—is concerned with the ionosphere and—to be more specific—the effects of the ionosphere on uhf and vhf radio-television signals entering it. At present, amateur radio observations are being used in this study and a plan is underway to include TV dx reports in the program. This is where you come into the picture.

The ionosphere study group is looking for consistent, monthly reports on any forms of unusual TV reception that might be linked to the ionosphere. If you feel that you might fit into this proposed program, drop me a line outlining your general dxing habits (time of day spent dxing, greatest reliable range, experience and a fairly complete description of your equipment). If enough interest is mustered for this project, I will attempt to carry the ball from here.

Why IGY now?

The IGY period began on July 1, 1957. This date was not picked on a haphazard guess, nor was it a matter of international politics. The predicted peak of the 11-year sunspot cycle, expected to fall within the 18-month IGY period, was the determining factor. Past experience has shown that definite correlations exist between high sunspot numbers and various effects here on earth—such as radio propagation, aurora and possibly weather conditions. To sum up, we can expect investigated—is concerned with the ionosphere and—to be more specific—the effects of the ionosphere on uhf and vhf radio-television signals entering it.

The ionosphere study group is looking for consistent, monthly reports on any forms of unusual TV reception that might be linked to the ionosphere. If you feel that you might fit into this proposed program, drop me a line outlining your general dxing habits (time of day spent dxing, greatest reliable range, experience and a fairly complete description of your equipment). If enough interest is mustered for this project, I will attempt to carry the ball from here.

Why IGY now?

The IGY period began on July 1, 1957. This date was not picked on a haphazard guess, nor was it a matter of international politics. The predicted peak of the 11-year sunspot cycle, expected to fall within the 18-month IGY period, was the determining factor. Past experience has shown that definite correlations exist between high sunspot numbers and various effects here on earth—such as radio propagation, aurora and possibly weather conditions. To sum up, we can expect investigated—is concerned with the ionosphere and—to be more specific—the effects of the ionosphere on uhf and vhf radio-television signals entering it.

The ionosphere study group is looking for consistent, monthly reports on any forms of unusual TV reception that might be linked to the ionosphere. If you feel that you might fit into this proposed program, drop me a line outlining your general dxing habits (time of day spent dxing, greatest reliable range, experience and a fairly complete description of your equipment). If enough interest is mustered for this project, I will attempt to carry the ball from here.

Why IGY now?

The IGY period began on July 1, 1957. This date was not picked on a haphazard guess, nor was it a matter of international politics. The predicted peak of the 11-year sunspot cycle, expected to fall within the 18-month IGY period, was the determining factor. Past experience has shown that definite correlations exist between high sunspot numbers and various effects here on earth—such as radio propagation, aurora and possibly weather conditions. To sum up, we can expect investigated—is concerned with the ionosphere and—to be more specific—the effects of the ionosphere on uhf and vhf radio-television signals entering it.

The ionosphere study group is looking for consistent, monthly reports on any forms of unusual TV reception that might be linked to the ionosphere. If you feel that you might fit into this proposed program, drop me a line outlining your general dxing habits (time of day spent dxing, greatest reliable range, experience and a fairly complete description of your equipment). If enough interest is mustered for this project, I will attempt to carry the ball from here.

Why IGY now?

The IGY period began on July 1, 1957. This date was not picked on a haphazard guess, nor was it a matter of international politics. The predicted peak of the 11-year sunspot cycle, expected to fall within the 18-month IGY period, was the determining factor. Past experience has shown that definite correlations exist between high sunspot numbers and various effects here on earth—such as radio propagation, aurora and possibly weather conditions. To sum up, we can expect investigated—is concerned with the ionosphere and—to be more specific—the effects of the ionosphere on uhf and vhf radio-television signals entering it.

The ionosphere study group is looking for consistent, monthly reports on any forms of unusual TV reception that might be linked to the ionosphere. If you feel that you might fit into this proposed program, drop me a line outlining your general dxing habits (time of day spent dxing, greatest reliable range, experience and a fairly complete description of your equipment). If enough interest is mustered for this project, I will attempt to carry the ball from here.

Why IGY now?

The IGY period began on July 1, 1957. This date was not picked on a haphazard guess, nor was it a matter of international politics. The predicted peak of the 11-year sunspot cycle, expected to fall within the 18-month IGY period, was the determining factor. Past experience has shown that definite correlations exist between high sunspot numbers and various effects here on earth—such as radio propagation, aurora and possibly weather conditions. To sum up, we can expect investigated—is concerned with the ionosphere and—to be more specific—the effects of the ionosphere on uhf and vhf radio-television signals entering it.

The ionosphere study group is looking for consistent, monthly reports on any forms of unusual TV reception that might be linked to the ionosphere. If you feel that you might fit into this proposed program, drop me a line outlining your general dxing habits (time of day spent dxing, greatest reliable range, experience and a fairly complete description of your equipment). If enough interest is mustered for this project, I will attempt to carry the ball from here.
The color bar generator is about as basic an instrument on the modern service bench as a vcm or vtvx.

A color bar generator is something like an automobile—after a certain amount of mileage, we had better have a tune-up if we expect it to serve us as expected.

There are several kinds of color bar generators and, of course, service and maintenance procedure differs for the various types of instruments.

**Generator types**

First of all, we must recognize the difference between a color bar generator, which provides true colors, as distinguished from a color-difference bar generator, which provides simulated colors.

We must also recognize the difference between a color-difference bar generator and a continuous-running subcarrier generator. If you connect the output from a simple rainbow generator to a wide-band scope, a sine-wave pattern is obtained, as shown in Fig. 1. We often refer to this signal output as a continuous subcarrier, but it is really a continuous offset subcarrier—its frequency is (or should be) 3.564795 mc, which is one horizontal-branching interval less than the color subcarrier frequency of 3.579545 mc.

Such generators are usually crystal-controlled, with a small trimmer capacitor shunted across the crystal to obtain the exact operating frequency. When the crystal is operating on frequency, we obtain a rainbow pattern on the screen of a color picture tube, as shown in Fig. 2. When the crystal is operating far off frequency, we obtain color sync breakup, as shown in Fig. 3.

The easiest and most straightforward way of checking the frequency of the crystal oscillator is with a good heterodyne frequency meter. If you operate this type of generator slightly off frequency, the pattern will not break color sync in a normally operating receiver, but a pull occurs, which causes the pattern to shift horizontally on the screen of the color picture tube, thus giving incorrect information.

The more elaborate form of color-difference signal is keyed into discrete bursts and horizontal sync pulses are provided. Frequency requirements are either 3.564795 mc, or 3.579545 mc, depending upon whether the generator is designed to operate at the true subcarrier frequency or at sidetick frequency. Fig. 4 shows the waveform from a generator of the first type and also illustrates a further service requirement: the peak-to-peak voltage of the sync pulse should be equal to the peak-to-peak voltage of the burst. Service controls are provided for this purpose and a wide-band scope is the most practical indicator to utilize in this regard.

The peak-to-peak voltage of the chroma bar is usually made equal to the peak-to-peak voltage of the burst, although some generators run the chroma bar voltage at a somewhat higher level. A service control is provided.

Space does not permit further coverage of service and maintenance procedures for color bar generators in this installment, but we will discuss more practical pointers another time.

**Horizontal pull**

On a Philco deflection chassis No. D-201, there is a pull horizontally at the bottom of the picture, which appears to be a vertical height trouble until a test pattern is displayed. Then it seems to be a horizontal linearity problem. I have checked everything associated with the vertical and horizontal circuits except the horizontal output transformer.

—M. T. S., Longview, Tex.

This report sounds suspiciously like electrolytic-capacitor trouble. We would suggest that you check the electrolytic associated with the sweep and sync for capacitance value and power factor.

Fig. 4—Accurate reproduction of this color TV waveform requires the vertical amplifier to have the same response at the color burst frequency as it has at the horizontal sync frequency.

Replace any of these electrolytics that fail below standard, and it is probable that the trouble will clear up.

**Poor fine detail**

I have a Magnavox 27-inch receiver, chassis CT-358BA. I don’t obtain fine detail and on certain channels whenever there is a vertical line in the picture, such as a door frame, it looks ragged. I realigned the set but still don’t obtain fine detail.—A. K., River Edge, N. J.

We would suggest that part of this trouble may be due to poor alignment, there is also a definite possibility of overloading and clipping in the sync signal, with possible entry of video camera signal into the sync channel.

Before realigning the receiver, I would suggest that you check the coupling capacitors in the if and video amplifiers for leakage. Also check the coupling capacitors in the sync channel. Replace any capacitors that show even a small amount of leakage.

This will probably serve to make the picture straight and, if the detail is still poor, a careful check of the alignment would be justified. Start with the tuner and follow through with the if ampli-
fier. Then, check the combined rf-if response curves on the various channels to make sure that you don’t have a mixer-regeneration problem on your hands.

Finally (and this is very important), sweep the video amplifier and make sure that you are getting full 4-me Bandpass through the video amplifier circuits.

Vertical roll

I have been troubled by what appears to be a heater-cathode short in one of the horizontal oscillator diagrams of Admiral 24E1 chassis. A bright horizontal line appears across the upper third of the raster, accompanied by a vertical roll that can’t be locked. The vertical hold control cannot be turned to make the picture roll down, only upward. The capacitor marked C1 on the schematic shows signs of leaking electrolyte, but all sections check OK on a capacitor checker.—K. M. Germany

This trouble is evidently one of those capacitor failures that doesn’t show up on routine checks. Substitution tests are usually a situation of this kind. You should start by replacing the multisection electrolytic that you mention, because there is possible leakage between sections, which would not be caught on a test of the individual sections.

As we all realize very well, the capacitor that looks the worst is usually not the culprit. So, if replacing the obvious unit does not do the trick, try substituting the other multiple units.

Horizontal curve

I have had several service calls on a Philco 22D1162. This set has a very bad S-shaped wave. I have replaced the sync separator OCS6, horizontal mfc 6AL5 and horizontal multivibrator 12AU7-A. Replacement cleared up the trouble for a while. The curve in the raster appears after the receiver has been operating for some time. All the dc voltages have checked out correctly. The trouble cannot be cured by adjustment of the horizontal hold and horizontal oscillator controls.—C. F. J., New York, N. Y.

This trouble could be due to heater-cathode leakage in the 6AM8 video detector. You do not mention whether the S-shaped wave is a 60- or 120-cycle pattern. This could be a good guidepost in weeding out possibilities.

I suggest that you first make sure that you have no tubes with heater-cathode leakage in the signal circuit. Then, if tube replacement does not clear up this trouble, go to work on the electrolytic capacitors. Check for low capacitance values, poor power factor and leakage between sections.

Intermittent sync

I am working on two TV receivers that are giving me a lot of trouble. They appear to have about the same kind of trouble. They operate OK for several days and then go out of sync. One is a Westinghouse Y2243-A and the other is a G-E Y2243-B.

The G-E will start with fuzzy edges like piecrust, but with smaller dips and then it will flip and display horizontal bars or three or four pictures horizontally.

When the Westinghouse chassis is acting up they tear in different spots of the raster and occasionally go out of horizontal sync.—F. P., Westfield, Mass.

Again, this repair is typical of the difficulties which occur when common electrolytic bypass or decoupling capacitors have become marginal. It is most likely that one or more of the electrolytic capacitors associated with the horizontal sync section have lost a substantial fraction of their original capacitance and have developed a low power factor. Also, do not overlook the possibility of leakage between sections of a multisection electrolytic.

Electrolytic capacitors have different characteristics when hot than when cold and their characteristics change after a period of operation as compared with their condition after a nonworking period. Any tests should be made after the receivers have been in operation for several hours.

Vertical rolling

I received a G-E 21C200 chassis with a case of picture rolling. The picture rolls slowly up or down until the vertical-hold control is adjusted. Then, in a few minutes, the picture will start to roll again. The owner informed me that the trouble started after they had a new picture tube installed. All dc voltages seem correct, allowing for the high line voltage which we have here.—W. R. M., Newton, N. J.

It is evident, of course, that the vertical oscillator is changing frequency in a high or a low direction from time to time. Also, because the picture rolls up, it also is evident that the vertical oscillator is not being locked in sync at times. This lack of vertical-sync lock is probably the root of the trouble.

The circuit arrangement of this receiver is such that the condition of the picture tube could affect sync action. I suggest that you first eliminate this possibility by checking with a test pip tube. If this clears up the trouble, a fault is indicated in the picture tube in spite of the fact that it is quite new. But if this does not correct the vertical sync hold, as is likely to be the case, you will have to dig deeper for the trouble. There is a certainty that you will find little or no vertical sync pulse at the output of the phase inverter (junction of R302 and C302). So, the problem is going to be to find out why this pulse is not present (during the time the picture rolls up). In making this type of test, do not confuse the vertical sync pulse with the kickback pulse from the vertical oscillator. If there is any doubt on this point, pull the vertical oscillator tube and substitute a dummy tube with all but the heater pins cut off. This will permit you to check the pulse from the integrator without interference.

Check the integrator plate and its associated circuit components. Trace back with the scope to find out where you are losing the vertical sync pulse. This probably sounds peculiar, but it is not impossible for a brand-new integrator plate assembly to be defective.

Poor sync

A Bendix 21R3 chassis has poor vertical and horizontal sync, with sound and picture OK. The horizontal locking-in range is critical. Vertical lock-in is also critical. There is a horizontal pull in the picture about 2 inches from the top and varying the contrast control tends to straighten out the pulling. Changes in cameras or background will usually cause the trouble, with buzz in the sound, after which the picture will stabilize. Vertical linearity is poor, with compression at the top.

The 6W6 runs extremely hot. The B-plus voltage at the cathode of the 6W6 measures 185. The set has too much width, which cannot be reduced, and the width control smokes whenever it is turned completely counterclockwise. The age voltage at the plate of the 6AU6 keyer is —36.—R. C., Chicago, Ill.

In response to your query, it appears quite likely that the horizontal output tube is generating too much sweep voltage. This follows from the fact that the 6W6 runs hot, and that the B-plus voltage at the cathode of the audio output tube is high. Also, the output from the keyer tube is high, and the picture width is excessive, which all points to the same trouble.

You should find 60-volt (peak-to-peak) drive at the grid of the horizontal output tube. This can be quickly checked with a calibrated scope. Adjust the horizontal drive control, if necessary.

There should be 10-volt bias at the cathode of the horizontal-output tube. The 10-kf cathode-bypass capacitor could possibly be shortened if you find little or no bias here.

Likewise, you should find 165 volts at the screen of the horizontal output tube. If this voltage is high, you should check the .047-mf bypass capacitor for leakage.
TELEVISION

By ROBERT B. COOPER, JR.

Types of dx reception and necessary receiving equipment and techniques

Along with predictions of dx conditions and news of unusual loggings, we often receive requests for information pertaining to antennas, when to look for dx, receivers, accurate record keeping and many other phases of full-scale dx-ing. Here are a few tips for those who are interested in TV dx but may not know how to break into the field.

Receiving dx stations (those not normally seen at your location) is not nearly so much a function of the location of the observer and the equipment used as it is of being at the right place at the right time. In dx-ing circles many make use of a "timetable" (see table) to give basic information concerning the types of dx we might expect during various periods of the year. During a year's time seasonal weather changes and the position of the Earth in relation to the Sun and other heavenly bodies have pronounced effects on dx conditions.

Types of dx reception

The most common form of dx is that denoted by the term "sporadic-E skip." Sporadic-E skip (abbreviated Es) affects the lower television channels (2-6), bringing reception to your location from stations on an average of 500-1,500 miles distant. Various forms of Es have been known to provide reception for distances as great as 6,000 miles, although this is exceedingly rare. Es is a result of the television signal being reflected from a densely ionized layer, called the E layer, of the ionosphere. This layer exists at a height of 60-70 miles above the Earth. Under normal conditions the layer's density is very low and very-high-frequency television signals pass through the layer and on into space, never to return. It is only during periods of freak ionization conditions that the layer forms (actually forming in spots and not as a whole layer) and causes low-channel television signals to rebound from it as if it were a mirror.

Occurring on all TV channels, but most pronounced on high-band (channels 7-13) vhf and on uhf, is tropospheric (abbreviated tropo) bending or conveyance of television waves to areas beyond the radio horizon via the troposphere. The tropospheric layer exists immediately adjacent to the Earth, and the majority of our weather occurs in it. Trops is actually caused by sharp boundaries formed in weather fronts which act as a duct, carrying the signal to distant points. This form of reception occurs, for the most part, during the spring, early summer and early fall months of the year. Distances covered vary from 200-800 miles.

A form of dx-ing theoretically possible, during the next few years at least, is F2 skip. Like the E layer, the F2 layer of the ionosphere is often capable of reflecting television signals back to Earth during years of peak sunspot activity. The channels influenced most often by this form of skip are the lowest (2-4). The distances covered by F2 are enough to stagger even the most imaginative mind, beginning at 2,200 miles and working upward in steps of 2,000 miles at a time. This form of dx-ing promises to be extra interesting as it will provide us with the opportunity to view programs originating in other countries and even other continents!

Lastly, we have what is commonly known as the dx-ers' form of dx. As sensitive receiver design developed to usable levels and antennas with higher gain were put on the market, alert observers began to notice a form of burst reception. Short bursts of reception could be obtained for seconds at a time during periods when no signs of dx were present. It was decided that these bursts were a result of meteorites entering the E layer of the ionosphere and burning up there. As the friction causes them to burn, they leave a trail of ionized gas. Thus, like regular Es, meteor bursts (or MS) could provide reception from stations 500-1,500 miles distant. As meteorites are entering the E layer at all times (though in varying degrees of intensity), we are able to log distant stations whenever we wish. The only hitch in the scheme is the short duration of the bursts. It usually takes many bursts to identify...
the program material and a few more to identify the source. Lots of patience and a good deal of practical experience really pay off with this form of dx-ing.

Keeping an accurate log is a very important part of dx-ing. As dxers, we are able to provide scientists with a great deal of information not obtainable in any other way. TV dx is definitively freakish in nature and is therefore subject to explanation. However, as with many other occurrences in nature, information is needed before detailed study may begin. RADIO-ELECTRONICS is providing without cost through the TV dx column specially prepared forms on which you may report your dx observations. When your reports are combined with those from other sections of the country, scientists get a broad view of dx conditions over the country as a whole for any given date. An accurate log is also important when you wish to write to stations requesting letters of verification for your reception. It is always best to include information as taken from the receiver screen or audio, referring to local advertisements, etc. This will help the station in verifying your report. Many dxers have verification letters from 100 or more stations.

Receiving equipment

During the past 2 to 3 years the old-timers in the dx game have become increasingly aware of the fact that the newer television receivers are by lacking in many dx essentials. In fact, with the current drive to use multipurpose tubes, etc. for receiver compactness individual set gain and stability have deteriorated measurably. Therefore, dxers usually recommend that newcomers in the game purchase a sensitive receiver having a cascode front-end (cascode rf stage). Keeping your receiver in good electrical working order is very important. If you do a moderate amount of dx-ing, change the rf amplifier tube every few months. Other important tubes such as the detectors, if amplifiers, rectifiers, etc. should all be tested frequently and perhaps changed completely every year. Remember, the only difference between the receiver you use for dx-ing and the one your neighbor uses for normal home viewing is the shape you keep yours in.

Boosters are also frequently mentioned. Remember this simple rule: If you have a late-model design, with a cascode type rf amplifier stage, boosters are of very little value. Receivers using pentode and triode rf amplifier stages will benefit greatly from a cascode booster stage.

When we approach the question of the correct antenna for dx-ing purposes (or just plain deep-fringe reception), we encounter a controversy. Some dxers prefer large-screen reflector arrays with dipoles situated in front for signal gain, while others lean toward the various forms of Yagi antennas while still others like the collinear style. To provide optimum gain on each channel with a single antenna is an engineering feat yet to be accomplished. However, several compromises may be made to give fair to good gain across the spectrum and still allow the use of a single antenna for all-channel vhf operation. What is wanted is as much gain as it is possible to get, high front-to-back ratio and good directivity. Many dxers use 5- or 10-element Yagi's for channel 2 and then some form of all-channel for the rest. The reason for this is that both Es and F2 work up from the lowest channels. Thus, a good antenna system on channel 2 is a big help. If you have a local on channel 2, a similar system for channel 3 would also serve the purpose. Stacking Yagi antenna arrays pays off for weak-signal reception.

Antenna transmission line is also important. Keep the line in as good physical condition as possible. Of course, the best line is that with the lowest signal loss: 300-ohm open-wire line does an admirable job and 450-ohm open-wire line is also very good. A problem here is matching the 450-ohm lead-in with a 300-ohm receiver input and 300-ohm antenna. If open wire can be used, we suggest the 300-ohm version. If you have problems with your open-wire line continually shorting to the mast or tower as you rotate the antenna, try using the 300-ohm tubular uhf line. The loss is very low and the plastic insulation keeps out moisture, dust, etc. Try to use just one piece of line from the receiver to the antenna as splices create more signal loss.

Getting your antenna high above ground and the surrounding objects is also of prime importance. If you live in an area with many power lines, poles, high trees, etc., raising your antenna above them will really help reception. Giving the antenna a clear shot at the dx stations is the whole idea in back of raising it into the heights. Power lines, rooftops, trees and the like all add to the amount of signal absorbed or reflected before it reaches your antenna. As you raise it up in the air, your antenna begins to break into signal levels that have not been decreased by absorption. A height of 70 feet above ground is a good minimum height for serious dxers, although good results can be had down to around 40 feet. A good rule might be: Raise the antenna as high as guy wire, guying space, pipe, neighborhood policy and your pocketbook allow.

Remember, you are using a high-gain antenna with its power punch concentrated in the forward direction. It

---

**DX TIME TABLE**

<table>
<thead>
<tr>
<th>Period of year</th>
<th>Types of dx (Times 24-hour LST)</th>
<th>Optimum Hours</th>
<th>Data</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nov. 15-Feb. 15</td>
<td>Sporadic Es</td>
<td>0700-0900</td>
<td>1600-2100</td>
</tr>
<tr>
<td>Feb. 1-May 15</td>
<td>F2 Skip</td>
<td>0700-1300</td>
<td>1100-1300</td>
</tr>
<tr>
<td>Apr. 7-30, 1955</td>
<td>Meteor scatter</td>
<td>0500-0900</td>
<td>1400-1600</td>
</tr>
<tr>
<td>May 15-July 30</td>
<td>Trops dx (ground wave)</td>
<td>0600-1100</td>
<td>1900-0200</td>
</tr>
<tr>
<td>Aug. 20-Sept.</td>
<td>Trops dx</td>
<td>no set time</td>
<td></td>
</tr>
</tbody>
</table>

**TELEVISION**

**NEW TV, channel 2, Mexico City, Mexico, seen in Temple, Tex., March, 1955.**

This is designed to reject signals from the rear and sides. Any one of the popular antenna rotators is recommended for dx reception from all directions.

When using a large Yagi antenna array be sure that it is at least four boommouthes above any surrounding objects like trees and rooftops. This will assure you of a proper radiation pattern. If you cannot erect a Yagi array so that it is several boommouthes...
TELEVISION

from any objects at the same height, it would be better to try some other form of antenna.

Dx tips

**Venetian blindes**: Horizontal bars move across the screen, alternating black and white. This is a sign of two (or more) stations on the same channel, the bars being what is commonly termed a beat note. The blind effect on a channel normally clear of them is the tipoff that some sort of dx is trying to appear. Careful orientation of the antenna will usually bring it in. If you are not able to bring the dx station through a local or sublocal station find the antenna heading in which the interference is strongest and then check the rest of the channels for signs of other dx stations.

**Frequent signal bursts on a clear channel**: This is a sign of either a meteorite shower or the formation of a Es cloud. In either case you should stick around for the next few hours and make frequent channel checks.

**Fringe-area stations lose their snow**: This is a sure sign that good trop conditions are forming. First, determine in which direction the conditions are coming. Then check the channels for weak stations not normally seen. (As fringe-area stations become of “local quality,” dx stations appear with “fringe-area quality.”)

If you live very near transmitters, there is not much that can be done for reception of dx stations on the same channels as the locals. For reception on adjacent channels, special traps can be used to filter out the overload from your locals, thus leaving the adjacent channels for dx reception. These adjacent-channel traps can do a lot for reception of Es signals. If you live 20 miles or so from the actual transmitter site, you should be able to bring strong E-skip stations in with the help of a folded-dipole antenna to attenuate the local station. The dipole antenna consists of a length of 500-ohm line cut to a half-wavelength on the interfering channel. Fed with another length of lead-in in the usual manner, you have a very effective antenna for cutting out locals by cancellation. Mount the dipole on a piece of board and experiment with it at various heights to find the highest you can go before getting into the extra-strong local signals. By carefully orienting the dipole, you will be able to “phase” out the local and allow the dx skip station to come through.

From several experiments made in California, we have found the best height above ground for the dipole is around 20 feet. For this antenna, height above ground is the all-important factor. If you wish to use a single dipole for the five low channels, find a compromise length in the vicinity of channel 4.

For the latest in dx information and predictions of things to come, watch RADIO-ELECTRONICS’ TV dx column. END

---

A TALE FROM CUBA

By L. F. FENTON

ONE of our service technicians brought a TV set to the shop. He reported “It shows white streaks on the screen, as if the antenna connections were loose.” I checked: as a matter of fact, it was loose.

The set works nicely, but after a while a flash appears on the screen, and then more of them. It seems there is some other fault besides the loose antenna. With a station tuned in, white horizontal streaks appear. Without a station, or with the antenna disconnected, there are no streaks, but bursts of dark dots. It seems there is some areeing in the set and its radiation enters through the front end. By removing the mixer tube—or any tube of the if or video strip—the dots disappear.

All that is left to do is to localize the areeing and remove it. Most probably some part of the high-voltage equipment is guilty. These parts are well secured in the high-voltage cage. Removing the cover, only the two high-voltage rectifier tubes and two 1.5-megohm resistors are visible. They are mounted on a piece of bakelite. The flyback transformer and the high-voltage filter capacitors are mounted on the rear of this form, and remain entirely hidden in the high-voltage cage. So I decided to go the easy way: check first the parts outside the cage. The areeing most likely occurs at the connection of the high-voltage lead to the metal picture tube; so I tighten it carefully. No result. Perhaps the horizontal output tube: I change it; I change the horizontal oscillator, the damper and the high-voltage rectifiers too. No result. The 1.5-megohm resistors check OK with an ohmmeter; but to be on the safe side, I exchange them. No result.

I put a new picture tube in the set. I try to tap gently (well, more or less gently) all tubes and other parts. I cannot provoke the streaks by tapping, moving, pushing or pulling any part of the set. On the contrary, the streaks seem to occur independently of any human influence. Very intriguing!

So then I disconnect a number of leads, remove the picture tube, the yoke and the cage to get at the flyback. Should this be the bad part, it would be a minor tragedy. It is of special construction, a standard flyback does not fit easily. Checking with an ohmmeter shows that the high-voltage winding is open; evidently it arcs inside the coil. So I have found it at last.

I install a new flyback. Yes, it behaves itself. I watch it several minutes. But what is this? Again a streak; then several more. These streaks do not appear as often as before, but they are most annoying. Is it possible that the brand-new flyback is defective? Out comes the high-voltage supply. The flyback checks OK with the ohmmeter. And I can see absolutely no trace of corona—only the streaks on the screen which are really annoying (or am I repeating myself?).

I decide to make another experiment. To localize the areeing I connect the video output of the sick set into the C-R tube of a second set. This arrangement works fine—picture and streaks appear on this tube too. Then I disable the high-voltage supply of the first set, removing the horizontal output tube— the streaks remain. I remove the horizontal and vertical oscillators and the sound section, with the same result. So it is definitely established, the fault is not in the high-voltage supply, neither in the vertical or sound section. In fact, the only remaining part in the front end, if and video strip and the low-voltage supply.

First I replace the front end. And believe it or not, for the first time there is a result, the streaks disappear. Well, to make a long story short, besides the flyback, a coil in the front end was guilty. It was open (ohmmeter reading more than 1,000 megohms), but it passed the whole plate voltage to the mixer tube. Evidently it arced. Replacing it with a new one, the set worked smoothly.

END

60

RADIO-ELECTRONICS

www.americanradiohistory.com
Practical COLOR

Installation

THEY ought to make the cook drink this coffee," Fuzzball grumbled. "That would be unconstitutional," Red observed; "cruel and unusual punishment. Besides, he's big enough and mean enough to make you drink it."

"Not to change the subject," replied Fuzzball, "but what's the pitch on horizontal dynamic convergence? You got me clued in pretty good on the vertical."

"Well, now," Red said slowly, "you'll find that horizontal isn't too much different from vertical. Unless, of course, you start getting some of them queer notions of yours."

"I'll pretend I didn't hear that last remark," replied Fuzzball evenly. "Should I keep the center of screen in convergence with the beam magnets while I'm working with the horizontal dynamic?"

Red turned to the tired-looking waitress. "Give the man a five-cent cigar, Bessie. He's hot as a pistol today."

"It figures," explained Fuzzball, "because that's what works out best when you're working with the vertical dynamic controls."

"Tell me more," Red said encouragingly. "You tell me," protested Fuzzball. "What do I do next?"

"Well, you should start by resonating the horizontal phasing coils."

"Come again, already?"

"First turn the blue amplitude control to maximum," Red explained patiently. "Then turn the core in the blue phasing coil to curve the dots to a dip in the center (a)... then adjust the horizontal amplitude control to get a good straight line (b)."

"Why?" asked Fuzzball. "Because I wanted to keep it to refer to," snapped Red.

"I mean, why do you want to resonate the phasing coil?" protested Fuzz. "Simple, you simple boy," Red explained, "because then you will have the coil pretty near its final setting. Saves a lot of wasted time."

"And you do the same thing with the..."

(Continued on page 78)

Part III—Wherein Red gives Fuzzball the pitch on horizontal dynamic convergence

By BOB MIDDLETON
everybody's doing it!

You'll get plenty of these detailed pictorial diagrams in your Heathkit construction manual to show where each and every wire and part is to be placed. Everything you do is spelled out in pictures so you can't go wrong. That's what makes it such fun!

and here's why...

1. You get higher quality at lower cost by dealing direct, and by doing your own assembly.
2. You receive personal, friendly, service (before and after sale) for complete satisfaction.
3. You benefit from the latest in engineering designs because of our concentration on kit-form equipment only.
4. You may depend on performance as advertised—backed by Heath's world-wide reputation for quality.
5. You can take a full year to pay with the HEATH EASY TIME PAYMENT PLAN.

Heathkits

...fun to build and a thrill to own!

Motion picture and TV personality Jackie Coogan, looks on with unbelieving interest as his 14-year-old son, Anthony, prepares to assemble his latest Heathkit, a hi-fi FM tuner. The Coopans have found out about the fun and savings of building their own electronic equipment the Heathkit way...so why don't you?

You'll get plenty of these detailed pictorial diagrams in your Heathkit construction manual to show where each and every wire and part is to be placed. Everything you do is spelled out in pictures so you can't go wrong. That's what makes it such fun!

and here's why...

1. You get higher quality at lower cost by dealing direct, and by doing your own assembly.
2. You receive personal, friendly, service (before and after sale) for complete satisfaction.
3. You benefit from the latest in engineering designs because of our concentration on kit-form equipment only.
4. You may depend on performance as advertised—backed by Heath's world-wide reputation for quality.
5. You can take a full year to pay with the HEATH EASY TIME PAYMENT PLAN.

Heathkits

...fun to build and a thrill to own!
HEATHKIT EXTRA PERFORMANCE 70-WATT AMPLIFIER KIT
For really high performance, with plenty of reserve power, the W-6M is a natural. The full 70-watts output will seldom, if ever, be required. However, this reserve insures distortion-less sound on power peaks. The W-6M will look along at normal listening levels and yet is always ready to extend itself when program material demands it, without the least amount of strain. The output circuit employs 6550 tubes with a special-design Peerless output transformer for maximum stability at all power levels. A quick-change plug selects 4, 8, and 16 ohms or 70-volt output and the correct feedback resistance. A variable damping control is also provided for optimum performance with any speaker system. Extremely good power supply regulation is possible through the use of a heavy-duty transformer along with silicon diode rectifiers, which are noted for their very long life, and yet are smaller than a house fuse. Frequency response at 1 watt is ±1 db from 5 cps to 80 kc with controlled hf rolloff above 100 kc. At 70 watts output harmonic distortion is below 2%, 20 to 20,000 cps and IM distortion below 1%, 60 and 6,000 cps. Hum and noise 88 db below full output. In addition to high performance, its line appearance makes it a pleasure to display in your living room. Proper layout of chassis insures ease of assembly by eliminating those cramped and difficult places to get at. Clear instructions—and top-quality components. Get started now and make this amplifier the heart of your hi-fi system. Shipped express only. Shpg. Wt. 50 lbs.

MODEL W-6M: Consists of W-6M kit, plus WA-P2 preamplifier. Express only. Shpg. Wt. 59 lbs. $129.70

HEATHKIT HIGH FIDELITY FM TUNER KIT
This tuner can bring you a rich store of FM programming, your least expensive source of high fidelity material. It covers the complete FM band from 88 to 106 mc. Stabilized, temperature-compensated oscillator assures negligible drift after initial warmup. Features broadbanded circuits for full fidelity, and better than 10 uv sensitivity for 20 db of quieting, to pull in stations with clarity and full volume. Employs a high gain, cascade RF amplifier, and has AGC. A ratio detector provides high-efficiency demodulation without sacrificing hi-fi performance. IF and ratio transformers are prealigned, as is the front end tuning unit. Special alignment equipment is not necessary. Edge-lighted glass dial for easy tuning. Here is FM for your home at a price you can afford. Shpg. Wt. 8 lbs.

MODEL FM-7A $25.95 (with cabinet)

HEATHKIT BROADBAND AM TUNER KIT
This AM tuner was designed especially for high fidelity applications. It incorporates a special detector using crystal diodes, and the IF circuits feature broad band-width, to insure low signal distortion. Audio response is ±1 db from 20 cps to 9 kc, with 5 db of preemphasis at 10 kc to compensate for station rolloff. Sensitivity and selectivity are excellent, and tuner covers complete broadcast band from 550 to 1600 kc. Quiet performance is assured by 6 db signal-to-noise ratio at 2.5 uv. Prealigned RF and IF coils eliminate the need for special alignment equipment. Incorporates AVC, two outputs, two antenna inputs, and built-in power supply. Edge-lighted glass slide-rule dial for easy tuning. Your "best buy" in an AM tuner. Shpg. Wt. 8 lbs.

MODEL BC-1A $25.95 (with cabinet)

HEATHKIT MASTER CONTROL PREAMPLIFIER KIT
Designed for use with any of the Williamson-type amplifiers, the WA-P2 has five switch-selected inputs, each having its own level control to eliminate blasting or fading while switching through the various inputs, plus a tape recorder output. A hum control allows setting for minimum hum level. Frequency response is within ±1/2 db from 15 to 35,000 cps. Equalization provided for LP, RIAA, AES, and early 78's. Separate bass and treble controls. Low impedance cathode follower output circuit. All components were specially selected for their high quality. Includes many features which will eventually be desired. Shpg. Wt. 7 lbs.

MODEL WA-P2 $19.75 (with cabinet)

An amplifier you will be proud to own

70-WATT AMPLIFIER

Selects and controls sound to your taste

PREAMPLIFIER
HEATHKIT ADVANCED-DESIGN 25-WATT HIGH FIDELITY AMPLIFIER KIT

Designed especially to satisfy critical audio requirements, the W-5M incorporates the extra features needed to complement the finest in program sources and speaker systems. Faithful sound reproduction is assured with a frequency response of ±1 db from 5 to 160,000 cps at 1 watt, and harmonic distortion is less than 1% at 25 watts, with IM distortion less than 1% at 20 watts. Hum and noise are a full 59 db below rated output, assuring quiet, hum-free operation. Output taps are 4, 8, and 16 ohms. Exclusive Heathkit features include the "tweeter saver", and the "bas-bas" balancing circuit, requiring only a voltmeter for indication. Years of reliable service are guaranteed through the use of conservatively rated, high quality components. KT66 tubes and Peerless output transformer are typical. Shipped express only. Shpg. Wt. 31 lbs.

MODEL W-5: Consists of W-5M kit above plus model WA-P2 preamplifier. Express only. Shpg. Wt. 38 lbs. $79.50

MODEL W-5M $59.75

HEATHKIT DUAL-CHASSIS 20-WATT HIGH FIDELITY AMPLIFIER KIT

The model W3-AM is a Williamson-type amplifier built on two separate chassis. The power supply is on one chassis, and the amplifier stages are on the other chassis. Using two separate chassis provides additional flexibility in installation. Features include the famous acrosound model TO-300 "ultralinear" output transformer and 5881 tubes for broad frequency response, low distortion, and low hum level. The result is exceptionally fine overall tone quality. Frequency response is ±1 db from 6 cps to 150 kc at 1 watt. Harmonic distortion is less than 1% and IM distortion is less than 1.3% at 20 watts. Hum and noise are 88 db below 20 watts. Designed to match the speaker system of your choice, with taps for 4, 8 or 16 ohms impedance. A very popular high fidelity unit employing top quality components throughout. Shipped express only. Shpg. Wt. 29 lbs.

MODEL W-3A: Consists of W-3AM kit above plus model WA-P2 preamplifier. Express only. Shpg. Wt. 37 lbs. $69.50

MODEL W-3AM $49.75

HEATHKIT SINGLE-CHASSIS 20-WATT HIGH FIDELITY AMPLIFIER KIT

The model W4-AM Williamson-type amplifier will amaze you with its outstanding performance. A true Williamson circuit, featuring extended frequency response, low distortion, and low hum levels, this amplifier can provide you with many hours of listening enjoyment with only a minimum investment compared to other units on the market. 5881 tubes and a special Chicago-standard output transformer are employed to give you full fidelity at minimum cost. Frequency response extending from 10 cps to 100 kc within ±1 db at 1 watt assures you of full coverage of the audio range, and clean clear sound amplification takes place in circuits that hold harmonic distortion at 1.5% and IM distortion below 2.7% at full 20 watt output. Hum and noise are 95 db below full output. Taps on the output transformer are at 4, 8 or 16 ohms. Shipped express only. Shpg. Wt. 28 lbs.

MODEL W-4A: Consists of W-4AM kit above, plus model WA-P2 preamplifier. Express only. Shpg. Wt. 35 lbs. $59.50

MODEL W-4AM $39.75

Heathkits...

by Daystrom

bring you the lasting satisfaction of personal accomplishment

HEATHKIT GENERAL-PURPOSE 20-WATT HIGH FIDELITY AMPLIFIER KIT

The model A-9C will provide you with high quality sound at low cost. Features a built-in preamplifier with four separate inputs, and individual volume, bass and treble controls. Frequency response covers 20 to 20,000 cps within ±1 db. Total harmonic distortion is less than 1% at 3 db below rated output. Push-pull 6L6 tubes are used, with output transformer tapped at 4, 8, 16 and 500 ohms. A true hi-fi unit using high-quality components throughout, including heavy-duty "potted" transformers. Shpg. Wt. 23 lbs.

MODEL A-9C $35.50
HEATHKIT "BASIC RANGE" HI-FI SPEAKER SYSTEM KIT
The extremely popular Heathkit model SS-1 Speaker System provides amazing high fidelity performance for its size. Features two high-quality Jensen speakers, an 8" mid-range woofer and compression-type tweeter with flared horn. Covers from 50 to 12,000 CPS within +5 db, in a special-design ducted-port, bass reflex enclosure. Impedance is 16 ohms. Cabinet measures 11¼" H x 23" W x 11¼" D. Constructed of veneer-surfaced plywood, ½" thick, suitable for light or dark finish. All wood parts are precut and predrilled for easy, quick assembly. Shpg. Wt. 30 lbs.

HEATHKIT "RANGE EXTENDING" HI-FI SPEAKER SYSTEM KIT
Extends the range of the SS-1 to +5 db from 35 to 16,000 CPS. Uses 15" woofer and super-tweeter both by Jensen. Kit includes crossover circuit. Impedance is 16 ohms and power rating is 35 watts. Measures 29¾" H x 23" W x 17¾" D. Constructed of veneer-surfaced plywood, ½" thick. Easy to build! Shpg. Wt. 80 lbs.

HEATHKIT "LEGATO" HIGH FIDELITY SPEAKER SYSTEM KIT
The quality of the Legato, in terms of the engineering that went into the initial design, and in terms of the materials used in its construction, is matched in only the most expensive speaker systems available today. The listening experience it provides approaches the ultimate in esthetic satisfaction. Two 15" theater-type Altec Lansing speakers cover 25 to 500 CPS, and an Altec Lansing high-frequency driver with sectoral horn covers 500 to 20,000 CPS. A precise amount of phase shift in the crossover network brings the high frequency channel into phase with the low frequency channel to eliminate peaks or valleys at the crossover point, by equalizing the acoustical centers of the speakers. The enclosure is a modified infinite baffle type, especially designed for these speakers. Cabinet is constructed of veneer-surfaced plywood, ½" thick, precut and predrilled for easy assembly. Frequency response 25 to 20,000 CPS. Power rating, 50 watts program material. Impedance is 16 ohms. Cabinet dimensions 41¼" L x 22¼" D x 34¾" H.


HEATHKIT SINE-SQUARE GENERATOR
The new AG-10 provides high quality, sine and square waves over a wide range, for countless applications. Some of these are: radio and TV repair work, checking scope performance, as a variable trigger source for telemetering and pulse work, and checking audio, video and hi-fi amplifier response. Frequency response is +1.5 db from 20 CPS to 1 MC on both sine and square waves, with less than .25% sine wave distortion, 20 to 20,000 CPS. Sine wave output impedance 600 ohms, square wave output impedance 50 ohms, except on 10v ranges. Square wave rise time less than .15 usec. Five-position range switch—continuously variable tuning—shielded oscillator circuit—separate step and variable output attenuators in ranges of 10, 1, and .1 volts for both sine and square wave, with extra range of .01 volt on sine wave. Both sine and square wave can be used at the same time without affecting either wave form. Power supply uses silicon-diode rectifiers. Shpg. Wt. 12 lbs.

HEATHKIT AUDIO ANALYZER KIT
The AA-1 is actually three instruments in one compact package. It combines the functions of an AC VTVM, an audio wattmeter, and an intermodulation analyzer. Input and output terminals are combined, and high and low frequency oscillators are built in. VTVM ranges are 0-0.1, 0.3, .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 and 150 w. IM scales are 1%, 3%, 10%, 30% and 100%. Provides internal load resistors of 4, 8, 16 or 600 ohms. A tremendous dollar value. Shpg. Wt. 13 lbs.

HEATH COMPANY A Subsidiary of Daystrom, Inc. BENTON HARBOR 20, MICH.
NOVEMBER, 1957
HEATHKIT "GENERAL PURPOSE" 5' OSCILLOSCOPE KIT

The model OM-2 Oscilloscope is especially popular with part-time service technicians, students, and high fidelity enthusiasts. It features good vertical frequency response ±3 db from 4 cps to over 1.2 mc. A full five-inch crt, and sweep generator operation from 20 cps to over 150 kc. Stability is excellent and calibrated grid screen allows precise signal observation. Extra features include external or internal sweep and sync, 1-volt peak-to-peak calibrating reference, 3-position step-attenuated input, adjustable spot shape control, push-pull horizontal and vertical amplifiers, and modern etched-metal circuits. Easy to build and a pleasure to use. Ideal for use with other audio equipment for checking amplifiers. Shpg. Wt. 21 lbs.

MODEL OM-2
$42.50

HEATHKIT AUDIO WATTMETER KIT

The AW-1 Audio Wattmeter can be used in any application where audio power output is to be measured. Non-inductive LOAD resistors are built in for 4, 8, 16 or 600 ohms impedance. Five power ranges cover 0-5 mw, 50 mw, 500 mw, 5 w, and 50 w full scale. Five switch-selected db ranges cover −10 db to +30 db. All indications are read directly on a large 4½" 200 microampere meter. Frequency response is ±1 db from 10 cps to 250 kc. Precision type multiplier resistors used for high accuracy, and crystal diode bridge for wide-range frequency response. This meter is used in many recording studios and broadcast stations as a monitor as well as servicing. A fine meter to help supply the answers to your audio operating or power output problems. Shpg. Wt. 6 lbs.

MODEL AW-1
$29.50

HEATHKIT AUDIO SIGNAL GENERATOR KIT

The model AG-9A is "made to order" for high fidelity applications, and provides quick and accurate selection of low-distortion signals throughout the audio range. Three rotary switches select two significant figures and a multiplier to determine audio frequency. Incorporates step-type and a continuously variable output attenuator. Output indicated on large 4½" panel meter, calibrated in volts and db. Attenuator system operates in 10 db steps, corresponding to meter calibration, in ranges of 0-.003, .01, .03, .1, .3, 1, 3, 10, 13 and 10 volts RMS. "Load" switch permits use of built-in 600-ohm load, or external load of different impedance. Output and frequency indicators accurate to within ±5%. Distortion less than .1 of 1% between 20 and 20,000 cps. Total range is 10 cps to 100 kc. Shpg. Wt. 8 lbs.

MODEL AG-9A
$34.50

HEATHKIT HARMONIC DISTORTION METER KIT

All sounds consist of dominant tones plus harmonics (overtones). These harmonics enrich the quality and brightness of the music. However, additional harmonics which originate in the audio equipment, represent distortion. Used with an audio signal generator, the HD-1 will accurately measure this harmonic distortion at any or all frequencies between 20 and 20,000 cps. Distortion is read directly on the panel meter in ranges of 0-1, 3, 10, 30 and 100% full scale. Voltage ranges of 0-1, 3, 10, and 30 volts are provided for the initial reference settings. Signal-to-noise ratio measurements are also permitted through the use of a separate meter scale calibrated in db. High quality components insure years of outstanding performance. Full instructions are provided. Shpg. Wt. 13 lbs.

MODEL HD-1
$49.50

Heathkits...

B. DAYSTROM
are well known for their high quality and reliability.

HEATHKIT AUDIO VTVM KIT

This new and improved AC Vacuum Tube Voltmeter is designed especially for audio measurements and low-level AC measurements in power supply filters, etc. Employs an entirely new circuit featuring a cascode amplifier with cathode-follower isolation between the input and the amplifier, and between the output stage and the preceding stages. It emphasizes stability, broad frequency response, and sensitivity. Frequency response is essentially flat from 10 cps to 200 kc. Input impedance is 1 megohm at 1000 cps. AC (RMS) voltage ranges are 0-.01, .03, .1, .3, 1, 3, 10, 30, 100 and 300 volts. Db ranges cover −52 db to +52 db. Features large 4½" 200 microampere meter, with increased damping in meter circuit for stability in low frequency tests. 1% precision resistors employed for maximum accuracy. Stable, reliable performance in all applications. Shpg. Wt. 5 lbs.

MODEL AV-3
$29.50
HEATHKIT COLOR BAR AND DOT GENERATOR

The CD-1 combines the two basic color service instruments, a Color Bar Generator and White Dot Generator in one versatile portable unit, which has crystal-controlled accuracy and stability (no external sync lead required). Produces white-dots, cross hatch, horizontal and vertical bars, 10 vertical color bars, and a new shading bar pattern for screen and background adjustments. Variable RF output on any channel from 2 to 6. Positive or negative video output, variable from 0 to 10 volts peak-to-peak. Crystal controlled sound carrier with off-switch. Voltage regulated power supply using long-life silicon rectifiers. Gain knowledge of a new and profitable field by constructing this kit. Shpg. Wt. 12 lbs.

HEATHKIT TV ALIGNMENT GENERATOR KIT

This fine TV alignment generator offers stability and flexibility difficult to obtain even in instruments costing several times this low Heathkit price. It covers 3.6 mc to 220 mc in four bands. Sweep deviation is controllable from 0 to 42 mc. The all-electronic sweep circuit insures stability. Crystal marker and variable marker oscillators are built in. Crystal (included with kit) provides output at 4.5 mc and multiples thereof. Variable marker provides output from 19 to 60 mc on fundamentals and from 57 to 180 mc on harmonics. Effective two-way blanking to eliminate return trace. Phasing control. Kit is complete, including three output cables. Shpg. Wt. 16 lbs.

HEATHKIT "EXTRA DUTY" 5 OSCILLOSCOPE KIT

This fine oscilloscope compares favorably to other scopes costing twice its price. It contains the extra performance so necessary for monochrome and color-TV servicing. Features push-pull horizontal and vertical output amplifiers, a SUP1 CRT, built in peak-to-peak calibration source, a fully compensated 3-position step-type input attenuator, retrace blanking, phasing control, and provision for Z-axis modulation. Vertical amplifier frequency response is within ±1.5 and ±5 db from 3 CPS to 5 MC. Response at 3.56 MC down only 2.2 db. Sensitivity is 0.025 volts RMS/inch at 1 kc. Sweep generator covers 20 CPS to 500 kc in five steps, five times the usual sweep obtained in other scopes through the use of the patented Heath sweep circuit. Etched-metal circuit boards reduce assembly time and minimize errors in assembly, and more importantly, permit a level of circuit stability never before achieved in any oscilloscope of this type. Shpg. Wt. 21 lbs.

HEATHKIT ELECTRONIC SWITCH KIT

A valuable accessory for any oscilloscope owner. It allows simultaneous oscilloscope observation of two signals by producing both signals, alternately, at its output. Four switching rates. Provides gain for input signals. Frequency response ±1 db, 0 to 100 kc. A sync output is provided to control and stabilize scope sweep. Ideal for observing input and output of amplifiers simultaneously. Shpg. Wt. 8 lbs.

HEATHKIT VOLTAGE CALIBRATOR KIT

This unit is an excellent companion for your oscilloscope. Used as a source of calibrating voltage, it produces near-perfect square wave signals of known amplitude. Precision 1% attenuator resistors insure accurate output amplitude, and multivibrator circuit guarantees good sharp square waves. Output frequency is approximately 1000 CPS. Fixed outputs selected by panel switches are: 03, 0.1, 0.3, 1.0, 3.0, 10, 30 and 100 volts peak-to-peak. Allows measurement of unknown signal amplitude by comparing it to the known output of the VC-3 oscilloscope. Shpg. Wt. 4 lbs.
HEATHKIT TUBE CHECKER KIT
Eliminate guesswork, and save time in servicing or experimenting. The TC-2 tests tubes for shorts, opens, filament continuity, and operating quality on the basis of total emission. It tests all tube types encountered in radio and TV service work. Sockets are provided for 4, 5, 6 and 7-pin, octal, and loctal tubes, 7 and 9 pin miniature tubes, 5 pin hytron miniatures, and pilot lamps. Tube condition indicated on 4½" meter with multi-color "good-bad" scale. Illuminated roll chart with all test data built in. Switch selection of 14 different filament voltages from .75 to 117 volts. Color-coded cable harness allows neat professional wiring and simplifies construction. Very easy to build, even for a beginner. Shpg. Wt. 12 lbs.

MODEL TC-2
$29.50

HEATHKIT HANDITESTER KIT
The small size and rugged construction of this tester makes it perfect for any portable application. The combination function-range switch simplifies operations. 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 (3000 ohm center scale). Very popular with home experimenters, electricians, and appliance repairmen. Slips easily into your tool box, glove compartment, coat pocket, or desk drawer. Shpg. Wt. 3 lbs.

MODEL M-1
$14.50

HEATHKIT PICTURE TUBE CHECKER KIT
The CC-1 can be taken with you on service calls so that you can clearly demonstrate the quality of a customer's picture tube in his own home. Tubes can be tested without removing them from the receiver or carts if desired. Checks cathode emission, beam current, shorts, elements, and leakage between elements in electromagnetic picture tube types. Self-contained power supply, and large 4½" meter. CRT condition indicated on "good-bad" scale. Relative condition of tubes fluorescent coating is shown in "shadowgraph" test. Permanent test cable with CRT socket and anode connector. No tubes to burn out, designed to last a lifetime. Luggage-type portable case. Shpg. Wt. 10 lbs.

MODEL CC-1
$22.50

HEATHKIT ETCHED-CIRCUIT VTVM KIT
This multi-purpose VTVM is the world's largest selling instrument of its type—and is especially popular in laboratories, service shops, home workshops and schools. It employs a large 4½" panel meter, precision 1% resistors, etched metal circuit board, and many other "extras" to insure top quality and top performance. It's easy to build, and you may rely on its accuracy and dependability. The VT-A will measure AC (RMS) and DC voltages in ranges of 0-1.5, 5, 15, 50, 150, 500 and 1500. It measures peak-to-peak AC voltage in ranges of 0-4, 14, 40, 140, 400, 1400 and 4000. Resistance ranges provide multiplying factors of X 1, X 10, X 100, X 1000, X 10k, X 100k, and X 1 megohm. Center-scale resistance readings are 10, 100, 1000, 10k, 100k, 1 megohm and 10 megohms. A db scale is also provided. The precision and quality of this VTVM cannot be duplicated at this price. Shpg. Wt. 7 lbs.

MODEL VT-A
$24.50

Heathkits...
BY DAVSTROM
let you fill your exact needs from a wide variety of instruments

HEATHKIT 20,000 OHMS/VOLT VOM KIT
This fine instrument provides a total of 25 meter ranges on its two-color scale. It employs a 50 ua 4½" meter, and features 1% precision multiplier resistors. Requires no external power. Ideal for portable applications. Sensitivity is 20,000 ohms-per-volt DC and 5000 ohms-per-volt AC. Measuring ranges are 0-1.5, 5, 50, 150, 500, 1500 and 5000 volts, AC and DC. Measures direct current in ranges of 0-150 ua, 15 ma, 150 ma, 500 ma and 15 a. Resistance multipliers are X 1, X 100 and X 10,000, with center-scale readings of 15, 1500 and 150,000 ohms. Covers -10 db to +65 db. Easy to build and fun to use. Attractive bakelite case with plastic carrying handle. Shpg. Wt. 6 lbs.

MODEL MM-1
$29.50

www.americanradiohistory.com
HEATHKIT RF SIGNAL GENERATOR KIT
Even a beginner can build this prealigned signal generator, designed especially for use in service work. Produces RF signals from 160 kc to 110 mc on fundamentals in five bands. Covers 110 mc to 220 mc on calibrated harmonics. Low impedance RF output in excess of 100,000 microvolts, is controllable with a step-type and continuously variable attenuator. Selection of unmodulated RF, modulated RF, or audio at 400 CPS. Ideal for fast and easy alignment of radio receivers, and finds application in FM and TV work as well. Thousands of these units are in use in service shops all over the country. Easy to build and a real time saver, even for the part-time service technician or hobbyist. Shpg. Wt. 8 lbs.

MODEL SG-8
$19.50

HEATHKIT LABORATORY RF GENERATOR KIT
Tackle all kinds of laboratory alignment jobs with confidence by employing the LG-1. It features voltage-regulated B+, double shielding of oscillator circuits, copper-plated chassis, variable modulation level, metered output, and many other "extras" for critical alignment work. Generates RF signals from 100 kc to 30 mc on fundamentals in five bands. Meter reads RF output in microvolts or modulation level in percentage. RF output available up to 100,000 microvolts, controlled by a fixed-step and a variable attenuator. Provision for external modulation where necessary. Buy and use this high-quality RF signal generator that may be depended upon for stability and accuracy. Shpg. Wt. 16 lbs.

MODEL LG-1
$48.50

HEATHKIT DIRECT-READING CAPACITY METER KIT
Here's a fast, simple capacity meter. A capacitor to be checked is merely connected to the terminals, the proper range selected, and the value read directly on the large 4½" panel meter calibrated in mmf and mfd. Ranges are 0 to 100 mmf, 1,000 mmf, .01 mfd, .1 mfd full scale. Not affected by hand capacity. Shpg. Wt. 7 lbs.

MODEL CM-1
$29.50

HEATHKIT "IN-CIRCUIT" CAPACITANCE TESTER
With the CT-1 it is no longer necessary to disconnect one capacitor lead to check the part, you can check most capacitors for "opening" or "shorting" in the circuit. Fast and easy—to save your valuable time in the service shop or lab. Detects open capacitors from about 50 mmf up, so long as the capacitor is not shunted by excessively low resistance value. Will detect shunted capacitors up to 20 mfd (not shunted by less than 10 ohms). (Does not detect leakage.) Employs 60 cycles and 19 megacycle test frequencies. Electron beam "eye" tube used as indicator. Compact, easy-to-build, and inexpensive. Test leads included. Shpg. Wt. 5 lbs.

MODEL CT-1
$79.50

HEATHKIT CONDENSER CHECKER KIT
This handy instrument uses an electron beam "eye" tube as an indicator to measure capacity in ranges of .00001 to .005 mfd, .05 mfd, .5 mfd and 1000 mfd. Also measures resistance from 100 ohms to 5 megohms in two ranges. Checks paper, mica, ceramic and electrolytic capacitors. Selection of five polarizing voltages. Shpg. Wt. 7 lbs.

MODEL C-3
$19.50

HEATHKIT VISUAL-AURAL SIGNAL TRACER KIT
Although designed originally for radio receiver work, the T-3 finds application in FM and TV servicing as well. Features high-gain channel with demodulator probe, and low-gain channel with audio probe. Traces signals in all sections of radio receivers and in many sections of FM and TV receivers. Built-in speaker and electron beam eye tube indicate relative gain, etc. Also features built-in noise locating circuits. Provision for patching speaker and/or output transformer to external set. Shpg. Wt. 9 lbs.

MODEL T-3
$23.50

HEATHKIT... are educational as well as functional

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

NOVEMBER, 1957
HEATHKIT IMPEDANCE BRIDGE KIT

The model IB-2A employs a Wheatstone Bridge, a Capacity Comparison Bridge, a Maxwell Bridge, and a Hay Bridge in one compact package. Measures resistance from 0.1 ohm to 10 megohms, capacitance from 100 mfd to 100 mfd, inductance from 0.1 mh to 100 h, dissipation factor (D) from 0.002 to 1, and storage factor (C) from 0.1 to 1000. A 100-0-100 mA meter provides for null indications. The decade resistors employed are of 1% tolerance for maximum accuracy. Completely self-contained. Has built in power supply, 1000-cycle generator, and vacuum-tube detector. Special two-section CRL dial insures convenient operation. Instruction manual has entirely new schematic that clarifies circuit functions in various switch positions. A true laboratory instrument, that will provide you with many years of fine performance. Shpg. Wt. 12 lbs.

HEATHKIT "LOW RIPPLE" BATTERY ELIMINATOR KIT

This modern battery eliminator incorporates an extra low-ripple filter circuit so that it can be used to power all the newest transistor-type circuits requiring 0 to 12 volts DC, and the new "hybrid" automobile radios using both transistors and vacuum tubes. Its DC output, at either 6 or 12 volts, contains less than 0.3% AC ripple. Separate output terminals are provided for low-ripple or normal filtering. Supplies up to 15 amps on 6 volt range or up to 7 amps on 12 volt range. Output is variable from 0 to 8 or 0 to 16 volts. Two meters constantly monitor output voltage and current. Will also double as a battery charger. Shpg. Wt. 23 lbs.

HEATHKIT ISOLATION TRANSFORMER KIT

The model IT-1 is one of the handiest units for the service shop, home workshop or laboratory. Provides complete isolation from the power line. AC-DC sets may be plugged directly into the IT-1 without the chassis becoming "hot". Output voltage is variable from 90 volts to 130 volts allowing checks of equipment under adverse conditions such as low line voltage. Rated for 100 volt amperes continuously or 200 volt amperes intermittently. Panel meter monitors output voltage. Shpg. Wt. 9 lbs.

Heathkits...

are designed with high-quality, name-brand components to insure long service life

HEATHKIT "Q" METER KIT

At this price the laboratory facilities of a Q Meter may be had by the average service technician or home experimenter. The Q Meter permits measurement of inductance from 1 microhenry to 10 millihenry, "Q" on a scale calibrated up to 250 full scale, with multipliers of 1 or 2, and capacitance from 40 mfd to 450 mfd = 3 mfd. Built in oscillator permits testing components from 150 kc to 18 mc. Large 4½" panel meter is featured. 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. Also checks distributed capacity and Q of coils. No special equipment is required for calibration. A special test coil is furnished, along with easy-to-follow instructions. Shpg. Wt. 14 lbs.

HEATHKIT REGULATED POWER SUPPLY KIT

Here is a power supply that will provide DC plate voltage and AC filament voltage for all kinds of experimental circuits. The DC supply is regulated for stability, and yet the amount of DC output voltage available from the power supply can be controlled manually from 0 up to 500 volts. At 450 volts DC output, the power supply will provide up to 10 ma of current, and provide progressively higher current as the output voltage is lowered. Current rating is 130 ma at 200 volts output. In addition to furnishing B+ the power supply also provides 6.3 volts AC at up to 4 amperes for filament. Both the B+ output and the filament output are isolated from ground. Ideal unit for use in laboratory, home workshop, ham shack, or service shop. A large 4½" meter on the front panel reads output voltage or output current, selectable with a panel switch. Shpg. Wt. 17 lbs.
HEATHKIT DX-20 CW TRANSMITTER KIT
The Heathkit model DX-20 "straight-CW" transmitter features high efficiency at low cost. It uses a single 6DO6A tube in the final amplifier stage for plate power input of 50 watts. A 6CL6 serves as crystal oscillator, with a 5U4GB rectifier. It is an ideal transmitter for the novice, as well as the advanced-class CW operator. Single-knob band switching is featured to cover 80, 40, 20, 15, 11 and 10 meters. Pi network output circuit matches various antenna impedances between 50 and 1000 ohms and reduces harmonic output. Top-quality parts are featured throughout, including "potted" transformers, etc., for long life. It has been given full "TVI" treatment. Access into the cabinet for crystal changing is provided by a removable metal pull-out plug on the left end of the cabinet. Very easy to build from the complete step-by-step instructions supplied, even if you have never built electronic equipment before. If you appreciate a good, clean signal on the CW bands, this is the transmitter for you! Shpg. Wt. 18 lbs. MODEL DX-20 $35.50

Heathkits...
by Daystrom
are designed by licensed ham-engineers, especially for you

HEATHKIT DX-35 PHONE AND CW TRANSMITTER KIT
The DX-35 transmitter can be thought of as the "little brother" of the DX-100. It features both phone and CW operation on 80, 40, 20, 15, 11 and 10 meters. A single 6146 tube is used in the final amplifier stage to provide full 65 watt plate power input on CW, or controlled carrier modulation peaks up to 50 watts for phone operation. Modulator and power supplies are built right in and single knob band switching is combined with a pi network output circuit for complete operating convenience. The tight fitting cabinet presents a most attractive appearance, and is designed for complete shielding to minimize TVI. Back panel control provides convenient switch selection of three different crystals, reached through access door at rear of cabinet. A most remarkable power package for the price. Complete step-by-step instructions with pictorial diagrams to assure your success in assembly. Shpg. Wt. 24 lbs. MODEL DX-35 $56.95

HEATHKIT DX-100 PHONE AND CW TRANSMITTER KIT
Listen to any ham band between 160 meters and 10 meters and note how many DX-100 transmitters you hear! The number of these fine rigs now on the air testifies to the enthusiasm with which it has been accepted by the amateur fraternity. No other transmitter in this power class combines high quality and real economy so effectively. The DX-100 features a built in VFO, modulator and power supplies, complete shielding to minimize TVI, and pi network output coupling to match impedances from approximately 50 to 600 ohms. Its RF output is in excess of 100 watts on phone and 120 watts on CW, for a clean strong signal on all the ham bands from 10 to 160 meters. Single-knob band switching and illuminated VFO dial and meter face add real operating convenience. RF output stage uses a pair of 6146 tubes in parallel, modulated by a pair of 1626's. High quality components are used throughout, such as "potted" transformers, silver-plated or solid coin silver switch terminals, aluminum heat-dissipating caps on the final tubes, copper plated chassis, etc. This transmitter was designed exclusively for easy step-by-step assembly. Shpg. Wt. 107 lbs. MODEL DX-100 $189.50

FUNCTIONAL DESIGN...
The transmitters described on this page were designed for the ham, by hams who know what features are desirable and needed. This assures you of the best possible performance and convenience, and adds much to your enjoyment in the ham shack.
HEATHKIT "AUTOMATIC" CONELRAD ALARM KIT
This conelrad alarm works with any radio receiver; AC-DC-transformer operated—or battery powered, so long as the receiver has AVC. Fully complies with FCC regulations for amateurs. When the monitored station goes off the air, the CA-1 automatically cuts the AC power to your transmitter, and lights a red indicator. A manual "reset" button reactsivate the transmitter. Incorporates a heavy-duty six-ampere relay, a thyratron tube to activate the relay, and its own built-in power supply. A neon lamp shows that the alarm is working, by indicating the presence of B + in the alarm circuit. Simple to install and connect. Your transmitter plugs into an AC receptacle on the CA-1, and a cable connects to the AVC circuit of a nearby receiver. A built-in sensitivity control allows adjustment to various AVC levels. Receiver volume control can be turned up or down, without affecting alarm operation. Build a Heathkit CA-1 in one evening and comply with FCC regulations now! Shpg. Wt. 4 lbs.

HEATHKIT "Q" MULTIPLIER KIT
The Heathkit Q Multiplier functions with any AM receiver having an IF frequency between 450 and 460 KC, that is not "AC-DC" type. It derives its power from the receiver, and needs only 6.3 volts AC at 300 ma (or 12 VAC at 150 ma) and 150 to 250 volts DC at 2 ma. Simple to connect with cable and plugs supplied. Adds additional selectivity for separating signals, or will reject one signal and eliminate heterodyne. A tremendous help on crowded phone and CW bands. Effective Q of 4000 for sharp "peak" or "null". Tunes any signal within IF band pass without changing the main receiver tuning dial. A convenient tuning knob on the front panel with vernier reduction between the tuning knob and the tuning capacitor gives added flexibility in operation. Uses a 12AX7 tube, and special high-Q shielded coils. Instructions for connecting to the receiver and operation are provided in the construction manual. A worthwhile addition to any communications, or broadcast receiver. It may also be used with a receiver which already has a crystal filter to obtain two simultaneous functions, such as peaking the desired signal with the crystal filter and nulling an adjacent signal with the Q Multiplier. Shpg. Wt. 3 lbs.

HEATHKIT GRID DIP METER KIT
A grid dip meter is basically an RF oscillator for determining the frequency of other oscillators, or of tuned circuits. Extremely useful in locating parasitics, neutralizing, identifying harmonics, coil winding, etc. Features continuous frequency coverage from 2 mc to 250 mc, with a complete set of prewound coils, and a 500 ua panel meter. Front panel has a sensitivity control for the meter, and a phone jack for listening to the "zero-beat." Will also double as an absorption-type wave meter. Shpg. Wt. 4 lbs.

Low Frequency Coil Kit: Two extra plug-in coils to extend frequency coverage down to 350 kc. Shpg. Wt. 1 lb. No. 341-A. $3.30

HEATHKIT ALL-BAND COMMUNICATIONS-TYPE RECEIVER KIT
This communications-receiver covers 560 kc to 30 mc in four bands, and provides good sensitivity, selectivity, and fine image rejection. Ham bands are clearly marked on an illuminated dial scale. Features a transformer-type power supply—electrical band spread—antenna trimmer—headphone jack—automatic gain control and beat frequency oscillator. Accessory sockets are provided on the rear of the chassis for using the Heathkit model QF-1, Q Multiplier. Accessory socket is handy, also, for operating other devices that require plate and filament potentials. Will supply +250 VDC at 15 ma and 12.6 VAC at 300 ma. Ideal for the beginning ham or short wave listener. Shpg. Wt. 12 lbs.

Cabinet: Fabric covered cabinet with aluminum panel as shown. Part no. 91-15A. Shpg. Wt. 5 lbs. $4.95.

model of-1 $9.95

model ar-2 $29.95 (less cabinet)

Heathkits...
by Daystrom
are outstanding in performance and dollar value
HEATHKIT REFLECTED POWER METER KIT

The Heathkit reflected power meter, model AM-2, makes an excellent instrument for checking the match of the antenna transmission system, by measuring the forward and reflected power or standing wave ratio. The AM-2 is designed to handle a peak power of over 1 kilowatt of energy and may be left in the antenna system-feed line at all times. Band coverage is 160 meters through 2 meters. Input and output impedances for 50 or 75 ohm lines. No external power required for operation. Meter indicates percentage forward and reflected power, and standing wave ratio from 1:1 to 6:1. Another application for the AM-2 is matching impedances between exciters or R.F. sources and grounded grid amplifiers. Power losses between transmitter output and antenna tuner may be very easily computed by inserting the AM-2 in the line connecting the two. No insertion loss is introduced into the feeder system, due to the fact that the AM-2 is a portion of coaxial line in series with the feeder system and line impedance connections are actually made to the line. Complete circuit description and operation instructions are provided in the manual. Cabinet size is 7-3/8" x 4-1/16" x 4-5/8". Can be conveniently located at operating position. Shpg. Wt. 3 lbs.

MODEL AM-2
$19.95

HEATHKIT BALUN COIL KIT

The Heathkit Balun Coil Kit model B-1 is a convenient transmitter accessory, which has the capability of matching unbalanced coax lines, used on most modern transmitters, to balance lines of either 75 or 300 ohms impedance. Design of the bifilar wound balun coils will enable transmitters with unbalanced output to operate into balanced transmission line, such as used with dipoles, folded dipoles, or any balanced antenna system. The balun coil set can be used with transmitters and receivers without adjustment over the frequency range of 80 through 10 meters, and will easily handle power inputs up to 250 watts. Cabinet size is 9" square by 5" deep and it may be located any distance from the transmitter or from the transmission line. Completely enclosed for outdoor installation. Shpg. Wt. 4 lbs.

MODEL B-1
$8.95

HEATHKIT 6 OR 12 VOLT VIBRATOR POWER SUPPLY KITS

These little power supply kits are ideal for all portable applications with 6 volt or 12 volt batteries, when you are operating electronic equipment away from power lines. By replacing the power supplies of receivers, small public address systems, or even miniature transmitters with these units, they can be used with conventional 6 or 12 volt batteries. Use in boats, automobiles, light aircraft, or any field application. Each unit provides 260 volts DC output at up to 60 milliamperes. More than one power supply of the same model may be connected in parallel for increased current capacity at the same output voltage. Everything is provided in the kit, including a vibrator transformer, a vibrator, 6X4 or 12X4 rectifier, and the necessary buffer capacitor, hash filter, and output filter capacitor. Shpg. Wt. 4 lbs.

6 VOLT
MODEL VF-1-6
$7.95 Each

12 VOLT
MODEL VF-1-12
$7.95 Each

HEATHKIT VARIABLE FREQUENCY OSCILLATOR KIT

Enjoy the convenience and flexibility of VFO operation by obtaining the Heathkit model VF-1 Variable Frequency Oscillator. Covers 160-80-40-20-15-11 and 10 meters with three basic oscillator frequencies. Better than 10 volt average RF output on fundamentals. Plenty of output to drive most modern transmitters. It features voltage regulation for frequency stability. Dial is illuminated for easy reading. Vernier reduction is used between the main tuning knob and the tuning condenser. Requires a power source of only 250 volts DC at 15 to 20 milliamperes and 6.5 volts AC at 0.45 amperes. Extra features include copper-plated chassis, ceramic coil forms, extensive shielding, etc. High quality parts throughout. VFO operation allows you to move out from under interference and select a portion of the band you want to use without having to be tied down to only two or three frequencies through use of crystals. "Zero in" on the other fellow's signal and return his CQ on his own frequency! Crystals are not cheap, and it takes quite a number of them to give anything even approaching comprehensive coverage of all bands. Why hesitate? The model VF-1 with its low price and high quality will add more operating enjoyment to your ham activities. Shpg. Wt. 7 lbs.

MODEL VF-1
$19.95
HEATHKIT ELECTRONIC IGNITION ANALYZER KIT

Previous electronic experience is not necessary to build this fine ignition analyzer. The construction manual supplied has complete step-by-step instructions plus large pictorial diagrams showing the exact placement and value of each component. All parts are clearly marked so that they are easily identified. The IA-1 is an ideal tool for engine mechanics, tune-up men, and auto hobbyists, since it traces the dynamic action of voltage in an ignition system on a cathode-ray tube screen. The waveform produced is affected by the condition of the coil, condenser, points, plugs, and ignition wiring, so it can be analyzed and used as a “sign-post” to ignition system performance. This analyzer will detect inequality of spark intensity, a poor spark plug, defective plug wiring, breaker-point bounce, an open condenser, and allow setting of dwell-time percentage for the points. An important feature of this instrument is its ability to check dynamic performance, with the engine in operation (400 to 5000 RPM). It will show the complete engine cycle, or only one complete cylinder. Can be used on all types of internal combustion engines where breaker-points are accessible. Use it on automobiles, boats, aircraft engines, etc. Shpg. Wt. 18 lbs.

HEATHKIT PROFESSIONAL RADIATION COUNTER KIT

This Heathkit professional-type radiation counter is simple to build successfully, even if you have never built a kit before. Complete step-by-step instructions are combined with giant-size pictorial diagrams for easy assembly. By “building it yourself” you can have a modern-design, professional radiation counter priced far below comparable units. Provides high sensitivity with ranges from 0-100, 600, 6000 and 50,000 counts-per-minute, and 0.02, 1, 10 and 0.1 microentgens-per-hour. Employs 900-volt bismuth tube in beta/gamma sensitive probe. Probe and 8-foot expandable cable included in kit price, as is a radiation sample for calibration. Use it in medical laboratories, or as a prospecting tool, and for civil defense to detect radioactive fallout, or other unknown radiation levels. Features a selectable time constant. Meter calibrated in CPM or mR/hour in addition to “beep” or “click” from panel-mounted speaker. Prebuilt “packaged” high voltage power supply with reserve capacity above 900 volt level at which it is regulated. Merely changing regulator tube type would allow use of scintillation probe if desired. Employs five tubes (plus a transistor) to insure stable and reliable operation. Kit price includes batteries. Shpg. Wt. 8 lbs.

Heathkits... by Daystrom

are supplied with comprehensive instructions that eliminate costly mistakes and save valuable time

HEATHKIT ENLARGER TIMER KIT

The ET-1 is an easy-to-build electronic device to be used by amateur or professional photographers in timing enlarger operations. The calibrated dial on the timer covers 0 to 1 minute, calibrated in 5-second gradations. The continuously variable control allows setting of the “on” cycle of your enlarger, which is plugged into a receptacle on the front panel of the ET-1. A “safe light” can also be plugged in so that it is automatically turned “on” when the enlarger is turned “off.” Handles up to 350 watts with built-in relay. All-electronic timing cycle insures maximum accuracy. Timer does not have to be reset after each cycle, merely flip lever switch to print, to repeat time cycle. A control is provided for initial calibration. Housed in a compact plastic case that will resist attack of photographic chemicals. A fine addition to any dark room. Shpg. Wt. 3 lbs.

HEATHKIT BATTERY TESTER KIT

The BT-1 is a special battery testing device that actually “loads” the battery under test (draws current from it) while it is being tested. Weak batteries often test “good” with an ordinary voltmeter but the built-in load resistance of the BT-1 automatically draws enough current from the battery to reveal its true condition. Simple to operate with “good-weak-replace” scale. Tests all kinds of dry, cell batteries within ranges of 0-15 volts and 0-180 volts. Slide switch provides for either 10 ma or 100 ma load, depending on whether you’re testing an A or B battery. Not only determines when battery is completely exhausted, but makes it possible to anticipate failure by noting weak condition. Ideal for testing dry cell hearing aid, flashlight, portable radio, and model airplane batteries. Test batteries in a way your customers can understand and stimulate battery sales. Shpg. Wt. 2 lbs.

www.americanradiohistory.com
HEATHKIT CRYSTAL RADIO KIT

The Heathkit model CR-1 crystal radio is similar to the "crystal sets" of the early radio days except that it has been improved by the use of sealed germanium diodes and efficient "high-Q" coils. The sealed diodes eliminate the critical "cats whisker" adjustment, and the ferrite coils are much more efficient for greater signal strength. Housed in a compact plastic box, the CR-1 uses two tuned circuits, each with a variable tuning capacitor, to select the local station. It covers the broadcast band from 540 to 1600 kc. Requires no external power whatsoever. This receiver could prove valuable to emergency reception of civil defense signals should there be a power failure. The low kit price even includes headphones. Complete step-by-step instructions and large pictorial diagrams are supplied for easy assembly. The instruction manual also provides the builder with the basic fundamentals of signal reception so that he understands how the crystal receiver functions. An interesting and valuable "do-it-yourself" project for all ages. Shpg. Wt. 3 lbs.

HEATHKIT PORTABLE RADIO KIT

HEATHKIT TRANSISTOR PORTABLE RADIO KIT

Heath engineers set out to develop a "universal" AM radio, suitable for use anywhere. Their objective was a portable that would be as much "at home" inside as it is outside, and would feature top quality components for high performance and long service life. The model XR-1 is the result of these efforts. Six name-brand (Texas Instrument) transistors were selected for extra good sensitivity and selectivity. A 4" by 6" PM speaker with heavy magnet was chosen to assure fine tone quality. The power supply was designed to use six standard size "D" flashlight cells because they are readily available, inexpensive, and because they afford extremely long battery life (between 500 and 1000 hours). Costs you no more to operate from batteries than what you pay for operating a small table-model radio from the power line. An unbreakable molded plastic was selected for cabinet material because of its durability and striking beauty. Circuit is compact and efficient, yet components are not excessively crowded. Transformers are prealigned so it is ready for service as soon as construction is completed. Has built in rod-type antenna for reception in all locations. Cabinet dimensions are 9" L x 8" H x 3½" D. Comes in holiday gray, with gold-anodized metal speaker grille. Compare this portable, feature by feature, to all others on the market, and you'll appreciate what a tremendous dollar value it represents! Shpg. Wt. 4 lbs.

HEATHKIT BROADCAST BAND RADIO KIT

This table-model broadcast radio is fun to build, and is a fine little receiver for your home. It covers the standard broadcast band from 550 to 1600 kc with good sensitivity and selectivity. The 5½" PM speaker provides surprisingly good tone quality. High-gain IF transformers, miniature tubes, and a rod-type built-in antenna, assure good reception in all locations. The power supply is transformer operated, as opposed to many of the economy "AC-DC" types. It's easy to build from the step-by-step instructions, and the construction manual includes information on operational theory, for educational purposes. Your success is assured by completely detailed information which also explains resistor and capacitor color codes, soldering techniques, use of tools, etc. A signal generator is recommended for final alignment. Shpg. Wt. 10 lbs.

Cabinet: Fabric covered cabinet with aluminum panel as shown. Shpg. Wt. 5 lbs. Part no. 91-9A. $4.95.

HEATH COMPANY A Subsidiary of Daystrom, Inc. BENTON HARBOR 20, MICH.
HEATHKIT FUEL VAPOR DETECTOR KIT

Protect your boat and its passengers against fire or explosion from undetected fuel vapor by building and using one of these fine units. The Heathkit Fuel Vapor Detector indicates the presence of fumes on a three-color “safe-dangerous” meter scale and immediately shows it is safe to start the engine. A pilot light on the front panel shows when the detector is operating, and it can be left on continuously, or just used intermittently. A panel control enables initial calibration of the detector when installed. Features a hermetically-sealed meter with chrome bezel, and a chrome-plated brass panel. It is very simple to build and install, even by one not having previous experience. Models FD-1-6 (6 volts DC) and FD-1-12 (12 volts DC) operate from your boat batteries. The kit is complete in every detail, even to the inclusion of a spare detector unit. Shpg. Wt. 4 lbs.

HEATHKIT BATTERY CHARGE INDICATOR KIT

The Heathkit model CI-1 Marine Battery Charge Indicator has been designed especially for the boat owner, although it has found use in service stations, power stations, and radio stations where banks of batteries are kept in reserve for emergency power. It is intended to replace the hydrometer method of checking storage batteries, and to eliminate the necessity for working with acid in small, below-decks enclosures. Now it is possible to check as few as one, or as many as eight storage batteries, merely by turning the switch and watching the meter. A glance at the meter tells you instantly whether your batteries are sufficiently charged for safe cruising. Dimensions are 2-7/8"W x 5-1/16"H x 2" D. Operates on either 6 or 12 volt systems using lead-acid batteries, regardless of size. Simple installation can be accomplished by the boat owner in fifteen minutes. Shpg. Wt. 3 lbs.

HEATHKIT ELECTROLYSIS DETECTOR KIT

The Heathkit model ED-1 Electrolysis Detector indicates the extent of electrolysis currents between the boat’s common ground and underwater fittings, except on boats having metal hulls. These currents, undetected, could cause gradual corrosion and deterioration of the propeller or other metal fittings below the water line. It is particularly helpful when installing electrical equipment of any kind, or to determine proper polarity when power is obtained from a shore supply. Easy-to-build, the model ED-1 consists of a hermetically sealed, waterproof meter, special sensing plate, and sufficient wire to install, including the necessary hardware. Mounts on instrument panel where it can be easily seen. Requires no power for operation, and gives instant warning to guard your boat for a lifetime. Shpg. Wt. 2 lbs.

HEATHKIT RF POWER METER KIT

The Heathkit RF Power Meter Kit is designed to sample the RF field in the vicinity of your transmitter, whether it be marine, mobile, or fixed. Output meter is merely placed in some location close to the transmitter, to pick up RF radiation from the antenna. Requires no batteries, electricity, nor direct connection to the transmitter. It provides you with a continuing indication of transmitter operation. You can easily detect if power is dropping off by comparing present meter readings with past ones. Operates with any transmitter having output frequencies between 100 kc and 250 mc, regardless of power. Sensitivity is 0.3 volts RMS full scale, and a special control on the panel allows for further adjustment of the sensitivity. Meter is a 200 ua unit, mounted on a chrome-plated brass panel. The entire PM-1 measures only 3-3/4" W x 6-1/4" L x 2" D. An easy way to put your mind at ease concerning transmitter operation. Shpg. Wt. 2 lbs.

Heathkits...

B Y D A Y S T R O W

now offer you completely modern marine equipment with outstanding design features

76

R A D I O - E L E C T R O N I C S

www.americanradiohistory.com
HEATHKIT TRANSISTOR
RADIO DIRECTION FINDER KIT

The Heathkit Transistor Radio Direction Finder model DF-1 is a self-contained, self-powered, 6-transistor super heterodyne broadcast radio receiver incorporating a directional loop antenna, indicating meter, and integral speaker. It is designed to serve primarily as an aid to navigation when out of sight of familiar landmarks. It can be used not only aboard yachts, fishing craft, tugs, and other vessels which navigate either out of sight of land or at night, but also for the hunter, hiker, camper, fisherman, aviator, etc. It is powered by a 9-volt battery. (A spare battery is also included with the kit). The frequency range covers the broadcast band from 540 to 1600 kc and will double as a portable radio. A directional high-Q ferrite antenna is incorporated which is rotated from the front panel to obtain a fix on a station and a 1 ma meter serves as the null and tuning indicator. The controls consist of: tuning, volume and power (on-off), sensitivity, heading indicator (compass rose) and bearing indicator (antenna index). Overall dimensions are 7 3/4" W x 5 3/4" H x 5 3/4" D. Supplied with slip-in-place mounting brackets, which allow easy removal from ship bulkheads or other similar places. Ship. Wt. 5 lbs.

MODEL DF-1
$49.95
(Available after November 15)

HOW CAN YOU MISS?
The Heath Company maintains a technical consultation service, should you experience some sort of difficulty in construction or operation. Although only a very small percentage of our customers ever have occasion to use this service (usually only beginners in electronics) it is still reassuring to know that technical help is available when needed. A service department is also available, should you wish a complete factory check of operation and alignment or repair. After you build your first Heathkit you'll realize how easy it is.

Free Catalog
Send for this informative booklet listing more than 100 "do-it-yourself" kits.

Pioneer in "do-it-yourself" electronics

Heathkit... by Daystrom are sold only by direct mail, passing middleman profits on to you


ORDER BLANK

Name ____________________________ Address ____________________________
City & Zone ____________________________ State ____________________________

SHIP VIA  [ ] Parcel Post  [ ] Express  [ ] Freight  [ ] Best Way

QUANTITY ITEM MODEL NO. PRICE

<table>
<thead>
<tr>
<th>QUANTITY</th>
<th>ITEM</th>
<th>MODEL NO.</th>
<th>PRICE</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

[ ] SEND FREE Heathkit Catalog

POSTAGE TOTAL

No. 77
VIDEO FIDELITY
with SLENDER LINE design

Fresh design ideas, new engineering concepts are combined in AMPHENOL’S Vi-Fi indoor TV antenna.

VIDEO FIDELITY is here! “Slide Rule tuning and transformer coupling for strong, sharp pictures in difficult reception areas—no complicated switches!

SLENDER LINE STYLING Vi-Fi is as thin and as modern as the new TV sets—no bulk, no mass!

THREE WAY MOUNTING versatility: On top, hidden or flush on back—no limitations!

Vi-Fi is available in VHF and VHF/UHF models, and in three color choices. It took two years to bring Vi-Fi to its present perfection—it will take you only two minutes to appreciate its many new advantages.

See your AMPHENOL Distributor for complete details.

AMPHENOL ELECTRONICS CORPORATION
chicago 50, illinois

TELEVISION
(Continued from page 61)

red and green phasing coils,” Fuzzball hazarded.

“That’s the general idea,” Red replied. “We’re through with the blue phasing coil for the time being, so we turn the blue amplitude control to zero,” Fuzzball’s eyes lit up brightly. “So then we would turn up the red amplitude control, and resonate the red phasing coil for a peak?”

“Don’t stop now, man.”

“And then we would turn the red amplitude control to zero?”

“Keep with it,” Red encouraged.

“And then turn up the green amplitude control, and resonate the green phasing coil for a peak?”

“Yes, and . . .”

“And finally turn down the green amplitude control to zero.” Fuzzball finished triumphantly.

Red slapped Fuzz enthusiastically on the back. “I don’t know how you do it,” he said admiringly.

“You really want to know how he does it?” Bess asked out of the corner of her mouth.

Fuzzball’s face clouded and his lip curled.

Red clapped his hand quick over Fuzzball’s mouth. “Uh, uh!” he warned, “make sure brain is in gear before putting mouth in motion,” he suggested.

“OK, OK,” said Fuzzball. “I’ll pretend I didn’t hear that one, either.”

“As before being so rudely interrupted,” Red continued, “you then adjust the horizontal amplitude control to get a good straight line of blue dots.” (Fig. 1-b.)

“I guess you pay attention only to the horizontal center row of dots,” Fuzz suggested.

“You got a mind like an elephant,” Red remarked. “You remembered from the vertical, didn’t you?”

“Shucks, it ain’t nothing,” replied Fuzzball modestly. “What next?”

“Next you straighten the lines of green and red dots with the amplitude controls, and touch up the beam magnets.”

“And then you have the horizontal converged,” Fuzzball concluded.

“Not unless you have beginner’s luck—you would, I suppose,” Red replied.

“No, you’ll find you can’t straighten the lines or dots completely with the amplitude controls. You go back and touch up the phase controls a bit.”

“When do you stop all this back-and-forth?” demanded Fuzzball.

“There’s a rule-of-thumb,” Red replied. “If you can stand back 4 feet from the screen and honestly see no misconvergence, you can consider that you have done a job of work.”

“By some strange coincidence, might you have another photo which you have tore out of R-E and showing this desirable situation?” asked Fuzzball softly.

“Put that in your pipe and smoke it,” Red suggested, showing him Fig. 2.

“Yop, I see what you mean,” mused
TELEVISION

Fuzz. "Tell me, do you like dots or lines better for this little routine?"

"Well, now—that depends," Red replied. "When you're getting the parallel lines there's no question but what lines are easier to work with and less confusing than a series of broken dots. But then, on the other hand, when you are getting down to the final convergence, there's nothing like the little dots to show you that maybe you aren't quite as smart as your mother thinks you are."

"Would you maybe by some strange . . ."

"So put that in your pipe too. Have a good smoke," suggested Reid. (Fig. 3).

"Yeah, I see what you mean," said Fuzz. "The crosshatch pattern doesn't show up this misconvergence nearly as plain as the little dots."

"You can just see the wheels turning in his busy little mind," Bass remarked.

Red spoke up quickly. "They smack that grass doesn't grow on a busy street, but Fuzzball is the exception that proves the rule. Here's a buck, Fuzz—go get a haircut—I'll pay for it."

"Better give him four bucks," suggested Bass, "so he can get all four corners trimmed."

Red clapped his hand over Fuzz' half-opened mouth. "Get going," he suggested.

END

HOT COIL

I was called upon to service a new television receiver, just delivered, the complaint being no sound and no picture after 5 minutes. I changed all tubes that might cause the trouble but the receiver still cut out after 5 minutes. As the customer did not want the chassis pulled, leaving them without television over the week end, they decided to have it taken to the shop the following Monday and take a chance that it might give them some use by turning it off and on at intervals.

I called back the following Monday and at the door the customer greeted me with the fact that he had managed to get the receiver working continuously. I found a fan underneath it which sent cool air into the bottom of the chassis through the wire mesh covering the vent hole in the base of the cabinet, a console model. This ingenious remedy had suggested itself to this customer when I said that it cut out after it warmed up.

Pulling the chassis, the faulty component was found to be the first peaking coil following the video detector in this intercarrier receiver. This coil was wound on a resistor but one end of the coil wire had not been soldered to the resistor lead. As it was loosely wound, 5 minutes of heat from the chassis made it expand sufficiently to open the circuit feeding the video amplifier and the sound if strip. The blast of cool air had prevented this component from absorbing any heat and had allowed the set to function normally.—G. N. Carter

Look... only the fluxvalve has 100% IQF*

Choice of the best phonograph pickup can only be resolved by comparison! What is the yardstick? . . . How can you tell? . . . What do you look for? . . . the answer is 100% Important Quality Features!

PICKERING has had long experience in the cartridge field, supplying the finest quality products for recording studios, broadcast stations, wired music services, and high fidelity home music systems. As a result of this extensive experience, PICKERING has developed the FLUXVALVE... the one cartridge which incorporates all of the Important Quality Features... so necessary for high fidelity reproduction from records.

Before you choose a cartridge... LISTEN AND COMPARE...demand 100% IQF!

<table>
<thead>
<tr>
<th>Feature</th>
<th>FLUXVALVE Cartridge A</th>
<th>FLUXVALVE Cartridge B</th>
<th>FLUXVALVE Cartridge C</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frequency Response Flat 2000000 cps ± 2 db (curves on sight) YES 20 Points</td>
<td>NO 0 Points</td>
<td>NO 0 Points</td>
<td>NO 0 Points</td>
</tr>
<tr>
<td>Low Tracking Force. 24 grams YES 20 Points</td>
<td>NO 0 Points</td>
<td>YES 20 Points</td>
<td>NO 0 Points</td>
</tr>
<tr>
<td>High Output. No Transformer Required YES 10 Points</td>
<td>NO 0 Points</td>
<td>NO 0 Points</td>
<td>YES 10 Points</td>
</tr>
<tr>
<td>Replaceable Styli YES 10 Points</td>
<td>NO 0 Points</td>
<td>NO 0 Points</td>
<td>YES 10 Points</td>
</tr>
<tr>
<td>1/2 mil Styli YES 15 Points</td>
<td>NO 0 Points</td>
<td>NO 0 Points</td>
<td>NO 0 Points</td>
</tr>
<tr>
<td>Oem Cartridge for LP's and 78's YES 10 Points</td>
<td>NO 0 Points</td>
<td>NO 0 Points</td>
<td>NO 0 Points</td>
</tr>
<tr>
<td>Anti-Noise Design YES 10 Points</td>
<td>NO 0 Points</td>
<td>NO 0 Points</td>
<td>NO 0 Points</td>
</tr>
<tr>
<td>Immaculately Sealed YES 10 Points</td>
<td>NO 0 Points</td>
<td>NO 0 Points</td>
<td>NO 0 Points</td>
</tr>
<tr>
<td>TOTAL POINT VALUE 100% 10% 10% 25%</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

THE FLUXVALVE... chosen time and again as the top cartridge solely on the basis of listening quality... by panels of qualified experts... tests which have proven that it is actually less costly to own a FLUXVALVE.

The FLUXVALVE preserves the quality and prolongs the life of your record since there is complete absence of resonances throughout the audio range.

It may interest you to know that the FLUXVALVE, because of its ability to make precise and reproducible record measurements, is used for calibrating recording channels and record masters.

Make the IQF test today... listen to your favorite record reproduced with a FLUXVALVE... the gentle pickup.

IMPORTANT QUALITY FEATURES
-since necessary for high fidelity reproduction from records.

PICKERING & COMPANY, INC., Oceanside, N.Y.

For those who can hear the difference, fine quality will be found only by products of PICKERING & COMPANY, INC., Oceanside, N.Y.

www.americanradiohistory.com
Superior's EMISSION TYPE TUBE TESTER

FOR

Model TD-55 - Terms: $6.95 after 10 day trial then $3.00 per month for 4 months.

Model TW-11 - Terms: $11.50 after 10 day trial then $5.00 per month for 6 months.

Model TV-12 - Terms: $22.50 after 10 day trial then $10.00 per month for 5 months.

Model TV-40 - Terms: $3.85 after 10 day trial then $4.00 per month for 3 months.

SHIPPED ON APPROVAL
NO MONEY WITH ORDER
NO C.O.D.

Superior's New Model TV-12

TRANS-CO nductance TUBE TESTER

TESTING TUBES
- Employs improved TRANS-CO nductance 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.

Extra Feature
Model TV-12 also Tests 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 Triacs. Whether made of Germanium or Silicon, either point contact or junction contact types.

Housed in hand-rubbed oak cabinet...

Superior's New Model TV-12

STANDARD PROFESSIONAL TUBE TESTER

- Tests all tubes, including 4, 6, 7, 8, 9, 12, 16, 18, 27, 29, 39 types.
- Uses the new self-cleaning Lever Action Switches for individual element testing. Because all elements are numbered according to pin-number is 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 TW-11 as any of the pins may be placed in the neutral position whenever necessary.
- The Model TW-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.
- Pre-moving built-in roll chart provides complete data for all tubes. All tube listings printed in large easy-to-read type.

NOISE TEST: Phone jack on front panel for plugging in either phones or external amplifiers will detect microphonic tubes or noise due to faulty elements and loose internal connections.

EXTRAORDINARY FEATURE: SEPARATE SCALE FOR LOW-CURRENT TYPES. Previously, on emission-type tube testers, it has been standard practice to use one scale for all tubes. As a result, the calibration for low-current types has been restricted to a small portion of the scale. The extra scale used here greatly simplifies testing of low-current types. Housed in hand-rubbed oak cabinet.

Superior's New Model TV-11

PICTURE TUBE TESTER

Not a Gadget—Not a Make-Shift Adapter, but a Wired Picture Tube Tester With a Meter for Measuring Degree of Emission—Only $15.85

Of course you can buy an adapter for about $5—which theoretically will convert your standard tube tester into a picture-tube tester; or a neon type instrument which sells for a little more and is supposed to be "as good as" a metered instrument. Superior does not make nor do they recommend use of C.R.T. adaptors or neon gadgets 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.T. Tubes and nothing else.

Tests ALL magnetically deflected tubes...in the set...out of the set...in the carton...in the car...in the sky...in the basement...in the garage...in the barn...in the office...in the store...
- 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 inter-element shorts and leakages up to 5 megohms.
- Tests for open elements.
- Tests for inter-element shorts and leakages up to 5 megohms.
- Tests for open elements.

EASY TO USE: Simply insert line cord into any 110 volt A.C. outlet, then attach tester socket to tube base (no 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.

$15.85 NET

SUPERIOR'S NEW MODEL TV-12

NO VACUUM TUBE TESTER

For a quick, easy check of any vacuum tube—without a lamp—without a vacuum—without vacuum tube tests. Simply plug into 110 volt A.C. outlet and test by jack application.

For use in...repair shops...schools...laboratories...vacuum tube sales...service departments...radio- tube testers...radio service...radio broadcasting...radio repair...radio manufacturers...radio advertisers...

SUPERIOR'S "NO VACUUM" TUBE TESTER

For a quick, easy check of vacuum tubes without a lamp, without a vacuum, without vacuum tube tests. Simply plug into any 110 volt A.C. outlet and test by jack application...

For use in...repair shops...schools...laboratories...vacuum tube sales...service departments...radio tube testers...radio service...radio broadcasting...radio repair...radio manufacturers...radio advertisers...

SUPERIOR'S "NO VACUUM" TUBE TESTER

For a quick, easy check of vacuum tubes without a lamp, without a vacuum, without vacuum tube tests. Simply plug into any 110 volt A.C. outlet and test by jack application...

For use in...repair shops...schools...laboratories...vacuum tube sales...service departments...radio tube testers...radio service...radio broadcasting...radio repair...radio manufacturers...radio advertisers...

SUPERIOR'S "NO VACUUM" TUBE TESTER

For a quick, easy check of vacuum tubes without a lamp, without a vacuum, without vacuum tube tests. Simply plug into any 110 volt A.C. outlet and test by jack application...

For use in...repair shops...schools...laboratories...vacuum tube sales...service departments...radio tube testers...radio service...radio broadcasting...radio repair...radio manufacturers...radio advertisers...

SUPERIOR'S "NO VACUUM" TUBE TESTER

For a quick, easy check of vacuum tubes without a lamp, without a vacuum, without vacuum tube tests. Simply plug into any 110 volt A.C. outlet and test by jack application...

For use in...repair shops...schools...laboratories...vacuum tube sales...service departments...radio tube testers...radio service...radio broadcasting...radio repair...radio manufacturers...radio advertisers...

SUPERIOR'S "NO VACUUM" TUBE TESTER

For a quick, easy check of vacuum tubes without a lamp, without a vacuum, without vacuum tube tests. Simply plug into any 110 volt A.C. outlet and test by jack application...

For use in...repair shops...schools...laboratories...vacuum tube sales...service departments...radio tube testers...radio service...radio broadcasting...radio repair...radio manufacturers...radio advertisers...

SUPERIOR'S "NO VACUUM" TUBE TESTER

For a quick, easy check of vacuum tubes without a lamp, without a vacuum, without vacuum tube tests. Simply plug into any 110 volt A.C. outlet and test by jack application...

For use in...repair shops...schools...laboratories...vacuum tube sales...service departments...radio tube testers...radio service...radio broadcasting...radio repair...radio manufacturers...radio advertisers...

SUPERIOR'S "NO VACUUM" TUBE TESTER

For a quick, easy check of vacuum tubes without a lamp, without a vacuum, without vacuum tube tests. Simply plug into any 110 volt A.C. outlet and test by jack application...

For use in...repair shops...schools...laboratories...vacuum tube sales...service departments...radio tube testers...radio service...radio broadcasting...radio repair...radio manufacturers...radio advertisers...

SUPERIOR'S "NO VACUUM" TUBE TESTER

For a quick, easy check of vacuum tubes without a lamp, without a vacuum, without vacuum tube tests. Simply plug into any 110 volt A.C. outlet and test by jack application...

For use in...repair shops...schools...laboratories...vacuum tube sales...service departments...radio tube testers...radio service...radio broadcasting...radio repair...radio manufacturers...radio advertisers...

SUPERIOR'S "NO VACUUM" TUBE TESTER

For a quick, easy check of vacuum tubes without a lamp, without a vacuum, without vacuum tube tests. Simply plug into any 110 volt A.C. outlet and test by jack application...

For use in...repair shops...schools...laboratories...vacuum tube sales...service departments...radio tube testers...radio service...radio broadcasting...radio repair...radio manufacturers...radio advertisers...

SUPERIOR'S "NO VACUUM" TUBE TESTER

For a quick, easy check of vacuum tubes without a lamp, without a vacuum, without vacuum tube tests. Simply plug into any 110 volt A.C. outlet and test by jack application...

For use in...repair shops...schools...laboratories...vacuum tube sales...service departments...radio tube testers...radio service...radio broadcasting...radio repair...radio manufacturers...radio advertisers...

SUPERIOR'S "NO VACUUM" TUBE TESTER

For a quick, easy check of vacuum tubes without a lamp, without a vacuum, without vacuum tube tests. Simply plug into any 110 volt A.C. outlet and test by jack application...

For use in...repair shops...schools...laboratories...vacuum tube sales...service departments...radio tube testers...radio service...radio broadcasting...radio repair...radio manufacturers...radio advertisers...
TRY FOR 10 DAYS

before you buy!  then if satisfactory pay in easy, interest free, monthly payments. See coupon below.

Superior's New
Model TV-50

7 Signal Generators in One!
- R.F. Signal Generator for A.M.
- R.F. Signal Generator for F.M.
- Audio Frequency Generator
- Marker Generator
- R.F. SIGNAL GENERATOR: 100 Kilocycles to 60 Megacycles on fundamentals and from 60 Megacycles to 180 Megacycles on powerful harmonics.

VARIABLE AUDIO FREQUENCY GENERATOR: Provides a variable 300 cycle to 20,000 cycle swept wave audio signal.
- CROSS HATCH GENERATOR: Pattern consists of 4 to 16 horizontal bars or 7 to 20 vertical bars.
- DOT PATTERN GENERATOR (FOR COLOR TV): 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 following markers are provided: 189 Kc., 262.5 Kc., 456 Kc., 800 Kc., 1000 Kc., 1400 Kc., 1600 Kc., 2000 Kc., 2500 Kc., 3579 Kc., 4.5 Mc., 5 Mc., 10.7 Mc., (3679 Kc. is the color burst frequency.)

Complete with shielded leads.

Superior’s New
Model 76

- IT'S A CONDENSER BRIDGE
- IT'S A RESISTANCE BRIDGE
- IT'S A SIGNAL TRACER
- IT'S A TV ANTENNA TESTER

SPECIFICATIONS
- CAPACITY BRIDGE SECTION 4 Ranges: .0001 Microfarad to .001 Microfarad; .001 Microfarad to .005 Microfarad; .005 Microfarad to .0001 Microfarad. Will also measure the power factor of all condensers from .1 to 1000 Microfarads.
- RESISTANCE BRIDGE SECTION 2 Ranges: 10 ohms to 50,000 ohms; 10,000 ohms to 5 megohms.
- SIGNAL TRACER SECTION With the use of the R.F. and A.F. Probes included with the Model TV-50, you can make stage gain measurements, locate signal loss in R.F. and Audio stages, localize faulty stages, locate distortion and hum, etc.
- TV ANTENNA TESTER SECTION Loss of sync, snow and instability are only a few of the faults which may be due to a break in the antenna, so why not check the TV antenna first? Locate a break in the TV antenna and measure the location of the break in feet from the set terminals.

Complete with R.F. and A.F. probes and test leads.

Superior’s New Model 770-A POCKET-SIZED VOLT-Ohm MILLIAMMETER

- USING THE NEW "FULLVIEW" METER 71%, MORE SCALE AREA—Occupies exactly the same space used by the older Standard 2/5. Meters, yet 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.
- Compact—measures 3⅛" x 3⅛" x 2⅜".
- "Full View" 2% accurate, 850 Microamperes D’Arsonval type meter.
- Housed in round-cornered, molded case.
- "Beautiful" black etched panel.

Specifications: 1 A.C. VOLTAGE RANGES: 0.1/30/150/300/1500/3000 Volts 6 D.C. VOLTAGE RANGES: 0.75/15/75/150/750/1500 Volts 2 RESISTANCE RANGES: 0.01/1000 Ohms, 0.1 M. Ohms, 3.12 Ohms.

Complete with test leads.

MOSS ELECTRONIC DISTRIBUTING CO., INC.
Dept. D-401, 3849 Tenth Ave., New York 34, N. Y.

Please send me the unit(s) checked. I agree to pay down payment within 10 days and to pay the monthly balance as shown. It is understood that if I should fail to make payment when due, the full unpaid balance shall become immediately due and payable.

Name
Address
City

All Prices net. F.O.B. N.Y.C.

- Model TV-11 Total Price $47.85
- Model TV-16 Total Price $52.85
- Model TV-20 Total Price $52.85
- Model TV-25 Total Price $58.85
- Model TV-30 Total Price $58.85
- Model TV-35 Total Price $64.85
- Model TV-40 Total Price $70.85
- Model TV-45 Total Price $77.85
- Model TV-50 Total Price $70.85

**NO INTEREST OR FINANCE CHARGES ADDED!**

If not completely satisfied, you are privileged to return the Tester to us, cancelling any further obligation.

Model 670-A—Terms $7.40 after 10 day trial then $3.30 per month for 6 months.

Model 770-A—Terms $3.85 after 10 day trial then $4.00 per month for 3 months.

Model TV-50—Terms $11.50 after 10 day trial then $6.00 per month for 6 months.

Model 76—Terms $6.95 after 10 day trial then $5.00 per month for 4 months.

Model 670-A—Terms $7.40 after 10 day trial then $3.30 per month for 6 months.
**TELEVISION**

**POSITIVE GRID**

The complaint on a Zenith 20J22 was one of horizontal frequency drift after the receiver had been on for about 2 hours. At this time the horizontal hold also became very sensitive.

After checking the horizontal oscillator, horizontal frequency control, and horizontal phase detector, the set was checked for defective components in these same circuits, all without finding the trouble.

Checking further, approximately 1 volt positive was found on the grid of the afc tube (½ 6SN7). The plate voltage was below normal also. When the tube was pulled out of the socket, the voltage on the grid went up to 20. Taking one part out of the circuit at a time, the voltage was found to be coming from two 100,000-ohm resistors in series, feeding the grid of the afc tube. When all parts were taken off both ends of the resistors, the voltage was still present. One of the resistors was tied between vacant pins 2 and 6 of the 6W4 tube, and the voltage was coming from pin 2. The socket was checked, and then the tube. The culprit: the 6W4.

Checking the construction of the tube, I found pin 2 was used inside the tube as a support for the mica spacer and was located directly under the plate structure. My guess as to the trouble—leaky mica.

A new tube was inserted, and the set worked fine. But just in case the next tube gets the same trouble-making idea, that resistor is now located between two terminals of a nice healthy tie post.—Robert A. Hiltzemper

---

**PACO ELECTRONICS CO., INC.**

70-31 84th Street, Glendale 27, L. I., N. Y.

A DIVISION OF PRECISION Apparatus Company, Inc.

Export: 458 Broadway, New York 13, New York

Canada: Atlas Radio Corp., Ltd., 50 Wingdale Ave., Toronto 10, Ont.
NEW
ONLY
PUBLICATION
OF ITS KIND!

Test Equipment Annual
MOST COMPLETE AND AUTHORITATIVE
GUIDE TO TEST INSTRUMENTS EVER PUBLISHED
Nothing else like it! A completely new and
different publication bringing you the most needed,
most requested information about all types of Test
Equipment and accessories. A 100% practical
guide for anyone who uses test equipment—written
in down-to-earth language and profusely illustrated.

8 FACT-PACKED SECTIONS:
• Test Equipment Methods, Measurement
  Analysis and General Information
• Using Test Equipment for Alignment
• Using Test Equipment for Troubleshooting
• Use and Selection of Test Equipment for Color TV
• Test Equipment for Special Applications
• Test Equipment Maintenance
• Questions and Answers About Test Equipment
You get all the useful information you need on
time, operation and maintenance of Test
Equipment. Each section of the book is packed
with data that will save you time and money—
techniques to make your present equipment
more versatile and valuable—full information
about new equipment designed for service
of new chassis and components.

Complete specifications on over
300 current models of test
equipment and accessories!
Includes full manufacturers' speci-
cations—and more
than 300 photos of equipment. For the first
time anywhere—a complete presentation of
test equipment grouped by logical instru-
ment type classification (not by brand
name). Covers everything:

• Pattern Generators
• AM, FM, Sweep & Marker
  Generators
• Audio & Square-Wave
  Generators
• Oscilloscopes
• VOM's
• VTFM's
• Power Meters
• Field Strength Meters
• Decade & Substitution Boxes
• Power Supply Equipment
• Tube Testers
• Transistor Testers
• CRT Testers
• Component Testers
• Other Meters & Probes
• Other Bench Equipment

ALL THE FACTS YOU WANT!

HOWARD W. SAMS & CO., INC.
Indianapolis 5, Indiana

LIMITED EDITION
Order Your Copy Today!

HOWARD W. SAMS & CO., INC.

Order from your Parts Jobber today, or
mail to Howard W. Sams & Co., Inc., Dept. 2-LL7,
2201 East 46th St., Indianapolis 5, Ind.

Send ____ copy(ies) of "Test Equipment Annual."
My (check) (money order) for $______ is enclosed

Name

Address

City: Zone State

(outside U. S. A. priced slightly higher)

www.americanradiohistory.com
FOR many years I have followed the many articles on transistors and transistorized devices such as radio receivers. Many attempts have been made to reduce size while still preserving the desirable features found in commercial portables. Something usually has to be sacrificed.

My main goal was to include in one package all those features that are desirable in a portable radio receiver. The final result was a 4 x 3 x 1-inch receiver, with good operating economy, high sensitivity, sharp selectivity and more than enough power to drive a 2½-inch FM speaker.

The set is a complete superheterodyne containing seven transistors and one crystal diode (see Fig. 1). The total cost of the transistors and diode is about $13. Three of the transistors are 2N112's. One functions as a converter, the other two as if amplifiers. A 1N34 crystal diode operates as both arc and

(Continued on page 93)

Fig. 1—Circuit of the receiver's four sections. Unmarked 33K resistor is R8 and the .01 capacitor C2 should be C3.

R1—27,000 ohms
R2, 4—100,000 ohms
R3—1,200 ohms
R5—220 ohms
R6, 17—470 ohms
R7—270,000 ohms
R8—7,000 ohms
R9—1,000 ohms
R11—pot, 10,000 ohms (Lafayette VC-28 or equivalent)
R12—62,000 ohms
R13—1,000 ohms
R14—1,000 ohms
R15—10,000 ohms
R16—420 ohms
R17—470 ohms
R18—2,000 ohms
R20—47,000 ohms

All resistors ¼ watt
Cl—midget tuning capacitor; rf section, 10—200 µf; oscillator section, 10—100 µf (Lafayette MS70 or equivalent)
C2—50 µf, 12 volts; miniature electrolytic
C3, C4, C5, C7, C9, C10, C11, C12—0.1 µf, miniature
C6, C8—2 µf, 12 volts, miniature electrolytics
C13, 4—1 µf, 12 volts, miniature electrolytics
C14—16 µf, 12 volts, miniature electrolytics
D—1N34

J—closed-circuit phone jack, miniature (Lafayette MS-282 or equivalent)
S—pot, on R11
Ti—Antenna coil 540—1650 kc, matched to Cl (Lafayette MS-272 or equivalent)
T1—oscillator transformer, 465—kc (Lafayette MS265 or equivalent)
T3, 4—ril transformers: primary 15,000 ohms Ct, secondary 400 ohms (Lafayette MS-340 or equivalent)
T3—ril transformers: primary 18,000 ohms Ct, secondary 1,000 ohms
T5—ril transformer: primary 10,000 ohms Ct, secondary 2,000 ohms (Argonne-119 or equivalent)
T7—ril transformer: primary .5 ohms Ct, secondary .3 ohms (Argonne AR-19 or equivalent)

V1, 2, 3—2N112
V4, 5, 6, 7—2N107
BATT, 9 volts, mercury (Malory TR-146R or equivalent)
Speaker, 3.2 ohm, voice coil, 2½ inches (Lafayette 5X-36 or equivalent)
Batellite sheet, ½ x 5 x 1/16 inches
Batellite sheet, ½ x 5 x 1/32 inches
Batellite sheet, ½ x 5 x 1/16 inches
Case, Lafayette 311 or equivalent
Transistor sockets (7)

*These resistors worked well with the values shown; however, you may find it necessary to adjust these values to those that will work well with the transistors used.

By HOWARD GRANOFF
Build the Best—build ALLIED knight-kits

the finest electronic equipment in money-saving kit form

LOWEST COST
ALLIED'S giant buying power passes biggest savings on to you—do the easy assembly and your finished instrument equals the performance and appearance of equipment selling for several times the low KNIGHT-KIT cost. Your savings are BIG.

EASIEST TO BUILD
KNIGHT-KIT "Step-and-Check" instruction manuals with wall-sized picture diagrams are marvels of clarity—it's like having a good instructor at your side. No experience required—you can easily build any KNIGHT-KIT and get professional results.

LATEST DESIGN
Each ALLIED KNIGHT-KIT incorporates the very latest circuitry for top-quality performance. Tried and proved professional design and the use of premium quality parts throughout help ensure your building success to bring you quality results.

MONEYBACK GUARANTEE. When properly assembled, KNIGHT-KITS fully meet published specifications or we refund your money in full.

Complete Kit Selection:
- HI-FI
- HOBBY
- INSTRUMENT
- AMATEUR

High Fidelity Everyone Can Afford
- World's Finest Hi-Fi Kits
- Custom-Styled
- Easiest to Build Hi-Fi
- Money-Saving

Knobitch-kit High Fidelity FM-AM Tuner Kit

Model Y-787

$49.95
Only $4.95 down

The best-looking, best-performing FM-AM tuner kit your money can buy! Carefully designed for quick, easy construction—a tuner you'll enjoy assembling and be proud to own, both for its amazing musical performance and outstanding beauty. Covers the full AM broadcast band and 88 to 108 MHz FM. On FM, sensitivity is a remarkable 2.5 microvolts for 80 dB of quieting; hum and noise, —60 db; IF bandwidth, 200 kc at 50% down on curve; response, + 0.5 db, 20-20,000 cps. On AM, sensitivity is 5 microvolts for 10 db signal-to-noise ratio; IF bandwidth, 8 kc at 50% down on curve; response, 20-8000 cps. Outstanding features include: Inertia Flywheel Tuning for effortless, accurate tuning; Automatic Frequency Control (plus AFC disabling) to "lock-in" FM stations; printed circuit board (with most of the kit wiring already done for you) assures time-saving, error-free assembly; pre-aligned RF and IF coils; tuned RF stage on FM; drift-compensated oscillator; neon glow tuning pointer; cathode follower output; two output jacks—one for recorder, one for amplifier; rotatable built-in ferrite antenna for AM. Includes beautiful French-gray case with chrome-finished tapered feet, 4 x 13 x 8". Ideal for use with 18, 20 or 30 watt KNIGHT-KIT amplifiers. Ready for easy assembly. Shpg. wt., 12 lbs.

Model Y-787, FM-AM Tuner Kit. Net only $49.95

Knobitch-kit 18-Watt Complete Hi-Fi Amplifier Kit

Model Y-786

$39.95
Only $3.95 down

Here is a custom-styled, easy-to-build complete Hi-Fi amplifier at a price that defies comparison. Delivers full 18 watts output with wide-range, flat frequency response for true Hi-Fi reproduction. Features 10 inputs for every possible signal source, including NARTB equalized tape head input. At full 18 watts output, distortion is only 0.5%; uses new RCA 6073 hi-fi output tubes. Frequency response is 10 Hz to 20,000 Hz; tape head and cartridge sensitivity; 5 microvolts for 18 watts output; hum and noise level better than 50 db below 18 watts. Output taps for 4, 8 or 16 ohm speakers. Controls: Input and Record Equalization; Bass Boost and Attenuate; Treble Boost and Attenuate; Volume. Simplest assembly is made possible through the use of an exclusive printed circuit switch and two printed circuit boards—most of the kit wiring is already done for you. With custom-styled French-gray "space-saver" case on tapered feet finished in chrome, 4 x 13 x 8". Complete with case, tubes, all parts, and step-by-step instructions, for easy, error-free assembly. Shpg. wt., 16 lbs.

Model Y-786, 18-Watt Hi-Fi Amplifier Kit. Net only $39.95

Easy Terms to Fit Your Budget. ALLIED KNIGHT-KITS may be purchased under our Easy Payment Plan. Your order need total only $45.00 or more—only 10% down, small monthly payments thereafter. No red tape—fast handling assured.

Order from ALLIED RADIO
100 N. Western Ave. • Chicago 80, Ill.

www.americanradiohistory.com
Now you can have Custom-Styled Hi-Fi in ALLIED

**knight-kit 30-Watt Complete Hi-Fi Amplifier Kit**

- Model Y-762
  - $76.95
  - Only $7.69 down

Comparable to the best in Hi-Fi—at far less cost! Deluxe features include: Linear-deluxe Williamson-type circuit for flawless response; equalization for all records within 1/2 db of recommended accuracy; 2 exclusive new printed circuit switches in preamp section (no complex wiring to do); 3 printed circuit boards for time-saving, error-free assembly; separate, continuously variable Level and Loudness controls; use of premium 12AY7 tube for low noise and hum; DC on all filaments of preamp tubes; exclusive A-AB-B speaker selector switch (use speakers of mixed impedances without mismatch). 8 inputs: Tape Head direct; G.E. and Pickering cartridges; Ceramic cartridge; Microphone; Auxiliary; Tape Preamp; Tuner (with separate Y-at Y-variable damping). Full records within ±0.5 db, harmonic 0.55%, distortion. 30 speakers Head direct; G.E. and Pickering cartridges; Ceramic cartridge; Microphone; Auxiliary; Tape Preamp; Tuner (with separate Y-at Y-variable damping).

**knight-kit High Fidelity FM Tuner Kit**

- Model Y-751
  - $38.95
  - Only $3.89 down

Here is top value in creative engineering, impressive hi-fi performance and distinctive design—a tuner you'll be proud to build and own. Covers the full FM band, 88 to 108 mc. Features Automatic Frequency Control (with disabling feature) to "lock-in" stations and prevent drift; Inertia Flywheel Tuning for smooth, accurate station selection; pre-adjusted RF coils; pre-aligned IF's; cascode broad-band RF amplifier; drift-compensated oscillator; neon bulb pointer. All critical wiring is already done for you in the form of a printed circuit board—assembly is simple. Sensitivity is 4 microvolts for 20 db of quieting across entire band; output, 2 volts at 1000 microvolts input; IF bandwidth, 200 kc; response, 20-20,000 cps. with only 0.6% distortion. Output jacks for amplifier and tape recorder; cathode follower output. Ideal for use with the KNIGHT-kit amplifiers, or any amplifier with phono-tuner switch. Features custom-styled case in French-gray, with tapered chrome-finished feet, 4 x 13 x 8". Includes all parts, tubes and step-by-step instructions for easy assembly. Shpg. wt., 12 lbs.

- Model Y-751. Hi-Fi FM Tuner Kit. Net only. .......... $38.95

**knight-kit Deluxe 3-Way Speaker System Kit**

- Model Y-937
  - $89.50
  - Only $8.95 down

Deluxe quality high fidelity speaker system at a money-saving low price. Easy to assemble—all you need is a screwdriver. System includes KNIGHT "Quick-Craft" corner-type folded-horn enclosure kit, and the famous-value KNIGHT 3-Way 12-inch speaker. Just assemble the enclosure—no finishing required—all surfaces are finished in hand-rubbed Korina blonde, mahogany or walnut. The speaker is the new 3-way type: 12" woofer cone for bass (full 134 pound woofer magnet), conical radiator for mid-frequencies, built-in compression-type tweeter (with wired level control and calibrated dial) for highest frequencies. Unexcelled enclosure efficiency and superb speaker performance combine to cover the whole spectrum of audible sound for true hi-fi response from 35 to 15,000 cps, ± 3 db. Kit includes 3-way speaker, prefinsihed enclosure panels, grille cloth, hardware and instructions. Specify Korina blonde, mahogany or walnut when ordering. Shpg. wt., 44 lbs.

- Model Y-937. 3-Way Speaker System Kit. Net only. .... $89.50

**knight-kit 10-Watt Hi-Fi Amplifier Kit**

- Model Y-753
  - $23.50
  - $2.35 down

Low-cost, authentic hi-fi amplifier. Response, ± 1 db, 30-20,000 cps. Input for crystal phono or tuner; chrome-plated chassis is punched for preamp kit below, to permit use of magnetic phono. Only 0.5 volt drives amplifier to full output. Separate bass and treble controls. Only 1% harmonic distortion. Matches 8-ohm speaker. 7 x 13 x 6". With all parts, tubes and instructions. Shpg. wt., 13 lbs.

- Model Y-753. Net only. .................. $23.50

- Y-235. Preamp Kit .................. $3.10

- Y-757. Metal Cover .................. $3.95

ALLIED RADIO America's Pioneer in Electronic Kits
knight-kits

THE VERY FINEST MUSICAL QUALITY—SO EASY TO BUILD
MONEY-SAVING HI-FI EVERYONE CAN AFFORD

knight-kit High Fidelity Preamp Kit
Model Y-754
$39.95
- Exclusive Printed Circuit Switches and Boards
- Equalization ±1/2 db of Recommended Accuracy
- 8 inputs including Tape Head
- Self-Powered
- DC on All Tube Filaments
- Custom-Styled

Only $3.99 down

Sensational Hi-Fi design at amazing low cost. Provides precise record equalization guaranteed within 1/2 db of recommended accuracy!—more accurate than all but the most expensive factory-built preamps. Includes exclusive new knight-kit printed circuit switches for easy, error-free assembly; 2 printed circuit boards eliminate all other wiring, except for power supply and control leads—so easy to build. Has built-in power supply; includes premium 12AY7 and ECC82 tubes. Frequency response, ± 0.5 db, 10-50,000 cps. Has 8 inputs: Tape Head; G.E. Phono; Pickering Phono; Ceramic; Microphone; Auxiliary; Tape Preamp; Tuner. Level adjustment for tuner input. Includes separate Bass and Treble controls; separate Level and Loudness controls; Rumble Filter switch; DC on all tube filaments; cathode follower output; 2 extra AC outlets. You get every advanced hi-fi feature in this easy-to-build preamp at the lowest possible cost. Includes beautiful custom-styled French-gray case, with tapered chrome-finished legs, 4 x 13 x 8". With all parts, tubes, step-by-step instructions; ready for easy assembly. Shpg. wt., 12¼ lbs.

Model Y-754. Hi-Fi Preamp Kit. Net only $39.95

knight-kit 25-Watt Hi-Fi Basic Amplifier Kit
Model Y-755
$44.50
- Hi-Fi Response, ± 0.5 db, 10 to 120,000 cps
- Only 0.15% Distortion at 30 Watts Output
- Printed Circuit Wiring Board + Chrome-Plated Chassis
- Williamson-Type Circuit with Over 25 Watts Output

Only $4.45 down

Here's superb Hi-Fi performance at less than half the cost of a comparable commercially-assembled unit. Williamson-type linear-dilute circuit delivers over 25 watts of virtually undistorted reproduction. Ideal for use with the knight-kit preamp at left. Includes printed circuit board for amplified, error-free assembly. Remarkable hi-fi response, ± 0.5 db, 10-120,000 cps at 20 watts. Harmonic distortion, 0.15% at 30 watts; 1.5% at 20 watts. Hum level, 85 db below 25 watts output. Output impedances, 4, 8 and 16 ohms; output tubes, 2-5881. Includes balance control for precise matching of the output tubes; variable damping control for maximum performance with any speaker system—prevents low-frequency distortion from overdamping or underdamping. Very attractive black and chrome styling, 6 x 14 x 9". An outstanding engineering achievement in a home hi-fi amplifier, delivering performance equal to the finest commercially assembled units. Includes all parts and tubes; with step-by-step instructions, ready for easy assembly. Shpg. wt., 25 lbs.

Model Y-755. 25-Watt Amplifier Kit. Net only $44.50

Y-759. Metal Cover for above; black finish. 5 lbs. Net $4.25

knight-kit 2-Way Hi-Fi Speaker System Kit
Model Y-789
$49.95
- Easy to Assemble—Pre-Finished Enclosure
- High Fidelity Response, 45 to 14,000 cps
- 12" Woofers and Horn-Type Tweeter
- A Wonderful Money-Saving Speaker Value

Only $4.99 down

BIG SAVINGS—assemble your own knight-kit 2-way speaker system—it's quick and easy! The cabinet is pre-finished in full-grained, high luster blonde or mahogany— you just assemble 7 pieces, mount the speaker components and enjoy rich, thrilling hi-fi sound—at incomparably low cost. Special Jensen-engineered baffle features “ducted port” construction to bring out the full beauty of bass notes, perfectly matching the Jensen woofer and compression tweeter; genuine L-pad control is rear-mounted to permit adjustment of tweeter for best tonal balance. Impedance, 16 ohms. The assembled unit delivers a frequency response of 45 to 14,000 cps. Enclosure measures 26 x 19 x 14". Beautifully styled to blend in any room. Kit includes Jensen 12" woofers, Jensen compression-type tweeter, pre-finished wood parts (with grille cloth installed), acoustic material, glue, hardware and step-by-step instructions. Absolutely no furniture finishing required. Specify blonde or mahogany finish when ordering. Shpg. wt., 33 lbs.

Model Y-789. 2-Way Speaker System Kit. Net only $49.95

knight-kit HI-FI IS AVAILABLE ON EASY TERMS TO FIT YOUR BUDGET
Fascinating ALLIED **knight-kits** FOR EXPERIMENTERS AND HOBBYISTS

### knight-kit 2-Transistor Pocket Radio Receiver Kit
- Model Y-762
- Loud, Clear Local Reception
- Newest Printed Circuit Board
- Built-in Loop Antenna
- Complete Kit—Nothing Else To Buy

**$14.65**

It's fun to build this pocket-size two-transistor radio—and you'll enjoy its crystal-clear local broadcast-band reception wherever you go! Fits in your pocket, or with its button-down flap, can be worn from your belt. Completely self-contained with built-in ferrite loopstick antenna—no external antenna needed. Extremely efficient reflex type 2-transistor circuit actually does the work of 3 transistors! Printed circuit board reduces building time to about one hour. Has air-dielectric variable capacitor for easy, accurate station tuning. Operates for months and months on long-life alkaline battery supplied. Sensitive miniature earpiece provides crystal-clear tone. Handsome tan carrying case, plastic-impregnated, is styled to resemble leather; only 4½ x 3¼ x 1½". Kit includes all parts, transistors, earpiece, battery and case. Shpg. wt., 1½ lbs.

Model Y-262. Net only **$14.65**

### knight-kit "Trans-Midge" Transistor Receiver Kit
- Model Y-767
- Tiny cigarette-pack-size one-transistor radio kit—fascinating to build—so low-priced. This novel miniature receiver will provide endless listening pleasure the moment assembly is completed. Covers the local AM broadcast band with exceptional sensitivity and selectivity. Special features include: Efficient, slug-tuned coil for excellent station separation; external knob for easy station tuning; low-drain transistor operating for months from single penlight cell supplied; hinged-back, red plastic case. Kit includes all parts, transistor, battery, compact case and easy-to-follow instructions for quick assembly. (External antenna and headphones required.)

**$24.50**

Shpg. wt., 8 oz.

Model Y-767. Net only **$2.45**

J-149. 4000 Ohm Headphones. 1 lb. **$2.15**

C-100. Antenna Kit. 1½ lbs. **$1.03**

### knight-kit 10-Circuit Transistor Lab Kit
- Model Y-299
- Sensational experimenters' transistor kit—an electronic marvel! Perfect for experimenters, student or hobbyist. Assemble basic parts one, then complete project after project (10 in all), by simply plugging leads into proper jacks on printed circuit board—no wiring changes needed. You learn how transistors operate by "plugging in" to make any one of the following circuits: AM radio for strong headphone reception; 2-stage audio amplifier; wireless broadcaster; code practice oscillator; electronic timer; electronic switch; electronic flasher; phototransistor relay; voice-operated relay; capacity-operated relay. Includes all parts, 2 transistors, battery, headphones, circuit leads, relay, photocell, special guide cards for each project, explanation of each circuit. 3 lbs.

**$15.75**

Model Y-299. Net only **$15.75**

### knight-kit 5-Transistor Superhet Personal Portable Radio Kit
- Model Y-766
- Styled to Equal the Finest
- Push-Pull Audio Drives 3½" Speaker
- Printed Circuit for Easy Building
- 200 Hour Battery Playing Life

**$29.95**

Beautiful, easy-to-build transistorized personal portable with every ultra-modern design feature: 5 Texas Instrument Co. transistors; latest printed circuit chassis for easy, error-free assembly; bigger-than-average 3½" speaker; class B push-pull audio output; built-in high-gain ferrite loopstick antenna; plus phone jack output for private listening; provides sensitive reception of the AM broadcast band with exceptional tone quality. Ultra-smart high-impact ivory plastic case has handsome gold trim with ebony accents; includes pull-out handle; only 7½ x 3½ x 1½". With all parts, transistors, 9 volt transistor radio battery, carrying case and instructions anyone can easily follow. Shpg. wt., 2 lbs.

Model Y-766. Net only **$29.95**

### "10-In-One" Electronic Lab Kit
- Model Y-265
- Famous experimenters' kit. Builds any of 10 fascinating projects, including broadcast receiver, wireless phone oscillator, code practice oscillator, signal tracer, relays, etc. Shpg. w., 8 lbs.

**$12.65**

Model Y-265. Net only **$12.65**

### "5-In-One" Electronic Lab Kit
- Model Y-770
- A favorite with beginners. After basic wiring is completed, you make circuit changes without soldering. Builds any of six favorite projects, including radio, wireless broadcast, etc. Shpg. w., 2 lbs.

**$8.45**

Model Y-770. Net only **$8.45**

### Crystal Set Hobby Kit
- Model Y-261
- Entertaining, educational. Delivers clear headphone reception of local broadcast stations. With all parts, ready for easy assembly. (Antenna and headphones required.) Shpg. w., 1 lb.

**$2.15**

Model Y-261. Net only **$2.15**

### Wireless Broadcaster Kit
- Model Y-705
- Plays music or makes announcements through your radio set—no connection to set required! Loads of fun—easy to build. Works up to 50 watts (from set). Shpg. w., 3 lbs.

**$9.50**

Model Y-705. Net only **$9.50**

ORDER FROM ALLIED RADIO 100 N. WESTERN AVE. • CHICAGO 80, ILL.
FINS TO BUILD...INSTRUCTIVE...LATEST CIRCUITS FOR TOP PERFORMANCE
WIDEST CHOICE OF QUALITY HOBBYIST KITS

**knight-kit Photoelectronic Relay Kit**
Model Y-722
$13.50
Advanced-design, ultra-sensitive photoelectronic relay—build it yourself and save! Dozens of uses for automatic control of lights, door annunciator, burglar alarm, counting devices, etc. Provides dependable operation up to 250 feet with white light, up to 125 feet with "sunlight" light (red filter) from Light Source Kit listed below. Selectable operator, with "trip" for burglar alarm to provide continuous ringing of alarm; and "auto" if relay is to operate each time beam is broken (for chimneys, counting devices, turn-on lights at darkness). Has SPST relay operated from thyratron; 6.3 v. terminals provide power for accessories. For 105-120 v., 50-60 cy. AC use. 6 lbs.

Model Y-722, Relay Kit. Net only $13.50

**knight-kit "Ocean Hopper" All-Wave Radio Kit**
Model Y-740
$11.95
This top-performing regenerative receiver puts a world of listening pleasure at your finger-tips. Tuning range (using coils listed below) is virtually world-wide; covers 155 ke to 35 me, including every type of radio transmission: AM broadcast, marine, aircraft, distress channels, direction-finding, Amateur, frequency-standard, foreign broadcast, and police. With bandspread tuning. For use with headphones or 3-4 ohm PM speaker. Kit is supplied with standard broadcast band coil and all tubes and parts. (Less extra coils, headphones, speaker and cabinet.) Shpg. wt., 5 lbs.

Model Y-740, Cabinet for above. 1.5 lbs. Net $2.90
Extra coils available: Long Wave Coil (155-470 ke). Net $3.50. Short Wave (185-41.1 me; 2.9-7.3 me; 17.5 me and 15.3-35 me). Each $5.50.

**knight-kit "Space-Spanner" Bandswitching World-Wide Radio Kit**
Model Y-243
$15.95
Broadcast or Short Wave Reception
Sensitive Regenerative Circuit
Convenient Bandspread Tuning
Built-In Loudspeaker
Imagine the thrill of hearing overseas broadcasts on a precision receiver you've built yourself—and then, at the flip of a switch, being able to tune to your favorite local broadcast station! Bandswitch selects exciting short wave, including foreign broadcasts, amateur calls, aircraft, police and marine radio on the 6.5 to 17 me range, as well as standard 540-1700 kc broadcasts. Features highly sensitive regenerative circuit. Includes built-in 4" PM speaker and beam-power tube for strong volume and clear tone. Headphone connectors are available for private listening; switch cuts out speaker. Controls: Bandspread, Main Tuning, Antenna Trimmer, Bandswitch, Regeneration, Volume. 7 x 11 x 7 1/2". Easy to build from step-by-step instruction manual. For 110-120 v., 50-60 cy. AC or DC. (Less cabinet.) Shpg. wt., 5 lbs.

Model Y-243, Cabinet for above. Shpg. wt. 2 lbs. Net $2.90

**knight-kit 2-Way Intercom System Kit**
Model Y-285
$14.75
- Low Cost—Easy to Assemble
- High Gain—Clear Tone
- Handsome Metal Cabinets
- Includes 50-Foot Cable

Easy to build at lowest cost—ideal for home, office, shop or school. Consists of Master unit and Remote unit. Remote unit may be left "open" for answering calls from a distance, for "baby sitting", etc. Remote may also be set for "private" operation—cannot be "listened-on" in, but it can be called and can originate calls. Master unit includes high-gain 2-stage amplifier, combination volume control and on-off switch, plus pilot light. Each unit has 4" PM dynamic speaker. System responds to every whisper. Handsome Antique white cabinets, each 4 1/4 x 16 1/4 x 12 1/2". With all parts, tubes and 50-ft. cable (up to 200-ft. may be added). For 110-120 v., AC or DC; 8 lbs.

Model Y-285, Master and one Remote. Net only $14.75
Model Y-286, Extra Remote Station Kit. 3 lbs. $3.75

**Phono Amplifier Kit**
$9.45
Build it yourself—and save! Ideal for use in a portable phonograph—just add record player and ohm speaker. 1 1/4 watt/second output. Inverse feedback circuit. Easy to assemble. Shpg. wt., 3 lbs.

Model Y-790. Net only $9.45

**Electronic Photoflash Kit**
$20.50
Ideal for color or black and white photography. 1/100th-of-a-second flash: 50 watt/second output. Synchronizes with any camera with X or O shutter. (Less batteries.) Shpg. wt., 4 lbs.

Model Y-244. Net only $28.50

**Code Practice Oscillator Kit**
$3.95

Model Y-239. Net only $3.95

**Phono Oscillator Kit**
$5.85
"Broadcasts" recorded music through any standard radio set up to 40 feet away. No direct connection to set required. Easy to build—fun to use. Shpg. wt., 2 lbs.

Model Y-760. Net only $5.85

FINES ELECTRONIC EQUIPMENT IN EASY-TO-BUILD MONEY-SAVING KIT FORM
Better By Far - ALLIED knight-kit

knigh-t kit Low-Cost Tube Tester Kit
Model Y-143
- With 16 Filament Voltages
- 600 Latest Tube Types Listed
- Easy-to-Read 4½ Meter
- Tests Series-String TV Tubes
Excellently designed for complete, up-to-date coverage of tube types. Tests series-string TV tubes; tests 4, 5, 6 and 7 pin large, regular and miniature types, octals, octalads, 3-pin miniatures and pilot lamps. Tests for open, short, leakage, hester continuity and performance (by amount of cathode emission). Big 4½ square meter glass clear "GOOD-REPLACE" scale. With line-voltage indicator and line-adjust control. Choice of 16 filament voltages from 0.63 to 117 volts to check virtually all receiving tubes; blank socket for future type tubes. Universal-type selection switches permit selection of any combination of pin connections. Single-unit, pre-assembled 10-level function switch simplifies and speeds assembly. Up-to-date illuminated roll chart lists over 600 tube types. Counter model case, 5 x 14 x 10". Easy to build. 14 lbs. Model Y-143. Net only $29.75
Model Y-142, Portable Case model. 15 lbs. Net $34.75
Model Y-141. Picture Tube Adapter. 1 lbs. Net $4.25

knigh-t kit RF Signal Generator Kit
Model Y-145
Build this wide-range, extremely stable RF signal generator—save two-thirds the cost of a comparable wired instrument! Large, semi-circular dial is clearly calibrated; range is covered in 5 separate bands for close accuracy in setting individual frequencies. Ideal for aligning RF and IF stages in radio and TV sets and for troubleshooting audio equipment. Dealers output on fundamentals from 160 kc all the way out to 112 mc; useful harmonics to 224 mc. Has built-in 400-cycle sine-wave audio oscillator for modulating RF; audio is also available externally. Features high-stability Colpitts circuit. Convenient jack for external modulation. Maximum audio output 10 volts; RF output over 0.1 volt on all ranges. Step and continuous-type attenuator controls. Supplied with precision-wound coils that require no adjustment. 7 x 10 x 5". Shpg. wt., 11 lbs. Model Y-145. Net only $19.75

knigh-t kit 1000 Ohms/Volt VOM Kit
Model Y-128
Exceptional accuracy and versatility at amazing low cost. Ideal for service shop, lab or Amateur use. Large 4½, 400 microamp meter with separate scales for AC and DC voltage and current, decibels and resistance. Uses 1% precision resistors; has 3-position function switch and 12-position range switch. 16 ranges include: AC, DC and output volts. 0-1-5-10-20-50-100-1000 (1000 ohms/volt sensitivity); Resistance, 0-1000-10,000 ohms and 0-1 meg (center-scale readings of 60, 150 and 1500 ohms); Current, AC or DC, 0-1-100 ma and 0-1 amp; Decibels. 20 to +09 in 6 ranges. Precision resistors are used as shunts and multipliers to assure exceptional accuracy of measurements. With all parts, battery, test leads and black bakelite case with convenient carrying handle, 6½ x 5½ x 3½". A great value in an easy-to-build quality instrument. Shpg. wt., 25½ lbs. Model Y-128. Net only $16.95

knigh-t kit Vacuum Tube Voltmeter Kit
Model Y-125
- 200 μA Movement, 4½ Meter
- Includes AC, Peak to Peak
- Balanced-Bridge, Push-Pull Circuit
- 1% Film-Type Resistors
Top buy in an extremely stable, highly accurate VTVM. Easy to assemble—entire chassis is printed circuit board. Perfect for radio-TV service work, lab and Amateur use. Features low-leakage type switches; 1% film-type precision resistors; balanced-bridge, push-pull circuit (switch to any range without readjusting zero set); zero center scale and direct-reading db scale; polarity reversing switch. Ranges: Input Resistance, 11 meg; DC and AC; 0-1-5-15-50-150-500-1500; AC Peak-to-Peak, 0-4-14-40-140-4000; Response, 30 cycles to 3 mc; Ohms, 0-1000-10K-100K and 0-1-10-100-1000 meg, db, 10 to 45. Includes all parts, tubes, battery, test leads and portable case, 7½ x 5½ x 4½". Easy to assemble. Shpg. wt., 6 lbs. Model Y-125. Net only $24.95
Model Y-126. Hi Voltage Probe; extends DC to 50,000 v. $4.75
Model Y-127. Hi-Frequency Probe; extends AC to 250 mc. $3.45

Transistor Checker Kit
$8.50
Checks gain ratio of all types of transistors; checks germanium and silicon diodes; checks for continuity and shorts. A valuable instrument at very low cost. Easy to assemble. Shpg. wt., 2 lbs. Model Y-149. Not only $8.50

Flyback Checker Kit
$19.50
Checks condition of all types of horizontal output transformers and deflection yokes, as well as TV linearity and width coils. 4½ meter; widest range in its field. Shpg. wt., 6 lbs. Model Y-118. Not only $19.50

Sweep Generator Kit
$43.75
Extreme linearity on a par with costly lab instruments; fundamental to 250 mc; output flat within 1 db; electronic blanking. Easy, money-saving assembly. Shpg. wt., 16 lbs. Model Y-123. Not only $43.75

Capacitor Checker Kit
$12.50
Tests capacitors while in the circuit! Has widest range—20 mmf to 2000 mmf. Exclusive circuit for cancelling lead capacity. "Magic Eye" indicator. Save 60% over factory-wired units. 6 lbs. Model Y-119. Not only $12.50

ORDER FROM ALLIED RADIO
100 N. WESTERN AVE. • CHICAGO 80, ILL.

www.americanradiohistory.com
MODEL SQUARE- WAVE VOLTAGE SIMULATIONS. SHARP WAVEFORM, EXCEEDINGLY ACURATE. CAREFULLY ENGINEERED FOR SCOPE USE. PUTS 100% PRECISION TO SCOPE SCREEN. PUTS HIGHEST POSSIBLE SIGNAL DFS ON THE SCOPE SCREEN. TRACES SIGNAL FROM ANTENNA TO SPEAKER. REPRODUCES SIGNAL AT PLATE OR GRID CONNECTION OF ANY STAGE. IDENTIFIES AND ISOLATES "IDEAL" STAGES. FEATURES: UNADJUSTABLE MAGIC EYE CAPABILITIES; CALIBRATED ATTENUATORS FOR SIGNAL PRESENCE INDICATION AND STAGE-BY-STAGE GAIN MEASUREMENTS; BUILT-IN 4 PM SPEAKER; COMBINATION 2-POSITION PROBE, ONE FOR RF (0.1 MHz), THE OTHER FOR AUDIO. PROVIDES NOISE-BASED WAVE-BASED CALIBRATION FROM 25 TO 1000 VOLTS, PROVISION FOR EXTERNAL SCOPE OR VTVU. BINDING POSTS PROVIDE OUTPUT TRANSFORMER AND SPEAKER SHUNT SPECIFICATION TESTS, PLUS EXTERNAL UP TO 280 VOLTS PEAK. WITH ALL PARTS, TUBES AND PROBE. $20.00.

Model Y-140. Net only. $29.50

VOLTAGE CALIBRATOR

$12.75

PERMITS USE OF ANY SCOPE WITH PRECISION PEAK-TO-PEAK AC VOLTMETER. PUTS TRUE SQUARE-WAVE VOLTMETER ON SCOPE SCREEN. SELECTS ANY VOLTAGE BETWEEN 0.1 AND 100 VOLTS; FEEDS EXTERNAL SIGNAL DIRECT TO SCOPE FOR INSTANT COMPARISON.

Model Y-136. Net only. $12.75

RESISTANCE SUBSTITUTION BOX

$5.95

EASILY DETERMINES RESISTOR VALUES REQUIRED IN ANY CIRCUIT. MAKES AVAILABLE 96 STANDARD OHM RESISTANCE VALUES IN 2 RANGES BETWEEN 15 OHMS AND 10 MEGOHMS, WITH 10% ACCURACY. SLIDE-SWITCH SELECTS RANGE; 18-POSITION SELECTOR FOR VALUE SELECTION. SHIPS WT. 2 LBS.

Model Y-139. Net only. $5.95

CAPACITANCE SUBSTITUTION BOX

$5.95

MAKES IT EASY TO FIND CAPACITOR VALUES NEEDED IN ANY CIRCUIT. PROVIDES 18 STANDARD VALUES FROM .0001 MF TO 2.2 MF, ± 20%. ALL VALUES ARE 600 VOLTS, EXCEPT 15 AND 22, WHICH ARE 400 VOLTS. 18-POSITION SELECTOR SWITCH. SHIPS WT. 2 LBS.

Model Y-138. Net only. $5.95

Audio Generator Kit

$31.50

EXCELLENT DESIGN; RANGE: 20 MESS TO 20 MHZ WITH 1% DISTORTION; 600 OHM OUTPUT; IDEAL FOR HIFI TESTING. OFFERS THE BEST RESPONSE OF A LAB STANDARD. SHIPS WT. 16 LBS.

Model Y-137. Net only. $31.50

R/C TESTER KIT

$19.50

MEASURES CAPACITANCE AND RESISTANCE. BALANCED-BRIDGE CIRCUIT; INDICATES POWER FACTOR; TESTS CAPACITORS AT RATED VOLTAGE, LARGE, EASY-TO-READ DIAL "MAGIC EYE." SHIPS WT. 10 LBS.

Model Y-124. Net only. $19.50

KNIGHT-KIT 5" GENERAL-PURPOSE SCOPE KIT

$42.00

FEATURE FOR FEATURE THE WORLD'S BEST OSCILLOSCOPE KIT VALUE. A STAND- OUT IN ITS CLASS WITH ALL THESE FEATURES: PRINTED CIRCUIT WIRING BOARD AND LACED HACNESS FOR QUICK, EASY INSTALLATION. PHANTASTRON SCAW Circuits for high linearity of sweep from 15 TO 150,000 CPS. 25 MILLIDIVISIONS FOR EACH SENSITIVITY—3 TIMES THAT OF SIMILARLY PRICED SCOPES. CALIBRATION VOLTAGE—1 VOLT PEAK-TO-PEAK SQUARE WAVE, FULLY ADJUSTABLE. VERTICAL AMPLIFIER—DISTORTION RESPONSE ± 3 DB, 3 EYES TO 1.5 MICROEYES (+ 8 DB TO 2.5 ME). Includes: Directly coupled positioning controls; retrace blanking circuit; frequency-compensated vertical input attenuator; positive and negative internal sync; high-2nd-anode voltage for high-intensity trace, input capacity, 45 milliamps. Kit includes CRT. 9½ x 17¼ x 14¾, 24 lbs.

Model Y-146. Net only. $42.00

KNIGHT-KIT HIGH-GAIN SIGNAL TRACER KIT

$26.50

A REMARKABLE VALUE IN AN EASY-TO-BUILD INSTRUMENT WHICH PERMITS VIRTUAL AND AURAL SIGNAL TRACING OF RF, IF, VIDEO, AND AUDIO CIRCUITS. Has highest gain in its price class. Traces signals from antenna to speaker. Reproduces signal at plate or grid connection of any stage. Identifies and isolates "ideal" stages. Features: usable gain of 90,000; "magic eye" with calibrated attenuators for signal presence indication and stage-by-stage gain measurements; built-in 4 PM speaker; combination 2-position probe, one for RF (0.1 MHz), the other for audio. Provides noise-based calibration. Built-in watt-meter calibrated from 25 to 1000 watts, provision for external scope or VTVU. Binding posts provide output transformer and speaker substitution test, plus external up to 280 volts PEAK. With all parts, tubes and probe. $21.00.

Model Y-135. Net only. $26.50

KNIGHT-KIT 5" WIDE-BAND OSCILLOSCOPE KIT

$69.00

5 MC WAVEFORM FOR COLOR TV; HORIZONTAL SWEEP TO 600 KC; 25 M/V/INCH SENSITIVITY; Z-AXIS INPUT; PRINTER PLATE OR GRID CONNECTION; MATCHING WITH KIT INCLUDED.

Model Y-144. Net only. $69.00

Y-148. Demodulator Probe, Net. $3.45

Y-147. Low Capacity Probe, 12mm, Net. $3.45

Y-149. Kit Form, Net. $149.00

ADVANCED-DESIGN INSTRUMENTS FOR SERVICE, INDUSTRIAL AND RESEARCH USE IN EASIEST-TO-BUILD, MONEY-SAVING KIT FORM

Take advantage of the most liberal Easy Pay plan in electronics. On Knight-Kit orders totaling $45 or more—the most convenient way to make your payments. Low carrying charges—no "red tape."
knight-kits for the radio amateur

knight-kit 50-Watt CW Transmitter Kit

Model Y-255 50-Watt Transmitter Kit

- Ideal for the Novice
- Pi Antenna Coupler
- Bandswitching
- 80 to 10 Meters

There's exceptional value in this very popular bandswitching transmitter kit. Compact and versatile, it's the perfect low-power rig for the beginning novice as well as the seasoned veteran. Has bandswitching coverage of 80, 40, 20, 15 and 10 meters. Rated at 50 watts—actually operates at up to 60 watts on 80 and 40 meters. Oscillator is efficient 8AG7, final is reliable 807. Crisp, clean, cathode keying of oscillator and final. Built-in pin-plugs permits use with random length antennas. Has highly effective TVI suppression. Other features not usually found in transmitter kits at this low price include: Ceramic-insulated final tank capacitor; pre-assembled switches; pre-wound parasitic chokes; ceramic coil forms; coax connector; crystal and VFO socket on front panel; power take-off jack for accessory equipment. Meter reads either plate or grid current of final. Takes crystal or VFO without circuit changes. Cabinet interior and chassis are copper-finished. Size, 10½ x 8½ x 8¼. With tubes and all parts for easy assembly. (Less crystal and key.) Shpg. wt., 19 lbs.

Model Y-255. 50-Watt Transmitter Kit. Net only $38.95

knight-kit Self-Powered VFO Kit

Model Y-723, VFO Kit. Only $7.65 down

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 bandwidth; 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: 40v on 80, 20v on 40. With Spot-Off-Transmit switch for spot frequency tuning. Extra switch contacts for operating relays and other equipment. Attractive metal cabinet, 8⅜ x 6 x 6½. Ready for easy assembly. Shpg. wt., 8 lbs.

Model Y-723. VFO Kit. Net only $28.50

knight-kit Amateur RF "Z" Bridge Kit

Model Y-253 "Z" Bridge Kit

Measures standing wave ratio (SWR) and impedance-of-antenna systems; ideal for adjusting antenna systems for optimum results. Measures impedances from 20 to 400 ohms up to 100 mc.; SWR to 150 mc. Any VOM may be used for null indicator. 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 (less meter). 2½ x 3 x 4½". Shpg. wt., 1½ lbs.

Model Y-253. "Z" Bridge Kit. Net only $5.85

All prices are in U.S. dollars. For Canadian orders, please add 10% for postage and packing. All orders must be prepaid in U.S. funds. Please allow 2 to 4 weeks for delivery. 

Allied Radio, Dept. PF, 100 N. Western Ave., Chicago 80, Ill.

Shine me the following knight-kits:

<table>
<thead>
<tr>
<th>Model No.</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>Y-255</td>
<td>$38.95</td>
</tr>
<tr>
<td>Y-253</td>
<td>$5.85</td>
</tr>
<tr>
<td>Y-723</td>
<td>$7.65</td>
</tr>
<tr>
<td>Y-725</td>
<td>$28.50</td>
</tr>
<tr>
<td>Y-727</td>
<td>$9.50</td>
</tr>
</tbody>
</table>

$... enclosed. (For parcel post, include postage—express is shipped collect)

Daniel My Down Payment in the amount of $... is enclosed. Send True Payment form.

Name

Address

City Zone State

All prices net F.O.B. Chicago

Our 37th Year

FREE 404-PAGE ALLIED CATALOG

See the 1958 ALLIED 404-Page Catalog for complete listings of more than 50 KNIGHT-KITS, covering Hi-Fi, Osby, Test Instrument and Amateur Radio. The 1958 ALLIED Catalog is your complete Buying Guide to the world's largest stocks of everything in Electronics.

Send FREE 404-Page 1958 ALLIED Catalog.

www.americanradiohistory.com
Construction details

The receiver consists of a main chassis assembly, containing three subassemblies plus the antenna and oscillator coils, battery clip and loudspeaker. The first of the three subassemblies is a 1/32-inch-thick aluminum bracket which supports tuning capacitor, phone jack and volume control. Fig. 2-a

The second subassembly is mounted on a bakelite chassis 3 1/4 x 3/4 x 1/32 inch and contains the converter, if amplifier and second detector stages. To mount transistor sockets and if transformers locate each part in its permanent place on the blank bakelite chassis and with a sharp tool mark the spot where the terminal of each part touches the chassis. After removing the sockets and transformers, 3/32-inch holes are drilled. Each part is placed in its proper location and its terminals are pushed through the holes. The if transformers are secured in place by bending the two metal mounting tabs and applying a drop of solder to each. The transistor sockets are held down by flowing solder into the holes from which the socket terminals protrude. Keeping wiring as short as possible, all components are wired directly to the sockets and transformer lugs where possible, otherwise to miniature eyelets. (See photo at left.)

The third subassembly is mounted on a 2 1/2 x 1 x 1/32-inch bakelite board. This assembly is the audio amplifier and contains four transistors, two transformers and other small components. The transistors are held in place by folding the mounting tabs, which are extensions of the transformer cover, under the chassis. Copper straps wrapped around the transformer add security and make good ground points (see Fig. 2-b). I found it convenient to slot the chassis so the tabs would fit into them and prevent the transformers from sliding around. As before, all small parts are wired directly between the major components or tied to eyelets.

On the main chassis a 3/16-inch mounting hole is drilled a bit to the right and rear of where the tuning capacitor will be located. The oscillator coil is inserted in this hole and cemented in place.

The first and second subassemblies are then set in place on the main chassis. Subassembly 1 (bracket supporting the tuning capacitor, phone jack and volume control) is secured as shown in the photo. Then assembly No. 2 is mounted on the left side of the main chassis just behind the tuning capacitor and held in place by two No. 4-40 screws. Two 3/16-inch spacers are used for support.

The output from the second detector on subassembly 2 is connected to a lug through which the rear mounting screw passes and is picked up by another lug on top of which the nut is tightened on the under side of the main chassis. A connecting wire is run from this lug (left rear corner) to an eyelet in the front right corner and then up to the volume control. Next make all
introducing the
NORDELCO 'CONTINENTAL'
three-speed portable TAPE RECORDER

Above is a technician's-eye view of the new Norelco 'Continental'. It is a reassuring picture to tape recorder mechanics — many are even calling the 'Continental' the most advanced machine of its type. But most of the readers of this magazine are not tape recorder mechanics — they are seekers of good sound. It is to these readers that we say — the specifications of the 'Continental' are great... but that's beside the point! We won't tell you about them yet—because we first want you to listen to the sound! Go to your dealer and ask for a demonstration. Then just listen. The Norelco 'Continental' will convince you with sound — not with cycles and decibels. Don't say we didn't tell you in time for Christmas!

Engineered by Philips of the Netherlands, world pioneers in electronic design.
Precision-crafted by Dutch master technicians.
Styled by the Continent’s top designers.
Three speeds (7½, 3½ and 1½ ips)...
twin tracks... pushbutton controlled.
Special narrow gap (0.0002 in.)
magnetic head for extended frequency response.
Built-in wide-range Norelco speaker:
Lightweight... easily portable... rugged.
Can also be played through external hi-fi system.

For the name and address of your nearest Norelco dealer, write to Dept. 94.
NORTH AMERICAN PHILIPS CO., INC.
High Fidelity Products Division
230 Duffy Avenue, Hicksville, L. I., N. Y.

RADIO-ELECTRONICS

Fig. 2—a—Bracket to support tuning capacitor, phone jack and volume control; b—securing the audio transformers.

other connections between the main chassis and subassemblies 1 and 2.

Alignment procedure

At this point power is applied and all alignment adjustments made. A signal generator is connected between the antenna terminal of the tuning capacitor and ground. The generator settings are modulation, 400 cycles—30%; frequency, 455 kc; output, 15 µv. An ac vtvm is connected between the center terminal of the volume control and ground. With the control on full and the meter set to the 03-volt range, T5 is tuned for a maximum indication on the vtvm. T4 is then tuned to resonance. This is repeated with T3. Then repeat the whole procedure.

Upon completing the alignment of the if stages, the signal generator and radio dial are tuned to 1550 kc (connections between signal generator and radio remain unchanged). The trimmer of the oscillator section of the tuning capacitor is adjusted for maximum response. Next the generator and radio dial are set to 600 kc. The slug in the oscillator is now adjusted for maximum response. This whole procedure is repeated. The final adjustment consists of tuning the signal generator and radio dial back to 1550 kc and adjusting the trimmer of the tuning capacitor's rf section for maximum response. Correct operation of the receiver is indicated by a reading of 012 volt on the vtvm, when the radio and signal generator are tuned to 1000 kc.

When alignment is completed, power is removed and the loudspeaker prepared for mounting. I used a Lafayette SK-65. It is not equipped with mounting holes in the rear frame. Four holes, therefore, have to be drilled and tapped for 6-32 machine screws.
RADIO

The holes must clear the magnet pole piece and side walls of the magnet housing. When drilling these holes, take care and don't get any metal filings between the voice coil and magnetic pole piece. I used cellophane tape to protect against this.

After the holes are drilled, the speaker with its voice coil terminals facing to the rear, is set in place in the center of the main chassis and as close to subassembly No. 2 as possible. With a scribe or some other sharp tool, the outline of the rear of the speaker in its permanent position on the main chassis is scratched. Next the speaker mounting holes are marked off. The speaker is removed and mounting holes are drilled in all members. The speaker fastened in place, subassembly 3 is mounted. This unit fits on the left side of the main chassis, directly behind the volume control, as shown in the photos. The mounting holes for this assembly are marked off next and drilled in all members. The amplifier strip is screwed in position, supported by two 3/16-inch spacers.

The battery clip is a standard holder for a Burgess Y-10 cell (Lafayette part MS-225) with its ends cut off. Mounting holes were drilled in each end of the battery-clip base and also in the rear and center of the main chassis. The battery clip is then mounted. When all remaining interconnections are completed, the receiver is checked for proper operation.

Mounting the speaker

The set is placed into its case and the position of the speaker hole marked off on the leather. A very sharp knife is used to cut a hole approximately 3/4 inch smaller in diameter than the speaker cone. A sheet of 1/32-inch bakelite is obtained and a ring cut with an inner diameter of 2 1/4 inches and an outer diameter of 2 ½ inches. Next out of a piece of stiff speaker grillecloth, a circular piece is cut to fit exactly into the hole in the bakelite ring. The grillecloth is then cemented into place. After the cement sets the bakelite ring is glued over the speaker hole in the case and allowed to set. The battery is installed and the set placed into the case. Calibration is checked for the necessity of making an oscillator adjustment.

With the volume turned on full, signal generator connected and set up as before and an ac volt meter across the voice coil of the loudspeaker the readings for my receiver were:

<table>
<thead>
<tr>
<th>Frequency (Hz)</th>
<th>Input (µv)</th>
<th>Output (volts)</th>
<th>Gain (db)</th>
</tr>
</thead>
<tbody>
<tr>
<td>600</td>
<td>15</td>
<td>0.25</td>
<td>84.5</td>
</tr>
<tr>
<td>1000</td>
<td>15</td>
<td>0.27</td>
<td>85.0</td>
</tr>
<tr>
<td>1600</td>
<td>15</td>
<td>0.25</td>
<td>84.5</td>
</tr>
</tbody>
</table>

The current drain from the battery is about 16 ma, which indicates a rather long battery life.

Local stations are easily received. Weak stations can be heard by using an earphone plugged into J1.

Is your pickup a GROOVE DIGGER?

Ordinary hi-fi pickups—even new models—are often highly destructive to records and styli. The chief reason is their poor compliance and large dynamic mass.

ESL electrodynamic cartridges can greatly prolong the life of your valuable records—and styli, too. Minimum lateral compliance is 6.8 x 10^-6 cm/dyne (two to seven times that of most leading pickups), and dynamic mass is only one one-thousandth of a gram.

Not only does the ESL in this way save many times its own cost, but it also sounds better—for better. It can reproduce your records with a naturalness and clarity you’ve never before experienced. Hear its superiority at your dealers, and write for details.

FOR LISTENING AT ITS BEST

Electro-Sonic Laboratories, Inc.
Dept. E • 35-54 Thirty-sixth Street • Long Island City 6, N.Y.

Concert Series cartridge $15.95 • Professional Series arm and cartridge $106.50 • Dust Bug $5.95

NOVEMBER, 1957

if you think
that all brands
of recording tape
are alike...
wait till you try
irish ferro-sheen!

Available wherever quality tape is sold.

95
How far can you go in Electronics without a Degree?

Without a formal degree, 25-year-old Bernie Roth is already established as a Computer Systems Field Engineer—handling a key responsibility with IBM. Bernie is part of a team maintaining an entire electronic digital computer system. In this assignment, he must stay abreast of all the most advanced electronic concepts—developing his professional know-how every day. "That's what's different about IBM," Bernie says. "The graduate engineer has an advantage anywhere—but here at IBM, the technician also can grow into managerial positions. IBM is one of the few organizations I know of that is willing to invest time and money in training the technical man—and then gauges his future ability strictly on performance."

IBM instituted its program for specialized technical training many years ago. The theory behind this built-in educational system asked the question: Why should the capable man be denied the opportunity simply because he lacks a formal degree? The wisdom and foresight of IBM's decision are reflected in the story of Bernie Roth—in the misgivings of his past—in the certainty of his future.
The Navy steers Bernie on the right course

When Bernie graduated from Flemington, N.J., High School in 1950, he received a general diploma—mathematics and science made up a small part of his curriculum. Enlisting in the Navy in 1951, Bernie proved his aptitude for technical work and was assigned to the electronics preparatory school in Jacksonville, Fla. Later, he attended the Class A Aviation Electronics School in Memphis, Tenn.... probably the most important phase of his naval training because it was in Memphis that he became convinced that a technical career was "Right up my alley." But an event that occurred during a furlough in the spring of 1955 put a brand-new light on Bernie's future.

Reports for training

Bernie smiled when he mentioned that his mother had a tendency to clip want ads. "It was just pot-luck that one of the ads she spotted was for IBM Kingston and Project SAGE." Soon afterwards, Bernie hopped a bus to Newark for an interview with the IBM representative. He took the required number of tests—talked over his hopes and ambitions, and "That's about all there was to it." In July, Bernie notified IBM that he was definitely available, and supplied the necessary references. Meanwhile, he made a study of IBM's history, its policies, its growth, and its future—all of which impressed him favorably. One day in September, Bernie received instructions to report to Kingston to begin training as a Computer Unita Field Engineer.

The material he studied at Kingston

"The Kingston program is a real experience, and quite an eye-opener in electronic techniques. First of all, I studied basic circuitry. Then, I actually learned a new way to think—the ability to comprehend the whole from the assorted parts. The student must know how to form logic blocks, and in time, he should be able to design his own circuits. All of this proved especially helpful once I got into the field. Later on, I studied the various input-output devices which are used as auxiliary units to the central computer. Finally, I analyzed the methods that supply the power for this electronic giant. Millions of watts are needed—a phenomenal amount. In general, I'd say that you couldn't find a better training ground for understanding the uses of electronic as well as electromechanical equipment."

How does the future look to Bernie?

A happy and prosperous future is in the offing for Bernie Roth. Now a Computer Systems Field Engineer, he's confident that in a short time he will qualify as a Group Supervisor, and the next step up the ladder would be Group Manager. "The real satisfaction in working with IBM," Bernie says, "is the opportunity to learn and understand more and more about electronic techniques. IBM is quick to recognize and reward improved ability through greater knowledge."

How does the future look to Bernie?

A happy and prosperous future is in the offing for Bernie Roth. Now a Computer Systems Field Engineer, he's confident that in a short time he will qualify as a Group Supervisor, and the next step up the ladder would be Group Manager. "The real satisfaction in working with IBM," Bernie says, "is the opportunity to learn and understand more and more about electronic techniques. IBM is quick to recognize and reward improved ability through greater knowledge."

What about you?

Since Bernie Roth joined IBM Military Products and the Project SAGE program, opportunities are more promising than ever. IBM will invest thousands of dollars in the right men to insure the program's success.

If you have 2 years' education and/or experience gained through technical schooling or military service, you can become a member of this important, permanent, expanding project as a Computer Unita Field Engineer. You'll receive 20 weeks' training at Kingston, N. Y., with full pay, plus living allowance, before assignment to a permanent location of your choice.

WRITE TODAY TO:
Mr. N. H. Heyer, Room 3111
Military Products Division
IBM Corp., Kingston, N. Y.

You'll receive a prompt reply. Personal interviews arranged in all areas of the United States, if your resume of experience and education indicates you have the qualifications.
The inverted technician who sticks his head under the dash of a new car is quite apt to find out that something new has been added in the auto-radio department. He is also quite apt to find that something old has been taken away! Especially, if he uses the oldest test in the book for auto radios: turning it on and listening for the vibrator!

Beginning with a few models last year and continuing in still greater numbers this year, the leading set makers are incorporating transistors in their auto radios. This is actually the first basic change in auto-radio design since the elimination of the B-battery box! Many of these sets use low-voltage tubes and transistors and thus have no high-voltage supply at all, ending the need for the familiar vibrator.

The new radios may be divided into three classes roughly speaking: the hybrid sets, using power transistors in the output, with conventional tubes in the rest of the stages; the hybrid sets using transistors for output, with the special low-voltage series of tubes, developed last year, which require only 12 volts plate or screen and, finally, the all-transistor sets. There are subclasses and variations of these, of course, which will be discussed as we go along.

Numerically, about the most popular of these seems to be the hybrid sets with power transistors in the output stage. Such transistors as Delco's 2N173, which may be superseded by the newer 2N278, Motorola's 2N34 (2N176, 2N178) and the Philco AR-6 and AR-5 are found here. These are all very similar in shape, differing mainly in type number and mounting methods. Driving power for these is furnished by an extra stage of audio amplification. This may be a tube or a lower-power transistor.

Coupling transistors
Transformer coupling between stages, not seen in commercial design for some time, is making a comeback. Proper impedance matching is very important in transistor circuitry: the transistor is a fairly low-impedance device compared to the very high impedances found in tube circuitry and the matching transformer plays a very important role. A tapped autotransformer is found in several circuits, stepping the higher output impedance of the transistor driver down to match the low input impedance of the following transistor stage.

Some single-ended circuits even use an autotransformer as an output transformer, tapping the 4-ohm speaker down on the single winding to a point 4 ohms from the ground end. After all, impedances are matched mainly to achieve maximum power transfer and the transistor is primarily a power-handling device, both on the input and output, as contrasted to the voltage-input—power-output vacuum tube. These considerations are taken care of in the design of the radio: all that the service technician is expected to do is restore the circuit to its original operating condition!

Typical of the transistorized hybrids made by Philco are the P-5701 and C-5707 radios. These sets differ mainly in their cases, using the same circuit internally. The AR-5 power transistor is used in the power output stage (see Fig. 1) and is mounted on a heat sink on one end of the chassis. The new series tubes that require only 12 volts on plate and screen are used elsewhere, eliminating the need for the vibrator and vibrator transformer.

Delco is making quite a few transistorized sets, both hybrid and all-transistor types. Typical of the hybrids is the Pontiac model, part of which is shown in Fig. 2. This is almost identical, circuit-wise, with the Chevrolet 987575, using the same tubes and transistor. A 12AF6 is used as rf amplifier; a 12AD6, oscillator-mixer; another 12AF6 in the if stage; a 12FS detector, while the drive for the 2N173 output is furnished by a 12K5. Notice the autotransformer used as output transformer.
Mr. Service Dealer...

PHILCO brings you extra picture tube business and extra dollars this Fall with a hard-selling, nation-wide advertising campaign. See your PHILCO DISTRIBUTOR. Cash in on this sales-making opportunity.

MARILYN VAN DERBUR, MISS AMERICA 1958

PHILCO

Star Bright 20/20

ALUMINIZED PICTURE TUBES

Philco picture tubes give the sharpest, brightest picture on any make or model television receiver. Your old set will seem like new with a Philco Star Bright 20/20 picture tube.

NATIONWIDE CAMPAIGN IN TV GUIDE AND LOCAL NEWSPAPERS TO RUN OVER YOUR NAME AND BRING CUSTOMERS INTO YOUR STORE

To back you up this Fall Selling Season Philco is running a tremendous advertising campaign in the magazine read by over 5,000,000 television enthusiasts... TV Guide. In addition, in local newspapers the story of Philco superiority is being told to millions of additional prospects all over America.

DOUBLE SELLING ADVANTAGES

Only replacement picture tube for any set doubly protected by written bond and warranty.

See your PHILCO DISTRIBUTOR. CASH IN ON THIS SALES-MAKING OPPORTUNITY

PHILCO Accessory Division

WORLD'S LARGEST DISTRIBUTOR OF
Service Parts • Accessories • Universal Components • Power Packed Batteries • Long Life Tubes • Heavy Duty Rotors • Star Bright 20/20 Picture Tubes • Long Distance Antennas

PHILCO ACCESSORY DIVISION
"A" STREET AND ALLEGHENY AVENUE
PHILADELPHIA 34, PENNSYLVANIA

Please send me further information on Philco's Star Bright 20/20 Aluminized Picture Tubes.

Name
Address
City Zone State
Delco Cadillacs 7268085

Delco's first completely transistorized radio is the model 7268085 used in the Cadillac Brougham. This set has a total of 13 transistors and 4 crystal diodes. A 2N150 is the rf amplifier, while 2N149's are used in the oscillator, modulator (mixer) and the first and second if amplifier stages. The third if amplifier is a type R-63, the detector a type R-62, with a type R-64 used as the audio amplifier. In the output stage, a 2N109 drives a push-pull pair of 2N276's. The signal-seeking tuner in this set uses a 2N149 as the trigger amplifier, with a 2N109 as the relay control unit. Together, these two transistors replace the familiar 12AU7 used for the same purpose in previous sets.

Two speakers are used, one in front and the other in the rear seat. A fader type control selects the volume level desired for each. Using all transistors, the set does not need a high-voltage power supply; all operating voltages are supplied by the car's 12-volt battery.

The most unusual feature of this and similar sets, to the technician accustomed to the large currents drawn by older sets, will be the current drain: 2 amperes! This small drain is made possible by eliminating the vibrator, power transformer, rectifier tube and filaments which, although necessary for the functioning of the (tube) set, make no contribution to amplifying the signal. The current used by the all-transistor set is practically all applied to direct signal amplification!

Motorola's entry in the hybrid field consists of several models, beginning with a five-tube one-transistor chassis. These sets use the low-voltage tubes, with a 2N176, 2N34 or 2N178 transistor in the power output stage. Circuit-wise, they are quite similar, using a 12BL6 rf amplifier, 12AD6 converter, 12B6 if amplifier, 12AE6 second detector-vcw-amplifier and a 12K5 as a driver for the transistor. They are built to fit the 1957 Dodge, DeSoto, Plymouth, Ford, Chevrolet and other cars.

Next is a chassis using the same tube lineup except for 12AC6's in the rf and if stages. This may be used, with the proper installation kit, in 1955 and 1956 Chevrolet, Buick, Oldsmobile, Pontiac and Studebaker cars, including the Hawks. This model, the 6TAS8, has a search tuner. Battery drain, at a 12-volt input, is only 2.7 amps and power output is 2.5 watts at normal volume with a 4-watt maximum.

A six-tube one-transistor chassis with search tuning, the MoPar 918-919, is used in the Dodge and DeSoto. Tube lineup is the same as in the sets previously mentioned, with a 2N176 power transistor. A novel feature of this chassis is the mounting of the transistor on a separate chassis, with the output transformer, heat radiator, etc. This is installed on the firewall for better cooling of the transistor.

The FEG-118806-G, an eight-tube chassis, with one transistor, using search tuning, is designed for custom installation in the 1957 Fords.

Two 2N170's are used in the output. They are mounted on the back of the case, with heavy aluminum heat-radiating fins. A sensitivity control is provided on the tuning for town and country areas. Manual pushbutton tuning is also incorporated in this design. This is the familiar cam and lever type.

Possibly the most elaborate set in the line is the Ford FEJ-18806-C (Motorola 79MS) designed for the Ford Thunderbird. Its output circuit is shown in Fig. 3. Nine tubes and two transistors power this one, which amplifies the signal. Volumatic agc circuit, described in the next installment, and the Eliminoise circuit to reduce noise pickup from power lines. Sensitivity control for the search tuner is also used.

Next month we discuss some of the interesting and different features of this new crop of auto radios. Transistor power supplies to replace the vibrator and a combined vcw-agc circuit will be described. Further articles will cover servicing problems in the new radios.
It's packed with career facts!  
SEND FOR THIS FREE BOOKLET TODAY

your future in the new world of ELECTRONICS

RADAR • GUIDED MISSILES • SERVO
COMPUTERS • AERONAUTICAL
BROADCASTING AM FM TV
MILITARY • NAVY • CAA
COMMUNICATIONS
MANUFACTURING

See what the rapidly expanding field of ELECTRONICS offers you

Mail this postage-free postcard today

CAPITOL RADIO ENGINEERING INSTITUTE
ECPD Accredited Technical Institute Curricula. Founded 1927
Dept. 1411-D 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 Electronic Engineering Technology.

Check: [ ] Electronic Engineering Technology
[ ] Broadcast (AM, FM, TV) Engineering Technology
[ ] Television Engineering Technology
[ ] Aeronautical Electronic Engineering Technology

Name: ____________________________ Age: ______
Street: ____________________________

City: [ ] Home Study [ ] Residence School [ ] Korean Veteran
Zone: ______ State: ______

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?

www.americanradiohistory.com
CREI prepares you quickly for success in electronics

The future is in your hands!

The signs are plain as to the future of the trained men in the electronics industry. It is a tremendous industry, and—at the present time there are more jobs than there are trained men to fill them. But—when there's a choice between a trained and untrained applicant, the trained man will get the job. Your biggest problem is to decide on—and begin the best possible training program.

Since 1927, CREI has given thousands of ambitious young men the technical knowledge that leads to more money and security. The time-tested CREI procedure can help you, too—if you really want to be helped. CREI lessons are prepared by experts in easy-to-understand form. There is a course of instruction geared to the field in which you want to specialize. You study at your convenience, at your rate of speed. Your CREI instructors guide you carefully through the material, and grade your written work personally (not by machine).

Industry Recognizes CREI Training.

CREI courses are prepared, and taught with an eye to the needs and demands of industry, so your CREI diploma can open many doors for you. Countless CREI graduates now enjoy important, good-paying positions with America's most important companies. Many famous organizations have arranged CREI group training for their radio-electronics-television personnel. To name a few: All American Cables and Radio, Inc.; Canadian Broadcasting Corporation; Columbia Broadcasting System; Gates Radio Company; Hoffman Radio Corporation; Federal Electric Corporation; Glenn L. Martin Company; Douglas Aircraft Co.; Pan American Airways, Atlantic Division; U.S. Information Agency (Voice of America); Canadair Limited; Trans-Canada Air Lines; United Air Lines. Their choice for training of their own personnel is a good cue for your choice of a school.

Benefits Felt Right Away.

Almost immediately you feel the benefits of CREI training. Your employer, when informed of your step toward advancement (only at your request), is certain to take new interest in you and in your future. What you learn in CREI Home Study can start helping you do a better job immediately.

CREI also offers Resident Instruction

at the same high technical level—day or night, in Washington, D. C. New classes start once a month. If this instruction meets your requirements, check the coupon for Residence School catalog.

Pays for itself quickly. Your very first raise could repay your investment in CREI training, and leave you a profit the very first year. Your increases in pay thereafter are all pure profit, and you'll be prepared for many more promotions and pay raises in the future years of your life.

ELECTRONIC TECHNICIANS

Growing Peninsula Co. has openings for 1st class electronic technicians to work directly with engineers in development of new products. Only those with CREI or equal training and 3 years minimum commercial experience will be considered. Top salaries to qualified applicants. Call Mr. McQuerry, DA 4-4738.

Industry Calls for CREI Training by Name... So Should You!

Here you see an actual help-wanted ad, one of many which specify "CREI or equal" training. This proves that industry approves CREI training, even insists on it!

Send card today for this fact-packed booklet. It's free.

Take 2 minutes to send for this booklet right now. We'll promptly send your copy. The rest—your future—is up to you.
When a transistor supplants the tube in a superhet's local oscillator, some new service problems arise. One is unfamiliarity with the circuitry of separate oscillators and oscillator sections of converters using a transistor. Another is the difficulty of determining when the oscillator is oscillating. And then there are subminiature parts and printed circuits to make servicing more difficult. Servicing procedures must follow an analysis in preference to cut and try.

Basic action
The basic ac circuit of transistor local oscillators and oscillator sections resembles their tube counterparts as Fig. 1 illustrates. We have a black box containing an amplifier of gain A in both instances. A portion of the amplifier's output is fed back into its input. The feedback must exceed 1/A as in tube circuits. Due to low resistances between the electrodes of the transistor, the feedback in excess of 1/A must be considerably greater than in tube types, where these interelectrode resistances and capacitances (B-E, B-C and C-E) are relatively nonexistent. Total feedback must be 1/A plus all losses.

If feedback is to the transistor's base, phase is reversed, as indicated by polarity signs (Fig. 1-a). Feedback to the emitter does not require phase reversal (Fig. 1-b).

Gain A of the transistor is governed by its quality and the relative currents its electrodes are permitted to draw. The currents are governed by the supply voltages and circuit resistances in series with emitter, base and collector. Assuming the transistor has sufficient gain (satisfactory transistor with proper electrode current supply), ac action is determined by the feedback circuit. The type of transistor (n-p-n or p-n-p) may be neglected in considering ac action. The circuits are similar for both types.

Fig. 2-a shows a typical converter type of local oscillator circuit abbreviated to illustrate only the rf (ac) action. The output of the transistor amplifier (from the collector) feeds through the oscillator coil's untuned winding. Output energy is transferred into the tuned winding by mutual inductance. A variable capacitor tunes this winding with the aid of an adjustable slug. Energy is fed back to the emitter via the feedback capacitor Cc. Since the emitter resistance is not bypassed to ground, the circuit acts like a grounded-grid amplifier in a vacuum-tube circuit. (The emitter is part of the base or input circuit.) Feedback is in phase here. The tap on the tuned winding fixes the amount of feedback.

Fig. 2-b illustrates base feedback. Output energy is transferred to the tuned winding as before. Out-of-phase energy is supplied the base through Cc. (Terminal 3 is in phase opposition to terminal 1.) An rf ground is required across the emitter resistance and from the end of the rf transformer. The winding's capacitance furnishes a path for the oscillator current through the rf transformer.

Fig. 2-c is similar to Fig. 2-b, with phase reversal being accomplished by proper connection to the pickup coil in series with the transistor's base. Since the collector is furnished with dc power through the oscillator coil, an rf ground is required at its cold end. The emitter likewise must be bypassed.

Typical commercial versions of the circuits of Fig. 2 are shown by Figs. 3, 4...

---

**Fig. 2—Typical transistor oscillator circuits.**

**Fig. 3—Partial diagram of Westinghouse H-597-P7 converter using emitter feedback.**
4, 5 and 6. Figs. 3 and 4 are converter applications while Figs. 5 and 6 demonstrate separate local oscillator types.

Very popular at the present is the emitter injection variety of Fig. 3. It follows Fig. 2-a closely. Fig. 4 is a base feedback with the coupling coil on the oscillator transformer in series with a pickup coil on the ferrite antenna. Rf (ac) grounds are supplied by capacitors C2, C3 and C4. Both the antenna and the oscillator coil are hot.

The local oscillator circuits are straightforward. A coupling coil in the emitter return of the mixer picks up oscillator energy in Fig. 5 while a coupling coil on the ferrite antenna furnishes oscillator energy via C4 in Fig. 6. When replacing these coils, polarity may have to be reversed to maintain proper sense of feedback.

Troubleshooting

The first phase of troubleshooting should be directed toward learning whether the oscillator is oscillating. Since little change in voltage occurs across any resistor in a transistor oscillator, by contrast with the developed voltage across a grid leak in tube types, some substitute must be found for the voltmeter to check for oscillator action.

One method is to use a working broadcast receiver. Its antenna is brought near the transistor radio's oscillator coil. If the broadcast set is tuned to some station between 960 and 1,650 kc and the tuning dial of the transistor radio is rotated, a birdie will be heard if the transistor local oscillator is functioning. Absence of a birdie means no oscillation at that frequency.

A communications type or shortwave receiver can extend the range to the 2,100 kc required to cover the entire transistor local oscillator range—most such sets employ 455 kc as the if, hence 1,650 + 455 = 2,105 kc. As most communications sets have an S meter or some form of arc indication, there is no need for having a station present as in the ordinary broadcast set. The meter will indicate a CW rf signal which can be identified by tuning the transistor radio dial which tunes the transistor local oscillator. The relative strength is indicated by the S meter or its equivalent.

If the shop has a grid-dip meter with wavemeter functions, it too may be used. Its coil is brought near the transistor local oscillator coil and the grid-dip meter tuning is turned slowly. The dip will indicate oscillation, and the amount of the dip will be roughly proportional to its strength with equal distance separating oscillator and dip-meter coil.

Another alternative is a simple wavemeter, which can be constructed quickly at low cost. The schematic is presented at Fig. 7 while the photos show its construction. The ferrite antenna is modified by removing about 10 turns from the white end. It is fastened in place through a hole in the plastic case with several dabs of glue. A crystal diode rectifies any oscillatory current picked up by the antenna and tuned by the midget variable capacitor across it. The diode's dc load has two outputs to accommodate a vom or vtvm. The vom is hooked between J1 and J3 and is used on its microampere range. The other output is between tip jacks J2 and J3. It is the voltage output for the vtvm.

In operation the antenna is pointed at the suspect circuit's oscillator coil from a distance of about 3 inches. The dial is turned and any oscillation is revealed by a deflection of the meter. The relative strength is proportional to the meter indication, provided distance and orientation of the antenna with respect to the oscillator coil remains approximately constant.

At resonance, the pickup coil can be moved closer to the oscillator coil until the oscillator conks out. About 150 µa can be delivered to a vom or about 2 volts to a vtvm. Probe the highest frequency in a transistor oscillator since it will tend to fail there in contrast to the lowest frequency in a tube oscillator or oscillator section. Unless 50 µa on a vom (move to a higher scale if necessary) or 1 volt on a vtvm can be ob-
Why you need every feature of these

NEW UNIVERSITY FOLDED-HORN ENCLOSURE KwikKits

Because ... in performance, mechanical design, construction and ease of assembly, these new KwikKits are unquestionably the very finest enclosure kits—at any price!

KEN-12 For 12" speakers & systems $44.75
KEN-15 For 12"/15" speakers & systems $59.50

ROOM-BALANCED PERFORMANCE

KwikKit acoustic design and tilted baffle combine direct speaker radiation and compensated rear horn loading in a way that blunts bass, middle and treble ranges perfectly ... for uniform response throughout the listening areas of a room.

HEAVIER CONSTRUCTION

Heavy 1/4" first grade, fully cured bun- ner for top, bottom, sides and back ... not flimsy 1/4" wood commonly used in "kits." Bigger, sturdier—as much as 35% better than others in the same price class. Eliminates apparent resonances so detrimental to achieving richer, clearer horn reproduction.

PRECISION MECHANICAL DESIGN

Extricate and interior elements, even the cleats, fit snugly within close tolerance "vab- bitted" grooves. Glazing and screwing of each piece results in reliably straight, permanent joints. No nailing used. No penal markings necessary. Mitering and plenty of glue blocks for truly rigid construction.

PLACE ANYWHERE IN ROOM

Under-side view shows how advanced design, self-centered folded horn extends to the front of the cabinet, providing low frequencies out into the room ... not back into a corner, splashed against the walls. Small slot in base is resistively controlled vent which equals woofer dis- persion requirements in compression chamber. KwikKits are therefore independent of room furnishings, shape or placement and can be used against a flat wall, in a corner ... even up in the air.

KWIKITS...THE PERFECT COMPLEMENT FOR P.S.E.*

There's no end of decorative treatment you can give your KwikKit enclosure. Genuine Korina veneer is same as used in fine furniture, and provides a polished finish. Decorative front mouldings have been de- signed to complement and enhance your present decor. Exquisite, textured grille fabric is equally at home in settings of any period and is acoustically correct to prevent high frequency attenuation.

FOOLPROOF ASSEMBLY

All pieces are pre-cut and pre-drilled ... engineered to go together quickly, All you need is a screwdriver! Tuffie board is pre-cut... blank plugs and adapters supplied for easy installation of additional components as your system expands. Your KwikKit includes all required hardware, plastic wood glue, sandpaper, Tuffie board, and pre-cut holes in plastic brings in room.

PROFESSIONAL RESULTS

There's no end of decorative treatment you can give your KwikKit enclosure. Genuine Korina veneer is same as used in fine furniture, and provides a polished finish. Decorative front mouldings have been de- signed to complement and enhance your present decor. Exquisite, textured grille fabric is equally at home in settings of any period and is acoustically correct to prevent high frequency attenuation.

MODEL KEN-12

KwikKits acoustic design and tilted baffle combine direct speaker radiation and compensated rear horn loading in a way that blunts bass, middle and treble ranges perfectly ... for uniform response throughout the listening areas of a room.

HEAVIER CONSTRUCTION

Heavy 1/4" first grade, fully cured bun- ner for top, bottom, sides and back ... not flimsy 1/4" wood commonly used in "kits." Bigger, sturdier—as much as 35% better than others in the same price class. Eliminates apparent resonances so detrimental to achieving richer, clearer horn reproduction.

PRECISION MECHANICAL DESIGN

Extricate and interior elements, even the cleats, fit snugly within close tolerance "vab- bitted" grooves. Glazing and screwing of each piece results in reliably straight, permanent joints. No nailing used. No penal markings necessary. Mitering and plenty of glue blocks for truly rigid construction.

PLACE ANYWHERE IN ROOM

Under-side view shows how advanced design, self-centered folded horn extends to the front of the cabinet, providing low frequencies out into the room ... not back into a corner, splashed against the walls. Small slot in base is resistively controlled vent which equals woofer dis- persion requirements in compression chamber. KwikKits are therefore independent of room furnishings, shape or placement and can be used against a flat wall, in a corner ... even up in the air.

KWIKITS...THE PERFECT COMPLEMENT FOR P.S.E.*

There's no end of decorative treatment you can give your KwikKit enclosure. Genuine Korina veneer is same as used in fine furniture, and provides a polished finish. Decorative front mouldings have been de- signed to complement and enhance your present decor. Exquisite, textured grille fabric is equally at home in settings of any period and is acoustically correct to prevent high frequency attenuation.

FOOLPROOF ASSEMBLY

All pieces are pre-cut and pre-drilled ... engineered to go together quickly, All you need is a screwdriver! Tuffie board is pre-cut... blank plugs and adapters supplied for easy installation of additional components as your system expands. Your KwikKit includes all required hardware, plastic wood glue, sandpaper, Tuffie board, and pre-cut holes in plastic brings in room.

PROFESSIONAL RESULTS

There's no end of decorative treatment you can give your KwikKit enclosure. Genuine Korina veneer is same as used in fine furniture, and provides a polished finish. Decorative front mouldings have been de- signed to complement and enhance your present decor. Exquisite, textured grille fabric is equally at home in settings of any period and is acoustically correct to prevent high frequency attenuation.

MODEL KEN-12

KwikKit acoustic design and tilted baffle combine direct speaker radiation and compensated rear horn loading in a way that blunts bass, middle and treble ranges perfectly ... for uniform response throughout the listening areas of a room.

HEAVIER CONSTRUCTION

Heavy 1/4" first grade, fully cured bun- ner for top, bottom, sides and back ... not flimsy 1/4" wood commonly used in "kits." Bigger, sturdier—as much as 35% better than others in the same price class. Eliminates apparent resonances so detrimental to achieving richer, clearer horn reproduction.

PRECISION MECHANICAL DESIGN

Extricate and interior elements, even the cleats, fit snugly within close tolerance "vab- bitted" grooves. Glazing and screwing of each piece results in reliably straight, permanent joints. No nailing used. No penal markings necessary. Mitering and plenty of glue blocks for truly rigid construction.

PLACE ANYWHERE IN ROOM

Under-side view shows how advanced design, self-centered folded horn extends to the front of the cabinet, providing low frequencies out into the room ... not back into a corner, splashed against the walls. Small slot in base is resistively controlled vent which equals woofer dis- persion requirements in compression chamber. KwikKits are therefore independent of room furnishings, shape or placement and can be used against a flat wall, in a corner ... even up in the air.

KWIKITS...THE PERFECT COMPLEMENT FOR P.S.E.*

There's no end of decorative treatment you can give your KwikKit enclosure. Genuine Korina veneer is same as used in fine furniture, and provides a polished finish. Decorative front mouldings have been de- signed to complement and enhance your present decor. Exquisite, textured grille fabric is equally at home in settings of any period and is acoustically correct to prevent high frequency attenuation.

FOOLPROOF ASSEMBLY

All pieces are pre-cut and pre-drilled ... engineered to go together quickly, All you need is a screwdriver! Tuffie board is pre-cut... blank plugs and adapters supplied for easy installation of additional components as your system expands. Your KwikKit includes all required hardware, plastic wood glue, sandpaper, Tuffie board, and pre-cut holes in plastic brings in room.

PROFESSIONAL RESULTS

There's no end of decorative treatment you can give your KwikKit enclosure. Genuine Korina veneer is same as used in fine furniture, and provides a polished finish. Decorative front mouldings have been de- signed to complement and enhance your present decor. Exquisite, textured grille fabric is equally at home in settings of any period and is acoustically correct to prevent high frequency attenuation.
tained, prior to the conking out, it is advisable to replace the oscillator coil, the feedback capacitor or both to obtain a satisfactory voltage. At least this amount should be secured over the entire band. If the oscillator fails at the extreme high-frequency, 2,000 kc or so, replace the transistor rather than the coil or feedback capacitor.

The dial on the instrument shown in the photos is calibrated in the rf frequency of the set being probed. The actual oscillator frequency is higher by the if, which is usually 455 kc. An example, 1,600 on the dial actually means 2,055 kc.

Gain troubles
If amplification A (Fig. 1 discussion) falls off as at the high-frequency end, the oscillator may stop or it may not have sufficient output for good mixing. Both troubles will be shown by the wavemeter just described.

Low gain means a bad transistor, improper voltages or defective circuitry. First, check the voltages present at the transistor with a relatively high-resistance voltmeter. A vtvm or a 20,000-ohms-per-volt vtvm is satisfactory. Pay particular attention to base and emitter voltages. The emitter is almost at base voltage. Base must be a trifle more negative for a p-n-p transistor or a trifle more positive for a n-p-n type, converter operation presumed. Separate local oscillators exhibit somewhat greater base-emitter differences. Even greater tolerance is permitted at the collector in both types.

Slight creepage due to aging may upset the rather critical base-emitter differential. And base or emitter voltages, or both, may require doctoring. Easiest to operate on is the emitter. Shunt the emitter resistance with a larger-ohmage resistor or preferably a potentiometer. If the oscillator starts, as evidenced by an oscillation test, the trouble has been localized. In making a permanent replacement, use less emitter resistance than necessary to start the oscillator. The oscillating transistor must have greater gain than just enough to maintain oscillation.

This is also true for the base supply network. Usually the base supply is provided by a series resistor and another that shunts the base to ground—a bleeder resistor such as Fig. 5 shows. Here R1 (3,300 ohms) is the series resistor while R2 (3,700 ohms) is the shunt bleeder. Replacement with 5% tolerance units may be required. Such a resistance network may be shunted as a service test by a higher resistance. A pot of about 25,000 ohms makes an excellent test gadget here. Shunting the shunt resistor will lower the base voltage and a shunt across the series resistor will increase the base voltage.

Any shunt test (Fig. 5) across the emitter resistance should be across the resistance—and not always from emitter to ground.

Capacitor and coil checks
Capacitor rf bypasses are used fre-
thousands of servicemen have happily discovered

TOBE QUALITY SERVICE CAPACITORS

have you?
**NEW STANDARD OF PERFORMANCE**

![Shure Studio Dynetic Phonographic Reproducer](image)

**IT TRACKS AT ONE GRAM! ITS FREQUENCY RESPONSE IS 20 TO 20,000 CPS (±2db)!**

**ONLY WITH THE STUDIO DYNETIC**

- Record and needle wear are drastically reduced!
- You can completely avoid record scratches!
- You never have to level your turntable!
- You don't have to worry about groove-jumping!
- You can get superb fidelity, even from warped records!

You get the excellent response, low distortion and high compliance of dynamic cartridge construction, plus high output, minimum hum pick-up and the elimination of tone arm resonance and needle talk. There are also the additional benefits of the elimination of the pickup of low frequency rumble and motor noise. This superb unit sells for $79.50 net. Your hi-fi dealer will be happy to arrange a demonstration.

*Write to Sales Department for reprints of informative, published articles.*

---

**RADIO**

**Fig. 4** — Converter of RCA 7-BT-10K features base feedback.

**Fig. 5** — Emitter feedback from separate local oscillator in Raytheon model 8TP2.

- The transistor

  Since the proper transistor may not be readily available for substitution checking, the elimination of other possible causes of oscillator failure is undertaken first. Testing a transistor in a transistor tester may or may not show up trouble, since cutoff frequency is not measured. Nor is the amplification measured with sufficient accuracy to predict performance in a particular type of local oscillator. Hence, substitution is the only practical way to test the transistor. Even then, check base and emitter voltage on the new transistor in place in the set, and remedy discrepancies from manufacturer's data by doctoring resistors.

---

**RADIO-ELECTRONICS**

**Fig. 7** — Circuit of a simple wavemeter for checking oscillator action in oscillator circuits. C1, a mid-value variable, has a range of 10—365 µf.

R1—4,700 ohms, 11/2 watt
R2—470,000 ohms, 1/2 watt
C1—10—365 µf, midgnd variable (Lafayette MS-224 or equivalent)
C2—.005 µf, ceramic
D—IN295, IN34, IN51 or equivalent
J1, J2—flip fingers, red
J3—flip jack, black
L—ferrite antenna (Lafayette MS-227 or equivalent)

Knob
Plastic box, 7/8 x 1 1/4 inch
Miscellaneous hardware

---

The Mark of Quality

IN ELECTRONICS SINCE 1925

SHURE BROTHERS, INC., 222 HARTREY AVENUE, EVANSTON, ILL.
CUT TESTING TIME IN HALF — DOUBLE TUBE SALES

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

NEW Model 650

Today's Fastest, Most Complete, Portable DYNAMIC MUTUAL CONDUCTANCE TUBE & TRANSISTOR TESTER

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

FAMOUS Model 500

World's Fastest Selling Portable DYNAMIC MUTUAL CONDUCTANCE TUBE TESTER

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

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

*Beware on request

B & K MANUFACTURING CO.
3726 N. Southport Ave., Chicago 13, Illinois
Export: Empire Exporters, 439 Broadway, New York 13, N.Y.
TIME BASE

Compact and easily built, this is a useful addition to any scope.

By JAMES G. ARNOLD

TIME-BASE marker generator can be utilized in many ways with any oscilloscope. The measurement of rise and decay times of waveforms is probably its greatest application.

Users of moderate-priced scopes know that the calibration of their sweep-frequency controls is at best only a rough approximation. The sweep generator of the oscilloscope is designed to allow the synchronizing voltage to control the sweep frequency. These facts make a means for measuring time (or frequency) on a scope highly desirable. A simple, low-cost unit which is adaptable as a modification for any scope is offered as an answer to this need.

Several methods are used to measure time on the oscilloscope screen in the more expensive instruments. One uses a closely controlled sweep circuit. The associated sweep controls are calibrated in units of time (microseconds). Another compares the waveform under observation with a sine wave of known frequency. The first method requires very complex and extensive circuitry as well as closely controlled voltages. The second is awkward since the signal must be switched off the vertical channel and the sine wave substituted. The time-base marker generator described here is a good compromise between these methods. Essentially, the observed waveform is compared with a signal of known frequency, but the signal of known frequency is applied to the intensity grid of the cathode-ray tube rather than the vertical plates. This allows the waveform under observation to remain on the screen while the time-base marker is on.

The purpose of the time-base marker generator is to produce a train of pulses in synchronization with the oscilloscope sweep voltage. Marker pulses are spaced 1-µsec apart and are used to blank out the trace at this interval. This results in the trace seen in Fig. 1. Time measurements on pulses and other waveforms are made by counting the number of dots between any two points on the waveform. See Fig. 2.

Generator operation

The generator circuit is shown in Fig. 3. The sweep voltage of the scope (Fig. 4-a) is fed to the input of V1. Input amplifier V1-a is adjusted to have the proper amplitude output. This adjustment will be discussed later. The output waveform (Fig. 4-b) is fed to the grid of the damper (V1-b). The dc bias on V1-b is sufficiently below cutoff (Eeo) to keep the tube cut off until it is brought out of cutoff by the positive-going sweep voltage. When V1-b is cut off, the 1-mc oscillator V2-a oscillates freely. But, when V1-b conducts, the grid coil of the 1-mc oscillator is effectively shorted and no signal is fed back to the grid of V2-a. Thus the oscillator is allowed to oscillate only while the grid

R1—pot. 500,000 ohms, 2 watts
R2, 3—2,000 ohms
R4—80,000 ohms
R5—pot. 100,000 ohms, 2 watts
R6—3,300 ohms
R7—1,000 ohms
R9—4,100,000 ohms
All resistors ½ watt, 10% unless noted

Fig. 2—Waveform with a 3-µsec rise time and 8-µsec decay time.

Fig. 3—Circuit of the time-base marker generator.

www.americanradiohistory.com
of V1-b is held below cutoff. The oscillator output is shown in Fig. 4-c.

The output of V2-a is fed to the grid of the clipper V2-b. The signal causes this grid to draw enough current to self-bias itself. Thus only the positive peaks of the grid signal are above cutoff (Fig. 4-d) and V2-b conducts only during these peaks. The resulting output is a train of negative pulses (Fig. 4-e). Each pulse corresponds to the positive peak of a cycle of the 1-mc oscillator and therefore the pulses are spaced 1-msec apart.

If this train of pulses is fed to the intensity grid of the C-R tube, a blanked interval will occur in the tube trace for each microsecond pulse.

To have a series of 1-msec dots appear on the screen, each pulse must occur exactly where a pulse occurred on the previous sweep. This means that, regardless of the sweep frequency, the first 1-mc pulse of each sweep must occur at the same distance from the beginning of the sweep. This is accomplished by damping out the oscillator near the end of the sweep. The oscillator is then shocked back into oscillation at the beginning of the sweep by the retrace voltage (the vertical portion of the sawtooth sweep). In Fig. 4-b the damper tube bias is adjusted so that the damper is above cutoff for approximately half of the sweep period. Thus, the oscillator is on for only half the sweep length. It is not necessary to hold the oscillator off for any great length of time. The bias on V1-b is usually adjusted until a line of well-defined dots extends across the screen from the extreme left to within a short distance from the right edge as in Fig. 1. A pulse is shown being displayed on this trace in Fig. 2.

Construction techniques

All parts are standard catalog items and are widely available with the exception of the 1-mc tuned transformer. This can be made by stripping down the windings of a standard 455-ke IF transformer. The turns of each winding should be removed until the coil resonates at 1 mc with 150-200 ma in parallel with each winding, giving the proper L-C ratio. This can be accomplished quite readily with the aid of a grid-dip meter. The parallel capacitors are then permanently mounted on the coil. A slug-tuned IF transformer is preferable.

After wiring the generator and connecting the voltage supply, adjust the oscillator by placing the antenna of a shortwave receiver near the tube. Allow the oscillator to run freely by adjusting R5 for maximum bias voltage (-105V). Tune the 1-mc transformer to a zero beat with WWV at 5 mc. This is the fifth harmonic of the oscillator. If it does not oscillate, reverse the connections of the grid winding.

The unit was constructed on a small subchassis and mounted on the oscilloscope chassis after completion. The generator can be built on a small subchassis and mounted in a position on the scope where there is some unused space. The B-plus, filament and bias leads are twisted into a neat cable and dressed along the edge of the chassis, terminating at the power supply of the scope.

A suitable power supply is shown in Fig. 5. The time-base marker can be used with any positive voltage from 100 to 300 dc. The unit draws about 10 ma. It is usually feasible to obtain this voltage from the scope's power supply. The negative voltage can also be taken from the scope's supply if it uses a negative supply. One ma is required for the negative voltage. In

Fig. 4—Waveforms at various points in the generator.
TEST INSTRUMENTS

the power supply (Fig. 5) either positive or negative portions may be eliminated if you desire to take either of these voltages from some existing supply.

The input is connected to the plate of the sweep amplifier or to one of the horizontal deflection plates of the C-R tube. On a 5BP1-A tube, pin 6 usually has the correct polarity. The proper connection can be determined when making final adjustments.

The output connection is shown in Fig. 6, the common arrangement of the high-voltage circuit in the majority of oscilloscopes. Components C and R are usually provided on scopes with Z-axis modulation or blanking. If they do not exist on the oscilloscope, they may be added. A good value for R is 470,000 ohms, 1/2 watt. Its value is not critical. C may be any value greater than 50 µuf, but it must have a voltage rating greater than the high voltage of the oscilloscope plus the B-plus voltage of the time-base marker generator. Take care to cut off all voltages and discharge the scope's high-voltage capacitors before making this connection.

Final adjustments

After the unit is connected and mounted, final adjustments are made. Set the sweep width of the oscilloscope to just cover the entire screen. With the bias control R5 set for 0 volts, adjust R1 to the point where half the trace is covered with marker dots. If the marker dots appear on the left side of the screen, the adjustment is correct. If they appear on the right side, the input signal should be taken from the opposite deflection plate. If the scope does not have a push-pull sweep circuit (one deflection plate is grounded), it is necessary to reverse the signal polarity by disconnecting C2 from the plate of V1-a and connecting it to the cathode. The same procedure is used for adjusting the signal input to the point where half the screen is covered with marker dots. When the adjustments are completed, the unit is ready for use.

In optimizing the marker generator for any particular sweep width, potentiometer R5 is turned past the point where all the trace is covered with dots. This increases the bias on V1-b. This bias is increased to the point just before the dots begin to blur. (When the dots blur, the oscillator is not being interrupted sufficiently to start oscillating at the same point on each sweep.) This will produce a well defined series of marker dots. By counting the dots between any two points on the trace, the time between these two points is measured. The number of dots seen on the scope is equal to the number of microseconds.

Possibly the most basic application of a time-base marker is that of frequency measurement. With a sine-wave on the oscilloscope screen, the time-base marker dots are counted across any complete cycle of the sine wave under measurement. This is the time period of one full cycle of the sine wave. The frequency can then be found by the formula:

\[ f = \frac{1,000,000}{t} \]

where \( t \) is the number of marker dots counted and \( f \) the frequency in cycles per second.

An excellent application for a time-base marker is found in testing amplifier response with a square-wave generator. Normally the square-wave method gives only an indication of "good" or "poor" response. By using the time-base marker, the actual high-frequency response can be determined. Count the number of dots that occur while the square wave rises from zero to 63% of its peak value. Then use the formula:

\[ f = \frac{159,000}{t} \]

where \( t \) is the number of dots counted and \( f \) the high-frequency 3-db point in cycles per second.

TV receiver servicing can be aided by a time-base marker—waveforms may be truly checked rather than "just looked at." To the experimenter, a time-base marker is indispensable in any waveform applications. Serious photographers can use the instrument and a scope to measure the peak and duration of light from various types of photoflash lamps and to check the shutter action and accuracy at different speed settings.

END
FULL COLOR TV

demands reliable

alliance

TELEVISION ANTENNA ROTATOR

DON'T ASK VIEWERS TO PUT UP WITH A 'STAY-PUT' ANTENNA!

- TV authorities admit the higher sensitivity of color.*
- Viewers won't tolerate weak, washed out color!
- Maximum directivity with ALLIANCE TENNA-ROTOR is the best insurance for top antenna performance—for FULL COLOR!

Wherever you find Color TV, it will pay you to recommend Alliance!

- Every color TV buyer is a potential Tenna-Rotor sale... even in metropolitan areas. Because the "fringe" area for color is closer to the transmitter!
- Viewers who might tolerate black and white TV that's "so-so", will not put up with irritating, "ghosty" color. And independent interviews at point of sale show that color TV customers find it easy to say Yes to Alliance Tenna-Rotor!

*Many TV authorities agree that color is more sensitive than black and white. "Chromatic gradation" with color that's ghosty, is harder on the eyes than black and white. Many recommend properly installed outdoor antennas with rotators, to improve directivity of the antenna, to help overcome interference and reduce annoying effects caused by the higher sensitivity of color, and the normal characteristic of color to "drop out" quicker.

Meet the Constant Changes in Television!

Alliance Tenna-Rotor makes any good outside antenna more directional. New stations, channel changes, new channels, more power, UHF-VHF... EVERYTHING NOW COLOR! They'll all add up to Alliance Tenna-Rotor!

THE ALLIANCE MANUFACTURING COMPANY, INC.
(Division of Consolidated Electronics Industries Corp.)
ALLIANCE, OHIO
In Canada—ALLIANCE MOTORS, Schell Avenue, Toronto 10

NOVEMBER, 1957
PORTABLE unit operates over broadcast band—can be used for intercom work

By JOSEPH CHERNOF

POCKET-SIZED signal generator is a handy gadget for any electronic lab or workshop. This transistorized unit (see diagram) covers the entire broadcast band (550-1700 kc), has a self-contained source of audio modulation and makes a useful signal generator for working in the field. It can also be used as a low-power transmitter for broadcasting through home radios or as part of a transistor intercom installation when fed by a suitable microphone. The generator draws only 2 ma from a 30-volt B battery, yet puts out a minimum of 3 volts rf throughout its tuning range.

G-E 2N76 p-n-p junction transistors are used in both the rf and af oscillator stages since a number of these units gave very consistent performance in this circuit. Using an rf transistor such as the G-E 2N78, with the proper coil and capacitor combination, would extend the tuning range of the unit to about 5 mc.

Feedback necessary to sustain rf oscillation with transistor V2 is provided through tapped windings on T2, a special transistor oscillator coil de-

Parts for transistorized signal generator
- R1-22,000 ohms
- R2-1 megohm
- R3-100,000 ohms
- R4-10,000 ohm pot., miniature, with spst switch
- C1-.02 µf
- C2-.05 µf
- C3-.001 µf
- C4-2-gang tuning capacitor, 10-365 µµf
- C5, C6-.001 µf
- BATT-30-volt miniature B battery (Eveready 413 or equivalent)
- V1, V2-2N76 transistors
- T1—miniature interstage audio transformer; primary resistance 15,000 ohms; secondary impedance 95,000 ohms (UTC O-Uncer or equivalent)
- T2—transistor oscillator coil, Miller 2023
- S—spst switch on R5
- Transistor sockets (2)
- Battery holder
- Phenolic sheet, 1/8 inch, approximately 3 x 4 inches
- Knobs (2)

Top—Components layout of signal generator.
Bottom—Checking receiver with signal generator.

Pocket-sized signal generator—has af and rf oscillators.
BUILD 16 RADIO CIRCUITS AT HOME
with the New Deluxe PROGRESSIVE RADIO "EDU-KIT"

A COMPLETE RADIO COURSE

Now Also Includes
★ TRANSMITTER
★ SIGNAL TRACER
★ SIGNAL INJECTOR
★ CODE OSCILLATOR

NO NEED TO SPEND HUNDREDS OF DOLLARS FOR A RADIO COURSE

The "Ed-U-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 practice and servicing.

You will learn how to build radios, using regular schematics; how to wire and solder in a professional manner; how to service 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, Progressive Signal Injector, Progressive Dynamic Radio & Electronics Tester & 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 service them. You will receive an excellent background for television.

Absolutely no previous knowledge of radio or science is required. The "Ed-U-Kit" is the product of many years of teaching and engineering experience. The "Ed-U-Kit" will give you with a basic education in Electronics and Radio, worth many times the complete price of $22.95. 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 job or a job with a future, you will find the "Ed-U-Kit" a worthwhile investment.

Many thousands of individuals of all ages and backgrounds have successfully used the "Ed-U-Kit" in more than 79 countries of the world. The "Ed-U-Kit" has been carefully designed, step by step, so that you cannot make a mistake. The "Ed-U-Kit" allows you to teach yourself at your own rate. No instructor is necessary.

PROGRESSIVE TEACHING METHOD

The Progressive Radio "Ed-U-Kit" is the foremost educational radio kit in the world, and is universally accepted as the finest of its kind. It utilizes the modern educational principle of "Learn by Doing." Therefore you construct, learn schematics, study theory, practice troubleshooting—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 "Ed-U-Kit." You then learn the function, theory and wiring of these parts. Then you build a simple radio. With this first step 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 complicated multi-tube radio circuits, and doing work like a professional Radio Technician.

Included in the "Ed-U-Kit" course are sixteen Receiver, Transmitter, Code Oscillator, Signal Tracer, and Signal Injector circuits which are not "unprofessional" "breadboard" experiments, but genuine radio circuits, constructed by means of professional wiring and soldering on metal chassis, plus the new method of radio construction known as "Printed Circuit." These circuits operate on your regular AC or DC house current.

A COMPLETE RADIO COURSE—NOTHING ELSE TO BUY

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, mica, ceramic and paper dielectric condensers, resistors, tef strips, coils, hardware tubing, punched metal chassis, Instruction Manuals, wire, solder, 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 "Ed-U-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 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. There is nothing else to buy. Everything is yours to keep.

UNCONDITIONAL MONEY-BACK GUARANTEE

ORDER DIRECT FROM AD RECEIVE FREE BONUS RESISTOR AND CONDENSER KITS WORTH $7.00

Send "Ed-U-Kit" Postpaid. I enclose full payment of $22.95. You send me FREE BONUS RESISTOR AND CONDENSER KITS and "Ed-U-Kit" C.O.D. I will pay $22.95 plus postage.

FREE EXTRAS
● SOLING IRON
● ELECTRONIC TESTER
● TESTER INSTRUCTION MANUAL
● SAFE-VOLTAGE SAFETY GUIDE
● QUIZZES
● TELEVISION BOOK
● TROUBLESHOOTING TIPS
● FREE BONUS RESISTOR AND CONDENSER KITS
● FREE Printout of F.C.C. LICENSE LEARNING CURRICULUM
● FREE ALIGNMENT TOOL
● CERTIFICATE OF MERIT

FREE BONUS RESISTOR AND CONDENSER KITS

Order direct from AD. Receive your FREE BONUS RESISTOR AND CONDENSER KITS right away. You get 900 resistors and 900 capacitors, worth $7.00, absolutely free. This is the only way to get these important parts quickly. These parts will be invaluable in helping you build your "Ed-U-Kit." You can't afford not to order direct from AD.

SERVICING LESSONS

You will learn to servise and repair radios and television receivers in your own home, and you will learn the service problems that you are most likely to encounter. You will learn to test and repair radios and TV sets in a professional manner.

You will learn to use the professional Signal Injector, the unique Signal Injector and the dynamic Noise & Electronics Tester. You will learn to use the progressive Signal Tracer, and the unique Signal Tracer and Signal Injector for servicing radios.

You will learn to use the progressive Signal Tracer, and the unique Signal Tracer and Signal Injector for servicing radios.

You will learn to use the progressive Signal Tracer, and the unique Signal Tracer and Signal Injector for servicing radios.

You will learn to use the progressive Signal Tracer, and the unique Signal Tracer and Signal Injector for servicing radios.

You will learn to use the progressive Signal Tracer, and the unique Signal Tracer and Signal Injector for servicing radios.

You will learn to use the progressive Signal Tracer, and the unique Signal Tracer and Signal Injector for servicing radios.

You will learn to use the progressive Signal Tracer, and the unique Signal Tracer and Signal Injector for servicing radios.

You will learn to use the progressive Signal Tracer, and the unique Signal Tracer and Signal Injector for servicing radios.

You will learn to use the progressive Signal Tracer, and the unique Signal Tracer and Signal Injector for servicing radios.

You will learn to use the progressive Signal Tracer, and the unique Signal Tracer and Signal Injector for servicing radios.

You will learn to use the progressive Signal Tracer, and the unique Signal Tracer and Signal Injector for servicing radios.

You will learn to use the progressive Signal Tracer, and the unique Signal Tracer and Signal Injector for servicing radios.

You will learn to use the progressive Signal Tracer, and the unique Signal Tracer and Signal Injector for servicing radios.

You will learn to use the progressive Signal Tracer, and the unique Signal Tracer and Signal Injector for servicing radios.

You will learn to use the progressive Signal Tracer, and the unique Signal Tracer and Signal Injector for servicing radios.

You will learn to use the progressive Signal Tracer, and the unique Signal Tracer and Signal Injector for servicing radios.

You will learn to use the progressive Signal Tracer, and the unique Signal Tracer and Signal Injector for servicing radios.

You will learn to use the progressive Signal Tracer, and the unique Signal Tracer and Signal Injector for servicing radios.

You will learn to use the progressive Signal Tracer, and the unique Signal Tracer and Signal Injector for servicing radios.
TEST INSTRUMENTS

 signed by J. W. Miller to provide proper impedance and phase relationships for optimum performance with transistor circuits. The primary of T2 is tuned by C4-a and C4-b, a two-gang standard broadcast-band tuning capacitor with both sections connected in parallel. A second tuning adjustment is provided by the adjustable ferrite core in T2. However, it was found that with the core adjustment on T2 screwed in about as far as it would go, C4-a and C4-b were adequate to cover the entire broadcast band.

Resistors R3 and R4 supply the proper dc bias to the base of V2, and C5 provides dc isolation while at the same time feeding rf energy back. Resistor R5, a miniature Clarostat potentiometer and switch assembly, serves as the rf output control, and C6 as rf output capacitor.

Feedback for rf oscillator transistor V1 is provided by transformer T1, a UTC 0-7. Almost any interstage type transformer with about a 3-to-1 turns ratio could be used as long as the higher-impedance winding goes to the collector of V1 and the lower-impedance winding to the base. Base bias for V1, supplied by R2 and R1, reduces total current drain of the stage to an extremely low figure.

With C2 connected across the secondary of T1 this circuit oscillates at about 5,000 cycles. A larger transformer with more inductance in the windings would lower this frequency considerably and C2 could probably be eliminated. The af output of V1 is coupled to the base of V2 through C3, producing fairly clean modulation of the rf carrier.

The 30-volt miniature B battery is mounted in a miniature battery holder now available commercially. Both 2N76 transistors are plugged into standard transistor sockets. This type of installation is preferable to making direct soldered connections to the transistor leads, risking damage by overheating.

The entire unit is built up on a ¾-inch-thick phenolic block, 3 inches wide and 4 inches long. The relatively large size of the tuning capacitor prevents using a smaller base. In transmitter or intercom applications V1 should be disabled. Then, fairly good voice modulation may be obtained by opening the connection to ground of the emitter element of V2 and inserting a carbon microphone in series.

The signal generator dial may be calibrated with the help of a home radio, by zero-beating its output against local broadcast stations of known frequency. Tune in a station around 600 kc and then, starting at the low-frequency end, tune the signal generator for a null between two whistles. Mark the dial with the station frequency. Repeat the operation on other stations every 20 kc or so across the broadcast band. The frequency stability of transistor oscillators is not exceptionally good so calibration should be rechecked frequently.

END

THE 555A

YOU NEED THESE FEATURES:

Meter Movement Protection up to 500 times overload is provided by a rectifier network.

The 555A Measures: AC Current, DC Current, AC Voltage, DC Voltage, Output, Resistance

43 Unduplicated Ranges
Separate Range and Function Switches
Double Magnetic Shielding
3½ DC, 4% AC Permanent Accuracy
Easy to Read, Four Color Scales 4½” long
Metal Case with Die Cast Bezel 6½” x 4½” x 2½”
Sensitivity: 20,000 Ohms/Volt DC, 2000 Ohms/Volt AC

NEW LOW PRICE
Not $49.50, but priced lower than ever before. Complete with probes and batteries. (Replaces former model 551)

NOW ONLY $44.95

PHAOOSTRON INSTRUMENT AND ELECTRONIC COMPANY
151 Pasadena Avenue, South Pasadena, California

116

RADIO-ELECTRONICS
Learn all about transistors by using them

PREPARE NOW FOR THE FUTURE!

Let's face it. Transistors are here...now! Advancement opportunities are waiting for those who know all about their basic fundamentals. Are you ready?

This new, profusely illustrated Transistor Home-Study Course, a CBS first, was written to make it easy for you to learn by using transistors. Service-dealers...technicians...and engineers find this residence-course-at-home both fast and fascinating. What you learn you remember because you do it yourself...by making several practical transistor devices which you can keep and use. Course was written for CBS by A. C. W. Saunders, a well-known educator and author.

Check the table of contents. Then read how easy it is for you to start your Transistor Course today.

CBS Transistor Course Includes
- Ten intensive lessons (with 3-ring binder)...
- Simplified basic theory...how transistors work
- Practical experiments and servicing techniques for: Amplifiers...applications in all fundamental circuits
- Oscillators...a-f, r-f, relaxation, multivibrator, special TV
- Rectifiers...diode and transistor rectifiers and detectors
- Practical commercial applications...immediate and future
- With free correction and consulting service...and up-to-date supplements for certified graduates

HOW TO GET IT
Call your CBS Tube distributor. He'll tell you how to get the CBS Transistor Home-Study Course, PA-175. See him, or write us...today!
By J. E. PUGH, JR.

Frequency comparison by the circular-trace method is very simple and permits accurate comparison of higher frequency ratios than possible with the conventional Lissajous-figure method.

In the circular-trace method, the lower frequency is used to generate a circle or ellipse on the oscilloscope by applying it to the horizontal and vertical amplifiers through an appropriate phase shifter. The higher frequency is applied to the vertical amplifier and appears as a modulation on the circle. Because the trace is circular, the forward and return portions of the pattern do not overlap as with Lissajous figures. Confusion is eliminated and comparison of very high frequency ratios is possible.

Although the higher and lower (reference and unknown) frequencies are interchangeable as connected to the phase shifter, a more easily read oscilloscope pattern is obtained when the lower frequency is used to generate the circular trace. In most scopes the gain and high-frequency response of the horizontal amplifier are less than those of the vertical amplifier so the lower frequency is applied directly to the horizontal amplifier.

The phase shifter can also be used for measuring percentage of modulation of both carrier and modulation frequencies.

**Comparator circuit**

The comparator is easy to build and operate. It can simplify frequency comparison—such as oscillator calibration—immensely. It is designed to permit direct connection to the oscilloscope. The basic phase shifter consists of C and R1 (Fig. 1) while resistors R2 and R3 isolate the higher-frequency generator from the lower-frequency generator and horizontal amplifier. Potentiometer R1 permits adjustment of the lower frequency's phase, as applied to the vertical amplifier. This allows the shape of the circular trace to be adjusted for best readability. C and R1 supply a usable phase shift from 20 cycles to about 1 mc. The low-frequency shift can be improved by increasing C to 0.1 μF—but at the expense of a smaller shift at the high-frequency end.

A 1 1/8 x 2 1/8 x 2 1/2-inch aluminum box houses the circuit. The layout is not critical, but clearance between parts must be watched as space is limited.

A double banana plug permits direct connection to the vertical amplifier terminals of the oscilloscope, and a single banana plug on a flexible lead connects to the horizontal amplifier. Both the reference and unknown frequencies are connected to the circuit through double banana plugs and jacks. The double banana plug for connecting to the vertical amplifier is mounted on one end of the case. (To match the vertical input of your scope another type of connector may be needed. Just replace the double banana plug with a connector to match your scope. —Editor) It is made from a double binding-post insulator and two banana plugs with threaded mounting studs.

---

**Fig. 1—Circuit of phase-shift comparator.**

**Fig. 2—Circular trace is obtained with comparator connected to a scope.**
Color Antennas
Specifically designed for color

TRIO

COLORITE
recommended for both color and black and white reception in areas formerly using conical and conical-yagi installations
small and compact for easier installation and improved outside appearance.
flat frequency response a necessity for good color reception

magna-chrome element system

The Micro-Chrome element system consists of an EXTENDED WING DIPOLE accurately coupled with a precision V-ed dipole. The combination is designed to modify the characteristics of the incoming color signal to assure true, full-color reception. The folded dipole is V-ed of the exact angle that gives greater gain and band width when used in conjunction with the EXTENDED WING DIPOLE. Extremely flat frequency response across the entire VHF band is obtained together with improved gain.

for the ultimate in color reception

TRIO
COLOR-ROYAL
high forward gain Sharper, Clearer Pictures High Signal-to-Noise Ratio
flat frequency response Improved Contrast on Black & White - Perfect Reproduction of the Color Signal
highest front-to-back ratio For Freedom From Co-channel Interference

THE LINE WITH PROTECTION

TRIO Manufacturing Company
GROESSEVILLE ILLINOIS

Export Sales Div., Scheel International Inc., 5909 N. Lincoln Ave., Chicago, U.S.A. Cable Address: HARSHEE

U.S. PATENT No. 2,772,413
CANADIAN PATENT No. 541,670

NOVEMBER, 1957
threaded studs are smaller in diameter than the holes in the insulator and a 
1/4-inch-diameter 3/8-inch-long sleeve is 
used to provide a good fit. The sleeve 
can be metal or fiber. The assembled 
plug is inserted in one of the double 
jacks before tightening the nuts to 
align the plugs correctly.

After construction is completed the 
individual plugs and jacks can be 
labeled with decals. The hot terminal 
of each plug and jack should be marked 
with a dab of red paint since they are 
not polarized.

How to use it

First insert the double banana plug 
of the comparator into the scope's ver-
tical input terminals. Connect the single 
plug to the horizontal amplifier jack.

If the reference frequency is the lower 
one—such as the 60-cycle power-line 
frequency or a variable low-frequency 
generator—connect it to the lower-
frequency terminals.

Now attach the unknown-frequency 
generator to the higher-frequency ter-ninals and reduce its output to zero. 
With the scope's sweep-selector switch 
set on external, adjust the comparator's 
phase control to give a circular sweep 
as illustrated in Fig. 2. The horizontal 
and vertical gain controls are adjusted 
to give a suitable size to the circle. 
Increase the output of the unknown-
frequency generator until the circle is 
well modulated but avoid overlapping 
the upper and lower portions of the 
trace. See Figs. 3, 4, and 5 for this 
pattern.

Adjust the reference frequency until 
a stationary pattern is obtained and 
count the number of cycles on the 
circle. This is most easily done by 
counting the number of peaks—posi-
tive or negative. Then determine the 
number of lines cut by a radial line 
through the circle. This is shown in 
Fig. 4. The frequency ratio is now 
determined by: Ratio = 
number of cycles (+ or - peaks) 
number of lines cut 

Fig. 3—Oscilloscope trace showing a fre-
quency ratio of 7:1.

Fig. 4—Pattern seen with 7:2 frequency 
ratio.

Fig. 5—This scope trace shows fre-
quency ratio of 17:1.

Fig. 6—Using comparator to measure 
percent of modulation.

In Fig. 3 the ratio is 7:1, in Fig. 4 it 
is 7:2 and in Fig. 5 it is 17:1.

When comparing frequencies over a 
wide range—when calibrating an audio 
signal generator with a 60-cycle refer-
cence frequency—it is not necessary to 
count cycles at each multiple of the 
reference frequency. Simply check the 
ratio at one of the lower multiples and 
add the reference frequency each time 
a stationary pattern with complete 
cycles (Figs. 3 and 5) is obtained.

For example, 60 would be added each 
time a stationary pattern of full cycles 
is obtained if the reference frequency 
is 60 cycles. An occasional count should 
be made to be sure that a multiple 
hasn't been missed.

It is possible to compare frequencies 
up to several megacycles. The upper 
limit is determined only by the fre-
quency response of the oscilloscope 
amplifiers.

The percentage of modulation can be 
obtained by using a reference fre-
quency much lower than the carrier 
frequency but higher than the modula-
tion frequency. Connections to the 
comparator are shown in Fig. 6. This 
will give a pattern as shown in Fig. 7.

This makes possible a very simple per-
cent-of-modulation measurement with-
out requiring a connection to the modu-
lation voltage.

By connecting the modulated carrier 
to the high-frequency terminal and the 
modulation voltage to the low-frequency 
terminal a pattern similar to the 
familiar trapezoid is obtained.

In either case the voltages will have 
to be about the same amplitude as when 
making modulation measurements using 
conventional methods.

In Fig. 7 the percent of modulation 
is 30 and is obtained by:

\[
\% \text{ modulation} = \frac{A - B}{A + B} \times 100
\]

When the reference frequency is 
equal to or less than the modulation 
frequency, the area between a and b 
will appear as a number of alternations. 
The shape of these alternations will 
depend on the shapes of the refer-
cence and modulation voltages and the 
number of cycles on their frequency 
ratio.

If the reference frequency is in-
creased until it nears the carrier fre-
quency, waves extending the entire 
width of the ring (from a to a') will 
begin to appear. The number of com-
plete cycles will indicate the carrier to 
reference frequency ratio.

END
Use Delco Radio Service Parts!

2N378—Highest power transistor used in auto radios.

Available everywhere through Electronic Distributors associated with...

Your Delco Radio Electronic Parts Distributor carries the complete line, giving you fast, dependable service on the items you'll need for Delco Radio—and other radio—service work. Delco Radio also provides:

- Wide selection of special application parts
- Complete technical training program
- Effective warranty program
- Dealer identification signs

Get the facts today on this truly profitable dealer setup, and grow with General Motors!

DELCO RADIO
DIVISION OF GENERAL MOTORS, KOKOMO, INDIANA

Www.americanradiohistory.com
To demonstrate how well Mallory "Gem" tubular capacitors resist moisture, we put some in plastic tubes filled with water. Months later, their internal resistance remains unchanged... proving there has been no moisture absorption.

Sure, you don't expect to submerge the capacitors you install. But when you're looking for top performance, even under the toughest humidity—always ask for Mallory "Gems."

Get your stock today from your Mallory distributor. He carries them in all popular ratings for by-pass and coupling applications.

P. R. MALLORY & CO., INC., INDIANAPOLIS 6, INDIANA

**MALLORY**

... another service-engineered product

**Months under Water...**

prove MALLORY "GEMS"

moisture proof

---

**new Records**

**MONITOR**

Note: Records below are 12-inch LP and play back with RIAA curve unless otherwise indicated.

IBERT: *Divertissement*
FRANCAIS: *Symphony for Strings*
Sinding conducting
MGM String and Chamber Orchestra
MGM E-3514

The recent Boston Pops recording of the *Divertissement*, which I liked very much, is a full-scale orchestral transcription. This is the original scoring for a smaller chamber orchestra and the effect is possibly even more amusing. The greater intimacy of the smaller group and the excellent presence projects a fine text in the living room. The Francais symphony is a seldom-heard work which most listeners should find interesting, pleasant and restful. The string bass on both sides is outstanding. Some pickups may be slightly overdriven on the peaks.

COBERT/LANG: *Frankie and Johnny*
Special cast and orchestra
MGM E-3499

This is another first performance of a dramatic musical but of a very different color. Based on the tale told in the classic jazz song *Frankie* and *Johnny*, it is billed as a legend in two acts. This presents the songs from the two acts as they had been performed on Broadway. I commend it to other companies as evidence that a Broadway type show can be recorded reasonably cleanly, with a minimum of overcutting, good tonal balance and fine sound.

**Calypso Jazz Sampler**
Cook XX-2

Another Cook sampler, this one with 14 selections from 9 of Cook's Caribbean albums, including at least one of all the various local types from pure calypso to steel band, recorded on the scene, pressed by microfusion and packaged in sealed, flexible, transparent plastic cases. Typical Cook quality with tremendous presence and a wide variety of high, middle and bass, text and showoff material. The nuances hit highs are especially impressive on equipment with a fine transient and high end response. The bass is live and different.

**Folk Music Festival (Songs and Dances of Kazakhstan, Kirghizia, Georgia and Moldavia)**
Various artists
Westminster WP-6055

Some 18 samples of folksongs of Russia in performances and recordings which are both rather amateur in quality but with on-the-verd-putt authenticity. The master tapes are Russian and recorded (but clearly not by Emory Cook) in the various provinces with indigenous performers. As for the songs and dances, they should be of interest not only to the folksong specialists but to the ordinary listener as well and would enliven a hi-fi concert nicely. Most of them have an "I played fiddle for the Czar" pattern, but some resemble Spanish flamenco more than anything else and others have definitely Oriental elements.

**Back on the Biggest**
Robert Elmore on Organ of Atlantic City Convention Hall

Bach buffs will be rebuffed by the very title and idea, but those who like their sound bigger and louder will find here a noteworthy experience, especially in big pedal bass and one of the longest reverberation periods on records.
NEW RECORDS (Continued)

Fiesta for Pipe Organ
With Rhythm Accompaniment
Alfred Mendez, Organist
RCA Victor LPM-1444
And now mambos, cha-cha-chas and other Latin musical tid-bits on the organ with a rhythm backing—a combination that is possible only with the help of multiple miking and electronic-reproduction. Anyhow, the combination of a fair pedal and sharp Latin style high highs is most individual and provides a unique hi-fi potpourri. Very clear and sharp.

Fingers on Fire
Arthur Smith and His Cracker-Jacks
MGM E-3525
Arthur Smith is the hill-billy virtuoso of the Carolinas radio and TV stations who is billed as "the world’s greatest guitar player" and here doubles on banjo, fiddle, mandolin and accordion in a dozen of his biggest hits, including Listen to the Mocking Bird, Yes, Sir, That’s My Baby, Chicken Strut, Freeze It Boogie, etc. Before you contest the claim, you’ll do well to listen to this. Notable hi-fi-wise for the very fine reproduction of the plucked instruments and the novel effects Arthur achieves, including clucking of chickens, chirping of birds, etc. And a far better recording than pop music usually receives.

A Night at Poppa John’s
Poppa John Goody, Piano with Various Backing
RCA Victor LPM-1424
Here’s more pop recorded cleanly and with high presence and notably sharp highs. Poppa plays ragtime with an infectious beat though not with the originality of Del Wood. Add this to the 1,400 shelf of really good pop recordings.

S. F. Record Tid-Bits
San Francisco M-33012
This is a sampler of this label’s complete catalog, but it is also an excellent review of the evolution of popular music from the nineties to the present. With the aid of mechanical music-makers such as the old player pianos and cylinder phonographs. The recording technique is top-notch in the audiophile class—and presents some brilliant hi-fi material with very sharp, clean highs and a notable drum in the Guckenheimer Band selection. The most unusual of all the samplers and sure to delight any hi-fi party. Warning: the selection from the Naughty Nineties really is: don’t play this for the maiden aunt except with forethought.

Hi-Fi Sounds for Hounds
San Francisco M-33009
If you have a really first-class system, particularly a pickup and speakers with a superb high end and transient response, this will deliver realism that will shame two-channel stereo. The bass drum on band 3 of the first side is most real, the roller-coaster ride has a terrific assortment of astonishingly clean mid-frequency transients. Among other novelties are a jug band, a one-man band, the surf of the Pacific and the best-yet reproductions of a tremendous orchestra type nickelodeon. Guaranteed to please on any system and positively astonish on the best.

The Orchestra
Stokowski
Capitol SAI-8385
It is becoming more and more difficult to think of something original in the way of demonstration records, but Capitol has managed the trick in this which presents a five orchestra under Stokowski playing eight works—first, the several sections of the orchestra alone and then in various combinations. The percussion section, Section I of Farberman’s Evolution, is particularly impressive, but the entire recording yields very impressive sound with excellent definition despite the use of a very live hall or studio. The recording is free of any audible distortion when the best pickups are used. Hi-fi fans will find

get the NEW MALLORY Dual Controls
the newest and surest solution to an old service problem

Here’s how you can put a stop to those time-consuming shopping tours and special orders... eliminate those “awaiting-parts” delays. Get Mallory dual control replacements... the newest and surest solution to the age-old servicing problem of where to find exact dual control replacements.

Your Mallory Distributor can assemble a custom-made dual concentric control, with or without a switch, in just 30 seconds... with the new Mallory components and technique. You’ll get a control to meet original specifications... to service just about any make or model TV set, or home or auto radio. The finished part will be as rigid as a one-piece control... won’t come apart in service.
Weller soldering guns make safe repairs to Heat-Sensitive Components

A WELLER Soldering Gun gives you precise control of heat. This feature is especially important when replacing heat-sensitive components. Here are some typical applications:

1 REPAIRING PLASTIC-MOUNTED-TRANSFORMERS. Your Weller Gun gives you precise heat control for this delicate operation. Prevents melting of plastic sockets; enables you to repair loose contacts and hair-thin coiling-windings without damage.

2 SOLDERING VOICE COIL CONNECTIONS. Heat-control characteristic of Weller Guns enables you to repair loose or broken voice coil connections on the reflecting surface of paper resonating cone. The slightest mishandling of a soldering iron would burn cone.

3 REPLACING CRYSTAL OSCILLATOR. Controlled heat is imperative for replacing crystal oscillator in color demodulator circuits. With a Weller Soldering Gun you get perfect heat control, thus avoid damage to delicate crystal element.

4 REPAIRING REMOTE-CONTROL TUNING UNITS. Your Weller Soldering Gun fits neatly into the small spaces between the terminal tabs on telephone-type relay stacks. Also, heat shut-off feature of gun prevents damage to insulation.

There are professional model Weller guns for every type of service work

Your choice of models . . . ranging from 100 to 250 watts single heat and 100 to 275 dual heat types. Suitable for every kind of service operation. All models heat in 5 seconds; provide instant, triggermatic control of temperature.

ORDER FROM YOUR ELECTRONIC PARTS DISTRIBUTOR

Weller ELECTRIC CORP.
601 Stone’s Crossing Road, Easton, Pa.

NEW RECORDS (Continued)

this both instructive and very impressive on good systems. But the Gates of Kiel is not nearly as spectacular as its Toscanini recording (RCA Victor LM-1558, Moussorgsky’s Pictures at an Exhibition).

TCHAIKOVSKY: Symphony No. 4
Scherechen conducting Vienna State Opera Orchestra
Westminster XWN-18522
I know of no symphony better suited for hi-fi demonstration than this with its brassy peaks, procession of instruments in solo passages, excellent drums and tremendous dynamic range. And both Scherechen and Westminster do it complete justice in this recording which presents both the crescendos and diminuendos with great clarity and cleanliness. The balance is especially good and even at moderate volume it yields a fine illusion of actual performance. The recording, on the deaf side, yields superior definition and yet, played back in a fair-sized living room, it delivers a just-right liveliness. An outstanding example of modern high-fidelity recording with no exaggeration but a high degree of verisimilitude.

Munch Conducts Wagner
Boston Symphony Orchestra
RCA Victor LM-2119
Another sampling of Wagner’s music in orchestral suites—Overture and Yeasney from Tannhauser, Magic Fire Music, and Siegfried’s Rhine Journey—in a suitably spirited performance by this superb orchestra whose choirs are as true as chords on a well-tuned piano. The recording is up to the very high quality so usual in RCA’s discs of this orchestra, and extremely clean even in the very big peaks. Pledge of brama, high highs, good bass and fair percussion for splendid showoff—especially the middle of the first side.

IBERT: Caprice
Divertissement
Suite Elizabethaine
Winterthur and Vienna Symphonies
Westminster XWN-15520
The Divertissement is deservedly popular for its satiric humor; the other two are less often played and in a more serious vein. Together they give a good review of Ibert’s range of styles, which can go from baroque to jazz. The recording is especially fine with excellent definition and is perfectly clean.

Band Music of HM Irish Guard Band
RCA Victor LM-2920
A fine variety of 14 concert pieces ranging from the Irish Washingwomen to Th Duce of the Tumbler—many of which are in the repertoire of our best high-school bands—brilliantly played by the band of Her Majesty’s Irish Guards. High-school band leaders should have a copy of all means, but the ordinary hi-fi listener will enjoy it, too. One of the very best brass-band recordings with excellent balance, a high degree of presence and good drum in spades.

Hi-Fi in La Española
Fennel conducting Eastman-Rochester Pops Orchestra
Mercury MG-50144
Ten Spanish classics from Andalucia and Malaguena to Guayancas and The Ritual Fire Dance from The Three Cornered Hat recorded with a very Olympian sound. The drums, especially, will delight everybody but particularly owners of big speaker systems. There are plenty of Latin high highs to try the tweeters, and the dynamic range will try everything from pickups to speakers. Should become very popular as a demonstration and showoff record, for few records deliver both ends as spectacularly.

SCHUBERT: Octet in F Major
Vienna Concert Hall Quartet plus Winds and Double Basses
Westminster XWN-18471
I have often remarked how much more real a chamber group sounds in the typical living room than does a big orchestra. Here is another very notable case in point. This is a quartet augmented by a double bass, clarinet, bassoon.
NEW RECORDS (Continued)

and French horn in a superb example of octet music. The definition, purity of tone and cleanliness of this recording can produce an illusion of presence so complete that the difference would be more remarkable. The highest difference is in the low level of the double bass.

CHARIN: Concerto for Accordion
SHASHAKOV: Concerto for Balalaika
GORODOVSKAYA:
Suite for Folk Orchestra

VITOLIN: Village Polka
Various Russian Orchestras
Westminster 18464

Of course, one of the best recordings from a sound quality viewpoint to come from the USSR, though not up to Westminster's own best. The accordion concerto is the more classical both in composition and orchestration; the others are definitely folksy in character. All of it is pleasant and obviously Russian.

KENNAN: Three Pieces for Orchestra
BERGMA:
Gold and the Senior Commandant

BERNARD ROGERS:
Once Upon a Time
Han son conducting Eastman-Rochester Orchestra
Mercury MG-50147

Three examples of programmatic music by three contemporary Americans in the spectacular Olympian recording technique with lots of tremendous drums and bass, but likely to overload even the finest pickups in the peaks. The music is not likely to be remembered long, but it is not unpleasant. Once Upon a Time has a real charm, as well as some fine high percussive and a final movement with big, low-down drums galore.

BACH: Sonata No. 2
Partita No. 3
Jascha Heifetz...

RCA Victor LM-2115

Two of the most remarkable—and difficult—works for the violin in magnificent performances by one of the greatest virtuosos, recorded close up to reveal to the knowing ear the technique of fingering and with one of the clearest and loveliest violin tones on records. I can think of no finer present for a violin student who also owns a good hi-fi, but anyone who loves the fiddle should be extremely pleased with it.

Curtain Going Up
Fiedler and Boston Pops
RCA Victor LM-2093

Pleasant orchestral postscript to the principal tunes from six recent Broadway shows: My Fair Lady, Carousel, Brigadoon, South Pacific, Wonderful Town and Camelot, plus a medley of Rogers' tunes. Not remarkable from a hi-fi point of view but clean and bright and free of the overall distortion most show recordings are guilty of.

BEETHOVEN:
Emperor Piano Concerto (No. 5)
Solomon, pianist
Menges conducting Philharmonia Orchestra
RCA Victor LM-2108

Herowitz in Recital
Selections from Public Performances
RCA Victor LM-1957

BEETHOVEN:
Piano Sonata No. 17 (Tempest)
CHOPIN: Etudes 1, 5 and 8
Mazurka in A
Scherzo in C Sharp Minor
Dolores Eastin
Alta Records 1001

About as useful a measure of very fine hi-fi systems as I know of is the reproduction of various pianos. The piano still remains the most difficult single instrument to record and reproduce faithfully, for it takes a superb combina-
NEW RECORDS (Continued)

Radio and Television TROUBLESHOOTING AND REPAIR gets right down to earth in guiding you through each service procedure from locating troubles quickly to fixing them fast and right.

For beginners, this famous 222-page book is an absolutely complete training course in professional methods. As experienced servicemen, it is the ideal way to develop better troubleshooting methods and shortcuts, to find quick answers to puzzling problems and to handle tough jobs faster.

Shortcuts, to find quick answers to puzzling problems and to handle tough jobs faster.

Block diagrams, oscillograph patterns, response curves to troubleshooting television to AM and FM receivers. FM and Detector sections, cut radio and many more.

Here are a few of the subjects covered in Radio and TV Troubleshooting and Repair: Component Trouble; Basic Troubleshooting Methods; Shortcuts, Tips and Ideas; Complete Guide to TV Service; Realignment Made Easy; FM Communications Receivers, Record Players, etc. Auto Radios; Loudspeakers; Tuners; Switching Mechanisms; and dozens more. 417 clear illustrations. Price only $7.50. See MONEY-SAVING OFFER in coupon.

MONEY-SAVING VIEWS OF TROUBLESHOOTING AND REPAIR

You can repair any radio or TV set . . . even special electronic equipment far better and faster when you know all about its circuits! That's where this 399-page Radio & TV CIRCUITRY and OPERATION is worth its weight in gold.

You locate troubles in far less time . . . because circuitry "Know-How" teaches you exactly what to look for and where. You make repairs better and faster . . . because you eliminate useless testing and guessing.

Radio & TV CIRCUITRY and OPERATION deals practically with every circuit and circuit variation used in modern receivers. It teaches you the peculiarities and likely trouble spots. Over 110-pages explains Television . . . from scanning to signal to every circuit detail of each of the receiver sections, including:


Throughout, this great book equips you with the kind of above-average service training that really pays off! Price only $7.50 . . . or see MONEY-SAVING OFFER in coupon.

PRACTICE 10 DAYS FREE!

Dept. RE-117, RINGHART AND COMPANY, Inc., 223 Madison Ave., NEW YORK 16, N.Y.

RFD books arrive right FREE EXAMINATION. If in 10 days you do not decide to buy, you may return books postage paid and you will be refunded the full amount paid.

SUGGESTED RETAIL PRICE $10.00. MONEY-SAVING COMBINATION both books for only $15.00. If you return books and they pay postage. Some 10-day return privilege with money promptly refunded.

MONEY-SAVING COMBINATION

Both books for only $10.00, you save $5.00. Payable at rate of $4.00 (plus postage) after 10 days, and $3.00 a month thereafter until $10.00 has been paid.

OUTSIDE U.S.A.—$8.00 for TROUBLESHOOTING AND REPAIR; $7.25 for CIRCUITRY AND OPERATION; $14.00 for both. Cash with order only.

Celebrate the ideal of transient response, dynamic range and freedom from wow and hangover to do an adequate job. Furthermore, if both Philips and ourselves and the technique of playing them are so highly individual that no two pianos sound exactly alike, even though played by the same person. Hence, system quality can be judged by the degree to which the differences are revealed: the better the recording and system, the more distinct each piano recording.

Here are three cases in point. The Horowitz, which was a collection of his recordings made over several years, is especially good for the purpose, presenting a variety of piano tones and recording quality (some of it quite poor). It provides, also, a fine sampling of the technique of an acknowledged modern virtuoso. Horowitz playing The Stars and Stripes Forever. In itself, it is worth the price.

The Emporer is one of the greatest of piano compositions and receives here a recording brilliant in sound and quite representative of today's piano recording technique.

The Dorothy Eustis on a new label represents a successful attempt to do better by the piano than with pianistic difficulties. Each. Here is a very clear, though one or two peaks may overdrive some pickups. Given a turntable without much wow, the piano is very true and sharp. The pressing is by the Microfloss process.

Fritz Kreisler Favorites
Rafael Druian, violin
Mercury MG.50119

A baker's dozen of Kreisler compositions, including Capriccio Capriccioso, Old Farmer, Liebesleid, Tambourine Chalos and six of the famous "horns" pieces ascribed to 18th and 19th century masters. I suppose many won't have to actual Kreisler performances, but Druian, concertmeister of the Minneapolis Symphonia, performs them with faithful sensibility and a beautiful fiddle tone free of edginess except in one or two peaks where some pickups may be overdriven or tweeters found wanting.

SIRUNICH: Concerto for Piano. Strings and Harps
MARKA RICHER: Concerto for Piano, Violas, Cellos and Basses
William Mazzocchi, Piano
Sirunich conducting MGM-String Orchestra

MEG E.5347

Both of these works are scarcely two years old. The Sirunich is engravingly unusual both for its odd instrumentation and its combination of modern and Spanish feelings: it shouldn't take much musical sophistication to like it and the solo part is very different. The piano is very fine and the cymbals deliver a surprising variety of effects. MGM has commendably held back its tendency to overrun on the Sirunich side, but the Richter side will present trouble to many pick-up especially when the piano hitsfff. It will not be easy to take except to those who like the modern idiom.

Last Call for Crazy Otto

About two years ago Germany exported some Polydor discs called Die Beschupige Drachtbromanze, featuring as the artist Der Schwabe Otto, who played a very schmaltzy ragtime piano with a rhythm backing. These laid the disc jackets on their ears for a while but will recall the air was full of Crazy Otto. There was a good reason for this the recording was terrible, with high's high so that they shamed our own 16-rpm pops and gave a real opportunity for AM and FM stations to show off their new high-fidelity equipment. Later they were issued on an American label on 38 rpm. Now Radio Shack of Boston is disposing of the remains of the original Polydors (three for $17 and up). We understand that the set be added to the library for demonstration as well as pleasure. They may also be available on other record bargain counters. There are three of them under the above title and Polyiord numbers: 22,009, 22,011 and 22,025.

Name and address of any manufacturer of records mentioned in this column may be obtained by writing Records, Radio-Electronics, 158 West 42 St., New York 11, N.Y.
PDC METERS. Kits for constructing a large number of meters from a few foundation movements. Contain moving and companion movements. Contain meters from constructing PDC METERS. Checks TUBE TESTER, Corp., meters. Than movement meters. Tipped (illus.) lets 6-motion kit (illustrated) make up almost 100 meters (dc voltimeters, micro- and milliammeters; ac voltimeters and milliammeters). 12-motion kit turns out more than 400 meters. 6-motion kit replaces stock of 2,000 meters. --Precise Development Corp., 2 Neil Court, Oceanside, N.Y.


IMPEDANCE BRIDGE KIT, model 1B-2A. Built-in power supply, 1,000-cycle generator, and vacuum-tube detector. 100-100-μa meter for null indications. Measures resistance from 0.1 ohm-10 megohms, capacitance from 10 μf-100 μf, inductance from 10 mh-100 h; dissipation factor from .002-.1. Q from 0.1-1,000. --Heath Co., 305 Territorial Rd., Benton Harbor, Mich.

TRANSISTOR TESTER, model TT-2. Checks current gain, leakage, opens, shorts and cutoff current of all transistors. Checks diodes for forward-reverse current gain. --Century Electronics Co. Inc., 111 Roosevelt Ave., Mineola, N.Y.

VOLTAGE DROPPER, model RP-612. Provides 6 volts from a 12-volt battery source. 4, 6 and 8-amp taps, 4½ x 3½ x 1 inch. --Rue Products, 1925 Venice Blvd., Venice, Calif.

TOROID COILS, for high-frequency applications. MQD series. Temperature-stabilized from -40°C to 85°C. 6 types ranging from 2-20 mh. Q of 170 at 50,000 cycles. Hermetically sealed. --United Transformer Corp., 150 Varick St., New York 13, N.Y.

HIGH-FREQUENCY CHOKEs. 4 ferrite head units. From 0.3-1.3 ph with 30-me ac resistance of 25-100 ohms. For use as filament chokes, parasitic suppressors and series elements of low-pass filters for frequencies of 3-200 me. --National Co. Inc., 61 Sherman St., Malden 48, Mass.

RF CHOKEs. RL-100, RL-101, RL-110, RL-111 and RL-112. Medium- and high-power units in 3 mounting types. For frequencies 3.5-31 and 12-55 me.

Raypar Inc., 7800 W. Addison St., Chicago 34, III.

CHOPPER INPUT TRANSFORMERS. Operate with signal levels of 0.1 μv with maximum transfer efficiency. Primaries

MAIL THIS COUPON OR CALL YOUR LOCAL PHILCO DISTRIBUTOR FOR FURTHER INFORMATION.

PHILCO Fidelitape

Philco Fidelitape will bring new customers into your store. Tape recorders are now in wide use and recording tape is one of the fastest growing businesses in America today. Make sure you get your share!

- Unequaled in uniformity of output. Guaranteed not to exceed ± 3 dB from reel to reel.
- Guaranteed splice free. Continuous output uniformity and freedom from distortion. Excellent response at high and low frequencies.
- Has a drier-type formula which prevents oxide rub off. Low surface friction reduces wear on heads.
- Has exceptionally low background noise through better dispersing of fine oxide particles. These oxides are magnetically oriented to provide increased output and reduced distortion.
- Has special anti-tack agent which eliminates possibility of sticking on hot erase and record heads.
- Has a moisture-repellent binder which assures smooth, quick and even under hot, humid conditions.

A. Extra strength in 1½-MIL Cellulose Film Acetate. 7" reel—1200 ft. . . . 5" reel—600 ft.
B. Extra length in 1-MIL Cellulose Acetate . . . 50% more tape on standard reel. 7" reel—1800 ft. . . . 5" reel—900 ft.
C. Extra length and extra strength in 1-MIL Mylar . . . Polyester Film. 7" reel—1800 ft. . . . 5" reel—900 ft.
NEW DEVICES (Continued)

for use with either dc chopper-modulated or ac signals. Sealed in high-permeability shielded cans. — James Vibrapow Co., 4690 N. Rockwell St., Chicago 18, Ill.


MINIATURE TRANSFORMERS, Teenyformers. 0.003 x 0.027 inch. 780 weight less than a pound. For transistor applications. — Gruber-Haldorson Transformer Corp., 2754 N. Pulaski Rd., Chicago 25, Ill.


CONSTANT-VOLTAGE TRANSFORMERS, 9 models. Regulate 6.3-volt filament supply within 1% with line-voltage variations up to 15%. Regulation automatic. Response time within 1.5 cycles. Current rating of 5-25 amperes. — Sola Electric Co., 4653 W. 16 St., Chicago 30, Ill.

REPLACEMENT UNITS. TV power transformers: P-3061 replaces G-E RTF-314; P-2847 Motorola 25C708664 and 25E791977; P-2876 RCA 7765 and P-3141 Zenith 96-1236. Filament transformers: P-2844 replaces Philco 30-8574-1; P-2846 Motorola 25B707190 and 25B700197 and P-2889 replaces Crosley 155902 RF chokes: BC-551, 2.5 mh, BC-552, 0.0 mh, and BC-553, 10 mh. — Merit Coil & Transformer Corp., 4427 N. Clark St., Chicago 40, Ill.

OUTPUT TRANSFORMER, model S-192. Primary, 10,000 ohms, ct; secondary, 3.2 ohms.

Unit rated at 10 watts. — Triad Transformer Corp., 4055 Redwood Ave., Venice, Calif.

VIBRATORS, Gold Label line. Quiet operation. Buttonless contact construction. — P. R. Mallory & Co. Inc., 34 S. Gray St., Indianapolis, Ind.

PRECISION RESISTORS, Rite-ohm series 77. Metal film type. Axial or radial leads. 100-300-1,000 ohms, 1/4 watt. — Ohmite Manufacturing Co., 3601 Howard St., Skokie, Ill.

CAPACITOR KITS, ceramics. CK-2 contains 150 most-needed disc ceramics in 2-drawer cabinet. CK-3 has 75 most-needed disc ceramics in 1-drawer cabinet. CK-4 offers 3 each of 4 different Universal ceramic capacitors mounted on a heavy card folder. — Sprague Products Co., 125 Marshall St., N. Adams, Mass.

CAPACITOR, type RQL. Mylar metallized in a hermetically sealed case. Reliable at temperatures up to 125° without derating. — Astron Corp., 225 Grant St., E. Newark, N. J.

ELECTROLYTIC CAPACITORS, Duo-O-Mite, series TF. High-quality tantalum-foil units manufactured in limited quantities. 0.25-140 µf. Voltages up to 150. — Ohmite Manufacturing Co., 3653 Howard Ave., Skokie, Ill.

SUBMINIATURE ELECTROLYTICS, type EE (Epoxy end fill) and type EM (spun end with rubber bushing). Voltage ratings of 1, 3, 6, 9, 18, 28, and 30. Size from 3/16 x ½ to 3/16 x ¾ inches. — Astron Corp., 255 Grant Ave., E. Newark, N. J.

CAPACITORS, type 660-UE. Mylar dielectric, molded in Epon. High humidity resist-

As Modern As Tomorrow
Kraeuter & Co., Inc.
For 100 Years the Finest in Hand Tools 1860-1960 • Newark, N. J.

This is Kraeuter's
Little Nipper
Only 4½" — but all bite and precision.

And below are Little Nipper's pals—Larry Long Nose, Rudy Round Nose, Frankie Flat Nose and Slick Cutter. They're all full of fight, too. Precision drop-forged for precision work. Cushion grips at no extra cost. The job goes easier and quicker with fine tools. And that's where Kraeuter comes in. Sold only through recognized, legitimate distributors.

Buy the finest
Buy Kraeuter
Buy American

No. 82 Actual Size
Basically NEW Development in Tube Tester Design in over 25 Years

Automatic and by far the Fastest, but... the real news is the Greatly Improved Circuit of this equipment which is the first important New Tube Tester Design in the past 25 years.

300% MORE ACCURATE: Tests Gm to an accuracy of 1%
(Most portable Gm testers attain 5% accuracy or less. Emission type testers cannot test for Gm and therefore have very poor performance in detecting weak tubes.)

SCREEN and PLATE VOLTAGES: 12 to 160 volts
This wide selection of voltages protects against obsolescence. For instance, new car radios use 12 volt plate voltage.

FILAMENT VOLTAGES: 0.1 to 119.9 volts in 1/10 volt steps
More and more tubes are now in use with odd filament voltages. The 123A will accurately test all of them at their exact filament voltage.

200 MA LOAD ON RECTIFIER TUBES:
This gives an accurate test of the operation of a rectifier tube under load.

NEW KNEE TEST:
This new test evaluates the ability of a tube to perform in TV horizontal or vertical output circuits. As a tube gets older it loses its ability to deliver current which results in non-linearity of raster, (crowding of the raster where one side pulls away, etc.). The 123A tests this "Knee" point to determine whether the tube will cause trouble in a TV set.

TESTS SHORTS and LEAKAGE TO 20 MEGOHMS
(Users have detected as high as 50 megohms leakage.)

EXTRA SENSITIVE GAS TEST and Grid Emission Test
Here is what a CARDMATIC user said, "My 123A paid for itself in 2 months simply by weeding out weak tubes in four kinds of TV circuits—Horizontal Output, Damper, Rectifier, I.F. This is in addition to time saved me in hit-or-miss tube substitution or hunting for other troubles when the tube was actually at fault. Another said, "My wife tests all the radio-TV tubes in my shop. She says the 123A saves her so much time she absolutely will not give it up."

Ask your jobber for a free demonstration of the 123A CARDMATIC in your shop.

Free technical booklet is available.

Write to...

THE HICKOK ELECTRICAL INSTRUMENT CO.
10531 Dupont Ave., Cleveland 8, Ohio
NEW DEVICES (Continued)

ance, high stability and low leakage—Good-All Electric Manufacturing Co., Ogallala, Neb.

HI-FI SOUND SYSTEM, Audiotone. Incorporates 5-watt amplifier with frequency response of 60-12,000 cycles. 8-inch woof-er and 3-inch tweeter with cross-over network.—Audio-Master Corp., 17 E. 45 St., New York, N. Y.

HI-FI RECORD CHANGER, GS-77. Automatic and manual operation at 4 speeds. Inter-mixes and plays all sizes of records at any selected speed, and automatically intermixes and plays 33- and 45-rpm records without regard to se-quence. 5-second change cycle. 4-pole hum-shielded motor.—Glaser-Stevens Corp., 2 Main St., Belleville, N. J.

AUDIO EQUIPMENT, transistorized 75/2 series TM-4 (illustrated) and TM-2, remote and studio mixer amplifiers. Fre-
quency response: 61 db, 60-17,000 cycles. Gain: 20 db, 30-db optional. 50-600-ohm input, 50- and 600-ohm outputs. Temperature-stabilized circuitry.—Dunlap Electronics Inc., 764 Ninth St., Des Moines, Iowa.

FINAL AMPLIFIER, HCA single channel. For large hotel or apartment distribution systems, 6-me bandwidth, 5-volt maxi-

TAPE RECORDER, magazine repeater. Pentron model A-4. Recorder-playback unit for con-
ing, PA systems, etc.—Shure Brothers Inc., 246 Hartrey Ave., Evanston, Ill.

TONE ARM, high-fidelity Micro-Balanced with two sealed viscous-damped pivots for hori-zontal and vertical movement. Stylus force adjustable from 0 to 15 grams. Single-hole mounting.—Gray Manufacturing Co., Arbor St., Hartford, Conn.


SPEAKER SYSTEMS, SFB/1. Ready-to-play 5-way system. 12-, 10- and 3-inch speakers. Two styles: Warwick (illustrated) and Windsor. Walnut, mahogany or blond finish.—British Industries Corp., 80 Shore Rd., Port Washington, N. Y.

CERAMIC CARTRIDGES, 5 series. Two models: 52' (illu-

trated) turnover cartridge for 78- and 45,33-rpm records; and

SPEAKER, model 217. Same specifications as previous speakers produced by this manufacturer but using a chemically treated cone (polymerized). Clearer, flatter response with absence of resonance is obtained.

TRANSMITTER—EXCITER, Viking Navigator, 40 watts CW. Pi-network output matches 400-ohm transmission line impedance. Bandswitching from 150 through 10 meters. Internal vfo and 60-watt peaks. Frequency range: 25 - 20,000 cycles.

WEATHERS Industries, 66 E. Gloucester Pike, Barrington, N. J.


VHF RECEIVERS. Each model has 8 tubes plus rectifier. Power supply for 115-volt ac operation and loudspeaker are built-in. Tunable units available in or crystal control. Kit or wired.

E. F. Johnson Co., Waseca, Minn.

808 B.C. Designed to work with marine radiotelephone units. Provides broadcast entertainment while still maintaining monitor service on marine frequencies.


ANTENNA TUNER, Globe Match Jr., model AT-3. For transmitters with power input of 100 watts or less. Provides second — harmonic attenuation. Unbalanced output. Globe Match-
**Kerosene or Gasoline Heaters! Reduced to $4.95**

Brand new. Esse-Burner type, gas or oil. Capacity, 10,000 B.T.U. per hour. No. 10 oil or kerosene. Only 12" high. Cost Grandma, many times this price. Shipped in original packing. No. 2 express. 

**HRU-28A GENERATOR—$79.50**

Homelite portable generator 28.5 V. 1500 rpm. 6 hp. 4.5 gal. tank. Use for power supplies for boats, marine-yard equipment, camp, house, etc. 

**New Torque Amplifier Only $11.95!**

New wide-range torque amplifier. (With Synchronost) Shipped in original packing. No. 2 express.

**BC-604 Transmitter—$99.95 ea.**

30 watt crystal controlled on 10 preselected channels in range of 130-150 Mc. Operates with one battery. 

**Military Telephone Receivers**

3000-5000 cycle wide band receptive. For use with any military phone. New in original packing. No. 2 express.

**New Vacuum Tube Recorder—$149.95 ea.**

Operates on any commercial power supply in range of 110-120 V. 60 cycle A.C. Operates 8 hrs. on the smallest battery. 

**PL-42 Precision Transformer—$19.95 ea.**

For recording wide range of frequencies. New in original packing. No. 2 express.

**New Type Recorder—$119.95 ea.**

Operates on 110 volts A.C. Will record from 75-20,000 cycle range. New in original packing. No. 2 express.

**Other Supplies:**

- Small high grade battery—$9.95 ea.
- Crystal for military phone—$3.50 ea.
- Vacuum tubes—$1.95 ea.
- Tube sockets—$0.25 ea.
- Crystal cutters—$1.95 ea.
- Paper tube tunnel—$1.50 ea.
- Crystal holders—$1.25 ea.

**Mail Order Form:**

Orders accepted for material needed. Write for rates. 

**LEEDS & NORTHRUP MICROELECTRONIC MICROFAX RECORDERS**

Repair and service recorders. New and used. Rate $65.00 ea. 

**D-2 Auxiliary Power Plant Engines**

Fairchild 10 hp. at 3200 r.p.m., magneto shielded ignition, two cylinder, air-cooled type. Made to drive P-1, R-2 and NEA-3 type generators. Automatic altitude control for use to 40,000 feet. Use this engine to drive generators, for welders or other uses where light weight quality engine is required. Guaranteed like new condition. Shipping weight 125 lbs. each. 

**Price $85 each**

24 volt, 200 amp. generator for above 
**$195 each** 
Shipping weight 50 lbs. each.
NEW DEVICES (Continued)

Trio Production, Chicago, third line of coaxially-mounted cabinets. Each is an all-steel cabinet, yet weighs only 19 pounds. New York

Universal Strap Standoff, IMP. Accommodates Nos. 8 and 9 standard wood-screw or stacked arrays, depending on required gain. G2510, G2550, G2560 and G2570.—Technical Appliance Corp., Sherburne, N. Y.

TRIO COLOR ROYAL, an all-channel color TV antenna. High forward gain and high signal-to-noise ratio. Flat frequency response over the VHF band.—Tri-Color Manufacturing Co., Griggsville, I11.

ALL-TRANSISTOR AMPLIFIER. 20 watts. For PA systems. Plugs in 50-20,000 cycles. Fully transistorized.—Universal Transistor Products Corp., 143 E. 49 St., New York 17, N. Y.


MAGNETIC SHIELDS. Fit 7- and 9-pin vacuum-tube socket assemblies with bayonet type flange. Shielding material insensitive to shock and may be worked or transported without affecting its magnetic shielding qualities. Does not retain residual magnetism or require periodic annealing. Perfection Mica Co., Magnetic Shield Div., 1322 N. Elston Ave., Chicago 22, Ill.

CONNECTORS, Q. Quick-Discon- nect, seven sizes with 3 shells: QO4, square flange receptacle; QO5, hermetically sealed round-flange receptacle and QO6, straight plug.—Cannon Electric Co., P. O. Box 3765, Terminal Annex, Los Angeles 54, Calif.

PHONO PLUGS AND JACKS molded to extension cable. Straight and right-angle types. Shielded handle.—Switchcraft Inc., 1328 N. Halsted St., Chicago 22, Ill.

FILM-COATED WIRE, Beldsor. Solders without stripping. Coated with Polyurethane film. AIEEE Class A 105°C. For transformer, motor armatures, field coils, radio and TV universal coils, etc.—Belden Manufacturing Co., 4647 Van Buren St., Chicago 30, Ill.


TUBE CADDY, model TC-5. More than 3,000-cubic-inch vol-

ume. Removable tool tray. 24 x 16⅜ x 8¼ inches.—Argos Products Co., Genoa, Ill.


LEARN MORE! EARN MORE! WITH H. C. CISIN'S TV SERVICE BOOKS

NEW! Guide to BASIC ELECTRICITY

Learn electricity at home with this easy-to-use manual. Full illustrations, step-by-step instructions. Find the trouble yourself. First two volts just off phone

Send for these two new books today. Examine them you will be more than satisfied.
Vol. 1 (No. E11) 50c
Vol. 2 (No. E21) 50c

ABC of COLOR TV

This easily understood new book takes the mystery out of Color TV. Fully illustrated. Covers basic color principles, color transmission and reception, the color signal, color tubes. Helps you read in this new field.
No. R1 51

TV TUBE LOCATORS

Vol. 1 & 2

Trouble indicating tube location guides

Valuable to service men with motor防空 squares and TV sets of all makes and models.
Vol. 1 (No. K1) $1.50
Vol. 2 (No. K21) 50c

Rapid TV Trouble SHOOTING METHOD

1957 novel TV servicing method makes tuning out troubles as rapidly as an expert.
No. T1 51

TV CONSULTANT

Just the info needed to start your own business. Includes how to recognize troubles, which repairs to perform, and how to indicate defective tubes and circuits. Illustrated.
No. L1 52

TV TROUBLE TRACERS

No, 10 different trouble indicating tube location guides. Perfect for the TV service man.
Vol. 1 (No. TTI) Order sets
Vol. 2 (No. TTO) $1.50 sets
Vol. 3 (No. TTT) $2.50 sets
Vol. 4 (No. TTV) 5-Set book
Vol. 5 (No. TTT) 10-Set book

RCA GUIDE—No. A1

No. G1 51

RCA & ADMIRAL TROUBLE INDICATING TV TUBE LOCATION GUIDES

These two books contain the most complete compilation of RCA and Admiral tube location guides ever published.

The RCA tube guide includes all TV models from the earliest 1947 sets to the latest models, more than 5000 ordinary TV tube circuits.
The Admiral guide covers all 1950 Admiral TV models from the earliest 1956 sets to the latest models. Also contains a PICUTURE GUIDE to tube trouble guides.
RCA GUIDE—No. A1

No. D1 52

ADMIRAL GUIDE—No. M1

No. D5 51

FREE: 50c Worth of Books—FREE—With eac purchase of entire CISIN TV LIBRARY of 12 valuable TV service books listed above, Regular Price $15.00—yours for only $14.50.

IF JOBER IS OUT OF STOCK MAIL "NO RISK" TRIAL ORDER COUPON 5-day Money Back Guarantee

H. G. CISIN, Dept. E-44, AMAGANSETT, N. Y.

Beginning find 5, STOPPARD following books:

<table>
<thead>
<tr>
<th>Name</th>
<th>Address</th>
<th>City</th>
<th>Zone</th>
<th>State</th>
</tr>
</thead>
<tbody>
<tr>
<td>M2</td>
<td>$1.50</td>
<td>A1</td>
<td>$1.50</td>
<td>TTI = $1.50</td>
</tr>
<tr>
<td>M6</td>
<td>$1.50</td>
<td>A2</td>
<td>$1.50</td>
<td>TTI = $1.50</td>
</tr>
<tr>
<td>M8</td>
<td>$1.50</td>
<td>A3</td>
<td>$1.50</td>
<td>TTI = $1.50</td>
</tr>
<tr>
<td>L1</td>
<td>$1.50</td>
<td>G1</td>
<td>$1.50</td>
<td>TTV = $1.50</td>
</tr>
<tr>
<td>L2</td>
<td>$1.50</td>
<td>G2</td>
<td>$1.50</td>
<td>TTV = $1.50</td>
</tr>
<tr>
<td>L3</td>
<td>$1.50</td>
<td>G3</td>
<td>$1.50</td>
<td>TTV = $1.50</td>
</tr>
<tr>
<td>E1</td>
<td>$0.50</td>
<td>G4</td>
<td>$0.50</td>
<td>TTV = $1.50</td>
</tr>
<tr>
<td>E2</td>
<td>$0.50</td>
<td>G5</td>
<td>$0.50</td>
<td>TTV = $1.50</td>
</tr>
</tbody>
</table>

Name
Address
City
Zone
State
ANNUAL CONVENTION

The National Alliance of Television & Electronic Service Associations (NATESA) held its 4-day convention in Chicago, Ill., whose attendance exceeded last year's high of 712.

During the session, a constitutional amendment, eliminating the last possible hindrance to the affiliation of existing state associations with NATESA, was placed in the record to be voted on at the spring directors' meeting. This meeting was voted to Missouri after invitation by a number of NATESA affiliates in that area. Buffalo, N. Y., and Miami, Fla., also extended invitations.

New officers were elected, with Russell Harmon of Cincinnati, Ohio selected to succeed Robert Hester as president. Hester could not succeed himself. Mac Metoyer, Kansas City, was elected secretary while Nelson Burns, Memphis, Tenn., was reappointed treasurer. Bertram Lewis, Rochester, N. Y.; Cordell Britt, Nashville, Tenn.; Vincent Lutz, St. Louis, Mo.; and Winston Haines, San Mateo, Calif., were elected as vice presidents in their respective divisions. The following were elected secretary for their division: Pat Pratt, Buffalo, N. Y.; Marvin Miller, Springfield, Ohio; Joe Driscoll, St. Paul, Minn.; A. Andrew, Denver.

ESFETA MEETS

Licensing was the major issue discussed at the regular September meeting of the Empire State Federation of Electronic Technicians Associations, Inc. (ESFETA), held in Ithaca, N. Y. Ben DeYoung acted as the host.

Dan Hurley, ESFETA president, pointed out that there was a possibility that captive service would benefit from a governmental licensing program. This would be due to the possibility of 30% of the practising technicians being eliminated, leaving an expanded market for the manufacturer.

Robert Henderson, Long Island delegate, stated that the self-licensing program in their area hasn't brought any noticeable response from the public. George Carlson, secretary, reported that Jamestown's self-certification program has resulted in public response, but only when individual members advertise their membership and the association presents the program through local advertising.

Bert Lewis, eastern vice president of NATESA, representing Rochester, urged ESFETA to encourage its members to participate in the CBS transistor training program.
The next meeting will be held Nov. 10 in Rochester. Norbert LeMay will act as host.

SERVICE SEMINAR

Fifty representatives of independent service organizations had a 2-day seminar at Lancaster, Pa. in the early part of September. Conducted for discussion of the latest improvements and developments in service techniques, and sponsored by RCA, a tour of the color picture-tube facilities at RCA's Lancaster plant and a preview of the fall color TV receiver sales program was included. The Quality Control Laboratory at Browns Mill, N. J., and the David Sarnoff Research Center, Princeton, N. J., were visited during the closing day of the session.

Addressing the group, D. R. Creato, secretary and vice-president of the RCA Service Co., noted that electronics has become an $11.5-billion-a-year industry and that servicing represents $2.8 billion or, roughly, a quarter of this total.

APPRENTICESHIP GUIDE

The Minnesota Television Service Engineers, Inc. (MINTSE) and Tung-Sol Electric Inc. have jointly published a Radio-TV Apprenticeship Standards Guide. The booklet, called Service Standards, contains a complete description of MINTSE's apprenticeship program.

According to John W. Hemak, who compiled the manual, its purpose is "to establish a foundation for the eventual recognition of electronic service as a professional activity."

The guide was printed by Tung-Sol through the efforts of Robert M. Andrews, manager of electronics and semiconductor products advertising. Copies are free to all jobbers, dealers and associations. They may be obtained from local Tung-Sol jobbers or by writing: TTLB, Special Services Dept., P. O. Box 1321, Indianapolis, Ind.

NEW SERVICING IDEA

A new group called Telectro Service Associates, Inc., has been formed in Detroit, Mich. A profit-making organization, it was formed by independent service dealers to promote and contract service for the service dealer.

Telectro has signed contracts with Philco and Sylvania to handle their warranty service on television, radios and phonographs. Local Hotpoint distributors have also selected Telectro to perform this job for them. Independent local service dealers will handle work in their area.

The officers of Telectro are: Karl Heinzman, H. & M. Electric, president; John Keppinger, Grosse Pointe Radio, vice president; Philip Fabian, Dexter TV, secretary, and Edward Brown, Visual Electronics, treasurer.

Board members are: E. J. Barton, Barton TV, 2 years; Steve Rabockay, Southwest TV, 2 years, and Edward Corrozi, Supreme TV, 1 year.
NOW...ENJOY HIGHER FI!

At last, a book written just to help give your hi-fi system the golden voice you want—within the limits of your budget! In his latest book, UNDERSTANDING HI-FI CIRCUITS, Norman H. Crowhurst, hailed on both sides of the Atlantic as an outstanding hi-fi authority, tells you which phase inverter is best, whether fixed or self bias gives less distortion in the power output stage, the merits of triode vs. pentode, how to use feedback, etc. He answers hundreds and hundreds of other questions to help you decide for yourself which circuit is best for you to reach the performance level you want.

This unusual book, handsomely bound in a deluxe 2-color gold leaf-stamped cloth cover, sells nationally for $5 but through the unique G/L Audio Hi-Fi Book Club, you can get it at the wholesale price of only $3.75! Read how you can get UNDERSTANDING HI-FI CIRCUITS and other great books by top drawer hi-fi writers like Marshall, Hoefler, Burstein and others—all at a saving of 25%.

How to Get This Book At a Big Saving!

- To enroll in the G/L Audio Hi-Fi Book Club fill in your name and address and indicate the book you want on the coupon below. SEND NO MONEY!
- We will send you the book you choose for a 10-day inspection in your own home. If you like it keep it and send your remittance of $3.75—the special wholesale club price. (We pay postage.)
- If not satisfied simply return the book in the container in which you received it.
- A new book will be sent to you on the same no-risk inspection plan about every four months.
- You agree to take a minimum of only four books for the whole period of enrollment—no time limit. You may cancel any time after that.

Other Books Already Published

NEW—JUST OFF THE PRESS
Elements of Tape Recorder Circuits—By Burstein and Pollak. Now in one book—everything you want to know about the electronic side of tape recorders. What to look for when you buy—why one works better than another—how to get maximum performance from all types. Covers fundamentals, amplifiers, head, bias, equalization, oscillators, design principles and many other phases for both hi-fi fans and technicians.

Basic Audio Course—By Donald Carl Hoefler. Complete coverage of theory and fundamentals from the physics of sound to advanced techniques, including amplifiers, feedback, power supplies, distortion, attenuators, speaker systems, and so much more it is impossible to list all here.

Maintaining Hi-Fi Equipment—By Joseph Marshall. Now for the first time—learn the techniques necessary to recognize and repair hi-fi troubles. Covers acoustic as well as electronic, electrical and mechanical faults. A must for the professional hi-fi man—or any audiophile who really cares about his hi-fi system.

Books for Future Publication

These books will be published one-at-a-time at regular intervals and sent to club members for the press.

- High-Quality Audio
- Audio Data Book
- Loudspeaker Enclosures

All these exclusive features yours with membership

- No-risk inspection plan
- First choice of latest hi-fi books at regular intervals
- Best hi-fi authors write specially for you
- Handsome and durable gold leaf-stamped cloth covers
- SAVINGS OF 25% over the 55 retail price!

SAVE $1.25 on each book—join the G/L Audio Hi-Fi Club today—you have nothing to lose—everything to gain

SEND IN THIS COUPON NOW

Remember YOU SEND NO MONEY! You keep only the books you want—pay only for those you keep!
New Tubes
& Semiconductors

The manufacturers have presented a versatile group of vacuum tubes and semiconductor devices this month. There's the world's first power tetrode transistor; a photocell that needs no amplifier circuit; a miniature power-output tube; a 110° picture tube and a rectangular 3-inch C-R tube. And to round out the collection you'll find an 85-watt power transistor.

H200E

A germanium p-n-p alloyed-junction power-tetrode transistor and designed to operate from 25-volt collector supplies, its linear amplification over wide current ranges permits high power output with low distortion. It is made by Minneapolis-Honeywell. A power output stage to demonstrate its excellent linearity is shown in the diagram. A low-distortion high-efficiency high power output is achieved without feedback and without input transformer drive. Hence, the circuit may be R-C-coupled or direct-coupled to a preceding stage. Up to 5 watts output can be obtained.

2N332, 3, 4, 5, 6

These grown-junction silicon transistors are especially designed for high-gain low-level applications where maximum reliability at a high ambient temperature is of prime importance. Made by Texas Instruments, the max-

N O V E M B E R, 1957

NEW AUTOMATION PUNCHED CARD TV TUBE TESTER PROVED!

IN OVER 7 MILLION TUBE TESTS!

Fastest, most complete portable dynamic mutual conductance tester!

Model DM456

IMMEDIATE DELIVERY!

136-10 31st Road, Flushing 54, N. Y.

NEW! 5-Transistor Pocket Radio!

Size of cigarette pack-

Scan. No external anten-

New in stations 100 miles away at night. Loud volume. Uses 1.5- cent flashlight battery that lasts 400 hours. Printed circuit. Free literature.

GARDNER ELECTRONICS CO., Dept. 12
2545 East Indian School Road • Phoenix, Arizona

www.americanradiohistory.com
NEW TUBES & SEMICONDUCTORS (Contd.)

<table>
<thead>
<tr>
<th>Tube</th>
<th>IR (ma)</th>
<th>PE (mw)</th>
<th>VCES</th>
<th>ICS</th>
<th>ICB</th>
</tr>
</thead>
<tbody>
<tr>
<td>2N332</td>
<td>33</td>
<td>34</td>
<td>35</td>
<td>36</td>
<td></td>
</tr>
<tr>
<td>Power gain at 1 mA (PGs)</td>
<td>35</td>
<td>39</td>
<td>39</td>
<td>42</td>
<td>42.5</td>
</tr>
<tr>
<td>(VCE(s) = 20 V)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(Rc = 1 k, Re = 20 k)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Frequency cutoff (mc)</td>
<td>4 5 8 6 7</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(VCE = 5 V, IC = 1 mA)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

6957

Head-on type of cadmium-sulfide photoconductive cell for use in light-operated controls. High illumination sensitivity permits direct relay operation in most applications without an amplifier. The unit is made by RCA.

Maximum ratings are: polarizing voltage, 256; power dissipation, sensitive surface fully illuminated, 0.5 watt; photocurrent 50 ma.

The diagram shows a typical high-sensitivity circuit using the 6957. The cell connects to pins 4 and 8 of an octal base.

Abbreviations

A number of abbreviations used in reference to transistor characteristics are often confusing. To end any doubt as to what a particular symbol stands for this list has been assembled.

Ic, Ie, I1—DC currents to collector, emitter or base.

VCE—Voltage, collector to base.

VEE—Voltage, emitter to base.

Vbe—Voltage, collector to emitter.

Vcb—Voltage, base to emitter.

BVCEO—Breakdown voltage, collector-to-base junction reverse-biased, emitter open-circuited (value of Ic should be specified).

Vce—Voltage, collector to emitter, at zero base current with the collector junction reverse-biased. Specify Ic.

BVBE—Breakdown voltage, collector-to-emitter, with base open-circuited.

VCE(s)—Supply voltage, collector to base.

VCEO—Supply voltage, collector to emitter.

Watch for more of this list next month.

2N451

This 65-volt 85-watt silicon power transistor is designed to be used in dc–dc or dc–ac converters as well as servo amplifiers, engine controls and power supplies. Capable of dissipating...
NEW TUBES & SEMICONDUCTORS (Contd.)

21CQP4

A 21-inch rectangular glass type television tube, it uses 110° magnetic deflection and electrostatic focusing. Announced by Sylvania, the 21CQP4 utilizes a straight electron-gun design, eliminating the need for an ion trap. It has a 6.3-volt 600-ma heater with a controlled warmup time of 11 seconds. Maximum ratings are:

- Ultron voltage: 19,800
- \( V_n \) (pos value): 1,100
- \( V_n \) (neg value): 550
- \( V_c \) (neg bias value): 154
- \( V_g \) (neg peak value): 220
- \( V_m \) (pos bias value): 0
- Peak, heater-cathode voltage: 200 (during warmup) 15 sec: 450

85 watts at 25°C, the G-E 2N451 has a nominal collector saturation resistance of 2 ohms.

Input impedance at a collector current of 1 amp is 25 ohms at 25°C. Maximum collector current rating is 5 amperes. Beta cutoff is 400 kc.

Produced by a vapor-diffusion process, the 2N451 is hermetically sealed in an all-welded case designed for mounting on an external heat sink by means of a single threaded stud.

“The high fidelity” might be defined as the precision reproduction of music by a system of specially-built components. Among these components—amplifiers, radio tuners, record players—nothing else is precision craftsmanship more important than it is in the loudspeaker.

Consider the function of a loudspeaker. It must vibrate at exactly the standard frequency as the electrical signal fed to it by the amplifier. This frequency may vary from 30 to as many as 15,000 times a second! Consider that now we are not dealing with electrons of negligible mass, neither are we working with a tiny phonograph stylus, in a loudspeaker we must control the actual physical movement of a considerably mass of metal and fiber. A moment's reflection will show that in this component precision craftsmanship is all important.

JBL Signature loudspeakers made by James B. Lansing Sound, Inc., are made with that degree of precision usually associated with scientific instruments or navigational chronometers. Perhaps they should not be called “loudspeakers” at all, but should be given the more technically correct appellation: precision transducers. No matter how difficult the manufacturing operation, if a refinement will result in better sound, it is built into JBL Signature Loudspeakers.

The place to see and hear JBL Signature units is in the component demonstration room of the authorized JBL Signature High Fidelity Sound Specialist in your community.

For his name and address, write to:
James B. Lansing Sound, Inc.
3249 Casitas Ave. • Los Angeles 39, Calif.
NEW TUBES & SEMICONDUCTORS (Contd.)

<table>
<thead>
<tr>
<th>Type</th>
<th>Symbol</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ir (0 sig) (ma)</td>
<td>92</td>
</tr>
<tr>
<td>(max sig)</td>
<td>105</td>
</tr>
<tr>
<td>Is (0 sig) (ma)</td>
<td>7</td>
</tr>
<tr>
<td>(max sig)</td>
<td>16</td>
</tr>
<tr>
<td>Rp (plate to plate)</td>
<td>8</td>
</tr>
<tr>
<td>(k ohms)</td>
<td>7.5</td>
</tr>
<tr>
<td>Total harmonic distortion (%)</td>
<td>2</td>
</tr>
<tr>
<td>Max sig pwr output (watts)</td>
<td>12.5</td>
</tr>
</tbody>
</table>

3AHPI, 2, 7, 11

This rectangular cathode-ray tube uses electrostatic focusing and deflection. It is 9.12 inches long, has a 6.3-volt 0.6-amp heater and is produced by Waterman Products Co.

Typical operating conditions are:

- \( V_{an} = 2,000 \)
- \( V_{an} = 330-820 \)
- \( V_{an} = 158 \) to 185

Deflection factors:
- D1 and D2 146-108
- D3 and D4 52-70

Basing diagram same as for 3RP1.

4JD4A4, 5

These silicon triode transistors are intended for amplifier applications in af and rf ranges. Both are diffusion-junction devices manufactured by General Electric by a diffusion-meltback process. They have a nominal input impedance (h.) of 55 ohms, when \( I_a = -1 \) ma and \( V_{em} = 5 \).

Nominal current-transfer ratio is 15 for the 4JD4A4 and 40 for the 4JD4A5, when \( I_a = -2 \) ma and \( V_{em} = 5 \).

Maximum ratings at 25°C are:

- \( V_{bo} = 30 \)
- \( V_{be} = 15 \)
- \( I_0 = 5 \)
- \( P_c (nmw) = (25°C) 150 \)
- \( (150°C) 25 \)

Nominal frequency cut-off (mc):
- \( f_{on} \) \( I_a = -2 \) ma
- \( V_{em} = 5 \)
- 25

RCA pix tubes

Three 90° television picture tubes have been announced by RCA. All have a straight gun design and do not need an ion-trap magnet. They are the 21CBP4-A, 2A4EP4 and 17BFP4.

6DQ5 Correction

An errata notice from RCA has indicated a change in the information presented in their original specifications for the 6DQ5, which appeared in the September issue on page 138. The connections for grid 1 and grid 2 were reversed. The correct connections should be: Pin 1 connects to grid 1 and pin 4 connects to grid 2.

END
FM ANTENNA

Recently I constructed an omnidirectional FM receiving antenna from details in the article "All-Way FM Antenna" in the March 1948 issue of RADIO-CRAFT. The antenna worked so well that I'd like to recommend it to those who haven't seen it. The dimensions on the diagram are for the FM broadcast band. The dipoles (A) are made of 300-ohm ribbon and are 0.45 wavelength long. The square is 0.5 wavelength long on each side. The four antennas in parallel have an effective impedance of 75 ohms when connected as shown by 0.25-wavelength phasing sections (B). The 75-ohm feed-point impedance is matched to the 300-ohm transmission line (lead-in) by a 0.25-wavelength section of 150-ohm line (C).

For other frequencies the dimensions of A, B, C and D in inches may be found by dividing 5,550, 2,950, 2,300 and 5,900, respectively, by the frequency in megacycles.—Henry O. Maxwell

LIGHT SWITCH CONTROLS GARAGE-DOOR OPERATOR

I wanted to install an electrically controlled solenoid release for a spring-operated garage-door opener in a home with a garage light controlled from a remote switch in the house. To avoid putting in special wiring and switches, I worked out a scheme for controlling the door operator and garage light individually from the original light switch. The circuit shown is designed so normal operation of the light switch will not activate the door opener but

NOW—Get it from your Parts Jobber!

Admiral—rated by servicemen as the most foolproof and trouble-free of all changers!

Admiral—built into more phonos and combinations than any other changer in the world!

Admiral 4-Speed Record Changer

Beige and Coral with Golden Trim (Base Optional)

HEAVY DUTY MOTOR — powerful 4-pole constant speed shaded pole induction type motor. Operates without hum, rumble or "wows" (as little as 0.1590). Maintains even speed even if line voltage varies. Six foot line cord attached.

CERAMIC PICK-UP CARTRIDGE — twin lever hi-fi cartridge changes with flick of the finger from LP to 78 r.p.m. needle. Impervious to heat and humidity. High lateral compliance minimizes wear, eliminates hum and distortion. Smooth even response (± 3db) over the full high-fidelity frequency range (30-15,000 c.p.s.).

Write for Illustrated Specification Sheet.

Admiral. / SPECIAL PRODUCTS DIVISION 3800 West Cortland Street Chicago 47, Illinois

NOVEMBER, 1957
**RADIO-ELECTRONICS**

(Continued)

The opener can be operated instantly from the same switch. Moreover, it is impossible for current to flow through the solenoid for a period longer than that required to open the door. This prevents an excessive duty cycle and keeps the opener coil from overheating.

The circuit connects to the ac line supplying the garage light. The connection can be made through an extension cord run from an adapter in the light socket. With this unit, the opener is operated by switching the light on, then off and on again within a few seconds. The second time that the light is switched on, the opener solenoid receives a 117-volt ac pulse of sufficient length to open the door, but not longer, even though the light remains on. Successive operations of the switch will not operate the solenoid if the on-off interval is longer than several seconds.

Here's how it operates: When the dirt 115-volt coil (with each closure of the light switch), the lower set of contacts allows C1 to charge from the selenium rectifier. When RY1 is released seconds later by turning off the light, the normally closed contacts connect the charged capacitor (C1) across C2 and the coil of dc relay R2. RY2 now closes and remains closed until most of the charge on C2 has leaked off through its high-resistance coil. (The period that RY2 remains closed is determined by its coil resistance and armature spring tension and the capacitance of C2.)

The solenoid will not operate if the light switch is kept off until after RY2 opens. But, if the switch is closed before RY2 opens, line voltage is applied to the solenoid through the closed contacts of RY1 and RY2 in series. Line voltage cannot remain on the solenoid for any great length of time because RY2 opens when the charge has leaked off C2. The circuit through the solenoid remains open until the control is triggered again by flipping the light switch off and on again. A low-wattage 115-volt pilot lamp may be connected across the solenoid as shown by dashed lines to indicate a malfunction such as sticking contacts on RY2 which will keep the voltage applied to the solenoid.—Bruce Morrisette

**IMPROIDRED IMPULSE RELAY**

During experimental or developmental work we may need a ratchet or impulse type relay to open or close
You can do a BETTER job FASTER when you use...

AEROVOX
CERAMIC CAPACITORS

You can be sure that Aerovox Ceramic Capacitors are exactly right for your service applications because of the extra-care taken in the manufacturing of these capacitors to provide you with trouble-free, exact-duplicate replacements. This extra-care assures your customers of easy put installations saving you time and money on costly call-backs.

The Aerovox line of ceramic capacitors is the most complete on the market. A type for every application is available to you for prompt delivery from the complete stock selection carried by your local Aerovox Distributor.

AERVOX CORPORATION
DISTRIBUTOR DIVISION
NEW BEDFORD, MASS.

The sound of the organ is one of the most difficult to reproduce, because of its wide tonal and dynamic range and because of the large amount of fundamental energy that appears at extreme bass frequencies.

At a recent public demonstration, staged by the Audio League at St. Mark's Church, Mt. Kisco, N. Y., the recorded sound of an Aeolian-Skinner organ (from stereo tape) was instantaneously alternated with that of the "live" instrument. The reproducing equipment selected included four AR-1 speaker systems. Here is some of the press comment on the event:

The Saturday Review (David Hobbs)

"Competent listeners, with trained professional ears, were fooled into thinking that the live portions were recorded, and vice versa... The extreme low notes were felt, rather than heard, without any "loudspeaker" sound..."

Audio (Julian D. Hirsch)

"Even where differences were detectable at changeover, it was usually not possible to determine which sound was live and which was recorded, without assistance from the signal lights... Facsimile recording and reproduction of the pipe organ in its original environment has been accomplished."

The price of an AR-1 two-way speaker system, including cabinet, is $185.00 in mahogany or birch. Descriptive literature is available on request.

ACOUSTIC RESEARCH, INC.
24 Thorndike St., Cambridge 41, Mass.
TERMINAL MARKING

If you have ever lost or misplaced a wiring sketch that was drawn as a guide to the replacement of a defective component with many color-coded leads, you will appreciate this convenient method of marking circuit terminals.

Keep a block of multicolored modeling clay on the bench and whenever you unsolder a lead mark the terminal with a small piece of that color clay. Remove the clay as you solder new leads in place.

The clay speeds up the repair and can’t possibly become mislaid or lost as a sketch could be.—John A. Comstock

SERVICING AID

When a new set comes into the shop, I always look up the code number for my service manual and jot it down on the back of the chassis with a grease pencil. Whenever one of these sets comes in for repairs I can tell at a glance just what manual contains the reference data. This trick is handy in speeding up future repairs.—Seot Moek

INDUCTANCE MEASUREMENT

Very often it is necessary to measure the inductance of unknown or home-made inductors. In most instances test equipment designed for this purpose, such as an impedance bridge, is not available.

The drawing shows a method of determining inductance values with an audio-frequency generator and a vtvm. The generator is set to provide an R-C coupled high-impedance output and the vtvm is set to a low ac scale.

A wide-angle, all-purpose, all-weather Public Address Speaker, complete with integral high-power super-efficient "Acousti-Matched" driver unit. "Acousti-Matched" means "Controlled Response" within the frequency limits most useful in P.A. and high level music reproduction. "Controlled Response" offers conversion efficiency never before obtainable in high-powered speakers. "Controlled Response" results in smooth reproduction — free from peaks which so often create and sustain acoustic feedback.

The CJ-44 conserves costly amplifier output power — fewer speakers do a complete job. The speaker horn is easily rotated for horizontal or vertical dispersion patterns.

The CJ-44 is the only high-powered P.A. speaker that can be equipped with the new ATLAS Universal Mounting Bracket, permitting quick and secure directional adjustment on both planes. Simple to make a horizontal or vertical adjustment as a final "touch-up" to the installation.

The CJ-44 is designed for the "tough jobs." No gimmicks, no fluffs, no wild claims — just a reliable super-efficient speaker for all applications.

Input Power: 30 watts constant
Input Impedance: 16 ohms
Response: 150-9,000 cps
Dimensions: Ball 23" x 13";
Over-all length 19"
Net Weight: 16 lbs.

NEW!

ATLAS "King Cobra-Jector"

CJ-44

Shown with
GL1 Universal Mounting Bracket
Complete with "Acousti-Matched" Built-In Driver Unit
List $72.50
NET $43.50

A wide-angle, all-purpose, all-weather Public Address Speaker, complete with integral high-power super-efficient "Acousti-Matched" driver unit.

"Acousti-Matched" means "Controlled Response" within the frequency limits most useful in P.A. and high level music reproduction. "Controlled Response" offers conversion efficiency never before obtainable in high-powered speakers. "Controlled Response" results in smooth reproduction — free from peaks which so often create and sustain acoustic feedback.

The CJ-44 conserves costly amplifier output power — fewer speakers do a complete job. The speaker horn is easily rotated for horizontal or vertical dispersion patterns.

The CJ-44 is the only high-powered P.A. speaker that can be equipped with the new ATLAS Universal Mounting Bracket, permitting quick and secure directional adjustment on both planes. Simple to make a horizontal or vertical adjustment as a final "touch-up" to the installation.

The CJ-44 is designed for the "tough jobs." No gimmicks, no fluffs, no wild claims — just a reliable super-efficient speaker for all applications.

Input Power: 30 watts constant
Input Impedance: 16 ohms
Response: 150-9,000 cps
Dimensions: Ball 23" x 13";
Over-all length 19"
Net Weight: 16 lbs.
the known capacitor (C) connected in parallel with the unknown inductor (L), the generator is tuned through its range until an indication is noted on the vtm. At this point the tuning should be carefully adjusted and the frequency recorded on a sheet of paper. The value of capacitor C will depend on the tuning range of the generator and the range of inductance to be measured. Capacitor values for use with any frequency range and any range of inductance may be determined by the formula:

\[ C = \frac{25,330}{fL} \]

where C is in microfarads (µf), L in henrys (h), and f is in cycles per second (cps).

The value of the measured inductance is determined by the formula:

\[ L = \frac{25,330}{fC} \]

—Michael S. Robbins

SHOESTRING AS SPAGHETTI

When I need some insulating spaghetti for low-voltage low-frequency applications, I use a length of shoestring. Since shoestring comes in several different widths and lengths and is hollow, it will fit most conductors. To insulate a wire, I simply select a shoestring of appropriate size, cut it to length, slip it over the wire and spray-insulate it with anti-coronado dope. The resulting spaghetti is durable and has good insulating properties.—J. C. Alexander

FUSE PULLER

In many TV receivers the high-voltage fuse is located in the high-voltage cage and to technicians with big hands can sometimes prove to be a slippery article.

You can beat this problem by slipping a piece of heavy, brown paper around the fuse for a handle or grip as in the diagram.

Cut a strip just wide enough to fit between the fuse clips—about \( \frac{3}{4} \) x 5 inches. The fuse can be easily pulled or replaced using this paper handle. Keep a couple in your tool kit.—Frank W. Dresser

RESISTOR REPAIRS

Vitreous-enamed wire-wound power resistors with cracked or broken ceramic cores can be repaired satisfactorily if the resistance element is unbroken. In a bottle cap, mix a little iron cement (Smooth-On) according to directions.
ARKAY

See and Hear the Fabulous ARKAY STEREO HI-FI KITS AND PREWIRED

At Last! "LIVING SOUND" STEREO At Sensible Prices by ARKAY

ARKAY MODEL FL-30 HI-FI PRE-AMPS

ARKAY HFT-7. AM-FM Tuner, All Sensitive, Waterproof, Built-in Amplifier, 2 aux. speakers, 250 watts, wired or prewired, KIT $32.00. WIRED $59.95.

ARKAY MODEL FL-35 Hi-Fi Tuner, All Sensitive, waterproof, built-in amplifier, 2 aux. speakers, 250 watts, wired or prewired, KIT $28.95. WIRED $59.95.

ARKAY MODEL ST-11 - Dinosaur 2 Disc Stereo, AM, FM, all Sensitive, Waterproof, built-in Amplifier, $47.95. WIRED $74.95.

ARKAY MODEL SP-6 - Dual Channel Hi-Fi Tape, all Sensitive, waterproof, built-in Amplifier, 2 aux. speakers, 250 watts, wired or prewired, KIT $34.95. WIREED $59.95.

ARKAY TV-5 - All-Purpose Pre-wired Kits, Three Sizes, Wiring Diagram included. KIT $39.95. WIRED $39.95.

Prices 5% higher west of Mississippi FREE! At your dealer or write for complete catalogues of Stereo & Monaural Hi-FI, Radio & TV, Kits & WIRED.

OPPORTUNITY ADLETS

RADIO-ELECTRONICS, 154 West 14 St., New York 6, N. Y.


CASH PAID! Sell your surplus electronic tubes. Want tuned, clean, transmitting, special purpose, receiving, TV type, miniature, electronic, broadcast. Also want military & commercial laboratory test and communications gear. We pay cash for tubes or obsolete equipment. Send specific details in first letter. For a fair deal write, wire or telephone: H. O. S. 612 Broadway, New York 13, N. Y. "IT'S FREE"


TRY THIS ONE (Continued)

Run a bolt through the resistor with a washer on each end and tighten the nut just enough to hold the broken pieces in place. Apply the iron cement over the break and let it harden before removing the bolt.

This method is better than using a bolt alone to make the repair because it does not interfere with the circulation of cooling air through the resistor. Keep the patch above ground because some of the conductive cement may be touching the wire element.—D. R. Frank

TRANSISTOR BATTERIES

Battery packs salvaged from personal type portable radios are handy when experimenting with transistors. The small wafer cells can be reassembled to provide almost any voltage likely to be needed for transistor projects.—T. Clark

PREVENT HEAT DAMAGE

Experiments know that during soldering pliers should be used to absorb the heat on the leads of delicate components. However, it's sometimes difficult to hold the pliers and do the soldering job too. The pliers will hold themselves in place when they are snapped around the lead if a rubber band is stretched around the handles.—Hugh Lineback

CARBON TET FUMES

In our shop we use a 10-inch electric fan to dissipate the fumes of carbon tetrachloride, contact cleaner and other dangerous chemicals. The fan is kept close to the chassis being serviced so it dissipates the fumes before the technician can detect the odor.—Seymour Winterfeld
**WEAK OR NO COLOR**

A fairly common cause of weak or no color in the RCA 21-CT-663U is an R240, normally 560 ohms, increasing in value and cutting down grid 2 voltage at V123. Every time this trouble has come up, we have found an inter-

mittent short in the tube or in C234, a 01-pF capacitor. We now change both the tube and capacitor any time R240 has changed value. Apparently the short causes an excessive flow of current through the resistor, heating it enough to change its value.—Warren Roy

**G-E 805**

Complaint, no picture, no sound, no raster, no nothing. This could be anywhere, but most probably low-voltage B or filament supply.

All tubes were. With such a group of symptoms there are but few remaining causes for no picture, no sound, no raster.

There were no visible signs of any part being overheated, burned or shorted, but I looked carefully for an open. I came there was a comming into the chassis because the tubes were heated. Tracing the acc line, I found it branching to the filaments and to the rectifier circuit at the line switch. (The switch and a thermal cutout are in series, common to filaments and selenium rectifiers.)

The 5-ohm resistor in the rectifier branch was open. This is a 4-watt, wirewound unit. I replaced it with a 5-ohm 10-watt, wirewound resistor. Whenever a wirewound resistor in a power supply goes, it is the better part of servicing discretion to replace it with one having twice the wattage rating of the original component.—David T. Armstrong

**ZENITH Z-2222C**

Trouble was narrow picture and decreased brightness. We found that the grid voltage of the horizontal output tube (6DQ6) was 38 volts negative instead of the rated — 45.

The set has a fixed input network to the output tube with no means of in-

**QUAM Adjust-a-Cone SPEAKERS**

They cost less because they fit right... the first time ... and they work right ... the first time.

With Quam Adjust-a-Cone Speakers there are no callbacks—caused by defective or non-fitting speakers—to eat up your profits.

Remember: a guarantee does not pay for your time or protect your reputation and customer goodwill ... so use Quam, the "no-callback" speaker.

**QUAM-NICHOLS COMPANY**

236 EAST MARQUETTE ROAD • CHICAGO 37, ILLINOIS

**OPPORTUNITY ADLETs (Continued)**

DISCOUNTS UP TO 50% except fair trade items—Came ria, pro pri etors, tape recorders, tapes, HIFIL com ponents. Write for individual quotations on your specific needs, no catalog. CLASSIFIED HIFI-FL EXCHANGE RE, 2375 East 65th St., Brooklyn 8, N.Y.

Tape recorders, tape, unusual values. Free Catalog.

DRENNER, 69-801 1/4 Street, Findlay 6, N.Y.

LABORATORY QUALITY equipment and Military Stuff, plus Electronic Books, and ENGINEERING ASSOCIATES. 424 Patterson Road, Dayton 2, Ohio.

HI-FI Amplifiers, Speakers, tape recorders, turntables, headphone transmitters, and overseas Will, National Hal gers, Hamekal, Johnson and Quam, Fast brands. SEN-EM RADO SUPPLIES 6115 Central Ave., Flushing, N.Y.

Tape, amplifiers, speakers, tape recorders, turntables, Headphone transmitters, and overseas Will, National Hal gers, Hamekal, Johnson and Quam, Fast brands. SEN-EM RADO SUPPLIES 6115 Central Ave., Flushing, N.Y.

UNUSUAL CONFIDENTIAL QUOTATIONS on all your "HI-FI" requirements. No Catalog. RAY ELETRONICS, 199 Liberty Street, N.Y. 6, N.Y. (Telephone 4-8971).

PATENT DRAWINGS of your inventions 35 years ex perts. Electronic diagrams to match office require ments. PATENT SERVICE ASSOCIATES, Haverhill, Mass.


"REVIEW" PIONEER Tape Supplies, 390 TURN BAIL SERVICE, Medford, Mass.

147
**BENCO**

**INTRODUCES ANOTHER TV LEADER!**

**5 VOLTS R. F.**

Maximum output

- 20 db gain minimum
- 6 mc/s bandwidth
- Silicon rectifier
- Available for Channels 2 to 13
- Will drive a low band signal through 2 1/2 mi. of K-14 type cable

**WRITE TODAY**
Benco Television Associates Ltd.,
P.O. Box 2735, Dearborn, Mich.

**HIGH OUTPUT SINGLE CHANNEL AMPLIFIER**

**PROVIDES THE HIGHEST OUTPUT OF ANY KNOWN TV CHANNEL AMPLIFIER**

The H.C.A. amplifier is designed for use as a final amplifier in large hotel or apartment distribution systems where it is necessary to locate all the amplifying equipment in one room or floor.

It is also useful for driving a TV signal over a long run of co-axial cable through inaccessible terrain.

A commercial transmitting tube is used for the final stage to deliver the full-rated output without distortion.

Price $250.00—Suggested User Net

**BENCO TELEVISION ASSOCIATES LTD.**
27 TABER ROAD, REXDALE, ONTARIO, CANADA

---

**TECHNOTES (Continued)**

Decreasing the drive. A 70-480-pf paddler was connected across the series half of C52 (2 x 801 pF, 10% dual) as shown in the diagram. The drive was adjusted with the paddler and the trouble disappeared.

(The paddler could have been connected from the control grid of the horizontal output tube to ground to cure excess drive.)—L. A. Williams

**WANDERING AGC**

This color set, an RCA CTCSN, had a raster but no picture. Tube substitution in the rf, if and Y amplifier had no effect. We noted that normal operation was restored by adjustment of the age threshold control. We let the receiver run for a while and the picture started to wash out. Replacement of the keyed age tube did not help. Resetting the threshold control did restore normal operation. We thought of leaky capacitors in the age line, but before starting on those an audible arc from the high-voltage cage was heard, with the picture overloading.

With scope and low-capacitance probe to the plate of the keyed age tube we were able to see the keyed pulse taking a nose dive and then jumping back to more than its initial peak-to-peak voltage. The arc, if still present, was no longer audible.

We replaced the horizontal output transformer as the next logical step. After replacing the transformer the keyed pulse remained stable, and the receiver has been operating for a month without further trouble.—Robert G. Middleton

**MOTOROLA TS902-A**

The trouble was loss of horizontal dynamic convergence. No response was obtained by adjusting the horizontal dynamic amplitude controls.

Visual inspection showed that lead A (see diagram) had broken loose from its joint at the blue amplitude control. The lead was resoldered, but still no response was obtained when the amplitude controls were varied.

A scope check across A and B showed only a 60-cycle parabola, which was being fed through from the vertical
TECHNOTES (Continued)

convergence system. Leads A and B were then disconnected and the scope check repeated. Now an apparently normal pulse output was obtained. This was a bit of a puzzler.

Then an ohmmeter check was made of the convergence winding. Infinite resistance was indicated. The winding was open, but the pulse waveform was observed on the scope screen because the scope has such high input impedance that the capacitive coupling across the open was sufficient to drive it.

When starting to replace the flyback, we observed that the flyback lead from the convergence winding was melted externally. Another lead was run from the terminal on the flyback board to the coil end, and the system took off and worked normally.

The lead had become fused because B-plus voltage is applied to the convergence winding and the broken lead at the amplitude control had shorted to chassis ground. Fortunately, the winding did not melt inside the coil, so flyback replacement was unnecessary.—R. M. Centerville

POOR COLOR SYNC

Last week we had an RCA 21-CT-660U pulled into the shop for poor color sync. With a color program on the air, perfectly normal color saturation would be present, but the color would just wander. A careful check through the circuit revealed that the V122B, the reactance tube, had low plate voltage. Further checks showed that a 2,200-ohm plate resistor R245 had gone up in value to 3,500 ohms. A quick replacement and everything was back to normal.—Mark Sargeon

END

“IT'S OUR GARDEN RAKE! I JUST HOOKED IT UP, AND IT WORKS FINE.”

NOVEMBER, 1957
WHAT'S NEW IN HI-FI

Gronmes Little Genie KITS
New exclusive method
"So simple... it's like magic."
- LAYER- BUILT
- COLOR-GUIDE
Write for details before you build another kit!

Before you build another kit see this new method of Kit Assembly. Each kit is complete with all parts and the new exclusive "Little Genie" Instruction Book.

LIG-K—Little Jewl) 10 Watt Amplifier with built-in preamplifier. Net. ... 24.95
207A-K—Hi-Fi Preamplifier (Self-Powered) Feedback circuit with 10 controls. Net ... 44.50
205-K—60 Watt Basic Amplifier for use with a preamplifier (such as 207A-K). Net. ... 79.50

NEW PG SERIES HI-FI AMPLIFIERS

20PG 20 Watt High Fidelity Amplifier
The new 20PG has greater flexibility of controls, new advanced circuitry and the highest quality components. Features: Feedback throughout, separate turnover and roll-off record compensators, new loudness control, wide range bass and treble controls, rumble and scratch filters and six inputs including tape head. Net Price. ... 89.50
15PG 15 Watt High Fidelity Amplifier. Has less power but the same advanced circuitry, the highest quality components and greater flexibility of controls. Net Price ... 69.50
10PG 10 Watt High Fidelity Amplifier. Here is new styling with a full set of controls providing exceptional flexibility in a moderately priced amplifier. Net Price ... 55.00

See your dealer or write...

Gronmes Div. of Precision Electronics, Inc. Dept. RE-11, 9101 King Street, Franklin Park, III.
□ Send details on "Little Genie" kits.
□ Send Free Hi-Fi Equipment Brochure.

Name _______________________
Street ______________________
City ________________________ Zone ______ State ________

Business and People

Triplet Electric Instrument Co., Bluffton, Ohio, in conjunction with its advertising agency, Burton Browne, Chicago, developed a new package for its vinyl and vtrn's. Each carton features a life-size photo of the unit for easy identification.

Orradio Industries, Opelika, Ala., is now marking its acetate-base long play tape in a distinctive new box.

Charles Golenpaul (top left), vice president of Aerovox Corp., was elected president of the Electronic Industry Show Corp., sponsor of the Electronic Parts Distributors Show. Mauro E. Schiffino (top right), Rochester Radio Supply, was elected vice president; Lew W. Howard (bottom left), Triad Transformer Corp., secretary, and Ray S. Laird (bottom right), Ohmite Manufacturing Co., treasurer.

Pyramid Electric Co., North Bergen, N. J., announced the top winners in its recent Twist-Mount Capacitor Contest. R. Berthold, Springfield Gardens, N. Y., won the grand prize, a weekend for

December

Radio-Electronics

With the

Annual Index
On Sale
November 26th

Radio-Electronics
BUSINESS AND PEOPLE (Continued)

Dealers, Jobbers and
Sold by

TV

Sylvana Electric Products broke ground for a new million-dollar addition to its Physics Laboratory in Bay-
side, N. Y.

Andre Meyer, senior partner of Laz-
ard Preses & Co.; Paul M. Mazur, part-
ner; Lehman Bros.; and Robert W.
Sarnoff, president of NBC, were elected new members of the Board of Directors of
RCA, increasing membership from
14 to 17.

Richard D. Ken-
nedy, advertising
account supervisor
of the General
Electric Apparatus
Dept., was promoted
from the new post
of advertising
and sales promotion
and manager of engineering for
the R.C.A. theatre and in
dustrial products, succeeds him as man-
ager, advertising and sales promotion
for industrial electronic products.

Leonard T. Don-
elley joined Allen
B. Du Mont Labs.,
Inc., Clifton, N. J.
as manager of com-
pONENT sales. He
comes to Du Mont
from W. L. Maxson
Corp., where he was administrative
assistant to the sales manager.

C. Graydon Lloyd
is the new general
manager of the General
Electric Specialty
Electronic Components
Dept., Auburn, N. Y. He
was promoted from
manager of engineering of the General
Electric Technical Products Dept.

MODEL F-1PK

- The tremendous demand for portable TV
sets opens another BIG market for good
set-to-antenna plug-in outlets. MOSLEY
Flush Sockets meet this need—supplying
attractive, convenient, customer-approved
wall outlets for every installation require-
ment.

Without MOSLEY TV Outlets, portable
TV—in most areas—can't be portable! Let
MOSLEY TV Outlets spark YOUR
Portable TV Sales!

For a complete line of up-to-date
TV Accessories and Electronic Components
send for our "57" catalog.

Please Mention
Radio-Electronics
When Answering
Advertisements

Morse Code

Sending—Receiving—Speed

Complete instructions.
Made easy with 45 or 75 RPM Record.
7 INCH 45 RPM ... SEND 5.25
12 INCH 78 RPM ... SEND 5.25
Preliminary printing and handling.

UNCLE SAM RECORDINGS • Dept. 8-E-11
59 East Van Buren Street Chicago 5, Illinois
Sold by leading hobby shops, radio-elec-
tronics dealers, mail order record shops, chain and department stores everywhere.

Orders, Jobbers and Mail Order Firms Inquiries Invited.

November, 1957

Scopes are
"Gold Mines"

...When you learn to use
them RIGHT... on all
types of service jobs!

This great book
Tells All You Need To
Know About Them!

Big 2nd
Edition

Contains Latest
Data and More
Than 30 Extra
Pages.
Includes use of
scopes in color
TV... black and
white TV... radio
Industrial Elec-
tronics... Teach-
ing... even in
plan energy work!

Here's the "secret"
of servicing any radio
or television set ever
built... eaiser, better
and faster!
In plan language, MODERN OSCILO-
SCOPES AND THEIR USES brings you the
data on scopes that you really need. It
Teaches you where, when and exactly how to use oscilloscopes on all
 types of jobs.
You can learn how to handle tough jobs easier and faster than you may
have thought possible. Every detail is clearly explained—from making connections to
adjusting components and setting the controls.

Work Easier—Better—Faster

Equally important, you learn how to ana-
lyze oscilloscope patterns accurately and in
less time. Almost 400 illustrations including
dozens of pattern photos make every step
perfectly clear.

This famous book—now in its revised 2nd
Edition—is more widely used than any other of
its type. That's because it gets right down
to "brass tacks" in a way you can hardly fail
to understand. No complicated mathematics.
No involved theoretical discussions. You learn
exactly how to use your oscilloscope on all
types of AM, FM and television service (in-
cluding color TV). You learn each step of
the work fully—from locating troubles fast to
handling tough realignment jobs.

Practice 10 Days FREE!

Dept. RE-117, RINEHART & CO., INC.
322 Madison Ave., New York 16, N. Y.

Send 2nd Edition of MODERN OSCILLOSCOPES
for 10-day FREE INSPECTION. I will then re-
nail $6.50 (plus postage) promptly in full payment
for return book and owe nothing. (S AVE! Send
$6.50 with order and we pay postage. Same 10-day
return privilege with money refunded.)

Name


Address

City, Zone, State

OUTSIDE U.S.A.—Price $7.00, cash with
order. Mail to: Money back if you return back in 10


www.americanradiohistory.com
BUSINESS AND PEOPLE (Continued)

Rein Narma was appointed manager of the Production and Engineering Divisions of Fairchild Recording Equipment Co., Long Island City, N. Y. He will also continue to serve as chief engineer.

David G. Cowden (top left), was named manager of special-purpose tube operations for the Sylvania Television Picture Tube Division, Seneca Falls, N. Y. He had been chief of mask operations in the Color TV Tube Dept. J. E. Schleener (right top), merchandising manager for the semiconductor division, is the new Eastern District sales manager of the division with headquarters in Woburn, Mass. Bernard R. McCarthy (bottom left) and Marvin E. Groll (bottom right) were appointed sales engineers for the Semiconductor Division with headquarters in Philadelphia and Woburn, Mass. respectively.

Jack K. Poff, Jobber Division sales manager for Pyramid Electric Co., was elected a director of National Electronic Instruments Inc., Matarawan, N. J.

Donald Wells and Lynn Lockwood joined Finney Co., Bedford, Ohio, from Welco Antenna Co. Wells will direct the Fino Models Unlimited Research Program and Lockwood will be a special factory representative. Richard Linnert, a well known television sales engineer, joined the company as special sales engineer.

Matthew James Leonard (left) is vice president, customer relations, Hycon Manufacturing Co., Pasadena, Calif. He joined the company from Hughes Aircraft Co. O. H. Mackey was appointed vice president and general manager of Hycon Electronics, a subsidiary. He was technical services manager of the former Military Electronic Division and served as manager of the subsidiary since last March.

Robert J. Reigel was elected vice president in charge of sales for Adorn Plastics Specialists Inc., Chicago.
Cordless Clock
Patent No. 2,786,972

This battery-powered clock uses a transistor circuit to produce enough alternating power to operate its motor. The frequency of the power is controlled by a resistor and a capacitor, which are used to control the alternating current obtained from the storage battery. The clock is intended for use in areas where power supplies are not available.

Superregenerative Receiver
Patent No. 2,792,494
Jerome J. Saron and Weng Young Chow, Syracuse, N. Y. (Assigned to General Electric Co.)

This is a good example of the simple, highly sensitive circuits that may be desired with modern transistors. It is a superregenerative receiver requiring only a 3-volt battery. One transistor (V3) operates as detector, the other as a separate quench oscillator (V1). V1 is a Unijunction N-p-n transistor. See "U. S. Unijunction," July, 1957, page 91, which describes a p-n structure. It will suffice to say here that both transistors are inherently regenerative and show a negative resistance when connected as in the diagram.

The ultrasonic frequency from the oscillator is developed across R1, which impresses it upon the regenerative detector. The carrier tank is L-C1, tapped for Hartley operation. R2 controls the tank's Q, which, if too high, results in critical tuning.

T is a matching transformer for headphones or amplifier and loudspeaker. C2 bypasses the quench frequency.

Modulation Control
Patent No. 2,759,052
Asa P. Macduffie, Hindale, and Robert C. Bliemow, Bothell, III., and William J. Parks, Fort Wayne, Ind. (Assigned to Motorola, Inc., Chicago, Ill.)

In a phase-modulation transmitter, the carrier frequency deviates in proportion to both amplitude and frequency of the modulating signal. This means that a low-amplitude high-frequency signal can overmodulate just as a low-frequency high-amplitude signal. This transistor circuit provides suitable clipping to prevent overmodulation.

The modulation signal is differentiated by R1-C1. This produces a voltage output that varies with the rate of change of signal. For example, a higher modulating frequency generates a higher output voltage than one of lower frequency, when both have the same amplitude. (The grounded-emitter CE721 is designated for symmetrical clipping at 9.7 volt.) Transistor output is interfaced by R3-C2 which compensates for the different frequencies of the signal. The output signal is now impressed on the modulator.

November, 1957

One Dollar buys
As much as $15 worth — Everything Brand New and sold to you with a money back guarantee.

Deduct 10% on any order.
Plus a free surprise package.

100 - Assorted 1/2 watt resistors
75 - Assorted 1 watt resistors
35 - Assorted 2 watt resistors
50 - Fuses 1/4 AMP, 250 volts 5/16" x 1-1/4"
5 - RCA & line cords 550, with plugs
10 - 6 ft. Electric line cords with plugs
5 - TV cheater cords with both plugs
4 - 50' Spools hook-up wire 5 colors
100' - Twin lead-in wire 3000, heavy duty
50' - Flat 4-conduct wire, many purposes
7 - Indoor TV antenna
20 - Ass't. ty knobs, escutcheon, etc.
35 - Ass't. rotary switches 815, 816, 817
100 - Coaxial cable, Nylen, 500 ft.
20 - Self-tapping screws 4" x 8".
25 - Ass't. tubular condensers
5 - Electrolytic cond. 100/50 50/25 volt
10 - Ass't. radio knobs screw and nut
100 - Ass't. knob setscrews
25 - Ass't. canister knobs
400 - Ass't. hardware, screws, nuts, rivets, etc.
1000 - Resistors 1/2 watt 10, 100, 1000
50 - Ass't. mica condensers value in 50's
50 - Ass't. ceramic condensers
10 - Ass't. volume controls 15, 30, 45
5 - Ass't. volume controls with switch
10 - Ass't. pilot lights
10 - Ass't. terminal strips
10 - Ass't. radio electro. condensers
15 - Ass't. tv electrolytic condensers
25 - Ass't. tv coils, small, good length
50 - Ass't. mica trimmer condensers
50 - Tubular condensers 600-800 volt
50 - Tubular condensers 1000 volt
20 - Tubular condensers 1200 volt
50 - Tubular condensers 1500 volt
3 - Electrolytic cond. 50/300 1500 volt
3 - Electrolytic cond. 40/10/10 4300 volt
3 - Electrolytic cond. 60/15/15 1500 volt
10 - Hv tubular condensers 6S-6000 volt
10 - Hv tubular condensers 25S-3000 volt
10 - Hv tubular condensers 5S-2000 volt
10 - Hv tubular condensers 5S-1500 volt
35 - Mica cond. 20-100 nano and 15-250 nano
35 - Mica cond. 15-250 nano and 15-450 nano
35 - Mica cond. 25-680 nano and 15-1000 nano
35 - Ceramic cond. 5-25-55S and 15-45 nano
35 - Ceramic cond. 5-25-55S and 15-1000 nano
50 - Ceramic cond. 5-25-55S and 5-5000 nano
75 - 4000, 1/2 watt resistors.
75 - 1500, 1/2 watt resistors.
75 - 2500, 1/2 watt resistors.
50 - 4700, 1/2 watt resistors.
75 - 2500, 1/2 watt resistors.
75 - 1000, 1/2 watt resistors.
75 - 1000, 1/2 watt resistors.
50 - 4700, 1/2 watt resistors.
100 - 2200, 1/2 watt resistors.
100 - 2200, 1/2 watt resistors.
100 - 2200, 1/2 watt resistors.
100 - 2200, 1/2 watt resistors.
100 - 2200, 1/2 watt resistors.
100 - 2200, 1/2 watt resistors.
100 - 2200, 1/2 watt resistors.
100 - 2200, 1/2 watt resistors.
100 - 2200, 1/2 watt resistors.
100 - 2200, 1/2 watt resistors.
50 - 2200, 1/2 watt resistors.
50 - 2200, 1/2 watt resistors.
50 - 2200, 1/2 watt resistors.
100 - 2200, 1/2 watt resistors.
100 - 2200, 1/2 watt resistors.
100 - 2200, 1/2 watt resistors.
100 - 2200, 1/2 watt resistors.
100 - 2200, 1/2 watt resistors.
100 - 2200, 1/2 watt resistors.
100 - 2200, 1/2 watt resistors.
100 - 2200, 1/2 watt resistors.
100 - 2200, 1/2 watt resistors.
100 - 2200, 1/2 watt resistors.
100 - 2200, 1/2 watt resistors.
100 - 2200, 1/2 watt resistors.
100 - 2200, 1/2 watt resistors.
100 - 2200, 1/2 watt resistors.
100 - 2200, 1/2 watt resistors.
100 - 2200, 1/2 watt resistors.
100 - 2200, 1/2 watt resistors.
100 - 2200, 1/2 watt resistors.
100 - 2200, 1/2 watt resistors. 

Deduct 10% on any order.
**TOWARD THE ULTIMATE IN TV RECEPTION**

**PROVEN by Performance!**

**PERSONNA-TONE**

Model PS-20
Remote Control EXTENSION SPEAKER
Highfidelity sound for home or auto.
Two volume controls—high and low.
TV listener, 405 speaker.
Select speaker and volume controls for
TV set. Personna-Tone or both
speakers. Wood veneer cabinet.
Complete with cable.
List 995.00

**DUAL-TONE**

Model DT-32
Dual Speaker VOLUME CONTROL
For auto radio sound extension.
Two volume controls—and for each
speaker. Volume of either speaker
adjusts to any level independently.
Ample cable for all cars.
List 395.00

**All-Purpose DeRO-JUVENATOR**

One resmulator replaces all.
Model RU-1—internal ferrite
wire for use on all series or parallel
sets. Fast, easy, flip panel.
List 395.00

**FREE Write for latest catalog**

**For the complete TV serviceman!**

**DeRO ELECTRONICS**

134 MASSAU RD. ROOSEVELT, L. I., N. Y.

---

**RADIO AND TV SERVICEMEN**

make more money with this

---

**SEC0 Model 107 TUBE TESTER**

3 complete tests in one handy instrument

Here's the tube tester every serviceman has been asking for! Designed for outstanding performance and accuracy—provides 3 important tests: Dynamic Mutual Cable Test of all popular radio and TV amplifier tubes—Cathode Emission Test for all tubes by free point selector system—nation ally accepted Grid Circuit Test developed and patented by Seco. Saves you valuable time—quickly pays for itself by justifiably selling and selling more tubes for you!

Completely self-contained in compact portable carrying case. Furnished with handy flip-chart for fast, easy tube set-up data.

**$1395.00 net**

Write today for free literature and catalog.

**SEC0 MANUFACTURING CO.**

5015 Penn Ave. So., Minneapolis, Minn.

---

**SOLAR BATTERY CHARGER**

Patent No. 2,780,765

Dwrl M. Chapin, Basking Ridge, Catlin S. Fuller, Easton, and Gerald L. Panter, Bernards Township, Somerset County, N. J. (assigned to Bell Telephone Labs., Inc., New York, N. Y.)

Solar cells have been used to power transistor radios and perform other light duty. An even more useful application is to charge a battery, so that power may be made available during the night or on dark days. The cells described here are highly efficient so that maximum power is delivered to the charging battery.

---

**You won't believe the realistic, life- like sound.”**

---

www.americanradiohistory.com
New! Superex Whisper PILLOW PHONE
List 595
Complete with 6' cord, wired plug and jack.
Now you can enjoy personal listening through the pillow with the comfort and relaxation of a loudspeaker! Exceptional tonal quality! Comes with simplified instructions for connecting to radio or TV set. Plugs into transistor radio directly in sanitary Ivory White.

New! Superex DYNAMIC EARPHONES
List 5450 ea.
Provides loud volume where others whimper! Finest quality construction... modern 2,000-ohm D.C. 8,000-ohm A.C. High sensitivity for low output circuits. Latest ferrite magnet; twisted pair wires minimize interference. Cushioned ear support. Comfortable ear coupling. Also available 4-ohms for 86% of Transistor Radios.

New! Superex IMP-PHONES
List 5225 ea.
Sub miniature lightweight crystal earphone with high sensitivity. Excellent high fidelity! High impedance (100,000-ohm) removable clear plastic tip; twisted pair wires for minimum interference. Circuits included show use as crystal microphone. Complete with instructions, circuits, phone tips, carrying case.

New! Superex PLUGS and JACKS
List 39 ea.
Smallest phone plugs and jacks available. Ideal for transistor and miniature applications. Plug overall length 1". dia. 1/4" mount in panels to 1/16" thick.

New! Superex VARIABLE CONDENSER
List 139
Ideal for transistor radios and wherever space is at a premium! Nearest type solid dielectric, 366 mmf... less than 1/8" thick. 1/4" shaft, 180 degree rotation, 1-hole mounting with hardware.

ORDER TODAY FROM YOUR JOBBER!
Examine FREE

Prentice-Hall ELECTRONICS & UHF LIBRARY

5 VOLUMES 1662 ILLUSTRATIONS

Pay Easy Installments If You Keep the Set

Send the Prentice-Hall ELECTRONICS & UHF LIBRARY (5 Volumes) for ten days free examination. If you like it and want it, return it in ten days and owe nothing. If you do not want it, send it back in ten days and owe nothing. Print the name, address, and station number on the prepaid postcard and mail it today. If you do not like it, keep it for ten days free. Send prepaid postcard for free information.

Prentice-Hall, Inc., Dept. 5744-P
Englewood Cliffs, N. J.

DO YOU HAVE THE EARS?

Easy listening—velvet smooth response over the entire audio range—that's what you get in a new Utah Unidrive Coastial High Fidelity Reproducer. Engineered for exceptionally fine frequency extension of both the bass and extremely high registers—a Unidrive will give you unsurpassed tonal quality—with minimum distortion—a velvet smoothness that is a revelation and a real pleasure to hear.

The Utah Unidrives are unique in design and assembly technique. A single, high efficiency magnet system drives two perfectly matched and balanced high and low frequency cones with mechanical crossover, to achieve an efficiency heretofore unattainable in conventional designs. A newly developed skiver roll cone treatment immeasurably increases speaker lifetime.

Easy listening—velvet smooth response over the entire audio range—that's what you get in a new Utah Unidrive Coastal High Fidelity Reproducer. Engineered for exceptionally fine frequency extension of both the bass and extremely high registers—a Unidrive will give you unsurpassed tonal quality—with minimum distortion—a velvet smoothness that is a revelation and a real pleasure to hear.

The Utah Unidrives are unique in design and assembly technique. A single, high efficiency magnet system drives two perfectly matched and balanced high and low frequency cones with mechanical crossover, to achieve an efficiency heretofore unattainable in conventional designs. A newly developed skiver roll cone treatment immeasurably increases speaker lifetime.

See and hear the new Utah Unidrives at your dealers where they are available in six models and five sizes—6 X 9, two 8", two 12" and 15". Starting at the unbelievably low price of only $15.95.

READ RADIO-ELECTRONICS EVERY MONTH

LMB presents The New "SAL-MET"

LMB Presents The New

PREF 1937 CATALOG covering the full precision engineered line of original box chassis as manufactured by LMB. The new line includes—JMB, BMB, and RZMB, new T.P., new Utility Incan. Eleven different sizes, 20 different shapes and styles. A ready reference catalog for precision engineering experiments or simple home work. Send in your LMB CATALOG now. SAL-MET—Soldering metal strip to metal strip—aluminum to aluminum, brass to brass, brass to aluminum, aluminum to brass, nickel to nickel! New soldering methods. Send for both LMB and SAL-MET Catalogs.

LMB, 1101 Venice Blvd., Los Angeles 15, Calif.

www.americanradiohistory.com
In Stock... at "the place to buy"

hallicrafters

Only $3141

PER MO.-JUST 10% DOWN
NET PRICE: $395.00

at WORLD RADIO

"The World's Largest Distributor
of Amateur Radio Equipment!"

Top Trades!
✓ Prompt Shipment!
✓ Easy Terms!

FREE 1958 Catalog
200 pages, hundreds of illustrations.
15,000 top value items write for yours, today!

Please send me Free Catalog... and complete info on Hallicrafters SX-101.

NAME:
ADDRESS:

CITY & STATE:

WORLD'S MOST PERSONALIZED ELECTRONIC SUPPLY HOUSE
415 W. BROADWAY COUNCIL BLUFFS IOWA

ELECTRONIC BRAIN
LOGIC
COMPUTERS, ROBOTS

- AUTOMATION

TRANISTOR DIGITAL COMPUTER KIT. Build the newest circuit, Multilithic, binary, counting, logic circuits, and "on", "off" flip-flops and use them. This is the first time we offer this kit after months of research and preparation. A "must" on the market for EEE, we thank our engineers, can be expanded with standard parts, to fit circuit range and budget. For immediate reply order by air mail. 9 items $59.50 for kit plus instructions.

ELEMENTARY RELAY COMPUTERS, 7 lessons on the principles of operation and programming. 50 circuits over simple algebra needed. Complete for $12.50.

LOGIC. Learn how to evaluate relay circuits and problems by use of Boolean algebra. Nine lessons plus projects. 10 lessons price less $12.50.

ROBOTS, manual on construction, building projects. The standard parts for electronics. Save money by building your own relays and circuits. You receive all parts and additional data for one year for FREE $50.00 price.

ELECTRONICS, learn the principles of radio, television, radar, test equipment, transistors, computers. 40 lessons plus three text books, $22.50 down and $18.00 per month for five months. This is the lowest price for the entire field.

RELAYS, build your own, learn how to re- evaluate, evaluate, buy, switch all types of relays. You will become an expert after reading this manual. Projects for building your own special types. $4.75 ppd.

EBB ENTERPRISES, INC.
1015 Atkin Ave., Salt Lake City 6, Utah

Name...
Address...

WWW.AMERICANRADIOHISTORY.COM
ask the
"Man-on-the-Roof"
why he prefers
South River
S N - 50
CHIMNEY MOUNT
SNAP- IN TYPE
with unique U-Bolt INSTEAD
OF SCREWS for easy one hand
installation. Hot Dip
Galvanized — 12 Ft. Straps
two to a set. Same Unique
U-Bolt snap on Snap-in Wall
Brackets. Also Available with
Stainless Steel Banding.
Write for new 1957 catalog

WRITE IT or DROP IT
the NEW QUIETROLE
Spray Pack
or the
QUIETROLE
Bottle with the
Eye Dropper Cap

Now QUIETROLE of-
fers you both types
of containers. Either
way assures you of
the same unfailing re-
results that QUIETROLE
is known for.

Make your next pur-
chase QUIETROLE, get
both and learn the dif-
terence between quali-
ity and poor substitutes. QUIETROLE
is the original product of its kind, it is a FIRST of
the industry and you can depend on it to end
your noisy control and switch troubles.

Readers of "TRANSISTOR CIRCUITS" can
now get QUIETROLE!

Rufus P. Turner, popular
transistor authority and engineer,
takes transistors out of the laboratory and puts them on
the work bench. He has collected over 150 practical
circuits for amplifiers, oscillators, power supplies, amateur equipment and other units.
All were designed — some by the author himself. All were tested in the
author's laboratory — and all of them work! No watering down with
transistor testing or theoretical explanation circuits! This book
offers a treasure chest of building blocks which will save hours of
timeless designing. You can put these circuits to an infinite number
of uses other than those originally sanctioned. No one who works
with transistors at home or in the lab can afford to miss Turner's
latest book. Order your copy now.

SOME OF THE HIGHLIGHTS
Audio Amplifiers • RF and IF Amplifiers • DC Amplifiers • Oscillators
• Power Supplies • Radio Receivers • Triggers and Switches • Control
Devices • Test Instruments • Amateur Devices • Miscellaneous
Circuits including Geiger counter, photo oscillator, hearing aid, and intercom.

ORDER THESE COMPANION VOLUMES
BY TURNER

Transistor Theory & Practice — The practical
man's "Bible" on transistors. Covers
theory, characteristics, tests, plus a
guide to commercial transistors. Written
so the practical man can read, under-
stand and learn how to work with tran-
sistors. No. 51—144 pages. $2.00

Transistor Techniques — A handbook for the experi-
menter who wants to work with trans-
istors! Gives scores of hints on how to
use transistors in various types of equip-
ment. Covers testing, performance, con-
struction, care and measurements. A
practical how-to-do-it book which keeps
theory and math to a minimum. No. 61
—66 pages. $1.50

MAIL THIS COUPON TODAY

GERSBACk LIBRARY, Inc., Dept. 117
154 W. 14th St., New York 11, N.Y.

My remittance of $ is enclosed. Please send
me the books checked below postpaid.

[ ] No. 68 Transistor Circuits. $2.75
[ ] No. 61 Transistor Techniques. $1.50
[ ] No. 51 Transistor Theory & Practice. $2.00
Prices 10% higher in Canada.

NAME ____________________________________________
please print

STREET ___________________________________________________________________

CITY _____________________________________________________________________
STATE ____________________________

This edition covers more general
ground than the previous one. It in-
cludes hints on lab techniques, shop
practice and basic transistor theory.
There are construction articles on radio
receivers, ham equipment, home broad-
casters, burglar and fire alarms. Printed
circuits, use of sun batteries and wir-
ing precautions are also discussed.

ELECTRONIC ENGINEERING, By
Inc., 330 W. 42 St., New York 36, N. Y.
525 pages 6 x 9. $8.

This book analyzes basic circuits used
in communications, computers and con-

control instruments. Both physical
and mathematical explanations are clearly
stated, with many examples worked out
in the text. Major chapter headings
include amplifiers, oscillators, sweep
generators, rectifiers, tubes and tran-
sistors. Feedback, frequency response
and other important topics are ade-
quate covered. An excellent study
and reference for designers, engineers
and technicians.

GETTING STARTED IN AMATEUR
RADIO, by Julius Berens, W2PIK. John
F. Rider, Publisher, Inc., 116 W. 11th
St., New York 11, N. Y. 5½ x 8½
inches. 136 pages. $2.40

Not many years ago, would-be hams
had to grope their way to a license for
there was little information available
unless they knew a friendly licensed
amateur. Today, it is possible for one
to become an amateur with a reason-
able amount of effort. Here is a book
that any ham would gladly recommend
to beginners. It tells the whole story—
how to study the law, how to use a
were the FCC regulations are printed at the back of the book.

The book prepares for both novice
and general-class licenses. No previous
technical knowledge is assumed.

TRANSISTOR APPLICATIONS, Vol.
II. Raytheon Manufacturing Co., 55
Chapel St., Newton 55, Mass. 58 pages,
8½ x 11 inches. 50c.

This edition covers more general
than the previous one. It in-
cludes hints on lab techniques, shop
practice and basic transistor theory.

This book analyzes basic circuits used
in communications, computers and con-
control instruments. Both physical
and mathematical explanations are clearly
stated, with many examples worked out
in the text. Major chapter headings
include amplifiers, oscillators, sweep
generators, rectifiers, tubes and tran-
sistors. Feedback, frequency response
and other important topics are ade-
quate covered. An excellent study
and reference for designers, engineers
and technicians.

TRANSISTOR CIRCUIT ENGINEER-
ing, edited by Richard F. Sheb, John
Wiley & Sons, Inc., 464 Fourth Ave.,
New York 16, N. Y. 5½ x 9 inches, 468
pages. $12.

This is an advanced transistor book
prepared by a staff of G-E engineers.
It shows how to design audio and video

www.americanradiohistory.com
amplifiers, oscillators and modulators as required. Bias and stabilizing networks receive full attention, and there are many practical examples. Formulas and graphs are often referred to. The final chapters show how these basic circuits are put to work in radio and TV receivers, filters, converters and power supplies.—IQ

ESSENTIAL CHARACTERISTICS, Tube Sales Section, General Electric Co., Schenectady, N. Y. 5½ x 8½ inches, 228 pages. 75c.

This spiral loose-leaf manual lists every tube likely to be encountered in radio and TV receivers. It shows the type of service, electrical characteristics and capacitance, besides physical data. Basing circuits on the same page.

Besides ordinary receiving tubes, the manual lists the special 1600, 5000, 6000 and 9000 series. Prototypes like 5U4-GB, 6AQ5, 6SN7, 12AX7, 6000 are included.

ESSENTIAL ELEMENTS

Several circuit average from again are presented here. They have been prepared by the SMPTE to work with the corresponding text given in Volume IV. In nonengineering terms it tells how to plan and process color films. Many color photos illustrate the theory of color, several of the more important commercial processes and the results of improper handling. One chapter deals with problems of TV color films and kinescope recordings.


A variety of useful, practical and experimental transistor circuits are described here. They are presented in a way that gives maximum benefit and information to those wishing to duplicate the device. Thus each schematic shows all component values. Several amplifiers are accompanied by their frequency response curves. Coil tables give winding data for several oscillators. Surface-barrier transistors and zeon diodes are represented in addition to the common p-n-p and n-p-n transistors.

Largest chapters are those devoted to audio amplifiers, radio receivers, and designing and photographing TV pictures.

SPECIAL! for Schools, TV Technicians & Customers in South America & Canada

DX-16 Super Deluxe TV KIT

The DX-16 SUPER DELUXE TV KIT is a worthy successor to the famous #630 TV KIT ... a product in which we took a leading role. In designing and engineering this NEW KIT, we used the #830 as a standard of comparison for POWER, STABILITY and FRINGE AREA RECEPTION ... resulting in a NEW TV CHASSIS equal in performance and with even greater versatility.

NEW DESIGN — Mounts Horizontally, Vertically or Sideways.

- Large 250 ma Power Transformer — not a hot chassis.
- Produces a Superior 16-Tube Chassis with 30-Tube performance.
- Latest advanced Intercarrier Circuitry and Multi-section Tubes.
- Standard Cascade Tuner for Selectivity and Fine Definition.
- 5 Microvolts Video Sensitivity (20 volts peak to peak at CRT grid).
- Fast Acting AGC for Drift Free, Steady and Clear Pictures.
- 3 Hi-gain Video LF. Stages for excellent Contrast and Details.
- AGC Level and Area Control, for adjusting reception to signal area.
- All Video and I.F. Coils factory pre-aligned and tuned.
- Horizontal Sweep Circuit is the famous RCA Synchronode Network.
- Large 12" Concert-Tone Speaker.

Dimensions 17½"H x 16"D Shipping weight 48 lbs.

ALL COMPLETE with LIFE-SIZE step-by-step Building Instructions (less tubes & CRT) .................................. $69.97

ALL COMPLETE with SET of WESTINGHOUSE TUBES (less CRT) .............................................................. $79.97

ALL COMPLETE with SET of WESTINGHOUSE TUBES and WESTINGHOUSE 21" 70° or 90° Aluminized CRT. .............................................................. $99.97

You may purchase the LIFE-SIZE step-by-step Instructions before purchasing KIT. Send $2.49 which you can deduct on purchase of KIT, or return for cash refund.

SPECIAL OFFER

BUILD YOUR TV CABINET

Comparable to the type that Top Mfrs. use on their finest TV Sets.

You receive the FRONT PANEL ASSEMBLY completely as pictured in genuine Maplewood, varnished or Brand Kashmir in a beautiful hand-crafted finish with MASK, SAFETY GLASS, DECALS and attachments. KNOB PANEL, reassembling color the preferred BACK with CRT CUP, BLUE SCREEN, HANDLES and making Easy-To-Follow Instructions. Do-it-yourself job is done for you. All you add are the BOTTOM & 2 corner STRIPS.

21" CABINET

H-26" - W-25½ - D-22½

$24.45

24" or 27" CABINET

H-36" - W-28½ - D-22½

$32.47

TV CRYSTAL-CLEAR LUCITE MASKS

Framed in Rich Goldleaf Finish

Tube Size Overall Dimensions

17" — Rectangular 15½" x 14½" 4.56
21" — Rectangular 16½" x 17½" 6.92
24" — Rectangular 20½" x 25½" 11.84
27" — Rectangular 26½" x 36" 12.18

On 17" and 21" specify type number of CRT used.

TV PLASTIC OPEN MASKS

Used in conjunction with safety glass

17" — Rectangular 15½" x 14½" 51.49
21" — Rectangular 16½" x 17½" 51.49
24" — Rectangular 20½" x 25½" 64.93
27" — Rectangular 26½" x 36" 77.45

On 17" and 21" specify type number of CRT used.

TV SAFETY GLASS in HANDY SIZES

16" x 12" 2.97 18" x 20" 5.15

16" x 12" 3.97 21" x 26" 5.87

BROOKS RADIO & TV CORP.

84 Vesey St., New York 7, N. Y.

TELEPHONE COHand 7-2359

NOVEMBER, 1957

159
control devices and test instruments. Here one will find data to assemble complementary and direct-coupled amplifiers, superhet, relays, alarms, signal injectors, dip oscillators, light meters and many others. Among other chapter headings are amateur devices, rf amplifiers and power supplies. This book is a saver of time and energy for all who work (or play) with transistors.


Having exhausted its first edition, this handy manual goes into the second. It meets the needs of technicians and hobbyists who wish to keep up with latest developments in transistors for radio, test equipment and gadgets. Complete specifications of nearly 50 G-E transistors are given. It also contains diagrams of many amplifiers, portable radios and hi-fi circuits. A table lists all Jetec transistor types with characteristics.

The manual begins with the theory of semiconductors and circuits. It shows how to bias properly, provide stabilization and couple multiple stages. Tone controls, preamplifiers, reflex if stages, converters and switches are drawn. Of course, the new Unijunction is described and many uses appear. Pulse circuits are also given considerable attention.

**TV TROUBLE TRACER**, Vol. 6. Harry G. Cisin, Amagansett, N.Y. 5½ x 8½ inches, 45 pages. 50c.

The sixth volume of this popular handbook can save hours of time and labor. It covers many portable TV sets of all manufacturers. Detailed drawings show the tube layouts of the various sets. Each tube is also marked with a code letter; for example, a vertical output tube is marked with a V for vertical. Forty common difficulties are illustrated by a test pattern showing the fault. A discussion of various faults that may be at the seat of the trouble is also given. Added help is given by indicating sets with selenium rectifiers and series circuits. Also contains tube locations of most recent RCA TV sets, portable and standard models. —LS

**CORRECTION**

The Patents column on page 140 of the September issue contains a queer typographical error, with hypenatges complete sentences from two different items. The last sentence in the second paragraph of the item "Volume Control Circuit" was transposed with the last sentence of the first paragraph of the item "Transistor Power from Local Radiation."

We thank Robert Sparkes, of Toronto, Ont., for this correction.
SCHOOL DIRECTORY

ENGINEERING DEGREES
UNDER AND POSTGRADUATE
E.E.
Option Electronics
Earned through
HOME STUDY
Residence Classes Also Available
PACIFIC INTERNATIONAL UNIVERSITY
5719-M, Santa Monica Blvd.,
Hollywood 38, Calif.

ELECTRONICS
PREPARE FOR A GOOD JOB!
BROADCAST ENGINEER
RADIO SERVICING AUTOMATION
TELEVISION SERVICING
BLACK & WHITE—COLOR
APPROVED FOR VETERANS AND SURVIVORS
BUILDING AIR CONDITIONED
SEND FOR FREE LITERATURE
BALTIMORE TECHNICAL INSTITUTE
1425 Eutaw Place, Baltimore 17, Md.

ELECTRONICS
ENGINEERING DEGREE IN 27 MONTHS
Prepare for leadership in the magnificent field of electronics! Earn a B.S. degree in 27 months, mathematics, electrical engineering, TV, advanced radio theory and design, Modern Calls, Low Bands, Wave-Form, Radar, Communication, Civil Engineering, Aircraft Engineering, Aeroscience, etc. Approved by the American Council for Education. Write for information.

CANDLER SYSTEM CO.
Dept. O-S, Beverly Beach, Calif., U.S.A.

INDIANA TECHNICAL COLLEGE
1911 E. Washington Blvd., Fort Wayne, Ind.

TOP-FLIGHT
ELECTRONICS

Write for Illustrated Catalog Today.
VALPARAISO TECHNICAL INSTITUTE
Dept. C
Valparaiso, Indiana

IS YOUR COMPLETE ACADEMIC EDUCATION AHEAD?

The following booklets—these are really helpful guides. Browse through them and decide whether a career in electronics/communications is a suitable career for you or not.

John B. McCarthy, Dir. Adm., for Catalog and "Your Career in Engineering and Communications"

TRI-STATE COLLEGE
24417 College Ave., Angola, Indiana

N O V E M B E R, 1957

Interesting, Pictorial FREE BOOKLET

Radio experts solve your engineering problems
Save $8.50 on newly revised RADIO ENGINEERING LIBRARY

At your fingertips in one convenient source—facts, standard references, data for the field of radio engineering. Highlights of latest developments in transistors, other semi-conductors, microwave tubes, pulse techniques, color TV and more. Covers everything from tube and circuit fundamentals through essentials of major fields of application.

OVER 4000 PAGES OF PRACTICAL MATERIAL!

Fire fast-packed volume of data, graphics, charts and tables. Everything in print today. Includes material on VHF, frequency modulation, instruments and methods for measuring high frequency etc. Delivered by radio experts as part of helpful material for engineers, designers, and others in communications, broadcasting, aircraft radio, and related fields. This library is yours at a special price on easy terms.

10-DAY FREE TRIAL
McGraw-Hill Book Co., Dept. RE-11
327 W. 41 St., New York 36, N. Y.
Send for 10-day FREE trial. The Radio Engineering Library. In 10 days you must return due $4, 50 or less. Further, if desired, return library at any time without notice. If you wish, return library postpaid.

Name
Address

CITY & STATE

Employed by

For price and terms write McGraw-Hill Book Co., RE-11

SEND COUPON

Milwaukee School of Engineering
Dept. RE1157, 1005 N. Milwaukee St.
Milwaukee, Wisconsin

Please send me the new booklet "Prepare for Your Career in Engineering." I'm interested in...

(name of course)

Age

City Zone State

I'm eligible for veteran's education benefits Yes ☐ No ☐ Discharge date

www.americanradiohistory.com
ADVERTISING INDEX

Radio-Electronics does not assume responsibility for any errors appearing in the index below.

Acoustic Research, Inc. 144
Aero Products Co. 163
Admiral Corp. 141
Aerosonic Corp. 141
Alliance Manufacturing Co., Inc. 123
Allied Radio Corp. 117, 118
Amphenol Electronics Corp. 78
Artex, Inc. 147
Astron Corp. 140
Atwood-Roebling Corp. 142
B & K Manufacturing Co. 159
Barry Electronics Corp. 162
Bell Telephone Labs. 136
Benco Television Associates Ltd. 148
Bogen (David) Inc. 174
Brooks Radio & Television Corp. 163, 169
Brookshaw Corp. 125
Burstein-Applebee Co. 164
CBS-Hytron 117
Capital Radio Engineering Inst. 101
Carson Studios 146
Central Division of Guild Union 148
Chicago Standard Transformer Corp. 134
Circuit Manufacturing Co., Inc. 156
Clay, H. C. 156
Cleveland Institute of Radio Electronics 9
Columbia Wire & Supply Co. 156
Cornell-Dubilier Electric Corp. 138
Corona Electronic School 131
Deere Radio Div. of General Motors 131
Dolby Electronic Products 117
Deutschman (Tubco) Corp. 167
DeVry Technical Institute 149
Drexel 145
DuMont (Allan B.) Labs. Inside Front Cover
Editors & Authors of Radio, TV 
Electro-Sonic Labs. 95
Electro-Tone Inc. Inside Back Cover
Electronic Business Enterprises 158
Electronic Instrument Co. 29, 50
(EICO) 125
Electronic Measurement Corp. 150
Electronic Publishing Co. 150
Elgin National Watch Co. 106
Erie Radio Co. 125
Fairchild Recording Equipment Co. 10
Gardner Electronics Co. 137
Garfield (D. B.) 154
General Cement Manufacturing Co. 135
Gernsback Literature advertisment 135
Grantham School of Electronics 155
Hawkins (R. W.) 126
Hepco Co. 62-77
Hetokki Electrical Instrument Co. 159
Hudson Specialties Co. 149
IBM 96-97
Indiana Technical College 146
International Correspondence Schools 13
Jackson Electrical Instrument Co. 130
Jensen Industries 157
Kroenert & Co. Inc. 129
Kuhn Electronics Products 163
LMH 104
Lafayette Radio 164-165
Lanning, (James E.) Sound, Inc. 139
Leeds & Northrup Co. 162
Majekia, (F. J.) Co. 148
Malory, (F. T.) 122-123
McGraw-Hill Book Co., Inc. 161
Merit Co. Electronic Manufacturing Corp. 160
Miller (Gustave) 125
Monley Electronics Inc. 151

Kits for Christmas!
GENIAC COMPUTER KIT

Control Panel of GENIAC set up to do a problem
You can construct over 50 different circuits and 40 different machines that compute, reason, solve puzzles and demonstrate a wide variety of basic computer circuits with the GENIAC electronic brain construction kit. Thousands of schools, colleges, industrial firms and private individuals have bought GENIACS since we first brought them on the market.
We have recently added a circuit for composing music, which gives us special pleasure because it was designed by a 16 year old boy who learned about computers from his GENIAC. Dozens of other youngsters have created their own designs for computing circuits, used GENIACS in their school projects and established a solid foundation of information on computers with GENIACS.
Each kit comes complete with Beginners Manual, Study Guide, instructions for building all the machines and circuits (exclusive of our GENIAC), parts tray and our complete question answering service. When you buy a GENIAC you are buying a first course in computer operation.
Each kit comes with a one week money back guarantee if you are not satisfied.
Price of Kit complete with parts tray, rack, all components, manuals and tests $19.95 (postpaid in U.S., add 8¢ west of Mississippi), $2.00 outside United States.)

OLIVER GAREFIELD CO., INC.
Dept. OA
124 Lexington Avenue
New York 16, N. Y.
Triplicate forms serve as order form, invoice and office record with spaces for complete information on every job. Separate listings for receiving tubes, pix tube, parts, serial numbers, labor and tax charges, signatures, etc. 75c a book, $6.50 for dust-proof box of 10.

... and for customer's prices on every replacement part, Dave Rice's OFFICIAL PRICING DIGEST listing over 60,000 items. $2.50

In stock at your distributor, or write

ELECTRONIC PUBLISHING CO. INC.
180 North Wacker Drive Chicago 6, Illinois

SAVE 1½ — PAY PART-BY-PART — HAVE FUN
Assembling the SCHOBER ELECTRONIC ORGAN in Kit form

Now you can afford a real, full concert organ, just like those made by the foremost organ manufacturers. Because over 1½ the cost is saved when you assemble it yourself. And it's REALLY EASY: only 24 separate units, all with printed circuits, and detailed-to-the-smallest-step instructions. In addition, you purchase each of the 24 kits when you are ready for it — and can afford it.

You'll get a real kick out of putting the Schober Electronic Organ together — and then sitting down and pulling the stops for Strings, Trumpets, Clarinets, Flutes, etc. Electronic Percussion optional; chimes available.

Compact CONSOLE

One of the many exclusive features of this exceptional organ is the handsome console, in a wide variety of finishes, it is equally at home in a traditional or modern setting, and takes little more space than a spinet piano.

Free Literature

Complete descriptive booklet and price list are available on request. And, if you wish to hear the glorious pipe organ tone of the Schober Electronic Organ, a 10" long-playing demonstration recording is available for $2. This is refundable when you order. Write today and see what a fine instrument you can get at such a great saving.

The SCHOBER ORGAN CORP.
2246 S. Broadway, New York 24, N. Y.* Designed by Richard H. Doty

CRISTAL CONTROLLED CONVERTERS

One of the many exclusive features of this exceptional organ is the handsome console, in a wide variety of finishes, it is equally at home in a traditional or modern setting, and takes little more space than a spinet piano.

Free Literature

Complete descriptive booklet and price list are available on request. And, if you wish to hear the glorious pipe organ tone of the Schober Electronic Organ, a 10" long-playing demonstration recording is available for $2. This is refundable when you order. Write today and see what a fine instrument you can get at such a great saving.

The SCHOBER ORGAN CORP.
2246 S. Broadway, New York 24, N. Y. *Designed by Richard H. Doty
Exclusive Lafayette Money Saving Values

LATEST IMPROVED MODEL PK-300 PROFESSIONAL TRANSCRIPTION TURNTABLE

New 3-speed instrument with built-in strobe and slayer for exact speed determination, and magnetic brake for instant stop and slow-speed operation. Precision ball bearing and felt surface. Heavy 1/2" cast aluminum plinth. Variable speed control permits smooth, stepless range of 1-1/2 to 7-1/2" per minute. Includes 3 spindle adapters. Power consumption 12 watts. 110-120 and 220-240 volt AC. Net weight 25 lbs. 72.50

PK-90 VISCOS-DAMPED TONE ARM

This transcriptions arm, extremely dependable and stable operating, utilizing the "floating action" principle of "viscous-damping". The arm is supported at a single point by a pivot and level bearing having negligible friction friction. Viscous damping is accomplished by a floating pivot arm socket. This damping control permits high compliance and negligible tracking error, and prevents dam- pout in flight. Observe that when the tone arm is moved away from position, the tone arm will be supported by a viscous damper and the sound will be heard as a slight damping effect. For information on ordering, see "Complete System" above. Net 49.50

16" VISCO-DAMPED TRANSCRIPTION TONE ARM

A 16" viscous damper arm on an unbreakable tub plate. An exclusive new unit eliminates possibility of silicone leakage. Features single point pivot mounting, transcription pickup arm adjustment controls, and the advanced single point pivot mounting. Complete with single point pivot mounting. Net 11.95

3 WAY SYSTEM WITH 15" WOOFER ... 8" MID-RANGE SPEAKER ... HORN TWEETER ... CROSSOVER NETWORK

15-INCH WOOFER WITH 31.5 OZ. MAGNET (SK-67) ... 8-INCH MID-RANGE DRIVER (SK-74) ... NEW HIGH SENSITIVITY INTEGRATED TWEETER (HW-7) ... 3-WAY CROSSOVER NETWORK (LN-3)

Lafayette presents this outstanding 3-way speaker system designed for the high fidelity enthusiast who desires more than the conventional speaker offered in his stereo system. By utilizing the lucid, crystal-clear performance of the HW-7 tweeter, LF-1 woofer and HF-1 mid-range driver, Lafayette achieves a complete audio performance as described by phonograph writers and discriminating music lovers who are aware of the quality and performance it has to offer. Complete speaker includes the SK-67 15" 35-watt woofer, HW-7 tweeter and the LN-3 3-way crossover network with level-Brilliance control. Net 17.95

6 TRANSISTOR SUPERHERET Receiver Kit

- 100% SUBMINIATURIZED
- SENSITIVE, SELECTIVE, STABLE
- PUSH-PULL OUTPUT - PLENTY OF POWER
- NO INCOMPARABLE VALUE

The Lafayette KT-119 6 Transistor Superhet Receiver Kit provides superior commercial quality with maximum sensitivity, selectivity and reliability. The KT-119 Kit features 6 selected transistors and circuitry a specially matched set of 3 12F6's, all high gain, high gain, high gain, and variable transistors. Has efficient 2.5" speaker and earphone jack for private listening. Complete with 5 tuning switches, pre- settable knobs and easy to follow step-by-step instructions. $25.00...

SK-67 SK-74 HW-7 LN-3

PK-100 $7.50

LAFAYETTE RADIO

165-08 Liberty Ave.
JAMAICA 33; N.Y.

RADIO-ELECTRONICS
NEW 180 PAGE ELECTRO-CATALOG FEATURING THE BEST BUYS IN THE BUSINESS

The newest and largest assortment of Electronic, Radio and TV parts, Hi-Fi and Public Address Components and systems, Test Equipment, tubes, Transistor Kits and miniaturized components for transistor circuitry, Ham Equipment, Biology Kits, Tools, Books, Microscopes, Binoculars, Telescopes, Cameras, and Drafting Equipment—ALL AT LOWEST PRICES—Catering to the economy minded dealer, serviceman, engineer, technician, experimenter and hobbyist. CRAMMED FULL OF MONEY SAVING BUYS. SEND FOR YOUR FREE COPY TODAY.

LAFAYETTE MASTER AUDIO CONTROL CENTER with BINAURAL CHANNEL AND DUAL VOLUME CONTROL. Years Ahead of Every Other Control Unit ... Ahead in Sound ... Ahead in Styling

... at prices everyone can afford

LAFAYETTE 12 WATT AMPERIFIER WITH CASE

Complete 12 Watt Power Amplifier with Built-in Preampulator-Equalizer

Brings Real Hi-Fi at Low Cost

LAFAYETTE HI-FI FM-AM TUNER WITH CASE

Armstrong Circuit With Limiter

Temperature Compensation and AFC

Like its matching amplifier, the Lafayette LT-25 FM-AM Tuner is a most unusual value with outstanding specifications and superb performance. Circuit features temperature compensation, A.C. to "lock-in" the station and A.F.C. defeat for precision tuning of weak stations. Inertia flywheel makes tuning smooth. High selectivity and sensitivity. Meets FCC requirements for radiated and conducted noise. Frequency response 20-20,000 cps ± 1 db on FM; 20,000-50000 cps ± 3 db on AM. Hum level 60 db below 100% modulation. A.F.C. defeated to match the LT-32 Amplifier. Comes complete with removable cover, with provisions for mounting either cabinet or on panel. Size 13 1/4" x 8 3/16" x 4 1/16". Shpg. wt., 15 lbs.

LAFAYETTE 6" BINAURAL TUNER, Complete With Case...

...at prices everyone can afford

NEW "DYNA-SLIM" MICROPHONE

• HIGH IMPEDANCE - 50,000 OHMS

• ON-OFF SWITCH

• "QUICK-SLIP" ADAPTER

New dynamic, high output microphone with all the features of "mini" costing less than 1/5 the price. Output level 10μv. Smooth response from 80 to 10,000 cycles. Condenser diaphragm. External on-off switch. Suits an off-the-shelf stand adapter in a wink. Standard 1/2"—27 adapter permits fitting into multi-angle use. Satin black and chrome finish. Complete with detachable cable and connector. 8" long, 1/2" max. dia. threaded panel. Shpg. wt., 2 lbs.

PA-43

Net 6.95
Dollar for dollar, feature for feature, you'll find RCA's WT-110A the fastest, most accurate automatic punched-card tester you can buy today. It's a virtually obsolescence-proof design ... from the exclusive RCA 700-card capacity magazine file that always keeps the pre-punched cards in type number sequence, to the fully automatic circuit setup (including all operating voltages) and the easy, do-it-yourself punch card accessories available to keep the tube-card file up-to-date!

See and test the WT-110A at your local RCA Distributor. Prove to yourself what a boost in business, prestige, profits the RCA-WT-110A can mean!

**NEW RCA WT-110A**

**AUTOMATIC TUBE-TESTER**

means more service profits!

- automatically sets up socket connections, and all operating voltages such as heater, signal, plate and screen voltages, and bias (both fixed and cathode).
- checks tubes for transconductance, gas, shorts, and leakage between elements.
- automatically selects correct conditions from 220 possible combinations of heater voltage (from 0.1 volt to 120 volts) at currents up to 4 amps., 10 bias voltages and 11 values of cathode resistors.
- tubes, such as rectifiers, tested under heavy load currents up to 140 ma per plate.
- high-and-low sensitivity ranges for leakage tests.
- 12-volt plate and screen supply for testing new autoradio tubes.
- meter protected against burnout.
- test card provided for checking instrument.
- 239 pre-punched cards supplied with instrument cover 95% of currently active TV tubes. Pre-punched accessory cards available.
- active card magazine capacity—350; storage capacity—350...a total capacity of 700 cards.

All this for $199.50

**USER PRICE (Optional)**

Prices higher in Hawaii and Alaska

---

**RCA**

**TEST EQUIPMENT**

**RADIO CORPORATION OF AMERICA**

Electron Tube Division, Harrison, N. J.
FOR HI-FI ON A BUDGET, FOLLOW THE ELECTRO-VOICE BUILDING BLOCK PLAN

Start with your basic speaker and improve your compatible E-V high-fidelity system one economical step at a time by adding Electro-Voice Speaker Building Blocks.

Here, we've started with an SP12—12-inch coaxial driver. Later, you add BB2—a T35 very-high-frequency driver, X36 crossover and AT37 level control with wiring harness. BB2, Net $50. Still later, augment with the BB4—to smooth and disperse treble range, it includes T25A treble driver, with 8HD horn, a second crossover—800-cps X8—and a second AT37 level control with wiring harness. BB4, Net $114.

Build Your Own E-V Speaker Enclosure with a Pre-Cut, Pre-Cleated 'Do-It-Yourself' Kit

There's no thrill like building your own speaker enclosure! Economize on your hi-fi system without sacrificing quality by assembling an E-V knock down kit of Korina plywood. Korina is of highest quality, naturally light in color, harder than mahogany, allows finishing to match any shade. There are seven models to choose from.

Shown dis-assembled is E-V's KD6 kit. Assemble it and you have a duplicate of our factory-built ARISTOCRAT enclosure of folded horn corner design for use with 12-inch drivers or separate multi-way systems. KD6, Net $39.

For all the facts about Electro-Voice 'Listeneered' high-fidelity components, see your distributor and write for complete details.
Troubleshooter at work

Here's how Microscopic Inspection by RCA helps reduce costly callbacks...

A bad tube, or a potential trouble-maker—can it get by this gal? Not likely. She's part of the specially trained RCA group of inspectors whose important job it is to find trouble and help prevent it from happening to you.

RCA Quality-Control Procedures include MICROSCOPIC INSPECTION OF POPULAR TV RECEIVING TYPES! These types are closely examined for possible poor welds, weld splatter, bad crimps, damaged stems, improper assembly, and many other factors that can affect top quality, long-term performance. Though the tubes may pass all electrical tests, such defects could slip by and mean the difference between a profitable service call and a costly callback.

You gain valuable assurances from this extra care: (1) that popular TV receiving types shipped to RCA Tube Distributors have had the extra benefit of the MICROSCOPIC INSPECTION PROGRAM and (2) that you can always service your customers with the confidence that RCA TV Receiving Types are top quality replacement tubes.

When you order—tell your distributor “RCA only” and watch your profits grow.

RCA RECEIVING TUBES
RADIO CORPORATION OF AMERICA
Tube Division, Harrison, N. J.