

**NOW! Build Single-Transistor Ignition**

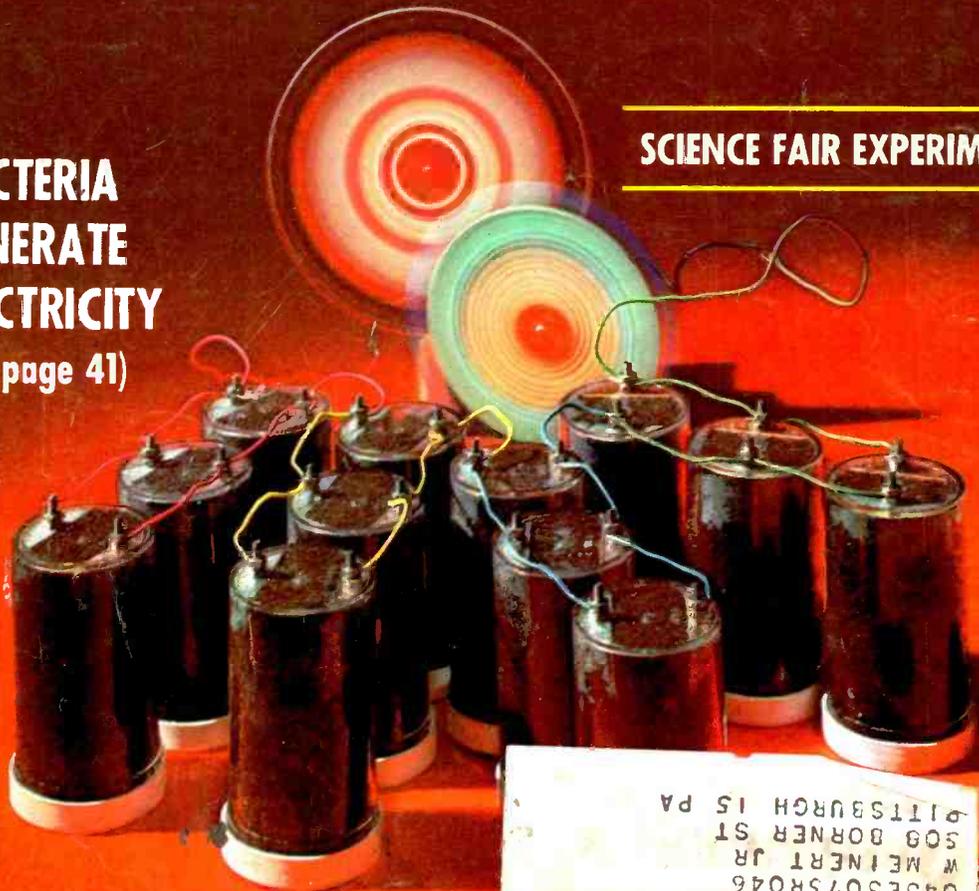
# POPULAR FEBRUARY 1964 ELECTRONICS

**35**  
CENTS

**Simplified Frequency-Finder ■ Photocell-Controlled  
Power Supply ■ How to Buy Resistors & Capacitors by  
the Bagful ■ CB Dummy Load ■ Household Appliance  
Wattage Reducer ■ Four-Way Oscillator ■ TV Camera Kit**

**BACTERIA  
GENERATE  
ELECTRICITY**  
(see page 41)

**SCIENCE FAIR EXPERIMENT**



043E3075R046  
W WEINERT JR  
508 BORNER ST  
PITTSBURGH 15 PA



# RI has been the Home for Radio-TV

## Fast growing need for Skilled Technicians

NOW is the time. Now you can move forward in this dynamic growing Age of Electronics. Half a million more skilled Technicians will be needed by 1970 to install, operate, service and supervise Electronic equipment in business, industry, the military. More Technicians are needed right now than engineers—from 4 to 7 times more! That's why NRI has continued to expand its home-study training, offering ambitious men a choice of instruction plans for a choice of career fields in Electronics. Now is the ideal time to find out about training at home with NRI, the oldest, largest school of its kind. Mail card today for our two new books. National Radio Institute, Washington, D.C.

### These Men Trained for Success With NRI—YOU Can, too



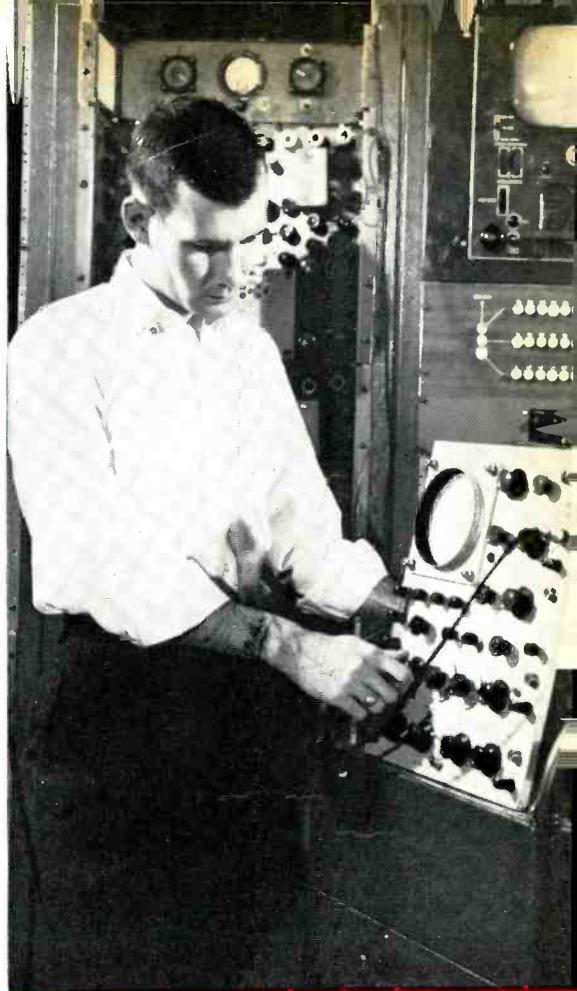
"I want to thank NRI for making it all possible," says Robert L. L'Heureux of Needham, Mass., who sought our job consultant's advice in making job applications and is now an Assistant Field Engineer in the DATAmatic Div. of Minneapolis-Honeywell, working on data processing systems.

His own full-time Radio-TV Servicing Shop has brought steadily rising income to Harlin C. Robertson of Oroville, Calif. In addition to employing a full-time technician, two NRI men work for him part-time. He remarks about NRI training, "I think it's tops."



"I can recommend the NRI course to anyone who has a desire to get ahead," says Gerald L. Roberts, of Champaign, Ill., whose Communications training helped him become an Electronic Technician at the Coordinated Science Laboratory, U. of Illinois, working on Naval research projects.

Even before finishing his NRI training, Thomas F. Favaloro, Sherburne, N.Y., obtained a position with Technical Appliance Corp. Now he is foreman in charge of government and communications divisions. He writes, "As far as I am concerned, NRI training is responsible for my whole future."



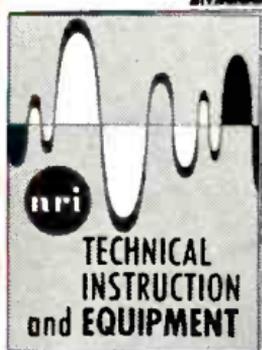
Save time and money  
Choose from

# TEN SPECIALIZED INSTRUCTION PLANS

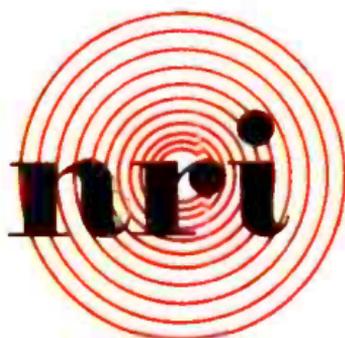
offered by NRI—  
oldest and largest  
school of its kind

**SEND FOR**

**2 NEW  
BOOKS**



**about career opportunities  
in ELECTRONICS and  
NRI instruction plans**



**TRAIN AT HOME WITH THE LEADER**

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



**BUSINESS REPLY MAIL**

NO POSTAGE STAMP NECESSARY IF MAILED IN THE UNITED STATES

POSTAGE WILL BE PAID BY



**3939 Wisconsin Avenue  
Washington, D.C. 20016**

# For nearly 50 years NRI Leader in training at home Electronics-Automation

**P**ERHAPS you're working in Electronics now and feel the need for an FCC License or more math . . . perhaps you're a hobbyist trying to decide between a career in Automation or Communications . . . perhaps you're a beginner who left school early and are interested in a spare-time or full-time business of your own servicing radio and TV sets. Worker, hobbyist or beginner, there's something for everyone among NRI's specialized instruction plans.

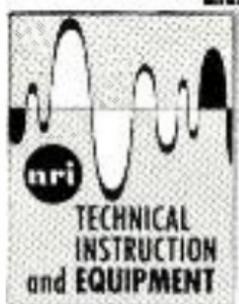
Whichever NRI training plan you select, there's nearly half a century of experience behind it. Nearly fifty years of simplifying and perfecting home-study techniques to make learning faster, easier, and more interesting. Send for two new books. Read about NRI's faculty and facilities. Get complete descriptions of NRI specialized instruction plans. Trial enrollment agreement. Monthly payments if preferred.

**CUT OUT AND MAIL**

**FREE**

**2 NEW BOOKS**

**NO STAMP NEEDED  
NRI PAYS POSTAGE**



National Radio Institute, Washington, D. C. 4BD4

Please send me your two books about opportunities in Electronics-Automation, Radio-TV and your specialized instruction plans.

Name \_\_\_\_\_ Age \_\_\_\_\_

Address \_\_\_\_\_

City \_\_\_\_\_ Zone \_\_\_\_\_ State \_\_\_\_\_

ACCREDITED MEMBER NATIONAL HOME STUDY COUNCIL

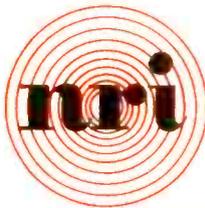
[www.americanradiohistory.com](http://www.americanradiohistory.com)

# NRI Equipment makes training faster, easier, more interesting

Thanks to NRI's pioneering home-study techniques, even men who didn't complete high school may successfully launch new careers. Of major importance are the creative Electronic Training Kits NRI furnishes *at no extra cost*. Use equipment you build to work exciting revealing experiments as you learn-by-doing. NRI equipment is designed to bring to life the things you read about in illustrated, easy-to-read texts. And all equipment is yours to keep and use.



**MAIL. POSTAGE-FREE CARD NOW**



**NATIONAL RADIO INSTITUTE**

Oldest and Largest Radio-TV  
Electronics Home Study School  
WASHINGTON, D.C.



## Pick Your Career in the Wonderful Field of Electronics

- 1. TELEVISION-RADIO SERVICING**  
Learn to service AM-FM Radios, black and white and color TV sets, Stereo Hi-Fi, PA systems, etc. A profitable, interesting field for part-time or full-time business of your own.
- 2. INDUSTRIAL-MILITARY ELECTRONICS**  
Learn Principles, Practices, Maintenance of Electronic equipment used today in business, industry, defense. Covers Electronic controls and measurement, computers, servos, telemetry, multiplexing, many other subjects.
- 3. COMPLETE COMMUNICATIONS**  
A comprehensive training program for men seeking careers operating and maintaining transmitting equipment in Radio-TV Broadcasting or mobile, marine, aviation communications. Prepares you for your First Class FCC License.
- 4. FCC LICENSE**  
Prepares you quickly for First Class License exams. Every communications station must have one or more FCC-licensed operators. Also valuable for Service Technicians.
- 5. MATH FOR ELECTRONICS**  
A short course package of carefully prepared texts that take you from basic arithmetic review through graphs and electronic formulas. Quick, complete and low in cost.
- 6. BASIC ELECTRONICS**  
An abbreviated, 26-lesson course covering Automation-Electronics, Radio-Television language, components and principles. Ideal for salesmen, hobbyists and others who find it valuable to be familiar with the fundamentals of this fast-growing industry.
- 7. ELECTRONICS FOR AUTOMATION**  
For the man with a knowledge of basic electronics who wants to prepare for a career in process control, ultrasonics, telemetering and remote control, electro-mechanical measurement, others.
- 8. AVIATION COMMUNICATIONS**  
For men who want careers working with and around planes. Covers direction finders, ranges, markers, loran, shoran, radar, landing systems, transmitters. Prepares you for FCC License.
- 9. MARINE COMMUNICATIONS**  
Shipboard transmitting equipment, direction finders, depth indicators, radar are all covered in this course. You prepare for your First Class Radiotelephone License with Radar Endorsement.
- 10. MOBILE COMMUNICATIONS**  
Training in installation and maintenance of mobile equipment and associated base stations like those used by fire and police, taxi companies, etc. Prepares you for First Class FCC License.

# POPULAR ELECTRONICS



POPULAR ELECTRONICS is indexed  
in the Readers' Guide  
to Periodical Literature

This month's cover photo by Bruce Pendleton

VOLUME 20

FEBRUARY, 1964

NUMBER 2

## Special Construction Feature

SIMPLEX Transistorized Ignition.....Edward P. Nawracaj 45

*At your request—a single-transistor ignition system  
featuring one of the extra-high-voltage 400:1 coils*

## Construction Projects

Light-Controlled Power Supply.....	53
High-Wattage Reducer.....Frank A. Parker	57
Four-Way Oscillator.....L. E. Byfield, K9ADD	59
R.F. Coil Frequency-Finder.....Leon A. Wortman	60
New Capacitors for the ARC-5.....E. H. Marriner	62
Dial, Buzz and Blink.....Art Trauffer	64

## Amateur, CB, and SWL

CB Dummy Load.....Alex F. Burr, 16W2941	58
Rx for the Amateur/SWL.....	67
Short-Wave Broadcast Predictions.....Stanley Leinwoll	70
Short-Wave Report: Old Station Returns to the Air.....Hank Bennett, W2PNA	71
English-Language Newscasts to North America.....	72
Across the Ham Bands: How Much Does It Cost to Be a Ham?.....Herb S. Brier, W9EGQ	73
On the Citizens Band.....Matt P. Spinello, KHC2060	78
Short-Wave Monitor Certificate Application.....	112

## Electronic Features and New Developments

The Amazing "Bug" Battery.....D. S. Halacy, Jr.	41
Bargains by the Bagful.....Oliver P. Ferrell	49
NEWS.....	56
Build-It-Yourself TV Camera Kit.....	62
Amplifier Quiz (Part 1).....Robert P. Balin	63
Product Reviews: Heathkit HW-22 40-Meter SSB Transceiver.....	66
Telcan—TV Tape Recorder Progress Report.....W. Steve Bacon	69
Pi in the Sky and Big Twist (a Carl and Jerry Adventure).....John T. Frye, W9EGV	76
Transistor Topics.....Lou Garner	80

## Departments

Operation Assist.....	6
Tips and Techniques.....	12
POP'tronics Bookshelf.....	20
New Products.....	24
Letters from Our Readers.....	28
Out of Tune.....	38

Copyright © 1963 by ZIFF-DAVIS PUBLISHING COMPANY. All rights reserved.

# Men 17-55

**JOB OPPORTUNITIES!  
EXCITEMENT!  
MONEY!**

All this  
can be  
Yours as a trained

## Electronics TECHNICIAN

**OVER 6,000 FIRMS HAVE EMPLOYED  
DeVRY TECH GRADUATES!**

Thousands of companies in the United States and Canada who have employed DeVry Tech men prove two most important facts: (1) Electronics is one of the biggest, fastest growing opportunity fields of our time; and (2) DeVry Tech graduates are "WANTED" MEN.

Whether DeVry Tech prepares you in spare time at home or in its modern Chicago or Toronto Laboratories, your training is designed to get you ready to meet the exacting standards of industry. You get practical training that not only helps to fit you for a job or a service shop of your own — but also gives you a foundation for a career that can be profitable the rest of your life.

You work over 300 learn-by-doing experiments at home, using DeVry Tech's exclusive Electro-Lab method. You build and KEEP valuable equipment. With another DeVry Tech exclusive, you have the benefit of training movies that you can show over and over again until basic points are crystal clear. Special texts guide you every step of the way as well.

### HOW DeVRY TECH CAN "BLUEPRINT" YOUR CAREER!

DeVry's faculty not only know how to teach Electronics, but they also understand men. They most likely know the type of problems you face. From this staff you get help, advice and understanding. It is this "human" side of DeVry's program that has caused many of our graduates to say: "DeVry Tech not only trains you for a job, they actually help you blueprint a profitable future!"

### NO ADVANCED EDUCATION NEEDED!

Why don't you write for FREE FACTS today? Learn how you TOO can be a member of the great fraternity of DeVry Tech graduates across the continent . . . men who were properly trained, encouraged, appreciated and understood! SEND IN COUPON NOW!

#### EFFECTIVE EMPLOYMENT SERVICE

DeVry Tech's effective Employment Service is available to all graduates without additional cost.

**2 FREE BOOKLETS!  
Send Coupon Today!**

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

# DeVry TECHNICAL INSTITUTE

Accredited Member of National Home Study Council

**CHICAGO • TORONTO**

Let DeVry help you to  
prepare and  
blueprint a  
Solid Career  
in this fast-  
Growing Field!



TELEVISION



COMPUTERS



MICRO-WAVES



RADAR



BROADCASTING



**DeVRY TECHNICAL INSTITUTE**  
4141 Belmont Ave., Chicago, Ill. 60641, Dept. PE-2-U

Please give me your two free booklets, "Pocket Guide to Real Earnings" and "Electronics in Space Travel"; also include details on how to prepare for a career in Electronics. I am interested in the following opportunity fields (check one or more):

- |  |   |
|--|---|
| <input type="checkbox"/> Space & Missile Electronics | <input type="checkbox"/> Communications         |
| <input type="checkbox"/> Television and Radio        | <input type="checkbox"/> Computers              |
| <input type="checkbox"/> Microwaves                  | <input type="checkbox"/> Broadcasting           |
| <input type="checkbox"/> Radar                       | <input type="checkbox"/> Industrial Electronics |
| <input type="checkbox"/> Automation Electronics      | <input type="checkbox"/> Electronic Control     |

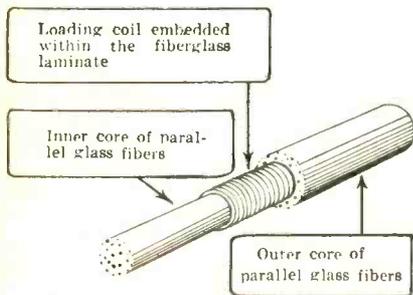
Name \_\_\_\_\_ Age \_\_\_\_\_

Address \_\_\_\_\_ Apt. \_\_\_\_\_

City \_\_\_\_\_ Zone \_\_\_\_\_ State \_\_\_\_\_

Check here if you are under 16 years of age.  
Canadian residents: Write DeVry Tech of Canada, Ltd.  
2075-A 970 Lawrence Avenue West, Toronto 19, Ontario

# Fiberglass + Process = THE DIFFERENCE



Compare the Versatile VIP — STYLE 173 — with any other loaded antenna. The exclusive Columbia Products ALL FIBER-GLASS construction builds in the rugged efficiency that makes the difference. The loading coil is embedded within the fiberglass laminate. There is no vinyl sheath to crack or craze.

The Columbia Products Company uses all fiberglass in a unique process to produce antennas of superior strength that withstand impact and flexing, hot weather and cold. Fiberglass also forms a natural barrier to precipitation static for improved reception . . . is non-corrosive and light weight.

Use the 4-ft. VIP for any frequency between 27 Mc. and 55 Mc. by simply trimming the tip with a fine tooth hacksaw or triangular file.

STYLE 173



**COLUMBIA PRODUCTS COMPANY**  
SHAKESPEARE CO. SUBSIDIARY, COLUMBIA, S. C.

CIRCLE NO. 4 ON READER SERVICE PAGE

SUBSCRIPTION SERVICE: All subscription correspondence should be addressed to POPULAR ELECTRONICS, Circulation Department, 434 South Wabash Avenue, Chicago 60605, Illinois. Please allow at least six weeks for change of address. Include your old address as well as new—enclosing if possible an address label from a recent issue.  
EDITORIAL CONTRIBUTIONS must be accompanied by return postage and will be handled with reasonable care; however, publisher assumes no responsibility for return or safety of art work, photographs or manuscripts.

# POPULAR ELECTRONICS

World's Largest-Selling Electronics Magazine

Publisher **PHILLIP T. HEFFERNAN**

Editor **OLIVER P. FERRELL**

Feature Editor **W. STEVE BACON, W2CJR**

Technical Editor **L. JEROME STANTON, W2WHM**

Art Editor **JAMES A. ROTH**

Associate Editor **MARGARET MAGNA**

Technical Illustrator **ANDRE DUZANT**

Editorial Assistant **NINA CHIRKO**

Editorial Assistant **PATTI MORGAN**

Amateur Radio Editor **H. S. BRIER, W9EGQ**

CB Editor **M. P. SPINELLO, KH2060**

Semiconductor Editor **L. E. GARNER, JR.**

Short-Wave Editor **H. BENNETT, W2PNA**

Contributing Editor **J. T. FRYE, W9EGV**

Radio Propagation Editor **STANLEY LEINWOLL**

Editorial Consultant **OLIVER READ, W4TWV**

Advertising Sales Manager **LAWRENCE SPORN**

Advertising Manager **WILLIAM G. McROY, 2W4144**

Advertising Service Manager **ARDYS C. MORAN**

ZIFF-DAVIS PUBLISHING COMPANY

Editorial and Executive Offices (212 ORegon 9-7200)  
One Park Avenue, New York, New York 10016

William B. Ziff, Chairman of the Board (1946-1953)  
William Ziff, President

W. Bradford Briggs, Executive Vice President

Hershel B. Sarbin, Vice President and General Manager

M. T. Birmingham, Jr., Vice President and Treasurer

Robert P. Breeding, Circulation Director

Stanley R. Greenfield, Vice President

Phillip T. Heffernan, Vice President

Midwestern and Circulation Office (312 Wabash 2-4911)

434 South Wabash Avenue, Chicago, Illinois 60605

Midwestern Advertising Manager JAMES WEAKLEY

Western Office (213 Crestview 4-0265)

9025 Wilshire Boulevard, Beverly Hills, California 90211

Western Advertising Manager, BUD DEAN

Foreign Advertising Representative

D. A. Goodall Ltd., London, England



Member  
Audit Bureau of  
Circulations



POPULAR ELECTRONICS is published monthly by Ziff-Davis Publishing Company at 434 South Wabash Avenue, Chicago 5, Illinois, February, 1964, Volume 20, Number 2. (Ziff-Davis also publishes Popular Photography, Electronics World, HiFi/Stereo Review, Popular Boating, Car and Driver, Flying, Modern Bride, Amazing, and Fantastic.) Subscription Rates: One year United States and possessions, \$4.00; Canada and Pan American Union Countries, \$4.50; all other foreign countries, \$5.00. Second Class postage paid at Chicago, Illinois, and at additional mailing offices. Authorized as second class mail by the Post Office Department, Ottawa, Canada, and for payment of postage in cash.

PAYMENT MAY ALSO BE REMITTED in the following foreign currencies for a one-year subscription: Australian pounds (2/6/10); Belgian francs (260); Danish kroner (36); English pounds (1/17/6); French francs (26); Dutch guilders (19); Indian rupees (26); Italian lire (3300); Japanese yen (1750); Norwegian kroner (38); Philippine pesos (21); South African rands (3.80); Swedish kronor (28); Swiss francs (23); or West German marks (21).

# Do you WISH you were EMPLOYED in ELECTRONICS?

## F.C.C. License — The Key to Better Jobs

An F.C.C. commercial (not amateur) license is your ticket to higher pay and more interesting employment. This license is Federal Government evidence of your qualifications in electronics. Employers are eager to hire licensed technicians.

## Which License for Which Job?

The THIRD 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 limited.

The SECOND CLASS radiotelephone license qualifies you to install, maintain and operate most all radio-telephone equipment except commercial broadcast station equipment.

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

## Grantham Training Prepares You

The Grantham course covers the required subject matter completely. Even though it is planned primarily to lead directly to a first class FCC license, it does this by TEACHING you electronics. Some of the subjects covered in detail are: Basic Electricity for Beginners, Basic Mathematics, Ohm's and Kirchhoff's Laws, Alternating Current, Frequency and Wavelength, Inductance, Capacitance, Impedance, Resonance, Vacuum Tubes, Transistors, Basic Principles of Amplification, Classes of Amplifiers, Oscillators, Power Supplies, AM Transmitters and Receivers, FM Transmitters and Receivers, Antennas and Transmission Lines, Measuring Instruments, FCC Rules and Regulations, and extensive theory and mathematical calculations associated with all the above subjects explained simply and in detail.

## Our Warranty

If you should fail the F.C.C. exam after finishing our course, we give additional training at NO ADDITIONAL COST. Read details in our free booklet.

# GET YOUR FIRST CLASS COMMERCIAL F.C.C. LICENSE QUICKLY!

## Learn by Correspondence or in Resident Classes

Grantham training is offered by correspondence or in resident classes. Either way, we train you quickly and thoroughly — teach you a great deal of electronics and prepare you to pass the F.C.C. examination for a first class license. Get details now. Mail coupon below.

THIS 44 PAGE  
BOOKLET  
FREE!

This free booklet gives details of our training and explains what an F.C.C. license can do for your future. Send for your copy today.



HERE'S PROOF that Grantham students prepare for F.C.C. examinations in a minimum of time. Here is a list of a few of our recent graduates, the class of license they got, and how long it took them:

	License	Weeks
Robert J. Maickel, 520 Market St., Havre De Grace, Md.	1st	20
James D. Neidermyer, R.D. 1, Leola, Pa.	1st	10
Denis Christopherson, 4402 Waite Lane, Madison Wisc.	1st	12
Guy C. Dempsey, 1326 19th St., Washington, D.C.	1st	12
Charles Bartchy, 1222 S. Park Ave. Canton 8, Ohio.	1st	10
William I. Brink, 12 Meade Ave., Babylon, L.I., N.Y.	1st	12
Earl J. Mahoney, Box 296, Newport, Vt.	1st	12
Hall Blankenship, Route 2, Rockwood, Tenn.	1st	12
David Kaus, 5218 Canterbury Way S.E., Washington, D.C.	1st	30
John A. Cork, 3535 N. Utah, Arlington 7, Va.	1st	12
Charles Deitzel, 342 Walnut St., Columbia, Pa.	1st	8½
Norman Tilley, Jr., 8613 Piney Branch, Silver Sprg, Md.	1st	30



# GRANTHAM School of Electronics



## FIVE CONVENIENT TRAINING DIVISIONS:

Los Angeles, Calif.  
1505 N. Western Ave., Los Angeles, Calif., 90027 HO 7-7727

South Gate Calif.  
9320 Long Beach Blvd., South Gate, Calif., 90280 564-3421

Seattle, Wash.  
408 Marion Street, Seattle, Wash., 98104 MA 2-7227

Kansas City, Mo.  
3123 Gillham Rd., Kansas City, Mo., 64109 JE 1-6320

Washington, D.C.  
821 — 19th Street, NW, Washington, D.C., 20006 ST 3-3614

MAIL COUPON NOW...NO SALESMAN WILL CALL

mail in envelope or paste on postal card

To: **GRANTHAM SCHOOL OF ELECTRONICS**

NATIONAL HEADQUARTERS OFFICE

1505 N. WESTERN AVE., LOS ANGELES, CALIF., 90027

Please send me your FREE 44 page booklet telling how I can get my commercial F.C.C. license quickly and can continue into advanced electronics if I wish. I understand there is no obligation and no salesman will call.

Name \_\_\_\_\_ Page \_\_\_\_\_  
(PLEASE PRINT)

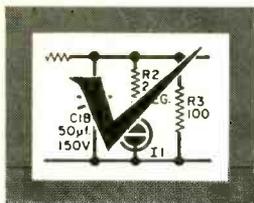
Address \_\_\_\_\_

City \_\_\_\_\_

State \_\_\_\_\_

I AM INTERESTED IN:  HOME STUDY  RESIDENT CLASSES 43-B

# Operation Assist



**T**HROUGH THIS COLUMN we try to make it possible for readers needing information on out-dated, obscure, and unusual radio-electronics gear to get help from other readers. Here's how it works: Check over the list below. If you can help anyone with a schematic or other information, *write him directly*—he'll appreciate it. If *you* need help, send a post card to **OPERATION ASSIST**, POPULAR ELECTRONICS, One Park Avenue, New York 16, N.Y. Give the maker's name, the model number, year of manufacture, bands covered, tubes used, etc. Be sure to print or type everything legibly, including your name and address, and be sure to state specifically what you want, i.e., schematic, source for parts, etc. Remember, *use a post card*; we can handle them much faster than letters. And don't send a return envelope; your response will come from fellow readers. Because we get so many inquiries, none can be acknowledged, and POPULAR ELECTRONICS

reserves the right to publish only those requests that normal sources of technical information have failed to satisfy.

## Schematic Diagrams

**Philco** type 38-2670A, code 325, using 6A8, 6K7, etc., no other data. (Gustow Albrecht, 5154 Tchendorp by Koln, Heerstrasse 201, W. Germany.)

**Panawade** Model 5016 TV receiver, about 1952, no other data. (M. D. Zimmer, Box 7856, Vandenberg AFB, Calif.)

**BC-976-A** military surplus receiver, 5 bands, 2 to 20 mc. (Sam Okuye, 10029 W. Olive Ave., Livingston, Calif.)

**Zephyr** AM-FM table model radio, ser. 8F508, 6 tubes, no other data. (M. Rodgers, 7301 Palais Rd., Stanton, Calif.)

**Philco** Model 3811 radio, 15 tubes, no other data. (George Flynn, 809 S. Greeley Highway, Cheyenne, Wyo.)

**ERLA** Model 203UL422 (E.R.L., Inc.) 2-band, 6-tube, a.c.-d.c. superhet, no other data. (Frank August, 412 John St., Braddock, Pa. 15104)

**Atwater Kent** Model 510, 10-tube superhet, 2-band, BC and s.w. to 3 mc., date unknown. (Walter Sobiesiak, 61-42 56th Drive, Maspeth 76, N.Y.)

**Hallicrafters** S-20R "Sky Champion" communications receiver. (Manuel Lopez, 522 E. 138th St., Bronx 54, N.Y.)

**United American Bosch** Model 850 (or 810), ser. 129750, 10-tube, BC and two s.w. bands, date unknown. (H. G. Albrecht, RFD 3, Rd. 6, Newtown, Conn. 06470)

**RCA Victor** Model 18T, ser. 109850, BC and s.w. radio, pushbutton tuning (pre-war?) also alignment data. (R. Marek, 12518 So. McVicker, Palos Heights, Ill. 60463)

**Altec** Model P-518A power supply, no other data. (Judd Lewis, II, #4 Misima, Lexington Park, Md.)

(Continued on page 8)



**IN ACTION!**

**NEW FOR '64**

**2-WAY RADIOS**

the "ESCORT" and "COMPANION II"

\$224.50



### NEW "ESCORT" Features

- Illuminated—8 fixed channels, tunable to receive and transmit 23 channels with external crystal socket—illuminated "S" meter and slide rule tuning dial—all transistor power supply.

Every transceiver is hand-wired, quality controlled along the production line and individually tuned and tested before it reaches you. Dependability is built in for long years of rugged service.

\$189.50



### NEW "COMPANION II" Features

- Illuminated—5 fixed channels, tunable to receive and transmit 23 channels with external crystal socket—illuminated slide rule tuning dial—all transistor power supply.

**NOW — AT YOUR DEALER**

Pearce-Simpson, Inc. PE-2

2295 N. W. 14th Street Miami, Florida 33125

Please send me details on

New "ESCORT"  "COMPANION II"

Name.....

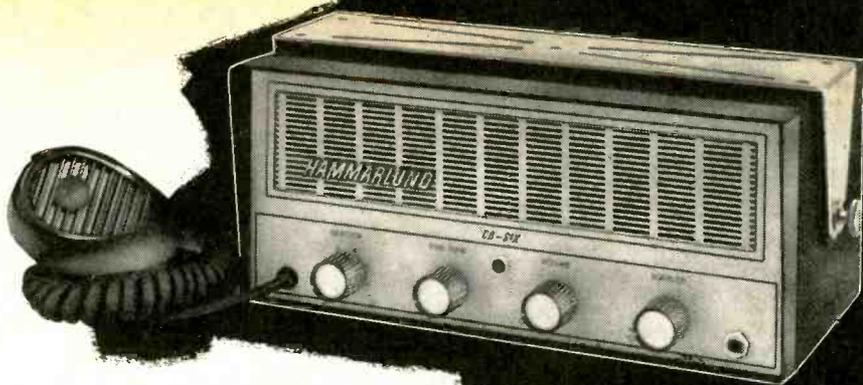
Address.....

City..... State.....



**PEARCE-SIMPSON, INC.**  
MIAMI, FLORIDA

CIRCLE NO. 23 ON READER SERVICE PAGE



# LOOK CLOSE!

## NOTICE A FAMILY RESEMBLANCE?

Perhaps not. But then Hammarlund's CB-6 is different.

Now—the world's most quality-conscious manufacturer of Amateur and SWL communications equipment has come up with the right unit for Commercial/Industrial CB Communications. Here is a rugged six-channel CB transceiver that has been built to take the pounding, jolts, and hard general usage found in heavy construction equipment—and still maintain outstanding sensitivity and 4 KC selectivity. Power output better than 3 watts.

This dual conversion superheterodyne transceiver has what it takes for professional quality transmit/receive ■ Built-in power supply ■  $\pm 3$  KC microfine vernier tuning ■ Optimum sensitivity and selectivity ■ dual-diode series-type noise limiter ■ Sensitive, positive-acting squelch.

Judge for yourself. See it at your nearest Hammarlund distributor or mail in the attached coupon for complete descriptive and technical data.

**\$179.50**

Includes mobile mounting bracket and P.T.T. microphone



**HQ-100A**—Single conversion top performance general coverage SWL and Ham receiver. . . . . **\$189.00**



**HQ-145X**—Dual conversion general coverage SWL and Ham receiver with single crystal controlled channel. **\$279.00**



**HQ-180A**—Famous triple conversion SWL and Ham receiver. Outstanding Amateur-SSB and general coverage reception. **\$429.00**



**HAMMARLUND MANUFACTURING COMPANY**

A GIANNINI SCIENTIFIC COMPANY

53 West 23rd Street, New York 10, New York

Please send info on the following units to:  CB-6  HQ-100A  HQ-145X  HQ-180A

Name \_\_\_\_\_

Address \_\_\_\_\_

City \_\_\_\_\_ Zone \_\_\_\_\_ State \_\_\_\_\_

CIRCLE NO. 13 ON READER SERVICE PAGE

# BIG MONEY IN THE 4 CORNERS OF THE WORLD!

in TELEVISION, RADIO,  
ELECTRONICS, RADAR, SONAR

**ONLY CHRISTY OFFERS  
COMPLETE TRAINING!**

Investigate the Christy Complete Course. Why be satisfied with less? CTS Shop Method, Home Training makes learning easy. You learn by working with actual equipment. You receive Comprehensive training from the start. **CAN EARN AS YOU LEARN.** You become qualified to open your own Electronics Repair business or to gain high pay as a TV, Radio, Electronics, etc., Technician.

**19 TRAINING KITS INCLUDED!** You receive a Multi-Tester, Oscillator, Signal Tracer, Oscilloscope, Signal Generator, Electronic Timer, Regenerative Radio, 24" TV set (optional) and other valuable testing equipment. **FREE BOOK AND TWO FREE LESSONS** yours for the asking! No obligation.

**CHRISTY TRADES SCHOOL**

3214 W. Lawrence Ave.,  
Chicago 60625



CHRISTY TRADES SCHOOL, Dept. T-1414  
3214 W. Lawrence Ave., Chicago 60625  
Write today for the 3 FREE BOOKS and Special Form for  
PAYING LATER from EARNINGS MADE WHILE LEARNING.

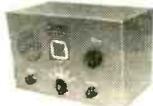
NAME .....AGE.....  
ADDRESS .....  
CITY .....ZONE.....STATE.....

**CIRCLE NO. 3 ON READER SERVICE PAGE**

## NEW - - by KUHN AM/FM VHF RECEIVER

Covers 26-54 and 108-174 MC in six calibrated bands with excellent sensitivity. Ideal for rapid scanning for CB, Amateur, Aircraft, or FM Police, Fire, etc. signals with controllable selectivity.

353-A  
\$48.70



### AIRCRAFT • POLICE • FIRE



348A  
Complete  
\$34.95

Transistorized, directly tuneable converter. Powered with self-contained mercury cell. Excellent sensitivity and stability. Designed for car, home or portable receivers.

315-B  
5-54 MC  
\$17.95  
115-160 MC  
\$18.95



Converts home or car radios to receive Fire, Police, Aircraft, CB, SW, etc. Exceptional sensitivity on High and Low Bands. High Band type adjusts to bracket 115-160 MC. Low Band type should be ordered for 33-47 MC, 40-52 MC, 26-30 MC, 9-12 MC, etc. May be adapted for transistorized car radios.

Order today or send for free catalog on full line  
of converters and receivers for every application.



20 GLENWOOD  
CINCINNATI 17,  
OHIO

**CIRCLE NO. 16 ON READER SERVICE PAGE**

## Operation Assist

(Continued from page 6)

**Abbott Instrument TR-4B** 2-meter transceiver. (Allan Jaworski, 42 Lucille Place, Passaic, N.J. 07055)

**Breting Model 14** communications receiver, ser. 49346, no more data. (J. C. Roseberry, P.O. Box 2130, Orcutt, Calif.)

**Radio City Multitester, Model 419.** (Harold F. Weyl, 66 Merlin St., Rochester 13. N.Y.)

**Emerson Model 1003,** 6-tube radio, about 1943. (Tom Martin, 573 Woodview Dr., Dayton, Ohio.)

**GE (Canada) Model A-70,** 8-tube, BC and s.w. receiver, and **Electronics Labs, Inc.** (Indianapolis, Ind.) Model 801 25-60 cps converter. (Jack Shinono, 2489 Fifth Line West, Erinedale, Ont., Canada)

**BC 423 Radio Modulator.** Signal Corps surplus. (Daniel A. Mann, 18 Queen St., Freeport, N.Y.)

**Cal-Lee Mfg. Co. Model F-100 "Metronome" FM Tuner,** no more data. (W. S. Rubin, 1663 S. Fairfax Ave., Los Angeles 19, Calif.)

**Silvertone Model 7048** s.w. radio, ser. 1410S1, no date, also need parts list. (Mike Brubaker, 3159 Shroyer Rd., Dayton, Ohio 45429)

**Crosley Model 516** 2-band superhet. BC and one s.w., 5 tubes, data unknown. **RCA Victor Model 76X11** 6-tube, BC superhet, about 1950. (W. L. Adams, Jr., Rte. 2, Trenton, N.C.)

**Hallicrafters S-20R "Sky Champion,"** about 1938. (Bob King, 4731 Cleveland, Apt. 200, Kansas City, Mo. 64130)

**Atwater Kent Model 9780** 8-tube, battery powered radio, BC and s.w., 1934. **Stromberg Carlson** 8-tube BC and s.w. superhet, chassis 14497 (no more data); also need speaker. (W. David Ferris, Rte. 2, Anadarko, Okla. 73005)

**Magnavox Model A,** type T.R.F. 5, battery powered radio, no date. (A. Tomaino, Jr., 18 Meadow St., Danbury, Conn.)

**Radiotel Model 1500** 5-tube set, Pacific Electron Prods., Long Beach, Cal. maker, ser. 1586. (L. J. Potter, 660 Union, N.E. Salem, Ore. 97301)

**Philco Model 48-482** code 121, 9-tube BC, s.w., FM receiver, about 1948. (Earl H. Smith, Jr., 121 Hillcrest Drive, Eufaula, Ala.)

**Abbott Instrument Model TR-4** transceiver. (Matthew Pruitt, P.O. Box 4096, Chase Hgts., S.C.)

**CG 46117** Navy surplus receiver, 7 to 27 mc., ser. 1572. (Fred Mann, 5205 Page St., Marrers, La.)

**Breting Model 12** receiver, no date. (James Lee, 39 Wedgewood Drive, Greenville, S.C.)

**Zenith Model Y 515,** 5 tubes, no date. **Zenith Model R432T,** 4 tubes, battery powered. **Philco Model 46-250,** 5 tubes, no date. (Jose Antonio Rojas, Pulperia Eduardo Perez, Alajuela, Costa Rica)

**Majestic Model 7C11D** AM-FM radio, no date. (Howard E. Fields, 10604 National Turnpike, Fairdale, Ky.)

**Colin B. Kennedy Model 110** Universal receiver, no date. All-wave receiver (same maker), no model, ser. L7563W5. (Burton Mahan, 15075 Herring Ave., San Jose, Calif.)

**Knapp Model TR-10** transceiver, also data for 12-volt use. (Max Boritz, 509 Ridge Road, Elmont, N.Y.)

### Special Data or Parts

**Superior Model TC-55** tube tester, replacement for meter. (S. A. Cooper, 1322 W. Jerome, Philadelphia, 40, Pa.)

**RCA type 106B** crystal receiver, ser. 8190, covers 200 to 3500 meters, and **Million Model Q** signal generator, any technical data on either. (Thomas Albright, 110 E. Delaware, Benton Harbor, Mich.)

**Ecophone Model EC-1A** 3-band s.w. receiver, operating and service manual needed. (Richard Mead, 832 N. First St., Alhambra, Calif. 91801)

**Freshman Masterpiece** 5-tube radio, ser. B92322, about 1938, need tubes, operating manual, schematic. (W. J. Hensel, 204 Odessa Ave., Wilmington 9, Del.)

**AME-100** communications receiver (like National HRO) made for U.S. Navy by Amalgamated Wireless, Ltd.,

(Continued on page 10)

Always say you saw it in—POPULAR ELECTRONICS

# NOW! GET ACQUAINTED WITH **ALLIED**

ORDER THESE POPULAR BARGAINS TODAY!



**10**  
25' Coils of  
Hookup Wire **ONLY 98¢**

Top buy in stranded copper wire, tinned and untinned; assorted colors, gauges and insulation. 10 coils, 1 lb. No. 39 A 935.

Circle 1 on coupon



**ONLY \$1.98**

**Speedway**  
Tube Cooling Fan

Prolongs tube life; provides better shielding for RF ampl. 3200 rpm; compact; 2 1/2 x 2 1/2 x 1 1/4". 115 VAC. 1 1/4 lbs. No. 39 A 457.

Circle 2 on coupon



**14 for 98¢**  
Assorted Slide Switches

Terrific buy! Assortment includes SPST, SPDT, DPST, DPDT types; up to 3 amps; U.L. listed. 14 switches, 7oz. No. 39 A 864.

Circle 3 on coupon



**\$1.69**  
Tube Checker with leads **ONLY**

Tests radio and TV tubes, and continuity of coils, appliances, etc. With leads. 117 v. 60 cy. A.C. 1 lb. No. 39 A 390.

Circle 4 on coupon



**3 for \$3.29**  
Stereo Demo Records

Set of 3 records checks every aspect of performance and quality of your stereo hi-fi system. A top buy! 2 lbs. No. 39 A 010.

Circle 5 on coupon



**2 for 79¢**  
Audio Power Transistors

Bargain! Two 2N176 transistors; 3 amps @ 30 v.; DC Beta—25 v. l.cbo; 3 ma. Pwr. gain—35.5 db. 6-12-28 v. 4 oz. No. 39 A 633.

Circle 6 on coupon



**ONLY \$3.95**  
SAVE!  
Communications Mike

Ceramic omnidirectional mike ideal for mobile, Ham and CB use. DPST switch. 80-9000 cps. High-imp. 5-ft. cable. 1 lb. No. 39 A 849.

Circle 7 on coupon



**3 ONLY 59¢**  
9-Volt Batteries

Quality long-lasting replacements for Burgess 2 U 6, RCA VS 3 2 3, Eveready 216 and others. Lowest price; from Japan. 6 oz. Pkg. of 3. No. 55 J 147.

Circle 8 on coupon



**3 for 78¢**  
Bargain Phone Plugs

Standard 1/2" plugs for extensions, speakers, headphones, monitoring equip.; 2 cond., unshielded. Pkg. of 3. 12 oz. Specify red or black handle. No. 39 A 020.

Circle 9 on coupon



**12 for \$1.98**  
Zener Diodes

Famous-brand Zener diodes, from miniature mw. units to stud-mounted 10-amp. types. 3-30 v. range. With diagrams. Pkg. of 12. 7oz. No. 39 A 008.

Circle 10 on coupon



**ONLY 98¢**  
50 Tubular Capacitors

Wax-impregnated capacitors; ranges from 100-600 WVDC in popular values. Various sizes. All values and working voltages marked. Pkg. of 50. 12 oz. No. 39 A 385.

Circle 11 on coupon



**ONLY 98¢**  
5-inch Round Speaker

Quality PM replacement; good fidelity. Power cap. 3.5 watts. Imp. 3.2 ohms. Magnet weight 0.53 oz. EIA mounting dimensions. 12 oz. No. 39 A 009.

Circle 12 on coupon



**ONLY \$5.85**  
12" Hi-Fi Speaker

Wide-range; with hi-frequency whizzer cone. 12 oz. magnet; 40-14,000 cps; cap. 25 watts; imp. 8 ohms; standard mountings. 7 lbs. No. 39 AX 742.

Circle 13 on coupon



**ONLY 98¢**  
2-Set Coupler

Transformer-type TV-FM coupler. Permits operation of 2 TV or 2 FM sets (or one of each) from a single antenna. Size, 3 1/2 x 1 x 1 1/4". 3 oz. No. 39 A 760.

Circle 14 on coupon



**ONLY 98¢**  
100 Terminal Strips

Less than a penny each! Brown bakelite strips, all 1/2" wide. Assorted length—1 to 6 terminals per strip; mixed lug and solder types. 12 oz. Pkg. of 100. No. 39 A 582.

Circle 15 on coupon



**ONLY 98¢**  
Handy Mini-Tester

Pocket-size neon-type voltmeter; measures AC/DC from 65-800 v.; determines grounded side of line. 4 oz. No. 58 A 426.

Circle 16 on coupon

**ORDER TODAY • Money Back Guarantee • Fast Shipment**

**ALLIED RADIO, 100 N. Western Ave., Dept. 3-B, Chicago 80, Illinois**

Ship me the items circled below in quantities shown:

QUANT.	QUANT.	QUANT.	QUANT.
1	5	9 Red Black	13
2	6	10	14
3	7	11	15
4	8	12	16

**NO COD's PLEASE:** \$ \_\_\_\_\_ enclosed  
(Please include postage; remit 15¢ per item ordered)

Name \_\_\_\_\_  
PLEASE PRINT

Address \_\_\_\_\_

City \_\_\_\_\_ Zone \_\_\_\_\_ State \_\_\_\_\_

**CIRCLE NO. 1 ON READER SERVICE PAGE**

[www.americanradiohistory.com](http://www.americanradiohistory.com)

# Operation Assist

(Continued from page 8)

(Australia), need 6G8G tube, alignment data, schematic. (Peter C. Brickey, 47B Fair Oaks, San Francisco 10, Cal.)

**Silvertone** radio-phonograph recorder, chassis 110-466, need operating instructions and schematic. (Charles Fencil, 5620 W. 79th St., Oak Lawn, Ill.)

**Phillips** type ND593V, 5-band car radio, need U. S. equivalents for Telefunken tubes, any service data, schematic. (Norman L. Zinn, 1209 Langley St., S.E., Grand Rapids, Mich. 49508)

**BC-453B** plug-in coil bracket needed. (Richard Vogt, 1845 N. Kostner Ave., Chicago 39, Ill.)

**Ecophone** receiver, made by The Radio Shop, Sunnyvale, Calif., in 20's. need any technical, historical data, tubes, schematic, source of parts. (William Webb, Janssen Hall, Greenville College, Greenville, Ill.)

**Type 1280** tube, or equivalent needed. (Harold Spring, 570 Little St., Elgin, Ill.)

**Ballantine** Model 300 VTVM, panel meter needed, any condition. (L. E. McCraw, 989 Echles St., Memphis 11, Tenn.)

**BC 348-R** receiver, maintenance manual needed. (Robert M. Bissell, DAFC, 405 CSG, Box 306, APO 74, San Francisco, Calif.)

**Precision** Model E-200-C signal generator, about 1943. Need alignment data. (C. Peacock, 3 Jenkins Drive, Indian Head, Md.)

**Crosley** Model 515 radio, need 6B5 tube, Miller #522 coil. (Rodney Babkirk, RFD 1, Scarborough 1, Maine.)

**Weston** Model 773 tube tester, date unknown, tube data charts needed. (N. Shyshuk, Box 744, Scranton, Pa.)

**Knight KX-60** amplifier, assembly manual needed. (David G. Raymond, 493 Snyder MRH, Champaign, Ill.)

**Type WE-10** Radio D Line (?) made by Western Coil & Electric Co., Racine, Wis., 6 tubes, battery-powered, tube types, battery voltages, schematic, etc., needed. (Ted R. Mize, 3738 East 6th St., Topeka, Kan.)

**Montgomery Ward** Model 62-194, 10-tube superhet, BC and s.w. to 18 mc., late 30's. any technical information, and schematic. (A. J. Eckhardt, 1311 Second Ave., Beaver Falls, Pa.)

**RCA** Model M-80605-15, 9-tube, BC and s.w., radio, using 6K7, etc., has phono input, any technical data, tube placement, alignment, etc., needed. (Lionel Kemp, P.O. Box 1701, Nassau, N.P., Bahamas)

**Barker & Williamson** HCL series coils, and 35-watt grid turret assembly, source of supply. (Gary Crane, 304 Virginia Ave., Santa Ana, Calif.)

**Solar** Model C-E capacitor analyzer, ser. E-5716, manual and schematic needed. (Richard Mead, 832 N. First St., Alhambra, Calif. 91801)

**Electronic System** Model E-10 science-electronics set, need instruction book and diagrams. (Richard Mead, 832 N. First St., Alhambra, Calif. 91801)

**Silvertone** Model 724, 4-band receiver, need instruction book. (J. J. Carlin, 41 Hazelwood Ave., Newark 6, N.J.)

**Heathkit** "Sixer," need diagram of conversion to push-to-talk microphone for mobile use. (Barry M. Wilson, 7604 S.W. Capitol Hill Road, Portland 19, Ore.)

**Solar** Model CE capacitor analyzer, parts list, alignment data, and schematic needed. (C. Razzgaitis, 1276 Eastwood Ave., Cleveland 24, Ohio)

**Crosley** Model 52, 3-tube, regenerative receiver, ser. 3839, about 1920 (?), need tubes and schematic. (William R. Maurer, 500 East North St., Cadillac, Mich. 49601)

**BC 1066B** 2-band, Signal Corps surplus receiver, need manual and schematic. (Terry M. Diggs, 209 North Ave., H. Haskell, Texas 79251)

**RCA** Model R-320 SC-88, 6-band, 13-tube receiver, need alignment, calibration data, schematic. (Wayne E. Hertel, 3508 Mildred, Wichita 8, Kansas)

-30-

## now available: a maximum-sensitivity FM receiver



it's called Metro-monitor.  
(sensitivity: .75 microvolt)

Here is a Metrotek first: a versatile, highly sensitive FM receiver designed for maximum performance and dependability. One glance at the specifications will convince you that this new unit is truly a remarkable breakthrough in the FM field. Exclusive franchises are available.

### SPECIFICATIONS:

MODEL 7147

25 - 50 mc

#### FEATURE

Sensitivity .75 microvolt or less for 20 DB quieting

Usable Signal 0.25 microvolt

Spurious Response At least 60 DB down

Selectivity 30 DB down  $\pm$  40 kc

6 DB down  $\pm$  8 kc

Frequency Stability  $\pm$  .002% crystal

controlled

Audio Output 2.0 watts maximum at

10% distortion

Squelch All electronic noise

compensated

Height 5 1/4 inches

Width 11 3/4 inches

Depth 6 3/4 inches

MODEL 7148

148 - 174 mc

#### FEATURE

Sensitivity 1.0 microvolt or less for

20 DB quieting

Usable Signal 0.35 microvolt

Spurious Response At least 60 DB down

Selectivity 30 DB down  $\pm$  40 kc

6 DB down  $\pm$  8 kc

Frequency Stability  $\pm$  .002% crystal

controlled

Audio Output 2.0 watts maximum at

10% distortion

Squelch All electronic noise

compensated

Height 5 1/4 inches

Width 11 3/4 inches

Depth 6 3/4 inches

The above specifications are fully guar-

anteed by Metrotek Electronics, Inc.

For further information, call or write:

**METROTEK ELECTRONICS, INC.**  
205 W. Cabarrus St.  
Raleigh, N. C. / 828-8481

CIRCLE NO. 19 ON READER SERVICE PAGE

# Who can build all this into a 6½" deep cabinet?

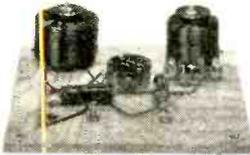


12" woofer with 6-lb. magnet structure, 2" voice coil, half-roll cotton surround, and 25 cps free-air resonance

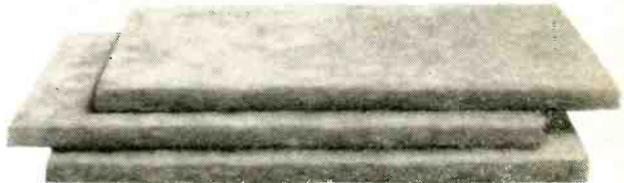


5" midrange driver with Butyl-coated surround and sealed metal back

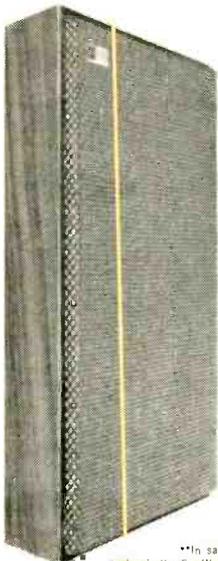
3" cone-type tweeter with 2-lb. magnet structure, hemispherical dome bonded directly to 1" voice coil, and sealed metal back



3-way inductive-capacitive dividing network with 1200 cps and 2800 cps crossovers, and continuously variable tweeter control



High-absorbency AcoustiGlas padding



## You! (with the Fisher KS-2 StrataKit)

You install the three drivers, wire them to the dividing network, put in the padding, complete the assembly of the cabinet — and you are the owner of the most advanced slim-line speaker system available today, only 6½" deep by 25" high by 20" wide. Despite its moderate dimensions, the Fisher KS-2 StrataKit has virtually uniform response from 35 to 20,000 cps and rivals the most advanced professional loudspeakers in clarity, transient response and over-all 'bigness' of sound. And — it is priced at only \$89.50.\* The Fisher KS-1 StrataKit, a slightly smaller and even slimmer (5¾" deep) 3-way system, costs only \$59.50.\*\*

**FREE! \$1.00 VALUE:** THE KIT BUILDER'S MANUAL, an illustrated guide to high fidelity kit construction, complete with detailed specifications of all Fisher StrataKits.

The  
KIT Builder's  
Manual

Fisher Radio Corporation  
21-40 44th Drive  
Long Island City, N. Y. 11101

Please rush THE KIT BUILDER'S MANUAL free of charge.

Name \_\_\_\_\_

Address \_\_\_\_\_

City \_\_\_\_\_ State \_\_\_\_\_

10212

\*In sanded but unfinished birch. Also available in unfinished walnut, \$94.50. Factory assembled, in finished birch, \$114.50; in oiled walnut, \$119.50.  
\*\*In sanded but unfinished birch. Also available in unfinished walnut, \$64.50. Factory assembled, in finished birch, \$84.50; in oiled walnut, \$89.50. All prices slightly higher in the Far West. Overseas residents write to Fisher Radio International, Inc., Long Island City 3, New York. Canadian residents write to Tri-Tel Associates, Ltd., Willowdale, Ont.

CIRCLE NO. 10 ON READER SERVICE PAGE

# DRAFTING

Let RCA train you at home for a profitable career!

Start now! Many opportunities in mechanical and electronic fields await trained draftsmen. RCA Institutes Home Training Course in Drafting will help qualify you for a responsible position on commercial or military projects. No previous technical training required. Liberal tuition plan. Classroom training at RCA Institutes Resident School in New York also available. Send coupon now for FREE BOOK and complete information.



**RCA Institutes, Inc.**  
A Service of Radio Corporation of America

RCA Institutes, Inc., Dept. PEX-24  
350 West Fourth Street, New York, N. Y. 10014  
Please rush me your FREE illustrated book and complete information about Home Training   
Classroom Training . No obligation. No salesman will call.  
Name ..... Age .....  
(please print)  
Address .....  
City ..... Zone ... State .....

## GIANT CB VALUES!!

- JOHNSON MESSENGER ..... \$109.95  
(includes pair Channel 11 crystals)  
You're on the air with 5 channels (was \$139.95)
- FREE — 4 PAIRS OF CRYSTALS — FREE (specify channels)
- JOHNSON MESSENGER TWO ..... \$169.95  
(includes pair Channel 11 crystals)  
For full 10 channel service (\$200.00 value)
- FREE — 9 PAIRS OF CRYSTALS — FREE (specify channels)
- JOHNSON MESSENGER III ..... \$189.95  
(includes pair Channel 11 crystals)  
Remove from car—use as Walkie-Talkie!
- FREE — 10 PAIRS OF CRYSTALS — FREE (specify channels)
- AC POWER SUPPLY ..... \$29.95
- TRIUMPH 10-TRANSISTOR WALKIE-TALKIE \$33.95  
(Noise limiter, bias stabilizer, auto squelch, Channel 7)  
(Uses 8 penlite cells @ 85¢ each.) (extra crystals \$4.95 pr.)
- PLUS BONUS OF FREE PAIR OF CRYSTALS (specify channel)
- HY-GAIN NEW CLR II COLINEAR ..... \$29.97  
(Hi-Strength, out-performs others!)
- FREE—50 ft. RG8U & \$2.95 Mobile Handbook—FREE

### SALE ON ULTRA-LO-LOSS FOAM COAXIAL CABLE!!!

- RG58U ..... 50 ft. for \$2.49 ..... 100 ft. for \$3.99
- RG8U ..... 50 ft. for \$4.95 ..... 100 ft. for \$8.99
- COMMAND CB CRYSTALS ..... EACH \$1.49  
(Specify Make, Model, Channel)
- 12 or more—\$1.39 ea.
- COMMAND CORSAIR MOBILE CB ANTENNA ..... SALE \$8.99  
(Single bumper mount, 102" stnl. steel whld, hvy. spring)

Check items wanted. Return ad or order with check or money order. Include postage, excess refunded. 50¢ service on orders under \$5.00. Beams and 102" whld antennas shipped REA Exp. 50% deposit on C.O.D.'s.

- SEND FOR GIANT NEW 1964 CATALOG—FREE

### GROVE ELECTRONIC SUPPLY COMPANY

4103 W. Belmont Ave. Telephone: (Area 312) 283-6160  
Chicago, Ill. 60641

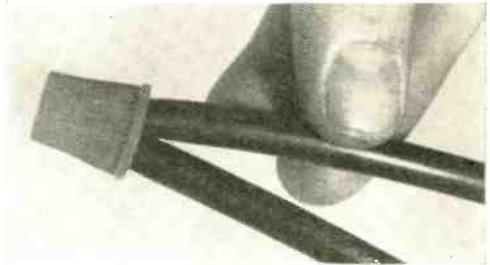
CIRCLE NO. 11 ON READER SERVICE PAGE



## Tips and Techniques

### EMERGENCY WIRE NUTS

Electrical supply stores sell the "wire nut" type of solderless connector in several sizes, but few such establishments are open on the week end, which is naturally the time you discover you need connectors. In a pinch, the cap from an old toothpaste tube

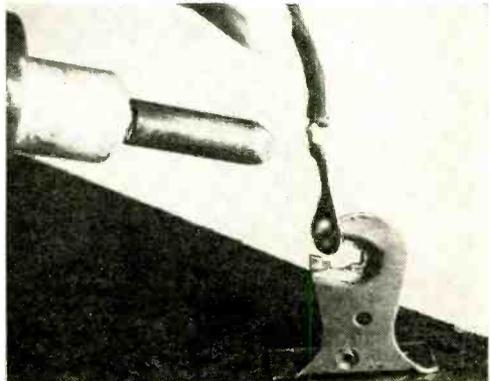


will serve almost as well, if you twist the wires together and trim them fairly short. For a permanent connection, put a little speaker cone cement or other adhesive in the cap before you screw it on.

—Charles Lang

### HANDY AID FOR UNSOLDERING LUGS

When you have a lot of lugs to remove, the operation can be speeded by fastening a hook to the edge of a shelf or upright over your bench. A large cup hook is ideal, but you can even press a curtain hanger



Always say you saw it in—POPULAR ELECTRONICS

# BUILD 20 RADIO

Reg. U. S.  
Pat. Off.



Training Electronics Technicians Since 1946

**CIRCUITS AT HOME**  
with the New

**PROGRESSIVE RADIO "EDU-KIT"®**

only  
**\$26.95**

**A Practical Home Radio Course**

**Now Includes**

- ★ 12 RECEIVERS
- ★ 3 TRANSMITTERS
- ★ SQ. WAVE GENERATOR
- ★ SIGNAL TRACER
- ★ AMPLIFIER
- ★ SIGNAL INJECTOR
- ★ CODE OSCILLATOR

- ★ No Knowledge of Radio Necessary
- ★ No Additional Parts or Tools Needed
- ★ EXCELLENT BACKGROUND FOR TV
- ★ School Inquiries Invited
- ★ Sold in 79 Countries

**YOU DON'T HAVE TO SPEND  
HUNDREDS OF DOLLARS FOR A RADIO COURSE**

The "Edu-Kit" offers you an outstanding PRACTICAL HOME RADIO COURSE at a rock-bottom price. Our Kit is designed to train Radio & Electronics Technicians, making use of the most modern methods of instruction. You will learn radio theory, construction practice and servicing. THIS IS A COMPLETE RADIO COURSE IN EVERY DETAIL.

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, Square Wave Generator and the accompanying instructional material.

You will receive training for the Novice, Technician and General Classes of F.C.C. Radio Amateur Licenses. You will build 20 Receiver, Transmitter, Transmitter, Code Oscillator, Signal Tracer and Signal Injector circuits, and learn how to operate them. You will receive an excellent background for television, Hi-Fi and Electronics.

Absolutely no previous knowledge of radio or science is required. The "Edu-Kit" is the product of many years of teaching and engineering experience. The "Edu-Kit" will provide you with a basic education in Electronics and Radio, worth many times the complete price of \$26.95. The Signal Tracer alone is worth more than the price of the entire Kit.

## THE KIT FOR EVERYONE

You do not need the slightest background in radio or science. Whether you are interested in Radio & Electronics because you want an interesting hobby, a well paying business or a job with a future, you will find the "Edu-Kit" a worthwhile investment.

Many thousands of individuals of all

ages and backgrounds have successfully used the "Edu-Kit" in more than 79 countries of the world. The "Edu-Kit" has been carefully designed, step by step, so that you cannot make a mistake. The "Edu-Kit" allows you to teach yourself at your own rate. No instructor is necessary.

## PROGRESSIVE TEACHING METHOD

The Progressive Radio "Edu-Kit" is the foremost educational radio Kit in the world, and is universally accepted as the standard in the field of electronics training. The "Edu-Kit" uses the modern educational principle of "Learn by Doing." Therefore you construct, learn schematics, study theory, practice trouble shooting—all in a closely integrated program designed to provide an easily-learned, thorough and interesting background in radio.

You begin by examining the various radio parts of the "Edu-Kit." You then learn the function, theory and wiring of these parts. Then you build simple radio. With this first set you will enjoy listening to regular broadcast stations, learn theory, practice testing and trouble-shooting. Then you build a more advanced radio, learn more advanced theory and technical details in a progressive manner, and at your own rate, you will find yourself constructing more advanced multi-tube radio circuits, and doing work like a professional Radio Technician.

Included in the "Edu-Kit" course are twenty Receiver, Transmitter, Code Oscillator, Signal Tracer, Square Wave Generator and Signal Injector Circuits. These are not unprofessional "breadboard" experiments, but genuine radio circuits, constructed by means of professional wiring or soldering on metal chassis, plus the new method of radio construction known as "Printed Circuitry." These circuits operate on your regular AC or DC house current.

## THE "EDU-KIT" IS COMPLETE

You will receive all parts and instruction necessary to build 20 different radio and electronics circuits, each guaranteed to operate. Our Kits contain tubes, tube sockets, variable, electrolytic, mica, ceramic and paper dielectric condensers, resistors, tie strips, coils, hardware, tubing, punched metal chassis, Instruction Manuals, hook-up wire, solder, selenium rectifiers, volume controls and switches, 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 electronic soldering iron, and a self-powered Dynamic Radio and Electronics Tester. The "Edu-Kit" also includes Code Instructions and the Progressive Code Oscillator. In addition to F.C.C.-type Questions and Answers for Radio Amateur License training. You will also receive lessons for servicing with the Progressive Signal Tracer and the Progressive Signal Injector, a High Fidelity Guide and a Quiz Book. You receive Membership in Radio-TV Club, Free Consultation Service, Certificate of Merit and Discount Privileges. You receive all parts, tools, instructions, etc. Everything is yours to keep.

## PRINTED CIRCUITRY

At no increase in price, the "Edu-Kit" now includes Printed Circuitry. You build a Printed Circuit Signal Injector, a unique servicing instrument that can detect many Radio and TV troubles. This revolutionary new technique of radio construction is now becoming popular in commercial radio and TV sets.

A Printed Circuit is a special insulated chassis on which has been deposited a conducting material which takes the place of wiring. The various parts are merely plugged in and soldered to terminals.

Printed Circuitry is the basis of modern Automaton Electronics. A knowledge of this subject is a necessity today for anyone interested in Electronics.

## FREE EXTRAS

### • SET OF TOOLS

- SOLDERING IRON
- ELECTRONICS TESTER
- PLIERS-CUTTERS
- ALIGNMENT TOOL
- WRITING SET
- VALUABLE DISCOUNT CARD
- CERTIFICATE OF MERIT
- TESTER INSTRUCTION MANUAL
- HIGH FIDELITY GUIDE • QUIZZES
- TELEVISION BOOK • RADIO
- TROUBLE-SHOOTING BOOK
- MEMBERSHIP IN RADIO-TV CLUB: CONSULTATION SERVICE • FCC AMATEUR LICENSE TRAINING
- PRINTED CIRCUITRY

## SERVICING LESSONS

You will learn trouble-shooting and servicing in a progressive manner. You will practice repairs on the sets that you construct. You will learn symptoms and causes of trouble in home, portable and car radios. You will learn how to use the Professional Signal Tracer, the unique Signal Injector and the dynamic Radio & Electronics Tester. While you are learning in this practical way, you will be able to do many a repair job for your friends and neighbors, and charge fees which will far exceed the price of the "Edu-Kit." Our Consultation Service will help you with any technical problems you may have.

## FROM OUR MAIL BAG

J. Stataitis, of 25 Poplar Pl., Waterbury, Conn. writes: "I have repaired several sets for my friends, and made money. The "Edu-Kit" paid for itself. I was ready to spend \$240 for a course, but I found your ad and sent for your Kit."

Bon Valerio, P. O. Box 21, Magna, Utah: "The Edu-Kits are wonderful. Here I am sending you the questions and also the answers for them. I have been in Radio for the last seven years, but like to build Radio Kits, and like to build Radio Testing Equipment. I enjoyed every minute I worked with the different kits; the Signal Tracer works fine. Also like to let you know that I feel proud of becoming a member of your Radio-TV Club."

Robert L. Shuff, 1534 Monroe Ave., Huntington, W. Va.: "Thought I would drop you a few lines to say that I received my Edu-Kit, and was really amazed that such a bargain can be had at such a low price. I have already started repairing radios and phonographs. My friends were really surprised to see me get into the swing of it so quickly. The Trouble-shooting Tester that comes with the kit is really swell, and finds the trouble, if there is any to be found."

## UNCONDITIONAL MONEY-BACK GUARANTEE

**ORDER DIRECT FROM AD—RECEIVE FREE BONUS  
RESISTOR AND CONDENSER KITS WORTH \$7**

- Send "Edu-Kit" postpaid. I enclose full payment of \$26.95.
- Send "Edu-Kit" C.O.D. I will pay \$26.95 plus postage.
- Rush me FREE descriptive literature concerning "Edu-Kit."

Name.....

Address.....

**PROGRESSIVE "EDU-KITS" INC.**

1186 Broadway, Dept. 613D, Hewlett, N. Y.

CIRCLE NO. 24 ON READER SERVICE PAGE

# Are You Sure That Your CB Transceiver is giving you... Best Results!

find out now with a  
**TRANSCHECK**

Measures power output from transmitter. Indicator for resonating transmitter power amplifier. Indicator for adjusting loading capacitor to antenna. Measures actual load into the antenna, beam or vertical. Checks power loss due to feedline mismatch.



Hammertone finish aluminum case size: 4 1/8" x 2 1/8" x 1 1/2". Operates with 52 ohm coaxial cable. Has coax connectors. Easy to use. Full instructions included.

**Model CB-52-C... only \$19.95**

For continued line insertion—no loading effect—no detuning effect—no appreciable power loss. Provides continual monitoring. Serves as a sensitive field strength meter. Has same applications but provides more measuring and checking facilities than Model CB-52-C. Size 5 1/4" x 2 1/4" x 2 1/4".



**Model CB-52-T... only \$24.95**

Don't get less than the best results from your CB equipment. Get a TRANSCHECK now and keep your sets operating at peak efficiency. It only takes a few minutes

to check out your troubles and correct them. Write for descriptive literature or see these fine Cesco Products at your distributor. If he can't supply you, send check or money order directly to us for prompt delivery.

*Cesco*  
DIVISION

**NEW-TRONICS CORP.**

3455 Vega Avenue, Dept. P, Cleveland 13, Ohio

CIRCLE NO. 20 ON READER SERVICE PAGE

## Tips

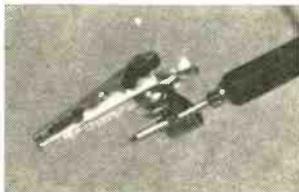
(Continued from page 12)

into service, as shown. Hooking the eye of the lug on the hook leaves one hand free to apply the iron, and permits the other hand to exert the pull needed to part lug and wire in the balky cases where the lug was crimped on before soldering.

—John A. Comstock

### IMPROMPTU TEST PROD CLIP

The lowly Fahnestock clip can be quickly pressed into service to convert a test prod to an alligator clip type, when the usual push-on clip is not at hand. Just fasten the Fahnestock clip to a spare alligator clip by means

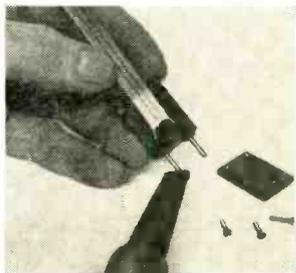


of the screw, and insert the end of the test prod in the spring connection of the Fahnestock clip, as shown, and you're in business.

—Robert E. Kelland

### PLUG-IN CONNECTOR FOR 300-OHM TWIN-LEAD

Connectors for 300-ohm ribbon transmission line can be bought at reasonable cost, but there are plenty of times when you need one right away, and the shop shelf is bare. If you have a spare crystal holder of the FT-243 variety, the problem is easily solved. If the crystal is still in the holder, disassemble the unit and remove it. Heat each pin with the soldering



iron and shake or blow out excess solder. Use a file to cut a groove in the Bakelite portion of the holder just wide and deep enough to fit snugly over the twin-lead you are using. Next, strip the conductors of the twin-lead back 5/8" to 3/4", clean and pre-tin them. Push them fully home in the crystal holder pins, solder, and reassemble the holder. Any standard crystal socket serves as a female connector on the receiver chassis.

—Waldo T. Boyd

Always say you saw it in—POPULAR ELECTRONICS

# POPULAR ELECTRONICS

## PRODUCT SERVICE PAGE

You can get additional information promptly concerning products advertised or mentioned editorially in this issue

**1** Circle the number on the coupon below which corresponds to the key number at the bottom of the advertisement or is incorporated in the editorial mention that interests you.

**2** Add up your total number of requests and fill in the box in the upper right-hand corner of the coupon.

**3** Mail the coupon to the address indicated below.

**4** Please use this coupon only for Product Service requests.

### POPULAR ELECTRONICS

P. O. BOX 8391  
PHILADELPHIA 1, PA.

NUMBER OF REQUESTS

*Please send me additional information about the products whose code numbers I have circled*

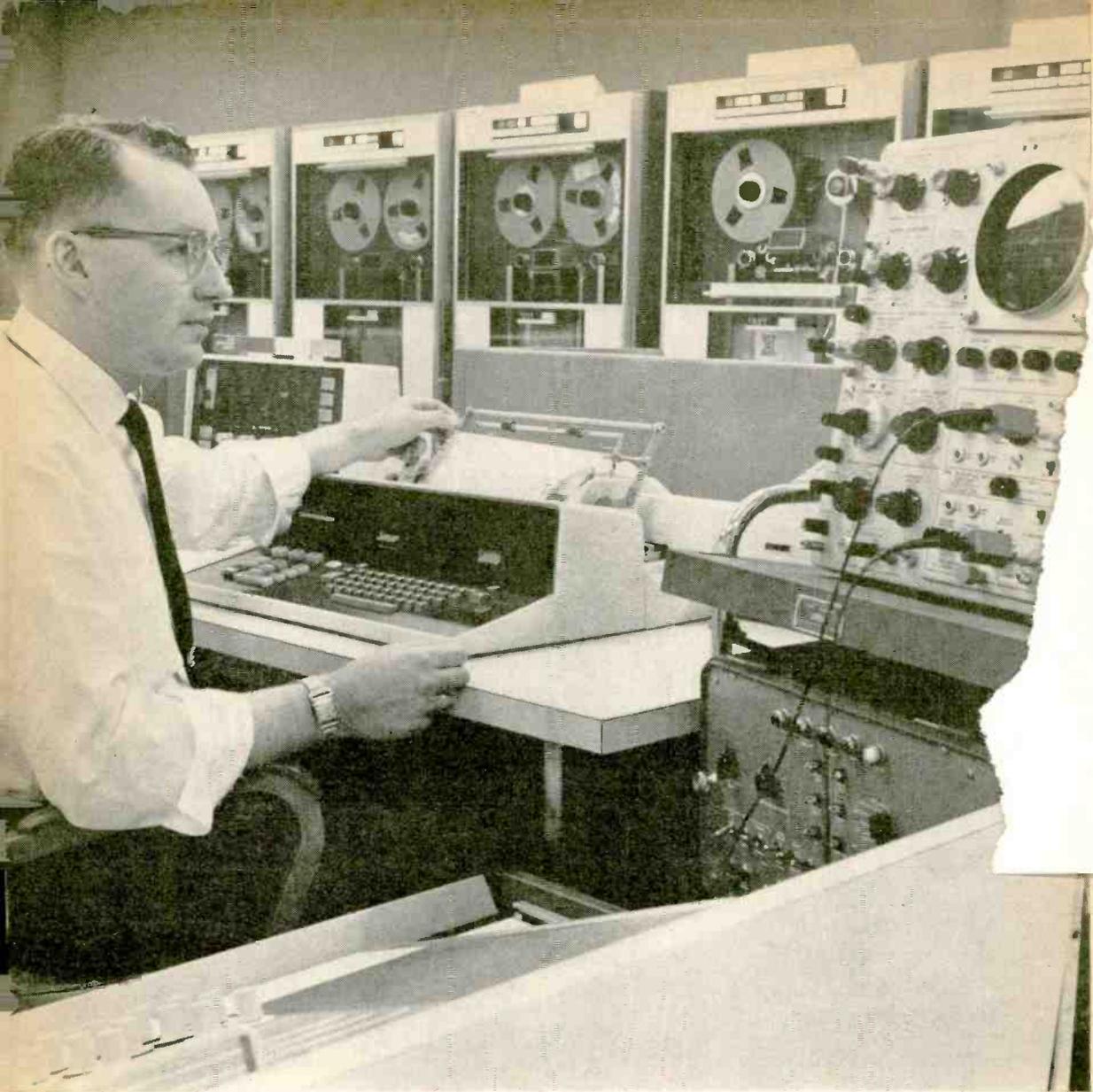
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25  
26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50  
51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75  
76 77 78 79 80 81 82 83 84 85 86 87 88 89 90 91 92 93 94 95 96 97 98 99 100

NAME (Print clearly) \_\_\_\_\_

ADDRESS \_\_\_\_\_

CITY \_\_\_\_\_ ZONE \_\_\_\_\_ STATE \_\_\_\_\_

**VOID AFTER FEBRUARY 29, 1964**



## Why Fred got a better job . . .

I laughed when Fred Williams, my old high school buddy and fellow worker, told me he was taking a Cleveland Institute Home Study course in electronics. But when our boss made him Senior Electronic Technician, it made me stop and think. Sure I'm glad Fred got the break . . . but why him . . . and not me? What's he got that I don't. There was only one answer . . . his Cleveland Institute Diploma and his First Class FCC License!

After congratulating Fred on his promotion, I asked him what gives. "I'm going to turn \$15 into \$15,000," he said. "My tuition at Cleveland Institute was only \$15 a month. But, my new job pays me \$15 a week more . . . that's \$780 more a year! In

twenty years . . . even if I don't get another penny increase . . . I will have earned \$15,600 more! It's that simple. I have a plan . . . and it works!"

What a return on his investment! Fred should have been elected most likely to succeed . . . he's on the right track. So am I now. I sent for my three free books a couple of months ago, and I'm well on my way to Fred's level. How about you? Will you be ready like Fred was when opportunity knocks? Take my advice and carefully read the important information on the opposite page. Then check your area of most interest on the postage-free reply card and drop it in the mail today. Find out how you can move up in electronics too.

# How You Can Succeed In Electronics

## . . . Select Your Future From Five Career Programs

### The "right" course for your career

Cleveland Institute offers not one, but five different and up-to-date Electronics Home Study Programs. Look them over. Pick the one that is "right" for you. Then mark your selection on the reply card and send it to us. In a few days you will have complete details . . . without obligation.

#### 1. Electronics Technology

A comprehensive program covering Automation, Communications, Computers, Industrial Controls, Television, Transistors, and preparation for a 1st Class FCC License.



#### 2. First Class FCC License

If you want a 1st Class FCC ticket *quickly*, this streamlined program will do the trick and enable you to maintain and service all types of transmitting equipment.



#### 3. Broadcast Engineering

Here's an excellent studio engineering program which will get you a 1st Class FCC License and teach you all about Program Transmission and Broadcast Transmitters.



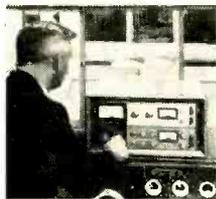
#### 4. Electronic Communications

Mobile Radio, Microwave, and 2nd Class FCC preparation are just a few of the topics covered in this "compact" program . . . Carrier Telephony too, if you so desire.



#### 5. Industrial Electronics & Automation

This exciting program includes many important subjects such as Computers, Electronic Heating and Welding, Industrial Controls, Servomechanisms, and Solid State Devices.



### An FCC License . . . or your money back!

In addition to providing you with comprehensive training in the area indicated, programs 1, 2, 3, and 4 will prepare you for a Commercial FCC License. In fact, we're so certain of their effectiveness, we make this *exclusive offer*:

The training programs described will prepare you for the FCC License specified. Should you fail to pass the FCC examination after completing the course, we will refund *all* tuition payments. You get an FCC License . . . or your money back!

### Cleveland Institute's new "Check-Point Plan" helps you learn faster and better

Cleveland Institute uses the new programmed learning approach. This "Check-Point Plan" presents facts and concepts in small, easy-to-understand bits . . . reinforces them with clear explanations and examples. Students learn more thoroughly and faster through this modern, simplified method. You too will absorb . . . retain . . . advance *at your own pace*.

### Job placement service . . . another CIE extra to help you get ahead in electronics

Once enrolled with CIE, you will get a bi-monthly listing of the many high-paying interesting jobs available with top companies throughout the country. Many Cleveland Institute students and graduates hold such jobs with leading companies like these: American Airlines, American Telephone and Telegraph, General Electric, General Telephone and Electronics, IBM, Motorola, North American Aviation, New York Central Railroad, Raytheon, RCA and Westinghouse.

### Electronics is a fast moving, dynamic industry . . . Cleveland Institute keeps you current

The Electron Bulletin is CIE's bi-monthly digest of new developments in the world's fastest growing industry. As a CIE student, you will get a free copy throughout your training to keep you up-to-date on Masers, Lasers, Solid State Devices, and other new inventions.



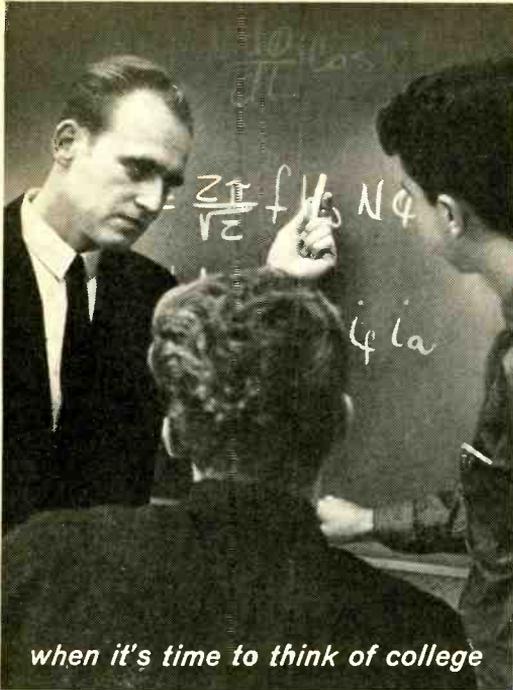
### Full accreditation . . . your assurance of competence and integrity

Cleveland Institute of Electronics is accredited by the Accrediting Commission of the National Home Study Council. You can be assured of competent electronics training by a staff of skilled electronics instructors.

**Your Future In Electronics Is Up To You. Make It A Brighter One. Mail Reply Card Today.**

# Cleveland Institute of Electronics

Dept. PE-14, 1776 E. 17th St., Cleveland 14, Ohio



when it's time to think of college

## find out about engineering at MSOE

Planning your education correctly now will enhance your career later! That's why you should obtain all the facts about MSOE programs in Electrical and Mechanical Engineering and Technology.

Learn about courses leading to 4-year Bachelor of Science and 2-year Associate in Applied Science degrees. Find out about MSOE scholarships, financial aids, job placement opportunities, and other services.

Assure yourself of a bright future in the exciting field of space age engineering and technology. Write for your free "Career" booklet which will tell you about educational advantages at MSOE.



# MSOE

**MILWAUKEE SCHOOL OF ENGINEERING** MS-214  
 Dept. PE-264, 1025 N. Milwaukee St.  
 Milwaukee, Wisconsin 53201

Tell me about an engineering career through residence study in:

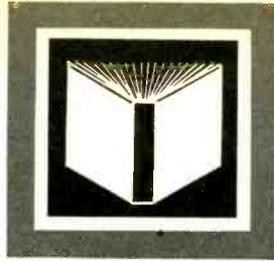
- Electrical fields       Mechanical fields

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

Address.....

City, State.....

CIRCLE NO. 35 ON READER SERVICE PAGE



## POP'tronics Bookshelf

### HI-FI PROJECTS FOR THE HOBBYIST

by Leonard Feldman

Approximately eight years ago, the Editor of POPULAR ELECTRONICS encouraged a budding audio specialist by the name of Len Feldman to design some gadgets for the hi-fi fan (monaural in those days). Len produced, and P.E. published, half a dozen projects that won excellent reader acceptance. During the interim from 1956 to 1963, Len remained very active in the hi-fi field, and as a part-time endeavor he assembled 20 build-it-yourself projects for this book. All of the projects are reasonably simple to construct, and each is complete within itself. Included are such items as a presence control, peak power indicator, scratch filter, stereo indicator, etc.—an excellent selection which should be enough to whet the appetite of any stereo fan with a home workshop. If your hi-fi setup is missing some gadget or circuit that the manufacturer "forgot to put in," take a look at Len's book. You'll buy it.

Published by Howard W. Sams, 4300 West 62 St., Indianapolis 6, Ind. 128 pages. Soft cover. \$2.50.

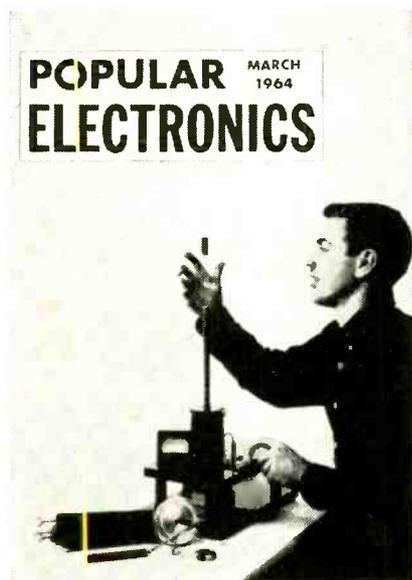


### A PROGRAMMED COURSE IN BASIC ELECTRICITY

Prepared by the New York Institute of Technology, this 7" x 10" publication carries the "workbook," or, in current terminology, the "programmed learning" idea to its ultimate extreme. Basically, the technique here is to present small bits of information and then ask a large number of questions that require a response from the reader. The chapters are devoted to the usual subjects up to, and including, a.c. circuit theory and resonance; they consist almost entirely of questions and answers. While anyone devoting the large amount of time required by the text to

Always say you saw it in—POPULAR ELECTRONICS

HERE ARE THREE  
CONSTRUCTION  
FEATURES YOU  
WON'T WANT  
TO MISS...  
YOU'LL GET THEM  
IN THE NEXT  
ISSUE OF  
POPULAR  
ELECTRONICS



#### THE STRANGE WORLD OF 60-CYCLE

**RESONANCE:** Every electronics experimenter is familiar with resonance and how it enables tuning in different radio or TV stations. But what happens when you build a device to resonate with the 60-cycle power line frequency? As well-known author, Walter Ford, relates it—all sorts of things can happen. You can build a "resonant motor" that operates without brushes. You can make an "electronic cannon" that will fire aluminum projectiles 10 feet into the air. Here's a construction project laced with useful theory that you'll want to build right away.

#### X-LINE BATTERY CHARGER

If you spent the last two months nervously watching the condition of your car battery—you're ready for the "X-line charger." It thinks for itself; just connect it to the car battery whenever you drive into the garage. You don't have to set the current or voltage and there's no chance of overcharging. Your "X-line charger" senses the condition of the battery automatically and charges it up to full-rate and then shuts itself off. When the battery goes down, the "X-line charger" goes on. This article describes how you can make this handy device from commonly available parts.

#### VHF AERO LISTENER

This VHF receiver is a little larger than the palm of your hand. It is self-contained, 100% transistorized, and drives its own built-in speaker. Tuning range is 108—132 megacycles, covering all of the VHF aeronautical channels. Besides this, it is ultra-sensitive and has an optional squelch adjustment. Unbelievable? Not really. Our do-it-yourself story will start you rushing for the workbench.

PICK UP YOUR COPY OF  
MARCH POPULAR ELECTRONICS  
AT YOUR FAVORITE NEWSSTAND.  
On sale February 20th—Only 35¢ a copy

# LATEST SAMS BOOKS FOR EVERYONE IN ELECTRONICS



## USE THIS HANDY ORDER FORM

- Practical Transistor Theory.** Up-to-date coverage of transistor devices, how they're used, how they work. Explains basic principles of transistor operation, describes typical circuits and operation of modern semiconductor devices. Order **PTW-1**, only. . . . \$2.95
- ABC's of Television.** Clearly explains the whole process of TV operations (black-and-white and color) from the studio cameras to the picture tube in the home TV receiver. You get a full understanding of basic TV transmission and reception principles with emphasis on how receivers work. **ATV-1**, only. . . . \$1.95
- Science Projects in Electricity/Electronics.** Demonstrates basic principles of electricity and electronics through the construction of fascinating projects that are not only instructive but useful. Ideal for self-learning or as science class project guide. Order **SPN-1**, only. \$2.95
  - Science Projects in Electricity. **SPE-1**, only. . . . \$2.95
  - Science Projects in Electronics. **SPJ-1**, only. . . . \$2.95
- Calculus for the Electronics Technician.** Provides a sound foundation in one of the basic mathematical processes necessary for a better understanding of electronics design. Anyone with a knowledge of high-school algebra can profit from this book. Order **CAL-1**, only. . . . \$4.95
- Closed Circuit TV Handbook.** The first complete guide to this increasingly important subject. Describes equipment and applications in education, business, industry, medicine, military, etc. Full details on CCTV planning, installation, operation, and service. Order **CLC-1**, only. . . . \$7.95
- Passive Audio Network Design.** Practical, ready reference handbook for audio technicians and engineers, providing full information on the circuit design, construction, operation, and testing of passive networks. Order **AHT-1**, only. . . . \$4.95
- How to Read Schematic Diagrams. **RSD-1**. . . . \$1.50
- Computer Circuit Projects You Can Build. **BOC-1**. . . . 2.95
- TV Diagnosis & Repair. **TDR-1**. . . . 1.50
- Radio Receiver Servicing. **RS-2**. . . . 2.95
- Modern Dictionary of Electronics. **DIC-2**. . . . 6.95
- TV Servicing Guide. **SGS-1**. . . . 2.00
- Handbook of Electronic Tables & Formulas. **HTF-2**. . . . 3.95
- Electronic Experiments & Projects. **ESE-1**. . . . 2.50
- Tube Substitution Handbook. **TUB-7**. . . . 1.50
- 101 Ways to Use Your VOM & VTVM. . . . 2.00
- Understanding Transformers & Coils. **TAC-1**. . . . 1.95
- Automotive Electronics Test Equipment. **AEL-1**. . . . 2.50
- How to Repair Major Appliances. **MAJ-1**. . . . 3.95

### Famous ABC's Books

- Computer Programming. **CPL-1**. \$1.95
- Electronics Drafting. **DRA-1** \$1.95
- Boolean Algebra. **BAB-1**. 1.95
- Transistors. **TRA-1** 1.25
- Electronic Test Equipment. **STE-1** 1.95
- Electronic Organs. **ECO-1** 1.95
- Electronics. **ELW-1**. 1.95
- Lasers & Masers. **LAL-1**. 1.95
- Short-Wave Listening. **SWL-1**. 1.95
- Computers 1.95

## HOWARD W. SAMS & CO., INC.

Order from any Electronic Parts Distributor or mail to Howard W. Sams & Co., Inc., Dept. PE-2  
4300 W. 62nd St., Indianapolis 6, Ind.

Send books checked above. \$\_\_\_\_\_ enclosed.

Send FREE Booklist.  Send Photofact Index.

Name \_\_\_\_\_

Address \_\_\_\_\_

City \_\_\_\_\_ Zone \_\_\_\_\_ State \_\_\_\_\_

IN CANADA: A. C. Simmonds & Sons, Ltd., Toronto 7

CIRCLE NO. 26 ON READER SERVICE PAGE

## Bookshelf

(Continued from page 20)

"complete" it will certainly learn the subject thoroughly, your reviewer is among those who tend to look askance at this so-called method of teaching.

Published by McGraw-Hill Book Company, Inc., 330 W. 42 St., New York, N.Y. 333 pages. Soft cover. \$6.95.



## PRACTICAL PROJECTS IN RADIO-ELECTRONICS

by Samuel L. Marshall and Irving Tepper

A listing of the chapter headings (or, rather, "Job" headings, to use this book's terminology) reveals its limited depth: "Forming Splices," "Fabricating a Speaker Grille," "Constructing a Diode Receiver," "Installing a Radio-Phonograph Switch," "Construction of a Mixer-Oscillator Circuit," etc. The title is somewhat misleading. The "projects" are practical only insofar as they serve as manual training devices (theory is introduced only where necessary) for the neophyte technician. The projects referred to are not practical in the sense of being especially useful. It is in the area of manual training—perhaps at the junior or senior high level—that this book would have its greatest usefulness.

Published by Howard W. Sams & Co., Inc., 4300 West 62 St., Indianapolis 6, Ind. Soft cover. 317 pages. \$4.95.

## CAPSULE REVIEWS

### ESSENTIAL CHARACTERISTICS, tenth edition

G.E.'s handy reference text on tubes, CRT's, and capacitors features base diagrams on separate "strip" pages at the bottom of the book with this edition. Published by General Electric Co., 3800 N. Milwaukee Ave., Chicago, Ill. Soft cover. 302 pages. \$1.50 . . . **ABC'S OF MODERN RADIO** by Walter G. Salm . . . Written for the layman, this latest book in the Sam's "ABC" series gives the reader a quick look at modern AM and FM receivers. Published by Howard W. Sams & Co., Inc., 4300 W. 62 St., Indianapolis 6, Ind. 128 pages. Soft cover. \$1.95 . . . **150 SCIENCE EXPERIMENTS STEP-BY-STEP** by Judith Viorst . . . Not in the field of electronics but of interest to science fair entrants, this paperback contains experiments in the fields of chemistry, physics, biology, weather, and numbers. Published by Bantam Books, Inc., 414 East Golf Rd., Des Plaines, Ill. Soft cover. 180 pages. \$ .60.

Always say you saw it in—POPULAR ELECTRONICS



# FREE LAFAYETTE RADIO ELECTRONICS

1964 Catalog No. 640

**422 GIANT SIZE PAGES**

## LAFAYETTE

"WORLD'S HI-FI & ELECTRONICS SHOPPING CENTER"

**GIVES YOU MORE IN '64!**

**MORE STEREO HI-FI • MORE C.B. EQUIPMENT**  
**• MORE TAPE RECORDERS • MORE HAM GEAR**  
**• MORE TEST EQUIPMENT • MORE TOOLS**  
**• MORE BOOKS • MORE P.A. EQUIPMENT**  
**• MORE RADIO & T.V. ACCESSORIES**

**MORE BUYING POWER**—choose from Lafayette's three Easy-Pay Credit Plans. Up to 24 months to pay, as little as \$5 monthly.



LA-224WX

**LAFAYETTE**  
**24-WATT STEREO**  
**AMPLIFIER**

LA-224WX

**49<sup>95</sup>**

- Freq. Resp. 20-25,000 CPS  $\pm 1$  db at 1 Watt
- Full Range of Stereo Control Facilities
- Low Distortion, Low Hum and Noise
- With Cage and Legs • Imported

**LAFAYETTE**  
**AMATEUR**  
**COMMUNICATIONS**  
**RECEIVER**



HE-30WX

KT-320WX

Semi-Kit **64<sup>95</sup>**

- 4-Band Coverage
- 8 Tubes plus Rectifier Tube
- Illuminated Slide-Rule Dial
- Built-in Q Multiplier
- Imported

HE-30WX

Wired **79<sup>95</sup>**

**LAFAYETTE**  
**ALL-TRANSISTOR**  
**C.B. "WALKIE-TALKIE"**

HA-70L  
**10<sup>95</sup>**  
 each  
 2-for-21.00



HA-70L

- Completely Wired — Not A Kit
- Great Fun for Kids Too
- Sensitive Super-regenerative Circuit
- With Antenna, Transmit Crystal, Battery • Imported

**LAFAYETTE**  
**4-TRACK STEREO**  
**RECORD/PLAYBACK**  
**TAPE DECK**

- Built-in Transistorized Record/Playback Preamps
- 2 Level Indicator Meters
- Records Sound-on-Sound
- Complete with Cables, Empty Reel • Imported



RK-140WX

RK-140WX  
 less case **99<sup>50</sup>**

RK-143WX  
 with case **114<sup>50</sup>**

**LAFAYETTE**  
**DELUXE C.B.**  
**TRANSCEIVER**

- 8 Crystal Receive and 8 Crystal Transmit Positions
- Built-in Selective Call Circuitry and Socket
- Dependable Relay Switching
- Push-To-Talk Ceramic Mike

HE-20CWX  
**109<sup>50</sup>**

MADE IN U.S.A.



HE-20CWX

**Our World-Wide Mailing Service Sends Your Christmas Gift Anywhere—At Home or Abroad**

**Mail the Coupon for Your**  
**FREE 1964 Lafayette Catalog**

LAFAYETTE MAIL ORDER & L. I. SALES CENTER  
 111 Jericho Turnpike, Syosset, L.I., N.Y.

OTHER LOCATIONS

Jamaica, N. Y.  
 Scarsdale, N. Y.  
 New York, N. Y.  
 Bronx, N. Y.

Newark, N. J.  
 Plainfield, N. J.  
 Paramus, N. J.  
 Boston, Mass.

Natick, Mass.

**LAFAYETTE Radio ELECTRONICS** Dept. 1B-4  
 P.O. Box 10, Syosset, L. I., N. Y. 11791

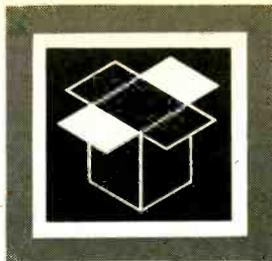
- Send me Stock No. \_\_\_\_\_ shipping charges collect.  
 \$ \_\_\_\_\_ enclosed.  
 I would like to order Stock No. \_\_\_\_\_ on the Easy-Pay Credit Plan.

Name \_\_\_\_\_  
 Address \_\_\_\_\_  
 City \_\_\_\_\_ Zone \_\_\_\_\_ State \_\_\_\_\_



Send me the  
**FREE 1964**  
**Lafayette**  
**Catalog 640**

CIRCLE NO. 17 ON READER SERVICE PAGE



## New Products

Additional information on products covered in this section is available from the manufacturers. Each new product is identified by a code number. To obtain further details on any of them, simply fill in and mail the coupon which appears on page 15.

### STEREO 15° DYNETIC CARTRIDGE

**75** Shure Brothers, Inc., has announced a radically new stereo dynetic cartridge with a no-scratch, retractile stylus that tracks at an effective vertical angle of 15 degrees. Called the M44, the new cartridge tracks records with the same effective vertical



stylus angle major recording companies now use for cutting master records. This reduces IM and harmonic distortion due to vertical

tracking error by 75 to 90 per cent. Frequency response is virtually flat from 20 to 20,000 cycles, channel separation is greater than 25 db at 1000 cycles, and compliance is  $25 \times 10^{-6}$  cm/dyne for the M44-5 with a .0005" diamond stylus,  $20 \times 10^{-6}$  for the M44-7 with a .0007" diamond stylus. Prices: M44-5, \$49.50; M44-7, \$44.50. (Shure Brothers, Inc., 222 Hartrey Ave., Evanston, Ill.)

### RELAY SERVICING TOOL KIT

**76** Designed principally for adjusting and maintaining relays and telecommunications equipment, the new Jonard Model K-55 15-piece tool kit is also suitable for use in working on other types of electronic devices. All of the tools are made of high-quality carbon steel with heavy chrome plating. They consist of two spring adjusters, duck-bill pliers, inspection mirror, armature bender, contact burnisher, tension gauge, screwdriver, 4-way tool, stop bender, thickness gauge, tweezers, selector switch brush, contact spray, and 12 replacement blades for the contact burnisher.

The kit is supplied in a heavy vinyl plastic case, with individual pockets for each tool. Price, \$26.90. (Jonard Industries Corp., Precision Tools Division, 3733 Riverdale Ave., Bronx 63, N.Y.)

### AMATEUR TRANSMITTER

**77** The HT-44 table-top transmitter announced by Hallicrafters provides the amateur radio operator with SSB, AM, and c.w. operation. It is systems-engineered to transceive with Hallicrafters' SX-117 receiver, but can be operated as an independent transmitter if desired. Features of the HT-44 include automatic amplified limiting



control plus full VOX, press-to-talk, and full c.w. break-in. In the AM position, carrier and both sidebands are transmitted for true AM. A stabilized phasing system is used for SSB generation. Price, \$395. A companion power supply, the P-150, which contains a built-in speaker and sells for \$99.95, is recommended for use with the HT-44. (Hallicrafters, 5th & Kostner Aves., Chicago 24, Ill.)

### FM STEREO TUNER-AMPLIFIER

**78** An FM stereo tuner and a 36-watt stereo amplifier have been incorporated on one chassis by EICO. The Model 2536 is available both as a kit and factory-wired. In the kit version, two of the most critical sections—the front end and the i.f. strip—are entirely prewired and prealigned



A high-quality circuit board is provided for the stereo demodulator and the coils supplied are also prealigned. The stereo amplifier provides 36 watts IHFM music power and 28 watts continuous power. Harmonic distortion at 10 watts per channel, 40 cycles, is 0.5%, and IM distortion at the 1 watt per channel level is down to 0.25%.

Magnetic phono or adapted ceramic phono, tuner, tape and auxiliary inputs are provided. Prices: \$229.95 wired; \$154.95 as a kit. (*Eico Electronic Instrument Co., Inc.*, 33-00 Northern Blvd., L. I. City 1, N. Y.)

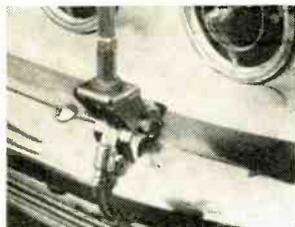
#### SIX-CHANNEL CB TRANSCEIVER

**79** The six-channel RAY-TEL TWR-4 CB transceiver has a built-in S-meter for monitoring transmitter and receiver performance, and is prewired with an external socket to accommodate a selective calling unit. Trim tabs provide precision frequency control. Automatic volume control and adjustable squelch combine to give the TWR-4 optimum reception. It's usable either as a mobile or a fixed installation. Price, \$179.95. (*Raytheon Distributor Products*, 55 Chapel St., Newton, Mass., 02158)



#### HEAVY-DUTY BUMPER MOUNT

**80** An extra-long stainless steel strap with worm adjustment enables Webster Manufacturing's new Band Spanner H-215 heavy-duty bumper mount for two-way radio antennas to be attached to all late-



model auto bumpers. Made from rust-free metals, the base is a bronze die casting with a heavy chrome plating, and the bracket, of stainless steel,

can be adjusted to a vertical position regardless of its placement on the bumper. Accepting all standard  $\frac{3}{8}$ -24" butt antennas, the brass whip socket is secured to the bracket with a sturdy  $\frac{3}{8}$ " stud. Price, \$14.20. (*Webster Manufacturing*, 317 Roebling Rd., South San Francisco, Calif.)

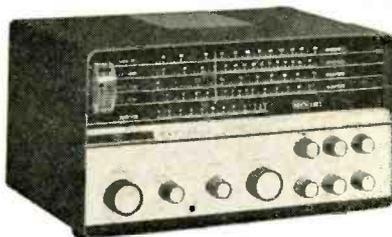
#### 80-WATT STEREO AMPLIFIER

**81** Each channel of the Sherwood S-5500-III stereo amplifier provides 40 watts of music power, or 36 watts continuous at 1½% IM distortion; there are speaker outputs for 16, 8 and 4 ohms. The phono channel features a filtered d.c. heater supply for very low noise and hum (measuring 72 db below rated output), and phono input sensitivity of 1.2 microvolts. Tape head sensitivity is 1.6 microvolts, tuner sensitivity

0.25 volt. The frequency response of the S-5500III is  $\pm \frac{1}{2}$  db from 20 to 20,000 cycles. Price: \$174.50; walnut leatherette case optional at \$7.50 extra. (*Sherwood Electronic Laboratories, Inc.*, 4300 N. California Ave., Chicago, Ill., 60618)

#### GENERAL-COVERAGE RECEIVER

**82** National Radio's NC-121 provides continuous coverage from 550 kc. to 30 mc. in four bands, an illuminated edge-reading signal strength meter, and a peaking Q-multiplier for optimum selectivity. Other features include handsread calibration charts for all popular foreign and amateur broadcast bands, separate r.f. and audio gain controls, SSB/c.w./a.g.c. control, prod-



uct detector, automatic series-gate noise limiter, and a transformer-operated power supply. A 5" speaker is built in. Price, \$129.95 with steel cabinet, \$149.95 with oiled walnut cabinet. (*National Radio Co., Inc.*, Dept. P, 37 Washingtgon St., Melrose 76, Mass.)

#### LOW-COST R.F. SIGNAL GENERATOR

**83** The stable, wide-range design of Lafayette's low-cost (imported) TE-20A signal generator makes it especially useful for i.f.-r.f. alignment, audio signal tracing, TV linearity checks, etc. The selector switch gives instant choice of six overlapping frequency ranges covering 120 kc. to 130 mc. on fundamentals, with harmonics usable to 380 mc. Outputs are unmodulated r.f., modulated r.f., and 400 cycles audio. The r.f. output is in excess of 100,000 microvolts. Stability is insured by a circuit which uses a 12BH7 twin-triode cathode follower-buffer and a 6AR5 a.f. oscillator. The a.f. output is 2-3 volts, a.f. input 4 volts across 1 megohm. Price, \$27.95. (*Lafayette Radio Electronics Corp.*, 111 Jericho Turnpike, Syosset, L.I., N.Y.)

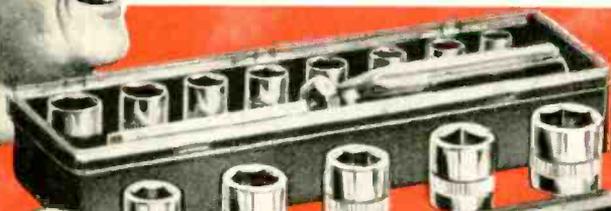




For home users...repairmen...

**GREATEST SOCKET WRENCH**

**111 pc. FORGED SELECT STEEL...**



**FULL PLATED  
12 Pc. 1/4" DRIVE  
SOCKET SET**

From 1/4" to 1/2" sockets, 4" L handle, 3 3/4" extens. on, 6 1/2" combination spinner handle and screwdriver. Sectional plastic case with hinged top.

**21 Pc. CHROME  
ADJUSTABLE  
HACKSAW SET**

Includes chrome plated frame and sure-grip handle. 10 medium blades, 10 coarse blades. Adjustable from 10" to 12".

**3 Pc. SCREWDRIVER SET**

**10 Pc. FEELER  
GAUGE SET**

From .002 to .025 blades.

**18 Pc. IGNITION SET**

**YOU GET ALL THIS**

- 10 1/2" Square Drive Sockets: 7/16" to 1"
- 1 5 1/2" Extension
- 1 10" Extension
- 1 Reversible Ratchet
- 1 15 1/2" Swing Head Handle
- 6 1/4" Drive Sockets, Hex Openings: 1/4" to 1/2"
- 2 1/4" Drive Sockets, Square Openings: 1/4" - 5/16"
- 1 Combination Plastic Spinner Handle and Screwdriver
- 1 4" L Handle
- 1 3 3/4" Extension
- 1 Plastic Socket Holder Box
- 4 Box Wrenches: 3/8" x 7/16" to 13/16" x 7/8"
- 6 Combination Wrenches: 3/8" to 3/4"
- 5 Open End Wrenches: 5/16" x 11/32" to 13/16" x 7/8"
- 9 Allen Type Wrenches: 1/16" to 5/16"
- 1 Plastic Carrying Roll
- 1 6" Combination Plier
- 2 Offset Screwdrivers: 1/4" Regular, \$2 Phillips type
- 1 Hack Saw
- 10 Coarse Hack Saw Blades
- 10 Medium Hack Saw Blades
- 2 Cold Chisels: 1/2" - 5/8"
- 1 Long Taper Punch
- 2 Plastic Handle Electrician's Screwdrivers
- 1 Plastic Handled Phillips Type Screwdriver
- 8 Ignition Wrenches: 13/64" x 15/64" to 11/32" x 3/8"
- 1 Ignition Screwdriver
- 1 Ignition Point File
- 7 Piece Spark Plug Gap Setter and Gauge, Blades .025 to .040
- 1 Plastic Carrying Roll
- 10 Piece Feeler Gauge, Blades .002 to .025 and steel ruler in stock holder
- 1 Metal Tool Box
- 1 Removable Tote Tray

**2 Pc. OFFSET  
SCREWDRIVER  
SET**

**10 Pc.  
SET SCREW  
WRENCH SET\***

From 1/16" to 1/8" wrenches, Snap-tite plastic carrying case.

**5 Pc.\*  
OPEN END  
WRENCH  
SET**

10 openings from 1/16" to 3/8"

**4 Pc.\*  
BOX  
WRENCH SET**

8 openings from 1/4" to 3/4"

**mechanics...production men...**

**TOOL VALUE EVER OFFERED!**

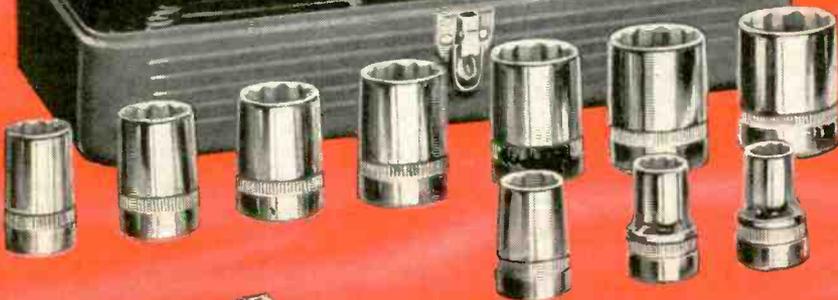
# SOCKET WRENCH and TOOL SET



**HEAVY GAUGE METAL HIP ROOF TOOL CHEST**  
 Also ideal for use as a Picnic Pack, Tackle Box or Storage Chest. Rugged, long lasting construction...attractive durable finish. With removable metal carrying tray. Specially designed to hold complete 111 piece set as well as additional equipment. 8" x 7 1/4" x 19".



**6 Pc.\* COMBINATION WRENCH SET**  
 From 3/8" to 1 1/4" wrenches



**COMBINATION PLIERS**



**ALL CHROME 14 Pc. 1/2" SQUARE DRIVE SOCKET SET**  
 From 3/16" to 1" sockets, 1/4" reversible ratchet, 15 1/2" swing head handle, 5 1/2" and 10" extensions.



**3 Pc. PUNCH and CHISEL SET**

**These 111 Tools**  
**\$49.95**  
**NOW ONLY**

**FREE! CONTINUITY TESTER**



You can't lose! This valuable Continuity Tester is yours FREE—even if you return the Socket Wrench Set after using it for the full trial period. Send for yours today!

**CLIP AND MAIL TODAY**

FINGERHUT PRODUCTS CO., 3104 W. Lake St., Minneapolis 16, Minn.

Send me your complete, 111 piece Sloan-Ashland Socket Wrench and Tool Set plus the free Continuity Tester. I understand I may use it for ten days free, and return it at your expense if I am not fully satisfied.

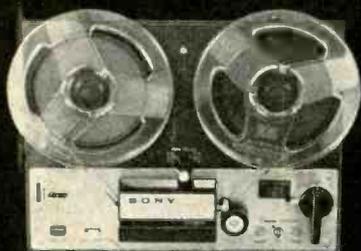
If I agree to keep it, I will pay only \$5.00 a month until I have paid the low price of just \$49.95 (plus shipping and handling). The Continuity Tester is mine to keep whether or not I decide to keep the Socket Wrench and Tool Set.

I am enclosing full payment of \$49.95 with the understanding that you will pay all shipping and handling charges. (Full money back guarantee!)

Name .....  
 Street ..... (Please print)  
 City ..... Zone ..... State .....  
 Where employed .....  
 Home phone number ..... 1207

\*ALL THESE TOOLS EXCEED GOVERNMENT TORQUE SPECIFICATIONS

**All new  
from Sony**



**a stereo deck  
with 3 heads!**



**and stereo  
recording amplifier**

Now you can add famous Sony 4 track stereo tape playback to your present hi fi system. Handsomely styled in gold and grey, with 3 heads, 2 speeds, vertical or horizontal mounting, automatic shut-off, tape counter and pause control, the new Sony 263-D is a remarkable value.

**Less than \$119.50**

For stereo recording, add the new Sony SRA-2L recording amplifier that instantly connects to the 263-D. Its matching gold and grey decor makes a handsome companion for your 263-D. All new from Sony!

**Less than \$99.50**

■ All Sony Stereorecorders are Multiplex Ready! ■ In New York visit the Sony Salon, 585 Fifth Avenue ■ For literature or name of nearest dealer write Superscope, Inc., Dept. F, Sun Valley, Calif. *The Tapeway to Stereo*

**SONY SUPERSCOPE**

**CIRCLE NO. 29 ON READER SERVICE PAGE**



## Letters from our Readers

Address correspondence for this department to:  
Letters Editor, POPULAR ELECTRONICS  
One Park Avenue, New York 16, N. Y.

### Monitoring Satellite Transmissions

■ I plan to build "The NASA-136" converter (June, 1962) for satellite listening, but I have a question: How can you tell which satellite is transmitting, and how do you go about getting a report verified? I faithfully read the "Satellites On The Air" column in POPULAR ELECTRONICS.

ROBERT DOCKERY, WPE4EPE  
Asheville, N.C.

*Good questions, Bob. About the only way to tell satellite transmissions apart is by frequency. Unfortunately, the accuracy required at the receiving end is of a high order—a frequency meter for setting the receiver (in the 15-meter band, since the receiver acts as a tunable i.f.) is almost a "must." To the best of our knowledge, satellite reception reports are not now being acknowledged.*

### "Rock-Bottom" Receiver Wanted

■ I enjoyed the article on VLF radio ("How We're Using 'Rock-Bottom' Radio," December, 1963) and would like to build a receiver for these frequencies. In addition to plans for a VLF receiver, how about publishing information on a frequency standard with output at 1, 10, and 100 kc., and at 1 mc., using a single 100 kc. crystal?

DALE A. POBLENZ, WA8FRD  
Wyandotte, Mich.

*A VLF receiver is in the works, Dale, and we hope to feature it in the near future. On the frequency standard, the circuitry required would be complex and expensive, requiring at least several multivibrators. Adjustment would also be critical. We feel that such a project would be of limited appeal in view of the problems involved.*

### Improved Mobile Rigs?

■ After reading the "CB Equipment Buyers Guide" in the August, 1963, issue, I'm prompted to ask why some manufacturer can't come up with a CB transceiver expressly for MOBILE use. Every year more and more big boxes turn up, and they keep getting heavier, larger, and more expensive. A mobile user doesn't need a lot of fancy added features such as variable tuning, crystal spotting, tuning meters, r.f. gain controls, and other things designed for the sit-at-home knob-twister. Taking a cue from the other mobile services, the ideal mobile CB rig should consist of: (1) a small speaker housed in a metal box with mounting bracket; (2) control box with

Always say you saw it in—POPULAR ELECTRONICS

# TOP PERFORMANCE AT ROCK-BOTTOM COST

With money-saving RCA Electronic Instrument Kits



## RCA WV-76A (K) HIGH SENSITIVITY AC VTVM KIT

Measures AC Voltages .0002-volt to 500 Volts  
Doubles as a Pre-amplifier

An exceptional two-way kit value! As a high sensitivity AC VTVM the new RCA WV-76A measures AC voltages from 10 mv to 100 v full-scale in nine overlapping ranges; special "low-cap" switch on probe extends upper range limit to 500 v. As a flat-response preamplifier, it provides a 3E db maximum gain on the 10 mv range.

- Flat frequency response  $\pm 1$  db from 10 cps to 1.5 Mc with probe or "direct"; and from 10 cps to 500 kc with probe switched to "low-cap."
- High input impedance for accurate measurements in circuits sensitive to loading.
- Easy-to-use, direct-reading decibel scales.
- Pre-assembled shielded probe and cable, all-metal case eliminate stray pickup.
- Large power-supply filter minimizes hum.
- Compact, lightweight, portable.

Kit price: only \$57.95\* • Factory-wired and calibrated: \$79.95\*



RCA WV-96C (K)  
SENIOR VOLT-OHM-METER KIT

Special 0.5-volt DC range for transistor circuits. Measures AC voltages 0.2 to 4200 peak-to-peak—including complex waves—ac 0.1 to 1500 rms; DC voltages 0.01 to 1500. Resistances 0.2 ohm to 1,000 megohms. Pre-assembled AC/DC CHMS probe. Big 6 1/2" meter. AC, DC accuracy  $\pm 3\%$  FS.

Kit: \$57.95\* Factory Wired \$79.95\*



RCA WV-77E (K) VOLT-OHM-METER KIT

Separate 1.5-volt rms and 4-volt peak-to-peak scales for accurate low AC measurements. Measures AC and DC voltages to 1500 volts, resistances from 0.2 ohm to 1,000 megohms. Ultra-thin probes, long flexible leads.

Kit: \$29.95\* Factory Wired \$45.95\*



RCA WV-38A (K)  
VOLT-OHM-MILLIAMMETER KIT

Accurately measures AC and DC volts, ohms, DC current, and capacitance. Special 0.25-volt and 1.0-volt DC ranges. 5 1/2" meter in plastic case—no glass to crack or shatter. Jacks on a side below switches to keep leads out of the way. Spring clips on handle to hold leads.

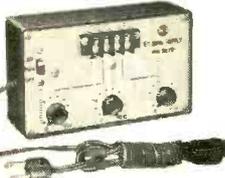
Kit: \$29.95\* Factory Wired \$43.95\*



RCA WD-33A (K) PORTABLE SCOPE KIT

For troubleshooting B&W and color TV, radio, hi-fi, tape recorder. Exceptional gain and bandwidth (response to 5.6 Mc) for toughest jobs. Scaled graph screen and integral calibrating voltage source for precise reading of peak-to-peak voltage. Supplied with direct/low-cap shielded cable.

Kit: \$79.95\* Factory Wired \$129.95\*



RCA WC-307B (K) TV BIAS SUPPLY KIT  
Three separate DC output voltages each adjustable from 0 to 15 volts provide bias voltages for a triggering RF and other circuits of color and black-and-white TV receivers. KR: \$11.95\*

## See them all at your Authorized RCA Electronic Instrument Distributor

For specifications and technical data on individual kits, write Commercial Engineering, Sect on B-133-W, RCA Electronic Components and Devices, Harrison, N. J.



RCA WE-93A (K) TRANSISTOR-RADIO  
DYNAMIC DEMONSTRATION KIT

Working six-transistor radio in color-coded panel board for instructional and demonstration purposes. Removable components includes 64-page RCA transistor manual containing detailed data on 373 semiconductor devices, representative transistor circuits, basic theory. Kit: \$39.95\*



RCA WE-95A (K) VOLT-OHM-MILLIAMMETER  
DYNAMIC DEMONSTRATION KIT

A functional, accurate V-O-M layout on panel board for instruction and demonstration. Each basic circuit separately color-coded. Measures AC volts, DC volts, DC current, ac ohms. One of the most useful test instruments in electronics. Kit: \$27.95\*

\*User price (post paid).



The Most Trusted Name in Electronics

# Jobs look for YOU in ELECTRONICS

Learn FAST—EARN FAST with  
MTI'S Unique  
Exclusive Training.

Whether it's a BIG PAY JOB you want or the chance to be YOUR OWN BOSS—your big opportunity today is WAITING for YOU in ELECTRONICS! MTI's unique SELECT-A-SKILL method quickly, easily qualifies you for the type of electronic work that's exactly right for YOU—COMMUNICATIONS ELECTRONICS, INDUSTRIAL ELECTRONICS, or RADIO & TV SERVICING. Previous experience proved unnecessary. Age no obstacle. You learn by doing, using your hands as well as your head—building electronic equipment, testing and experimenting with SEVEN BIG MASTER ELECTRONIC KITS! Train at home, in leisure time or through resident courses in Jacksonville. And you can earn while you learn!

MAIL COUPON TODAY for FREE BOOK and MTI's unique SELECT-A-SKILL Opportunity Finder that can take the guesswork out of YOUR FUTURE!

An ACCREDITED Member, National Home Study Council

MASSEY TECHNICAL INSTITUTE  
Dept. 11-BB-02, Jacksonville 6, Florida

Please rush to me, without obligation your FREE BOOK "Pick Your New World of Opportunity in Electronics" PLUS your SELECT-A-SKILL Opportunity Finder.

MASSEY TECHNICAL INSTITUTE  
Dept. 11-BB-02, Jacksonville 6, Florida  
I am interested in:  
 Home Training     Classroom Training  
Name \_\_\_\_\_  
Address \_\_\_\_\_  
City \_\_\_\_\_ Zone \_\_\_\_\_ State \_\_\_\_\_



## SKILLS PAY BILLS

With millions unemployed—there is NO PLACE for men without special skills! Let MTI give you the training you NEED to insure your future!



## Letters

(Continued from page 28)

on-off, crystal, squelch and volume controls; (3) trunk-mounted transceiver chassis. The control box could be quite small—very easy to mount on or under the dash. The coax run to a bumper-mounted antenna could be kept short for good efficiency with the transceiver in the trunk.

LAWRENCE W. CONFER, Capt., USAF  
Warner Robins, Ga.

We agree that some of the features suggested by Capt. Confer are highly desirable, but there are also a number of drawbacks. A separate control box-transceiver arrangement means that a multi-conductor control cable must be strung through the car back to the trunk; ditto for power cables. Lastly, crystal switching could be a real problem. Conclusion? A de luxe mobile could be designed along these lines, but the price would be high and installation awkward.

## Using Salvaged Components

■ As a devoted reader of your magazine since 1960, I have just one complaint. All of your projects are built from new, and often expensive, components. Even projects termed "inexpensive" can be quite costly to a student who has only a small allowance to work with, and there are a great many students among the ranks of electronic hobbyists. How about publishing projects which can be assembled from old TV sets, radios or surplus equipment?

DANIEL L. RAISKIN, WB2DWL  
Far Rockaway, N.Y.

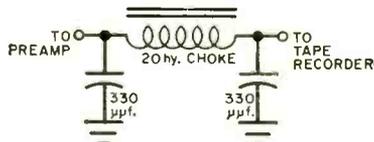
We agree with you in principle, Dan, but the practicalities go a bit deeper. Actually, a large percentage of the projects published in POPULAR ELECTRONICS can be built with salvaged components. The only problems are that the builder must have test equipment (a VOM is minimal) and a good knowledge of components to be able to make such substitutions. By specifying exact parts, we hope to please everybody—those who have a well-stocked junk box and know how to use it, and those who must buy parts because they lack the knowledge or materials to make substitutions.

## Scratch Filter for 78 RPM Records

■ I have several hundred old 78 rpm records that I would like to record on tape, but most of them have too much surface scratch to make this worthwhile. Can you tell me how to build a scratch filter to solve this problem? Also, should it be placed in the pickup leads or between the phono preamp and the input of the tape recorder?

GUY H. ALBRIGHT  
Idleale, Colo.

While it would be impossible to recommend a specific filter arrangement—this depends on the type of cartridge you are using—a 100,000-ohm potentiometer



across the pickup leads will work with some magnetic cartridges (G.E. types, for example). Actually, though, you should be able to achieve about the same effect by setting the amplifier treble control at a low level. Another possibility would be to try the capacitor-

Always say you saw it in—POPULAR ELECTRONICS

# FREE INTERNATIONAL CATALOG



## YOUR 1964 BUYING GUIDE

FOR PRECISION  
MADE RADIO  
CRYSTALS AND  
ELECTRONIC  
EQUIPMENT

International Crystal Mfg. Co., Inc. P64  
18 North Lee, Oklahoma City, Okla.

Rush 1964 Catalog

Name \_\_\_\_\_

Please Print

Address \_\_\_\_\_

City \_\_\_\_\_ Zone \_\_\_\_\_ State \_\_\_\_\_

Circle No. 15 on Reader Service Page

# You get two very important benefits from this great new CB transceiver:

1. *Hallicrafters performance standards.*
2. *Change from a \$100 bill.*



## NEW CB-7

six channel citizens band  
TRANSCEIVER

**\$99<sup>95</sup>**  
complete

You also get a flock of other, very useful benefits that help to make the CB-7 the greatest transceiver value in citizens band history.

- New design concepts give you great economy with no sacrifice in performance.
- Six channel, crystal-controlled convenience.
- New all-electronic push-to-talk circuitry.
- Highly compact new size (only 12" x 5" x 7") . . . same great "drop-down" chassis feature as CB-3 series.
- Nothing else to buy! Ready to operate either base AC or mobile DC, including all necessary power cords and mounting bracket.
- Standardized channel crystals — interchangeable in all Hallicrafters transceivers.
- Accommodates all CB-3 Series accessories: HA-9 S-Meter; HA-11 Noise Eliminator; HA-12 Encoder/Decoder; HA-13 VFO.
- Full 100% modulation capability; sensitivity 1  $\mu$ v for 10 db. S + N/N ratio; power input 5 watts, receive output 2 watts.



The new ideas in communications  
are born at . . .

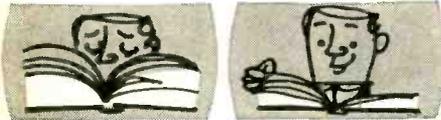
# hallicrafters

Export: Hallicrafters International Div.; Canada:  
Gould Sales Co., Montreal, P.Q.

5th & Kostner Aves., Chicago, Illinois 60624

CIRCLE NO. 12 ON READER SERVICE PAGE

To kit builders who go through THICK and THIN



to get the best . . .



**SEND FOR THE THIN!**

You don't judge a book by its cover. Nor by the number of pages. If you're looking for weight, don't bother with the Conar catalog. But if you're looking for quality electronic kits that are backed by a *no-loopholes guarantee*, you'll want to study our careful selection of do-it-yourself and assembled units. There's something for everyone: TV set kits to transistor radios, VTVM's to scopes, tube testers to tools. For years of pleasurable performance, for fun and pride in assembly, mail coupon below. Discover why Conar, a division of the National Radio Institute, is the fastest growing entry in the kit and equipment business.

**CONAR**

**MAIL NOW**

**CONAR**

3939 Wisconsin Ave., Washington 16, D.C.

Please send me your catalog.

BA4C

Name \_\_\_\_\_

Address \_\_\_\_\_

City \_\_\_\_\_ Zone \_\_\_\_\_ State \_\_\_\_\_

## Letters

(Continued from page 30)

*choke combination shown in the schematic between your preamp and tape recorder. The values of the capacitors can be determined experimentally.*

### Short-Wave Receiver Picks Up TV Sound

■ While tuning in the vicinity of 4.5 mc. with a portable short-wave receiver recently, I heard the sound portion of the TV program that another member of the household was watching. When the channel was changed, I heard the different sound portion. Could you explain this?

CHARLIE BRICE  
Chester, S. C.

*Glad to, Charlie. The sound i.f. frequency in your TV set is 4.5 mc. This i.f. signal is being radiated by the set's wiring, and possibly by the power line and TV antenna.*

### Furnace Control System Wanted

■ How about some ideas on an electronic control system using an indoor sensing unit, or thermostat, and an outdoor sensing unit for those of us who heat our homes with steam, hot water or hot air? Such a system (sometimes called an anticipating control system) could turn the heat on or



off in advance as the outside temperature rises or falls. The advantages would be many where there is a large variation between daytime and nighttime temperatures and the heating system is a bit sluggish in its pickup or has a tendency to overshoot the desired temperature in the morning.

H. S. COMMONS  
Albany, Oregon

*Anyone have a control circuit for reader Commons?*

### AREC Applauded

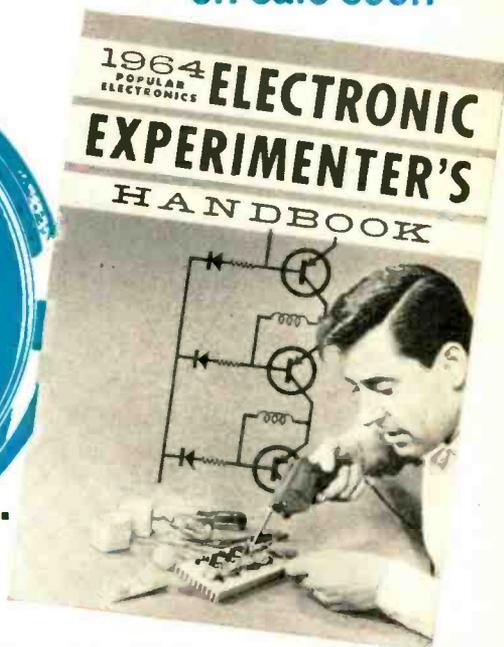
■ Recently a small tornado tore through an outlying community causing great damage and loss of life. Since our regional broadcast network is a news and communications media, we were flooded with calls concerning the welfare of people and property in the disaster area. As phone lines were down, I called both the local CB club and the local chapter of the Amateur Radio Emergency Corps for assistance. Within 15 minutes an AREC member arrived packing a complete homemade portable station with him. The first report from the disaster area came in exactly 46 minutes after aid was requested—by amateur radio. I was told later that many AREC members had left the shelter of their cars, carrying 12-watt 40-meter transceivers they had designed themselves on their backs. A report from the CB club took two hours; the reason given for the delay was that messages had to be relayed over the 12 miles from the tornado area

(Continued on page 38)

Always say you saw it in—POPULAR ELECTRONICS



on sale soon



If you like the challenge of working on your own construction projects, this is the publication for you! It's chock full of projects, detailed charts, circuit diagrams, cutaways, and photographs — all in one handy, compact 164-page magazine. Your copy of **ELECTRONIC EXPERIMENTER'S HANDBOOK** offers you hours and hours of enjoyment while you build fascinating projects like these:

**ELECTRONICS AROUND THE HOME:**

Power Failure Emergency Lighting • BC Photoflash Slave • Thermistor Fish Finder • Low Power Metal Locator.

**HiFi-STEREO:**

Amplifier Modules • "Mello" Monster • New Design Bass Reflex • Silent Hi-Fi Listening • Salvaging Old Cabinets.

**COMMUNICATIONS FOR THE HOME HOBBYIST:**

In-Flight Eavesdropper • 50-mc. Simple Superhet • Wired Wireless for Colleges • Technician Band Transceiver • Pep Up Lazy Crystals • The Best from W9EGQ.

**ELECTRONICS IN THE WORKSHOP:**

Listen to the Ultrasonics • Super Magnet Picks Up Aluminum • CB/Ham Crystal Test Set • Loudness Continuity Checker • Sound A Above Middle C • Little Volter Power Supply.

**... PLUS MANY MORE**

You'll want to be sure you get this year's edition of this fast-selling, much-in-demand **HANDBOOK**. It's now on sale at your favorite newsstand. Be sure to pick up a copy of the 1964 **ELECTRONIC EXPERIMENTER'S HANDBOOK**.

Ziff-Davis Service Division, Dept. EEH PE24  
589 Broadway, New York 12, N.Y.

Please send me \_\_\_\_\_ copies of the 1964 **ELECTRONIC EXPERIMENTER'S HANDBOOK**, at \$1.00 each plus 15¢ shipping and handling charge per **HANDBOOK**.

I enclose \_\_\_\_\_

Name \_\_\_\_\_

Address \_\_\_\_\_

City \_\_\_\_\_ Zone \_\_\_\_\_ State \_\_\_\_\_

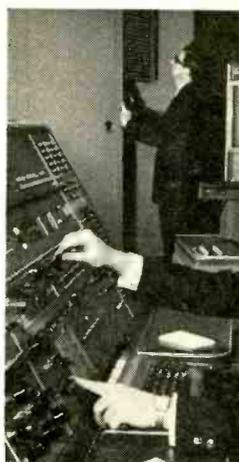
# A NEW WORLD OF OPPORTUNITY AWAITS YOU WITH N.T.S. ALL-PHASE HOME TRAINING IN ELECTRONICS



You can install and maintain electronic circuitry in missiles and rockets... specialize in micro-waves, radar and sonar.



You can succeed in TV-Radio Communications... prepare for F.C.C. License, service advanced satellites for industry and defense.



You can service and repair the electronic "brains" of industry—computers, data processing, and other automation equipment.



You can become a highly-paid TV-Radio Technician, an electronics field engineer, or succeed in your own sales and service business.

## The N.T.S. Master Course enables you to do more, earn more in **ELECTRONICS • TELEVISION • RADIO**

YET N.T.S. TRAINING COSTS NO MORE THAN OTHER COURSES FAR LESS COMPLETE

THERE'S A GOOD REASON WHY N.T.S. Master-Training opens a wide new world of opportunity for you in Electronics, Television, Radio.

EVERYTHING YOU LEARN, from start to finish, can be applied DIRECTLY to ALL PHASES of the Electronics Industry.

AS A RESULT, the N.T.S.-Trained Technician can move ahead faster, IN ANY DIRECTION—from TV-Servicing to Radio Communications to Space-Missile Electronics and Automation for industry and defense. You can go wherever pay is highest and opportunity unlimited.

ELECTRONIC CIRCUITRY, for example, is one of science's miracles that is BASIC to the entire field of Electronics. It is used in satellites, computers and space capsules as well as in today's television sets and high fidelity equipment. N.T.S. SHOWS YOU HOW to service and repair electronic circuitry for ALL electronic applications.

YOU WORK ON MANY PRACTICAL JOB PROJECTS. You build a DUAL SPEAKER, standard

broadcast-short wave receiver (dual speakers for better sound distribution), plus a large-screen television set from the ground up. N.T.S. training kits contain all the parts you need... at NO EXTRA COST. (See box next page.) You also receive a PROFESSIONAL MULTITESTER to use during training and on the job.

### READ THESE TYPICAL "SUCCESS REPORTS" FROM N.T.S. STUDENTS AND GRADUATES:

"Your home study course in Electronics has been very beneficial to me... I earn top wages as Electronic Installer at Douglas Aircraft... my success is due to National Technical Schools' excellent training..." Arnold Jones, Los Angeles, Calif.

"... My employers are expanding and plan to open a new department within the next 2 years... they have urged me to complete your course as soon as possible... my supervisor says that your course is by far the finest one he has seen..."

E. P. Gardner, No. Battleford, Canada

"... I am now in charge of Instrumentation, a new field for my company... my training has paid off better than I had hoped for..."

W. F. Fitzpatrick, Waco, Texas

START NOW. A wide, new world of opportunity awaits the man trained in Electronics by National Technical Schools—a recognized leader in technical training for 58 years. See next page.

ACCREDITED MEMBER—NATIONAL HOME STUDY COUNCIL

# N.T.S. GIVES YOU EXTRA BENEFITS —IN TRAINING, ON THE JOB, IN DAILY LIFE

## TRAINING BENEFITS

The N.T.S. Master Course embraces ALL SECTORS of Electronics—Industrial, TV-Radio Communications, Servicing. You become that indispensable man—the all around technician.

ONE MASTER COURSE COVERS THE FIELD. LOW TUITION INCLUDES EVERYTHING—Tools, manuals, counselling, all equipment. (We do not divide the field into separate courses separate tuitions.)

YOU GET 19 KITS OF LATEST, PROFESSIONAL EQUIPMENT; including a professional, factory-made, precision Multitester and a new, screen TV picture tube. All yours to keep.

ADDITIONAL ASSET: N.T.S. HOME TRAINING IS BASED ON METHODS USED IN SHOPS AND CLASSROOMS OF THE N.T.S. RESIDENT SCHOOL AT LOS ANGELES. No other method of teaching has proved so successful for home



Home Training is Shop-Tested in the N.T.S. Resident School at Los Angeles.

MAIL REPLY CARD  
OR COUPON FOR  
FREE BOOK AND  
ACTUAL LESSON

ENROLL BY MAIL—AND SAVE MONEY. Lower costs for us means lower tuition for you.

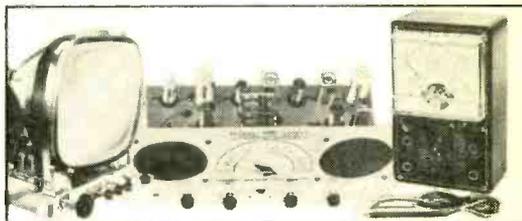
### RESIDENT TRAINING AT LOS ANGELES

to take your Electronics-TV-Radio training in our famous Resident School in Los Angeles—the oldest and largest school of its kind in the world—Request Resident School catalog and information, or check coupon.



**NATIONAL TECHNICAL SCHOOLS**

WORLD-WIDE TRAINING SINCE 1905  
4000 So. Figueroa St., Los Angeles 37, Calif.



The newest, professional equipment—19 kits in all. Yours to keep.

## 2 ON-THE-JOB BENEFITS

ALL-PHASE training puts you in an enviable position. You can pick and choose your career. Specialize or go into business for yourself. Your services will always be in demand wherever you go—and you can go anywhere. Electronics is a vital part of almost every business today.

Earn while you learn. Many students start earning extra money within a few weeks and help pay for their tuition. You can, too.

## 3 LIFETIME BENEFITS

Your success is ours. N.T.S. Graduate Advisory Service stands ready to help in solving technical problems of your job, in securing an FCC License, in establishing your own business, in countless other ways. No charge for this lifetime service.

Detach, fill in, and mail the postage-paid card today. A complete, fully-illustrated "Opportunity" Book and Actual Lesson will be mailed to you. Go over them carefully. We believe you will make the right decision . . . that ONE Master Course at ONE low tuition is the best way to become the "Man in Demand" in Electronics, Television, and Radio.

**NATIONAL TECHNICAL SCHOOLS**

WORLD-WIDE TRAINING SINCE 1905

**National Technical Schools, Dept. R26-24**  
4000 S. Figueroa St., Los Angeles, Calif., 90037

Please Rush FREE Electronics-TV-Radio "Opportunity" Book and Actual Lesson. No Salesman Will Call.

Name \_\_\_\_\_ Age \_\_\_\_\_

Address \_\_\_\_\_

City \_\_\_\_\_ Zone \_\_\_\_\_ State \_\_\_\_\_

Check if interested ONLY in Resident Training at L.A.

High school home study courses also offered. Check for free catalog.

# MOVING?

## ATTACH LABEL HERE

If you've recently changed your address or plan to in the near future, be sure to notify us at once. Place magazine address label here and print your new address below.

### NEW ADDRESS:

Name \_\_\_\_\_

PLEASE PRINT

Address \_\_\_\_\_

City \_\_\_\_\_ Zone \_\_\_\_\_ State \_\_\_\_\_

PLEASE FILL IN MOVING DATE BELOW:

If you have any other questions about your subscription be sure to include your magazine address label when writing us.

Mail to: POPULAR ELECTRONICS,  
434 So. Wabash Ave., Chicago 5, Ill.

## FOR CITIZENS BAND

# Hy-Gain's GOT IT!

Hy-Gain's BASE STATION AND MOBILE ANTENNAS FOR CITIZENS BAND

If you're working Citizens Band... if you're looking for optimum performance from your antenna system...if you're looking for an antenna to fit a particular space requirement or a special purpose Hy-Gain's GOT IT! They're all pictured and fully described in Hy-Gain's exciting 16-page catalog...the fabulous CLR II...famous "Topper" mobile whips...Beams that deliver 8 to 10 times power increase...a unique solid-state CB-AM coupler...the world's first lifetime Lightning Arrester...the fantastic Co-Phaser...and, many, many more. Get your free copy of Hy-Gain's Citizens Band Antenna Catalog today...see the line with a record of "firsts." At your favorite Hy-Gain Distributors or write:

**HY-GAIN ANTENNA PRODUCTS CORP.**  
8492 N.E. Highway 6, Lincoln, Nebraska

CIRCLE NO. 34 ON READER SERVICE PAGE

## Letters

(Continued from page 32)

to the city, where they were finally relayed via telephone to me. At this point, the AREC boys had it all sewed up. They did the best job of reporting I have ever seen, and with great efficiency. In regard to Mr. Hamilton's letter ("Letters From Our Readers," November, 1963), I think he has his gun pointed in the wrong direction, don't you?

EDWIN PETZOLT  
Gardner, Mass.

### Two-Meter Simple Transmitter?

■ The "2-Meter Simple Superhet" (September, 1963) is just what I have been looking for, and the instructions on how to build it are excellent. How about a companion transmitter? The ideal one for me would be a low-cost, crystal-controlled c.w.-AM job capable of about 25 watts input.

DON ROASCH  
Saginaw, Mich.

*Thanks for the letter, Don. We hope to have a transmitter project along the lines you mention sometime in the near future.*

### Medal Offered for "Transitips"

■ Our village idiot hung a lamp socket on a single seven-strand wire behind a translucent screen, and produced a light by taking three strands of the wire and fastening them under one screw of a plug and the other four strands under the other screw. When we removed the screen, we found he had a candle burning behind it. For this feat we gave him a tin medal of which he is very proud. We would like to send a similar award to Lou Garner for his "Transitips" circuits ("Transistor Topics," November, 1963, page 107) in which he shows one input wire and one output wire with no return circuit. All Lou has to do is disclose the secret.

MARTIN KULISEK  
Youngstown, Ohio

*The return wires in both the input and output circuits would go to the positive side of the battery, Martin. Incidentally, this type of diagrammatic shorthand is by no means uncommon. Lou Garner conveys his thanks for your offer of the medal, but he has already received so many that he's clean out of chest-room.*

-30-

## Out of Tune



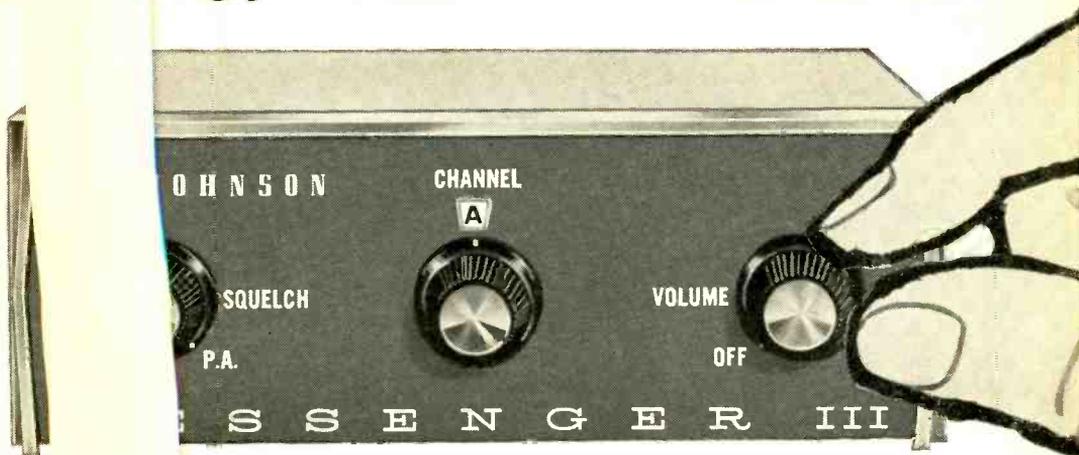
**CONVERTING YOUR FIRST "COMMAND" RECEIVER** (June, 1963, pages 47, 48). In the schematic on page 47, the heater pins of the 12A6 should be 2 and 7, not 7 and 8. In last paragraph on page 48, "pin 7 of the 12SR7" should be "pin 8."

**THE CODE BANDER** (August, 1963, page 46). In the Parts List, B & W 3015 should be used for L1, not B & W 3014.

-30-

Always say you saw it in—POPULAR ELECTRONICS

# Most Versatile! Most Power Out! Everything you ever wanted in a CB transceiver!



The 11 Channel "Messenger III" will change every idea you ever had about what a Citizens Band unit should offer! Tiny, all transistor, it's really quiet, really hot! Interchangeable for base or mobile—use it as a full 5-watt battery powered portable pack set or a 3-watt PA system. Other transistor-type units equalled but didn't exceed the performance of tube-type units—but the "Messenger III", with an aero-space transistor developed for the communications satellite, delivers more power output with maximum legal efficiency. The conversion receiver with high 1st IF provides excellent spurious and image rejection. "Close-in" and "forget" "Volume" and "Squelch" controls make it possible for the first time. Furnished with a microphone with "full-grip" push-to-talk bar. Full line of accessories available for base, mobile, portable field pack, or public address use!

C. 42-150 . . . . . "MESSENGER III" . . . . . \$189.95 NET

### PORTABLE FIELD PACK WITH THE PUNCH OF A MOBILE!

Powered by self-contained, rechargeable nickel-cadmium batteries. Simply slide your "Messenger III" into rugged high-impact plastic carrying case—mate battery connections—attach antenna—and you've got a full 5-watt portable pack set that is ideal for any type of field application. Accepts two batteries—has built-in recharger! Meter function and rate-of-charge selected by separate front panel switches. Built-in meter indicates battery condition. Accessory cables furnished to permit operating from 12 volt vehicle battery through the cigarette lighter receptacle, or from any 117 volt AC outlet.

See the "Messenger III" at your distributor's or write for full color literature.



**E. F. JOHNSON COMPANY**

2409 TENTH AVENUE S. W. • WASECA, MINNESOTA

CIRCLE NO. 33 ON READER SERVICE PAGE

## BEST BUYS IN STEREO AND MONO HI-FI

Stereo/  
mono  
4-track  
tape  
deck  
3 motors  
#2400  
Semikit  
(transport assembled & tested)  
\$199.95; Wired \$269.95



Stereo FM Multiplex Tuner ST97  
Kit \$99.95\* Wired \$149.95\*



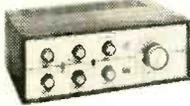
70-Watt Integrated  
Stereo Amplifier ST70  
Kit \$99.95 Wired \$149.95



FM-AM Stereo Tuner ST96  
Kit \$89.95\* Wired \$129.95\*

40-Watt Integrated  
Stereo Amplifier ST40  
Kit \$79.95 Wired \$129.95

New Classic Series  
36-Watt FM-Multiplex  
Stereo Receiver 2536  
Kit \$154.95\* Wired \$209.95\*



New Classic Series  
FM-Multiplex Stereo Tuner 2200  
Kit \$92.50\*; Wired \$119.95\*



New  
Classic  
Series

36-Watt Stereo Amplifier 2036  
Kit \$79.95; Wired \$109.95  
50W-2050 K. \$92.50; W. \$129.95  
80W-2080 K. \$112.50; W. \$159.95

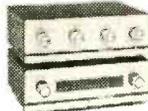


Stereo  
Power  
Amplifiers

Kit Wired  
70W HF87A: \$74.95 \$114.95  
100W HF89A: \$99.50 \$139.50



12-Watt Mono Amp. HF-12A  
K. \$39.95; W. \$59.95; Incl. Metal Cover  
FM Tuner HF-90A K. \$44.95\*; W. \$69.95\*



2-way system 6 1/2" woofer. HFS-10.  
W. \$29.95 - 2-way system 8" woofer  
HFS-8. W. \$44.95 - 3-way system 10"  
woofer HFS-6. K. \$59.95, W. \$89.95



## BEST BUYS IN CITIZENS TRANSCEIVERS, HAM GEAR, RADIOS

Dual Conversion CB Transceiver 777. Kit \$119.95; W. \$189.95.

770 Series  
CB Transceivers  
from Kit  
\$79.95;  
Wired  
\$109.95



Transmitters from \$59.95  
90 watt CW transmitter #720  
Kit \$89.95. Wired \$129.95



Hand held  
Citizens Band  
Transceiver #740  
incl.  
rechargeable  
battery & charger.  
Kit \$54.95.  
Wired \$79.95.



## BEST BUYS IN TEST EQUIPMENT

Peak-To-Peak  
VTVM = 232  
& Uni-Probe®  
(U.S. Pat.)  
Kit \$29.95  
Wired \$49.95



VTVM #222  
Kit \$27.95 Wired \$42.95

General  
Purpose  
3" Scope #430.  
Kit \$65.95; Wired \$99.95



DC-5 MC  
5" Scope = 460  
Kit \$89.95  
Wired \$129.50



General Purpose 5" Scope #427  
Kit \$69.95 Wired \$109.95

Dynamic  
Conductance  
Tube &  
Transistor  
Tester.  
#667 Kit  
\$79.95;  
Wired  
\$129.95.  
Tube Tester #628  
Kit \$44.95; Wired \$59.95



RF Signal  
Generator  
= 324  
Kit \$28.95  
Wired \$39.95



V-O-M  
1000  
ohms  
volt  
#536  
Kit  
\$14.95;  
Wired  
\$18.95.  
20,000 ohms volt  
=565. Kit \$24.95;  
Wired \$29.95



Extra Low  
Ripple 6- &  
12V Battery.  
Eliminator  
& Charger.  
#1064  
Kit \$45.95;  
Wired \$54.95  
#1050. Kit \$29.95; Wired \$38.95.  
#1060 for transistor equip.  
Kit \$39.95; Wired \$49.95



TV-FM  
Sweep &  
Post Injection  
Marker  
Generator #369  
Kit \$89.95; Wired \$139.95



Deluxe Multi-Signal  
Tracer #147-A  
Kit \$29.95; Wired \$44.95

# NEW EICO®

# KITS FOR 1964

A line-up of the best buys in stereo hi-fi, tape recorders, test equipment, CB & ham gear. You can save up to 50% by building them yourself, or buy them factory-wired and still have the best values available. More than 230 Eico products to choose from.



EICO ELECTRONIC INSTRUMENT CO., INC.  
131-01 39th Avenue, Flushing, N. Y. 11352  
PE-2

Send 1964 Catalog.

Name .....

Address .....

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

Add 5% in the West \*Incl. F.E.T.

Listen to the EICO Hour, WABC-FM, N. Y. 95.5 MC, Mon.-Fri., 7:15-8 P.M.

CIRCLE NO. 6 ON READER SERVICE PAGE

# THE AMAZING "BUG" BATTERY



By D. S. HALACY, JR.

*Want to build a biological fuel cell? Fantastically economical, they're the power source of the future*

Illustrated on this month's cover is a radically new kind of power converter called a biocell. To drive the electric motors, it is changing a fuel directly to electricity with no intermediate steps. As with any new system or device, there are "bugs" in the biocell. But engineers are not trying to eliminate all the bugs, or more accurately, the bacteria, because they are generating the electricity. Far past the gimmick stage, a number of more refined biochemical fuel cells, to use their proper name, are demonstrating their potential as a new power source for the space age. Investigations are under way with a view toward using biocells in the "closed-cycle" of a spacecraft like Apollo to convert waste material into fresh water



COVER STORY

# THE AMAZING "BUG" BATTERY

and food and, at the same time, generate electricity to power radios, radar and telemetry gear, and other on-board auxiliary equipment.

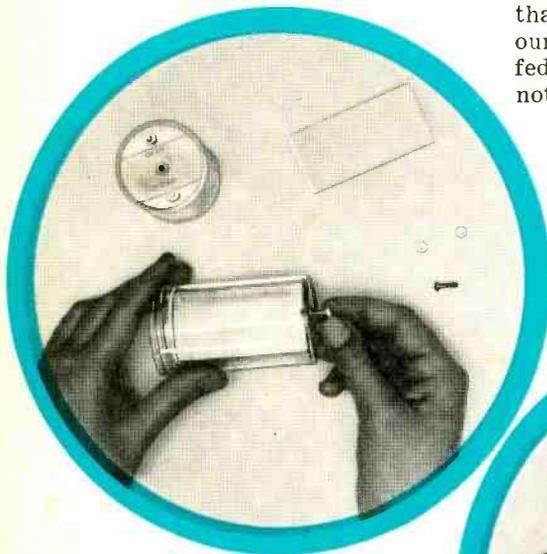
Land-based biocells have powered radio transmitters, driven model boats, and lighted fluorescent tubes. A Navy-sponsored design floats in the sea and generates a multi-watt output. Thus, although the biocell is not yet rolling off the production line for general use, the promise of this newest and most exotic fuel cell seems tremendous.

Up to the present time, man has pro-

duced the electricity he uses by mechanical or electrochemical means. Biochemistry now looms as a major producer of power for us, and it is not the science-fiction or Sunday supplement writers but scientists themselves who suggest such "way-out" possibilities as turning the Black Sea into a gigantic "bug battery" to light parts of the country surrounding it. A more modest idea is that of using sewage, garbage, or wastes like those from paper mills to feed bacteria. This not only produces power heretofore untapped; it also gets rid of the waste material much more efficiently than conventional means.

Whether or not the biocell will produce power for a mill per kil hour remains to be seen. One of the nearer developers has predicted a bonanza, and there is general agreement that bio-power will figure importantly in our future. After all, biochemistry has fed and clothed us all this year. Let not let it furnish the power.

The aluminum and copper electrodes are bolted in the plastic containers (top) which are then filled with the carrier (below). The biocells begin producing electricity when activator is added—12 are enough to run a small electric motor, power a transistor radio, or light a small pilot lamp.



Build your own bug battery? It's perfectly feasible with the Electron Molecule Research kit illustrated in these two photos. Distributed by Allied Electronics (the industrial branch of Allied Radio Corp.), 100 N. Western Ave., Chicago 80, Ill., the kit sells for \$16.95 under stock number 7E658, and includes material for 12 cells—plastic containers, copper and aluminum electrodes, harmless bacteria in a carrier, activator (powdered brown rice husks), hardware, wire.

**The Biocell's Past.** Although even the ancient Romans were aware of electricity in living things and actually used the torpedo ray fish in shock treatment of the mentally ill, the idea of putting bacterial metabolism to work as an electrical power plant dates back only about 50 years. In 1912 a British botanist, M. C. Potter, put together a half-dozen "cells" using yeast around carbon electrodes. This primitive bacterial battery generated a current Potter measured at 1.25 milliamps.

The feat caused no sudden selling of utilities stocks. Other researchers conducted similar experiments at irregular intervals, however, and in 1931 B. Cohen at Johns Hopkins Medical School here in the United States reported on a bacterial battery that upped Potter's output to about 2 ma. It was not until about 1960 that biocell research got into high gear, with several groups pushing the idea at the same time.

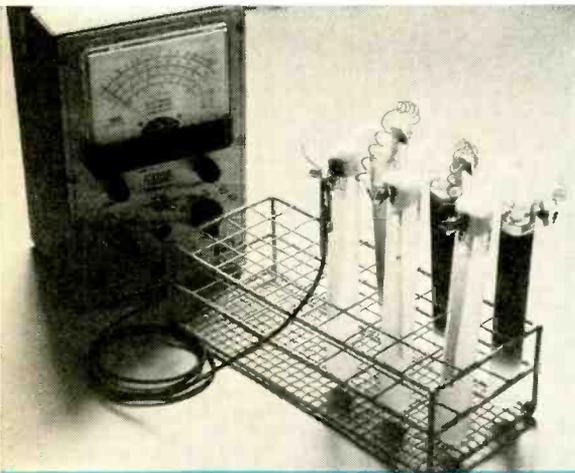
In his work for the Department of Interior's Geological Survey, biologist Dr. Frederick Sisler became greatly interested in the fact that decomposition of organic matter on the ocean bottom, plus the chemical and physical conditions in

the ocean, led to production of a weak electric current. He began to work toward developing a biocell exploiting this phenomenon.

Dr. John Welsh and his associates at Joseph Kaye and Company, a Cambridge, Massachusetts, research firm, noted that all fuel cells had certain common denominators—fuel, plus a catalyst to accelerate the electrochemical reaction. And since enzymes from living cells are the ultimate in catalysts, Welsh felt that biochemistry might speed some reactions a million-fold.

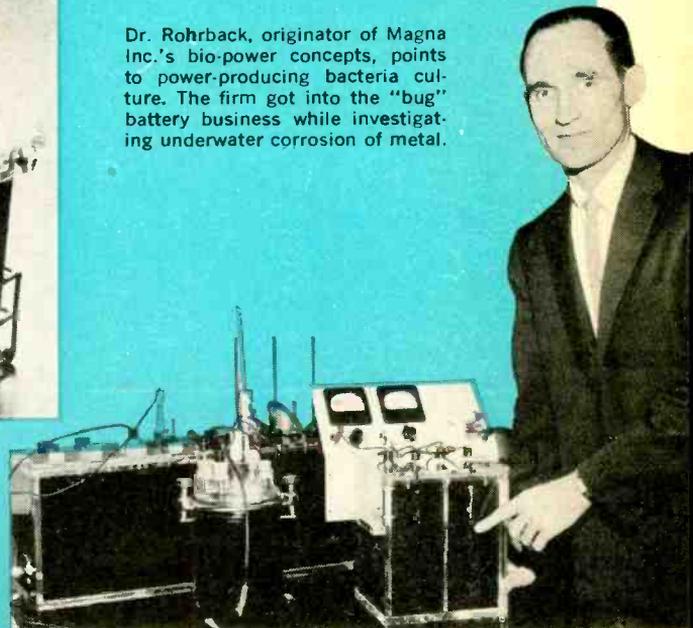
A third group, Magna Industries, Inc. of California, came onto the biocell idea in a roundabout way. Investigating the corrosion of oil wells and pipe lines under the sea, they found that bacteria were the culprits. They found too that these bacteria were generating tiny amounts of electricity while doing the dirty work. So Magna began to investigate the possibility of setting these tiny workers at a more useful task: that of producing electric power for seagoing equipment.

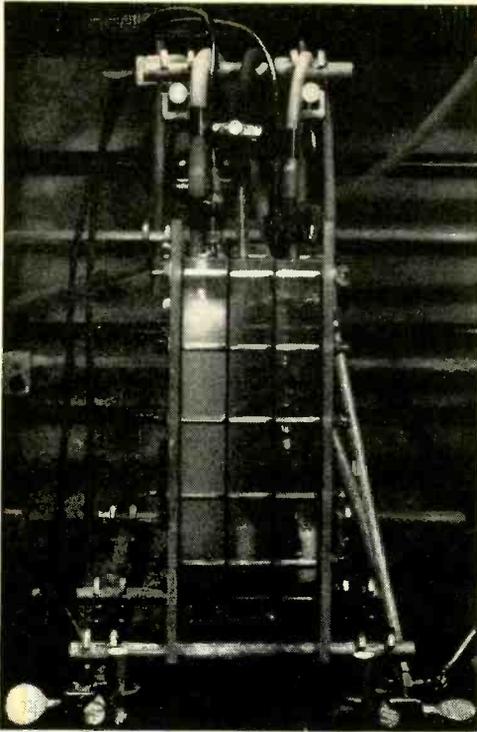
So immediately successful was biocell work that predictions were made in 1961 that a 1-watt cell was feasible and that



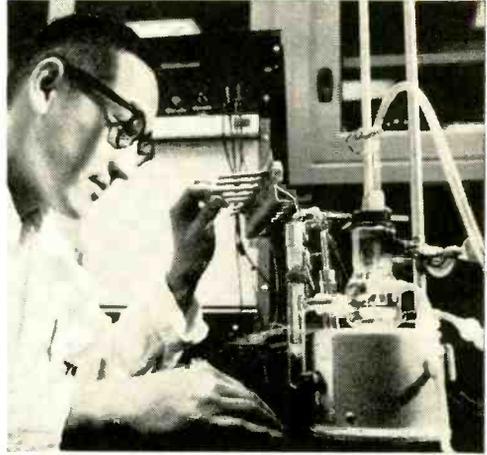
Another type of biocell kit is the one above made by Rowland Labs, 345 E. Forsyth St., Jacksonville, Fla. (\$14.95). Making use of anaerobic sulphate-reducing bacteria (dark tubes) and artificial sea water (light tubes), the cells produce 1.5 volts at 100 microamperes.

Dr. Rohrback, originator of Magna Inc.'s bio-power concepts, points to power-producing bacteria culture. The firm got into the "bug" battery business while investigating underwater corrosion of metal.





The elaborate apparatus at left is an experimental hydrocarbon biocell being tested at Socony Mobil Oil Company Field Research Laboratory.



Reversing the usual procedure, power can be fed to a biocell to produce chemical reactions. Above, Dr. Y. H. Inami does so in a NASA study to simulate reactions that occur in biocells.

a radio might be powered with bacterial electricity within a few years. These things materialized even sooner than hoped for. In 1962, Sisler and his associates in a newly formed private firm demonstrated a small transmitter with a range of 15 miles, and also a model boat operating on biocells, tapping the water it floated in.

The first biocell conference was held in 1962 in Corvallis, Oregon. About a dozen firms were active by then in the new field, both with company-funded studies and work backed by the Army, Navy, Air Force, and NASA. In just a couple of years the biocell had jumped from laboratory test tube to serious contender as a new power source.

**How It Works.** Every living thing, man, mouse, or microbe, is a biochemical fuel cell. It takes in food or "fuel" and breaks the material down to a lower form, extracting energy in the process. Some of this energy appears in the form of electricity. Luigi Galvani was intrigued by the animal electricity he found in frogs, but his countryman, Volta, turned scholars of electricity in another direction with his Voltaic pile,

a device considered the original battery.

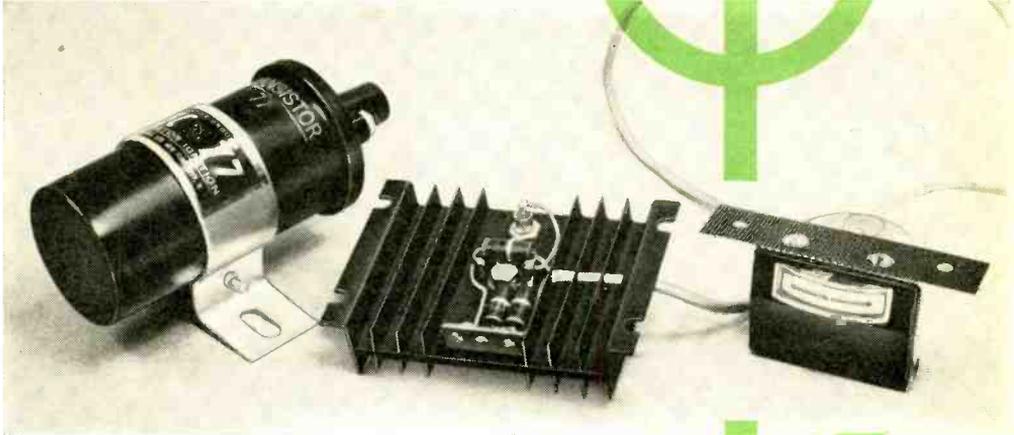
Make electrodes of two dissimilar materials, place an electrolyte between them, and current flows. This is the same "oxidation-reduction" process that goes on in living things that breaks down fuel into energy and waste. Oxidation familiar as burning, is made, in a battery, to push electrons around a circuit instead.

The battery is a handy device, but expensive. It would be better to be able to "burn" cheaper fuel in it to produce electricity, and in 1839 an Englishman named Grove did just that. His battery used hydrogen gas instead of zinc or other metal as a fuel, and was the forerunner of today's "hydrox" fuel cells. Before the turn of the century other workers had improved Grove's idea and coined the name "fuel cell." But another means of generating electricity was making its debut. Called the dynamo, it ushered in the age of the mechanical production of electric power.

Since even the most efficient turbine generators are doomed by the inexorable laws of thermodynamics to waste

*(Continued on page 103)*

# BUILD



# SIMPLEX TRANSISTORIZED IGNITION

By EDWARD P. NAWRACAJ

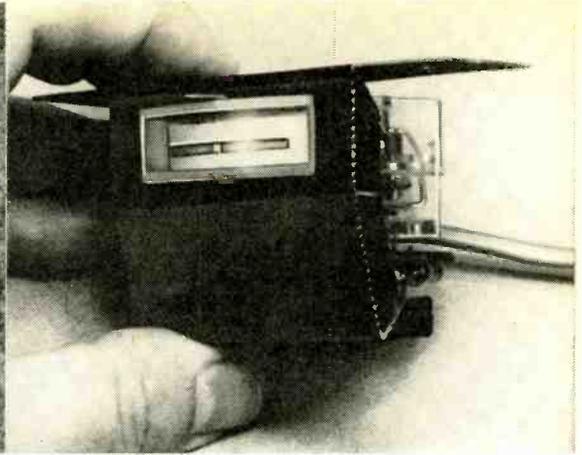
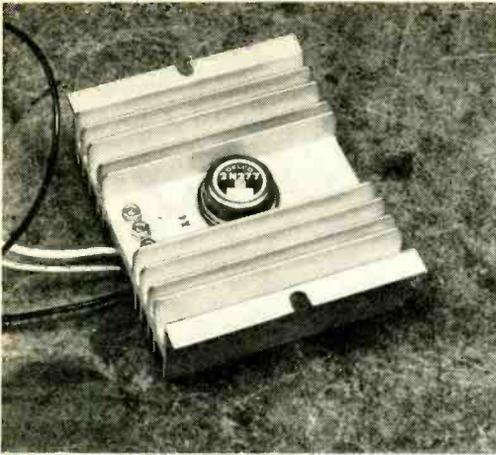
**Single transistor with zener protection works best with 400:1 turns ratio ignition coil; dwell meter accessory is described in detail**

EDITOR'S NOTE: The first excursion of POPULAR ELECTRONICS into the field of building transistorized ignition systems (June and October, 1963, issues) continues to elicit hundreds of letters and postcards. Since many readers have expressed an interest in experimenting with a basic system using a 400:1 ratio ignition coil, we present this month a project which will fulfill their requests. The SIMPLEX has been in operation in half a dozen cars for the past six months. We are pleased with its performance, and are happy to say that its construction entails only a modest investment.

**T**HE ADVANTAGES of transistorized ignition systems are not to be lightly dismissed. A 95 per cent reduction in current flow through the breaker points virtually eliminates this sore spot in en-

gine tune-ups. Changing the ignition coil ratio from 100:1 to 400:1 means greater spark voltages and more efficient engine operation at higher speeds. Greater gas economy and reduced engine maintenance result.

The question of whether *every* car on the road can—or should—be converted to transistorized ignition remains unanswered. Nevertheless, every electronics experimenter with a car in his garage will find it worthwhile to try it. The SIMPLEX is an easy, foolproof method of finding out how much advantage you'll gain in converting to transistorized ignition—and if it does work as well as you hope (this should be the case



The arrangement of components here differs from that shown on preceding page. In this photo, the transistor has been inverted and all connections made on the top side of the heat sink. In the lead photo, all connections appear on the underside. In an earlier prototype, paralleled resistors were used to obtain the necessary wattage rating at R3.

A special scale and bracket were fashioned by the author for his dwell meter. After checking the meter readings with the graph on page 48, a new scale was drawn. A heavy red line is divided so that a white spot is equivalent to 2° of dwell angle—this indicates the “safe” range, and the red line indicates that the points are bad.

with nine out of ten cars), you can go a step further and build a dwell meter to continuously monitor your car's performance.

**Circuit Description.** Three resistors, one zener diode, one transistor, and a new ignition coil comprise the SIMPLEX circuit. A commonly available 15-amp germanium power transistor is used in a grounded-base circuit, which functions as a switch. Collector current flow is limited to 10 amps by ballast resistor *R1* and the primary winding resistance of *T1*. At normal operating temperatures, the current transfer characteristic of a 2N277 results in a base current (through the breaker points) of only 250 ma. Since the usual current flow through the points without transistorized ignition is 5-6 amps, this results in a very substantial reduction in point erosion.

Resistor *R2* shuts the transistor switch off when the breaker points open. A 1-watt zener diode, *D1*, is connected between the *base* and *collector* of transistor *Q1*. This diode has a breakdown voltage below that of the collector-base circuit. Should an abnormal transient back voltage develop in the automotive electrical circuits, the diode will limit the reverse voltage applied to *Q1*. This is one of the most economical means of protecting a transistor ignition system.

**Simplex Construction.** Only a few points need elaboration when it comes to constructing the SIMPLEX circuit. A good-size heat sink should be used, such as a Delco 7276040, Astro 2504, Delta NC-403, Wakefield NC621B, etc.\* Insulated terminals or a barrier strip are required to mount the zener diode and two resistors, and number 16 stranded wire should be used for wiring.

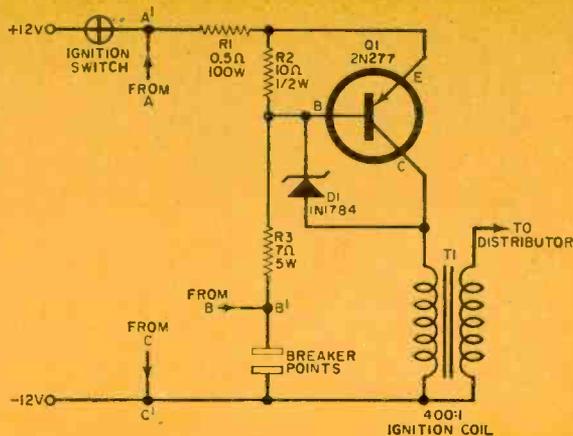
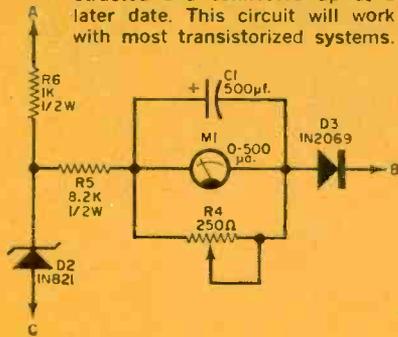
Transistor *Q1* must be electrically insulated from the heat sink. Mica wafer insulation is required. Before mounting *Q1*, a light coat of silicone grease should be applied to both sides of the larger mica insulator. This will enhance the heat transfer between the transistor and the heat sink.

**Transistor or Diode Substitution.** There are several possible substitutes for the 2N277 transistor. In selecting one, however, consideration must be given to the 15-amp, 40-volt power ratings in relation to the current transfer characteristics of the 400:1 turns ratio coil, and the value of the ballast resistor. An excellent replacement is the 2N1554A.

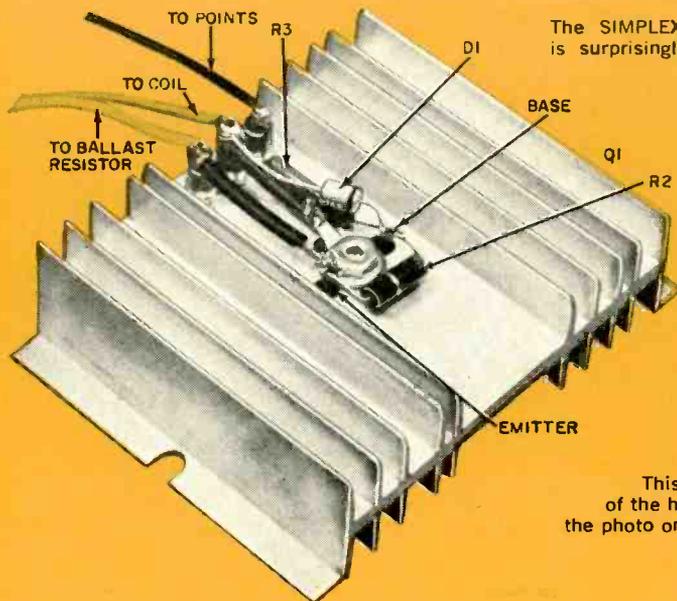
If a substitution is made for the transistor, one must also be made for diode

\*At this writing, a bargain combination heat sink and 2N277 transistor was being sold by John Meshna, Jr., 19 Allerton St., Lynn, Mass. It is shown in the photo above and on page 47. Write for price information.

Dwell meter circuit can be constructed and connected up at a later date. This circuit will work with most transistorized systems.



The SIMPLEX ignition circuit is surprisingly easy to build.

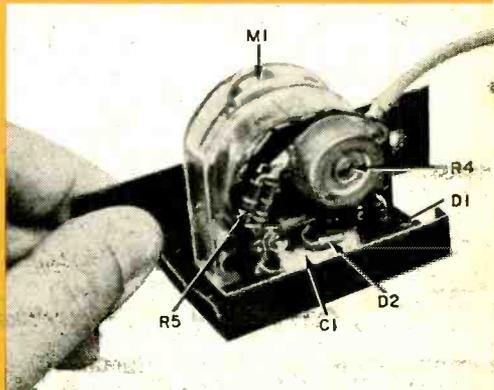


This is the underside of the heat sink shown in the photo on the facing page.

### PARTS LIST

- C1—500- $\mu$ l., 3-w.v.d.c. capacitor
- D1—Zener diode (type 1N1784A, 1N2900A, or 1N3033B when used with a 2N277 transistor at Q1; type 1N3037A, 1N3038B, or 1N2905A when used with a 2N1554A transistor at Q1)
- D2—Zener diode, 6.2 volts, type 1N821
- D3—Silicon diode, 200 PIV, 750 ma., type 1N2069
- M1—500-microampere meter—see text
- Q1—Transistor, 2N277 or 2N1554A; must complement zener diode D1
- R1—Ballast resistor, 0.5 ohm, 100 watts
- R2—100-ohm,  $\frac{1}{2}$ -watt resistor
- R3—7-ohm, 5-watt resistor
- R4—250-ohm, wire-wound miniature potentiometer, screw-driver adjustment
- R5—8200-ohm,  $\frac{1}{2}$ -watt resistor
- R6—1000-ohm,  $\frac{1}{2}$ -watt resistor
- T1—Ignition coil, 400:1 turns ratio (This circuit has been tested with AEC 77-Palmer T-400, and Slep F-400T coils, all of which performed satisfactorily)

All components for the dwell meter are attached to a phenolic board that is bolted to the meter.



**D1.** Permissible zener diodes when using a 2N277 transistor are the 1N1784A, 1N2990A, and 1N3033B. If a 2N1554A transistor is used, the zener diode should be either a 1N3037A, 1N3038B, or 1N2995A.

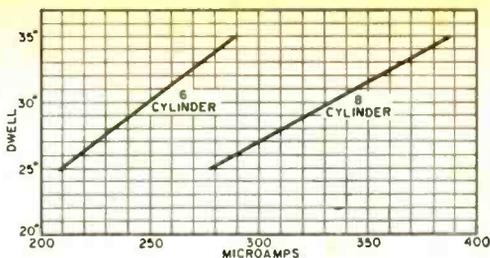
**Dwell Meter.** Of the four readily monitored characteristics of the modern six- or eight-cylinder engine (engine revolutions, timing, dwell angle, and vacuum pressure), only the dwell angle and the timing of the distributor breaker points are directly related to the use of a transistorized ignition system. Once installed and calibrated, the dwell meter in the diagram on page 47 will indicate wear of the distributor rubbing block or malfunctioning of the points. The battery current consumed in operating the dwell meter is very small, and the entire meter assembly can be built on a miniature chassis and installed on the lower edge of the dashboard.

Operation of the dwell meter is not limited to use with the SIMPLEX ignition system—it can be attached to almost any other transistorized system. For convenience, the SIMPLEX and the dwell meter can be built at different times as two separate projects. Interconnections are shown in the two diagrams on page 47—simply attach A to A', B to B', and C to C'.

The dwell meter is voltage-sensitive, necessitating the use of a small zener diode at D2 to regulate this circuit. Resistors R4 and R5 limit the current flow through the meter and capacitor C1 smooths circuit action to prevent meter pointer oscillation at slow engine speeds.

In operation, the dwell meter circuit is completed by the closing action of the breaker points. The meter indicates current proportional to the ratio of the time the breaker points are closed to the total time lapse between one spark and the next. This dwell time is proportional to the angle through which the distributor cam turns between closing of the points and their reopening, which is called the dwell angle.

**Building the Dwell Meter.** Any 0-500 microampere meter can be used in this circuit. The author was fortunate in obtaining a "surplus" edgewise meter that made a very neat package. The meter terminals are used to hold a small phenolic board in position—the board sup-



When a 500-microampere meter is set up according to procedures outlined in text, dwell angle readings will correspond to above current readings.

ports the remaining components in this circuit. An aluminum wrap-around was fashioned to attach the meter to the underside of the dash panel.

When you're ready to calibrate the dwell meter, ask your garage mechanic for the correct dwell angle setting for your car. This is usually between 25° and 35°, but varies in different makes and models. When you have this figure, you can determine your actual dwell angle by noting the current indicated by the dwell meter, finding where a vertical line for this current intersects the plotted line in the graph,\* and mentally drawing a horizontal line to the dwell angle scale.

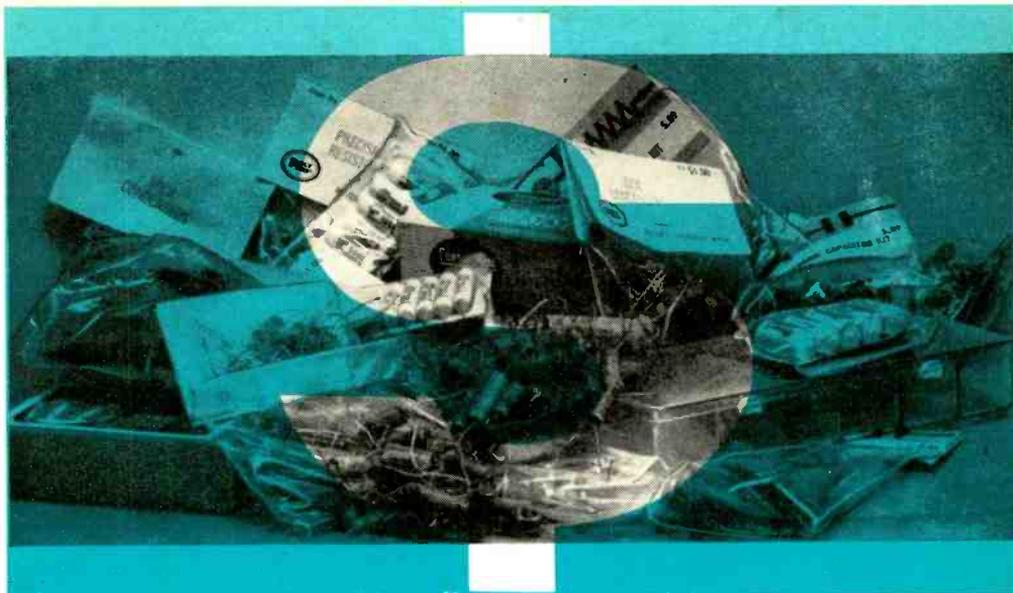
If you prefer not to use the graph and want to mark the meter dial directly in dwell angle, slip off the meter case carefully, and mark a white "okay" band centered on the correct scale point for your car. Make the band just wide enough to indicate the plus or minus 1° tolerance of the dwell angle, and add a red band above and below the white band, extending out another 4°. As an example, consider a six-cylinder car designed for a 30° dwell angle. From the graph it is clear that the correct dwell angle is indicated by a current of 250  $\mu$ a. For 29° the current is about 242  $\mu$ a. (actually 241.6+  $\mu$ a.), and for 31° it is about 258  $\mu$ a. This gives the upper and lower limits of the "okay" band, and the edges of the red "out of tolerance" band can be determined in the same way.

To adjust the dwell meter on first in-

(Continued on page 96)

\*The graph lines are based on multiplying the dwell angle in degrees times the number of cylinders, dividing by 360°, and multiplying the resulting fraction times the full-scale (500- $\mu$ a.) current.

# BARGAINS



## BY THE BAGFUL

***With a few careful purchases, you can stockpile many of the resistors and capacitors you'll need for project building***

By **OLIVER P. FERRELL**, Editor

### **PART I RESISTORS AND CAPACITORS**

**E**VERY radio parts store worth its salt these days offers a variety of "poly" bags full of capacitors, resistors, potentiometers, transistors, diodes—everything but the kitchen sink. Mail-order catalogs and flyers are full of assortment offers and several companies specialize in selling nothing but bags of various radio components.

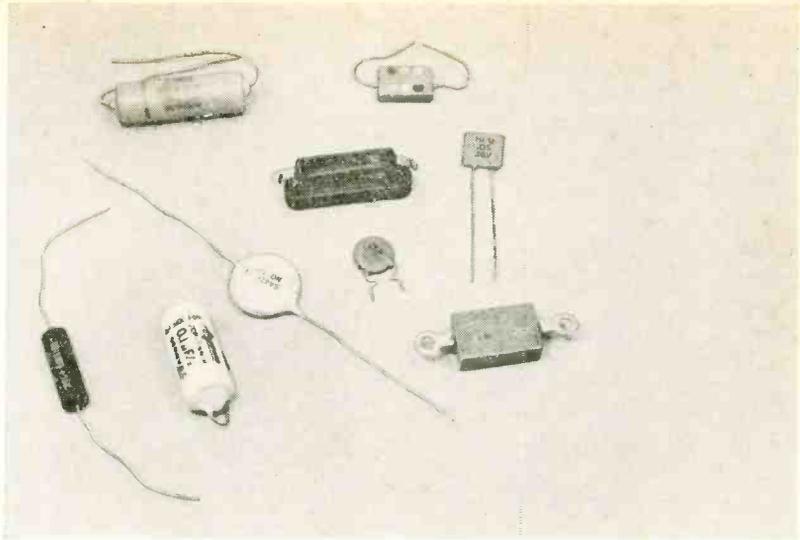
POPULAR ELECTRONICS has spent several months quietly investigating poly bag assortments of resistors and capacitors. These two categories of *bargain bags* are discussed below; a subsequent article will deal with potentiometers, chokes, and hardware.

First of all, why buy assortments at all? Inveterate electronic project builders are well aware that there are numerous

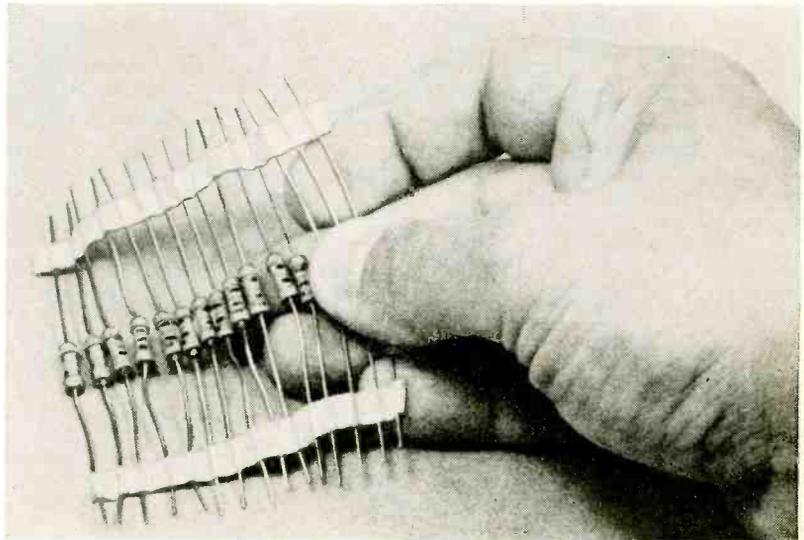
ways and means of cutting project costs. The so-called "junk box" of re-usable parts is one method. A second is stocking up resistors and capacitors obtained in poly bag assortments. As opposed to buying each resistor or capacitor in a project individually, a stockpile can shave these costs by 70-80 per cent.

We found that poly bag assortments included everything from floor sweepings of some unknown manufacturer to carefully packaged, top-quality merchandise. The buyer has no recourse (*caveat emptor*) but to accept what the poly bag contains without question. The only firm guideline that we could uncover as to the possible worth of a bargain bag is to know with whom you are dealing. Mail-order companies with business reputa-

These are a few of the different types of capacitors (mica, ceramic, molded paper, etc.) culled from poly bag assortments. The two mica capacitors with eyelet leads are over 15 years old. They are not color-coded; values are hot-stamped on bodies of the capacitors.



In disposing of these tubular ceramics, no effort was made to even separate them from an adhesive strip. Obviously, they are all the same value.



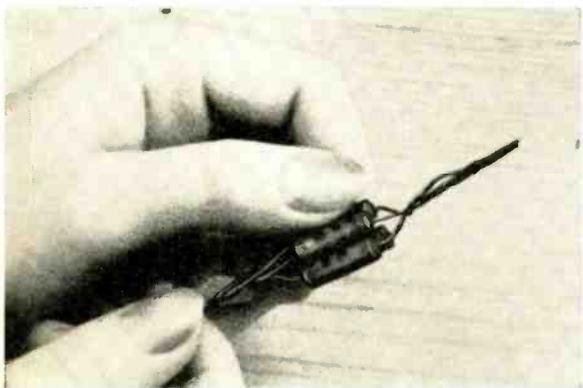
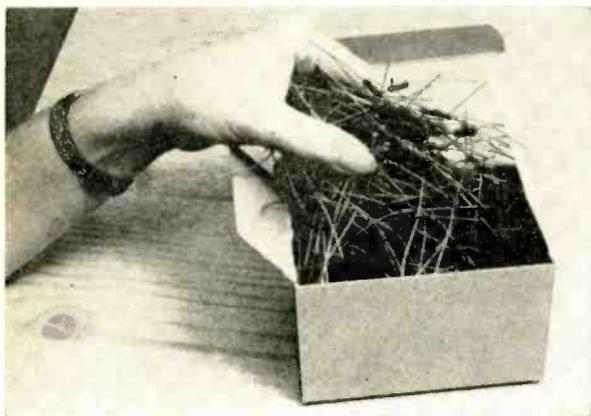
tions at stake and speciality houses dealing in bargain bags will nine times out of ten sell exactly what they advertise.

The same cannot be said for at least one-third of surplus or distress equipment mail-order houses, or most of the inhabitants of "radio row" stores in major metropolitan areas. The latter stores—specializing in a walk-in-off-the-street trade—offer very tempting bargains that are difficult to resist. But, resist them you should, even though the investment is almost always under \$2. Often as not, you'll be glad you did.

**Bargains, Bargains, Bargains?** As examples of "radio row" transactions, here are two instances that occurred during our poly bag hunts in lower Manhattan. In one store a sign proclaimed drastic price reductions in resistor assortments from \$1.98 to \$1.49 to a new final "low-low" of 99¢—an irresistible bargain. A sealed box (poly bag inside) was purchased and from its weight appeared to be packed. It was—with 481 resistors of the same value!

A second store offered precision wire-wound and carbon-film resistors—30 for \$1.29. The count was correct and we

This was our prize purchase. All 481 resistors are of the same value although the exterior wrapping of this assortment said it contained 100 different resistors.



In the politest terms, these four resistors can be called "floor sweepings." Twisting the leads together was done by a technician, eliminating the chance that the resistors would be new stock.

found values ranging from a low of 100 ohms to a high of 3.32 megohms. However, four of the 30 resistors were unmarked and if you can describe a more worthless electronic item than an unmarked "precision" resistor we'd like to hear about it.

Purchases via mail order from any of the five top distributors, plus one speciality mail-order house, were satisfactory. With few exceptions, the components were clean, well-marked, of fairly recent manufacture and of good quality. A sampling of capacitors indicated that only one out of a possible 50 would be

### "BAD" ASSORTMENT

#### 25 Mica Capacitors for 89¢

4	3.7 $\mu\text{f.}$	2	68 $\mu\text{f.}$
1	7.5 $\mu\text{f.}$	1	680 $\mu\text{f.}$
1	25 $\mu\text{f.}$	1	800 $\mu\text{f.}$
3	27 $\mu\text{f.}$	2	900 $\mu\text{f.}$
8	60 $\mu\text{f.}$	2	1000 $\mu\text{f.}$

Although far from obsolete, this assortment clearly established that mica capacitors are "on their way out." Capacitors from five different manufacturers were represented and all showed distinct signs of aging. Seven capacitors had pre-World War II color coding (nearly invisible) and two of the 27- $\mu\text{f.}$  capacitors were unmarked. This was a local (New York City) purchase.

### "EXCELLENT" ASSORTMENT

#### 50 Tubular Capacitors for 98¢

19	0.001 $\mu\text{f.}$ , 60 w.v.d.c.
6	0.0015 $\mu\text{f.}$ , 600 w.v.d.c.
1	0.0018 $\mu\text{f.}$ , 400 w.v.d.c.
6	0.002 $\mu\text{f.}$ , 150 w.v.d.c.
6	0.002 $\mu\text{f.}$ , 400 w.v.d.c.
1	0.0022 $\mu\text{f.}$ , 400 w.v.d.c.
1	0.0022 $\mu\text{f.}$ , 600 w.v.d.c.
4	0.0027 $\mu\text{f.}$ , 600 w.v.d.c.
1	0.003 $\mu\text{f.}$ , 400 w.v.d.c.
5	0.005 $\mu\text{f.}$ , 200 w.v.d.c.
1	0.007 $\mu\text{f.}$ , 600 w.v.d.c.
2	0.01 $\mu\text{f.}$ , 100 w.v.d.c.
1	0.01 $\mu\text{f.}$ , 600 w.v.d.c.
1	0.015 $\mu\text{f.}$ , 200 w.v.d.c.
2	0.1 $\mu\text{f.}$ , 200 w.v.d.c.
1	0.2 $\mu\text{f.}$ , 400 w.v.d.c.
1	0.5 $\mu\text{f.}$ , 600 w.v.d.c.

This mail-order assortment contained 59 capacitors instead of the advertised 50. All were in good shape, although obviously "over-runs" from TV set manufacturers. All were clearly imprinted, and all tested "good."

leaky, shorted or open on being tested.

Some of the problems that do beset bargain capacitors, especially those purchased from doubtful sources, are old, obsolete or indistinguishable color codes and markings. Fortunately, these troubles do not usually affect resistors. Our sampling showed that only one out of every 90 resistors would either be open or have indiscernible markings.

On the other hand, precision resistors are *always* a poor buy in poly bag assortments. The offerings are generally over-production runs of highly irregular values used in test equipment manufac-

## "BAD" ASSORTMENT

### 50 Resistors for 99¢

2 0.33 ohm, 1/2 watt	1 7500 ohm, 1 watt
3 3.3 ohm, 1/2 watt	1 8200 ohm, 1/2 watt
1 15 ohm, 1/2 watt	2 8200 ohm, 3 watt*
2 180 ohm, 1/2 watt	2 10,000 ohm, 1 watt
2 390 ohm, 2 watt*	1 10,500 ohm,
1 470 ohm, 3 watt*	precision
1 560 ohm, 1 watt	1 18,000 ohm, 2 watt
1 680 ohm, 1 watt*	1 68,000 ohm, 2 watt,
1 820 ohm, 1/4 watt,	20%
20%	1 75,000 ohm,
2 910 ohm, 1/2 watt,	1/2 watt
5%	2 44,000 ohm, 2 watt
1 2700 ohm, 1 watt	2 330,000 ohm,
1 4700 ohm, 1 watt	1 watt
1 4700 ohm, 4 watt*	1 750,000 ohm,
3 4700 ohm, 2 watt	1 watt, 5%
1 6800 ohm, 1/4 watt,	1 1.2 meg., 1 watt
20%	1 2.2 meg., 1 watt
2 6800 ohm, 1/2 watt	2 20.0 meg., 1/2 watt
1 6800 ohm, 1 watt	

At first glance—while the resistors were still in the poly bag—this looked like a promising purchase. Unfortunately, the assortment was more of a hodge-podge containing all wattage values from 1/4 to 4 watts. Particularly bad in this assortment was the absence of values in the range of 75,000 to 330,000 ohms. All resistors identified by the asterisk had no color code. This was a "radio row" purchase.

ture. Wattages are rarely indicated (perhaps on one unit out of ten) and you take a chance in using a precision resistor in any circuit that draws more than a watt. Also, the need for precision resistors in everyday electronic experimenting is unbelievably small.

**What To Buy.** There are several rules-of-thumb in buying poly bags. If you can see the bags be sure that component leads are uncut and have not been shortened for use in printed circuit wiring. In the case of resistors, check that the one-half-watters have either a silver or gold tolerance color-coding band. Also, ancient 2-watt resistors were much longer and thinner than present-day units—they are not a good buy.

Capacitors must be watched carefully, although the signs of age are more obvious (see photo) than with resistors. Ceramic disc capacitors should be checked for signs of poor dipping—the colored ceramic insulation does not cover all of the capacitor body. Units of this type are "seconds" and are not safe to use.

## "EXCELLENT" ASSORTMENT

### 40 Disc Ceramic Capacitors for \$1

2 12.0 $\mu\mu\text{f.}$	3 100 $\mu\mu\text{f.}$
1 15.0 $\mu\mu\text{f.}$	1 120 $\mu\mu\text{f.}$
1 18.0 $\mu\mu\text{f.}$	7 470 $\mu\mu\text{f.}$
3 22 $\mu\mu\text{f.}$	1 390 $\mu\mu\text{f.}$ (1.5 kv.)
3 27 $\mu\mu\text{f.}$	1 680 $\mu\mu\text{f.}$
2 33 $\mu\mu\text{f.}$	4 1000 $\mu\mu\text{f.}$
1 39 $\mu\mu\text{f.}$	2 0.005 $\mu\text{f.}$
2 47 $\mu\mu\text{f.}$	6 0.01 $\mu\text{f.}$
1 56 $\mu\mu\text{f.}$	3 0.02 $\mu\text{f.}$ (1.6 kv.)
2 68 $\mu\mu\text{f.}$	1 0.05 $\mu\text{f.}$ (25 v.)
1 82 $\mu\mu\text{f.}$ (2 kv.)	1 0.047 $\mu\text{f.}$ (50 v.)

Even though this assortment contained a few "seconds" there was a surplus of nine extra capacitors—plus an unusual 27/27  $\mu\mu\text{f.}$  duoceramic not listed above. The distribution of values was remarkable in this poly bag—note the volume of most-used values (470 and 1000  $\mu\mu\text{f.}$ ).

In the great welter of assortments, special "buys," and "good deals," the average buyer of poly bags has reason to be hopelessly confused when it comes to determining just what he's getting for his money. In early December, as this article was written, the following average prices (cents-per-unit) were computed from our survey.

#### Resistors:

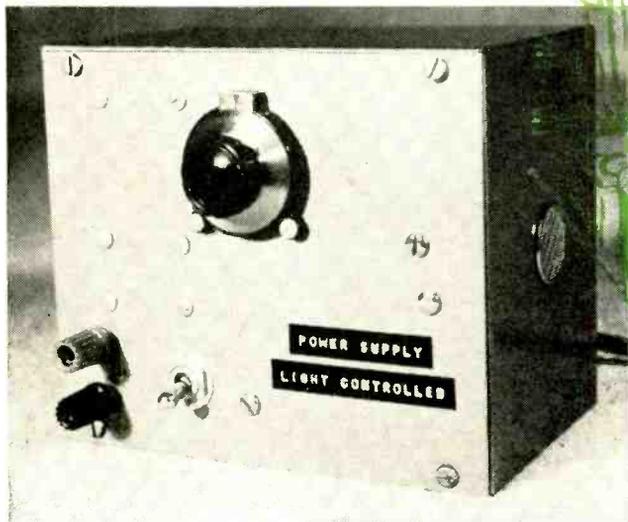
Top-grade 1/2-watt .....	.03
Second grade 1/2-watt .....	.015
1- and 2-watt .....	.035
3-watt, or higher (carbon) .....	.05
3-watt, or higher (w.w.) .....	.08
Precision .....	.07

#### Capacitors:

Ceramic discs .....	.03
Ceramic tubulars .....	.02
Top-grade mica .....	.03
Second grade mica .....	.02
Paper or molded .....	.035

The experimenter will find that an \$8-\$10 investment in poly bag resistor and capacitor assortments will be money well spent. We suggest that the following components be purchased as a start: two good 1/2-watt resistor assortments, one good 1-watt resistor assortment, one ceramic disc assortment, and two bags of mica or molded capacitors. Unless you need them for some specific purpose, defer buying precision resistors or electrolytic capacitors until a later date. However, if you expect to try out transistor circuits, a good assortment of high-capacitance, low-voltage electrolytics can be added to the above list. —30—

**Here's the first in a series of construction articles planned to test your "Ingenuity Quotient." Study it carefully, develop an improved model, and tell us how and why your version is better.**



## LIGHT-CONTROLLED POWER SUPPLY

**A** BENCH POWER SUPPLY providing up to 500 ma. at a potential adjustable from 0 to 25 volts d.c. is a handy thing to have around if you experiment with transistors. Here is one that provides stepless control of the output voltage, without use of a costly variable transformer, or a big, heat-producing power rheostat. It's no bigger than a desk phone, can be built in a couple of evenings for under \$13.00 and, though very useful as is, can be readily modified and improved upon by circuit-wise experimenters.

**About the Circuit.** The basic circuit is a conventional full-wave bridge rectifier made up of diodes *D1*, *D2*, *D3*, and *D4*. Power to the bridge at 25 volts a.c. is supplied from the secondary of trans-

former *T1* through fuse *F1*, which is included to protect the supply from damage by overloads.

The unique feature of the supply is the means for controlling the output voltage. This consists of photocell *PC1* in series with the primary winding of *T1*, lamp *II* (which illuminates the photocell), and a metal vane controlled mechanically by means of a panel knob with a calibrated dial. The vane acts as a shutter to control the amount of light reaching the photocell. The resistance of the photocell is high when it is not illuminated, and decreases as the light reaching it increases, becoming less than 20 ohms under strong light flux.

Lamp *II* is a 115-volt type, connected directly across the a.c. supply line. It

Position of lamp on support bracket must line up with light shield and photocell. Note location of diode terminal board, and mounting of heat sink. Insulate capacitor C1 can from support clamp with tape wrap if negative lead is to be off ground. Vane shaft is aluminum.

## YOUR "INGENUITY QUOTIENT" CAN PAY OFF

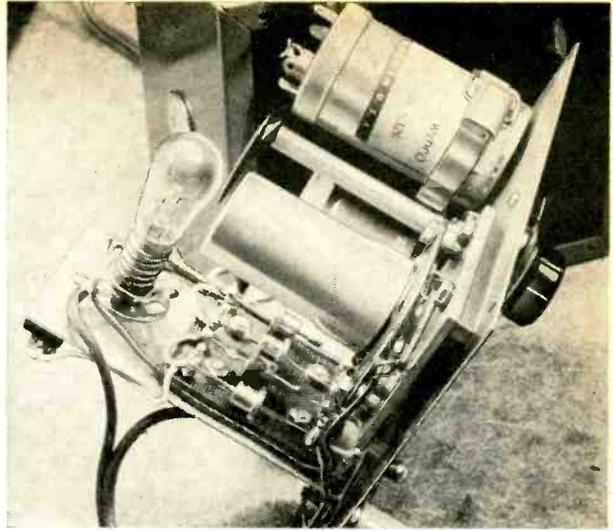
As a *POPULAR ELECTRONICS* reader, you demonstrate a more-than-average interest in technical knowledge and progress. And if mail is any indication, you and other readers have more than the average share of inventiveness and electronic know-how.

With this article, *P.E.* is launching a series designed to give all readers a chance to test their technical prowess against some typical product improvement problems, with recognition and reward for the better solutions, as judged by the editorial staff.

Here's the deal. Each article in the series will describe a useful electronic device that works after a fashion, but not as well as we think it could. It may be too touchy and critical in adjustment, too costly for the job it does, or not usable for as many jobs as the basic idea suggests it might be. Whatever its defects in your eyes, your task is to study the design, note its shortcomings, and redesign it to do its job better or cheaper, or both, or to serve added purposes not covered in the original design.

Give your Ingenuity Quotient free rein, and when you've got your improved model working, draw a schematic, make a photograph or drawing, and write us about 250 or 300 words describing it. Tell what it does better, how it does it, and what parts you changed or added (if any), and why. Be sure to use parts available from regular mail-order distributors (no gold-plated "frammisettes" from \$10,000 war-surplus "turbo-encabulators"), tell us where you got them, and what they cost.

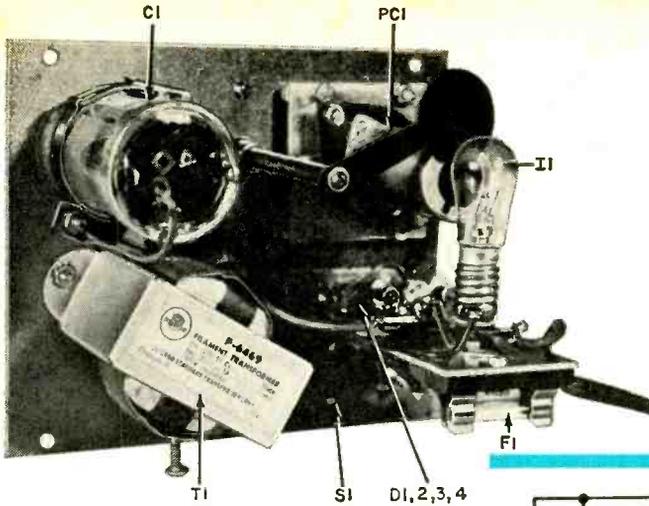
You'll be paid at our regular editorial rates, your article will be published, and you'll receive full credit for your accomplishment. Okay, men, crank up those soldering irons. Let's go!



therefore burns at full brightness whenever S1 is closed. The photocell is enclosed in a light shield consisting of an open-top tube shield, which minimizes the amount of stray light that can reach the cell. When the shutter vane is turned to completely cover the opening in the light shield, the photocell resistance is high, and the output voltage is minimum. As the vane is swung aside, allowing an increasing amount of light to reach the cell, the output voltage rises, reaching maximum when the cell is fully illuminated.

**Photocell Facts.** The heart of this controllable power supply circuit is the photocell, which is a recently developed unit of the photoconductive type. The resistance of this type of cell is high in darkness, and decreases as the light striking the sensitive element is increased. The essential feature of this cell, designated the LDR-25 by the maker, is that it can handle a considerable amount of power as compared to most other available photocells. Also, it sells at a modest \$1.50.

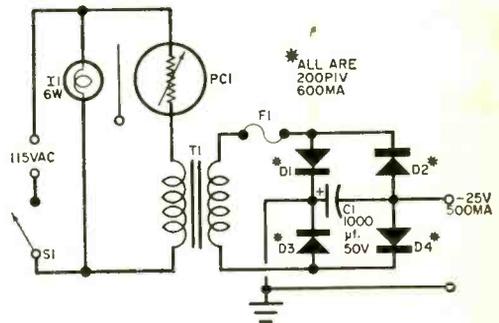
Mounted on an adequate heat sink, the LDR-25 can handle up to 500 ma., and it is rated at 25 watts total dissipation. Up to 200 volts a.c. or d.c. may be applied across the cell, as long as the current and dissipation ratings are not exceeded. It is the relatively high power-handling capability of the LDR-25 that makes it applicable to this circuit, and



Mount all parts far enough in from panel edge to clear lip of box during assembly. Shutter vane is shown clear of shield hole for maximum light on cell.

#### PARTS LIST

C1—1000- $\mu$ l., 50-volt electrolytic capacitor  
 D1, D2, D3, D4—600-ma., 200-PIV silicon diode  
 F1—1-ampere glass fuse  
 I1—115-volt, 6-watt, screw base lamp  
 PCI—Photocell (Delco LDR-25)  
 S1—S.p.s.t. toggle switch  
 T1—Power transformer: primary 115 volts; secondary 25 volts, 1 ampere (Stancor P-6469 or equivalent)  
 1—6" x 5" x 4" metal box (Bud CU-729 or equivalent)  
 1—Miniature vernier dial and knob assembly, (Lafayette F-348 or equivalent)  
 1—9-pin tube socket and shield  
 2—Binding posts (if used)  
 Misc.—Line cord, lamp socket, fuse holder, terminal board, scrap aluminum, hardware, hook-up wire, etc.



Vertical line between lamp and photocell in schematic diagram represents shutter vane. Circuit is shown with plus side of output grounded, but may be left floating if both output terminals are insulated from box.

that suggests many other uses which we hope our ingenious readers will explore.

**Construction.** This prototype unit was built in a 4" x 5" x 6" metal box having removable front and back panels. All parts are mounted on the front panel as shown, making it easy to assemble and wire the unit. The rectifier diodes are mounted on a small piece of terminal board, which is supported by a bracket made from a scrap of aluminum. This bracket also supports the lamp base and the fuse holder for F1.

The photocell is mounted in firm contact with a piece of 3/32"-thick aluminum, 2" square, which serves as a heat sink. The heat sink is fastened to the front panel with four screws, but is held away from the panel enough to clear the

inside end of the dial mounting screw, by means of two strips of aluminum that serve as spacers.

The positioning of the lamp, photocell and dial shaft must be done so as to put the lamp filament directly over the opening of the cell's light shield, and allow the vane to swing clear of the light shield opening. Other parts may be mounted as convenient, since their placement is not critical.

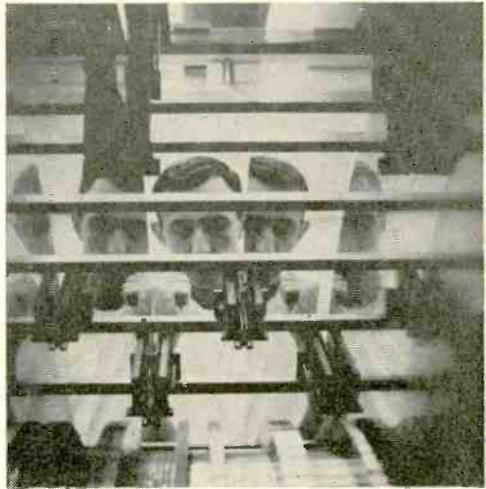
The light shield for the photocell was made from a 9-pin tube base and shield assembly by removing the tube base from the shield mounting ring, and the spring from inside the shield. The

(Continued on page 106)

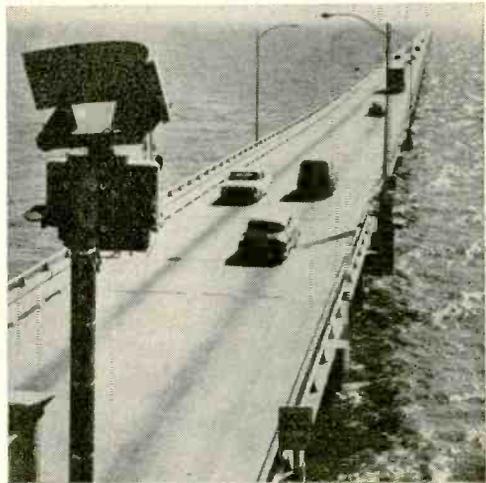


◀ **NEW GI RADIO**—Two units weighing just 1½ lb. total will replace the Army's 7-lb. "Handie-Talkie." Helmet-mounted receiver has 13 transistors, 7 diodes; hand-held transmitter 12 transistors. Miniature dry batteries are used.

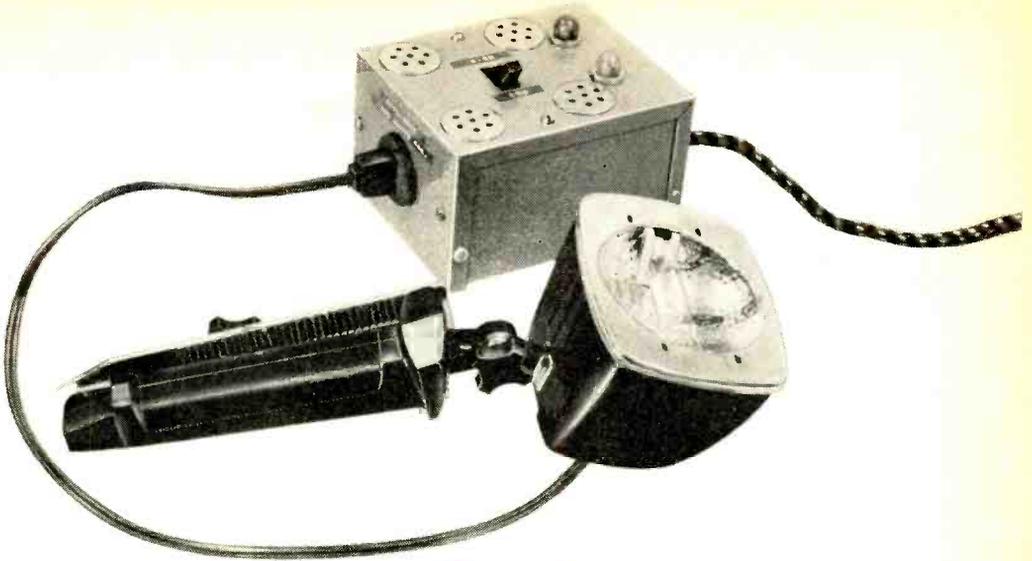
**MEMORY DISCS**—The five technicians in the photo are one: his image is reflected from two 47" shiny, magnetic cobalt-covered computer memory discs recently developed by General Precision. Each stores 51 million bits of data.



**RADAR GUARDS MOTORISTS**—Radar antenna, left, looks out over the world's longest causeway spanning 24-mile-wide Lake Pontchartrain near New Orleans. To safeguard motorists who "go to sea" in foggy weather, Raytheon radar keeps an electronic lookout for loose, drifting barges or disabled vessels.



◀ **CORONA SPOTTER**—This Little League Eliot Ness is aiming a corona detector—not a gun—developed by Westinghouse. Corona from high-voltage lines, which wastes electricity and develops radio interference, may be spotted 75 feet away by aiming through the telescopic sight. Trigger turns on circuitry which makes corona static audible in speaker.



# HIGH WATTAGE REDUCER

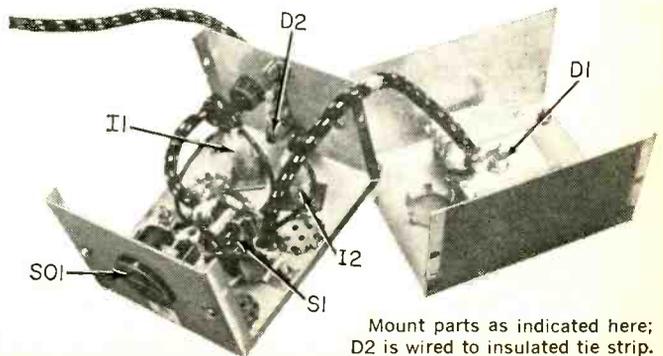
Use low-cost, high-amperage silicon diodes for easy power control

**T**HIS HANDY PROJECT is a by-product of our space age. Without the impetus to develop high-amperage, solid-state rectifiers necessary for the space program, electronics experimenters would not have been able to buy "over-runs," surplus or seconds. As it is, silicon diode rectifiers with 20-ampere ratings are being offered for about \$3. The multiple household uses for these devices have never been fully explored, so here are a few ideas on how to use them—you'll probably find many more.

As shown above, you can extend the life of your home movie high-intensity lighting equipment. You can halve the output of a 1000-1200 watt electric heater (as long as it does not incorporate a motorized fan), giving you controlled warmth and "reserve" heating power. The same applies to a soldering iron (no guns), or perhaps

your electric cooker (again, no motor). You'll find the "Reducer" inexpensive and easy to build. Best of all, the unit itself consumes no power—it simply saves it.

Construction is simple, requiring only that the heat sink be well insulated from the aluminum box. The author used surplus ceramic bushings about 3/4" high, threaded on both ends. A 20-amp diode will run hot



Mount parts as indicated here; D2 is wired to insulated tie strip.

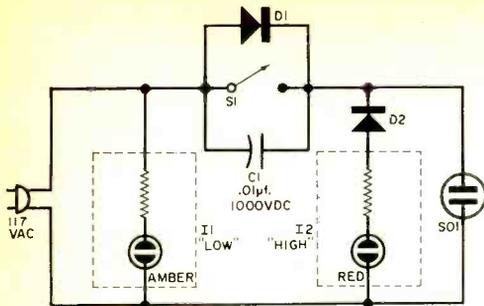
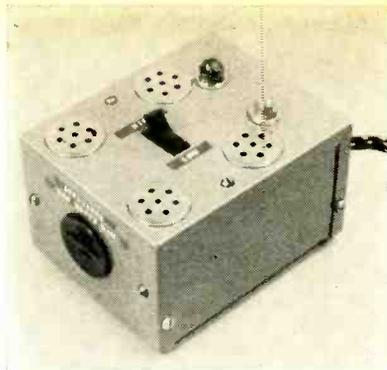


Diagram shows simplicity of High Wattage Reducer.



In addition to mounting D1 on heat sink, ventilation holes should be provided to dissipate heat generated in operation.

#### PARTS LIST

- C1—0.01- $\mu$ f., 1000-volt ceramic disc capacitor
- D1—20-ampere, 400 PIV silicon diode, stud mounting
- D2—50-ma., 200 PIV silicon diode
- I1—Neon lamp assembly with built-in resistor, amber color lens
- I2—Neon lamp assembly with built-in resistor, red color lens
- S1—S.p.s.t. switch, heavy-duty (15-ampere minimum rating)
- SO1—Chassis-mount a.c. socket
- 1—3" x 4" x 5" Minibox
- 1—Heat sink (Carl Cordover HSR-4 or equivalent)
- Misc.—Four threaded ceramic bushings to hold heat sink, heavy-duty a.c. cord, terminal strip, wire, solder, hardware

in series with appliances that have a rated power drain of 1400-1500 watts, so the heat sink is a must—it also makes a convenient mount for the diode.

Holes for ventilation should be punched in the aluminum box as in the photos. Two neon lamps (optional) were incorporated in the circuit to show operation. When switch S1 is open, D1 and D2 are back-to-back, and I2 will go out. When switch S1 is closed, both neons go on and the silicon diode is switched out of the "Reducer" circuit.

—Frank A. Parker

## CB Dummy Load

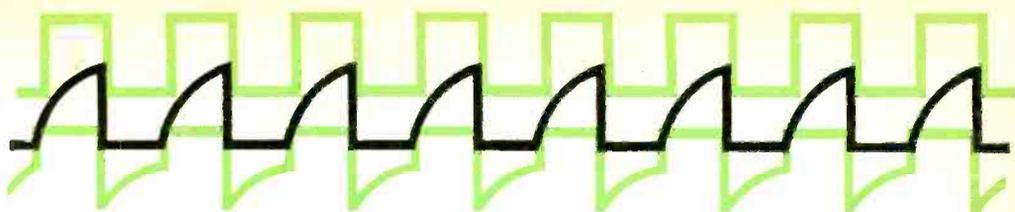
CITIZENS BAND regulations prohibit the practice of tuning up your transmitter while putting a "dead" carrier on the air. The commonly-used light bulb dummy antenna prevents this, but it changes resistance with brightness.

The dummy load shown at right is easily made by soldering a bus bar to the center post of a coax connector and two resistors between the bus bar and the shell. If your CB transmitter uses 52-ohm coax line, make the load of two 100-ohm, 2- or 3-watt resistors. For 72-ohm line, use two 150-ohm, 2- or 3-watt resistors. Be sure that the resistors are carbon and not wire-wound. Wire-wound units will introduce inductance and upset readings.

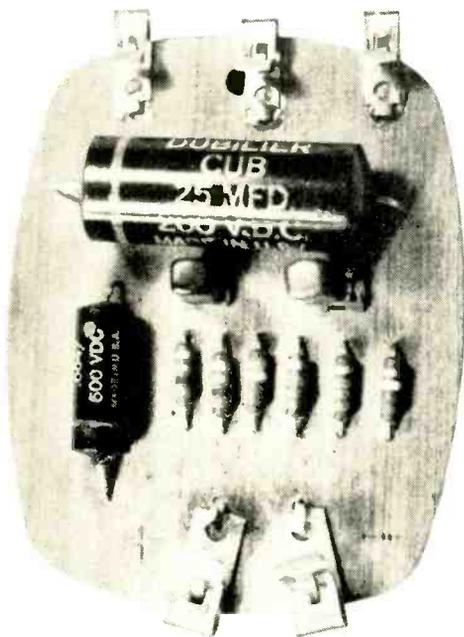
Tune up with the dummy load using the internal metering in your CB unit or the r.f. probe of a VTVM clipped across the load. A reading of 13-13½ volts corresponds to 3.5 watts output with 52-ohm line.

—Alex F. Burr, 16W2941

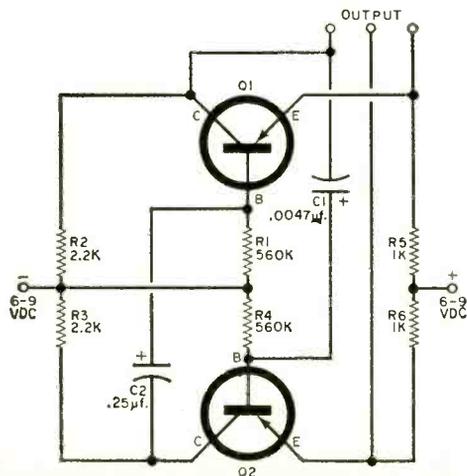




# Four-Way Oscillator



Almost nothing is critical about this one—parts values may be varied to give different frequencies and waveforms. CK722's were used for Q1 and Q2.



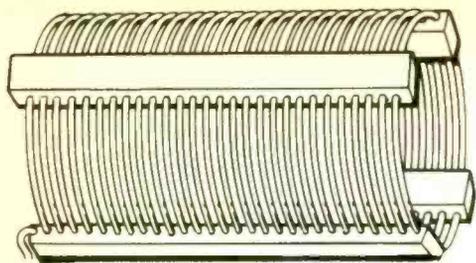
**I**F YOU'D like to try your hand at a very intriguing, easy to build, inexpensive transistor project, the "Four-Way Oscillator" is for you. As indicated in the drawings above, it generates square waves (comparable in quality to those produced by a commercial audio square-wave generator), and at least several other waveforms of different frequencies, shapes and strengths. The unit can also serve as a CPO, a grid dipper modulator, or as a go-no-go transistor tester.

A quick look at the schematic tells the story—the Four-Way Oscillator is actually a simplified free-running multivibrator, unusual in that only ten components are required. With the parts values shown, square-wave output of about 800 cps can be taken from the first two terminals at the top. Varying the value of *C1* will change the output frequency. Taking the output from different combinations of terminals will give different waveforms and different frequencies. Actually, output can be taken from almost any point in the circuit—it's fascinating to experiment while watching a 'scope or while monitoring the signals with a pair of headphones.

The Four-Way Oscillator makes an excellent tester for small-signal *pnp* transistors. Defective units—including those with excessive leakage—will simply not work when used to replace either *Q1* or *Q2*—CK722's in the author's unit. Power supply voltage is not critical, but better square-wave linearity was obtained with 9 volts than with 6. The value of *C2* can be made considerably smaller without affecting the circuit; changing resistor values will change the waveforms obtainable.

To keep the cost down, the author's unit was built on a small chip of Formica (kitchen cabinet dealers use them for samples, and they should be available for the asking) measuring 2 3/4" x 3". Holes were drilled to accommodate component leads, transistor sockets, and Fahnestock clips for battery leads and output terminals.

The oscillator makes a handy addition to any test bench. —L. E. Byfield, K9ADD



# R.F. Coil

*No more hit-or-miss coil*

**W**HILE there's nothing wrong with the time-honored cut-and-try technique of winding coils for a receiver or transmitter, you can save yourself a lot of time and trouble by building this simple "R.F. Coil Frequency-Finder" for use with an external signal source such as an r.f. signal generator, a VFO, or a grid dipper.

The design of the unit is straightforward. The unknown coil is connected in parallel with *C2*, a midget 140- $\mu$ f. variable capacitor, through *J2* and *J3*. The only power required is the r.f. furnished by the signal source through *J1-C1*. When the coil and *C2* resonate with the external r.f. source, energy is absorbed by the circuit and rectified by *D1*, giving a reading on the 50- or 100- $\mu$ a. meter, *M1*.

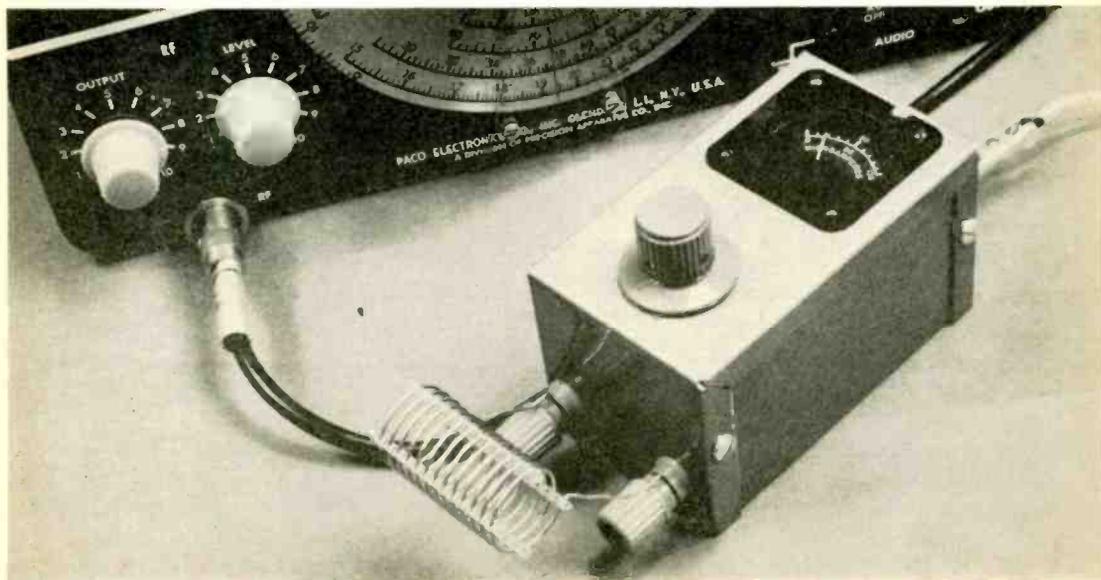
**Construction.** Cut a hole for *M1* near one end of the 2 $\frac{1}{4}$ " x 2 $\frac{1}{4}$ " x 4" Minibox.

Drill a hole to mount *C2* close to the other end of the box. Locate holes for the coil jacks, *J2* and *J3*, in the end of the box near *C2*. Terminal *J1* is mounted at the opposite end near the meter. Both *J1* and *J2* must be insulated from the metal box. Wiring is done point-to-point, keeping leads as short as possible; use a heat sink when soldering *D1*.

Although a 100- $\mu$ a. meter was used in the author's model, a 50- $\mu$ a. movement will give better sensitivity (although possibly at greater cost). In any case, a miniature meter of the relatively inexpensive imported variety should prove perfectly satisfactory.

Install a knob with a pointer on *C2*'s shaft, and calibrate *C2*, marking the minimum point (*C2* fully open) 10  $\mu$ f. and the maximum point 150  $\mu$ f. (*C2* fully closed). From these two points, estimate the 75 and 100  $\mu$ f. points

External r.f. source—signal generator or VFO—is the only power required to operate the unit.



# Frequency-Finder

winding—all it takes is a meter, a few parts, and r.f. source

By LEON A. WORTMAN

and mark them on the panel. Decals, if available, will make a professional-looking scale. The markings (slightly greater than  $C2$ 's maximum and minimum capacities to compensate for the unit's internal capacity) will be only roughly accurate, but quite adequate in this application.

**Operation.** To use the Frequency-Finder with an r.f. generator, simply connect the center conductor of the output cable to  $J1$ , leaving the shield unconnected. Connect the unknown coil to  $J2$ - $J3$ , keeping leads as short as possible. If the coil is to be used with a capacitor of any type, set  $C2$  to that value; otherwise, at minimum.

Sweep across the desired frequency range with the r.f. signal generator until you find the resonant point indicated by a maximum reading on  $M1$ . The resonant frequency of the coil and  $C2$  can then

be read directly on the dial of the r.f. generator. Keep the output low, consistent with a readable indication on  $M1$ . A VFO can be used in the same manner. If the r.f. source is poorly calibrated, you can double-check by tuning its signal in on an accurate receiver.

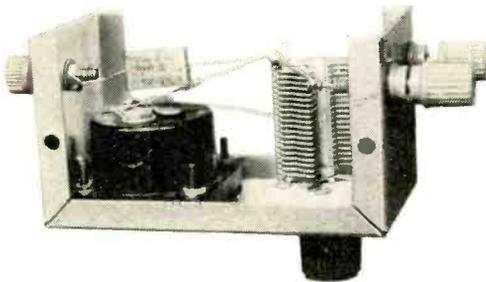
To use the Frequency-Finder with a grid-dip oscillator, plug the appropriate coil into the dipper, set it in the oscillating mode, and bring it to within a few inches of the unknown coil. Adjust the tuning dial of the grid dipper for peak indication on  $M1$ . Read the resonant frequency from the dial of the grid dipper, ignoring, for this test, the dipper's own meter and sensitivity control.

**Other Uses.** Another method of using the Frequency-Finder is to set the r.f. source at a predetermined frequency, and adjust  $C2$  to determine how much capacitance is required to make the unknown coil resonate.

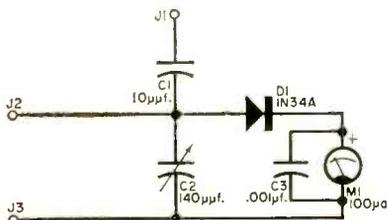
The value of a small capacitor can be estimated with the unit. Connect a coil to  $J2$ - $J3$ , set  $C2$  at 150  $\mu\mu\text{f.}$ , and tune the r.f. source for maximum indication. Connect the unknown capacitor in parallel with the coil at  $J2$ - $J3$ , and reset  $C2$  for maximum indication. The value of the unknown capacitor is approximately equal to the maximum value of  $C2$  (150  $\mu\mu\text{f.}$ ) minus the new setting of  $C2$  that restores  $M1$  to maximum reading.

Coils are easy to add to, or subtract from, if you use the Frequency-Finder first—try it.

-30-

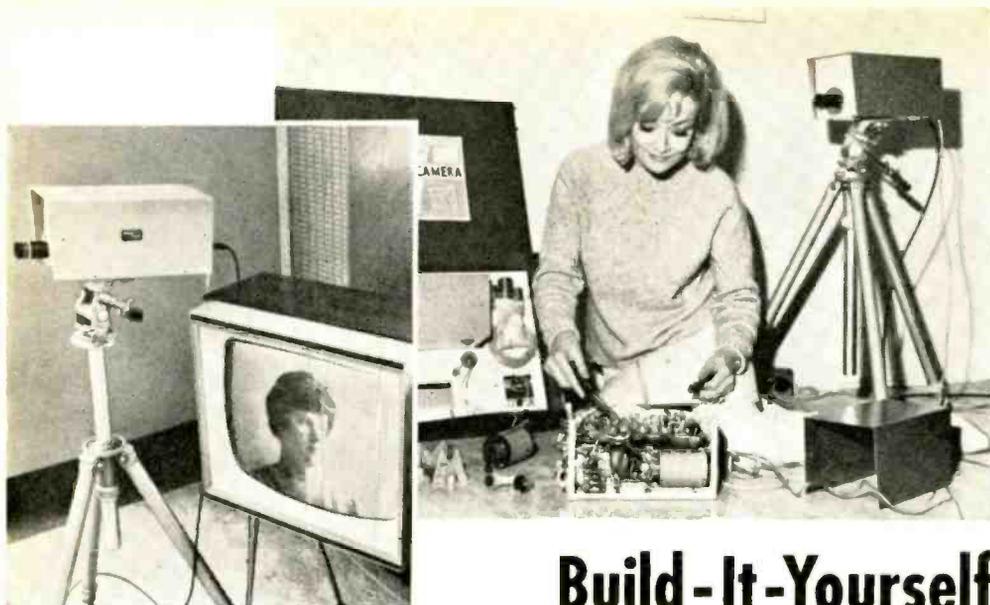


Frequency-Finder is mounted in small Minibox; all wiring is done point-to-point to keep leads short.



## PARTS LIST

- $C1$ —10  $\mu\mu\text{f.}$  mica or ceramic capacitor
- $C2$ —140  $\mu\mu\text{f.}$  midget variable capacitor
- $C3$ —.001  $\mu\mu\text{f.}$  ceramic disc capacitor
- $D1$ —1N34A diode or equivalent
- $J1, J2, J3$ —Insulated binding posts or jacks
- $M1$ —50 or 100  $\mu\text{a. d.c.}$  microammeter
- 1—2 $\frac{1}{4}$ " x 2 $\frac{1}{4}$ " x 4" aluminum box
- 1—Knob with pointer



## Build-It-Yourself TV Camera Kit

**O**NE OF THE HITS of a recent London trade show was this transistorized TV camera kit that sells (in England) for just \$200 complete with lens and vidicon tube.

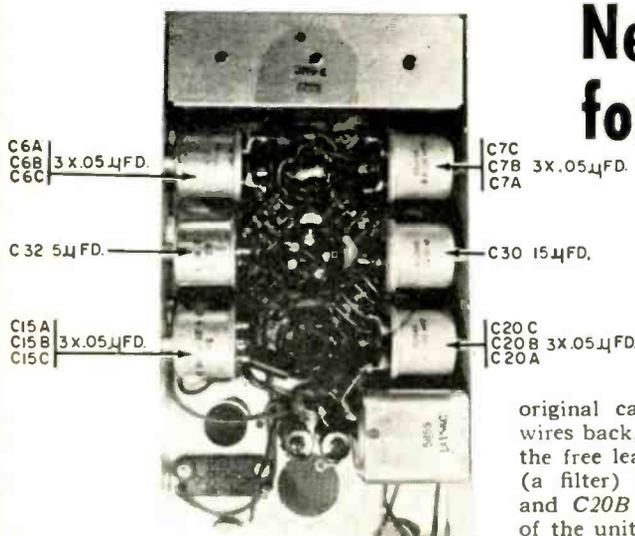
Called the "Beukit," the camera is made by Beulah Electronics, a London firm, and is designed to work with any TV set through a connection to the antenna terminals. Incorporating 13 transistors and 6 diodes, the unit is said to provide a resolution of about 2.5 megacycles—adequate for closed-circuit and experimental work. Most of the wiring is done on a printed circuit board, and non-critical circuitry is employed to obviate the

need for test equipment to adjust the unit.

To keep cost down, the firm has introduced a low-cost lens with fixed iris and wide focus range. Changes in lighting are compensated by adjusting camera target or beam controls. The vidicon is an "experimenter's" type, but provides good-quality pictures as the photo at the left shows. The camera will be distributed in the United States by Olson Electronics, 260 S. Forge St., Akron, Ohio.

-30-

## New Capacitors for the ARC-5



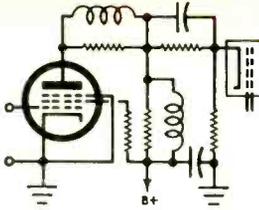
**I**F YOU own a weary Command receiver with electrical-ly or physically leaky bypass capacitors, you can easily restore it with ten .02 μf., 600-volt ceramic discs (they work as well as the old .05 μf. units and are readily available) and a midget 15 μf., 30-volt electrolytic. Clip

original capacitor leads one by one, trace wires back, and install new units, grounding the free lead to the nearest ground lug. C32 (a filter) can be discarded; C15B, C15C, and C20B are not used in some versions of the unit.

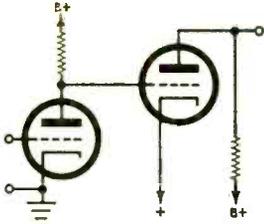
—E. H. Marriner

# AMPLIFIER QUIZ PART I

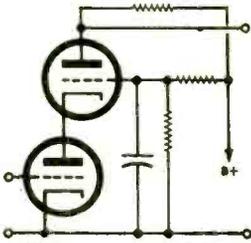
By ROBERT P. BALIN



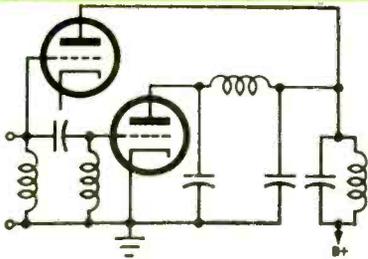
A



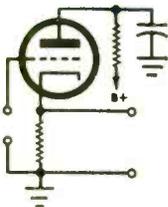
B



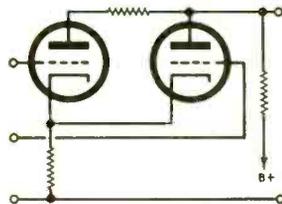
C



D



E



F

Over the years many types of vacuum tube amplifiers have been devised for specific uses. Here are six that range from easy to tough in difficulty of recognition. Try your hand at matching up the circuits (A-F) shown with the names (1-6) commonly given them in electronics handbooks. Even old-timers may have trouble recognizing all six without guesswork. Next month Part II will offer six transistor circuits to tax your memory.

1 Cascode amplifier

C

2 Cathode follower amplifier

E

3 Direct current amplifier

B

4 Video amplifier

A

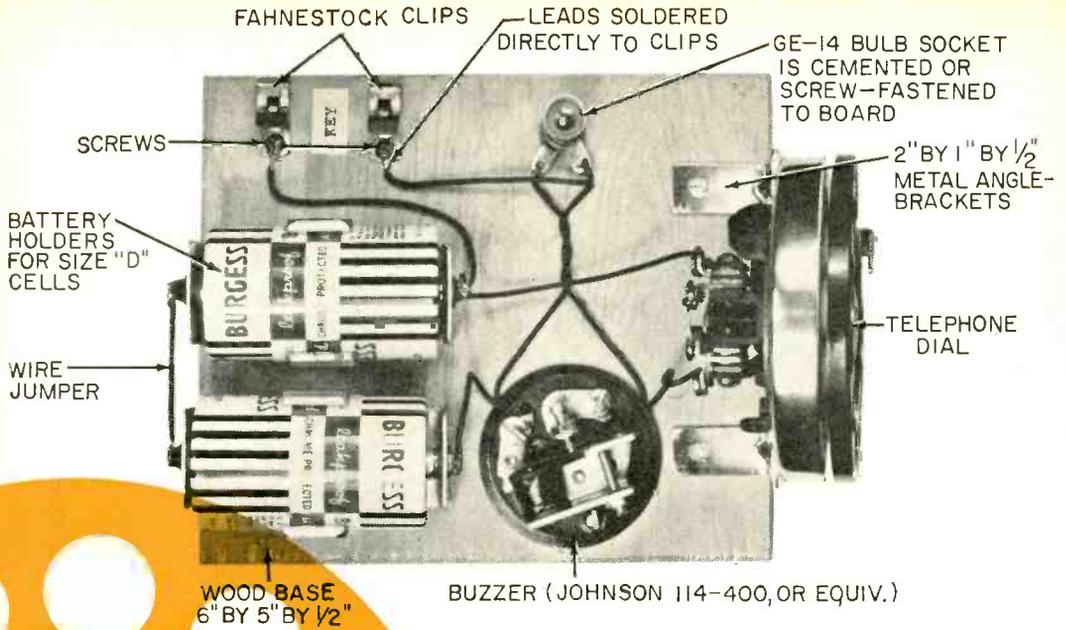
5 Differential amplifier

F

6 Doherty amplifier

D

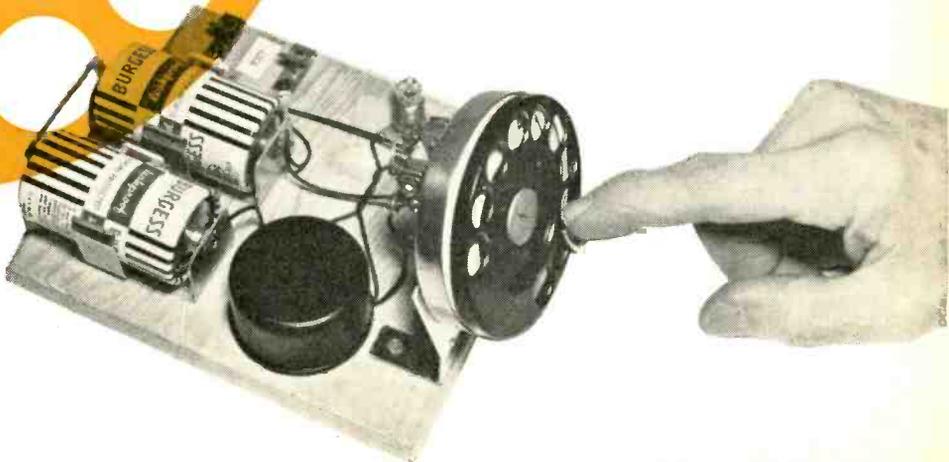
(Answers on page 94)

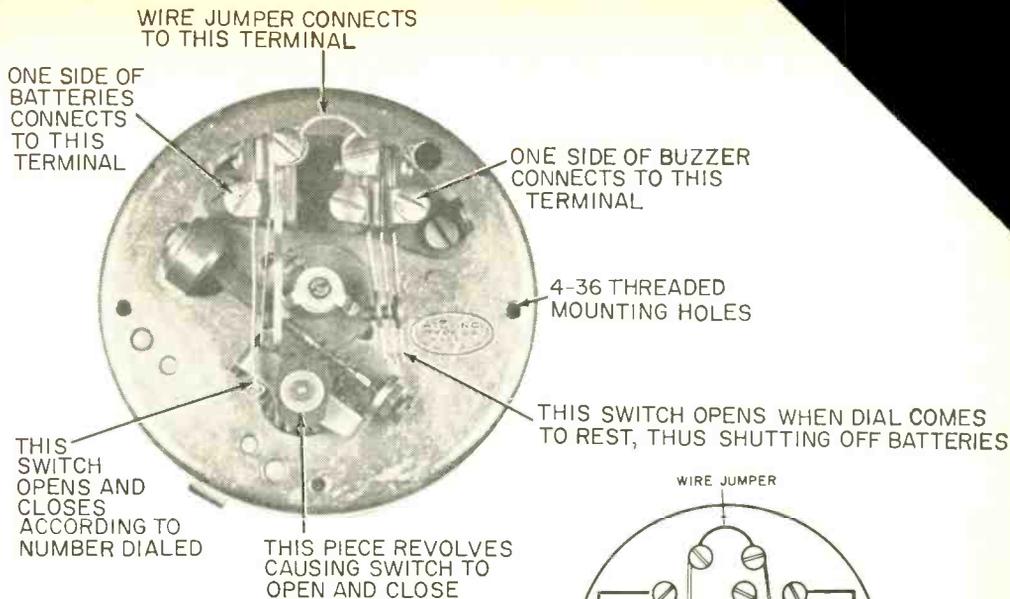


# DIAL, BUZZ and BLINK

**H**ERE'S a project that accomplishes two objectives: It demonstrates how a dial telephone mechanism operates and makes a wonderful plaything for the kids. There's no tricky wiring involved, and you can probably throw it together in an hour.

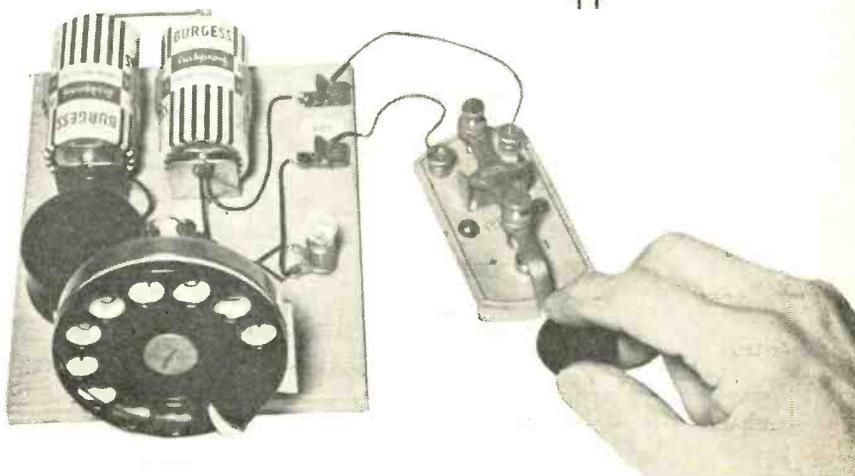
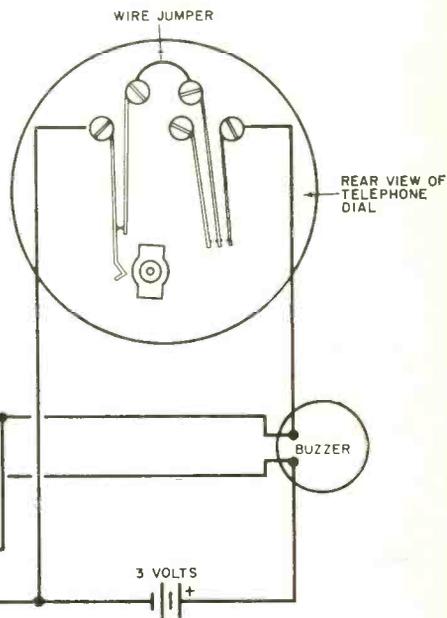
The illustrations show how the dial mechanism, flashlight batteries, buzzer, flashlight bulb, and a couple of Fahnestock clips are connected. If you want to, you can put a telegraph key in the circuit to make a code practice setup.





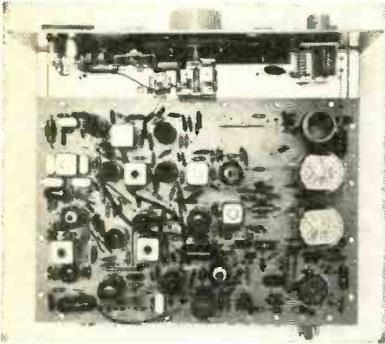
**Dial mechanisms are currently advertised by the following mail-order houses. At this writing, they are listed by: Olson Electronics, 260 S. Forge St., Akron, Ohio; Fair Radio Sales, 2133 Elida Rd., Box 1105, Lima, Ohio; Surplus Center, 900 West O St., Lincoln, Nebr.; and MDC Industries, 923 W. Schiller St., Philadelphia 40, Pa. Prices range from \$1 to \$2.15, depending upon the condition of the mechanism.**

**—Art Trauffer**

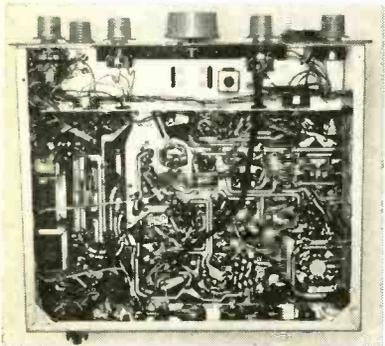


# Product Reviews

## HEATHKIT HW-22 40-METER SSB TRANSCEIVER



Reader Service No. 84—see page 15



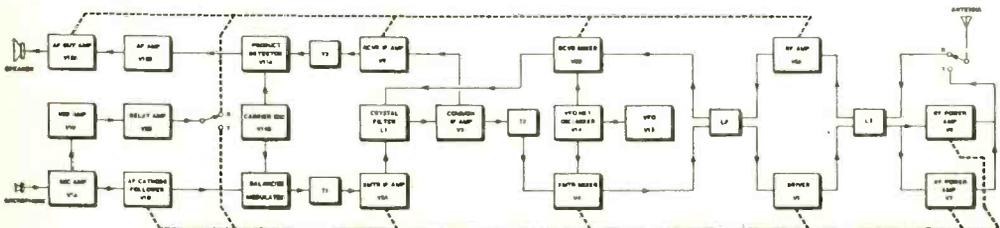
**I**F YOU WANT to go to sideband transceiver operation without straining the budget, there's now a way to do it: Heath Company's line of \$119 (less power supply) single-band, 200-watt PEP sideband transceiver kits. These 12-pound, go-anywhere lightweights—ideal for mobile or portable use—pack a large amount of communications capability into a small package, as the Editors of POPULAR ELECTRONICS discovered during construction and testing of the 40-meter unit, the HW-22.

Designed purely for SSB (lower sideband), the HW-22 covers 7.2 to 7.3 mc. Front panel features include selectable PTT, VOX, or tune operation; r.f. and a.f. gain, VOX sensitivity, final tune, and large VFO (tuning) knob. Other controls include S-meter adjust, VOX delay, mike gain, tune level, and final bias. The S-meter reads relative output on transmit, and final cathode current with a switch.

Fourteen tubes are used in the crystal-filter rig, plus a four-diode balanced modulator. Common to both receiver and transmitter (see diagram) are the VFO—keeping receiver and transmitter locked on the same frequency—i.f. amplifier V3, crystal filter, carrier oscillator V11B, and a number of passive components. Two 6GE5's driven by a 12BY7 are at the business end of the transmitter; a 6EA8 serves as the receiver r.f. amplifier/mixer, followed by two i.f. stages, product detector and audio output. Receiver sensitivity is rated at 1  $\mu$ a. for a 15 db signal plus noise-to-noise ratio; selectivity 2.7 kc. at 6 db.

Construction and adjustment of the HW-22 is easy. All parts (except outboard controls) are mounted on the large printed circuit board (see photos). A dummy load and VTVM are sufficient to align the unit. Voice intelligibility and carrier and unwanted sideband suppression are excellent. Universally good reports were received on the air.

-30-





## Rx for the Amateur/SWL

*Prescription for the reception problems that plague both the ham and the SWL? Much of it lies in receiver design*

**D**ESPITE the thousands of advanced SWL's and hams whose interest in radio does not stop at the edges of the ham bands, ham-band-only receivers have gained much ground in recent years. The reasons are easy to understand: Crowded band conditions and the growth of single sideband (SSB) put a larger premium on selectivity, stability, and ease of tuning. These qualities are a lot easier to achieve over the limited ham bands than they are over the entire short-wave spectrum.

Nevertheless, among the general coverage receivers now available, there are a few that extend most of the advantages of the limited-coverage specialized amateur receiver to the amateur/SWL. The Hammarlund HQ-180AX is one of them.

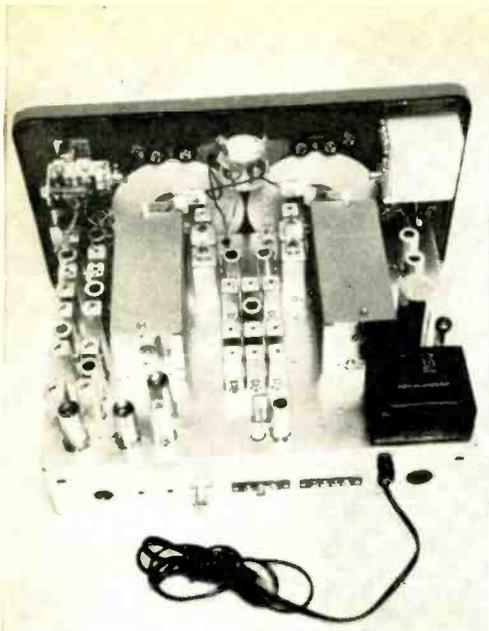
The trend in popular ham-band-only receivers has been toward dual or triple conversion, with separate first oscillator crystals used for each band covered;

tuning, over a limited i.f. range, is done in the second mixer oscillator.

The HQ-180AX, like most general-coverage receivers, has a tunable, wide-range first mixer oscillator following a r.f. stage that is "peaked" from the front panel. A unique feature in the "A" versions of the HQ-180 is a separate filament transformer that keeps the filaments of the first oscillator and mixer tubes heated as long as the receiver is plugged into an a.c. socket. The effect of this—together with the rugged construction, voltage regulation and temperature-compensated circuitry—is a receiver with crystal-like stability free from significant warm-up drift.

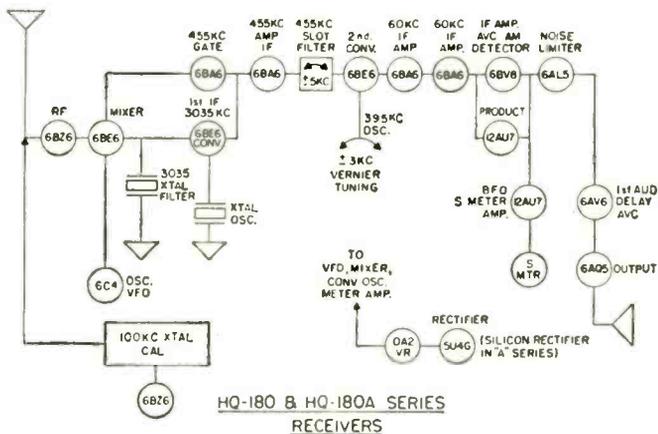
**Molding the Passband.** One of the interesting assets of this receiver is the extent to which the operator can tailor the passband (selectivity) of the receiver to different modes of transmission and to band conditions.

Frequency coverage of the HQ-180AX



Rugged, heavy construction, characteristic of Hammarlund designs, is evident above, as is the complete shielding and "openness" of chassis. The cabinet wrap-around is made of perforated stock for better heat dissipation. The HQ-180AX performs as expected under the "drop test"—jarring does not change the frequency.

The basic circuitry of the receiver is evident from the block diagram at right; 17 tubes are used in the triple-conversion unit. In late "A" and "AX" models, the rectifier tube has been replaced by two semiconductors.



is from 540 kc. to 30 mc. with double conversion to 7.85 mc., and triple conversion from 7.85 to 30 mc. As shown in the block diagram on this page, a crystal filter is permanently installed at the first i.f. Following is a crystal-controlled converter (or i.f. "gate" on the lower bands where dual conversion is utilized), a highly effective slot filter in the 455-kc. i.f. section, and a final converter that heterodynes signals down to 60 kc., the frequency at which detection takes place.

In the 60-kc. section are a vernier tuning control that varies the frequency of the last converter over a 6-kc. range, a sideband selector switch (upper, lower,

or both), and a four-position selectivity control that permits the receiver bandwidth to be varied from .5 to 3 kc. on either sideband, or from .5 to 6 kc. on both sidebands.

The effect of these controls plus the slot filter is to allow the receiver passband to be precisely adjusted to eliminate heterodynes, splatter, and QRN, and to greatly simplify SSB tuning. With the selectivity control, the passband can be easily narrowed to the point where the intelligibility of the received signal is best and interference least—.5 or 1 kc. for c.w., 2 or 3 kc. for phone. An interfering signal within this passband or close to its edges can be removed with the slot filter which, in effect, is a "hole" which moves across the passband as the slot is adjusted.

Speaking of heterodynes, the HQ-180AX's excellent selectivity curve does

a good job of picking off one sideband of a regular AM signal in a manner akin to a "signal splitter." If you find that there's a station practically on top of the one you're after, you simply move over to the side of the carrier opposite the interfering station by flipping the sideband selector switch and slightly retouching the tuning.

**Four Detectors.** The HQ-180AX includes four "detectors"—a conventional AM diode detector, a product detector for c.w. and SSB signals, and two a.v.c. (automatic volume control) circuits. Fast attack a.v.c. is applied to the sec-

(Continued on page 102)

# Telcan-TV Tape Recorder Progress Report

By W. STEVE BACON

Feature Editor



Above: British unit; American model differs in detail only. Right: N.Y.C. TV program being taped (top) and then played back (bottom). Taped picture is of good quality.



**B**ACK in the month of September, 1963, POPULAR ELECTRONICS was the first nationally circulated monthly magazine to announce a new home TV tape recorder selling for peanuts compared to units then on the market. In the weeks that followed, stories on the new Telcan unit appeared in every conceivable medium—some laudatory, some as straight news reports, and at least one downright skeptical.

Now, we are pleased to report that the Telcan unit, which recently crossed the Atlantic for a New York demonstration under the sponsorship of Cinerama, the concern which will market it in the U.S., is everything the inventors say it is. Not only is Telcan good, but it will shortly be available in this country, perhaps as soon as April, 1964. A maximum U.S. price estimate—mass production may drive costs down—is put at “somewhere under \$300—including a TV camera.” According to an unconfirmed report, a kit version may also be made.

What exactly can Telcan do? As we reported in September, the unit can tape sound and pictures from an ordinary TV set; in conjunction with a TV camera costing about \$150, it can be used to

tape home movies. The American model of the machine records up to 44 minutes of sound and video on an 11” reel of ordinary audio tape using two tracks at 22 minutes per track.

While the quality of the picture off the tape is not quite as good as a picture off the air—there are a few lines in the taped picture and definition is slightly reduced—the quality is adequate and can be expected to improve with further development.

**Technical Details.** We term Telcan “spectacular” for several reasons—largely due to the technical prowess displayed by Norman Rutherford and Michael Turner of Telcan, Ltd., its inventors. The unique feature is the single stationary recording head assembly which is made in two parts. As the tape passes between the two sections, a video signal two megacycles wide is recorded on it. Exactly how this is accomplished has not yet been revealed, but details will be forthcoming in the near future when patent arrangements have been completed.

Following, point by point, are the mechanical features of the recorder.

● Controls—recording contrast, playback contrast, head alignment, sound  
(Continued on page 88)



# Short-Wave Broadcast Predictions

FEBRUARY 1964

BY STANLEY LEINWOLL, Radio Propagation Editor

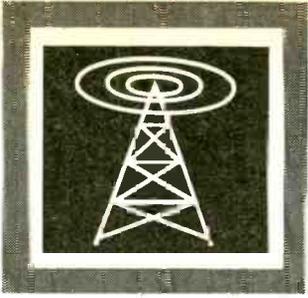
SHORT-WAVE LISTENERS who collect rare QSL cards will be interested in a special card being offered by *Radio Liberty*, a private, non-profit-making organization that broadcasts to the U.S.S.R. in 17 languages of the Soviet Union. To celebrate its tenth anniversary on the air, *Radio Liberty* has had printed a limited number of these special QSL cards, which show a projection of the organization's target area. The cards will be sent to anyone who reports reception of their programs. For complete schedule information, write to Jason H. Smith, Jr., Engineering Department, *Radio Liberty*, 30 East 42 St., New York 17, N. Y.

		TIME (EST)												
Between Eastern USA and:		00	02	04	06	08	10	12	14	16	18	20	22	24
Western Europe		6	6	7	7	15	17	17	11	9	7	6	6	
Eastern Europe		6	6	6	7	15	17	11	9	7	7	6	6	
South & Central America		11	11	9	11	17	17	17	17	17	17	11	11	
Near East		6	6	7	9	15	15	11	9	9	9	7	7	
North Africa		6	6	6	7	17	17	17	11	9	9	7	7	
South & Central Africa		9	9	9	11	21	21	21	21	17	15	9	9	
Australia & New Zealand		9	9	11	9	11	11	*	17	21	17	11	9	

		TIME (CST)												
Between Central USA and:		00	02	04	06	08	10	12	14	16	18	20	22	24
Western Europe		6	7	7	7	17	17	11	9	7	7	6	6	
Eastern Europe		7	7	7	7	11	11	9	7	7	7	7	7	
South & Central America		9	9	9	15	17	17	17	17	17	15	11	9	
North Africa		7	7	7	9	17	17	15	9	9	9	7	7	
South & Central Africa		7	7	7	11	17	21	21	21	17	11	9	7	
Far East		7	7	7	7	7	9	9	11	15	15	9	7	
Australia & New Zealand		9	11	11	9	11	17	*	21	21	21	15	11	

		TIME (PST)												
Between Western USA and:		00	02	04	06	08	10	12	14	16	18	20	22	24
Western Europe		6	7	7	9	15	15	9	7	6	6	6	6	
Eastern Europe		7	9	9	7	9	7	7	7	7	7	7	6	
South & Central America		9	11	9	15	17	17	17	17	15	11	9	9	
Africa		7	7	9	9	15	15	15	15	15	11	9	9	
Far East		7	7	7	9	7	9	7	15	17	15	9	7	
South Asia		6	6	6	7	9	9	9	9	15	15	9	7	
Australia & New Zealand		9	9	9	7	11	17	21	21	21	17	11	9	

To determine the frequencies and times for best short-wave reception in the United States, select the table for the area you are located in, read down the left-hand column to the region you want to hear, then follow the line to the right until you are under the figures indicating your approximate local time. The boxed numbers will tell you the frequency band (in megacycles) to listen to during any 2-hour interval. Asterisk (\*) indicates that signals will probably not be heard.



# Monthly Short-Wave Report

By **HANK BENNETT**, W2PNA/WPE2FT  
Short-Wave Editor

## OLD STATION RETURNS TO THE AIR

**O**N SEPTEMBER 28 of last year, your Short-Wave Editor was one of the first listeners to tune in CFCX operating from Montreal, Quebec, on 6005 kc. There had been no advance notice that CFCX was planning to return to the air, and it took several hours of listening to determine the identity of the station. Announcements revealed that it was in the Montreal area and the signal strength indicated that it was much lower-powered than CFRX, Toronto, and CHNX, Halifax, both of which were operating in the same frequency band.

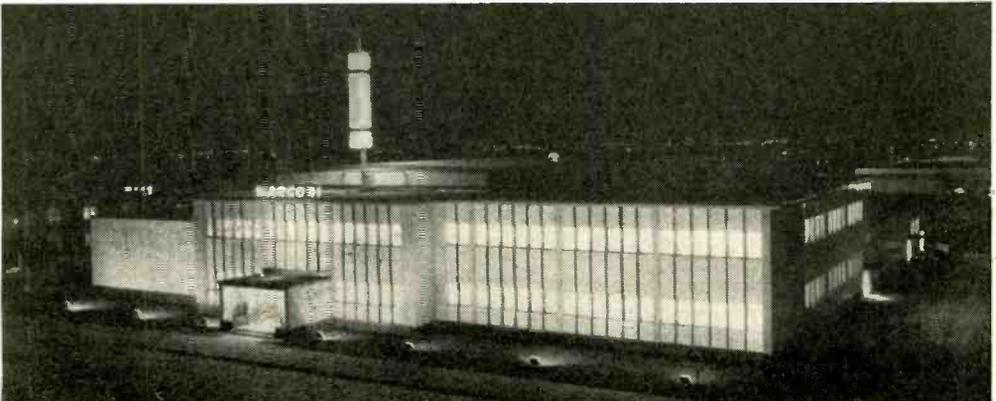
We dropped a report to the station—at the time we correctly guessed that it was the

short-wave counterpart of CFCF since the announcements left little doubt that the programs were originating from that medium-wave station. Shortly thereafter, we received a cordial letter and verification card from the Canadian Marconi Company signed by George Bowden, VE2IF, studio supervisor for CFCF-TV. Their address is 405 Ogilvy Ave., Montreal 15, Quebec.

What is now station CFCX was originally licensed as VE9DR and operated from Drummondville, Quebec (how many of our readers ever verified that one?) from 1930 to 1932, when the location was changed to the Mt. Royal Hotel in Montreal. The call-sign became CFCX in 1936 and the station operated from Montreal until 1948 with only 75 watts. In late 1963 CFCX once again commenced operations, testing with 75 watts, and later increasing power to 500 watts. Their transmitter is now located at Caughnawaga, Quebec.

Station CFCX, owned and operated by

Station CFCX, off the air since 1948, has been revived by the Canadian Marconi Company; it's the short-wave counterpart of the medium-wave station CFCF. Photo at left shows a portion of the present CFCF-CFCX transmitting facility at Caughnawaga, Quebec. Below is a view of the outside of the Canadian Marconi building in Montreal taken at night.



the Canadian Marconi Co., is in service to help give listeners in Canada's northlands "something to listen to other than stations from behind the Iron Curtain." The antenna at CFCX is beamed 320-360 degrees north and 140-180 degrees south, which puts the New York-New Jersey area directly in the southern beam. According to Bowden, numerous reports from the southern areas show excellent signal strengths, and encouraging reports are coming in from the north as well. The latter territories will have much improved service now that the power has been raised to 500 watts.

Voice announcements are aired from time to time giving frequency, mailing address, reception report requests, and other timely information. Stamps or International Reply Coupons are not required for confirmation — just a sincere and honest report of reception.

In addition to CFCX, Canadian Marconi also operates CFCF on 600 kc., with 500

watts; CFCF-FM on 92.5 mc., with 41,500 watts ERP; and CFCF-TV, channel 12, with 325,000 watts ERP.

Prior to the time when VE9DR was licensed, the station operated under the temporary call-sign of XWA. This was in 1919 and operations shortly ceased for a few weeks or months. During the period when XWA was off, KDKA in Pittsburgh, Pa., started broadcasting. XWA, therefore, may have actually been one of the first broadcast stations with regular programs in North America. However, in fairness to everyone concerned, CFCX is claiming only to be the first station in Canada. Should any of our old-time readers actually have a verification or other positive proof that XWA was on the air before KDKA, it might be of interest to both parties.

We are grateful to George Bowden for his assistance in the preparation of this article.

(Continued on page 108)

---



---

## ENGLISH-LANGUAGE NEWSCASTS TO NORTH AMERICA

---



---

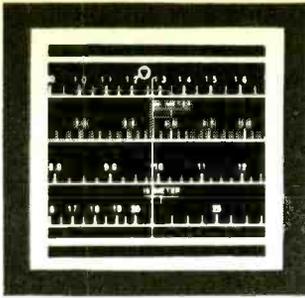
*All of the stations below specifically beam English-language newscasts to the U.S.A. The times may vary a few minutes from day to day.*

COUNTRY	STATION	FREQUENCY (kc.)	TIMES (EST)
Australia	Melbourne	17,840, 15,220 9580	2030, 2130, 2330 0745
Bulgaria	Sofia	6070 (and/or 9700)	1900, 2000, 2300
Canada	Montreal	11,720, 9625, 5970	1800 (Caribbean)
East Congo	Leopoldville	11,755	1630, 2100, 2230
Czechoslovakia	Prague	11,990, 9795, 9550, 7345, 5930	2030, 2230
Denmark	Copenhagen	9520	2100, 2230
Finland	Helsinki	15,185	1530 (Mon., Fri.)
West Germany	Cologne	15,405, 11,795 9640, 6160 9735, 9575, 6145	1010 2035 0000
Hungary	Budapest	11,910, 9833, 7220 9833, 7220	1900 2230
Italy	Rome	11,905, 9575	1930, 2205
Lebanon	Beirut	11,890	1630
Netherlands	Hilversum	17,810, 15,445 11,950, 9590 9715, 6085 6035, 5985	1030 (Tues., Fri.) 1415 (Tues., Fri.) 1630 (exc. Sun.) 2030 (exc. Sun.)
Portugal	Lisbon	6185, 6025 (and/or 9740)	2105, 2305
Spain	Madrid	9360, 6130	2215, 2315, 0015
Sweden	Stockholm	17,840 11,805	0900 2045, 2215
U.S.S.R.	Moscow	9740, 9730, 9700, 9680, 9660, 9650, 9620, 9610, 9570, 7320, 7310, 7240, 7200, 7150 (may not all be in use at any one time)	1730, 1900, 2000, 2100, 2300, 0040
Vatican City	Vatican City	9645, 7250, 6145	1950

---



---



# Across the Ham Bands

By **HERB S. BRIER**, W9EGQ  
Amateur Radio Editor

## HOW MUCH DOES IT COST TO BE A HAM?

**M**OST HAMS have had the experience of hearing a visitor say that he would like to become a ham, but couldn't afford it. Is there any truth in the belief, common outside the amateur ranks, that ham radio is an expensive hobby? Let's look at the facts.

Statistics indicate that the average ham spends about \$150 a year on his hobby. Possibly this figure is a little on the low side; nevertheless, we know that an effective low-power station consisting of a receiver, transmitter, antenna, and necessary accessories can be put together for under \$150. We also know of course that some hams spend far more than \$150 a year on their hobby, but most of us recognize that \$100 to \$150 a year can build up a very effective amateur station within a few years.

How do these figures compare with the cost of other popular habits, hobbies and recreations? Smoking? A pack of

cigarettes a day comes to over \$100 a year. Even a single Coke or Pepsi a day amounts to enough in a year (\$36.50) to keep a low-power station going, once you've got it set up.

What about bowling? If you bowl two nights a week, it probably costs you at least \$4—without any of the extras like a soft drink or two, and maybe a snack afterward. Is \$200 a year spent on bowling considered an extravagance? Even the fellow who has no specific hobbies at all, who merely permits himself a congenial night on the town once or twice a month, spends more on his pleasure than many a ham spends on his hobby.

Of course radio amateurs have no objection to the other fellow spending what he pleases on his own recreation, whatever it may be. But let's put an end to the fiction that amateur radio is an expensive hobby. By the way, have you

---

## Novice Station of the Month

---

This efficient-looking station belongs to Terry Neifeld, KN3VJY, Baltimore, Md. His equipment includes a National NC-270 receiver, and Globe Chief De Luxe and Heathkit Two-er transmitters. Forty-three states and six countries grace Terry's log book. For submitting this photo in our Novice Station of the Month contest, Terry will receive a one-year subscription to POPULAR ELECTRONICS. If you would like to enter the contest, send us a clear picture of your station—preferably showing you at the controls—along with some information about yourself, your equipment, and operating achievements. Entries go to Herb S. Brier, Amateur Radio Editor, Box 678, Gary, Indiana.



priced a set of golf clubs, or a two-week hunting trip to Canada or the Rockies? And how about skeet shooting, yachting, skiing, outboard racing, and photography, to name a few other hobbies? Do they cost less per year than amateur radio?

## NEW RULES FOR HAM LICENSES

Even before they went into effect, the new procedures for obtaining a Novice, Technician, or Conditional class license described last month have been modified by the FCC.

As the rules now stand, when you are ready for the exam, you select a volunteer examiner. He must be at least 21 years old, and must hold an amateur license of General Class or higher grade, a commercial radiotelegraph license, or be employed in the service of the United States as the operator of a manually-operated radiotelegraph station. Also, you must write to the Federal Communications Commission, Gettysburg, Pa., 17325, or to the nearest FCC field office and request Amateur Application Form 610.

Upon receipt of the form, the examiner will give you the international Morse code test. If you fail, the examination ends at that point. If you pass, the examiner will mail your filled-in Form 610 and his own signed statement that you passed the code test to the FCC at the address given above. In his statement, the examiner must describe his

qualifications for conducting the examination, and must include with the statement and Form 610 your \$4 license fee in the form of a check or money order payable to the FCC. Of course, in the case of a Novice license application, there is no fee. In a few weeks, your license will be mailed to you.

## CLASSIC HAM CIRCUITS

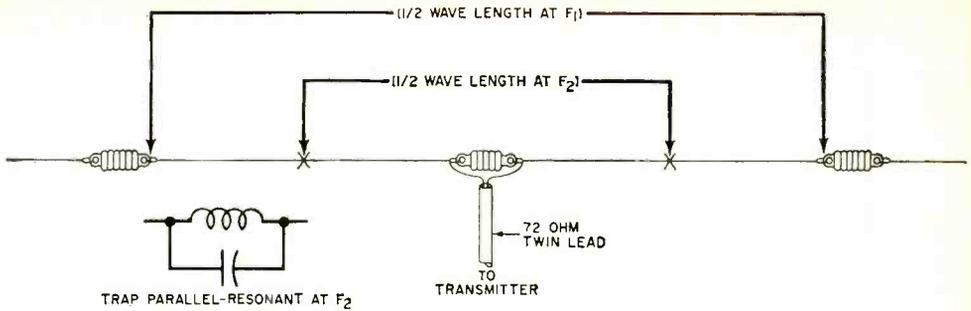
Probably two-thirds of the hams on the 10-, 15-, and 20-meter bands who use beam antennas have "tri-band" arrays. In fact, a large portion of all antennas in the ham bands from 3.5 to 29.7 mc are multi-frequency types, whether or not they are beams. The reason for the great popularity of such antennas is that they permit effective operation on several bands with a single antenna, and usually without requiring any adjustments, switches, or more than one transmission line. Introduced to radio amateurs by Chester L. Buchanan, W3DZZ, the multiband antenna makes band-hopping easy; just switch the transmitter to the new band and you're ready to go with no further fuss or bother.

**How Multi-Frequency Antennas Work.** The principle on which most multiband antennas are based is surprisingly simple. Basically, it is merely that a high-Q tuned circuit looks like a very high resistance at its parallel-resonant frequency, but like a moderate value of inductance at frequencies well below resonance.

In the schematic drawing, the antenna is assumed to be one-half wavelength long at the operating frequency. For an antenna made of wire, the length is



Anthony A. Mirra, K1ZFV, Roslindale, Mass., a triple-threat 'man, sports additional calls of WPE1AOB and 1W9389. His Johnson Viking drives a four-element Telrex beam supported 45 feet above ground. A Hallicrafters SX62A and Hammarlund 170A inhale the incoming signals. Tony's record: 50 states, 21 countries.



By substituting traps for insulators at "X" points, one dipole will work on two bands.

about 130 feet at 3.6 mc., and the impedance seen by a feedline connected at the center is about 60 ohms, varying somewhat with the proximity of other objects, such as the ground. At either end of such an antenna, the impedance is several thousand ohms. A transmission line of 50 or 75 ohms impedance will make a good match to such an antenna if connected at the center, resulting in a low standing wave ratio and easy loading at the transmitter end.

But if we try to drive this same antenna at 7.2 mc., each half of the antenna is a half-wave long at the new frequency, and the transmission line is in effect connected to the ends of two separate half-wave antennas strung in a line. Since the impedance at the end of a half-wave antenna is so high, there is a mismatch of as much as 100:1, or greater.

Most of the energy will, therefore, be reflected back toward the transmitter,

The station of Paul Zolig, WN9HHF, Chicago, Ill., is an excellent example of a compact arrangement that still permits good ventilation of equipment.



the SWR will be high, and it will be impossible to load the transmitter properly. Attempts to drive the final amplifier to full output will probably result in arcing over the final amplifier tuning capacitor, high losses in the transmission line, and the risk of permanent damage.

Of course, if we cut each of the antenna halves in the middle at the points marked "X" in the drawing and insert insulators, the two parts of the original antenna still connected between the insulators to the feed line will then be a half-wave long at the new operating frequency, the impedance at the feedpoint will be again about 60 ohms, and operation will be the same as at 3.6 mc.

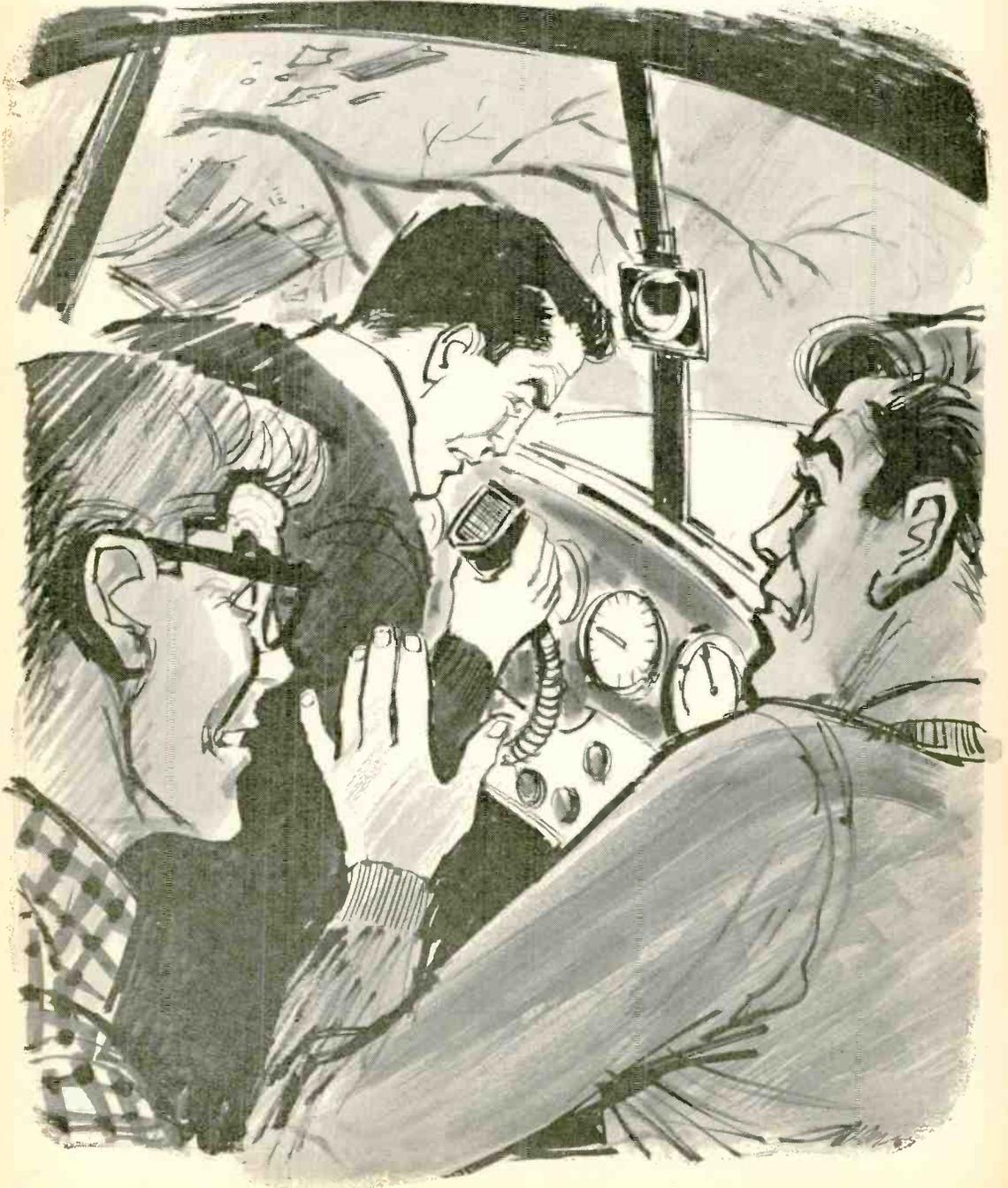
Obviously it wouldn't be very practical to lower an antenna and insert or take out insulators every time we changed bands. Suppose, however, that we put a high-Q tuned circuit in series with the antenna at the two points marked "X." If these tuned trap circuits are parallel-resonant at 7.2 mc., they will act as two very high resistances, isolating the center half of the antenna from the two end quarters. The result is that the center half radiates as a resonant half-wave dipole at 7.2 mc.

If we again try to drive the whole antenna at 3.6 mc., the tuned traps at the "X" points look not like high resistances but like small inductances. Therefore, by trimming enough wire from the end portions of the whole antenna to compensate for the effects of the trap inductances at 3.6 mc., we can again get half-wave resonance at that frequency. And by inserting additional pairs of tuned traps in the same manner, other bands can also be covered with the same antenna.

(Continued on page 100)

A Carl and Jerry Adventure in Electronics

# Pi in the Sky and



By  
**JOHN T. FRYE**  
W9EGV

# Big Twist

**T**HE FEBRUARY AFTERNOON was unseasonably warm. Low clouds scudded across the sky and a gusty, damp wind was blowing from the southwest as Carl parked the car at the Parvoo University Airport.

"There's Bill's Cessna parked on the apron," Jerry said, climbing out of the car, "but I don't see Bill. You sure he wanted us to fly up-river with him to see the ice jam this afternoon?"

"Sure I'm sure," Carl retorted. "There he is now over by that hangar. He's motioning to us. Let's see what he wants."

Bill Vardon, a senior at Parvoo, had a wealthy father back in Texas who had the poor taste to make his fortune in neither cattle nor oil. Instead, he had piled up dimes from a chain of root beer and hot dog stands extending clear across the country, but those dimes had bought Bill his own airplane and had made him a BMOC. He was, though, a "very right guy" in both Carl's and Jerry's eyes.

"Before we take off, I thought you electronic buffs might like a close-up look at the DC-six MPATI plane in the hangar here," tall, lanky Bill drawled. "I've got permission for us to go inside."

"We sure would," Jerry said promptly.

Both boys, of course, knew about MPATI, the Midwest Program on Airborne Television Instruction, that now was in its third year of operation. They knew that every Monday through Thursday morning of the school year a big DC-6 took off from its base at the Parvoo University Airport and climbed to its station at 23,000 feet over the little town of Montpelier in northeastern Indiana. There, staying within a ten-mile circle, it flew for better than five hours in a shallow figure-eight pattern so that turns could always be made into the wind. During this time two complete UHF TV transmitters inside the plane telecast simultaneous but different programs on channels 72 and 76. The video-

taped educational programs telecast had been prepared by the finest TV instructors discovered in a nation-wide talent search, and they covered such subjects as English, French, Spanish, history, literature, music, dramatics, science, and math. Because of the last subject, some wag had dubbed the program "Pi in the Sky." The educational telecasts were picked up and used by schools in six states within a 200-mile radius of Montpelier.

**T**HERE SHE IS, fellows," Bill said as they stopped beneath the wing of the plane that looked much larger inside the hangar than it did outside. "This plane is kept standing by in case something goes wrong with the other one flying on station. It's stocked with duplicate tapes and could take over the telecast as soon as it takes off and climbs to position."

"What's that long thing in the plastic cover sticking back beneath the belly of the plane?" Carl wanted to know.

"That's the twenty-four-foot transmitting antenna," Bill answered. "When the plane is on station, this is moved hydraulically to a straight-down position and a gyro keeps it within one degree of the vertical during all normal flight maneuvers. If it wasn't for that, the transmitted signal pattern would be tilting all over the place when the plane banks or climbs, and reception in many places would be pretty bad."

"One antenna for two transmitters?" Jerry queried with raised eyebrows.

"That's right. The klystron final stages of both transmitters—which operate at about five kw each—feed the same antenna through a diplexer arrangement that prevents interaction. That's just one of some of the 'firsts' the MPATI engineers have worked out."

"Must be a lot of valuable electronic gear inside that plane," Carl observed wistfully.

"I'm sorry I couldn't wangle permission for us to go inside the plane today," Bill replied, "but it's really something to see. Six and a half tons of transmitters, video tape equipment, operating consoles, and test equipment are bolted down in there. I say 'bolted down' because every bit of equipment has to be mounted solidly enough to take the

*(Continued on page 88)*



# On the Citizens Band

with **MATT P. SPINELLO**, KHC2060, CB Editor

**T**HE ELEVENTH ANNUAL FLY-IN Convention of the Experimental Aircraft Association was held at Greater Rockford (Illinois) Airport last August. A hefty responsibility for coordinated safety was placed on the shoulders of airport authorities and Citizens Band radio during the five-day event. More than 2000 EAA members and guests saw to it that control-tower workers charted some 13,000 flight operations—take-offs and landings—4725 of them in just one day. By the second day of the get-together 113 amateur-built planes had checked in along with 40 antique aircraft. More than 125 factory-built planes were also tied down at the airport.

Any day is a busy day at a controlled airport. Add approximately 200 additional planes and several thousand extra take-offs and landings per day and everybody's got their hands full: pilots, control tower, ground crew, mechanics, the works! EAA officials stated that Robert Selfridge, Greater Rockford Airport manager, and his crew—with the help of CB radio—set an all-time record of operations for any airport anywhere in the world with their EAA Fly-In performance.

**CB: Fly-In Work-Horse.** To facilitate the control tower's communication overload during the fly-in, ten Citizens Band transceivers were employed to handle as much of the EAA's operations as possible. Two 5-watt rigs were used, one in the control tower and one roving unit in an automobile, while eight hand-held transceivers covered the airstrips and grounds. Regular airport facilities were closed during nightly airshow and stunt-flying performances by the EAA. During these events the hand-held units were used in jeeps and carryalls to control flight traffic. These vehicles, including the familiar "follow me" jeep, covered ground control traffic and taxiing aircraft.

Citizens Band communications were actually put to work from 9 a.m. to 9 p.m. daily during the week-long event. The roving unit participated as a trouble-shooter, handling requests for parts, gasoline and

covering problems of a general nature. Combined, the ten-unit system was also used to relay information from planes in the air, handled EAA traffic pertaining to possible hazards on the field or in the area, and covered EAA committee messages regarding upcoming events, times, etc.

**Airborne Radio Discussed.** Najeeb E. Halaby, administrator of the Federal Aviation Agency, was among the dignitaries who attended the fly-in. Chief Halaby did some "hangar flying" with about 1200 EAA members, explaining government regulations which have restricted their flying.

One of the major issues discussed was the question of barring pilots without two-way radio equipment from landing at controlled-area airports with control towers. Halaby reminded them that safety was a prime target in writing the "laws of the

This is how the eleventh annual Fly-In of the Experimental Aircraft Association looked to EAA members in the air. Ten CB transceivers were used to handle much of the EAA's communication operations on the crowded airstrips.

Rockford Register-Republic Newsplane  
Photo by Don Holt



sky, or, as you know them, the FAA regulations." He said, "all rules but the law of gravity can be waived on occasion by the FAA if you request a waiver ahead of time."

Other questions raised pertained to why pilots could not get approval for transistorized equipment or radios operated by dry batteries, and what could be done for those who could not afford required two-way radio equipment. Halaby's reply indicated that the rules are specific but are subject to change if manufacturers meet FAA specifications on lower cost models.

Illinois Governor Otto Kerner was so impressed by what he saw during an hour-long tour of the 175 aircraft on the field, he proclaimed the following day as Experimental Aircraft Day in Illinois.

They were all there: antique hand-builts from the early '20's, original renovated craft, biplanes, mini-mustangs, a homemade

delta-wing and even a twin-fuselage jet. A plane from California, hardly a bicycle, handled pedals on a bicycle, handled a delta-wing plane like a vet at 130 mph in close to 300 hours of flying time.

Our thanks to Rockford News-Sentinel for use of material in this column; to Paul Glynn for his contributions; and to Paul Aylesworth for a spot of epoxy cement at a critical moment. It replaced our walkie-talkie antenna enabling us to monitor the EAA control tower!

**C.A.P.—CB.** Many fine comments have been received across this desk since our October OTCB coverage of the Civil Air Patrol. It has been gratifying to note the number of CB'ers interested in joining the C.A.P. to be of some service with their equipment.

It was set up differently in the beginning. 26.62 mc. had been allocated to the C.A.P. so they might incorporate Citizens Band equipment into their activities and needs. Now a reverse! Experienced CB operators realizing the scope of public service possibilities as C.A.P. members have begun to join with C.A.P. organizations across the country. This not only qualifies them to add that 26.62 mc. crystal to their equipment to be used in search and rescue operations; it also gives them a chance to get a well-rounded education in search and rescue procedures from the air and on the ground, gives them first-aid training, and exposes them to the experience of a national service organization that has been around for over 22 years. What's more, C.A.P. membership furthers the interests and education of the air-minded who might not otherwise be able to afford training or flight time.

Art Nagy, 7W3659, a long-time contributor of CB information to this column, has informed us of the Broward Citizens Radio Club's (Fort Lauderdale, Fla.)  
*(Continued on page 107)*



Don Hart, assistant communication coordinator during EAA Fly-In Week, is shown with one of eight handie-talkies used between the airport control tower and EAA members on the ground and in the air.

When thunderstorms and high winds threatened the Fly-In one day, EAA pilots made a mad dash with their craft for the nearest hangar facilities.



Rockford Register-Republic

February, 1964

79

# Transistor Topics

By LOU GARNER, Semiconductor Editor

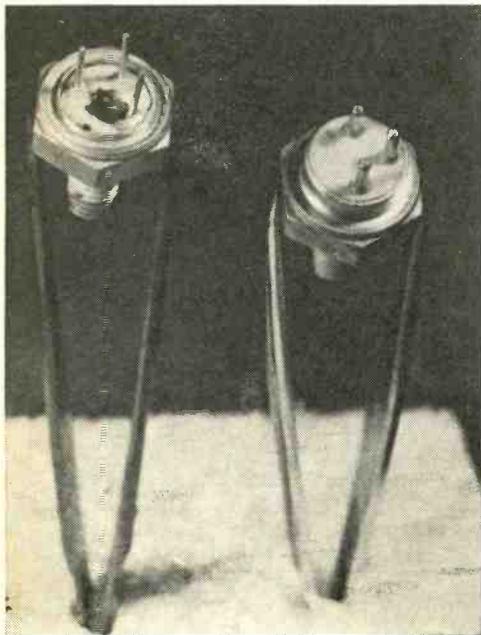
**T**HE DEVELOPMENT of a new UHF silicon transistor with a high-frequency power output five to ten times greater than that of earlier types has been announced by the Radio Corporation of America. The experimental unit, identified as type TA-2307, was developed under the technical direction of the U.S. Army Electronics Research and Development Laboratories at Ft. Monmouth, N.J. Although the TA-2307's first applications are expected to be in military and satellite transmitters, lightweight radar, and microwave relay equipment for TV and telephone communications, this is probably the first of a new "generation" of high-frequency power transistors which, one day, will be available to hams and home experimenters for use in transmitters, transceivers, and similar UHF projects.

As shown in the photograph on this page, the new UHF transistor's external appearance differs from that of more familiar units

in that it is hermetically sealed in a stud-type, ceramic-metal case. This recently developed package design combines the advantages of lead isolation, good thermal conductivity and low parasitic reactances.

Called an *overlay* transistor because of its construction, the TA-2307's "heart" is a tiny checkerboard structure far smaller than the head of a pin. It consists of a mosaic made up of 156 individual microscopic high-frequency transistors which are integrated by means of the overlay structure and applied on a tiny silicon wafer by a photo-etch process. Each emitter element is a square measuring only 0.0005 inch on the side. The emitter-base regions are interconnected by both metallic and semiconductor materials to spread the current flow uniformly. The individual emitter squares are clearly visible in the accompanying photomicrograph.

The TA-2307's average performance characteristics are illustrated graphically in Fig. 1. As a class C common-emitter



Held by tweezers in photo at left are two of RCA's new UHF "overlay" transistors; the unit at the right is hermetically sealed in a ceramic-metal case. In the enlarged photomicrograph below you can see a section of the transistor showing the individual emitter "squares" and connecting metalized overlay.

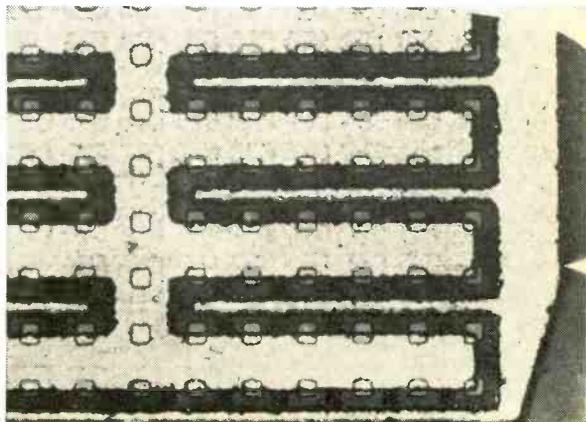
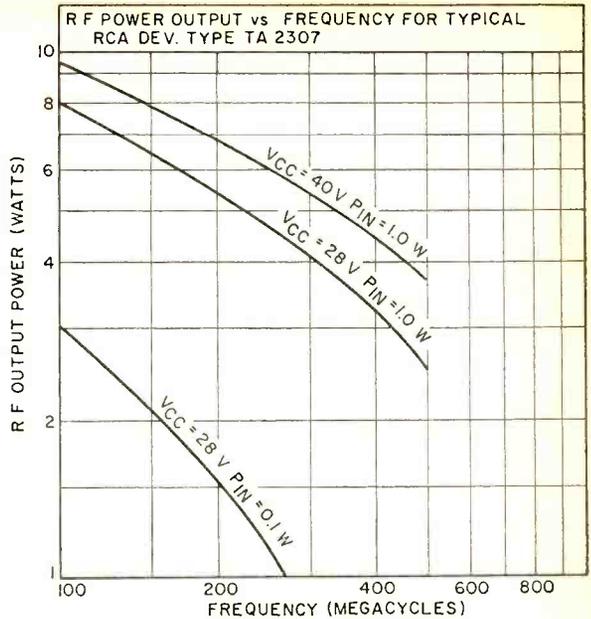


Fig. 1. Typical performance characteristic curves for RCA's "overlay" transistor. Note that several watts can be delivered at frequencies up to 500 mc.



amplifier, for example, a typical unit can provide 4.5 watts output at 400 mc. with 40 volts collector voltage, while selected units can deliver as much as 5 watts at 500 mc. with 7 db gain. In comparison, the maximum power output achieved heretofore by transistors at 500 mc. was considerably less than one watt.

**Readers' Circuits.** If a dozen experimenters were asked to develop a circuit for any given project, chances are they would present just as many different designs. As an example, two different receiver circuits are shown in Figs. 2 and 3. Both employ two transistors, cover the AM broadcast band, have loudspeaker output, require moderate-length external antennas, are battery-powered, and feature diode detectors—yet in all other respects the two designs are as different from each other as night is from day.

The circuit in Fig. 2 was submitted by reader George Fraser (512 W. Third St., Moscow, Idaho). According to George, "This is a dandy little radio, if you don't mind low fidelity. It gives surprising (although moderate, of course) volume with a modest aerial (window screen) and ground on local stations."

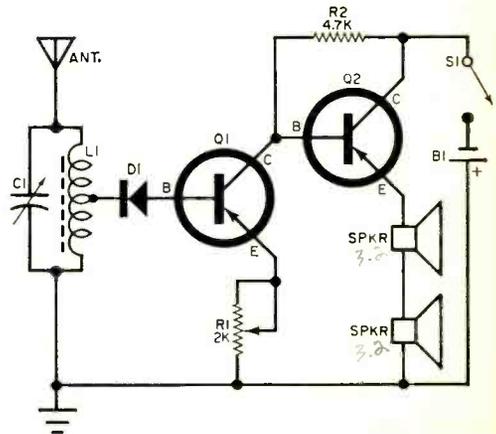
Referring to the diagram, r.f. signals picked up by the antenna-ground system are selected by tuned circuit  $L1-C1$  and applied to diode detector  $D1$ . The resulting audio signal is applied to a two-stage, direct-coupled audio amplifier,  $Q1-Q2$ , which, in turn, drives a pair of series-connected loudspeakers. Both stages employ  $npn$  transistors, with  $Q1$  in the common-emitter configuration and  $Q2$  as an emitter-follower. Potentiometer  $R1$  serves as a combination bias and gain control, while resistor  $R2$  acts as  $Q1$ 's collector load. Operating power is furnished by a single battery,  $B1$ , controlled by s.p.s.t. switch  $S1$ .

George used "on hand" components in assembling his model. Potentiometer  $R1$  is a 2000-ohm unit and  $R2$  is a 4700-ohm,  $\frac{1}{2}$ -watt resistor. Capacitor  $C1$  is a standard

365- $\mu$ f. tuning capacitor and  $L1$  a familiar broadcast-band loopstick with a center tap added. Diode  $D1$  is a general-purpose type—typically, a 1N34. The transistors, too, are general-purpose  $npn$  units; George used Lafayette SP238's. The loudspeakers are 4" units with 3.2-ohm voice coils. Any s.p.s.t. switch may be used for  $S1$ —toggle, slide or rotary. Finally, the battery is a single 1.5-volt cell, such as a standard flashlight battery.

You should have no difficulty in duplicating George's circuit, for neither layout nor wiring is critical and a number of parts

Fig. 2. Although neither layout nor wiring is critical in the receiver circuit submitted by reader George Fraser, diode and battery polarities are.



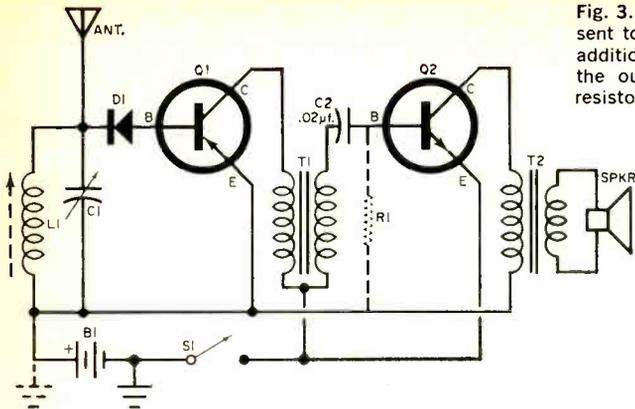


Fig. 3. This receiver circuit was sent to us by Kenneth Baer. If additional bias is necessary for the output stage, a half-watt resistor can be added as shown.

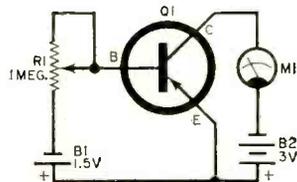
substitutions can be made. A variety of transistor types may be substituted—2N111's, 2N139's, 2N218's, 2N409's, or 2N410's, for example. A single loudspeaker with an 8-ohm voice coil can be used in place of the series-connected units; if series units are used, however, make sure that the speakers are wired in phase. Both diodes and battery polarities are critical.

Our second receiver circuit, shown in Fig. 3, was submitted by reader Kenneth J. Baer (2902 Anderson St., North Bellmore, N.Y.). Ken has contributed to this column before. His current design features transformer-coupling and both *pnp* (*Q1*) and *npn* (*Q2*) transistors in the common-emitter configuration.

The receiver's "front-end" is generally similar to the one used in George's circuit. The r.f. signals picked up by the antenna-ground system are selected by tuned circuit *L1-C1* and detected by diode *D1*. The resulting audio signal is amplified by a two-stage transformer-coupled amplifier, *Q1-Q2*, and used to drive a loudspeaker. In operation, *Q1*'s base bias is furnished by the d.c. component of the detected signal while *Q2*'s bias is supplied by its inherent leakage. Transformer *T1* is used for inter-stage coupling and *T2* to match *Q2*'s collector impedance to the loudspeaker voice coil. Coupling capacitor *C2* isolates *Q2*'s base and thus prevents a short of its leakage bias through *T1*'s secondary winding. Circuit operating power is supplied by a 3-volt battery, *B1*, controlled by s.p.s.t. switch *S1*.

Standard, readily available components are used throughout. Coil *L1* is a broadcast-band ferrite loopstick coil and *C1* a 365- $\mu$ f. variable capacitor. Capacitor *C2* is a 0.02- $\mu$ f. ceramic or paper unit—its working voltage is not critical. Diode *D1* may be a 1N34, 1N34A or 1N60. Type CK722 or 2N107 is suitable for *Q1* and type 2N229 for *Q2*. Transformer *T1* should have a 5000-ohm

Fig. 4. With this simple circuit, received from reader Charles Rakes, you can easily check a low-power transistor's d.c. gain. See *Transitips*.



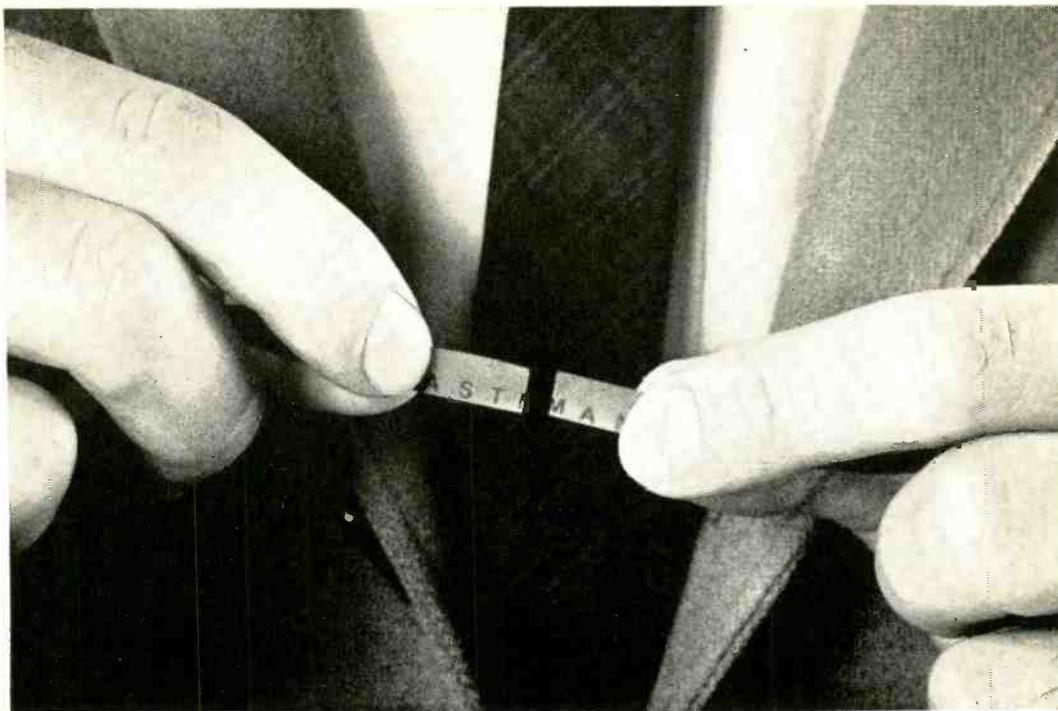
primary and 3000-ohm secondary (the center-tap, if provided, is not used), while *T2* should have a 2000-ohm primary and 10-ohm secondary. Ken used an Argonne AR-173 and AR-114 for *T1* and *T2*, respectively. Any size speaker with an 8- to 10-ohm voice coil should give acceptable performance. The power supply is made up of two flashlight or penlight cells in series, but, if preferred, can be a single 3-volt battery (*B1*). A slide or toggle switch is used for *S1*.

Ken's circuit can be assembled bread-board fashion or on a conventional chassis as preferred by the individual builder. Again, neither lead dress nor layout is critical. In some cases it may be necessary to provide additional bias for the output stage, *Q2*. This can be accomplished by adding a half-watt resistor, *R1*, as shown in dotted outline in Fig. 3. The resistor's value should be determined experimentally for optimum performance, but, in general, should fall between 100,000 ohms and 1 megohm.

**Transitips.** We've received a number of requests for additional information on testing semiconductor devices. As you may recall, last month we discussed a simple diode tester suggested by reader Ronald Wilensky. Another reader, Charles D. Rakes (Oak Grove, Mo.), has written to pass on his useful technique for checking a low-power transistor's d.c. gain.

Charles's basic method is illustrated in Fig. 4. The only items needed are a VOM, a 1-megohm potentiometer (*R1*), a few  
(Continued on page 98)

## Now...a new EASTMAN Sound Recording Tape!



Take a piece of the new Eastman tape. See how tough it is... how clean it breaks under stress.

### Look! No stretch...when it breaks—it breaks clean!

**NEW!** Support material for EASTMAN Sound Recording Tapes is DUROL Base. A specially prepared form of cellulose triacetate—smooth, tough, durable, highly flexible—provides high strength with low elongation. When equipment accidents happen, it breaks clean. Splices are made easily, quickly—with minimum program loss.

**Lifetime Coding:** your assurance of highest quality. Printed on the back of all EASTMAN Sound Recording Tapes is a continuously repeated, permanent legend. This identifies Eastman Kodak Company as the manufacturer and provides a convenient means of indexing these tapes.

**New "R-type" binder.** This gives a smoother, tougher surface, thereby reducing tape noise and distortion. In addition, it provides extreme abrasion resistance, preventing oxide build-up at the head. Even more important, however, are the amazing magnetic properties of coatings of "R-type" binder which make possible two superlative tapes—both available now...

**At leading electronic supply houses:** Type A303, a vastly superior low-print tape with output comparable to a fine general-purpose tape... also Type A304, a high-output tape with remarkably low print-through characteristics.

© Eastman Kodak Company, MCM LXI

For information,  
see your electronic supplier or write  
Magnetic Products Sales

**EASTMAN KODAK COMPANY**  
**Rochester, N.Y. 14650**

CIRCLE NO. 7 ON READER SERVICE PAGE



Unique ultra-handly Thread-Easy Reel with indexing scale and built-in splicing jig.

Exclusive with **RCA** ...

**AUTOTEXT**<sup>®</sup>

**the faster,  
easier way  
toward a career  
in electronics**

**Amazing home training method makes learning almost automatic**

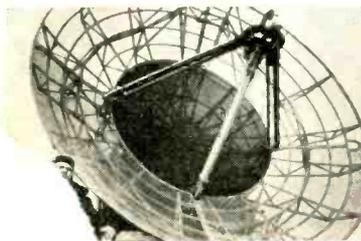
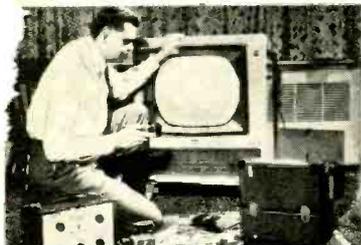
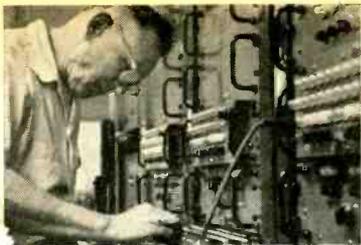
**Exclusive with RCA.** "AUTOTEXT" the revolutionary home training method introduced by RCA Institutes, Inc., is stirring the interest of thousands. Every day, "AUTOTEXT" is helping people like yourself join the thousands of other successful electronic students who are working toward profitable careers right now! This faster, easier way to learn electronics uses the latest scientific development in the field of home training—and "AUTOTEXT" is exclusive with RCA.

**New trend in education.** This exciting new trend in education represents a significant advance in teaching electronics. People who have been interested in careers in electronics in the past, but have had difficulty with conventional home training methods, can now begin to master the fundamental principles of electronics almost automatically. Tested in schools throughout the country, checked out and proved with thousands of students, programmed instruction is helping people learn more quickly and with less effort.

**Prove it to yourself now!** If you have a natural inclination or interest in the exciting field of electronics, that's all you need. RCA "AUTOTEXT" will help you do the rest. And the future is unlimited. Jobs are available for qualified technicians in Space Electronics, Communications, TV, Computer Programming, Automation, and many other electronic fields. The important thing is to get started now!

**Complete course available.** Right now, RCA Institutes offers you a complete Home Training Course ("Introduction to Electronics") using the "AUTOTEXT" method. You get a complete set of theory lessons, service practice lessons, experiment lessons, and all the kits you need. And most important, "AUTOTEXT" takes most of the effort out of learning the all-important groundwork of the electronics field.

**Get complete information now without obligation.** Send the attached postcard and check "AUTOTEXT".



**SEND**

## Wide choice of Home Training courses in Electronics:

- Autotext  
Introduction to Electronics
- TV Servicing
- Color TV
- Communications Electronics
- FCC License Preparation
- Mobile Communications
- Automation Electronics
- Electronic Fundamentals  
(also available in Spanish)
- Computer Programming
- Transistors
- Electronic Drafting
- Industrial Electronics  
Automatic Controls  
Industrial Applications  
Nuclear Instrumentation  
Digital Techniques

RCA Institutes Home Training Courses are complete step by step easy-to-understand units. You get prime quality equipment in the kits furnished to you, and all of it is top grade. It's yours to keep and use on the job.

**Liberal Tuition Plan.** RCA Institutes Home Training Courses are available under a liberal tuition plan that affords you the most economical possible method of home training. You pay for lessons only as you order them. If, for any reason, you should wish to interrupt your training, you can do so and you will not owe a cent until you resume the course. No long-term obligations!

**Set Your Own Pace.** RCA Institutes Home Training takes into consideration your own ability, finances and time. You learn at your own speed, in the most effective manner, with personalized instruction every step of the way. You get theory, experiment, and service practice beginning with the very first lesson. All lessons are profusely illustrated—a complete training package in every way.

## CLASSROOM TRAINING

RCA Institutes Resident Schools in New York City, and RCA Technical Institute in Cherry Hill near Camden, N. J., offer classroom training that will prepare you to work in rewarding research and production positions in many fields of electronics. No previous technical training required for admission. You are eligible even if you haven't completed high school.

**Free Placement Service.** RCA Institutes Resident School graduates are now employed in important jobs at military installations, with important companies such as IBM, Bell Telephone Labs, General Electric, RCA, in radio and TV stations and in communications systems all over the country. Many other graduates have opened their own businesses. A recent New York Resident School class had 92% of the graduates who used the FREE Placement Service accepted by leading electronics companies, and had their jobs waiting for them on the day they graduated!

**Coeducational Day and Evening Courses** are available at Resident Schools. You can prepare for a career in electronics while continuing your normal, full-time or part-time employment. Regular classes start four times a year.

SEND POSTCARD FOR FREE ILLUSTRATED BOOK TODAY! SPECIFY "AUTOTEXT", HOME STUDY OR CLASSROOM TRAINING.

**RCA INSTITUTES, INC.** Dept. PE-24

A Service of Radio Corporation of America.  
350 West 4th St., New York, N. Y. 10014



**The Most Trusted Name in Electronics**

February, 1964

## Telcan—Progress Report

(Continued from page 69)

volume, rewind, start, stop. The contrast controls are gain controls for the video record and playback circuits.

● Circuitry—all transistorized on three printed-circuit boards. A total of 30 transistors are used in the three modules, one of which is for sound, one for recording video, and one for playback. It is contemplated that servicing will be done, at least initially, by simply replacing a defective module with a new one.

● Tape speed—120 ips; to simplify the tape transport mechanism, the unit is designed to climb to full speed from rest in five seconds; braking is also done over a five-second slow-down.

● Tape and recording head life—tape life is in excess of 500 playings. The tape comes in contact with one part of the two-section head which is wearable. The life of this wearable section is put at 100 hours, with replacements available at an estimated cost of \$2.

● Head alignment—as might be expected, this is critical; however, the head azimuth can be easily adjusted (much like focusing a movie projector) by means of a simple knob control.

**Problems of Invention.** In conversations with Rutherford and Turner, we noted that the time that had elapsed between the first announcement of the machine and the New York demonstration had led to a number of skeptical comments. "Yes," Rutherford replied, "the disclosure of the machine was premature—and this showing is also. Unfortunately, they were necessary to finance further development." He also conceded that production estimates had been on the optimistic side—to date, only 25 of the British version of Telcan, carrying an estimated price tag of about \$160, have been produced.

It appears, however, that the problems the inventors have had in manufacturing and marketing the TV tape recorder are on the verge of being solved. A number of successful prototypes are in existence, and they demonstrate a recording technique heretofore considered impossible.

-30-

## Pi in the Sky

(Continued from page 77)

stress of a very rough landing. Aviation authorities insist on this. At the same time, the stuff has to be shock-mounted to prevent the vibration of the plane from knocking the sensitive, high-gain circuits out of whack."

"It must take a lot of power to feed two complete TV transmitters," Jerry said thoughtfully. "Where does it come from?"

"Back in the non-pressurized tail section are gas-turbine-driven, four-hundred-cycle generators that put out seventy-five kw. The standard TV transmitters had to be modified to use the four-hundred-cycle a.c., but they had to do it—higher-frequency power means a lot less iron in the generators and transformers, and a lot less weight."

"How many guys does it take to man this flying TV station?" Carl asked.

"Six. Three are flight crew, and the other three are technicians who operate the transmitters and keep an eye on performance. The signals are monitored all the time by technicians right here in the hangar, and they keep in touch with the TV guys in the plane through a radio circuit entirely separate from the one used by the pilot and the control tower. Any time the received signal gets bad, it's seen by the technicians on the ground and corrected by those in the plane if possible. Right now no live programs are shown, but they have a camera in the plane for transmitting test patterns between programs and to make slide announcements on program changes, transmission quality, and so on."

"How would you like this kind of set-up for ham TV experiments?" Carl asked Jerry.

"Great, but a little expensive to operate," Jerry replied laughingly.

"Well, men, we'd better be shoving off for a look at that ice jam," Bill broke in. "The flying weather is not so hot, and I want to be back at the airport before dark. The air is unstable, and there's an alert out for possible tornadoes up until midnight. I don't think there's anything

# Step up to All-Transistor Stereo Power...



## and All-Transistor AM-FM Stereo Tuning



### at Low Cost... with this Matched Pair

Combine the quick, clean unmodified response of "transistor sound"; cooler, faster, "hum-free" operation; longer life; plus wide-band AM, FM, FM Stereo and you have Heathkit's newest low-cost All-Transistor Stereo twins!

Both units feature dependable, "trouble-free" 20-transistor, 10-diode circuitry... sleek, low-silhouette walnut cabinet styling with extruded gold-anodized aluminum front panels... secondary controls that are conveniently protected under the hinged lower front panel... compact, "fit-anywhere" size (15"W x 3-3/4"H x 11-3/8"D)... plus an easy-on-the-budget price, only \$99.95 each!

With the AA-22 Amplifier you enjoy 40 watts of continuous power, 66 watts of music power at  $\pm 1$  db from 15 to 30,000 cps; 5 stereo inputs; 4, 8, and 16 ohm outputs; plus tape recorders; 5-position selector switch; a 3-position mode switch; dual tandem volume, bass & treble controls.

And the AJ-33 Tuner features built-in stereo demodulator; AGC for constant volume; AFC for drift-free reception; stereo indicator light; Stereo Phase Control for maximum separation and minimum distortion; filtered stereo tape recording outputs; a tuning meter; flywheel tuning; voltage regulated power supply; illuminated slide-rule dial; and pre-built, pre-aligned FM "front-end" tuner and AM-FM I.F. circuit board for easy assembly.

Start enjoying the "transistor sound" of tomorrow by ordering these advanced all-transistor units today!

Kit AA-22 Amplifier, 14 lbs..... \$99.95  
 Kit AJ-33 Tuner, 14 lbs..... \$99.95



**FREE 1964 HEATHKIT CATALOG**  
 See these and over 250 other exciting Heathkits available in easy-to-build kit form. Save 50% or more by doing the easy assembly yourself! Send for your free catalog today!



**HEATHKIT**  
by Daystrom

10-2-5

**HEATH COMPANY**  
 Benton Harbor, Mich. 49023

Enclosed is \$\_\_\_\_\_, plus postage. Please send model (s) \_\_\_\_\_

Please send my Free 1964 Heathkit Catalog.

Name \_\_\_\_\_

Address \_\_\_\_\_

City \_\_\_\_\_ State \_\_\_\_\_ Zip \_\_\_\_\_

HF-160R

CIRCLE NO. 14 ON READER SERVICE PAGE



**FREE**

Fill in coupon for a FREE One Year Subscription to OLSON ELECTRONICS Fantastic Bargain Packed Catalog—Unheard of LOW, WHOLESale PRICES on Brand Name Speakers, Changers, Tubes, Tools, Stereo Amps, Tuners, CB, and other Bargains.

NAME \_\_\_\_\_  
 ADDRESS \_\_\_\_\_  
 CITY \_\_\_\_\_ ZONE \_\_\_\_\_ STATE \_\_\_\_\_

If you have a friend interested in electronics send his name and address for a FREE subscription also

**OLSON ELECTRONICS  
 INCORPORATED**

845 S. Forge Street Akron, Ohio 44308

**CIRCLE NO. 21 ON READER SERVICE PAGE**

## NICKEL-CADMIUM BATTERIES 95¢ ea.

The Battery That's Used in Guided Missiles  
 Now Released as Government Surplus



Ideal for photography, models, searchlights, anywhere a lightweight high capacity storage battery is needed. Sintered-plate Nickel-Cadmium, plastic-cased, alkaline storage batteries designed for "NIKE" Missile and now surplus. A lifetime battery with no known limit of service (over 5000 recharges on test without loss of capacity). Other features: Virtually indestructible, compact and lightweight, withstands heavy shock and vibration, flat voltage curve during discharge retains charge year or more, high discharge rate up to 50 amps for this cell. No corrosive fumes to harm clothing or equipment, spill-proof construction, discharges in any position, indefinite storage without deterioration, operates in temperatures -60°F. to +200°F.

Each cell is approx. 4 ampere hour capacity. Nominal voltage per cell is 1.25 volts. (A 6-volt battery requires 5 cells). Cell size 6" H. x 2" W. x 1/2" T. Wt. 6 oz. ea. Uses Potassium-Hydroxide (30% by weight) electrolyte. Add only distilled water periodically. A fraction of Government cost.

Used cells (as received from the Gov't).....\$ .95 ea.  
 Brand New cells ..... 2.49 ea.

### MOTOR STARTING CELLS

30 A.H. cells, Nickel-Cadmium, steel-cased, with 1/2" screw terminals for mom. current drains to 1000 amps. Size 8 1/2" H. x 3" W. x 1 3/16" T. Wt. approx. 3 1/4 lbs. Permanently sealed. No filling necessary.

Used cells .....\$2.95 ea.  
 New cells ..... 5.95 ea.

All cells guaranteed to your satisfaction or money refunded (less postage).

## ESSE RADIO COMPANY

42 W. South St. Indianapolis, Indiana, 46225  
 CIRCLE NO. 9 ON READER SERVICE PAGE

to worry about, or I wouldn't go up, but I don't want to be up there in the dark playing blindman's buff with some twist-ers I can't see."

A FEW MINUTES LATER the boys were in the Cessna four-place plane waiting for permission to take off. Jerry sat to the right of Bill; Carl took one of the seats behind them. Permission was given, and they were off down the runway, gathering speed as melted snow-water splattered from beneath the wheels of the tricycle landing gear up against the bottom of the plane.

Bill, an expert pilot, took the plane off the ground quickly and smoothly. He circled and then leveled off well below the clouds and set a northeast course that followed the twisting ribbon of the Wabash River. The air was rough and bumpy, but a tail wind sped them along upstream until they reached the jam in the river some thirty miles from their starting point.

As Bill dipped a wing and circled lower, the boys could see the jam was a big one. Great cakes of ice had humped up to a height of several feet above the normal level of the river, and the dammed-up water had spread out across the fields on either side and was cutting new channels back into the river below the jam. Broken cakes of ice stood on end as far upstream as the boys could see, and Bill flew on up-river to find out how far the jam extended. No open water was seen until they were almost to the town where Carl and Jerry lived, nearly seven miles above where the jam started.

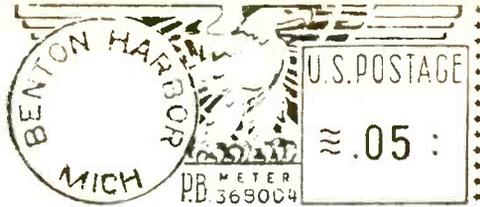
"Guess I'll fly south a ways and then cut across to fifty-two and follow that back into Parvoo," Bill said, banking the Cessna away from the river. "Say, what school's that down there?"

"Lincoln Township Consolidated School," Jerry said, looking down at the brick school building surrounded by soggy cornfields. "Look at the parabolic antenna on top of the building pointing over to the east. They must watch the MPATI programs . . ."

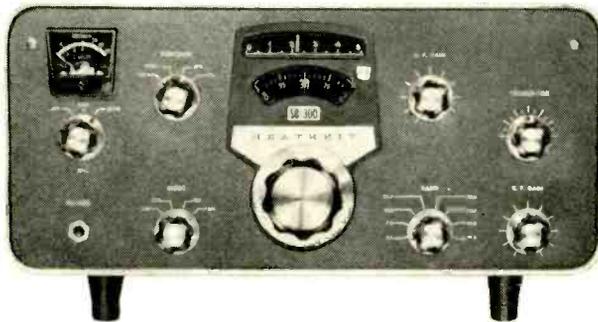
"Hey, Bill, look over to the right!" Carl interrupted. "Is that what I'm afraid it is?"

Bill took one look at the dark funnel that had suddenly lowered from the

# Here's your only "middleman"...



## when you buy a Heathkit®!



Just a few postage stamps from Uncle Sam is all it takes to move your Heathkit from factory to you. There's no one in between . . . no distributor . . . no dealer. This means that you put your money in the product, not its distribution. It means better quality and performance at lower cost.

And there are other advantages! Free consultation services and personal assistance in the selection, construction, and use of any Heathkit . . . original replacement parts, factory repair and fast, to-your-door delivery.

Add the 50% savings of "do-it-yourself" and you'll see why Heathkit equipment is your best buy in electronic kits!

A superb Example of Heathkit Quality . . . The New SB-300 SSB Amateur Receiver . . . Only \$265.00

Check these Features!

- Professional styling & features at 60% savings!
- Complete coverage of 80 through 10 meter amateur bands with all crystals furnished, plus provision for VHF converters
- Prebuilt, calibrated linear master oscillator (LMO)
- 25 KC per tuning knob revolution offers band-spread equal to 10 feet per megacycle
- Built-in crystal calibrator
- 2.1 KC crystal bandpass filter
- Stability of 100 CPS after initial warmup
- Wiring harness & two heavy-duty circuit boards for easy assembly.

Check these Specifications!

**Frequency range (megacycles):** 3.5 to 4.0, 7.0 to 7.5, 14.0 to 14.5, 21.0 to 21.5, 28.0 to 28.5, 28.5 to 29.0, 29.0 to 29.5, 29.5 to 30. **Intermediate frequency:** 3.395 megacycles. **Frequency stability:** 100 cps after warmup. **Visual dial accuracy:** Within 200 cps on all bands. **Electrical dial accuracy:** Within 400 cps on all bands. **Backlash:** No more than 50 cps. **Sensitivity:** Less than 1 microvolt for 15 db signal plus noise-to-noise ratio for SSB operation. **Modes of operation:** Switch selected: LSB, USB, CW, AM. **Selectivity:** **SSB:** 2.1 kc at 6 db down, 5.0 kc at 60 db down (crystal filter supplied). **AM:** 3.75 kc at 6 db down, 10 kc at 60 db down (crystal filter available as accessory). **CW:** 400 cps at 6 db down, 2.5 kc at 60 db down (crystal filter available as accessory). **Spurious response:** Image and IF rejection better than 50 db. Internal spurious signals below equivalent antenna input of 1 microvolt. **Audio response:** **SSB:** 350 to 2450 cps nominal at 6 db. **AM:** 200 to 3500 cps

nominal at 6 db. **CW:** 800 to 1200 cps nominal at 6 db. **Antenna input impedance:** 50 ohms nominal. **Muting:** Open external ground at Mute socket. **Crystal calibrator:** 100 kc crystal,  $\pm .005\%$ . **Front panel controls:** Main tuning dial; function switch; mode switch; AGC switch; band switch; AF gain control; RF gain control; pre-selector; phone jack. **Rear apron connections:** Accessory power plug; HF antenna; VHF #1 antenna; VHF #2 antenna; mute; spare; anti-trip; 500 ohm; 8 ohm speaker; line cord socket; heterodyne oscillator output; LMO output; BFO output; VHF converter switch. **Tube complement:** (1) 6BZ6 RF amplifier; (1) 6AU6 Heterodyne mixer; (1) 6AB4 Heterodyne oscillator; (1) 6AU6 LMO osc.; (1) 6AU6 LMO mixer; (2) 6BA6 IF amplifier; (1) 6AU6 Crystal calibrator; (1) 6HFB 1st audio, audio output; (1) 6AS11 Product detector, BFO, BFO amplifier. **Power supply:** Transformer operated with silicon diode rectifiers. **Power requirements:** 120 volts AC, 50/60 cps, 50 watts. **Dimensions:** 14" W x 6" H x 13" D.

**FREE CATALOG**

Send for your Free copy today! Fully describes over 250 exciting Heathkits at savings of 50% or more! Choose from the world's largest selection of quality instruments in easy-to-assemble kit form!



**HEATH COMPANY** 10-2-1  
Benton Harbor, Mich. 49023

Please send free 1964 Heathkit Catalog.

Name \_\_\_\_\_

Address \_\_\_\_\_

City \_\_\_\_\_ State \_\_\_\_\_ Zip \_\_\_\_\_

AM-135R

*Buy Now—See Order Blank Page*

clouds two or three miles to the southwest and then banked the plane sharply away from the course he had been flying.

"It's a twister, all right," he said grimly, "and we don't want to tangle with it."

With awe the boys watched the slender, writhing column of the tornado and the path of destruction it was leaving behind it. "It's sure traveling in a straight line," Carl remarked. "Look at it chewing up that telephone line! Say, if it keeps going the way it's headed, that school is going to be right in its path!"

Bill was already on the plane's radio calling the control tower at Parvoo and asking the operator to call the school and warn them of the approaching tornado. In a few seconds—they seemed like minutes to the boys watching the relentless advance of the evil thing—the tower reported it was impossible to get through to the school. The telephone lines were down. Probably they were the same lines the boys had seen destroyed.

"Maybe I can buzz the school and get someone's attention," Bill suggested, heading back toward the building.

"Not a prayer of a chance." Carl said, shaking his head. "With that big SAC base only ten miles away, there's hardly a minute of the day or night without the sound of some kind of plane around here. Even if you got someone outside, that grove of trees southwest of the school screens off the sight of anything coming from there. Could you land, maybe?"

Bill shook his head. "I can't land along the road because of the power lines. The fields are so soupy with this thaw that we would flip over as soon as our wheels touched. I sure hate . . ."

"Wait! There's still a chance!" Jerry exclaimed. "Call the control tower and have them phone the guys in the MPATI hangar. Ask them to have the technicians in the plane put warning slides in front of the announcement cameras for both transmitters. It's a slim chance, but it's all we've got."

**B**ILL WAS ON the radio before Jerry finished. The alert control tower operator immediately grasped the plan. By the time he radioed back to tell the boys

the MPATI plane was telecasting the warning, the tornado was scarcely half a mile away. Bill flew away from the storm at right angles to its path, and the boys watched helplessly as the funnel cut through the grove of trees, uprooting them and tossing them about as though they were straws, and then advanced directly on the school building.

For several minutes after the funnel struck the building nothing could be seen but flying debris; then, suddenly, the funnel was sucked back up into the clouds as though satisfied with the devastation it had wrought. As the dust settled, the boys saw that a whole wall of the upper story on the north side had been torn out. Most of the roof was gone. As Bill circled the building at a low level, the boys could not see a single unbroken pane of glass.

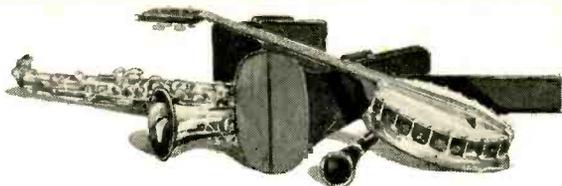
But even as they watched, sick at heart, students and teachers came pouring up an outside basement entrance and spread out over the brick-strewn yard. A young man, apparently the principal, noticed the plane flying anxiously overhead and suddenly began shoving the



students into groups. At first the boys in the plane were puzzled; then they saw what he was doing. The groups of students spelled out in ragged letters: "O.K." The plane carried three light hearts as it turned toward Parvoo.

When the boys landed, they learned the rest of the story that had been relayed to the MPATI people by the principal as soon as he had been able to get through on the telephone. A class had

# You could assemble an orchestra-



# building the Heathkit organ's easier!



**And a lot less expensive!** In fact, the exciting 1964 Heathkit version of the famous Thomas organ saves you 50% and more over comparable organs!

**And it's simple to build!** No special skills or knowledge required! Includes everything—even a pre-aligned tone generator so you can easily tune the organ yourself!

**But here's the best part!** You create all the music of an orchestra on a professional-performing instrument that's simple to play . . . Designed for beginners as well as advanced players! Create ten true voices in all . . . trombone, oboe, cornet, flute, reed, violin, saxophone, horn, viola, and diapason . . . with the touch of a tab! Create the strumming of a banjo, mandolin, or balalaika, or the staccato of a marimba with a new feature called Variable Repeat Percussion . . . another Heathkit extra at *no* extra cost!

**In addition enjoy features like these!** • Variable Bass Pedal Volume control • Manual Balance Control • Variable Vibrato • Standard Expression Pedal • 13-note Heel & Toe Bass Pedals • Two overhanging 37-note keyboards • Factory-assembled, hand-crafted walnut cabinet • 20-watt peak-power amplifier • Transistorized tone generators . . . warranted for 5 years.

**Heard it yourself!** Send for 33 $\frac{1}{3}$  rpm demonstration record (see coupon at right) and be convinced. Building and playing this beautiful instrument is a

rewarding project for the whole family. Compare, and see why you'll be wise to choose a Heathkit!

*Kit GD-232A, Organ, 160 lbs. . . . . \$349.95*  
*GDA-232-1, matching walnut bench, 19 lbs. . . \$24.95*  
*GDA-232-2, self-teacher recorded lessons, 5 lbs. . . \$50 value! . . . . . Only \$19.95*  
*GDA-232-5, 7" 33 $\frac{1}{3}$  rpm demonstration record. . . 50c*



**FREE 1964 HEATHKIT CATALOG**  
 See these and over 250 other exciting Heathkits available in easy-to-build kit form. Save 50% or more by doing the easy assembly yourself! Send for your free catalog today!



10-2-3

**HEATH COMPANY**  
 Benton Harbor, Michigan 49023

Enclosed is \$ \_\_\_\_\_, plus freight. Please send model(s) \_\_\_\_\_

Please send Free copy of 1964 Heathkit Catalog.

Name \_\_\_\_\_

Address \_\_\_\_\_

City \_\_\_\_\_ State \_\_\_\_\_ Zip \_\_\_\_\_

CL-169R

*Buy Now! See Order Blank Page*

**CIRCLE NO. 14 ON READER SERVICE PAGE**

# FREE GIANT NEW CATALOG



100'S OF BIG PAGES  
CRAMMED WITH SAVINGS

## BURSTEIN-APPLEBEE CO.

Dept. 1A, 1012 McGee St., Kansas City 6, Mo.

Rush me FREE 1964 B-A Catalog.

Name .....

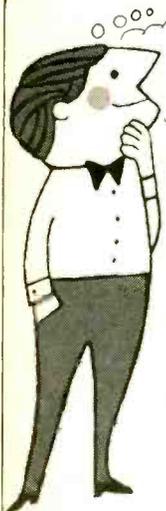
Address .....

City ..... State .....

SEND  
FOR IT  
TODAY

FREE

CIRCLE NO. 2 ON READER SERVICE PAGE



## WHAT CAN YOU DO WITH PHOTOCONDUCTORS?

Use headlights to open the garage door... build a model railroad crossing guard... make a light meter... or invent your own project, using the new Sylvania photoconductor kit. 52-page booklet, included, gives instructions and circuits for 20 fascinating do-it-yourself projects.

Ask for Photoconductor Kit PCK-10 at Sylvania Electronic Distributors, or send \$9.95 (plus 50¢ handling charge) to Dept. PCK-10, Sylvania Electric Products Inc., 1025 Westminister Drive, Williamsport, Pa., and we'll send one postpaid.

Mention this magazine.



### NEW SYLVANIA KIT

contains 3 photoconductors, AC/DC relay, resistor, mounting bracket, how-to-build-it booklet.

CIRCLE NO. 32 ON READER SERVICE PAGE

been watching a French telecast when the hastily-printed warning flashed on the screen of the receiver. The teacher told the principal, and he immediately herded all students into the southwest corner of the basement according to a prearranged disaster plan. Not a single child received a scratch.

"Everything and everybody got into the act today," Carl mused as he and Jerry drove back to their residence hall. "Ice jam, Bill's Cessna, the DC-six, the airborne transmitters, the receiver in the school, two-way radio circuits, telephone lines, the three of us, the MPATI crew and technicians, the tower operator, the school teacher, the principal—take away any one of these essential links, and I hate to think of the results.

"Yep," Jerry agreed. "Roles ranged from the hero, Pi in the Sky, to the villainous Big Twist!"

—30—

## Amplifier Quiz Answers

(Quiz on page 63)

- 1 - C The CASCODE amplifier uses one triode as a grounded-cathode amplifier driving the cathode of a second triode in a grounded-grid circuit. It has the good signal-noise ratio of a triode, and the gain of a pentode.
- 2 - E A CATHODE FOLLOWER amplifier has very high input impedance, low output impedance, and provides power gain, but a voltage loss.
- 3 - B A DIRECT CURRENT amplifier is direct-coupled (uses no coupling capacitors), and can amplify a change of the d.c. voltage between its input grid and cathode.
- 4 - A The VIDEO amplifier is broadbanded by means of a complex network in its plate circuit, to pass the entire band of video frequencies to the cathode of the TV picture tube.
- 5 - F A DIFFERENTIAL amplifier has two inputs, and provides a single output proportional to the difference between the two input signals.
- 6 - D The DOHERTY amplifier used in some fixed-frequency broadcast transmitters employs one tube to provide normal carrier level output, and a second tube for the added carrier output needed to transmit the positive peaks of the modulation wave.

Always say you saw it in—POPULAR ELECTRONICS

# From Parts...



# To Picture In Just 25 Hours



## Heathkit High Fidelity Color TV For As Low As \$349

25 hours of relaxing fun! That's all! And you've built the *new* Heathkit High Fidelity 21" Color TV with the finest color circuitry, components, and performance possible today. Goes together quickly, easily. *No* special skills or knowledge required! And you enjoy quality features and "true-to-life" color pictures comparable to units costing \$600 or more!

**Compare These Heathkit Features With Others!** 27 tube, 8-diode circuit with optional UHF • High definition RCA 70° 21" color tube with anti-glare, bonded-face safety glass • Degaussing coil & built-in dot generator for perfect picture adjustments • Automatic Color Control • Gated Automatic Gain Control for peak performance • 24,000 volt regulated picture power • Hi-Fi sound with outputs for speaker and hi-fi amp • Deluxe Nuvistor tuner with "push-to-tune" fine tuning for individual channels • 3-Stage high gain video I.F. • Line thermistor for longer tube life and thermal circuit breaker for component protection • All critical circuits factory built & tested • Can be custom mounted (requires GRA-53-3 mounting kit) or installed in handsome walnut finish hardboard cabinet • One year warranty on picture tube, 90 days on parts.

**Learn Color TV Theory—Save on Maintenance Costs!** The Heathkit instruction manual contains circuit diagrams, alignment, and theory sections so you can easily make necessary adjustments with confidence.

**Enjoy The Beauty Of Color TV** with the added fun and satisfaction of a Heathkit! Order now!

- Kit GR-53, chassis & tubes, 118 lbs. . . . . \$349.00*
- GRA-53-1, walnut hardboard cabinet, 70 lbs. . . . \$49.00*
- GRA-53-3, custom mounting kit, 10 lbs. . . . . \$4.00*
- GRA-53-2, UHF Converter, 3 lbs. . . . . \$20.00*



**FREE 1964 HEATHKIT CATALOG**  
Gives full description and specifications of Color TV, plus over 250 others in Test, Amateur Radio, Hi-Fi, Marine, Educational fields! Send for your Free copy now!



**HEATH COMPANY** 10-2-4  
Benton Harbor, Mich. 49023

Enclosed is \$\_\_\_\_\_, plus shipping. Please send model (s) \_\_\_\_\_

Please send my Free 1964 Heathkit Catalog.

Name \_\_\_\_\_

Address \_\_\_\_\_

City \_\_\_\_\_ State \_\_\_\_\_ Zip \_\_\_\_\_

CL-166R

*Buy Now! See Order Blank Page!*

**CIRCLE NO. 14 ON READER SERVICE PAGE**



# COYNE

TRAINS YOU  
IN SPARETIME  
AT HOME

## TELEVISION

COLOR TV-  
RADIO-ELECTRONICS

Coyne—and only Coyne—can give you this modern, TV Home Training. Easy to follow 2150 photos and diagrams covering Radios, TV, Color, UHF, Transistors. We also show you how to start making money while learning, right at home. Get your basic training at home, then make a flash finish with 2 weeks of actual shop work in Chicago under direction of same instructors who guide our resident students.

**LOW COST—Easy to Pay**  
You don't pay for costly "put together" kits. Small monthly payments and low, low cost make it easy for everyone to train. Free employment service for graduates—or we show you how to start your own service business on a "shoestring." Send name today for complete facts and valuable book on Television. No salesman will call. Everything mailed free, postpaid.

**Coyne Electrical School**  
Chartered as an Educational Institution Not for Profit  
1501 W. Congress Parkway  
Dept. 24-H2, CHICAGO 7, ILL.

**FREE**  
of Extra Charge  
to Graduates  
**TWO WEEKS**  
Shop Training in Chicago

No increase in home training cost, but the day you graduate you will be entitled to two full weeks of personal instruction on actual projects in the great Shop-Labs of Coyne in Chicago—without one cent of extra tuition whatsoever.

**FREE Just Send Name**  
No charge. No obligation. No salesman will bother you. Just send name for free copy of big 24 page book on quickest, lowest cost way to train for top pay job or business of your own. . . Mail coupon today.



**B. W. Cooke, Pres. Home Training Division, Dept. 24-H2  
1501 W. Congress Parkway, Chicago 7, Ill.**

Please mail free book and offer of two weeks personal training in Chicago without extra tuition for home study graduates. Explain low monthly payments.

NAME \_\_\_\_\_

ADDRESS \_\_\_\_\_

CITY & STATE \_\_\_\_\_

**750 Ma. SILICON EPOXY DIODES**  
200 piv 10c, 400 piv 20c, 600 piv 25c.

**SILICON POWER TRANSISTORS**

2 N 1039 50c 2 N 1041 \$1.50 2 N 511A 75c  
2 N 456 35c 2 N 1046 95c 2 N 1046A \$2.00

\$2.00 min. order. Cash, check or money order. Write for catalog of complete line of Diodes, transistors, tubes, relays, transformers, resistors, etc. Enclose 10¢ for mailing.

**INTERSTATE ELECTRONICS**

P.O. Box 8848, University Park Denver, Colo.  
Money Back Guarantee

## SIMPLEX Transistorized Ignition

(Continued from page 48)

stalling it, remove the coil lead from the center of the distributor cap (to prevent starting) and turn the engine over to a crankshaft angle at which the breaker points are firmly closed. Now turn on the ignition key (engine at rest) and adjust potentiometer  $R_4$  to make the dwell meter read exactly full-scale. Cement or otherwise lock the shaft of potentiometer  $R_4$  to prevent accidental change of adjustment, and your dwell meter is calibrated.

If you find the meter cannot be made to read full scale by means of  $R_4$ , use a slightly lower value of  $R_5$ .

Note that for eight-cylinder engines the correct dwell angle current reading is well above the center of the scale. This does not affect accuracy or ease of reading.

**Testing the SIMPLEX.** The transistor in this circuit is easily damaged by excessive current. Before turning on the system, make sure the ballast resistor has not been omitted. If it has, there will be a 48-amp current surge when the breaker points close—and goodbye, transistor.

Your SIMPLEX ignition system should give as long and trouble-free service as any currently available transistor ignition equipment. If you want to check on its operation, measure the current flow with the engine running at fast idling speed. Insert a 15 or 20-amp d.c. ammeter in series with the ballast resistor before starting the engine, and note the operating current, which should be 10 amperes,  $\pm 1$  ampere.

If the current is greater than 11 amperes, a slightly higher value of ballast resistor is required. If the current reading is under 9 amperes, first make sure that there are no loose or corroded connections in the ignition wiring. If the low current is not due to poor connections, connect a 2-ohm, 100-watt adjustable resistor in parallel with the ballast resistor, adjust it to bring the operating current up to 10 amperes, and your SIMPLEX ignition system is ready to go.

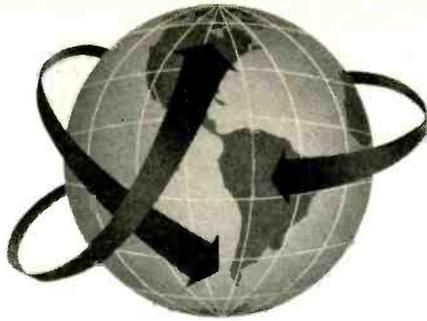
-30-

### ASSEMBLE THIS ALL BAND BATTERY SHORT WAVE RADIO FOR \$9.95!



LISTEN AROUND THE WORLD—UP TO 12,000 MILES AWAY! Ships, Aircraft, Voice of America, Russia, London, Australia, Amateur, Citizens, Police—Also USA Broadcast. 5 WAVE BANDS. 1/2 to 40 MC. Calibrated tuning dial. We only 3 lbs. NOW HEAR THE WHOLE WORLD TALKING DAY OR NIGHT! SEND ONLY \$2.00 (cash, ck, mo.) and pay postman \$7.95 COD postage or send \$9.95 for P.P. delivery. Complete basic kit as shown. Free Broadcast Coil and Plastic Case if you order now! Available only from Western Radio, Dent. BEL-2, Kearney, Nebr.

# What in the world is going on?



## With Heathkit SWL receivers - you know!



You're there when it happens... with just the touch of the tuning knob on your Heathkit Shortwave Listener's Radio! Enjoy on-the-spot news and sporting events from Tokyo, England, France, Germany, Moscow... anywhere! Tune in fascinating amateur radio broadcasts, or listen to your favorite programs on popular AM stations! Take your pick! You *know* "what in the world is going on" with a Heathkit SWL radio!

### Heathkit Shortwave Listener's Radio ... Fun to build, a top performer!

- Covers standard broadcast and 3 shortwave bands—550 KC to 30 MC • Large, easy-to-read illuminated slide-rule dial • Complete controls for full operating convenience • Built-in speaker and tuning "S" meter • Simple circuit board construction for "beginner" building.

Kit GR-91... 14 lbs. .... \$39.95

**SPECIFICATIONS**—Frequency range: 550 kc to 30 mc in four bands. Short wave, broadcast bands clearly marked on dial. **Controls:** General coverage tuning. Bandsread tuning. Antenna trimmer. Bandswitch. Noise Limiter—ON/OFF. phone-Standby-CW switch, BFO control. Audio Gain. AC-ON/OFF. Headphone jack. Q-multiplier input jack. **Power requirements:** 105-125 V 50/60 cycles AC. 30 watts. **Dimensions:** 12 $\frac{1}{2}$ "W x 5 $\frac{1}{2}$ "H x 8 $\frac{1}{2}$ "D.

### Heathkit All-Transistor Portable Shortwave Receiver... Now Only \$95

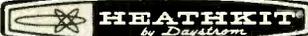
- Deluxe ten-transistor, six-diode circuit • Covers standard broadcast and shortwave bands—550 KC to 32 MC • Ceramic IF transfilters for fixed aligned band pass • Telescoping 50" whip antenna—built-in tuning meter • Sturdy one-piece metal cabinet with carrying handle • Operates anywhere with built-in battery power supply.

Kit GC-1A... 18 lbs... Was \$109.95... Now... \$95.00  
Assembled GCW-1A... 20 lbs. Was \$193.50...  
Now... \$165.00

**SPECIFICATIONS**—IF Frequency: 455 kc. Frequency coverage: 550 kc to 32 mc in 5 bands with calibrated bandsread scales (oscillator tuning) for 80, 40, 20, 15 and 10 meter amateur bands and 11 meter citizens band. **Selectivity:** 3 kc wide at 6 db down. **Sensitivity:** 10 uv broadcast band, 2 uv short wave bands for 10 db signal-to-noise ratio. **Output:** 400 milliwatts max. **Battery life:** up to 400 hours normal intermittent service using 8 standard size "C" cells. **Dimensions:** 6 $\frac{1}{2}$ "H. x 12"W. x 10"D.



**FREE 1964 HEATHKIT CATALOG**  
See these and over 250 other exciting Heathkits available in easy-to-build kit form. Save 50% or more by doing the easy assembly yourself! Send for your free catalog today!



**HEATH COMPANY** 10-2-6  
Benton Harbor, Mich. 49023

Enclosed is \$ \_\_\_\_\_, plus postage. Please send model (s) \_\_\_\_\_

Please send my Free 1964 Heathkit Catalog.

Name \_\_\_\_\_

Address \_\_\_\_\_

City \_\_\_\_\_ State \_\_\_\_\_ Zip \_\_\_\_\_

GX-125

*Buy Now! See Order Blank Page!*

## Transistor Topics

(Continued from page 82)

flashlight cells (*B1* and *B2*), a few clip leads, and, if desired, a transistor socket. The circuit arrangement shown is used for checking *pnp* transistors, but *npn* types can be checked just as easily by reversing all meter and battery polarities.

The suggested test technique is a simple step-by-step procedure:

1. First check the transistor for "shorts" or "opens." See "*Transistor Tester Round-up*," P.E. January, 1963, for a simple method of doing this. If the unit is "good," proceed to step 2.

2. Connect the circuit shown in Fig. 4, setting *R1* to its maximum resistance value. Battery *B1* is a single flashlight cell, *B2* two cells in series. The VOM is used as an 0-1 milliammeter.

3. Adjust *R1* until *Q1*'s collector current (*I<sub>c</sub>*), indicated by *M1*, reads 500 microamperes.

4. Disconnect the batteries and check *R1*'s value, using *M1* as an ohmmeter. Now determine the base current (for *I<sub>c</sub>*=500 microamps) by dividing this value into *B1*'s voltage (1.5 volts). Record this as *I<sub>b1</sub>*.

5. Reconnect the circuit and check *I<sub>c</sub>* again to make sure *R1*'s setting has not shifted accidentally, then adjust *R1* until *I<sub>c</sub>* is 1.0 ma.

6. Again, disconnect the batteries and check *R1*'s new value. Use this to determine the base current (for *I<sub>c</sub>*=1.0 ma.), as in step 4. Record this as *I<sub>b2</sub>*.

7. Subtract *I<sub>b1</sub>* from *I<sub>b2</sub>* to determine the difference in base current required to cause a collector current change of 500 ma. Record this as *dlb*.

8. Calculate transistor gain by dividing *dlb* into the difference in *I<sub>c</sub>* (500), making sure that *dlb* is expressed in microamperes.

An example may prove helpful. Suppose the resistance measured in step 4 is 300,000 ohms and in step 6 is 60,000 ohms; then

$$I_{b1} = \frac{1.5}{300,000} = 5 \mu\text{a.}, \text{ and}$$

$$I_{b2} = \frac{1.5}{60,000} = 25 \mu\text{a.}$$

$$\text{From this,} \\ dlb = I_{b2} - I_{b1} = 25 - 5 = 20 \mu\text{a.}$$

$$\text{Finally,} \\ Q1\text{'s gain} = \frac{500}{dlb} = \frac{500}{20} = 25.$$

If desired, the technique outlined may be used to check a transistor's gain for any given difference in collector current, provided the base currents (*I<sub>b1</sub>* and *I<sub>b2</sub>*) can be measured or calculated. Although the values suggested apply specifically to small signal transistors, a similar method might be used to check high-power transistors. Here, a higher current range would be needed for checking *I<sub>c</sub>* (500 ma. to 1 ampere, for example), and *R1* would be replaced with, say, a 1000-ohm potentiometer. In addition, since the base currents would be much greater, they could be measured directly in steps 4 and 6, rather than calculated by using *R1*'s value.

**Product News.** RCA (Somerville, N. J.) has announced two new transistor types. The 2N2857 is a UHF silicon epitaxial planar transistor useful to 1200 mc.; it is designed for low-noise amplifier, oscillator, and converter applications. The other one, Type 2N2953, is a *pnp* germanium unit with a minimum gain of 200 and a cutoff frequency of 10 mc.; it is especially designed for the driver stages of audio amplifiers.

A series of five solar batteries called "Solarpacks" has been introduced by the International Rectifier Corporation (233 Kansas St., El Segundo, Calif.). Made up from a number of cells mounted in an anodized aluminum casting and protected by a weather- and heat-resistant epoxy, these units can supply from 3.5 to 16 volts at current ratings from 30 to 120 ma., depending on type.

A new 25-ampere transistor claimed to be industry's highest frequency germanium power transistor has been introduced by Motorola Semiconductor Products, Inc. (5005 East McDowell Rd., Phoenix 8, Ariz.). An epitaxial base type, features a gain-bandwidth product of 30 mc. Identified as Type 2N2912, the device is specially designed to operate efficiently in power converters powered by low-voltage sources such as solar cells, thermoelectric generators, sea cells, fuel cells, and rechargeable 1.5-volt batteries.

Also from Motorola comes news of a new series of high-frequency, small-signal transistors for communications and TV applications requiring high-gain, low-noise devices. The line features "mesa-type" transistors and includes both *npn* silicon and *pnp* germanium units. Basic characteristics are a 2000-mc. maximum *f<sub>osc</sub>*, a power gain of 17 db at 200 mc., and low noise ratings.

That closes the semiconductor story for now. We'll be back next month with more circuits, tips and news.

—Lou



## Across the Ham Bands

(Continued from page 75)

**Multiband Beams and Verticals.** Exactly the same principle is applied in designing multiband beam antennas, tuned traps being inserted in the parasitic (director and reflector) elements as well as the radiator. In a multiband vertical, in which the ground (or an artificial ground plane) serves as one half of the whole antenna, only one tuned trap need be inserted in the vertical element for each band.

In comparing the efficiency of a multiband antenna to that of a simple half-wave dipole cut to the same frequency, actual figures are rather hard to get, but some experiments by the author indicate a difference of no more than a db or so in favor of the one-band dipole. Most hams regard this as a small price to pay for the convenience of a single antenna giving good performance on several bands without switching or adjustments.

As mentioned before, Chet, W3DZZ, first brought this type of antenna to the attention of amateurs in his articles "Duo-Band Ham Antenna," in *Radio and Television News* for December, 1950, and "Multi-Match Antenna System" in *QST* for March, 1955. Incidentally, many of the original W3DZZ tri-bander beams are still radiating potent signals on the 10-, 15-, and 20-meter bands.

### News and Views

**Ralph David Miller, III, WP4BPH**, 17 Onix St., Bucare, Rio Piedras, Puerto Rico, has a sad, sad story to tell. Many weeks ago, he ordered a new receiver to go with his new Novice license. Alas! he still has no receiver, but by visiting other Puerto Rico hams, Ralph has managed to work 12 states, Canada, and the Canal Zone. Ralph reports that he is giving away a couple hundred pounds of spare parts and tubes. All you have to do is to ask and pay parcel post from Zone 8. . . . **WPR-N**. Did you know that you can earn an attractive certificate by working ten Novice (WP4) stations on the island of Puerto Rico? Send your list of stations worked and QSO information certified by two other amateurs, plus \$1, to Awards Manager, Puerto Rico Amateur Radio Club, P.O. Box 476, Roosevelt Station, San Juan, Puerto Rico. . . . **Louis Toth, Jr., WN2JJK**, 132 Lowell St., Cartaret,

N.J., 07008, keeps 15 meters hot with a Johnson Ranger transmitter exciting a 40-meter dipole antenna, and he receives on a Hallcrafters S-108. Thirty-two states worked (28 confirmed) and nine countries worked would indicate that the combination does what it is supposed to. Louis divides his time unevenly between 15 and 40 meters; he has his Rag Chewers' Club certificate, and is a member of the Cartaret Civil Defense organization.

**Ann Richards, WN6EDN**, 10018 Hawthorne Blvd., Inglewood, Calif., really has the 40-meter band doing just what she wants it to do. In her first six weeks on the air, Ann has worked 36 states and four countries. In just one evening, she worked New Zealand, Midway Island, and Mexico. A home-brew vertical antenna excited by a home-brew 60-watt transmitter, and a Hallcrafters S-40B receiver are Ann's tools of accomplishment. She and her husband, **Jim, WA6VAE**, attribute the excellent results obtained to the fact that they took great pains to make certain that the antenna was properly tuned, as indicated by a 1.2:1 reading on the SWR bridge. By the way, while Ann is knocking them off on 40, Jim (WA6VAE) works 2 meters with a home-brew 15-watter, although he admits that he does get his time in on the 40-meter rig, too. . . . **Larry Schimelpfenis, WN0GQI**, 441 South 21 St., Fargo, N.D., got off to a fast start with his Eico 723 transmitter, National NC-98 receiver, and a two-crop antenna farm—a 40-meter dipole and a 15-meter ground-plane vertical. A new state a day for the first two weeks was entered in Larry's log.

**Richard Livingston, WN5GJC**, 4304 Zion St., Little Rock, Ark., 72204, really isn't using that crying towel, even though after starting out with a bang—three states worked the first day—his ham career has been mostly spent in debugging his transmitter. When it's working, the transmitter feeds an 80-meter dipole or a 100' long wire. His receiver is a Knight-Kit. . . . **Norman B. Weingrow, WB2DLP**, Director of Stissing Lake Camps, Pine Plains, N.Y., invites those interested in learning ham radio to contact him at his classroom in the Electric Shop at the Russell Sage Junior High School 190, Forest Hills 75, N.Y. . . . **Jordan Kaplan, W9QKE**, 318 West Adams St., Chicago 6, Ill., who could work "mobile" on three ham bands simultaneously (if he had three heads) suggests that hams who have been experiencing erratic results from transistorized mobile power supplies check the ground connection between the power supply and the car body, and from the car battery to the car body.

We're out of space again. Before we go, remember that this is your column. Keep your news and views and pictures coming. By the way, we welcome contributions from all classes of hams—from Novice to Extra Class! Address your mail to Herb S. Brier, W9EGQ, Amateur Radio Editor, POPULAR ELECTRONICS, P.O. Box 678, Gary, Indiana, 4601. 73,

*Herb, W9EGQ*



# NOW...GET THE FINEST STEREO TEST RECORD ever produced

for just...\$4.98

Featuring Tests Never Before Available  
To The Hobbyist

## Why We Make the Model 211 Available Now

Although there are many stereo test records on the market today, most critical checks on existing test records have to be made with expensive test equipment.

Realizing this, HiFi/STEREO REVIEW decided to produce a record that allows you to check your stereo rig, accurately and completely, just by listening! A record that would be precise enough for technicians to use in the laboratory—and versatile enough for you to use in your home.

The result: the HiFi/STEREO REVIEW Model 211 Stereo Test Record!

## Stereo Checks That Can Be Made With the Model 211

- ✓ Frequency response — a direct check of eighteen sections of the frequency spectrum, from 20 to 20,000 cps.
- ✓ Pickup tracking — the most sensitive tests ever available to the amateur for checking cartridge, stylus, and tone arm.
- ✓ Hum and rumble — foolproof tests that help you evaluate the actual audible levels of rumble and hum in your system.
- ✓ Flutter—a test to check whether your turntable's flutter is low, moderate, or high.
- ✓ Channel balance — two white-noise signals that allow you to match your system's stereo channels for level and tonal characteristics.
- ✓ Separation—an ingenious means of checking the stereo separation at seven different parts of the musical spectrum—from mid-bass to high treble.

**ALSO:** ✓ Stereo Spread  
Speaker Phasing  
Channel Identification

## PLUS SUPER FIDELITY MUSIC!

The non-test side of this record consists of music recorded directly on the master disc, without going through the usual tape process. It's a superb demonstration of flawless recording technique. A demonstration that will amaze and entertain you and your friends.

### UNIQUE FEATURES OF HiFi/STEREO REVIEW'S MODEL 211 STEREO TEST RECORD

- Warble tones to minimize the distorting effects of room acoustics when making frequency-response checks.
- White-noise signals to allow the stereo channels to be matched in level and in tonal characteristics.
- Four specially designed tests to check distortion in stereo cartridges.
- Open-air recording of moving snare drums to minimize reverberation when checking stereo spread.

## All Tests Can Be Made By Ear

HiFi/STEREO REVIEW's Model 211 Stereo Test Record will give you immediate answers to all of the questions you have about your stereo system. It's the most complete test record of its kind—contains the widest range of check-points ever included on one test disc! And you need no expensive test equipment. All checks can be made by ear!

*Note to professionals: The Model 211 can be used as a highly efficient design and measurement tool. Recorded levels, frequencies, etc. have been controlled to very close tolerances—affording accurate numerical evaluation when used with test instruments.*

## DON'T MISS OUT—SUPPLY LIMITED

The Model 211 Stereo Test Record is a disc that has set the new standard for stereo test recording. Due to the overwhelming demand for this record, only a limited number are still available thru this magazine. They will be sold by POPULAR ELECTRONICS on a first come, first serve basis. At the low price of \$4.98, this is a value you won't want to miss. Make sure you fill in and mail the coupon together with your check (\$4.98 per record) today.

### FILL IN AND MAIL TODAY!

Stereo Test Record  
Popular Electronics—Dept. SD  
One Park Ave., New York 16, N.Y.

Please send me \_\_\_\_\_ test records at \$4.98 each. My check (or money order) for \$ \_\_\_\_\_ is enclosed. I understand that you will pay the postage and that each record is fully guaranteed. (Orders from outside the U.S.A. add 50c to partially defray postage and handling costs.)

Name \_\_\_\_\_ (Please Print)

Address \_\_\_\_\_

City \_\_\_\_\_ Zone \_\_\_\_\_ State \_\_\_\_\_

Sorry—No charges or C.O.D. orders!

PE 24

**POPULAR** FEBRUARY 1964  
**ELECTRONICS**



Send  
**POPULAR  
ELECTRONICS**  
Every  
Month

NAME.....

ADDRESS.....

CITY..... ZONE..... STATE.....

3 years for \$10

Check one:  2 years for \$7

1 year for \$4

*In the U. S., and possessions.*

Payment Enclosed  Bill Me

Foreign rates: Canada and Pan American Union countries, add .50 per year; all other foreign countries, add \$1 per year.

New  Renewal

Mail to: **POPULAR ELECTRONICS**

Dept. 1-1200, 434 S. Wabash Ave., Chicago 5, Ill.

**Rx for the Amateur/SWL**

(Continued from page 58)

ond i.f., third mixer, and the first 60-kc. i.f. Delayed a.v.c. derived from the first audio stage is applied to the r.f. stage only when the signal reaches a predetermined level—a definite aid in receiving weak signals. A front panel control switches the a.v.c. between “off,” “slow,” “medium,” and “fast” positions. “Slow” or “medium” a.v.c. allows the receiver to automatically adjust itself to bursts of r.f. energy—as opposed to a relatively constant carrier—such as those that make up a SSB signal.

Other features of the HQ-180AX worthy of mention include a fixed-tune BFO arrangement that is switched into play for SSB reception, making BFO adjustment unnecessary. New with the “AX” version is a 6CW4 crystal oscillator and 11 crystal sockets mounted as a subassembly on the upper left of the front panel. The crystal oscillator is designed to give very accurate fixed-tune reception on CB, amateur net or MARS frequencies, etc.

Standard receiver features are calibrated bandspread on the amateur bands, plus an arbitrary scale, 100-kc. crystal calibrator, continuously adjustable noise limiter, send-receive circuitry, and accessory and control sockets.

**Ideal SWL Receiver.** The HQ-180AX is the SWL's answer—whether he prowls the heterodyne-filled 31- and 49-meter bands, or prefers the BCB—to a prayer for a receiver that will do everything. Speaking of the BCB, fans of this part of the radio spectrum will find the main tuning spread so great that the band is divided into two segments (including, incidentally, 160 meters)—540 to 1050 kc., and 1050 to 2050 kc.

The receiver provides great versatility without compromise, not only in the range of frequencies it covers, but in the modes—AM, SSB, and c.w.—in which it can be operated. Needless to say, the Hammarlund HQ-180AX is a piece of gear for the radio man who enjoys operating his equipment.

-30-

Reader Service No. 85—see page 15

Always say you saw it in—POPULAR ELECTRONICS

**EARN** Electronics Engineering **DEGREE**

You can earn an A.S.E.E. degree at home. College level HOME STUDY courses taught so you can understand them. Continue your education, earn more in the highly paid electronics industry. Missiles, computers, transistors, automation, complete electronics. Over 27,000 graduates now employed. Resident school available at our Chicago campus—Founded 1934. Send for free catalog.

**AMERICAN INSTITUTE OF ENGINEERING & TECHNOLOGY**

1137 West Fullerton Parkway, Chicago 14, Ill.

**TRANSISTOR IGNITION**

COMPLETE LINE OF WIRED CONVERSIONS, KITS, PARTS AND SPECIAL HIGH-RATIO COILS. FREE LISTS.

TX300 300:1 Low Inductance COIL..... \$ 7.95 net p.p.  
T400 The original HIGH EFFICIENCY 400:1 COIL recommended in ELECTRONICS WORLD and P.E. .... \$11.95 net p.p.  
RXX1 KIT 1 trans. Zener Diode, 300:1 coil..... 19.95 net p.p.  
TKX1 KIT 1 trans. Zener Diode, 400:1 coil..... 21.95 net p.p.  
T35C KIT 3 trans. for your standard coil..... 14.95 net p.p.  
B1208 12v. Ballast for Trans. Coils 0.4 ohm coil..... 1.0 ohm coil..... 1.50 net p.p.

Kits include heatsink and hardware. Specify 6 or 12v. neg. or. Adapter for POSITIVE Ground—\$2.50 Quantity discounts.

Electronics Opportunity, Institute on Electronics

**TRANSFIRE® DIV. PALMER ELECTRONICS LABS INC.** Carlisle, Mass. 41 Te 6 7 456-2626

GET INTO **ELECTRONICS**



V.T.I. training leads to success as technicians, field engineers, specialists in communications, guided missiles, computers, radar, automation. Basic & advanced courses. Electronic Engineering Technology, an ECED accredited Technical Institute curriculum. Associate degree in 29 months. B.S. obtainable. G.I. approved. Start February, September. Dorms, campus. High school graduate or equivalent. Catalog.

**VALPARAISO TECHNICAL INSTITUTE**  
DEPARTMENT PE, VALPARAISO, INDIANA

## The Amazing "Bug" Battery

(Continued from page 44)

more than half the fuel fed them, in the mid-1940's we turned belatedly again to the century-old idea of the fuel cell. Progress has been considerable, and today we have fuel cells powering everything from golf carts to the Apollo space vehicle.

In a typical fuel cell, hydrogen is fed to one electrode and oxygen to the other. Separated by an "ion exchange" membrane rather than the liquid or paste electrolyte of the storage battery, the fuel cell produces electricity—and water. This by-product is important on space missions, obviously. In theory, a fuel cell can be 100 per cent efficient. However, some energy is required to excite the molecules to an energy level necessary for the reaction producing current flow, and there is some resistance in the cell. Practically, 75 per cent is a good figure of merit.

With this kind of performance it might be wondered who needs batteries made from bugs. But the conventional fuel cell still has drawbacks. Hydrogen and oxygen are expensive, and power densities of fuel cells are rather low even though they are more attractive than regular batteries. A fuel cell that operates on cheap fuel oil is needed, and work is going on in this direction. Catalysts to speed up the reaction and cut down the internal loss of power are important. Such things as platinum, and more recently, nickel boride, are being

used. Unfortunately, fuel cells using inexpensive hydrocarbon fuels such as natural gas, octane, etc., seem to require expensive catalytic electrodes such as spongy platinum.

The stage was now set for the entry of the bacteria battery, the biochemical fuel cell. As Dr. Welsh and others had noted, bacteria and their derivatives provide catalysts *par excellence*. And they are not nearly so fussy as more conventional catalysts. Experiments suggest that bacteria may make hydrocarbon fuel cells practical. More important, biocells have already shown they can turn even waste material into power.

The Electron Molecule Research bio-battery in action on the cover represents the simplest type of bio-power. With its aluminum and copper electrodes it might appear to be a galvanic battery, using the rice husk "carrier" as an electrolyte. However, if a weak acid solution is added instead of the bacteria nutrient, current flow lasts only a short time. Thus the bacteria seem able to prevent polarization, or coating of the electrodes, that halts the reaction. EMR demonstration cells have been operated for more than a year with no decrease in output.

In more sophisticated biocells the anode and cathode sections are separated by an ion-exchange "bridge" through which ions diffuse to sustain current flow. Bacteria are placed at one or both electrodes and promote the process of stripping electrons from the "fuel" provided them.

In addition to more effective catalytic action and the use of cheaper fuels, the biocell operates at room temperature rather than the high temperatures re-



### EXTRA QUALITY & VALUE!

## Sonar CITIZENS BAND RADIO

No where else but at Sonar can you get such performance and quality at this low price! Check these features: Dual conversion • RF output meter • Signal strength meter • Crystal spotting switch • Illuminated panel • 8 channels, crystal-controlled • Receiver tunes 23 channels • Class "B" modulation • 1-year guarantee

SONAR RADIO CORPORATION, 73 Wortman Ave., B'klyn 7, N. Y.

Please send me complete information on Model "G" CB Radio.

NAME \_\_\_\_\_ 298

ADDRESS \_\_\_\_\_

CITY \_\_\_\_\_ STATE \_\_\_\_\_

CIRCLE NO. 28 ON READER SERVICE PAGE

quired in some fuel cells. It is also characterized by the mild, "natural" conditions at which life processes take place, with a pH factor in the neutral range and a dilute water solution as an electrolyte.

Fuel for the biocell varies from sugar to organic sea material, yeast, mushrooms, or urea. The U. S. Bureau of Mines has demonstrated a biocell operating on the inorganic material, pyrite, or fool's gold. Suggested are such things as grass, dry leaves, sewage, and other waste materials. One of the most interesting biocells was made by Magna researchers, using bacteria at one electrode and algae at the other, with sunshine as fuel! In effect this represented a biological solar battery and offers the intriguing possibility of converting sunlight to electricity more efficiently than the photovoltaic cell.

The biocell, like the conventional fuel cell, is not without its drawbacks, of course. Compactness is not among its merits, as witness the bulk of the EMR do-it-yourself battery. Densities of only several amperes per square foot of electrode surface have been reported and this is not sufficient for many applications.

The potential difference exhibited by living materials leads to mild reactions, and the voltage of typical cells is only about half a volt. Cell resistance is a problem, as is the proper shape and size of the cell itself. And obviously the bacterial "workers" must be fed and thus gobble up half the available energy!

Success already achieved with biocells, despite little real knowledge of the phenomenon of bioelectrochemistry, seems to indicate that the biocell's problems are not insurmountable. Compared with those of harnessing the power of nuclear fusion they seem small by contrast, though, of course, nobody suggests that the payoff will be as great. Right now researchers know that the biocell works; they want to know how to make it work better and the chances are good that they will succeed.

**Biocells—Today and Tomorrow.** Space planning is helping to boom biocell development. When NASA asked for bids on a project there were 33 responding firms. Contracts have gone to four of them, and working systems may be part

of manned space vehicles within several years. This is the "Space Oasis" concept, referred to before, with biocells working in conjunction with an algae solar converter in the spaceship's closed cycle. Magna Corporation, Marquardt Inc., General Electric, and Ford's Aeronutronic Division are doing such research work for NASA.

In operation, such a closed-cycle plant will process waste material to provide water, food, and electricity to operate radio and other auxiliary equipment. As an example of the potential power supply, tentative specifications describe a 20-watt urea-fueled battery with 100 ampere-hour daily output from the waste of one crew member.

Much farther along are U. S. Navy projects. Magna has produced multi-watt units of a marine bio-battery. These are presently being used only to power transmitters in buoys, but there are heady suggestions of bio-powered boats for the future. General Scientific Corporation has also produced prototype units for the Navy.

A submarine to be powered by conventional fuel cells is being studied, and there is a possibility that the biocell may be advantageous in such applications. If the model boat already demonstrated, and the hints of using the Black Sea as a power source can be taken seriously, the term "ocean current" takes on an entirely new meaning!

In addition to these programs and other government-funded work, there are privately sponsored projects in the biocell field, with some aimed at commercial use of the new power source. On land the biocell may be put to work first in powering remote electrical and electronic installations, aircraft landing lights, fence chargers for ranches and farms, and similar tasks. Army portable radars have already operated successfully on conventional fuel cells and such military gear using bio-power seems possible.

Later on may come projects like harnessing the energy in sewage, paper mill effluent, and so on. While conventional generating plants are obviously safe for many years to come, developments in biochemistry may eventually lead to low-cost industrial electricity competing in some areas with that produced by fossil fuels.

More easily foreseeable are processes in which the biocell does a dual job. It has been pointed out that a brewery is a potential power plant if the heat of fermentation can be converted to electricity. The same might apply to a bakery and to other industries dependent on biochemical action.

The biocell may also prove of great value as a chemical process rather than a power producer. Since the fuel cell can work both ways, electricity might be supplied to the cell and the bacteria furnish useful by-products rather than electricity. Another interesting suggestion is use of the biocell as a detector of germs during possible germ warfare, since a foreign strain of bacteria would adversely affect the electrical output.

The conventional fuel cell has a history of more than 20 years of accelerated development. Even though it is still a long way from perfected, it is considered worthy of spending additional millions toward improvement. Application of the biocell, on the other hand, came just three years ago and it has made amazing progress in that short time.

Many scientists feel that attempts to exploit bio-power this early are putting the cart before the horse and that many more years of basic study are indicated first. However, Ernest Cohn, head of NASA's Electrochemical Technology Projects, points out an interesting parallel in the chemical industry. While papers and theses are still being written describing original research on production of ammonia, we nevertheless have an excess of manufacturing capacity for the compound.

Not sure just how the biocell really works, scientists and engineers are nevertheless putting it to use. Given 20 years, it too may do some marvelous things. Meanwhile, you can put together a simple bio-battery of your own and watch, or listen to, bug-power go into action!

-30-

**For Concord transceiver information**

write Concord or visit your nearest  
Olson Electronics Store—

CHICAGO • CLEVELAND • DETROIT • PITTSBURGH  
AKRON • COLUMBUS • BUFFALO • ATLANTA  
LOS ANGELES OR RADIO SHACK, BOSTON

# "I READ YOU LOUD AND CLEAR"

## Concord TG-093 (100 MW) Two-Way Radio Transceiver

- Exclusive built-in loading coil antenna allows 20% greater range
    - Base station operation available with special AC-2 adaptor
    - Crystal controlled transmit and receive (27.065 MC)
      - Crystal change without realignment
    - Superhet receiving circuit
      - Die cast metal case
      - 9 transistors, 2 diodes
- No License Required*

ANTENNA TELESCOPES TO OVER FOUR FEET



# CONCORD

CONCORD ELECTRONICS CORPORATION

Contact your Concord dealer for full details or write:  
809 North Cahuenga Boulevard, Dept. 25, Los Angeles 38, Calif.  
In Canada: Regal Industries Ltd., Montreal and Toronto

CIRCLE NO. 5 ON READER SERVICE PAGE

# new Allen hex screwdrivers

work faster easier... reach  
where wrenches won't go



## fixed handle SCREWDRIVERS

11 hex sizes:  
.050" to 1/4"  
Precision formed,  
alloy steel blades  
Shockproof,  
breakproof,  
amber plastic  
(UL) handles

## detachable BLADES

8 hex sizes:  
1/16" to 3/16"  
Fit all "99" Series  
handles  
Available singly —  
as a set of six in  
free plastic pouch  
— or in roll kit  
with handle

# XCELITE

XCELITE INC. • 20 BANK ST., ORCHARD PARK, N. Y.  
Please send free literature N763.

name \_\_\_\_\_

address \_\_\_\_\_

city \_\_\_\_\_

state & zone \_\_\_\_\_

CIRCLE NO. 31 ON READER SERVICE PAGE

## Light-Controlled Power Supply

(Continued from page 55)

mounting ring was then attached to the fiber wafer provided with capacitor C1 for off-ground mounting, and the wafer was mounted over the photocell by means of two machine screws which fasten it to the heat sink.

A slot in one edge of the back plate provides an opening for the line cord. This opening must be close-fitting enough to prevent the entry of ambient light, which would reduce the range of control provided by the photocell.

**IQ Exercise.** This prototype model does operate fairly well, but it has some shortcomings, and does not in our opinion make optimum use of the parts and the basic idea. Nor does it exploit all the possibilities for control the LDR-25 characteristics suggest. To set your mind juggling ideas, here are some of the points on which the prototype falls short.

For one thing, enough light from the lamp appears to leak around the vane and under the wafer to seriously restrict the range of adjustment. Also, despite the use of a vernier-type knob, the range of control covers only a small portion of the dial, due to the shape of the vane and the position in which it is mounted.

The heat sink is small, and due to the spacers is not thermally in good contact with the box. These facts, and use of a 6-watt lamp totally enclosed within the box, combine to limit the power the photocell can safely pass to a level far below its 25-watt maximum dissipation rating, despite two screened ventilation holes in the box ends.

Then there's the feasibility of using the LDR-25 in some sort of feedback arrangement to regulate output voltage or current, and many other possibilities that sharp-minded readers will doubtless perceive. The idea is to give your imagination free rein, limited only by the stipulations that the device is to be a low-voltage power supply in which light has a control or regulatory function. All in all, the prototype unit, made for us by Harold Reed, should be a fine basis to start from in demonstrating your Ingenuity Quotient.

-30-

## On the Citizens Band

(Continued from page 79)

decision to join forces with the Civil Air Patrol late last year. Art relates that the basic purpose of the B.C.R.C. is to help members further their interest in electronics and to be of civic value. The club feels that the latter purpose is being accomplished through their sponsorship of a C.A.P. squadron.

To the Broward Citizens Radio Club's knowledge, they are the first CB club in the country to have organized a C.A.P.-CB Squadron. Art promises they'll take a back seat if another club can prove otherwise, but to date they're pretty certain their C.A.P. action is a first!

**Club Chatter.** The Teen Keystone Radio League, Philadelphia, Pa., claims a first among the younger CB set. The club has been in operation for one year as of November '63 with membership ages ranging from 12 to 20 years. Group claims 100 per cent participation in all activities—without one citation ever received for misuse of the band. The T.K.R.L.'s first club paper, *The Keystoner*, issued Nov. 1, is clean-cut, well-written. Its pages feature a "Price Watch" listing everything from coins (Philadelphia-style) to increases and decreases in CB equipment prices. Paper also features rule warnings, "Space For Sale" (they need ads), and "Help Wanted" (they need typists, artists, proofreaders and others for the paper). If you're in the area and would like to help out this young group, drop a line to *The Keystoner*, 7807 Thouron Ave., Philadelphia, Pa.

The Citizens Radio Association of Lake County, Waukegan, Ill., participated in what was termed an S.O.S. program last

October. A shipment of oral polio vaccine was found frozen on the day it was to have been used to inoculate county residents. The club's emergency patrol set up communication facilities in 29 clinic sites throughout Lake County to assist in delivering vaccine and other needed items to those clinics that experienced shortages. The group handled emergency runs for eight hours, was highly commended by civic and medical authorities, and invited to lend a hand at the next inoculation.

The Otter Valley Citizens Radio Club paper, *QRM*, recently reported on the fall session of the Tri-State CB Conference held in Schenectady, N.Y. Conference was attended by over 60 member-representatives of 14 CB clubs from New York, Vermont, Massachusetts, and Connecticut. Items discussed included goals for improving CB, how to maintain membership, publicity and public relations, publications, finances, activities, meeting places, community services and communications.

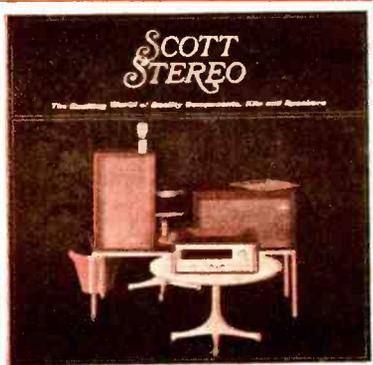
*The CB Broadcaster*, printed voice of the Greater Dallas Citizens Band Club, Dallas, Texas, lists the following month's monitoring schedule two weeks in advance of the duty-dates. To eliminate confusion and to be sure everyone knows what's happening and when, the assigned day of the week is listed, as is the date, the monitor's name, his call-sign, and his phone number. In the event the scheduled monitor knows in advance he will be unable to cover his duty period, seven alternate monitors are listed.

The 1964 club roster is near completion. If you haven't forwarded this year's officers, changes of address and any and all information of interest to CB'ers across the country—do it now! Forward your material (and pictures!) to Matt P. Spinello, CB Editor, One Park Avenue, New York 16, N.Y.

I'll CB'ing you.

—Matt, KHC2060

**FREE...  
SCOTT  
CUSTOM  
STEREO  
GUIDE**



New 24-page 1964 Custom Stereo Guide packed with photos, descriptions, and specifications of all Scott tuners, amplifiers, tuner/amplifiers, speakers, and kits. Also . . . articles and pictures on decorating your home with stereo, selecting a tuner and amplifier, and how FM multiplex stereo works. Send for your copy today.

Rush me the new 1964 Scott Guide to Custom Stereo. 520-02

Name.....

Address.....

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

H.H. Scott, Inc.  
111 Powdermill Road  
Maynard, Massachusetts



EXPORT: Morhan Exporting Corp., 458 Broadway, N. Y. C.  
CANADA: Atlas Radio Corp., 50 Wingold Avenue, Toronto

CIRCLE NO. 27 ON READER SERVICE PAGE

# Back Issues Available

Use this coupon to order back issues of **POPULAR ELECTRONICS**

We have a limited supply of back issues that can be ordered on a first-come, first-served basis. Just fill in the coupon below, enclose your remittance in the amount of 50¢ each and mail.

ZIFF-DAVIS SERVICE DIVISION  
 Dept. BCPE 589 Broadway  
 New York 12, New York

Please send the following back issues of  
**POPULAR ELECTRONICS**.

I am enclosing ..... to cover cost of  
 the magazine, shipping and handling.

Month ..... Year .....  
 Month ..... Year .....  
 Month ..... Year .....

Name .....  
 Address .....  
 City ..... Zone ..... State .....

No charge or C.O.D. orders please.



send for NEW FREE  
**CRYSTAL CATALOG**  
 with NEW TRANSISTOR  
**OSCILLATOR CIRCUITS**

## Citizen Band Class "D" Crystals

3rd overtone — .005% tolerance — to meet all FCC requirements. Hermetically sealed HC6/U holders, 1/2" pin spacing, .050 pins. (Add 15¢ per crystal for .093 pins). **\$2.95 EACH**

All 23 channels frequencies in stock: 26.965, 26.975, 26.985, 27.005, 27.015, 27.025, 27.035, 27.055, 27.065, 27.075, 27.085, 27.105, 27.115, 27.125, 27.135, 27.155, 27.165, 27.175, 27.185, 27.205, 27.215, 27.225, 27.255.

Matched crystal sets for ALL CB units (Specify equipment make and model numbers) **\$5.90 per set**

## RADIO CONTROL CRYSTALS

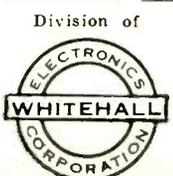
in HC6/U HOLDERS—SIX FREQUENCIES

In stock for immediate delivery (frequencies listed in megacycles; tolerance .005%, 1/2" pin spacing, .050 pin diameter, .093 pins available, add 15¢ per crystal.) Specify frequency.

26.995, 27.045, 27.095, 27.145, **\$2.95 EACH**  
 27.195, 27.255 .....  
 (add 5¢ per crystal for postage and handling)

## ORDER FROM CLOSER PLANT TEXAS CRYSTALS

DEPT. P  
 1000 Crystal Drive  
 FORT MYERS, FLORIDA  
 Phone 813 WE 6-2109  
 TWX 813-334-2830  
 AND  
 4117 W. Jefferson Blvd.  
 LOS ANGELES, CALIF.  
 Phone 213-731-2258  
 TWX 213-737-1315



CIRCLE NO. 30 ON READER SERVICE PAGE

## Short-Wave Report

(Continued from page 72)

### Current Station Reports

The following is a resume of current reports. At time of compilation all reports are as accurate as possible, but stations may change frequency and/or schedule with little or no advance notice. All times shown are Eastern Standard and the 24-hour system is used. Reports should be sent to P.O. Box 254, Haddonfield, N.J. 08033, in time to reach your Short-Wave Editor by the eighth of each month; be sure to include your WPE Monitor Registration and the make and model number of your receiver.

**Afghanistan**—A registered letter from Kabul brought this latest schedule: on 15,225 kc. at 0530-0600 in Eng. to the Far East; at 1330-1400 in German and at 1400-1430 in French to Europe; on 15,135 kc. at 0600-0630 in Eng. to S.E. Asia and Indonesia; on 11,955 kc. at 1300-1330 in Arabic; on 4775 kc. at 0830-0900 in Urdu, at 0900-0930 in Eng., and at 1230-1300 in Russian.

**Bolivia**—CP18, *R. El Condor*, Oruro, 6070 kc. is still operating here in Spanish only with closing at 2200 after which CE607, Santiago, Chile, is heard.

**Brazil**—ZYR232, *R. Universitaria Santos Dumont*, Sao Jose dos Campos, is noted on 17,725 kc. around 1900 with classical and semi-classical music and multilingual announcements and requests for reports. This station is operated by students of the *Technological Institute of Aeronautics*.

**Ceylon**—The Commercial Service of *R. Ceylon* now transmits on announced frequencies of 15,205 and 9667 kc. at 2030-2230 (Sundays to 2330) and on 9667 kc. at 0730-1145. Special requests are being made for reception reports of sponsored programs; be sure to indicate the name of the sponsor. Reports go to Radio Advertising Services, P.O. Bag 10013, Bombay 1, India.

**Chile**—Noted after several years is CE602, *R. Portales*, Talca, 6020 kc. A local news bulletin in Spanish is given at 0005; semiclassical music follows. In years past they verified with a photographic-type card.

**Colombia**—*R. El Sol de Cali* is now on 5040 kc. and usually good from early evening. A letter from the station states that 6115 kc. is no longer in service. Station HJBG, *La Voz del Norte*, is again active on 4875 kc., though only fair. Station HJEQ, *La Voz de Cauca*, 6145 kc., is noted at times at 2000-2030 but with severe QRM. Station HJAG, *Emissora Atlantico*, 4900 kc., is fair to good most evenings from 1900 on.

**Congo (West)**—Brazzaville has discontinued their xmsn to N.A. However, their 1400-1500 xmsn to Africa on 15,190 kc., can usually be heard well. There is a newscast at 1430.

**Czechoslovakia**—*R. Prague* has instituted a new xmsn to N.A. on Sundays at 1000 on 15,285 and 17,830 kc. Reception reports are re-

quested. This is in addition to the regularly scheduled N.A. xmsns. Prague's Spanish xmsn on Mondays at 2100 on 6000 kc. is causing severe QRM to R. Americas.

**Ecuador**—Currently being heard: HC2VP, R. Atalaya, Guayaquil, 4600 kc., with Latin American music and ads to 2200, an ID, then a short news bulletin, all Spanish; HCBK2, R. El Mundo, Guayaquil, with Spanish news at 2345 on 4710 kc.; HCQR1, R. Quito, La Voz de Capital, Quito, 4923 kc., with Latin American music and ads from 2200, many ID's.

**Egypt**—Cairo is noted on 9675 kc. at 1638-1700 with a newscast from 1645. A musical mailbag program is aired at 1701-1715.

**Ethiopia**—Station ETLF. Radio Voice of the Gospel, Addis Ababa, 15,435 kc., has Eng. news at 1515-1525 daily to W. Africa. The 9760-kc. outlet is heard from 1300 s/on in Eng., then into language.

**Ghana**—R. Ghana, Accra. is heard well at 1600-1635 on 11,800 kc.; at 0945-1028 on 17,910 kc.; and from 0935 to Sudan and Ethiopia on 15,190 kc. These are all in English.

**Honduras**—Station HRQW, R. Juventud, Tela, is noted on 4995 kc. at 1945-2010 with ID's, music, and ads.

**Iran**—A station believed to be R. Teheran has been tuned on 9660 kc. with singing at 1045, an ID in Persian (?) at 1100, then more singing to 1128. An ID was given, anthem played, and s/off effected at 1130.

**Japan**—At press time. R. Japan's xmsn to N.A. at 1830 was being aired on 11,705, 11,780, and 15,135 kc., replacing 15,190 and 15,305 kc.

**Jordan**—Reported by one of our top men, Amman was noted on the unusual frequency of 8938 kc. from 1703 to 1900 s/off with singing, some western music, and mostly Arabic language. Has anyone else heard this station?

**Korea (South)**—The newest schedule from the Voice of Free Korea reads: General Service in Eng. at 0030-0100 on 11,925 kc.; at 0230-0300 on 15,125 kc.; and at 0530-0600 on 9640 kc. There is a 10-minute newscast at each opening. English to S.E. Asia is broadcast at 0900-0930 on 15,125 kc. French to Europe is broadcast at 0200-0230 and to Asia at 0930-1000, both on 15,125 kc. Spanish to Latin America is aired at 2230-2250, and Korean to the same areas at 2250-2300, both on 9640 kc. Reception reports are encouraged.

**Mexico**—Station XEBH, Hermosillo, Sonora, was noted on 11,560 kc. for several days but it was probably only spurious radiation from XEBR, 11,820 kc., which relays XEBH, 920 kc. Station XEWW, Mexico City, has been noted at times testing around 7200 kc.; further details are lacking.

**Morocco**—Rabat, 15,070 kc., has French at 1515-1530. Eng. from 1530 to past 1600 with

#### SHORT-WAVE ABBREVIATIONS

annt—Announcement	QRM—Station interference
Eng.—English	QSL—Verification
ID—Identification	R.—Radio
kc.—Kilocycles	s/off—Sign-off
mc.—Megacycles	s/on—Sign-on
N.A.—North America	xmsn—Transmission
	xmttr—Transmitter

## Do You Save Your Copies of POPULAR ELECTRONICS?

Keep them neat and easily accessible with a handsome Jesse Jones File that's designed to hold a full year's copies.

Jesse Jones Box Corp., Dept. P.E. Box 5120  
Philadelphia 41, Pa.

Please send me: (Fill in title, quantity and check appropriate column for color desired)

MAGAZINE TITLE	QUANTITY	BLACK BACKING/MAROON SIDES	MAROON BACKING/BLACK SIDES
Popular Electronics	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____

\$2.95 each, 3 for \$8.00 or 6 for \$15.00—shipped prepaid—fully guaranteed

Total amount enclosed \_\_\_\_\_

Name \_\_\_\_\_

Address \_\_\_\_\_

City \_\_\_\_\_ Zone \_\_\_\_\_ State \_\_\_\_\_

## B.S. degree in 36 months

Small professionally-oriented college. Four quarter year permits completion of Engineering or Business Administration degree in three years. Summer attendance optional. One-year Drafting-Design Certificate program. Founded 1884. Rich heritage. Excellent faculty. Small classes. Well equipped labs. New library. Residence halls. 200-acre campus. Graduate placement outstanding. Modest costs. Enter March, June, Sept., Jan. Write J. D. McCarthy, Director of Admissions, for Catalog and Visa Book.

**TRI-STATE COLLEGE**

3624 College Avenue  
Angola, Indiana

# ELECTRONICS

Train in the new shop-labs of the world famous

**COYNE ELECTRONICS INSTITUTE**

on a quarter million dollars worth of equipment. Non-Profit Institute—Est. 1899. Courses: Electronics • Electricity • TV-Radio. Mail coupon or write for FREE BOOK, "Your Opportunities in Electronics". No Salesman will call.

COYNE ELECTRONICS INSTITUTE Educ. Serv. Dept. 24-M  
1501 W. Congress Parkway, Chicago, Ill. 60607

NAME \_\_\_\_\_ PHONE \_\_\_\_\_

ADDRESS \_\_\_\_\_ AGE \_\_\_\_\_

CITY \_\_\_\_\_ STATE \_\_\_\_\_

## DX Awards Presented

*The following DX'ers have qualified for awards this month (100, 75, 50, and 25 countries verified). Congratulations, and welcome to the Awards List!*

### One Hundred Countries Verified

John W. Reasoner (WPE0CLU), Ames, Iowa  
 Bill Wambach (WPE9AT), Evansville, Ind.  
 Joseph L. Hueter (WPE3EP), Philadelphia, Pa.

### Seventy-Five Countries Verified

Richard E. Lawrenson (WPE1QY), Camp Lejeune, N.C.

### Fifty Countries Verified

David C. Eastman (WPE1AW), Ashton, R.I.  
 Frank Gregory (VE3PE1VQ), Brampton, Ontario, Canada  
 Will White III (WPE4FWR), Lexington, Ky.  
 Norman W. Styer Jr. (WPE3AA), Elverson, Pa.  
 Jerry H. Drott (WPE4ECG), Charleston, Miss.

### Twenty-Five Countries Verified

Steve D. Carver (WPE2FVK), East Aurora, N.Y.  
 B. L. Manohar (VU2PE1D), Hubli, India  
 Joe Kasser (G2PE5S), London, England  
 Robert H. French (WPE8FGH), Bellaire, Ohio  
 Michael Fusick (WPE9EZK), Chicago, Ill.  
 Asher Fried (WPE2JNR), Paterson, N.J.  
 Mario Caleri (WPE1FFP), Lincoln, R.I.

Martin Thrope (WPE1ETP), Lowell, Mass.  
 D. M. Elliott (VE5PE1G), Moose Jaw, Sask., Canada  
 Robert F. Seiloff, (WPE8BAI), Battle Creek, Mich.  
 Charles Kaminski (WPE1DYZ), Norwich, Conn.  
 Walter Poppinga (WPE9CBC), Lafayette, Ind.  
 Daniel Dravet (VE2PE1EB), Montreal, Quebec, Canada  
 Al Burzynski (WPE6DJB), Glendale, Calif.  
 Robin Martin (WPE2GEH), Glen Head, N.Y.  
 Richard Thomas (WPE9JS), Minooka, Ill.  
 Lewis Strassberg (WPE2GWH), Brooklyn, N.Y.  
 Bruce Antonoff (WPE2KUG), New York, N.Y.  
 Mike Pilon (VE2PE1FW), Dorval, Quebec, Canada  
 Francis E. Duck (VE3PE5W), Grassie, Ontario, Canada  
 Robert Reinhard (WPE3EXG), Middletown, Pa.  
 Richard Mills (WPE2HOZ), New York, N.Y.  
 Jessee Ring (WPE4GLK), Narrows, Va.  
 Patricio McGrath (6YAPEIA), Kingston, Jamaica  
 Gale B. Francis (WPE9ERD), Sacramento, Calif.  
 Edward C. Bassett (WPE9EHF), Toledo, Ill.  
 David Decsman (WPE2FWL), Buffalo, N.Y.  
 John O'Donnell (WPE9GCK), Edwardsville, Ill.  
 Terry A. Radtke (WPE9FEL), Zachow, Wisc.

news from 1600 on. This is the African beam.

**Netherlands**—At deadline time, *R. Netherland* was airing its "Dutch By Radio" courses as follows: at 0230-0250 to Australia and New Zealand on 11,730, 9715, and 9630 kc., to India and W. Australia on 15,445 kc., and to Europe on 6020 kc.; at 1030-1050 to Middle and Far East on 15,445 and 11,710 kc., to Africa on 15,425 kc., and to Europe on 6020 and 5980 kc.; at 1740-1750 to N.A. and Europe on 9715 and 6085 kc.; and at 2030-2050 to N.A. on 6035 and 5950 kc. The lessons are repeated on Wednesdays at 1000-1020 to Middle and Far East on 15,445 and 11,710 kc., to Africa on 15,425 kc., and to Europe on 6020 and 5980 kc.; at 1530-1550 to N.A. and Europe on 9715 and 6035 kc.; and at 1730-1750 to N.A. and Europe on 9715, 6085, and 6020 kc. A new course is planned for 1964; details will be given as soon as they are received. Meanwhile, the "Happy Station Program" is being aired on Sundays as follows: at 0100-0225 to Australia, New Zealand, and Pacific areas on 9715 and 9630 kc.; at 0530-0800 to Europe, Far East, and Pacific areas on 21,480, 15,425, 6020, and 5980 kc.; at 1100-1225 to Africa, Middle East, and Europe on 17,715, 15,425, and 6020 kc.; at 1600-1730 to Latin America, Spain, and Portugal on 11,730, 6085, and 6020 kc.; and at 2100-2230 to N.A. on 9590 and 5984 kc.

**Peru**—Station OAX10, *R. Chiclayo*, Apartado Postal 229, Chiclayo, has moved from 5680 kc. to 5521 kc. and features many time checks and ads. They close at 0000. Station OAX3E, *R. Huaras*, Huaras, 5699 kc., also closes at 0000 after a lengthy listeners' request program; reports of this being on 5710 kc. are in error and probably refer to *R. Ayaviri*, another Peruvian on 5714 kc. Station OAX8Q, *R. Pucallpa*, Jiron Ucayali, Pucallpa, 9580 kc. has been heard but with great difficulty around 1839-1850 in Spanish with ads and local news. Station OAX8F, *R. Loreto*, Casilla

174, Iquitos, 9504 kc., is often confused with HI4U, Santo Domingo, D.R., on 9505 kc. and/or the Chilean station on 9502 kc. Station OAX8F operates in dual, at times, with 4456 kc.

**Reunion**—St. Denis was tentatively logged on 3380 kc. with African-type music at 1815-1830; French news at 1830-1845; music to 1900; unreadable after 1915.

**South Africa**—A new schedule shows operations at 2200-2300 on 6150 and 7275 kc., at 0500-0945 on 21,690 kc., at 0945-1300 on 9525 kc., at 1300-1615 on 2775 kc., at 0500-1210 on 15,080 kc., at 1210-1500 on 11,900 kc., and at 1500-1615 on 6150 kc. This is the African Service.

Station ZUD, a telephone station in Olifantsfontain, operates daily around 2215 on 9180 kc. with a test xmsn. They will verify.

**Switzerland**—Berne's N.A. East Coast xmsn is now beamed on 9665 kc. (replacing 11,865 kc.), 9535 and 6165 kc. at 2030-2145. The West Coast xmsn at 2330 has been deleted and incorporated into the India and Pakistan xmsn at 0945-1100 on 11,865 and 9665 kc. (to India and Pakistan) and 15,315 kc. (to N.A.).

**Turkey**—Ankara's latest schedule shows Eng. at 0845-0915 to S. and S.E. Asia on 17,820 kc. and at 1600-1700 (no target area listed but presumably to Europe and United Kingdom) on 15,160 kc.

Erzurum, 7647 kc., is noted with Arabic chanting from 2302; some modern European music around 2327; all announcements in Turkish. This is a regional station.

**U.S.S.R.**—*R. Kiev* has Eng. to N.A. on Mondays, Thursdays, and Saturdays at 2100-2120 on 7210, 9610, 9670, and 9710 kc., and at 2300-2320 on 7190, 7210, and 9710 kc.

**Vietnam (North)**—Hanoi was noted on 9760 kc. at 0550 with native music, at 0600 a gong and native language ID, then a talk, at 0615 music and another talk. A report to the station was returned from San Francisco with

the notation that mail service to this country had been suspended.

**Clandestine**—The mailing address for *R. Libertad* is P. O. Box 1624, Miami 1, Florida, not Box 2624 as previously listed in this column. A self-prepared QSL, written in Spanish, was returned with the signature of Humberto Lopez Perez, Engineer. (One reader asked if this station were located aboard the *S. S. Rex*. While your Short-Wave Editor has also noted that the *Rex* has been in the news recently and while we believe that *R. Libertad* is on shipboard, we still have no information as to exactly what ship, if any, is used as headquarters for this station.)

### Medium-Wave Stations

The standard broadcast band continues to command a considerable amount of attention during the current cycle of minimum sunspots. The following is a listing of stations heard within the past month by DX'ers in many of the Eastern states, plus a few items from Californians. Try for them; you'll log a number of countries that you won't normally catch on the short waves. The listing is by frequency.

- 550 Montego Bay, Jamaica—nights
- 560 YVLX, *R. Rumbos*, Caracas, Venez.—nights; Kingston, Jamaica
- 580 WKAQ, San Juan, P.R.—nights
- 584 Madrid, Spain—around 1840-1900
- 620 HIST, *R. Santo Domingo*, D.R.—nights
- 625 TIRICA, *La Voz de la Victor*, San Jose, C.R.—around 2100
- 640 Point-a-Pitre, Guadeloupe—sunset
- 642 Paramaribo, Surinam—best on Mondays at 0345
- 644 St. Johns, Antigua—around sunset
- 650 YVQO, *Ondas Portenas*, Venez.—1830-1930
- 660 TGLM, *R. Seis Sesenta*, Guatemala—2300-0000
- 670 HRN, *La Voz de Honduras*, Tegucigalpa—2300-2330
- 675 Union Radio, Nicaragua—fair 0000-0100
- 690 R. Progreso, Havana, Cuba—around 2230
- 700 Montego Bay, Jamaica—around sunset
- 720 YVQR, *R. Cumana*, Cumana, Venez.—nights  
HJAN, *Emissora Unidas*, Colombia—1930-2030
- 725 TILX, *R. Colombia*, San Jose, C.R.—0000-0200
- 730 CMCA, Havana, Cuba—evenings; Eng. at 1800-1830  
XEX, Mexico City—around 2215  
HJCU, *R. Tricolor*, Colombia—1900-2000
- 740 HRYN, *La Voz Del Merendon*, Honduras—2300-0000
- 750 Port Maria, Jamaica—around sunset
- 755 CSA3, Lisbon, Portugal—evenings around 1820 with English "Voice of the West" program
- 775 TIW, *Radio City*, San Jose, C.R.—nights
- 782 CSB9, Miramar, Portugal—evenings
- 820 HJED, Cali, Colombia—evenings; some Eng. ID's
- 828 YNOL, *Ondas Del Luz*, Managua, Nicaragua—English religious programs during the evenings
- 833 Belize, British Honduras—very strong

## POPULAR ELECTRONICS

February 1964

### ADVERTISERS INDEX

READER SERVICE NO.	ADVERTISER	PAGE NO.
1	Allied Radio	9
	American Institute of Engineering & Technology	102
2	Burstein-Applebee Co.	94
	Capitol Radio Engineering Institute, The	THIRD COVER
3	Christy Trades School	8
	Cleveland Institute of Electronics	16, 17, 18, 19
4	Columbia Products Company	4
	Conar	32
5	Concord Electronics Corporation	105
	Coyne Electrical School	96
	Coyne Electronics Institute	109
	DeVry Technical Institute	3
6	EICO Electronic Instrument Co., Inc.	40
7	Eastman Kodak Company	83
8	Electro-Voice, Inc.	FOURTH COVER
9	Esse Radio Company	90
10	Fisher Radio Corporation	11
	Grantham School of Electronics	5
11	Grove Electronic Supply Company	12
12	Hallicrafters	31
13	Hammarlund Mfg. Co.	7
14	Heath Company	89, 91, 93, 95, 97, 99
34	Hy-gain Antenna Products Corp	38
15	International Crystal Mfg. Co., Inc	30
	Interstate Electronics	96
33	Johnson Company, E.F.	39
16	Kuhn Electronics Inc.	8
17	Lafayette Radio Electronics	23
	Massey Technical Institute	30
19	Metrotek Electronics, Inc.	10
35	Milwaukee School of Engineering	20
	National Radio Institute	SECOND COVER
	National Technical Schools	34, 35, 36, 37
20	New-Tronics Corp.	14
21	Olson Electronics Incorporated	90
	Palmer Electronics Labs., Inc	102
23	Pearce-Simpson, Inc.	6
24	Progressive "Edu-Kits" Inc.	13
	RCA Electronics Components and Devices	29
	RCA Institutes, Inc.	12, 84, 85, 86, 87
	Rad-Tel Tube Co.	118
26	Sams & Co., Inc., Howard	22
27	Scott Inc., H.H.	107
28	Sonar Radio Corporation	103
29	Superscope, Inc	28
32	Sylvania Electric Products Inc.	94
30	Texas Crystals	108
	Tri-State College	109
	Valparaiso Technical Institute	102
	Western Radio	96
31	Xcelite Inc.	106

CLASSIFIED ADVERTISING 114, 115, 116, 117

- evenings; Eng. from 1900; s/off 2235; they announce as *British Caribe* in Spanish
- 840** Castries, St. Lucia—French but with some Eng. ads  
HJBI, *Ondas Del Caribe*, Colombia; evenings; best at 0000-0100  
KOST, location unknown, definite ID (KOST listed as an FM station in Houston, Texas, on 100.3 mc.—Ed.)
- 845** Rome, Italy—early evenings; French news at 1930
- 855** PJC2, *R. Curom*, Willemstad, Curacao—nights
- 870** WHOA, San Juan, P. R.—sunset
- 900** CMJV, Ciego de Avila, Cuba—evenings  
XEW, Mexico City, Mexico—2030-2100.
- 925** TIR, *Radion*, Costa Rica—after 0000
- 935** Agadir, Morocco—around 1845

- 950** LR3, Buenos Aires, Argentina—0415-0445
- 965** YNLU, *R. Managua*, Nicaragua—nights
- 970** WIVI, Christianstad, Virgin Islands—sunset
- 1000** WBNB, Charlotte Amalie, Virgin Islands—sunset
- 1033** HJGE, *R. Bucaramanga*, Colombia—Eng. ID at 2230
- 1035** 4VE, Cap Haitien, Haiti—evenings in Eng. and French
- 1043** Dresden, East Germany—strong around 2230
- 1050** XEG, Monterrey, Mexico—Eng. around 0130
- 1075** TIFC, San Jose, C.R.—Spanish and Eng. religious programs
- 1090** CX28, *R. Imparcial*, Montevideo, Uruguay—around 0245

## SHORT-WAVE MONITOR CERTIFICATE APPLICATION

ALL radio listeners interested in furthering the hobby of SWL'ing—regardless of whether you DX on the BCB, VHF, TV, SW, or FM bands—are eligible to apply for a POPULAR ELECTRONICS "Certificate of Registration." You must have verified (have QSL cards from) a minimum of five radio stations, of which one was outside the borders of the United States. There is no age limit, or special equipment qualification; the only requirement is that the applicant have a sincere interest in radio communications.

A new certificate processing procedure

has just been introduced. All certificates are filled in and lettered before mailing. All certificates are now mailed flat and unfolded. If you want to register and receive your WPE identification sign, fill in the new application blank below before March 15, 1964. Mail with 25 cents in coin to: Monitor, POPULAR ELECTRONICS, One Park Avenue, New York, N. Y., 10016. Canadians should use their own currency. All other applicants not in the U. S. A. should use five International Postal Reply Coupons. Allow 2-4 weeks for processing.

(Please Print)	(Do not fill out)
Name .....	
Street, City and Zone .....	
State and Zip .....	
Receivers in use	
Make	Model
Make	Model
Age	Occupation
.....	.....
Ham/CB call -letter assignment(s) .....	
I listen mostly to SW Broadcast      Hams      CB      BCB      VHF      VLF .....	
I use the following antennas .....	
I have      QSL cards and      countries verified.      Check if subscriber to P.E. .....	
Signature	Date
.....	
(Good only until March 15, 1964)	

### SHORT-WAVE CONTRIBUTORS

Andrew Kasparson (WPE1DFW), Auburn, Mass.  
 Michael Bugaj (WPE1EZB), Middletown, Conn.  
 Riley Sundstrom (WPE2AJ), Stockton, N. J.  
 Irwin Belofsky (WPE2BYZ), Brooklyn, N. Y.  
 Gerry Klinck (WPE2FAH), Buffalo, N. Y.  
 Harley Rutstein (WPE2HKR), Englewood, N. J.  
 Les Shattuck (WPE2HZU), Locke, N. Y.  
 Bruce Telzer (WPE2JKR), Long Beach, N. Y.  
 Emil Vandevelde (WPE2KUS), Oakland, N. J.  
 Al Quagliari (WPE2KMI), Albany, N. Y.  
 Dean Steiner (WPE2KIX), New York, N. Y.  
 John Feldman (WPE3HUC), Feasterville, Pa.  
 John McKillop (WPE3EML), Washington, D. C.  
 Joseph Hueter, Sr. (WPE3EP), Philadelphia, Pa.  
 R. M. Daniel, Jr. (WPE3EXJ), Swarthmore, Pa.  
 Grady Ferguson (WPE4BC), Charlotte, N. C.  
 Chuck Edwards (WPE4BNK), Fort Lauderdale, Fla.  
 John Brunst (WPE4BQ), Neptune Beach, Fla.  
 David Pope (WPE4DMV), Crescent Beach, S. C.  
 Roy Moore (WPE4FWH), Hazard, Ky.  
 Steve Kerel (WPE4FZZ), Chester, Va.  
 Jack Keene (WPE5BMP), Houston, Texas  
 John Hopkins (WPE5DPV), New Orleans, La.  
 Bill Lund (WPE6CJ), Manhattan Beach, Calif.  
 Charles Matterer (WPE6DCA), San Leandro, Calif.  
 W. E. Lipis (WPE6EVA), El Cajon, Calif.  
 Bob Bilkiss (WPE6EVA), Los Angeles, Calif.  
 John Miller (WPE6FOC), Parkersburg, W. Va.  
 Dan Schonberg (WPE6FII), Shaker Heights, Ohio  
 Jerry Heien (WPE6BOD), Berkeley, Ill.  
 Phil Cutler (WPE6EFL), Barrington, Ill.  
 Pat Zuller (WPE6FST), Lombard, Ill.  
 Arthur Backstrom (WPE6GJK), Chicago, Ill.  
 John Beaver, Sr. (WPE6OAF), Pueblo, Colo.  
 Jack Perolo (WPE6EIC), Sao Paulo, Brazil  
 Gary Cooper (WPE6EIMX), St. Catharines, Ont.,  
 Canada  
 Doug Renwick (WPE6EAX), Stettler, Alberta, Canada  
 Ashok Shanku (WPE6EIE), Bombay, India  
 Arnon Akomer, M.D., Hollywood, Fla.  
 Joe Piechuta, Meriden, Conn.  
 Clifford Stott, W. Springfield, Mass.

- 1155 HIAS, Santo Domingo, D.R.—nights  
 1196 *Voice of America*, Munich, Germany—  
 sunset; Eng. news at 0000  
 1205 Bordeaux, France—around 2230 but as  
 early as 1630 in Conn.  
 1235 ZBMI, Hamilton, Bermuda—nights  
 1376 Bordeaux, France (same as on 1205 kc.)  
 1385 4VS, Port-au-Prince, Haiti—nights  
 1395 HCVE4, Esmeraldas, Ecuador—nights  
 1466 3AM2, Monte Carlo, Monaco—sunset;  
 also around 0030  
 1500 Fort-de-France, Martinique—1800-2100  
 1538 Dakar, Senegal—1815-1830 or around  
 local sunset  
 1540 ZNS, Nassau, Bahamas—excellent all  
 day in southeastern states; good even-  
 ings in many areas  
 1565 *R. Libertad*—s/off 0037.  
 1570 XERL (formerly XERF) Ciudad  
 Acuna, Mexico—Eng. around 0200; re-  
 ports go to XERL, Del Rio, Texas

The above stations represent only a small fraction of what can be heard in the frequency range of 540-1600 kc. The times given for these stations are not their only operating times; they are the times when you stand a reasonably good chance of hearing them provided that you tune carefully and that conditions are better than average.

We would welcome reports of medium-wave stations other than those listed here, as well as more reports from our West Coast readers. No doubt some of the DX'ers in western states can hear some of the trans-Pacific stations. Give us an indication of the best times to listen.



**SPECIAL VALUE!**

**5-SOCKET  
CONTINUITY  
TESTER \$9.95  
VALUE**

**ONLY \$3.95**

Instantly tests filaments in radio and TV tubes, and indicates which are burned out. Ideal instrument for checking all household appliances. Fits all types of tube bases—7-pin, 9-pin, octal, loctal and TV picture tubes. Operates on 117V AC-DC. Now at an extraordinary low price.

**FULLY GUARANTEED!  
ORDER TODAY!**

Consumer Service Company  
 589 Broadway  
 New York 12, N. Y.

Please send me \_\_\_\_\_ Continuity Testers at \$3.95 each (N.Y.C. residents please add 4% Sales Tax). My check (or money order) for \$\_\_\_\_\_ is enclosed. I understand that you will pay the postage and that each Continuity Tester is fully guaranteed.

Name \_\_\_\_\_

Address \_\_\_\_\_

City \_\_\_\_\_ Zone \_\_\_\_\_ State \_\_\_\_\_

(SORRY—No Charges or C.O.D. Orders.)

# ELECTRONICS MARKET PLACE

RATE 60¢ per word. Minimum 10 words prepaid. April issue closes February 5th. Send order and remittance to Martin Lincoln, POPULAR ELECTRONICS, 1 Park Ave., New York 16, N. Y.

## FOR SALE

**GOVERNMENT** Surplus Receivers, Transmitters, Snooper-scopes, Parabolic Reflectors, Picture Catalog 10¢. Meshna, Nahant, Mass.

**WPE-CB-QSL** cards—Brownie-W3CJI—3111A Lehigh, Allentown, Pa. 18103. Catalogue with samples 25¢.

**CB WPE QSL** Cards, Samples Free. Radio Press, Box 24, Pittstown, New Jersey.

"**SPECIAL!** WPE-SWL-CB-QSL cards, 3 colors, \$2.50 per 100—Free Samples, Garth, Jutland, New Jersey."

**TRANSISTORIZED** Products Importers catalog, \$1.00. Intercontinental, CPO 1717, Tokyo, Japan.

**INVESTIGATORS**, free brochure, latest subminiature electronic listening devices. Ace Electronics, 11500-L NW 7th Ave., Miami 50, Fla.

**CANADIANS—GIANT** Surplus Bargain Packed Catalogs. Electronics, Hi-Fi, Shortwave, Amateur, Citizens Radio, Rush \$1.00. (Refunded). ETCO, Dept. Z., Box 741, Montreal, CANADA.

**TELEPHONE** Voice Switch (LS-500), Actuates automatically and unattended any tape or wire recorder. Pictorial installation instructions included. \$23.75. Post Paid US. WJS Electronics, 1525 No. Hudson, Hollywood 28, Calif.

**14** Weather instrument Plans \$1.00. Saco, Box 2513B, South Bend, Indiana.

**TRANS-NITION** electronic ignition parts kit. Negative ground \$20.00. Coil, Manual special \$8.50. Manual \$2.00. Anderson Engineering, Wrentham, Massachusetts.

**INVESTIGATORS!** Do your own sound work. Send \$1.00 for brochure of latest electronic equipment. WJS Electronics, 1525 No. Hudson, Hollywood 28, California.

**SUPERSENSITIVE** Listening-In-Device picks up any telephone conversation in vicinity. No connection to telephone necessary. Easily concealed. \$2.98 complete. Consolidated Acoustics, F1302 Washington Street, Hoboken, New Jersey.

**DIAGRAMS** for repairing Radios \$1.00. Television \$2.50. Give make model. Diagram Service, Box 1151 PE, Manchester, Connecticut 06042.

**SAVE Money—Free** catalog: Photography, Tape Recorders, Hi Fidelity, Electronics, Tools. Wholesale Radio & Camera Co., Box 3085, Phila. 50, Pennsylvania.

**CB QSL** Cards—Over 45 highly attractive designs, 2 colors on glossy white. Other CB novelties. Call Record Books, Plastic Card Holders, Warning Stickers and Gag Signs. Catalog Free! Woody, 2611 Shenandoah, St. Louis 4, Mo.

**ROCKETS:** Ideal for miniature transmitter tests. New illustrated catalog, 25¢. Single and multistage kits, cones, engines, launchers, trackers, technical information, etc. Fast service. Estes Industries, Penrose 18, Colorado.

**TELEPHONE** Extension in your car. Answer your home telephone by radio from your car. Complete diagrams and instructions \$2.75. C. Carrier Co., 6311 Yucca St., Hollywood 28, Calif.

**EAVESDROP** with a pack of cigarettes. Miniature transistorized FM Radio Transmitter Complete diagrams and instructions \$2.75. C. Carrier Co., 6311 Yucca St., Hollywood 28, Calif.

**POLICE** Radar Detector plus legal Jammer. Stop before Radar Speed Traps. Build for less than \$10.; used with Car Radio. Complete construction details, \$3.75. C. Carrier Co., 6311 Yucca St., Hollywood 28, Calif.

**RECORD TV** Programs at home. Easy to construct. Watch your favorite TV Shows whenever you wish. Complete construction details \$4.75. DB Enterprises, 8214 Sunset Blvd., Hollywood 46, Calif.

**COLOR TV.** Convert your black and white TV to color. Completely Electronic. No mechanical gadgets. Costs about \$35. Complete construction details \$4.75. DB Enterprises, 8214 Sunset Blvd., Hollywood 46, Calif.

**BE A Spy.** Correspondence course on Wire Tapping, Bugging, Telescopic sound pickup, recording techniques, microphotography, and invisible photography. Lessons in Surveillance, tailing, and use of equipment. Complete course \$22.50. C. Carrier Co., 6311 Yucca St., Hollywood 28, Calif.

**ANSAPHONE.** Automatic Telephone Answering Machine delivers and takes messages. Build under \$40. Plans \$4.75. Seaway Electronics, 6311 Yucca St., Hollywood 28, Calif.

**TAIL** Transmitter. Tiny Transistorized Transmitter for the Private Eye. Signals its location for miles. Construction Details \$4.75. DB Enterprises, 8214 Sunset Blvd., Hollywood 46, Calif.

**TRANSISTORIZED** Ignition parts kit for "Popular Electronics Operation Pickup". Complete with recommended parts and special heat sink. For 6 and 12 volt negative ground automobiles. Shipped prepaid USA. Only \$14.99. Order Today. Electronics Kits, Box 1504, La Jolla, Calif.

**BUY** From Factories! Appliances, cameras, watches, etc! Free details! Cam Company, 436PH Bloomfield Ave., Verona, N. J.

**IGNITION!** Kits \$14.95: Transistors, Coils, Parts. Free lists. Transfire, Carlisle, Massachusetts.

**ELECTRONIC** Parts Bargains Semiconductors, Tubes, etc., free catalog for postcard. Franklin Electronics, Box 51A, Brentwood, N. Y. 11717.

**TV Camera.** Build for less than \$50. Construction details \$4.75. DB Enterprises, 8214 Sunset Blvd., Hollywood 46, Calif.

**TOLL** Free Distance Dialing. By-passes operators and billing equipment. Build for \$15.00. Ideal for Telephone Company Executives. Plans \$4.75. Seaway Electronics, 6311 Yucca St., Hollywood 28, California.

**TRANSISTOR** ignition described June and October Popular Electronics, "Operation Pickup." Complete kit finest components quickly assembled. Guaranteed. Negative ground kits \$14.95 Postpaid. Positive ground \$19.95 Postpaid. Specify 6 or 12 volt when ordering. Electromart, 1616 S. 81st St., Milwaukee, Wis.

**MAKE** amazing radio from razor blade. Really works. Complete plans 50¢. Miniature powerful germanium diode radio kit, complete, \$2.75. Phillippi, Suite 222, 3166 Maple Drive, N.E., Atlanta 5, Georgia.

**CB-QSL-SWL** cards. Samples 10¢. Include your personal picture on cards. No extra Cost. Signal, Adams County, Manchester, Ohio.

**10 DISTANCE** Crystal set plans—25¢; 20 different—50¢. Catalog. Laboratories, 1131-L Valota, Redwood City, California.

**NEW & Used** Citizen Band and 2-way F.M. Radio Equipment. Send for list. Dealers inq. invited. Becom Co., Seminary Hts., 817—LY 4-5172, Weatherford, Texas 76086.

**PRINTED** Circuit Resist—Applied with ordinary pen. \$1.00. Louis Tate, Box 19083, Indianapolis, Indiana.

**MAGAZINES** (back issue)—electronic, tv, radio. Landa, Clayton R2, Ga., 30525.

**ATTENTION:** Antique Edison Cylinder Phonographs, Released from storage, each phonograph in working order, complete with outside concert horn, stand, cylinders. Each \$80.00. Whitlock Storage, 114 State, Brewer, Maine.

**GREATEST Buys!** Electronic Surplus list 10¢. Western Electric Mercury Wetted Relay SPDT 5AMP Contacts, only \$2.95 postage paid 2 for \$5. (\$15. Value) Fertik's, 9th Tioga, Phila. 40, Penna.

**TV Camera** components at lowest prices. Send 10¢ for money-saving list. Vanguard, 190-48—99th Avenue, Hollis, N.Y. 11423.

**BARGAINS!** Used Ham, Cb, Test equipments. List 10¢. Brand's, Sycamore, Illinois.

**CONVERT** any television to sensitive, big-screen oscilloscope. Only minor changes required. No electronic experience necessary. Illustrated plans, \$2.00. Relco Industries, Box 10563, Houston 18, Texas.

**TRANSISTORIZED** treasure finder kits, assembled models from \$19.95. Free catalog. Relco, Box 10563, Houston 18, Texas.

"**LITTLE-Listener**" picks up both ends of telephone conversation without detection. Easily concealed up to 100 feet from any telephone. No wires directly to telephone required. No expensive amplifier necessary as with "coil" type pickup. Complete with earphone, \$4.95. Deeco, Box 7263-AD, Houston 8, Texas.

**SUPERSENSITIVE** directional microphone picks up faint sounds at 300 feet. Detects sound through ordinary walls. Easily built for \$7.00. No electronic experience necessary. Plans, \$2.00. Dee Company, Box 7263-F, Houston 8, Texas.

**PRINTED** Circuit Boards, Hams, Experimenters. Free Catalog. P/M Electronics, Box 6288, Seattle, Washington 98188.

**CB** transmitters \$6.00. Other bargains, send 10¢ for list. Vanguard, 190-48-99th Ave., Hollis 23, N. Y.

**10** Radio, Television diagrams. Our choice. \$1.00 Plus 20¢ stamps. Diagrams, Box 1151 PE, Manchester, Conn.

**PROTECT** your VOM against damage from overloads. Metergard installed in minutes protects against 100 times overload. Money back guarantee. Only \$2.95. Lectrotech, Inc., P.O. Box 531, Skokie, Ill.

**FREE** Transistor Ignition information. Save gas, money. Cut Maintenance. Ignitioneering Company, Box 38-C, Wilton, Connecticut.

**QSL'S** \$2.50/100. Exciting 1964 Catalogue 10¢. Longbrook, Box 393-Y, Quakertown, N.J.

**NEW** Electret Plastic has 5000 Volt permanent charge. Send \$1.00 for sample. Good Sales Co., P. O. Box 468, Flemington, N.J.

**CBer's.** Increase talk power with a transistor clipper. Internal and external models. From \$13.95. Write: J.A. Electronics, Box 645, Teaneck, N.J.

**GRILLE** Cloth, latest patterns. Assortment of 6 pieces 12"x24" only \$1.00. Shipping Weight 2 lbs. Naefly Pastics, RT 1 Box 44 A, Madison, Wis. 53716.

**CHANGE** Black-White TV To Color In Moments. Send Size Screen. \$2.98. Delecto Electronics, 4725 45th N.E., Seattle 05, Wash.

**CRYSTAL** Controlled Transistor Converter C.B. Police 10 or 6 meters. Tune on B-cast receiver. Complete with crystal \$18.00. Pell, 8 Milton Street, Lynn, Mass.

## WANTED

**CASH** Paid! Unused tubes, electronic equipment. Barry, 512 Broadway, N.Y.C. 12.

**QUICKSILVER,** Platinum, Silver, Gold. Ores Analyzed. Free Circular. Mercury Terminal, Norwood, Mass.

**\$50 A** day, men or women, full or part time. Demonstrator and brochures shipped on receipt of \$10.00. Money back guarantee. Shipped FOB. Or send \$1.00 for details, brochure. Raymar Enterprises, Box 602E, Lynwood, Calif.

**GET** Top Dollar for Radio, Television and special purpose tubes. Tell us what you have. Metropolitan Overseas Supply Corp., 443 Park Avenue South, New York 16, N. Y., Tel. MU 6-2835.

**HOBBYISTS** Wanted to build circuits for us. We will supply complete plans. Send \$2. for plans, shipping instructions, and the current price we are now paying. Electronic Distributors, General Delivery, Slidell, Louisiana.

**TELESCOPE** Sound pick up to ¼ mile. Write Box 113 Popular Electronics, One Park Avenue, N.Y. 16, N.Y.

## HAM EQUIPMENT

**CB-Walkie-Talkie.** Transistorized kit. Two for \$25.00. Princess, Box 52, Station F, Toledo, Ohio.

**CBER'S HAMS:** Compact AAA-1 Clipper-filter kit triples talk-power, fits any CB transceiver, improves selectivity; \$10.99. Double reception with SK-3 Preselector for GW-10, GW-11; SK-4 Preselector fits GW-12 internally! Kit, \$8.99; wired, \$11.99. SK-20 Preselector, tunable 3.5-30 megacycles, kit, \$18.98. (featured page 64, October Popular Electronics). Noisejector, NJ-7, \$4.49. Prices postpaid! Free kit, antenna list.) Holstrom Associates, P.O. Box 8640-E, Sacramento, Calif. 95822.

## HIGH-FIDELITY

**DISGUSTED** with "Hi" Hi-Fi Prices? Unusual discounts on your High Fidelity Requirements. Write Key Electronics, 120 Liberty St., New York 6, N. Y. DI 6-4191.

**WRITE** for lowest quotations, components, recorders. No Catalogs. Hi-Fidelity Supply, 2817-QC Third, New York City 55.

**HI-FI** Components, Tape Recorders at guaranteed "We Will Not Be Undersold" prices. All brands in stock. 15-day money back guarantee. 2 year warranty. Write your requirements for quotation. No Catalog. Hi-Fidelity Center, 1797-P 1st Ave., New York 28, N.Y.

"**LOW,** Low quotes: all components and recorders. HiFi, Roslyn 9, Penna."

**MELLO** Monster Exponential Folded Horn PE Oct 1962 Full Scale Plans and Construction Details 8" or 12" \$2.00 each. Misco F8-HFD Extended Range Speaker \$11.88 Postpaid. Roald E. Dybvig, 2754 Xenwood, Minneapolis 16, Minn.

**HI-FI** Components. Tape Recorders at guaranteed "We Will Not Be Undersold" prices. All brands in stock. 15 day money back guarantee. 2 year warranty. Write for quotation, your requirements. No Catalog. Hi Fidelity Center - 1797 1st Ave., New York 28, N.Y.

## TUBES

**BEFORE** You Buy Receiving Tubes, Test Equipment, Hifi Components, Kits, Parts, etc. . . . send for your Giant Free Zalytron Current Catalog, featuring Standard Brand Tubes: RCA, GE, etc.—all Brand new Premium Quality Individually Boxed, One Year Guarantee—all at Biggest Discounts in America! We serve professional servicemen, hobbyists, experimenters, engineers, technicians. Why Pay More? Zalytron Tube Corp., 461 Jericho Turnpike, Mineola, N. Y.

**TUBE** Headquarters of The World! Free Catalog (tubes, electronic equipment) write! Barry, 512 Broadway, N.Y.C. 12.

**RADIO & T.V.** Tubes—33¢ each. Send for quantity discounts & free list. Cornell, 4213 University, San Diego, California.

**\$30.00** value—7" TV test picture tube, perfect for 70° and 90° sets, built-in ion trap—your cost \$6.99. Tubes—new, jobber-boxed RCA, G.E. etc.—65% off list prices. Special: Tube #6146—\$2.95 each. Send your order. We pay postage (you save 4%). Immediate delivery. Write for Free Catalog listing thousands of parts, phono needles, tubes, etc. Arcturus Electronics Corp., Dept. ZD, 502 22nd St., Union City, N. J.

**TOP** Brand Tubes at Terrific Savings. If you need new radio, television or special purpose electron tubes, you'll want our free catalog. Metropolitan, 443 Park Avenue South, New York 16, N. Y., MU 6-2835.

**BRAND** New Tubes. World's lowest prices on Radio, TV—industrial—special purpose tubes. Write for free parts catalog. United Radio., Newark, N.J.

## TAPE AND RECORDERS

**TAPE** Recorders, Hi-Fi, components, Sleep Learning Equipment, tapes. Unusual Values Free Catalog. Dressner, 1523PE, Jericho Turnpike, New Hyde Park 11, N. Y.

**SELF-Hypnosis** may help you many ways. New Tape or LP-record teaches you quickly, easily! Free literature. McKinley Company, Box 3038, San Bernardino, California.

**TAPE** Recorder Sale. Latest models \$10.00 above cost. Arkay Sales, 22-31 Riverside Ave., Medford 55, Mass.

**SAVE** 30-60% Stereo music on tape. Free bargain catalog/blank tape/recorders/Norelco speakers. Saxitone, 1776 Columbia Road, Washington, D. C.

**RENT** Stereo Tapes—over 2,500 different—all major labels—free brochure. Stereo—Parti, 1616-PE Terrace Way, Santa Rosa, California.

**ROBERTS Recorders.** Immediate Delivery (including 770). Trades accepted. Request information. Caravelle, 916 McLean, Yonkers, N.Y.

**AMERICAN Recorders.** 4-track stereo play, mono record. Incredible Discount Price \$89.50. Caravelle, 916 McLean, Yonkers, N.Y.

## REPAIRS AND SERVICING

**TV Tuners rebuilt** and aligned to Specifications. Guaranteed all makes, One Price. \$9.50 Complete. Plus Shipping. Valley Tuners, 5641-D Cahuenga, North Hollywood, Calif.

**TV Tuners rebuilt** and aligned per manufacturers specification. Only \$9.50. Any make UHF or VHF. We ship COD. Ninety day written guarantee. Ship complete with tubes or write for free mailing kit and dealer brochure. JW Electronics, Box 51C, Bloomington, Indiana.

**DIAGRAMS:** Radio, Television, HiFi Stereo; \$1.00. State make, model. Schematic Collector, 618 4th St., Newark 7, New Jersey.

**METERS**—Multimeters Repaired and calibrated. Free estimates—catalog. Bigelow Electronics, Box 71-E, Bluffton, Ohio.

**TELEFIXIT** Alltime Bestseller Nontechnical TV Repair Book with Famous Troubleshooting Charts, 60¢ postpaid 2 for \$1.00. Telefixit, Box 714, Manhasset 4, N.Y.

**T.V. Tuners**—Fast Service. Rebuilt, Aligned, air checked. VHF only. Prepaid or C.O.D. \$9.00 Texas Tuners. Box 222, Robert Lee, Texas.

## PATENTS

**INVENTIONS;** Ideas developed for Cash/Royalty sales. Raymond Lee, 2104G Bush Building, New York City 36.

## INSTRUCTION

**LEARN** While Asleep, hypnotize with your recorder, phonograph. Astonishing details, sensational catalog free! Sleep-Learning Association, Box 24-ZD, Olympia, Washington.

**FCC License** in 6 Weeks. First Class Radio telephone. Results Guaranteed. Elkins Radio School, 2603B Inwood, Dallas, Texas.

**HIGHLY** Effective home study review for FCC commercial phone exams. Free literature! Wallace Cook, Box 10634, Jackson 9, Miss.

**DRAFTING,** Blueprint reading, schematics. Send \$2.00 first lesson. Complete home course \$25.00. Prior Inc., 23-09 169 Street, Whitestone 57, New York.

**COMPUTERS,** Electricity, appliance repairs—home study courses. Worldwide Institute, Dept. 1004, 2555 Shelley, Indiana, Pennsylvania.

**PHOTOGRAPHY** For Pleasure or profit. Learn at home. Practical basic training. Long established school. Free booklet. American School of Photography, 835 Diversey Parkway, Dept. 2532, Chicago 14, Illinois.

**MATHEMATICS.** Electronics. Pay as you learn. Free brochure. Indiana Home Study, 64 Hemenway Road, Saxonville, Massachusetts.

## INVENTIONS WANTED

**INVENTIONS** wanted. Patented; unpatented. Global Marketing Service, 2420-P 77th, Oakland 5, Calif.

**INVENTORS.** We will develop, help sell your idea or invention, patented or unpatented. Our national manufacturer clients are urgently seeking new items for outright cash sale or royalties. Financial assistance available. 10 years proven performance. For free information, write Dept. 41, Wall Street Invention Brokerage, 79 Wall Street, New York 5, N.Y.

## GOVERNMENT SURPLUS

**FREE** War Surplus Catalog when you order our Directory! Jeeps \$188, Airplanes \$159, Boats \$7.88, Generators \$2.68; typical government sale prices when buying 10,001 surplus items wholesale direct. Full details, 587 locations, procedure \$1.00. Surplus, Box 177 C1 York, Penna.

**FREE** "How To Buy Government Surplus Information," with 20 pounds of New Surplus Electronic Equipment. Tubes, Transistors, Transformers, Motors, Relays and countless other valuable components. \$1,000.00 Government Value for \$4.95. Send \$1.00, Shipped C.O.D. Evergreen Electronic, Box 2233, Everett, Washington.

**JEEPS** \$64.50, boats \$6.18, typewriters \$4.15, airplanes, electronics equipment, thousands more in your area, typically at up to 98% savings. Complete directory plus sample Surplus Marketletter \$1.00. Surplus Service, Box 820-J, Holland, Michigan.

## BOOKS

**AUTHORS!** Learn how to have your book published, promoted, distributed. **FREE** booklet "ZD," Vantage, 120 West 31 St., New York 1.

**WANTED:** Short stories, books, articles, plays of all descriptions for sale to publishers, producers. Free Literature! Literary Agent Mead, Dept. 39A, 915 Broadway, N.Y.C. 10.

**BOOK** 200 Electric Stunts \$1.00. Cutziff, 875 Arastradero, Palo Alto, Calif. 94306.

**HORROR** Books—free literature. The World Famous Trans-International Publishing Co., Box 2942, Paterson, N.J.

**MENTAL** Radio—operate yourself as a transceiver. Electrocosmic. Clayton R2-3, Ga., 30525.

## MUSIC

**POEMS** wanted for songs and records. Send poems. Crown Music, 49-RB West 32, New York 1.

## PHOTOGRAPHY-FILM, EQUIPMENT, SERVICES

**MEDICAL** Film—Adults Only—"Childbirth"—1 reel 8mm. \$7.50—16mm \$14.95. International, Greenvale, L. I., New York.

**SCIENCE** Bargains—Request Free Giant Catalog "CJ"—148 pages—Astronomical Telescopes, Microscopes, Lenses, Binoculars, Kits, Parts. War surplus bargains. Edmund Scientific Co., Barrington, New Jersey.

**PHOTOGRAPHERS** Earn Part Time, Write: PCI Dept. 470, Arlington 10, Virginia.

**CB** Stations on Photostamps \$1.50 Samples 10¢. Morgan, 443 Euclid, Akron, Ohio.

## EDUCATIONAL OPPORTUNITIES

**DETECTIVE** Profession. Home Study. Lapel pin, Certificate. Future. 2759AG W. Broadway, Los Angeles 41, Calif.

**LEARN** While Asleep. Remarkable, Scientific, 92% Effective. Details Free. ASR Foundation, Box 7021, Dept. e.g., Lexington, Kentucky.

## LEATHERCRAFT

**FREE** "Do-It-Yourself" Leathercraft Catalog. Tandy Leather Company, Box 791-L50, Fort Worth, Texas.

## BUSINESS OPPORTUNITIES

**INVESTIGATE Accidents**—Earn \$750 to \$1,000 monthly. Men urgently needed. Car furnished. Business expenses paid. No selling. No college education necessary. Pick own job location. Investigate full time. Or earn \$6.44 hour spare time. Write for Free Literature. No obligation. Universal, CZ-2. 6801 Hillcrest, Dallas 5, Texas.

**BUY Direct from factories.** Appliances, cameras, watches! Free details! Cam Co., 436 PE Bloomfield Ave., Verona, N. J.

**VENDING Machines**—No Selling. Operate a route of coin machines and earn amazing profits. 32-page catalog free. Parkway Machine Corporation, 715PE Ensor Street, Baltimore 2, Md.

**ELECTROPLATING** equipment and supplies. All types for home work shops. Free Catalog. HBS Equipment Division, 3445 Union Pacific, Los Angeles 23, Calif.

**I MADE \$40,000.00 Year by Mailorder!** Helped others make money! Start with \$10.00—Free Proof. Torrey, Box 3566-N, Oklahoma City 6, Oklahoma.

**BIG Money**—Operate own fix-it shop. Service household appliances, motors, mowers, saws, skates, etc. Free book. Christy Trades School, A1714, 3214 W. Lawrence, Chicago 25.

**EARN Extra money** selling advertising book matches. Free samples furnished. Matchcorp, Dept. MD-24, Chicago 32, Illinois.

**SELL Electron Tubes.** Liberal Commissions. Territories Available Throughout World. Write in Confidence to Box 112. Popular Electronics, One Park Ave., N. Y. 16, N. Y.

**PIANO Tuning** learned quickly at home. Tremendous field! Musical knowledge unnecessary. Information free. Empire School of Piano Tuning, Dept. PE, Box 327, Shenandoah Station, Miami, Florida 33145. (Founded 1935.)

**IF you have something to sell,** let the readers of Popular Electronics know about it through the classified advertising columns. It costs very little—only 60¢ a word, including your name and address. Your ad will be seen by more than 400,000 active buyers of electronic gear and components. Act now! Write your classified ad today, enclose payment and mail to: Martin Lincoln, Popular Electronics, One Park Avenue, New York 16, New York.

## EMPLOYMENT INFORMATION

**FOREIGN Employment.** Construction, other work projects. Good paying overseas jobs with extras, travel expenses. Write only: Foreign Service Bureau, Dept. D, Bradenton Beach, Florida.

**EMPLOYMENT Resumes.** Earn more by presenting yourself to prospective employers more effectively. Send only \$2.00 (cash or money order) for complete Resume Writing Instructions, including sample and instructions for letter of transmittal. J. Ross, 63-61 Yellowstone Blvd., Forest Hills 75, New York, Dept. 6J-PE.

**FLORIDA!** Rocketing central Florida aerospace expansion creating many employment and business opportunities. Directory describing area aerospace employers plus "Florida Facts in Brief" \$1.00. Data Service, Box 175-E, Roseville Park, N.J.

## STAMPS AND COINS

**ONLY 10¢.** North America Collection Plus 121 Foreign Flag Stamps. Valuable get-acquainted offer. Big collection of genuine, all-different postage stamps of Greenland (North Pole), St. Pierre, Newfoundland, Canada—Eskimos, Indians, 1862 British Columbia & Vancouver Is. Cent., Nova Scotia, etc. United Nations, U.S. Stamps—19th Century, First Plane, Steamboat, Pony Express, many others. Also, Colonial & Civil War Commems. Plus flag stamps of 121 foreign countries. Extra! Collector's catalog; exciting selection of stamps on approval; and "How to Recognize Rare Stamps." Send only 10¢. Kenmore, Milford EF-631, New Hamp.

**CURIOUS** coins and odd paper money from seven countries! Yours for only 10¢ \$100,000 Confederate "money" facsimile bonus for promptness. Other interesting offers on approval. Littleton Coin Co., Littleton M12, N.H.

**100 Foreign coins** for \$2.95. Pickford, Box 188PE, Tolleson, Arizona.

**TOPS!** Mystery lot of over 500 different world-wide only 35¢. Tremendous value! Approvals included. Offer to adults only. Littleton Stamp Co., Littleton Q12, New Hampshire.

**FREE**—Mint British Colonials from Maldives, Solomon Islands, Pahang, St. Christopher, Nevis, Sarawak, Cayman Islands, Gilbert Ellice. Free with approvals. Viking, Great Neck 50, N.Y.

**WOW!** 110 All Different Germany 10¢! Zeppelins, Semi-Postals, Airmails, High values, etc. Giant Catalog, bargain lists included with beautiful approvals. Jamestown Stamp, Dept. A24EG, Jamestown, N.Y.

## MISCELLANEOUS

**INVESTIGATORS,** free brochure, latest subminiature electronic listening devices. Ace Electronics, 11500—K NW 7th Ave., Miami 50, Fla.

**"HOME Brew Recipes"**—Beer, Ale, Liquors, Wines! Recipes, \$2.00 Postpaid. Supplies, Hydrometers list included! Research Enterprises, 29-D Samoset Road, Woburn, Massachusetts.

**HYPNOTIZE Unnoticed!** Patented new hand device makes you a Hypnotist first day or refund! Hypnotist's Handbook included! \$2.00. Hypnosis Foundation, Box 487, La Mesa 9, California.

**FAMILY Wine Formulas!** Elderberry, Concord, Dandelion, many others! Hydrometers, Supplies Headquarters! Manual \$2.00. Brugenheimer Company, Box 201-3, Lexington, Massachusetts.

**WILD Labels, bumper strips!** Strange, startling, unconventional! Crazy Labels, Box 15-H, Olympia, Washington.

**NEW Vortex theory** for atoms and elementary particles as a unique and satisfactory structural explanation for the entire Periodic Table. Nuclear theory scrutinized and rejected. 1963 edition. 25¢ postpaid. C. F. Krafft, 4809 Columbia Road, Annandale, Virginia, 22003.

**HYPNOTIZE quickly, effortlessly, or refund!** \$2.00. Request free catalog. Hypnomode, Box 244-D, Cedarburg, Wisconsin.

**\$130 Average Race Day Profit** with \$50. 25 years results in amazing copyright book. Hitchings, Box 5712-2, Carmel, Calif.

**CANADIAN Lands, seized and sold for taxes.** Our 47th annual series of lists, describe many choice properties, situated from coast to coast, acquired by us through Tax Sale. Priced as low as five dollars per acre, guaranteed perfect title, small monthly payments, no mortgage. Beautifully situated hunting and fishing camps, where there is real sport; summer cottage sites, heavily wooded acreages. Now is the time to invest in Canada's minerals, forests and farms. Write to-day for free twenty page booklet with full explanation. Tax Sale Service, Room 301-Z, 85 Bloor St., E. Toronto 5, Canada.

**HYPNOTIZE** secretly, cleverly, one glance . . . or money-back. \$2. Elton S, Box 115-PEA, Forville, Indiana.

**HYPNOTIZE** over telephone. Simple . . . one word technique \$2. Results or refund. Elton's, Box 115-PEB, Forville, Indiana.

**250 cards.** Business, personal. \$2.29 ppd. Samples. Garner's, 6486 Gale, Long Beach, Calif. 90805.

**LABELS**—plastic with adhesive, three-cents per letter, free sample, Ejay Electronics, Grass Valley, Calif.

**INDEPENDENT Thinkers**—investigate Humanism, the scientific personal philosophy! Free literature. American Humanist Association, Dept. PE2, Yellow Springs, Ohio.

**STAMMER**—Stutter—No More (Dr. Young.) Write: Gaucho, Box 9309-E8, Chicago 90.

**"FLYING Saucers Contact Me By Short Wave Radio!"** Now in "UFO International!"—\$1.00. Amalgamated Flying Saucer Clubs, Dept. B, 2004 Hoover, Los Angeles, Calif. 90027.

**WHATEVER** your wants look to these columns for results. For complete details concerning classified ads write Martin Lincoln, Popular Electronics, 1 Park Avenue, New York 16, New York.

# RAD-TEL'S

## QUALITY

# BRAND NEW TUBE SALE!

LOW, LOW PRICES--COMPARE

UP TO  
**SAVE 75% OFF\***



\*Manufacturers Suggested List Price

## ONE YEAR GUARANTEE

RAD-TEL WILL REPLACE ANY TUBE THAT DOES NOT GIVE EFFICIENT PERFORMANCE FOR 1 YEAR FROM DATE OF PURCHASE.

## ONE DAY SERVICE

OVER 500 TYPES IN STOCK  
ORDER TYPES NOT LISTED

**FREE!** Send For New Tube & Parts Catalog  
**FREE!** Send For Trouble Shooting Guide



### TUBE SUBSTITUTION BOOK

**\$1.25**  
No. 193

- Over 11,000 direct tube substitutes
- Only all-inclusive directory of electron tube equivalents:
  - For USA electron tubes
  - Substitutes for foreign tubes
  - Picture tubes, newer models
  - Picture tubes, older models
  - transistor replacements
  - Army-Navy, V.I. substitutes



### CHEATER CORD

Easy to work on set while panel is off.

6 ft., No. 154 29¢ ea. Lots of 3—25¢ ea.



## RAD-TEL TUBE CO.

TV, RADIO AND HI-FI

DEPT. PE 55 CHAMBERS STREET, NEWARK, NEW JERSEY 07105

TERMS: 25% deposit must accompany all orders, balance C.O.D. Orders under \$5. add \$1 handling charge plus postage. Orders over \$5. plus postage. Approx. 8 tubes per 1 lb. Subject to prior sale. No C.O.D.'s outside continental U.S.A.

Fast, Dependable service — Selling direct by mail for over 16 years

RAD-TEL Tube Co. Total Tubes \$ \_\_\_\_\_  
Dept. PE Total Part(s) \$ \_\_\_\_\_  
55 Chambers Street Postage \$ \_\_\_\_\_  
Newark, New Jersey 07105 Grand Total \$ \_\_\_\_\_

ENCLOSED IS \$ \_\_\_\_\_ Please rush order.

SEND: \_\_\_\_\_ TUBE SUBSTITUTION BOOK, No. 193 @ 1.25 EACH

\_\_\_\_\_ Cheater Cord 29c ea. Lots of 3 - 25c ea. #154

Orders under \$5.00 - Add \$1.00 handling charge - plus postage.

**FREE!**  Send FREE Tube and Parts Catalog  
 Send FREE Trouble Shooting Guide

NAME \_\_\_\_\_

ADDRESS \_\_\_\_\_

CITY \_\_\_\_\_ ZONE \_\_\_\_\_ STATE \_\_\_\_\_

### EACH TUBE ATTRACTIVELY BOXED & BRANDED RAD-TEL

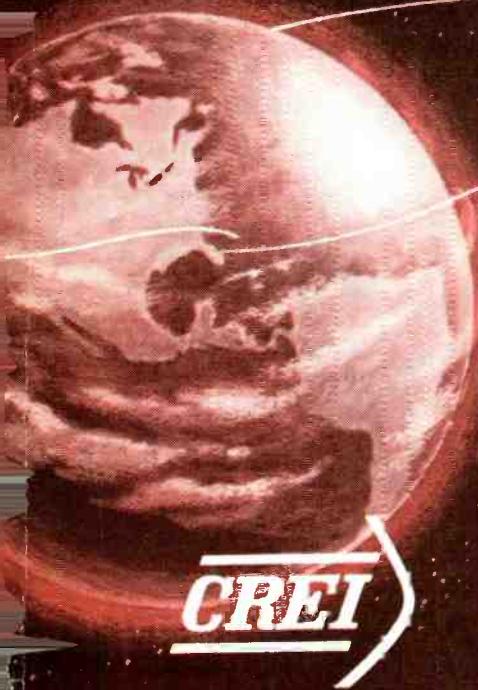
Qty.	Type	Price	Qty.	Type	Price	Qty.	Type	Price	Qty.	Type	Price
—	024	.79	—	6AU8	.87	—	6K6	.63	—	12CU5	.58
—	1AX2	.62	—	6AV6	.41	—	6S4	.52	—	12CUG6	1.06
—	1B3	.79	—	6AW8	.90	—	6SA7GT	.99	—	12CK6	.54
—	1DN5	.55	—	6AX4	.66	—	6SH7	1.02	—	12D4	.69
—	1G3	.79	—	6AX5	.74	—	6SJT	.88	—	12DE8	.83
—	1J3	.79	—	6BA6	.50	—	6SK7GT	.95	—	12DL8	.88
—	1K3	.79	—	6BC5	.61	—	6SL7GT	.84	—	12DQ6	1.04
—	1R5	.77	—	6BC8	1.04	—	6SN7	.65	—	12D57	.84
—	1S5	.75	—	6BE6	.55	—	6SQ7GT	.94	—	12D75	.76
—	1T4	.72	—	6BF5	.90	—	6T4	.99	—	12D77	.79
—	1U5	.65	—	6BF6	.44	—	6T8	.85	—	12D78	.78
—	1X2B	.82	—	6BG6	1.70	—	6U8	.83	—	12DW8	.89
—	2AF4	.96	—	6BH8	.98	—	6V6GT	.54	—	12DZ6	.62
—	3AL5	.46	—	6BJ6	.65	—	6W4	.61	—	12ED5	.62
—	3AU6	.54	—	6BJ7	.79	—	6W6	.71	—	12EG6	.62
—	3AV6	.42	—	6BK7	.85	—	6X4	.41	—	12EK6	.62
—	3BC5	.63	—	6BL7	1.09	—	6X8	.80	—	12EL6	.50
—	3BN6	.75	—	6BN6	.74	—	7A8	.68	—	12EZ6	.57
—	3BU8	.78	—	6BQ6	1.12	—	7AU7	.65	—	12F8	.66
—	3BY6	.58	—	6BQ7	1.00	—	7EY6	.75	—	12FA6	.79
—	3BZ6	.56	—	6BU8	.70	—	7Y4	.69	—	12FM6	.50
—	3CB6	.56	—	6BX7	1.11	—	8AU8	.90	—	12FR8	.97
—	3CS6	.58	—	6BZ6	.55	—	8AW8	.93	—	12FX8	.90
—	3DG4	.85	—	6BZ7	1.03	—	8BQ5	.60	—	12GG6	1.06
—	3DK6	.60	—	6C4	.45	—	8CG7	.63	—	12J8	.84
—	3DT6	.54	—	6CB6	.55	—	8CM7	.70	—	12K5	.75
—	3GK5	.99	—	6CD6	1.51	—	8CN7	.97	—	12L6	.73
—	3Q4	.63	—	6CG7	.61	—	8CS7	.74	—	12SF7	.69
—	3S4	.75	—	6CG8	.80	—	8EB8	.94	—	12SK7GT	.95
—	3V4	.63	—	6CL8	.79	—	8FQ7	.56	—	12SL7	.80
—	4BQ7	1.01	—	6CM7	.69	—	9CL8	.79	—	12SN7	.67
—	4CS6	.61	—	6CN7	.70	—	11CY7	.75	—	12SQ7GT	.91
—	4DT6	.55	—	6CQ6	.92	—	12A4	.60	—	12U7	.62
—	4GM6	.60	—	6CR6	.60	—	12AB5	.60	—	12V6	.63
—	5AM8	.79	—	6CS6	.57	—	12AC6	.55	—	12W6	.71
—	5AN8	.90	—	6CS7	.69	—	12AD6	.57	—	12X4	.47

### RAD-TEL TUBE CO. NOT AFFILIATED WITH ANY OTHER MAIL ORDER TUBE COMPANY

—	5AQ5	.54	—	6CU5	.58	—	12AE6	.50	—	17AX4	.67
—	5AT8	.83	—	6CU6	1.08	—	12AE7	.94	—	17DQ6	1.06
—	5BK7	.86	—	6CY5	.70	—	12AF3	.73	—	18FW6	.49
—	5BQ7	1.01	—	6CY7	.71	—	12AF6	.67	—	18FX6	.53
—	5BR8	.83	—	6DA4	.68	—	12AJ6	.62	—	18FY6	.50
—	5CG8	.81	—	6DE6	.61	—	12AL5	.47	—	19AU4	.87
—	5CL8	.76	—	6DG6	.62	—	12AL8	.95	—	19BG6	1.39
—	5CQ8	.84	—	6DJ8	1.21	—	12AQ5	.60	—	19EA8	.79
—	5EA8	.80	—	6DK6	.59	—	12AT6	.50	—	19T8	.85
—	5EU8	.80	—	6DN6	1.55	—	12AT7	.76	—	21EX6	1.49
—	5J6	.72	—	6DQ6	1.10	—	12AU6	.51	—	25AX4	.70
—	5T8	.86	—	6DT5	.81	—	12AU7	.61	—	25C5	.53
—	5U4	.60	—	6DT6	.53	—	12AV6	.41	—	25CA5	.59
—	5U8	.84	—	6DT8	.94	—	12AV7	.82	—	25CD6	1.52
—	5V6	.56	—	6EA8	.79	—	12AX4	.67	—	25CU6	1.11
—	5X8	.82	—	6EB5	.73	—	12AX7	.63	—	25DN6	1.42
—	5Y3	.46	—	6EB8	.94	—	12AY7	1.44	—	25EH5	.55
—	6AB4	.46	—	6EM5	.77	—	12AZ7	.86	—	25L6	.57
—	6AC7	.96	—	6EM7	.82	—	12B4	.68	—	25W4	.68
—	6AF4	1.01	—	6EU8	.79	—	12B06	.50	—	32ET5	.55
—	6AG5	.70	—	6EV5	.75	—	12BE6	.53	—	35C5	.51
—	6AH4	.81	—	6EW6	.57	—	12BF6	.60	—	35L6	.60
—	6AH6	1.10	—	6EY6	.75	—	12BH7	.77	—	35W4	.42
—	6AK5	.95	—	6FG7	.69	—	12BK5	1.00	—	35Z5	.60
—	6AL5	.17	—	6FV8	.79	—	12BL6	.56	—	36AM3	.36
—	6AM8	.78	—	6GH8	.80	—	12BQ6	1.16	—	50B5	.69
—	6AQ5	.53	—	6GK5	.61	—	12BR7	.74	—	50C5	.53
—	6AS5	.60	—	6GK6	.79	—	12BV7	.76	—	50EH5	.55
—	6AT6	.49	—	6GN8	.94	—	12BY7	.77	—	50L6	.61
—	6AT8	.86	—	6H6	.58	—	12BZ7	.86	—	70L7	.97
—	6AU4	.85	—	6J5GT	.51	—	12CN5	.56	—	11Z73	.85
—	6AU6	.52	—	6J6	.71	—	12CR6	.67	—	807	.75

PRINTED IN U.S.A.

Protect your future  
through the New  
CREI Program in  
Space Electronics



What happens to transistors in the Van Allen Belt? How are vacuum tubes used in space? Why can't regular lubricants be used on moving parts in a spacecraft? To what extent has the space effort changed reliability standards?

These and other questions reflect the changes taking place with space applications of electronics. Project Apollo and other missions in the space effort are rapidly outdated conventional concepts.

Has the  
Space Age  
outdated  
your knowledge  
of Electronics?

Postage will be paid by

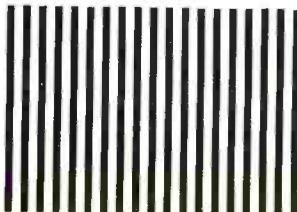


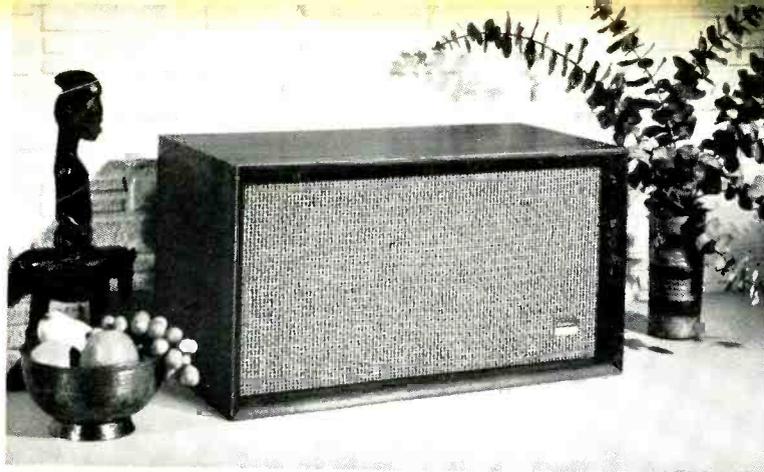
The Capitol Radio Engineering Institute  
3224 Sixteenth Street, N.W.  
Washington, D. C. 20010

**BUSINESS REPLY MAIL**  
NO POSTAGE STAMP NECESSARY IF MAILED IN THE UNITED STATES

**VIA AIR MAIL**

First Class  
Permit No. 288-R  
Washington, D. C.





## The Most Sweeping Change in Speaker System Design... Starts with the New E-V FOUR!

Until now, there have been just two ways to determine the absolute quality of a speaker system: the scientific method, and the artistic approach. But each, by itself, has not proved good enough.

The scientist, with the help of impersonal equipment, charts and graphs, has strived to obtain the finest possible measured results. If the figures were right, then it *had* to sound right, and anyone disagreeing was dismissed as "not objective". But often, two speakers measured substantially the same, yet sounded quite different.

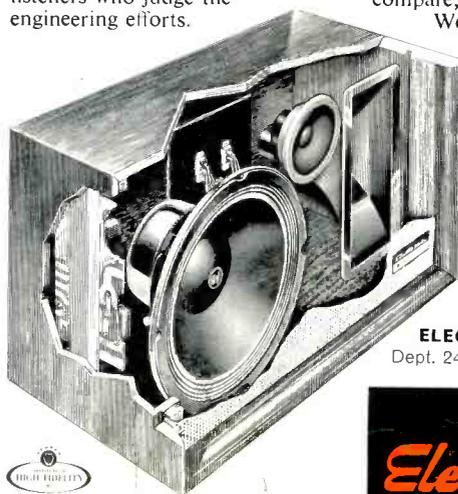
On the other hand, the artistic school of loudspeaker design has depended on the judgement of a handful of experts whose "golden ears" were the final yardstick of perfection. If you didn't agree with the experts, your ear was "uneducated" and not discriminating. But too often the measured response of the expert's system fell woefully short of reasonable performance—proof that even trained listeners can delude themselves when listening to loudspeakers.

Now, with the introduction of the E-V FOUR, Electro-Voice has pioneered a blend of the best features of both measurement methods to lift compact speaker performance to a new level of quality. It wasn't easy. The use of both techniques required extensive facilities, something E-V enjoys in abundance.

For instance, E-V has one of the industry's largest, most completely-equipped laboratories for the study

of acoustical performance. Actually, the E-V engineering staff alone is larger than the entire personnel complement of many other speaker firms. In the E-V lab, measurement of speaker performance can be made with uncommon precision. And the interpretation of this data is in the hands of skilled engineers whose full time is devoted to electro-acoustics.

But beyond the development of advanced scientific concepts, E-V embraces the idea that a thorough study of the subjective response to reproduced sound is essential. E-V speakers must fully meet both engineering and artistic criteria for sound quality. Where we differ from earlier efforts is in greatly increasing the sample of expert listeners who judge the engineering efforts.



*E-V FOUR components include: 12" acoustic suspension woofer | Ring-diaphragm mid-range driver | 3" dynamic cone tweeter | Etched circuit crossover*

**ELECTRO-VOICE, INC.**  
Dept. 244P, Buchanan, Michigan



CIRCLE NO. 8 ON READER SERVICE PAGE

www.americanradiohistory.com