

GET THE BEST POSSIBLE TV PICTURE

POPULAR ELECTRONICS

JUNE
1970

50
CENTS



**ATTACK DELAY FOR NEW GUITAR SOUND ● AUDIO
SIGNAL INJECTOR ● YOUR OWN AIR PURIFIER
● HOW TO GET FM MUSIC WITHOUT COMMERCIALS
BUILD A MOTOR CONTROL DEMONSTRATOR ●**
**IN THE PRODUCT GALLERY: Heathkit GR-78 Receiver
and the Regency TMR-4 Monitoradio ●**



Our color camera captures the artistry of a printed circuit board from the Heathkit GR-78 Receiver

Discover the ease and excitement of learning Electronics with programmed equipment NRI sends you

When you train at home with NRI, you train with your hands as well as your head. You learn the WHY of Electronics, Communications, TV-Radio the NRI pioneering "3-Dimensional" way. NRI training is the result of more than half a century of simplifying, organizing, dramatizing subject matter, and providing personal services unique for a home study school. You get the kind of technical training that gives you priceless confidence as you gain experience equal to many, many months of training on the job.

NRI—The 53 Year Leader in Electronics Training



APPROVED UNDER NEW GI BILL

If you served since January 31, 1955, or are in service, check GI line in postage-free card.



*Earn \$5 or more an hour
spare or full time in*

TV-RADIO SERVICING

Color Television has arrived. Sales are soaring, along with the continuing popularity of other home entertainment equipment like portable radios, tape recorders, hi-fi sets, phonographs and auto radios. TV-Radio servicing is one of your best routes to spare-time earnings, a good paying job or a business of your own. NRI not only trains you quickly and expertly, but also shows you how to get started in Servicing soon after you enroll, earning as you learn. NRI trains you in today's methods of installing and repairing all Electronic equipment for the home—including booming Color TV. You even build, experiment with and keep to enjoy your own solid-state radio and your choice of black-and-white or Color TV receiver. Like thousands of others, you can be earning \$5 or more an hour extra in spare time starting soon.

*There's money and
success awaiting you in*

BROADCASTING— COMMUNICATIONS

The experience you gain from intensely practical NRI training in Complete Communications equals as much as two years of training on the job. With NRI, you can train for a choice of careers ranging from mobile, marine and aviation radio to TV broadcasting and space communications. You learn how to install, maintain and operate today's remarkable transmitting and receiving equipment by actually *doing* it. You build and experiment with test equipment, like a VTVM you keep. You build and operate amplifier circuits, transmission line and antenna systems, even build and use a phone-cw transmitter suitable for transmission on the 80-meter amateur band. Whichever of five NRI Communications courses you choose, you prepare for your FCC License exams, and *you must pass your FCC exams or NRI refunds your tuition in full.*

*Move ahead in America's
fast growing industry as*

ELECTRONICS TECHNICIAN

Electronics touches everyone's lives. This vast field of opportunity is open to you with NRI training. Industrial/Military Electronics training—like all NRI courses—prepares you quickly, thoroughly the practical "hands on" way. You build with, and learn to understand the functions of, today's miracle solid-state components like printed circuits, diodes and transistors. You build and experiment with Electronic circuitry used in automation, data processing, ultrasonics, telemetry. Whatever your interest in Electronics, NRI training can fill your needs. Prove to yourself what nearly a million NRI students could tell you . . . that you get more for your money from NRI. Check the postage-free card and mail it today for your FREE NRI Color Catalog. No salesman will call. NATIONAL RADIO INSTITUTE, Electronics Division, Washington, D.C. 20016.

YOU GET MORE FOR YOUR MONEY FROM NRI — Build, test,

explore, discover. Everything you see here is included in one NRI course—including Color TV. Other courses equally complete. And you'll be surprised at the low tuition costs. Text for text, kit for kit, dollar for dollar—you get more for your money from NRI.



POPULAR ELECTRONICS

VOLUME 32 NUMBER 6

JUNE 1970

WORLD'S
LARGEST-SELLING
ELECTRONICS
MAGAZINE

FEATURE ARTICLES

- | | | |
|---|-----------|--------------------------|
| NO SNOW IN JUNE
<i>Match your TV antenna to receiver</i> | 27 | George Manser |
| VECTOR-CIRCUIT MATCHING QUIZ | 30 | Robert P. Balin |
| BUILD A TRANSCIPITOR
<i>Clean air for many applications</i> | 31 | Waldo T. Boyd |
| BUILD A SIGNAL INJECTOR
<i>Must for audio checks</i> | 43 | Don Lancaster |
| PHOTOCELL MOTOR CONTROL DEMONSTRATOR
<i>Great teaching and display project</i> | 46 | Bob Koval |
| SIMPLE SCA ADAPTER
<i>FM music without commercials</i> | 49 | William F. Splichal, Jr. |
| MODIFY YOUR ELECTRONIC GUITAR SOUND
<i>Add attack delay</i> | 53 | John S. Simonton, Jr. |
| BUCK UP BASS RESPONSE
WITH A SUPER WOOFER | 62 | Eric Pavlak |
| KOOL-KEEPING KWIZ
<i>Check your coping quotient</i> | 63 | Carl Kohler |
| THE PRODUCT GALLERY
<i>Heathkit GR-78 Receiver
Regency TMR-4 Monitorradio</i> | 65 | |
| OPPORTUNITY MIRROR
<i>Thoughtful reflections on your future</i> | 69 | David L. Heiserman |
| SHORT-WAVE LISTENING | 76 | Hank Bennett, W2PNA |
| SOLID STATE | 79 | Lou Garner |
| AMATEUR RADIO | 81 | Herb S. Brier, W9EGQ |
| ENGLISH LANGUAGE NEWS BROADCASTS TO N.A. | 83 | Roger Legge |

DEPARTMENTS

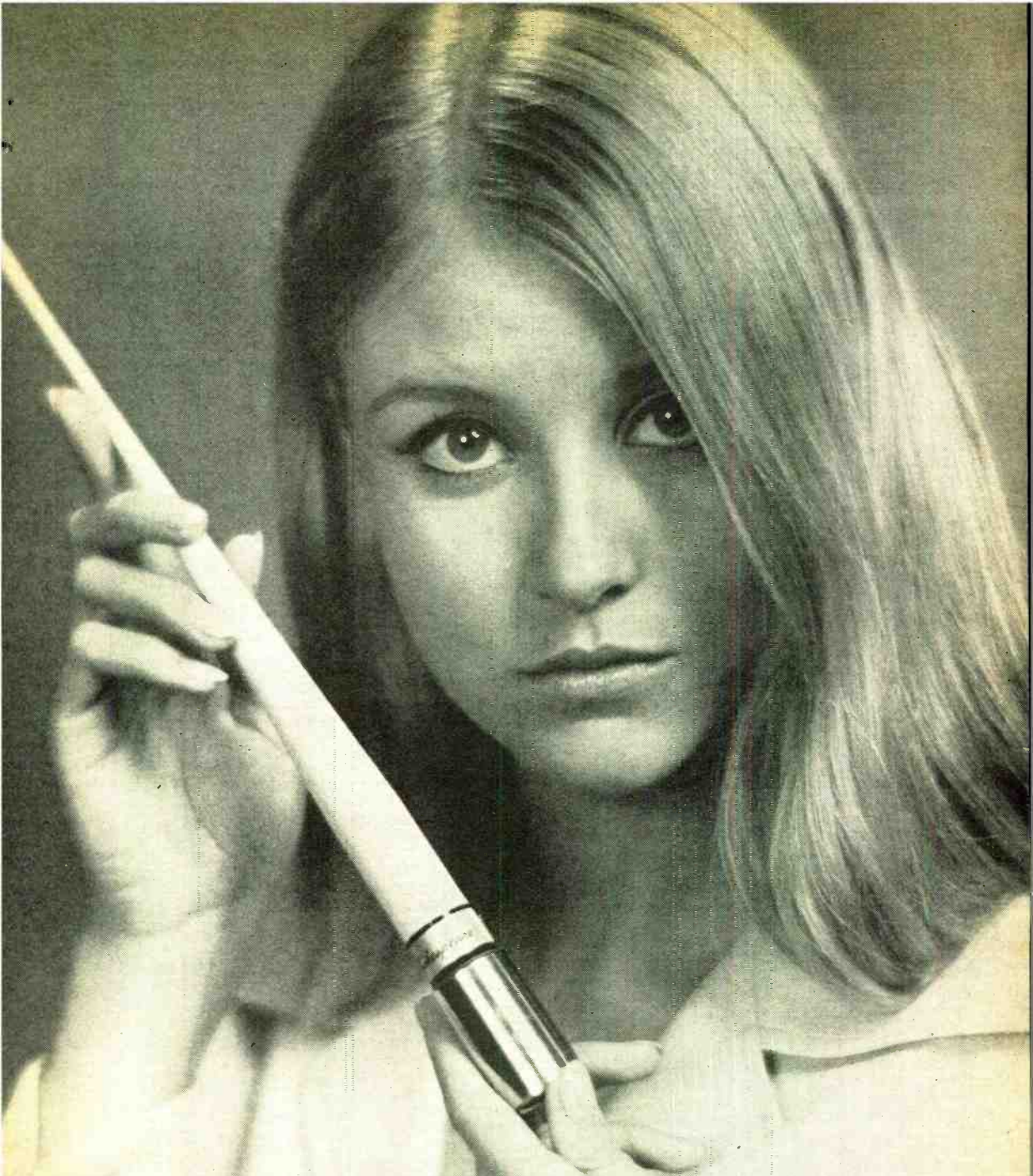
- | | |
|--|---------------|
| LETTERS FROM OUR READERS | 8 |
| OUT OF TUNE | 10 |
| ELECTRONICS LIBRARY | 12 |
| READER SERVICE PAGES | 15, 95 |
| NEW PRODUCTS | 22 |
| OPERATION ASSIST | 94 |
| NEW LITERATURE | 97 |
| INDEX TO VOLUME 32 (JAN.-JUNE 1970) | 98 |

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

Copyright © 1970 by ZIFF-DAVIS PUBLISHING COMPANY. All rights reserved.

POPULAR ELECTRONICS, June 1970, Volume 32, Number 6, Published monthly at One Park Ave., New York, N.Y. 10016. One year subscription rate for U.S., U.S. Possessions and Canada, \$6.00; all other countries, \$7.00. Second class postage paid at New York, N.Y. and at additional mailing offices. Authorized as second class mail by the Post Office Department, Ottawa, Canada and for payment of postage in cash. Subscription service and Forms 3579: P.O. Box 1096, Flushing, N.Y. 11352. Editorial offices for manuscript contributions, reader inquiries, etc.: One Park Ave., New York, N.Y. 10016.

This month's cover photo by
Oliver P. Ferrell



Shakespeare



MAKES THE BEST ANTENNAS

*This "PERFECT 36" is one
of a great, complete line.*

C/P Corporation Division, The Shakespeare Co., P.O. Box 5207, Columbia, S.C. 29205

New SAMS Books

Transistor Substitution Handbook, 10th Edition
Updated to include thousands of substitutions for all types of bipolar transistors: U.S. and foreign, home-entertainment and industrial. Computer-compiled for accuracy. Also includes manufacturers' recommendation for general-replacement transistors. Order 20773, only..... \$1.95

Color TV Training Manual, 3rd Edition
Best guide for technicians preparing to service color TV. Includes detailed explanation of color principles, circuits, setup procedures, alignment, and troubleshooting; full-color illustrations. Order 20736, only..... \$6.95

ABC's of Air Conditioning
Explains in simple language the laws of physics which relate to air conditioning and how these laws are applied practically in the design and manufacture of all types of air conditioning units and systems. Order 20725, only..... \$2.95



1-2-3-4 Servicing Transistor Color TV

The ingenious "1-2-3-4" servicing method is applied here to the repair of transistor color TV sets. Covers the fundamentals of transistor color circuitry; explains how to apply the method for quick, easy troubleshooting and repair. Order 20777, only..... \$4.95

Tape Recorder Servicing Guide

Explains in detail the principles of magnetic recorder circuitry. Describes components and systems and provides comprehensive instructions for preventative maintenance, adjustments, and repair. Order 20748, only..... \$3.95

1-2-3-4 Servicing Automobile Stereo

This book first explains the electronic and mechanical principles of automobile stereo, fm multiplex, and tape cartridge systems; then shows how to apply the "1-2-3-4" method for quick troubleshooting and repair. Order 20737, only... \$3.95

HOWARD W. SAMS & CO., INC.

Order from any Electronic Parts Distributor, or mail to Howard W. Sams & Co., Inc. Dept. PE-6 4300 W. 62nd St., Indianapolis, Ind. 46268

Send the following books: Nos. _____ \$ _____ enclosed

Name _____

Address _____

City _____ State _____ Zip _____

CIRCLE NO. 28 ON READER SERVICE PAGE

POPULAR ELECTRONICS

LAWRENCE SPORN
Publisher

OLIVER P. FERRELL
Editor

LESLIE SOLOMON
Technical Editor

JOHN R. RIGGS
Managing Editor

EDWARD I. BUXBAUM
Art Director

ALEXANDER W. BURAWA
Associate Editor

ANDRE DUZANT
Technical Illustrator

PATTI MORGAN
Assistant Editor

JUDITH L. HOGAN
Editorial Assistant

H. BENNETT, W2PNA
H. S. BRIER, W9EQ
L. E. GARNER, JR.
DAVID L. HEISERMAN
Contributing Editors

RICHARD J. HALPERN
Advertising Manager

ROBERT UR
Marketing Manager

MARGARET DANIELLO
Advertising Service Manager

FURMAN H. HEBB
Group Vice President

Electronics and Photographic

ZIFF-DAVIS PUBLISHING COMPANY
Editorial and Executive Offices
One Park Avenue, New York, New York 10016
212 679-7200

Midwestern Office
The Patis Group, 4761 West Tawny Ave.,
Lincolnwood, Illinois 60466, 312 679-1100
GERALD E. WOLFE, DICK POWELL

Western Office
9025 Wilshire Boulevard, Beverly Hills, California 90211
213 CResview 4-0265; BRadshow 2-1161
Western Advertising Manager, BUD DEAN

Japan: James Yagi
Ishikawa Mansion #4, Sakuragaoka
Shibuya-ku, Tokyo, 462-2911-3

Circulation Office
P.O. Box 1096, Flushing, N.Y. 11352

William Ziff, President
W. Bradford Briggs, Executive Vice President
Hershel B. Sarbin, Senior Vice President
Stanley R. Greenfield, Senior Vice President
Philip Sine, Financial Vice President
Walter S. Mills, Jr., Vice President, Circulation
Phillip T. Heffernan, Vice President, Marketing
Frank Pomerantz, Vice President, Creative Services
Arthur W. Butzow, Vice President, Production
Edward D. Muhlfeld, Vice President, Aviation Division
Irwin Robinson, Vice President, Travel Division
George Morrissey, Vice President
Sydney H. Rogers, Vice President

Ziff-Davis also publishes Airline Management and Marketing, Including American Aviation, Boating, Business & Commercial Aviation, Car and Driver, Cycle, Electronics World, Flying, Modern Bride, Popular Photography, Skiing, Skiing Area News, Skiing Trade News, Stereo Review, and Travel Weekly.

Forms 3579 and all subscriptions correspondence should be addressed to POPULAR ELECTRONICS, Circulation Department, P.O. Box 1096, Flushing, N.Y. 11352. 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.



Member Audit Bureau
of Circulations

Midland goes mobile in SSB/AM

To offer a complete, compatible 3-way system

Now! Base, mobile, hand-held... a complete system of SSB/AM transceivers. A new 23-channel mobile unit packs all the power and performance of the famous 13-880 base station. Add the 3-channel hand-held unit for a complete, fully compatible system with an unlimited range of applications. All use separate transmitters for AM and SSB (upper and lower) which assures superior performance on both. Dual-conversion receivers all have crystal lattice filter, full squelch, noise blanker and AGC. It adds up to three of your best buys in SSB!



New 23-Channel 5-Watt AM, 10-Watt SSB Mobile Transceiver
 Mobile companion to the 13-880. Fully equipped to operate independently on upper and lower side band, all AM channels. Compatible with all other CB units. F.E.T. front end, RF/"S" meter, clarifier control, PA switch. Model 13-873 \$359.95



3-Channel AM/SSB
 Operates independently on upper, lower SSB and 3 AM channels. Combination SSB clarifier, AM delta tuning. Squelch, built-in battery meter, center-loaded telescoping antenna, earphone, batteries, strap. Model 13-778 \$219.95



23-Channel AM/SSB Base-Mobile
 All deluxe features plus these extras: AC-DC operation, built-in SWR system, on/off/transmit lights, built-in digital clock. Mike, headphone, PA jacks. With all accessories. Model 13-880 \$369.95

For free color brochure, write: Dept. 1406
 P.O. Box 1903, Kansas City, Mo. 64141

MIDLAND
 INTERNATIONAL®

Prices shown are suggested retail.

CIRCLE NO. 20 ON READER SERVICE PAGE

have you any idea
how many ways you can
use this handle?



as a screwdriver...



for slotted, Allen hex, Phillips, Frearson, Bristol, Clutch Head, Scrulox® screws

as a nutdriver...for hex nuts, screws, and bolts



as an awl/scraper and reamer



It accommodates 49 interchangeable blades of various types and sizes.

Its patented spring device permits quick blade insertion and removal.

It's shockproof, breakproof (UL) plastic. Comes in three sizes — regular, junior, stubby — also Tee type.

It's available in a great variety of sets from 39-piece roll kits to compact, pocket cases.

For information on time-saving, space-saving Xcelite "99" tool kits and sets, mail coupon below.



XCELITE®

XCELITE, INC., 20 Bank St., Orchard Park, N. Y. 14127
Send Catalog 166 with information on "99" sets and kits.

name _____

address _____

city _____ state & zip _____

In Canada contact Charles W. Pointon, Ltd.

CIRCLE NO. 33 ON READER SERVICE PAGE

letters

FROM OUR READERS

HIGH SCHOOL ELECTRONICS

There is an error in your monthly department, "Opportunity Mirror," (March, 1970) where it is intimated that electronics is not taught in high schools.

Here at the Greater Lawrence Regional Vocational Technical High School, Andover, Mass., a curriculum involving a vocational major is combined with academic courses. These meet regular high school requirements and give the student the benefit of a high school diploma and a vocational or technical certificate for his major subject.

Being a member of the graduating class this year I look forward to the vast number of opportunities available to me as a result of being a student in the electronics program of this school. I will also have the opportunity to continue employment under the terms of our high school's cooperative work programs. It is also possible to continue on in our high school through its post graduate and institute programs, or advance into another popular area of electronics, Computer Programming.

PHILIP MARCELLO
Methuen, Massachusetts

BINGO FOR THE BAMBOO BROADCASTER

Thank you for printing the article, "Bamboo Missionary Broadcaster" (February, 1970, p 61).

R. L. FULLER
San Mateo, Ca.

Congratulations on the foresight and character to print the excellent article on the "Bamboo Missionary Broadcaster." These people have been ignored and neglected too long. How about an article on TransWorld Radio?

R. G. THOMPSON
Milwaukee, Wis.

I enjoyed reading the wonderful story by John Kimberley on the Far East Broadcasting Company. Don't forget some of the other missionary broadcasters such as HCJB and 4VEH.

R. J. ENGEART
Princeton, Iowa

CB LICENSE PLATE

On behalf of the Twin Ports CB Radio Club (Duluth, Minn./Superior, Wisc.), we

POPULAR ELECTRONICS



Put these on in only 28 weeks.

Sergeant's stripes. Yours. In the U.S. Army. If you're a high school graduate it can happen. In the Army's new NCO Candidate Program.

After 16 weeks of basic and advanced individual training you start a 12 week academic course as a corporal. When you complete this phase successfully, you'll be promoted to sergeant.

The Army needs leaders in the ranks. Men who can make quick decisions. Accept responsibilities. Earn the respect that goes with them. And the extra cash.

Serve your hitch wearing sergeant's stripes. See your Army recruiter about the NCO Candidate Program. Send the coupon or write: Army Opportunities, Dept. 200A, Hampton, Va. 23369.

Your future, your decision...choose ARMY.

Army Opportunities
Dept. 200
Hampton Va. 23369

2 PE 6-70

How can I be wearing sergeant's stripes in 28 weeks?

Name _____ Date of birth _____

Address _____

City _____

County _____ State _____

Zip _____ Phone _____

Education _____

Sound us out

...and you will be listening to the most brilliant sound reproduction you can get from an automatic turntable.

The BSR McDonald 600.

Its precision British craftsmanship can be seen... and heard.

There's anti-skate control. And a tone arm that's so finely counterbalanced, this superb turntable can even play upside-down, and still track perfectly.

A pause control lever allows you to stop playing anywhere on the record and then repositions to the exact same groove.

Groovy.

And when the last record has played, the Decor-Matic power switch on the base shuts off both the turntable and the complete system automatically.

The BSR McDonald 600 must already be sounding pretty good to you. So when you're in the market for a hi-fi stereo system, be sure your dealer demonstrates it with a BSR McDonald turntable.

It'll speak for itself.

Write for detailed specifications on the 600 and all the BSR McDonald Automatic Turntables.



BSR (USA) LTD.; BLAUVELT. N.Y. 10913



CIRCLE NO. 6 ON READER SERVICE PAGE

feel that CB'ers may be able to obtain license plates in the state of Minnesota and have petitioned our legislative representative in this district. We appreciate that there may be an additional cost for this service, but we are confident that most CB'ers will be willing to pay this extra fee.

We would like to have other known and established CB clubs in the state of Minnesota support our efforts in this endeavor.

J. C. MAUSOLF

Twin Ports Citizen's Band Radio Club
2717 East 5th Street
Duluth, Minn. 55812

LOUD, BUT NOT TOO LOUD

To escalate a treble boost for guitar (letter from J. R. Guthrie, March, 1970, page 13) into the urban noise pollution problem is downright silly. Does this mean that POPULAR ELECTRONICS should stop printing speaker designs or hi-fi amplifiers with more than 1 or 2 watts output?

The treble boost can add a whole new world of harmonic content to low and middle register instruments. If Mr. Guthrie is concerned about noise pollution, he should participate in some of the ecological and environmental organizations now springing up to combat this serious problem. Writing to POPULAR ELECTRONICS about the fabled sins of an innocuous device does nothing to lift the cloud of noise and dirt that has settled over us.

CRAIG ANDERTON
Philadelphia, Pa.

TAPE RECORDING, MORE LITERATURE

Your reader, R. Stoddard (April 1970, p 8), should find Skip Athey's book, *Magnetic Tape Recording*, published by NASA in 1966 a valuable addition to his library. I believe it is still available from the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402. It was selling for \$1.25. This is a general book, not one devoted to hobbyists, or even sound recording, but a study of it would benefit any tape recorder user.

W. L. SMITH, W3GKP
Spencerville, Md.

OUT OF TUNE

Various gremlins got into the works in our April issue. In the "Micro'Lign Generator" article on page 49, the leads on the transistor case outline for Q1-Q3, should be E, C, and B, left to right. On page 40, "Digital Logic Microlab," the figure number should be 8. Parts I, J, and K were omitted due to lack of space. On page 57, "100-kHz Standard," the prices in the parts should be \$2.15 for the board, \$9.85 for the kit.

POPULAR ELECTRONICS



The New COBRA 24... Wild, but never Primitive!

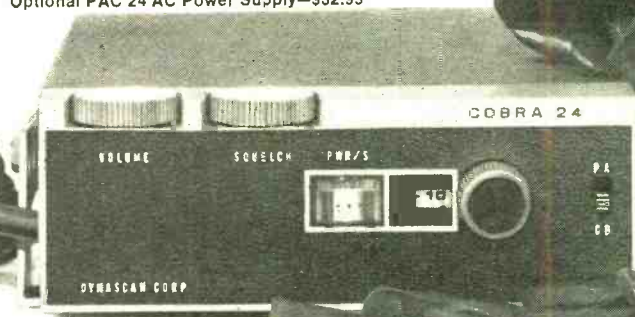
Watch for It! The New 23-
Channel Radio that brings
order to the CB Jungle!

The COBRA 24 lurks no longer. It has struck with deadly effectiveness to prey on the weaknesses of others. With more power, more intelligence, more beauty than any other radio in its class.

- 5-watts input, maximum talk power with DYNABOOST speech compression, a Dynascan exclusive
- Selective, dual-conversion, superhet receiver with ceramic filter to give outstanding selectivity and gain
- Message gets through crisp and clear when others are garbled and unclear
- 23 crystal-controlled channels—no extra crystals needed
- Positive/negative ground operation without internal wiring changes needed—with reverse polarity protection
- All solid-state plus FET and integrated circuitry
- PA/CB switch with adjustable volume
- Illuminated channel selector and "S" meter for night transmission
- Includes push-to-talk microphone
- Meets FCC requirements—operates on 12 volts DC

There are other reasons for COBRA superiority. Get all the facts from DYNASCAN. Better yet, visit the COBRA dealer near you. He will show you through the CB jungle!

Cobra 24 Net \$169.95
Optional PAC 24 AC Power Supply—\$32.95



Product of DYNASCAN CORPORATION
1801 W. Belle Plaine, Chicago, Illinois 60613

CIRCLE NO. 11 ON READER SERVICE PAGE

LISTEN IN

on Police and Fire Conversations
and Weather Reports



Combination Hi/Lo Band FM-VHF Monitor*



6 high band frequencies (150 MHz to 175 MHz) and 6 low band frequencies (25-50 MHz), crystal controlled, all in one unit let you tune-in wherever the action is. This handsome receiver features an RF peaking control for exceptional sensitivity and a tone control switch for "highs" and "lows". Suitable for 12 volt D.C. mobile or base station use. Solid state design, integrated circuits.

Model COP-50HL. Only \$139.95

High or Low Band VHF Monitors With Built-In AM Radio!

3 crystal controlled channels plus regular AM broadcast band give you all the VHF or Low Band Police and Fire, news and weather reports you want plus music and entertainment. Solid state with squelch control, high performance. Pocket size, too.

Hi-Band (150-175 MHz) Model COP-20H.
Only \$33.50

Lo-Band (25-50 MHz) Model COP-30L.
Only \$33.50

Prices slightly higher West of Rockies.

*"Magnet Mount" base antenna and
"Quick Grip" mobile antenna available.



ELECTRONICS library

QUIET

NETWORK THEORY

by J. B. Murdoch

Classroom tested, this book can be considered two different college courses under the same cover. The first part of the book concentrates on steady-state linear networks and the latter part on free and forced behavior of such networks. The detailed material is sufficient for two whole semesters in electrical engineering.

Published by McGraw-Hill Book Co., 330 West 42 St., New York, NY 10036. Hard cover. 525 pages. \$16.

BASIC ELECTRICITY/ELECTRONICS, Books 1 and 2

This two-volume set, put together by Training & Retraining, Inc., is a widely used student-tested course. It provides the beginner with a solid grasp of the elements of electricity and electronics and equips the technician-level student with the basic knowledge and preparation to advance into specialized fields. Book 1 is devoted to tube and transistor circuits, test instruments, and motors and generators. Book 2 covers the principles and applications of electricity and electronics and a.c.-d.c. circuits. Both books are written in a programmed-text format. The text is well written and profusely illustrated to show and explain every item discussed.

Published by Howard W. Sams & Co., Inc., 4300 West 62 St., Indianapolis, IN 46268. Hard covers. 640 pages Book 1, 704 pages Book 2. \$9.95 each book.

WAVE GENERATION AND SHAPING Second Edition

by Leonard Strauss

In the decade since the first edition of this book appeared, solid-state technology has revolutionized active circuit design, and IC's have replaced discrete components. Written primarily as a textbook, the objective is to present a logical unified approach to the analysis of those circuits in which the non-linearity of the active device is the significant factor. A developmental treatment is followed as focus is placed on the essential features of practical wave generating, shaping, and logic circuits. The book is divided into



COURIER COMMUNICATIONS

100 Hoffman Place, Hillside, N. J. 07205
Canada: Province of Ontario

Please send me more information on Courier Monitor/
Receivers and name of nearest dealers. Dept. PE-6

Name

Address

City State Zip

Hear It While It's Happening!

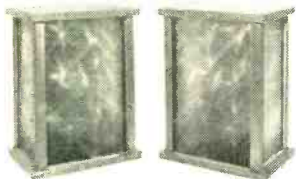
CIRCLE NO. 12 ON READER SERVICE PAGE

Enjoy Discoteque Light Shows at Home — Be it Bach, Beethoven, Folk, Soul, Rock and Roll

Add a new sensation to your favorite listening pleasure. A panoramic display of sound to multi-color light patterns.



Color Organs



Dual Channel Color Organ Model GF-2F—\$49.95 pair. User Net.

A pair of bookshelf size; 3 sided prismatic glass enclosure with walnut finish top and bottom. Each unit is a dual channel color organ. Lights respond with sound amplitude (volume) and with different sound frequencies.



3 Channel Color Organ, Model CVA-3F — \$49.95 each User Net.

3 channel color organ. Each channel of lights have their own sensitivity control. Lights respond with sound amplitude (volume) and with different sound frequencies.

3 Channel Color Organ Model LGF-3F—\$47.95 each User Net.

3 sided prismatic glass enclosure with walnut finish top and bottom. 3 channel color organ. Each channel of lights have their own sensitivity control. Lights respond with sound amplitude (volume) and with different sound frequencies.



Stereo (dual channel) Color Organ Model CVA-6F, \$69.95 each User Net.

A stereo (dual channel) system complete in one walnut finish bookshelf cabinet. Each channel is independent and uses 2 individual sensitivity controls per channel.

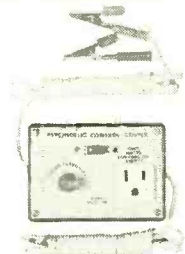


Color Centers



3 Channel Frequency Divided Color Control Center Model PCC-3LF \$34.95 User Net.

Any sound from a Hi-Fi, phono, radio, etc. may be fed into this unit. Each channel is independent and uses 3 individual sensitivity controls per channel. Lights respond with sound amplitude (volume) and with different sound frequencies.



Single Channel Color Control Center, Model PCC-10F — \$16.95 User Net.

Any sound from a Hi-Fi, phono, radio, etc. may be fed into this unit. Converts sound to light variations. Will handle up to 600 watts of plugged in lamps.



3 Channel Color Control Center, Model PSA-3LF — \$19.95 User Net.

Any sound from a Hi-Fi, phono, radio, etc., may be fed into this unit. The PSA-3LF will change the sound variations to light variations. 3 individual sensitivity controls are used for 3 separate channels each capable of accommodating 500 watts of external lights.



Stereo Color Control Center Model PCS-5LF — \$34.95 User Net.

2 separate inputs and outputs for true stereo sound to light conversion. Separate sensitivity controls for each stereo channel. Each channel handles up to 500 watts of controlled lights.

Strobe Lights



Model ST-2F \$34.95 wired, \$24.95 kit, User Net. Walnut wood case. High intensity strobe. Easy to use and build. Built in Strobe speed control



Model STCC-3F, Strobe 3-channel Color Organ Combination \$79.95 wired, \$49.95 kit, User Net. Oiled walnut cabinet. Contains high volt strobe. Complete unit in one. Built-in 3-channel frequency divided color control center

FREE 1970 CATALOG

Send me free catalog describing the full BOWMAN line of dozens of best buys and name of nearest dealer.

BOWMAN LEISURE INDUSTRIES CORP.
155 East First Ave./Roselle, N. J. 07203
Phone (201) 241-2670-1



Name _____

Address _____

City _____ State _____ Zip _____

PE-670

CIRCLE NO. 7 ON READER SERVICE PAGE

June, 1970

13

SWITCH ON



Musi-cube the "switched on" speaker

Musi-Cube has revolutionized the idea of what a speaker should be. Four "switched on" color designs make them fun—even when they're quiet. And because Musi-Cubes measure just 7 $\frac{3}{8}$ " on a side, you can put them almost anywhere. 50 to 16,000 Hz response and full 12-watt music power rating produces a sound so big, you have to hear it to believe it. Write for free full color literature.

Argos[®]
PRODUCTS COMPANY

600 So. Sycamore, Genoa, Ill. 60135

CIRCLE NO. 2 ON READER SERVICE PAGE

Citizens Band for Everyone



the
MICRO-12 Only **79⁹⁵**
Stock No. 99-31957WX

Can you get desperately needed help on the highway for your flat-tire, mechanical breakdown, or sudden illness?

Over two million calls for assistance were handled by CB radio last year. And with a Micro-12 as a traveling companion you can keep in touch on any of 12 CB Channels . . . you can get help when and where you need it most!

Uses 12 volts DC, (optional AC power supply and portable battery pack available). Meets FCC and Canadian D.O.C. requirements. Complete with push-to-talk dynamic mike, mobile mounting bracket, channel 10 crystals, DC power lead, and FCC form 505. Size: 1 $\frac{3}{4}$ Hx5Wx1 $\frac{1}{2}$ "D.

See your dealer or write us for full details. And write for our FREE 1971 Catalog 710 available in late summer.

LAFAYETTE Radio Electronics
P. O. Box 10, Dept 35060
Syosset, L. I., New York 11791

CIRCLE NO. 18 ON READER SERVICE PAGE

five parts: Models and Logic; Timing; Switching; Memory; and Oscillations. The material in the text is on the graduate or advanced undergraduate engineering level.

Published by McGraw-Hill Book Co., 390 West 42 St., New York, NY 10036. Hard cover. 775 pages. \$16.50.

LASERS AND HOLOGRAPHY

by Winston F. Kock

Holography, like ordinary photography, is a way of recording a scene on film. But while the photograph displays the scene in only two planes (it has no depth), the hologram is a three-dimensional display of the scene; it actually has depth that changes perspective with the changing angle of view. In this book, the reader is introduced to the holography technique by a careful review of the underlying wave concepts, including coherence, diffraction, and interference. The atomic process by which lasers generate their special coherent light is explained. Also shown is how the unique properties of holography will make the laser a valuable instrument in the future of photography.

Published by Anchor Books, Doubleday & Co., Inc., 501 Franklin Ave., Garden City, NY 11530. Soft cover. 103 pages. \$1.25.

1-2-3-4 SERVICING AUTOMOBILE STEREO

by Forest H. Belt & Associates

Anyone who services electronic equipment faces the dilemma of speed versus thoroughness. A simple procedure that gets the job done correctly is the best approach. And that is just what is involved in this book; getting the job done the easy way and the right way. The 1-2-3-4 method of finding troubles, coupled with the Easy-Read format of writing and editing, make even the most complicated discussions easy to understand. The topics are carefully organized and thorough explanations, supported by clear illustrations are provided. Whether you are a student, practicing technician, or curious layman, you will understand automobile stereo systems when you have finished reading this book.

Published by Howard W. Sams & Co., Inc., 4300 West 62 St., Indianapolis, IN 46268. Soft cover. 192 pages. \$3.95.

ELECTRONIC CIRCUIT DESIGN HANDBOOK

Perhaps the most interesting section in most electronics engineering magazines is the one devoted to unique circuit ideas submitted by the readers. Although complete and useful in themselves, such basic circuits may also serve as the kernel of a more complex design idea. The editors of *EEE* magazine have gathered together more than 600 such design ideas, supplemented them with more than 750 diagrams, waveforms, and parts lists, and organized them into 19 sections. Each section is devoted to a specific area, such as amplifiers, oscillators, counting and timing circuits, gat-

(Continued on page 100)

POPULAR ELECTRONICS READER SERVICE PAGE

free information service:

Here's an easy and convenient way for you to get additional information about products advertised or mentioned editorially (if it has a "Reader Service Number") in this issue. Just follow the directions below... and the material will be sent to you promptly and free of charge.

1. On coupon below, circle the number(s) that corresponds to the key number(s) at the bottom or next to the advertisement or editorial mention that is of interest to you. (Key numbers for advertised products also appear in the Advertisers' Index.) Print or type your name and address on the lines indicated.

2. Cut out the coupon and mail it to: POPULAR ELECTRONICS, P.O. Box 8391, Philadelphia, PA 19101.

note: If you want to write to the editors of POPULAR ELECTRONICS about an article on any subject that does not have a key number, write to POPULAR ELECTRONICS, One Park Avenue, New York, N.Y. 10016. Inquiries concerning circulation and subscriptions should be sent to POPULAR ELECTRONICS, P.O. Box 1096, Flushing, N.Y. 11352.

POPULAR ELECTRONICS

P.O. BOX 8391
PHILADELPHIA, PA. 19101

Void After July 31, 1970

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 _____ STATE _____ ZIP CODE _____

6 Na

8 New Action-Packed Kits From Heath —



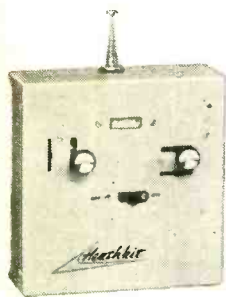
Heathkit GD-101
\$49.95*



NEW Heathkit "Spectre" 1/8 Scale R/C Car Join The Most Exciting New Hobby In America . . .

building and racing radio-controlled Grand Prix cars up to scale speeds of 200 mph. The Heathkit "Spectre" R/C car reaches that speed and has already proven itself a winner. And no wonder; its design is unique. It has a chrome plated steel chassis, adjustable caster and toe-in, specially formulated rubber tires that lock onto the cast nylon wheels, independent front suspension for excellent cornering and a 5.5:1 gear ratio for maximum torque at all speeds. The snap on, 1/8 scale car body (length: 19 3/4") is of high impact plastic — almost indestructible. Suspension is by real coil springs. The radio equipment compartment is dirt and oil proof. The Heathkit "Spectre" is the only complete car kit available. You get the body, chassis, wheels & tires, 4 oz. fuel tank & tubing, equipment case & protective foam, centrifugal clutch & gears, axles, servo linkages & mounting tape, all hardware, decals, numbers and a comprehensive manual. The "Spectre" accepts any .15 to .23 cubic inch R/C engine and any proportional R/C electronics system. It requires only two servos to operate the steering, brake and throttle. Get in on all the thrills of R/C car racing at the lowest possible price . . . order a Heathkit "Spectre".

Kit GD-101, R/C car only, 8 lbs. \$49.95*
Assembled GDA-101-1, Veco .19 R/C engine, 1 lb. \$19.95*



Transmitter

Heathkit GD-57
\$129.95*



Receiver

Battery Pack

Servos

NEW Heathkit 3-Channel Digital Proportional R/C System For Planes, Gliders, Cars And Boats

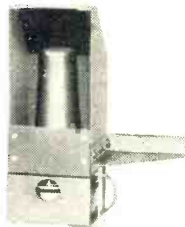
Ideal for use with the new Heathkit "Spectre" R/C car to give you total control . . . ease of handling. Here's what the Heathkit GD-57 R/C system includes: Transmitter with assembled, factory aligned RF circuitry; new 2 oz. miniature receiver that needs no IF alignment, in a tough nylon case; you also get two servos; all plugs; connectors; cables; charging cord; new flat-pack rechargeable nickel-cadmium transmitter and receiver batteries . . . and a special soldering iron. You can have your choice of five operating frequencies in each of three bands . . . 27, 53 or 72 MHz. This is the most value ever offered in a 3-channel rig.

Kit GD-57, transmitter, receiver, 2 servos, batteries, charging cord, switches and soldering iron, (specify freq. desired), 11 lbs. \$129.95*
Kit GDA-57-1, transmitter, battery, charging cord, (specify freq. desired), 5 lbs. \$54.95*
Kit GDA-57-2, receiver only, (specify freq.), 1 lb. \$34.95*



Amplifier & Controls

Heathkit Siren & Speaker
\$99.95*



Concealed Horn



Exterior Horn

NEW Heathkit Siren/PA For Licensed Emergency Vehicle Only

Hey Chief! Save up to 60% on a new electronic siren/PA system by ordering the low cost Heathkit GD-18. The siren gives both "wail" and "yelp" warnings at 55 watts output power, and you can adjust the pitch. As a public address it will amplify your voice with a full 20 watts of power, and it's practically immune to acoustical feedback. (Either PA or siren can be interrupted to use the other.) Incoming radio calls can be channeled through the GD-18 so you can hear them when away from your vehicle. Use it on any 12-volt auto electrical system with either positive or negative frame ground. It will operate from -20° to 150° F conditions. Control panel is lighted. Comes with gimbal bracket mounting. Take your choice of speakers . . . concealed or exposed.

Kit GD-18, Siren/PA Amplifier, 7 lbs. \$54.95*
Assembled GDA-18-1, Exterior Horn, 9 lbs. \$49.95*
Assembled GDA-18-2, Concealed Horn, 4 1/2 x 4 1/2 x 13", 9 lbs. \$49.95*
System GD-18A, (includes GD-18 plus exterior horn), 16 lbs. \$99.95*
System GD-18B, (includes GD-18 plus concealed horn), 16 lbs. \$99.95*

Heathkit MI-29
\$84.95*



NEW Heathkit Solid-State Portable Fish Spotter

Costs half as much as comparable performers. Probes to 200 ft. Doubles as depth sounder. Transducer mounts anywhere on suction cup bracket. Adjustable Sensitivity Control. Exclusive Noise-Rejection Control stops ignition noise. Runs for 80 hrs. on two 6 VDC lantern batteries (not included). Manual explains typical dial readings. Get set for next season; order your Heathkit MI-29 today.

Kit MI-29, 9 lbs. \$84.95*

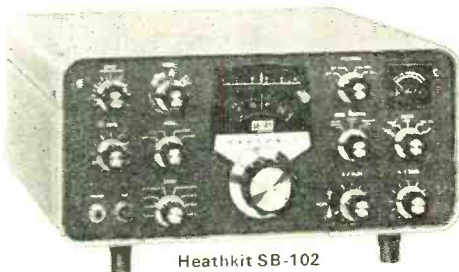
The Value Leader



NEW Heathkit 5-Band SSB Amateur Transceiver

The new Heathkit SB-102... proud successor to the famous "100" & "101". You can expect top performance and value from this rig... and you get it. An all solid-state Linear Master Oscillator delivers faster warmup, greater stability and better tracking... new receiver circuitry gives better than 0.35 uV sensitivity for real performance under bad band conditions. Plus all the features that made the SB-101 the world's most famous, most popular transceiver... 180 watts PEP SSB input... 170 watts CW input... 80 through 10 meter coverage... USB, LSB or CW modes... built-in VOX or PTT operation... built-in CW sidetone... built-in 100 kHz crystal calibrator... Triple Action Level Control for reduced clipping & distortion... fast, easy handswitching and tune-up... rugged, inexpensive 6146 finals... separate headphone level control & front panel jack... simple assembly with circuit board-wiring harness construction... sharp Heathkit SB-Series styling plus many more features. Order yours now.

Kit SB-102, 23 lbs. \$380.00*
 Kit SBA-100-1, mobile mt., 6 lbs. \$14.95*

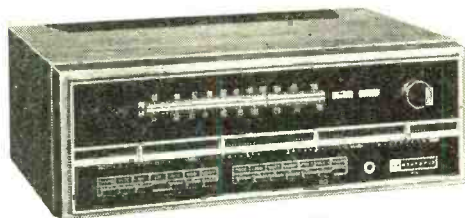


Heathkit SB-102
\$380.00*

NEW Heathkit 60-Watt AM-FM-FM Stereo Receiver

Superb stereo performance at budget price, that's the new Heathkit AR-19. A giant, electronically regulated power supply provides 60 watts IHF music power (ideal for all modular and high efficiency speaker systems)... frequency response is -1 dB from 6 Hz to 35,000 Hz... and Harmonic & IM distortion are less than 0.25% at any output. This advanced performance assures you of crisp, clean highs without ringing or breakup... solid, clean-cut lows without distortion — just pure, uncolored sound reproduction at all frequencies and power levels. The FM Stereo circuitry is unequalled by any receiver in this price class... a factory assembled & aligned FET FM tuners... superior overload characteristics & 2.0 uV sensitivity... a factory assembled & aligned FM IF circuit board with 4 IC's for superior AM rejection, hard limiting, greater stability and 35 dB selectivity... a precision ball-bearing inertia flywheel for smooth, precise tuning... two front panel tuning meters for exact station selection. Other features include modular snap-out circuit boards, built-in self-servicing capability, hi-fi AM reception and much more. Make the AR-19 the heart of your stereo system now.

Kit AR-19, 29 lbs. \$225.00*
 Assembled AE-19, oiled pecan cabinet, 10 lbs. \$19.95*



Heathkit AR-19
\$225.00*

Heathkit Solid-State Metal Locator

Here's versatile, professional performance in a metal locator at lowest cost. The all solid-state GD-48 uses a unique induction balance detection system that doesn't produce a tone until metal enters the search field... eliminates having to listen for a change in tone. The built-in sensitivity control allows adjustment to detect varying size objects down to 6 feet. A built-in speaker audibly signals presence of metal... for higher sensitivity use the accurate front-panel meter. And the front-panel headphone jack lets you use headphones to screen out annoying background noise. Look no further for an excellent metal locator... order the GD-48 now.

Kit GD-48, 4 lbs. \$59.95*
 GDA-48-1, 9 V battery, 1 lb. \$1.30*

Heathkit GD-48
\$59.95*



Heathkit Screw-Drive Radio-Controlled Garage Door Opener Now Costs Less

Like having a personal doorman. The powerful yet gentle screw-drive door mechanism gives you ease & convenience you want with the reliability & safety you need. Just a touch of a button and the factory assembled & aligned UHF electronics open your garage door from up to 150 ft. away and turns on a light too. Once inside, another push of the button closes the door safely behind you, yet the light remains on long enough for you to enter your home. Fast, easy one-night assembly... all wires pre-cut with connectors installed... no soldering. Fits any 7 1/2" overhead, jamb or pivot single or double size residential doors. Automatic instant reverse feature prevents injury to kids, pets, etc. Send for yours now.

GD-209A, mechanism, receiver & transmitter, 66 lbs. \$139.95*
 GD-209B, mechanism, receiver & 2 transmitters, 66 lbs. \$149.95*



New Lower Price
 Kit GD-209A
\$139.95*



NEW
FREE 1970 CATALOG!
 Now with more kits, more color. Fully describes these along with over 300 kits for stereo/hi-fi, color TV, electronic organs, guitar amplifiers, amateur radio, marine, educational, CB, home & hobby. Mail coupon or write Heath Company, Benton Harbor, Michigan 49022.

HEATHKIT
a Schlumberger company

HEATH COMPANY, Dept. 10-6
 Benton Harbor, Michigan 49022

Enclosed is \$ _____ plus shipping.

Please send model (s)

Please send FREE Heathkit Catalog. Please send Credit Application.

Name _____

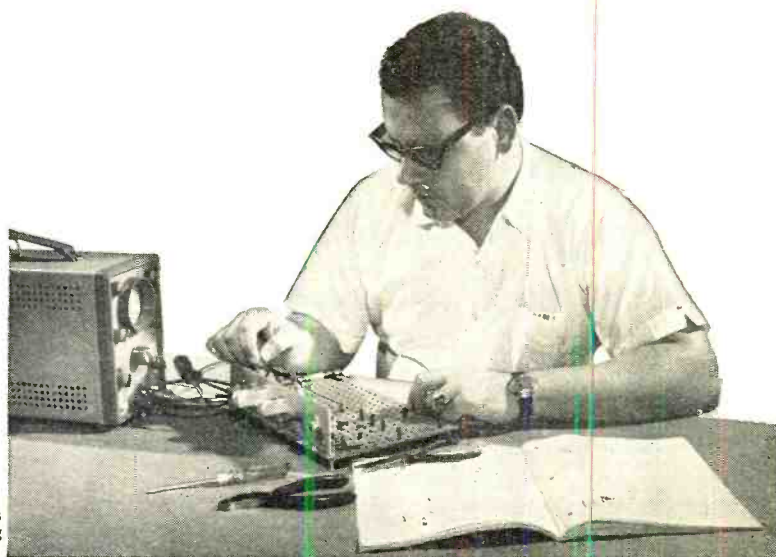
Address _____

City _____ State _____ Zip _____

*Mail order prices; F.O.B. factory. Prices & specifications subject to change without notice. CL-386

CIRCLE NO. 17 ON READER SERVICE PAGE

10 Reasons why RCA Home Training is your best investment for a rewarding career in electronics:



Performing transistor experiments
on programmed breadboard — using
oscilloscope

1 LEADER IN ELECTRONICS TRAINING

When you think of electronics, you immediately think of RCA... a name that stands for dependability, integrity and pioneering scientific advances. For over a half century, RCA Institutes, Inc., a service of Radio Corporation of America, has been a leader in technical training.

2 RCA AUTOTEXT TEACHES ELECTRONICS FASTER, EASIER, ALMOST AUTOMATICALLY

Beginner or refresher, AUTOTEXT, RCA Institutes' own method of programmed Home Training will help you learn electronics more quickly and with less effort, even if you've had trouble with conventional learning methods in the past.

3 THOUSANDS OF WELL PAID JOBS ARE NOW OPEN TO MEN SKILLED IN ELECTRONICS

RCA Institutes is doing something positive to help men with an interest in electronics to qualify for rewarding jobs in this fascinating field. Every year, literally thousands of high paying jobs in electronics go unfilled just because not enough men take the opportunity to train themselves for these openings.

4 WIDE CHOICE OF CAREER PROGRAMS

Start today on the electronics career of your choice. On the attached card is a list of "Career Programs", each of which starts with the amazing AUTOTEXT method of programmed instruction. Look the list over, pick the one best suited to you and check it off on the card.

5 SPECIALIZED ADVANCED TRAINING

For those already working in electronics or with previous training, RCA Institutes offers advanced courses. You can start on a higher level without wasting time on work you already know.

6 PERSONAL SUPERVISION THROUGHOUT

All during your program of home study, your training is supervised by RCA Institutes experts who become personally involved in your efforts and help you over any "rough spots" that may develop.

7 VARIETY OF KITS YOURS TO KEEP

To give practical application to your studies, a variety of valuable RCA Institutes engineered kits are included in your program. Each kit is complete in itself. You never have to take apart one piece to build another. At no extra cost, they're yours to keep and use on the job.

8 FROM RCA INSTITUTES TRANSISTORIZED TV KIT, VALUABLE OSCILLOSCOPE

Those enrolled in RCA's television course or program receive complete transistorized TV Kit. All students receive a valuable oscilloscope—both at no extra cost and only from RCA Institutes.

9 CONVENIENT PAYMENT PLANS

RCA Institutes offers a unique tuition plan that lets you progress at your own pace. You only pay for lessons as you order them. You don't sign a contract obligating you to continue the course. There's no large down-payment to lose if you decide not

to continue. However, if you desire, RCA Institutes also offers a convenient monthly payment plan.

10 RCA INSTITUTES GRADUATES GET TOP RECOGNITION

Thousands of graduates of RCA Institutes are now working for leaders in the electronics field; many others have their own profitable businesses. This record is proof of the high quality of RCA Institutes' training.

CLASSROOM TRAINING ALSO AVAILABLE

If you prefer, you can attend classes at RCA Institutes Resident School, one of the largest of its kind in New York City. Coeducational classroom and laboratory training, day and evening sessions, start four times a year. Simply check "Classroom Training" on the attached card for full information.

JOB PLACEMENT SERVICE, TOO!

Companies like IBM, Bell Telephone Labs, GE, RCA, Xerox, Honeywell, Grumman, Westinghouse, and major Radio and TV Networks have regularly employed graduates through RCA Institutes' own placement service.

SEND ATTACHED POSTAGE PAID CARD TODAY! FREE DESCRIPTIVE BOOK YOURS WITHOUT OBLIGATION! NO SALESMAN WILL CALL!

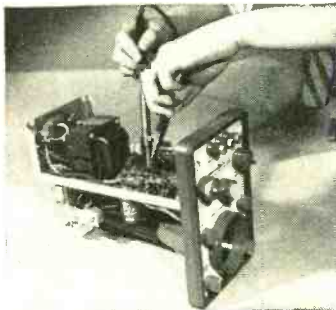
All RCA Institutes courses and programs are approved for veterans under the New G.I. Bill.

RCA INSTITUTES, DEPT. 694-006-0
320 West 31st Street,
New York, N.Y. 10001

Accredited Member National Home Study Council

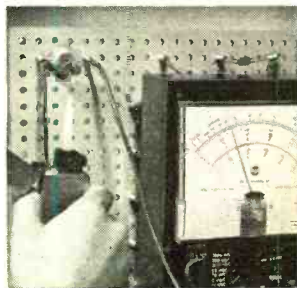
RCA

Construction of Multimeter.



Construction of Oscilloscope.

Temperature experiment with transistors.



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 on page 15 or 95.

COMMUNICATIONS RECEIVER KIT

Armchair adventuring is more fun than ever when you tune in on the world with a receiver you've built yourself. This is the idea behind the new Knight-Kit Model R-195

budget-priced communications receiver kit. The kit features a "modular concept" in which most parts

are already soldered to printed circuit boards and all critical adjustments have been made at the factory so that the builder merely interconnects the boards. The assembled R-195 tunes the international and domestic short-wave stations in three bands (1.8-4.8, 4.8-12, and 12-30 MHz), marine weather and navigational beacon stations on long wave (200-420 kHz), and standard AM broadcast band. A specially designed r.f. section features 2 μ V sensitivity for 10 dB S+N/N. Selectivity is 4.5 kHz bandwidth at 6 dB. Other features include automatic noise limiting, a.v.c., BFO for CW and SSB reception, remote receiver muting, 4" speaker, and a headphone jack.

Circle No. 78 on Reader Service Page 15 or 95

STEREO CASSETTE DECK

The Lumistor Products Model LP-1 stereo record/playback deck is unique in that it is designed to allow for conversion to play four-track "quadrasonic sound" cassettes. The deck was designed to provide the features and operation convenience of quality reel-to-reel decks while retaining the convenience of cassette handling. Featured are interlocking controls, a

four-pole synchronous motor, three-digit counter, dual VU meters with separate input level controls, and all interconnecting cables. Present plans are for the four-track converter pack to be made available to those who wish to convert to quadrasonic sound capabilities as soon as prerecorded cassettes for the new sound become available.

Circle No. 79 on Reader Service Page 15 or 95

7-IN-1 BIAS SUPPLY FOR COLOR TV

A new bias supply for color TV alignment has been introduced by Sencore. The Model BE156 meets the demands of the TV receiver manufacturers by providing three separate 25-volt supplies that can be switched positive or negative as indicated by alignment instructions provided by the TV receiver manufacturers.

Tube operated receivers require negative voltages, while most solid-state receivers use positive voltages. A seventh range of 0-75 volts has been provided to meet the specifications of the manufacturers who use 67.5 volts to bias the chroma amplifiers during alignment. All three supplies are well filtered at 0.1% ripple and have little or no interaction between them.

Circle No. 80 on Reader Service Page 15 or 95

AUTO-REVERSE STEREO TAPE RECORDER

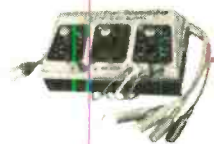
The Sony Model 780 automated tape recorder, available from *Superscope*, is designed for the connoisseur who wants and can afford the best. It features a three-motor drive system that is completely independent of the 60-Hz line power frequency to provide precise speed control. Any external altering circumstance is automatically and instantaneously compensated for by a sophisticated regulating system. Automatic reversing is accomplished through an electronic sensory system: no metal foil or subsonic tones are required to activate the auto-reverse. The 780 is equipped with the Sony Noise Reduction System that provides noise-free playback of all recorded tapes by automatically reducing the gain of the playback amplifier during quiet passages. The Model 780 includes vari-speed tuning, front panel bias switch, and feather touch control buttons. Another new feature is the ferrite Roto-Bilateral Head that allows recording and playback in both directions with simultaneous tape monitoring.

Circle No. 81 on Reader Service Page 15 or 95

REGULATED LOW-VOLTAGE SUPPLY

The new Heathkit Model IP-28 current-limiting regulated lowvoltage supply, available from the *Heath Company*, incorporates a number of features that will make it attractive to servicemen, experimenters, and anyone interested in solid-state circuitry. It is capable of delivering from 1 to 30 volts at 1 ampere

maximum load with less than 50-mV variation. For critical circuits where the voltage drop across the supply leads is critical, the



Now it costs less to own the best VOM you need.



The New RCA WV-510A Solid-State Master VoltOhmyst®

I.Q.*

*Inexpensive Quality
†Optional Distributor
Resale Price

RCA

The best you need is the new solid-state RCA WV-510A Master VoltOhmyst®. The most functional VOM we've ever produced, the 510A has all the features you'll ever need no matter what your requirements may be.

And we've added some extra features you won't find in any competitive VOM, at any price... features designed to make your work easier, help you get the job done faster.

For example: RCA WV-510A operates from batteries or AC. Remove the detachable AC line cord while you're taking a measurement and the batteries take over immediately without a flicker of the pointer. And you'll get maximum life from the batteries because they're always on trickle charge during AC operation. Stability? Switch from range to range and watch a whole series of measurements without constantly zero-adjusting the meter.

Some statistics:

Current:

0.01 milliampere to 1.5 amperes in 8 ranges.

Resistance:

0.02 ohm to 1000 megohms in 7 ranges.

DC Volts:

0.01 volt to 500 volts in 8 ranges.

AC Volts:

0.2 to 1500 rms AC volts in 7 ranges plus peak-to-peak voltages of complex waveforms.

21 megohm resistance on all DC ranges.

And it's only \$128,† complete with DC/AC ohms probe and flexible shielded input cable with BNC connector, and removable AC line cord.

Some statistics! For complete details, contact your local RCA Distributor.

RCA Electronic Components | Harrison, N. J. 07029

CIRCLE NO. 27 ON READER SERVICE PAGE

PRODUCTS (Continued from page 22)

IP-28 is equipped with a remote sensing feature that reduces the voltage variation to less than 20 mV. A front panel rocker switch selects range of either 1-10 volts d.c. or 1-30 volts d.c., and the output on both is continuously variable. Variable current limiting in two switch-selected ranges from 10-100 mA or 10 mA-1 ampere is also included to protect the load. A 3½" meter can be switched to indicate either voltage or current.

Circle No. 82 on Reader Service Page 15 or 95

MOBILE POWER INVERTER

The new "Quad-Continental" inverter available from *Terado Corp.* converts 12-volt d.c. to 117 volts a.c. at 60 Hz while maintaining the a.c. frequency within 0.25 Hz, regardless of input voltage or load. The Model 50-110 inverter can handle up to 1200 watts of output loading. Hence, it is ideal for powering small-to-medium compressor type refrigerators. The Quad is completely filtered for operation of sound equipment. It comes with a control harness and features solid-state circuitry and forced air cooling.



Circle No. 83 on Reader Service Page 15 or 95

STEREO FM RECEIVER FOR CARS

Stereo Magic recently announced a stereo FM receiver as an add-on accessory to fit all cars. With the Model DFM-888 receiver, any car owner can enjoy stereo FM broadcasts while on the road. The DFM-888 is all solid state in construction, employing 21 transistors, 11 diodes, and 4 thermistors. The result is a powerful circuit with 101dB sensitivity (signal-to-noise ratio of 30 dB), 5 watts r.m.s. of audio output power, and only 3% distortion at 1 watt. The receiver features a.f.c. with a holding range of 600 kHz and a frequency range of 50-10,000 Hz. The DFM-888 operates on 12 volts d.c., negative ground, and fits easily under the dash in most cars.



Circle No. 84 on Reader Service Page 15 or 95

PORTABLE CASSETTE RECORDER

A portable cassette recorder with random function controls and door loading has been made available by the *Ampeco Corp.* Designated the "Micro 9," the recorder has positouch controls that allow random switching from one function to another without using the stop control. The door loading feature allows rapid and easy insertion and removal of cassettes. The Micro 9 operates on a built-in battery supply or from 117 volts a.c.; and

with an optional adapter, it can even operate from a 12-volt source. Automatic record control, transistor regulated motor, and earphone monitoring during recording are among the extra features of the new recorder.

Circle No. 85 on Reader Service Page 15 or 95

HI/LO BAND MONITOR RECEIVER

A new Hi/Lo Band VHF-FM monitor receiver, Model COP-50HL, from *Courier Communications*, has a built-in 117-volt a.c. power supply for home or office use; yet, it can be operated as a mobile receiver from 12-volt d.c. sources. It has six high-band frequencies between 150 and 175 MHz and six low-band frequencies between 25 and 50 MHz. Other features include exclusive crystal control on all channels (crystals not included) to assure on-frequency monitoring; solid-state design incorporating IC's exclusive r.f. peaking control for obtaining maximum sensitivity; adjustable squelch; and tone control switch for emphasizing highs or lows.



Circle No. 86 on Reader Service Page 15 or 95

PROFESSIONAL VTVM

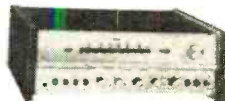
The *Mercury Electronics Corp.* Model 1700C is an advanced design vacuum-tube voltmeter that will meet the demands of the technician's most rigid requirements. It has a large 6" wide-view meter featuring double jewelings at the pivot (with individual side and tail weights), anti-parallax mirrored scale, and easy-to-read scale markings. The highest quality components are said to be used throughout. Wide frequency response is featured in the a.c. voltage mode for compatibility with color TV receiver servicing, FM multiplex troubleshooting, and general industrial applications. Also available in kit form.



Circle No. 87 on Reader Service Page 15 or 95

AM/STEREO FM RECEIVER

Olson Electronics' 85-watt solid-state AM/stereo FM receiver, Model RA-194, has a brushed aluminum front panel with a three-dimensional effect that contrasts strikingly with its oiled walnut enclosure. Contemporary styling is enhanced by an illuminated slide rule dial, FM stereo indicator lamp, and precise tuning meter. Technical specifications: 2-μV FM sensitivity; greater than 30 dB multiplex separation; 30-20,000 Hz audio range; 4-16-ohm output impedance; 22-transistor, 13-diode, 2-IC, and one-FET complement; circuit breaker overload protection; headphone jack; tape output.



Circle No. 88 on Reader Service Page 15 or 95



Grrrrrr.

(The Tiger 23. \$149.95)

The Tiger 23. The new untamable radio from Pearce-Simpson, a Division of Gladding Corporation.

The Tiger 23. A radio you'll have to reckon with. Because no other CB in the world can offer all these features at the same price. Only \$149.95.

Start with styling. Smart, clean lines. Wood-grain finishing. Brushed chrome. Illuminated dials. Velvet smooth controls.

And more. 23 channels plus PA, modulation light, external speaker jack, plug-in dynamic microphone, and large illuminated combination RF-S meter.

But that's still not all. The Tiger 23 includes an Automatic Noise Limiter with manual over-ride. Automatic Modulation Control for ultimate talk power. Television Interference Trap. Receiver

Delta Tune Switch that corrects for the other guy's off-frequency transmissions.

And inside, the latest in solid state circuitry including ceramic filter to bring in sharp clear signals, Integrated Circuit, and Field Effect Transistor.

Put it all together and you've got a radio that won't quit. A radio from Pearce-Simpson, the finest name in Marine radios, CB's, antennas, and electronic communication equipment. And backed by Gladding Corporation, first in outdoor recreation since 1816.

The Tiger 23. If you can handle it.

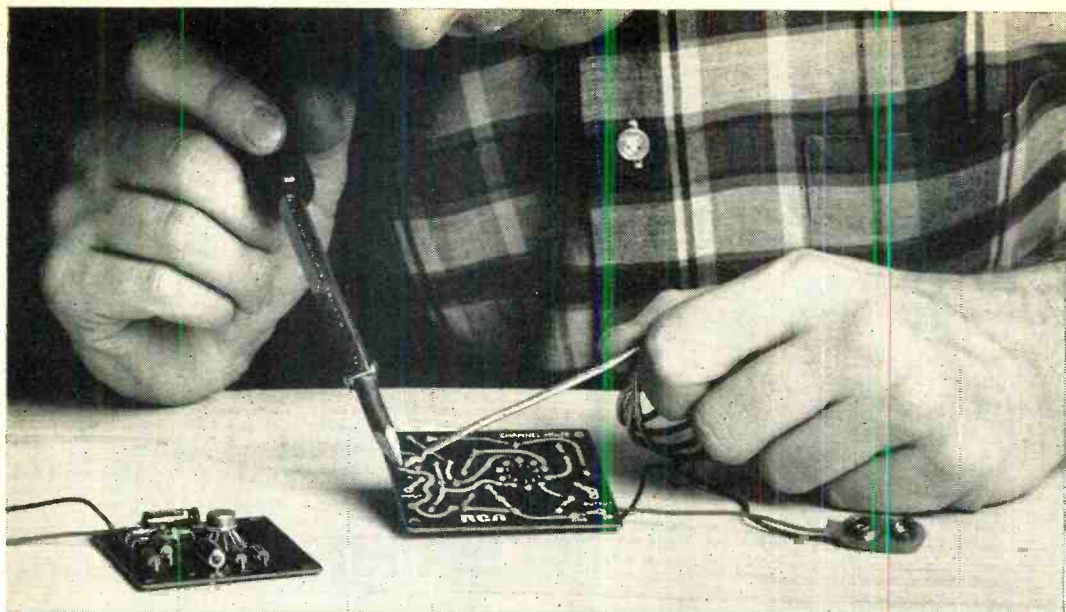
Pearce-Simpson



A Division of Gladding Corporation
First in outdoor recreation since 1816.

GLADDING

CIRCLE NO. 24 ON READER SERVICE PAGE



For use at home, on hobby bench, or in classroom

Assemble these new RCA IC Experimenter's Kits quickly and easily. All the active and passive components, the pre-drilled printed circuit boards, and full clear instructions are included. (Add your own preference of alarm indicator to kits KC4005 and KC4006.)

KC4000: Microphone Preamp IC Kit—a high-gain, low-noise, wideband preamplifier that accommodates both low- and high-impedance microphones.

KC4001: 2-Channel Mixer IC Kit—combines any two audio inputs, such as microphone, radio, phono, or oscillator, into a single output.

7 KC4002: Audio Oscillator IC Kit—for testing audio, hi-fi equipment, and amateur radio transmitters—also for code practice.

KC4003: Amplifier/Oscillator IC Kit—a 500 mW audio amplifier or a variable tone audio oscillator.

KC4004: 9-V Regulated Power Supply IC Kit—supplies 9 volts DC output with voltage regulation of 3% at a maximum current of 250 mA.

KC4005: Intruder Alarm IC Kit—a circuit that develops a "whooping" signal for a security system.

KC4006: Fire Alarm IC Kit—a low-melting-point solder sets off this circuit for a warning device.

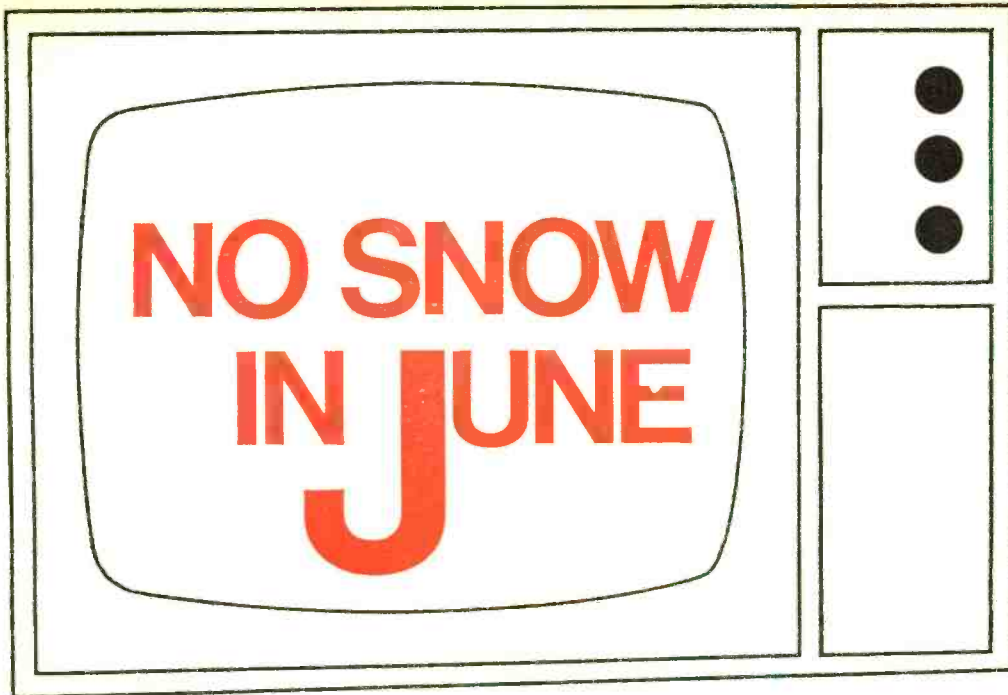
KC4500: IC Kit Enclosure and Hardware Pack—optional for KC4000, KC4001, and KC4002—a handsome, sturdy, prepunched case with input and output jacks, switch, and other hardware.

Buy these kits from your RCA Distributor. For information, write: RCA Electronic Components, Commercial Engineering, Section F-133SD/S30R, Harrison, N.J. 07029

(STARTING AT UNDER \$5.00*) * Optional distributor resale price

RCA

POPULAR ELECTRONICS



MATCH YOUR TV ANTENNA TO RECEIVER
FOR BEST POSSIBLE PICTURE

BY GEORGE MONSER

GOOD TV RECEPTION is not obtained by accident; it is carefully sought for and designed into your antenna system. You can get the best antenna and lead-in cable money can buy, but if the antenna is not impedance-matched to the cable and/or the cable is not matched to the TV receiver, you might just as well be using outdated "rabbit ears." This is especially true for color TV reception—and not just in the "fringe" reception areas.

Everything in your TV receiving system must be just perfect, and the only way you can make sure that it is to do the job right—the first time. But do not think that you have to be a TV antenna/transmission line expert to set up a receiving system. With the help of the information provided in this article, you can set up the best possible antenna system.

The Loss Factor. Nothing is perfect. No matter whether it is an automobile en-

gine or an electronic circuit, every system suffers from some type of loss which reduces its efficiency. While you cannot completely eliminate receiving system losses (known as signal attenuation), you can limit them to an acceptable level.

To demonstrate how loss becomes a critical design factor, consider a 300-ohm folded dipole antenna (tuned or cut to any TV channel) connected to a length of 300-ohm twin-lead cable. Very little loss would occur between the antenna and cable for the channel to which the antenna is tuned. But for all other channels in the TV band, the loss might be as high as 3-4 dB; and over the complete band, an average loss of 2 dB would be typical, enough to cancel the characteristic 2-dB gain of the folded dipole (favorably oriented) antenna.

Now, consider a resonant 300-ohm folded dipole, reflector, and several director array (representative of most commercial TV receiving antennas). An estimated 2-dB loss would occur at the

antenna/cable connection due to the lowering of the dipole's impedance. (The effect of placing a reflector and directors in close proximity to the folded dipole is to lower the 300-ohm characteristic impedance of the dipole to about 70-100 ohms). But since this antenna array provides 6-10 dB of gain, a 2-dB loss, severe in our first case, can usually be acceptable, particularly in good reception areas.

For both cases cited above, the cable lead-in loss, assuming about 40' of twin-lead at VHF, amounts to between 0.6 and 1 dB. Hence, the total loss in antenna signal strength is 3 dB. This means that only 50% of the antenna signal power would be delivered to the TV receiver.

Reducing the Losses. The choice of improving the antenna-to-transmission line match basically involves inserting an impedance-matching transformer between antenna and line. The drawing in Fig. 1 illustrates the makeup of one type of



Fig. 1. Transformers are cut to specific lengths for individual channels or for multichannel band.

transformer you can use. It is easy to fabricate and consists of two lengths of 300-ohm twin-lead cable.

The decision of whether to fabricate your own transformer as opposed to buying one that is commercially made should depend on the end results. Tests made with both types show that at the 70-MHz frequency of channel 4, the commercial ferrite-core balun *lowers* the signal level by about 2 dB, while the quarter-wave, twin-lead homebrew transformer *improves* the signal level by 1.5 dB.

Lead-in attenuation, the other loss (amounting to less than 1 dB) can be slightly reduced, but not without considerable effort. Here, two possibilities exist: transition from the antenna to a homebrew 600-ohm open-wire lead-in and back to 300 ohms at the TV receiver; or transition from the antenna to homebrew

1"-diameter, 77-ohm coaxial line and back to 300 ohms at the receiver. Neither of these alternatives will yield a line loss less than 0.3-0.5 dB, which hardly seems worthwhile by itself. However, if a choice were to be made, it would probably be easier to stay with a balanced line and use 600-ohm open line. (Fig. 2 illustrates how this can be accomplished

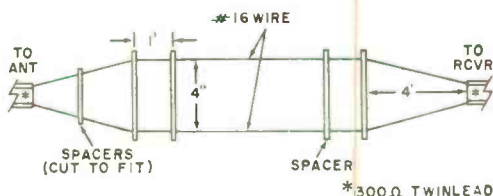


Fig. 2. Insulator spacers support gradual tapers when matching 600-ohm open line to 300-ohm cable.

with #16 wire and a wire separation of 4" to yield a line loss of about 0.25 dB/100' at 88 MHz, or less than 0.15 dB for a typical 40' run.)

You may be wondering when and where it is advantageous to use these methods for improving signal transfer. As a general rule, they should be employed in "fringe" reception areas to improve weak TV channel reception. When making your own transformer or transformers, refer to the Table for the proper quarter-wave transformer lengths to use for each TV channel in the VHF spectrum. The lengths listed were computed assuming standard 300-ohm twin-lead cable with a phase factor of 0.84, which is typical for polyethylene-jacketed twin-lead.

Now, take three practical examples to show how to improve TV reception. In the first example, suppose you have a good quality commercial antenna array and wish to improve reception on Channel 4 by inserting a transformer section between the antenna and a 300-ohm twin-lead line. Select the transformer length section from the Table; in this case, 36" is indicated. Cut two pieces of twin-lead cable to *exactly* 36" (plus about 1/2" extra at each end). Strip away 1/2" of insulation from each end of both cables. Then, connect the lengths of twin-lead in parallel with each other (see Fig. 1).

TRANSFORMER SIZES	
VHF Channel	Transformer Length (inches)
2	43
3	40
4	36
5	32
6	29
7	14
8	13.6
9	13.1
10	12.8
11	12.4
12	12.0
13	11.7

Insert the transformer section between the antenna and twin-lead lead-in cable. This should yield an improvement of 1.5 dB in signal strength and a noticeable improvement in Channel 4 fringe-area reception.

For our second example, suppose you use the same antenna and want the best possible reception. Rather than running 300-ohm twin-lead cable, try using lower loss 600-ohm open line. This can be done fairly easily by following the instructions detailed in Fig. 2. At both the antenna and TV receiver, the line must be tapered gradually to the 600-ohm spacing of the open line. When completed, the installation should yield about a 2-dB improvement in signal reception, slightly better than in the first example.

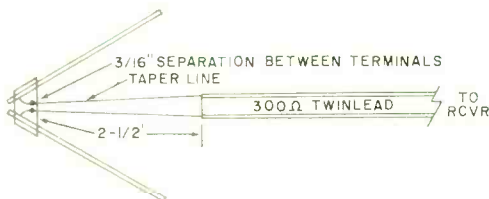


Fig. 3. Gradual taper matches 300-ohm twin-lead cable to 150-ohm impedance of Pyramidal Antenna.

As a final example, assume you are planning to erect the Pyramidal TV/FM Antenna ("Build The 'Pyramidal' TV/FM Antenna," POPULAR ELECTRONICS,

July 1969). This antenna's impedance is about 150 ohms, which means that 300-ohm twin-lead cable is reasonably ideal to use. However, for the ultimate match, you should insert a tapered section of line between the antenna connecting terminals and the 300-ohm twin-lead lead-in cable as shown in Fig. 3 to improve reception by about 0.5 dB.

The added complication of tapering the line in the last example might not be

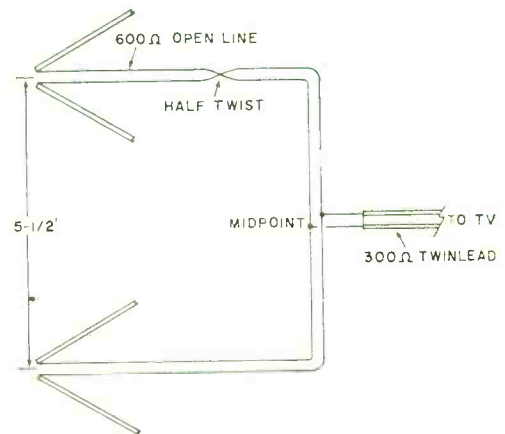


Fig. 4. Open line matches two Pyramidal Antennas to 300-ohm cable. Note half twist in 600-ohm line.

justified, considering that this antenna has a nearly flat gain characteristic of 10 dB for all VHF TV channels.

Finally, suppose that even 10 dB of gain is not enough to provide quality fringe-area reception. You could stack two Pyramidal antennas as shown in Fig. 4 to obtain 13 dB overall gain. Here, the individual antenna connecting point impedances can be tapered to 600 ohms and then paralleled, providing an ideal match to the 300-ohm twin-lead cable line to the receiver. In the illustration, the center-to-center spacing between the antennas is 5'. Of course, the antennas could just as easily be placed side by side to yield the same resultant gain; but erection on a single mast is usually easier to implement.

Now that you have been apprised of good receiving system basics, you can start designing your own system. And with the warm weather here, what better time is there to tackle the job? -30-

VECTOR-CIRCUIT MATCHING QUIZ

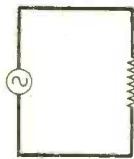
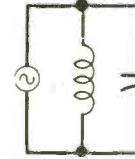

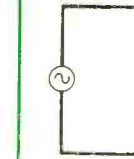
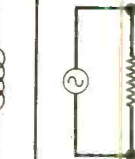
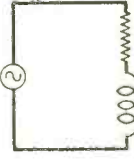
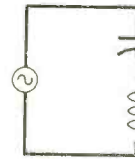
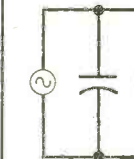
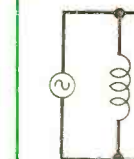
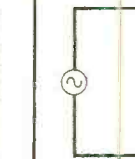
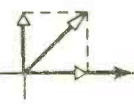







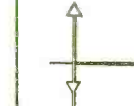

BY ROBERT P. BALIN

Vector diagrams are widely used to show the magnitude and phase relationships between voltages and currents in an a.c. circuit. A knowledge of vectors is a must for understanding the theory behind frequency modulation and detection, color TV and feedback circuits.

Ten circuits (1-10) are shown below; vector diagrams (A-J) representing the voltages and currents in the circuits are also shown. To test your knowledge of vectors, match the diagrams to the circuits. Note that this is a simple matching quiz—obviously special cases might exist if the effects of resonance were considered. It is also assumed that all elements are pure (that is, capacitors have only capacitance, inductors only inductance, and resistors only resistance).

Standard counterclockwise vector rotation is used to indicate angles of lead and lag. A white arrowhead represents a voltage vector; a black arrowhead is a current vector. In all cases, the reference is the line along the horizontal, extending to the right. Relative vectors are shown for all voltages and currents in each circuit.

(Answers on page 96)

 1	 2	 3	 4	 5
 6	 7	 8	 9	 10
 A	 B	 C	 D	 E
 F	 G	 H	 I	 J

BUILD A



TRANSCIPITOR

GIVES YOU GOOD, CLEAN AIR FOR MANY APPLICATIONS

BY WALDO T. BOYD

HAVE YOU EVER painted a very special piece of equipment, only to have it ruined by dust or bugs while drying? Or have you ever had a delicate biological or chemical experiment spoiled by strange gases and smoke in the air? If you have either of these, or any other, needs for a source of truly clean air, the "Transcipitor" is for you.

This clean-air device uses a high-voltage charge in an enclosed column of moving air to remove dust, smoke, and other particulant matter. The column enclosure can be made from a stack of discarded coffee cans (with the ends removed) or from a length of sheet-metal downspout, topped with a small blower. The electronic "heart" of the Transcipitor is a 10-kV d.c. power supply. Power for the device can be obtained either from a 12-volt battery or a transformer/

rectifier combination operated from the 117-volt a.c. line.

How It Works. A single isolated conductor, connected to the high-voltage source, is run up through the center of the metal column—the latter being grounded. When air moves through the column all particulants receive a charge from the static field within the column. They immediately fly to the grounded column and cling there where they are joined by millions of other particles until there is actually a visible coat of dust on the inside of the column. When the power is turned off, the dust particles fall slowly to the bottom of the column and can be removed easily.

This system is essentially a miniature version of the type used in factory chimneys to remove residue from the smoke.

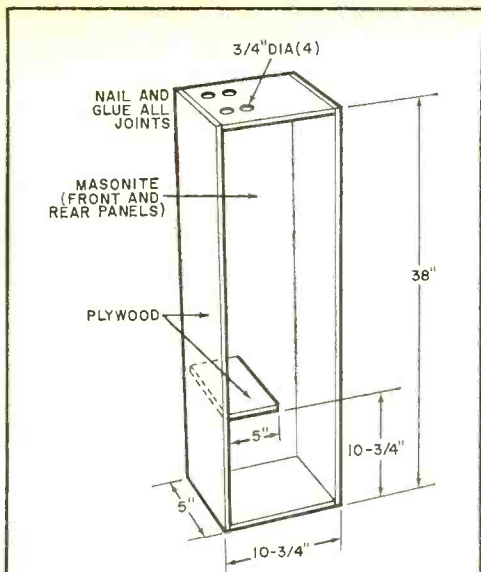


Fig. 1. The cabinet is made from soft pine and Masonite. The front door is not shown.

BILL OF MATERIALS

- 2—5" x 38" pieces of $\frac{1}{2}$ " pine*
- 2—5" x 10 $\frac{3}{4}$ " pieces of $\frac{1}{2}$ " pine
- 1—10 $\frac{3}{4}$ " x 38" piece of thin hardwood
- 1—10 $\frac{3}{4}$ " x 31" piece of thin hardwood
- 1—5" x 5" piece of $\frac{1}{2}$ " pine
- Misc.—Plastic-covered vacuum cleaner hose; blower/motor from auto defroster, heater, etc., 12-volt or small 117-volt unit; sealant for motor mounting (RTV-102 or similar); mounting hardware; etc.

*All dimensions may vary. See text.

Cabinet Construction. Dimensions of the case for the Transcibitor are not critical. A layout of the author's prototype is shown in Fig. 1. Any kind of wood (such as pine) can be used for the sides, top and bottom but the front and back panels are of thin hardwood. A 5" shelf, located 10 $\frac{3}{4}$ " from the bottom of the cabinet is attached to the side and rear, with another screw inserted through the front panel when it is put into place.

Four $\frac{3}{4}$ " ventilation holes are drilled in the top, while the front panel is cut 6" or 7" short to allow air to enter at the bottom. The height of the column (in this case six 1-lb coffee cans, plus the fan) dictates the height of the cabinet. It is best to assemble the column first and then build the cabinet.

If you are going to use coffee cans for the column cut the bottoms out of five of them, but leave the bottom in the sixth for mounting the fan. Stack five cans together, align them as closely as possible and spot solder them together. Wrap tape around the seams to make them airtight.

The fan is mounted on the sixth (top) can. The fan can be salvaged from an old automobile heater or an evaporative cooler, or you can buy one at a surplus supply house. A small 12-volt type is best, but a fan with a 117-volt motor can be used. The fan and motor assembly should be smaller than the top of the coffee can on which it is to be mounted.

Cut a hole in the bottom of the sixth can to fit the fan intake and mount the fan as shown in Fig. 2. Temporarily set this can (and fan) aside.

Stand the 5-can stack up. In the bottom can, drill a series of $\frac{3}{16}$ " holes about $\frac{1}{8}$ " apart around the can about 1 $\frac{1}{2}$ " from the bottom. (Most cans have an indentation ring around the can at about



Fig. 2. The small fan is cemented to its hole in top of can. Make sure that the joint is airtight.

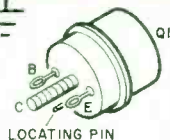
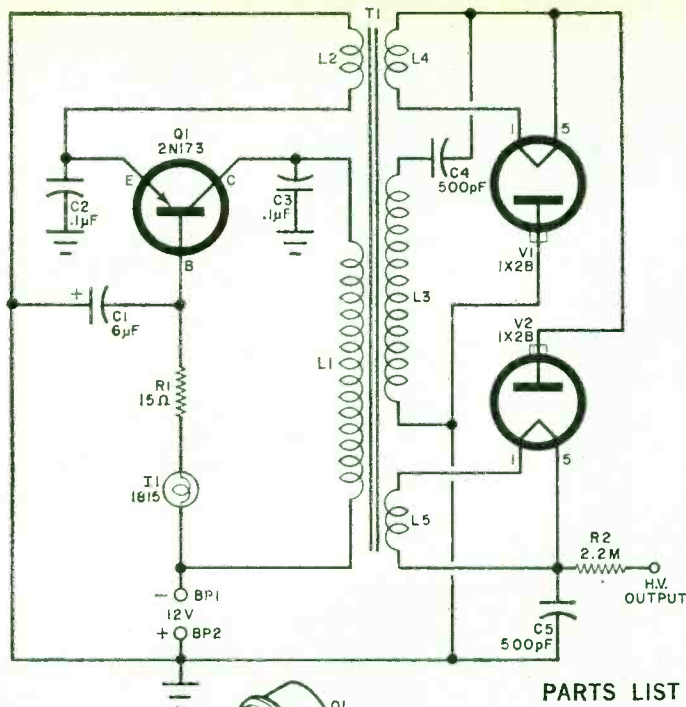


Fig. 3. The circuit is a simple power oscillator driving a voltage-doubler circuit. The two high-voltage capacitors and the flyback transformer can be salvaged from old television set.

PARTS LIST

- BP1, BP2—Binding post (one red, one black)
 C1—6- μ F, 15-volt electrolytic capacitor
 C2, C3—0.1- μ F capacitor
 C4, C5—500-pF, 20-kV "doorknob" capacitors (used in TV high voltage)
 I1—12-volt pilot lamp (GE 1815 or similar)
 Q1—2N173 or IEP 223 power transistor
 R1—15-ohm, 5-watt resistor
 R2—2.2-megohm, $\frac{1}{2}$ -watt resistor
 T1—TV horizontal flyback transformer (Stancor 110-290 or similar)
 V1, V2—1X2B high-voltage rectifier tube
 Misc.—Heat sink (Wakefield NC621B or similar); insulated mounting hardware for transistor; silicone grease; pilot light holder; 9-pin anti-corona high-voltage rectifier sockets (2); ceramic supports for sockets (2); feedthrough insulator (E.F. Johnson 135-48 or similar); length of $\frac{1}{2}$ " high-voltage tubing; length of $\frac{1}{8}$ " plastic tubing; length of nichrome wire; suitable metal chassis.

that point which you can use as a guide.) Deburr the holes. About 1 $\frac{1}{2}$ " from the top of the can (or in the top indentation ring if it has one), drill four holes 90° apart around the can. Use a thin bit ($\#43$) for these holes. Drill four similar holes in the fifth or top can.

Thread a $\#6$ nylon string through the four holes in the bottom can so that a "crosshair" is created. Make the string tight and apply a little glue on the outside knots to make sure that they hold. Do the same thing on the fifth can. These

crosshairs will be used to support and insulate the high-voltage wire in the center of the column. Do not attach permanently the can with the fan at this time.

Place a plastic lid over the open end of the bottom can and stand the stack in the cabinet.

If you use sheet-metal downspout for the column, make the column as high as six coffee cans and drill all holes in approximately the same places. You will have to mount the fan on a piece of metal and secure this to the column later.

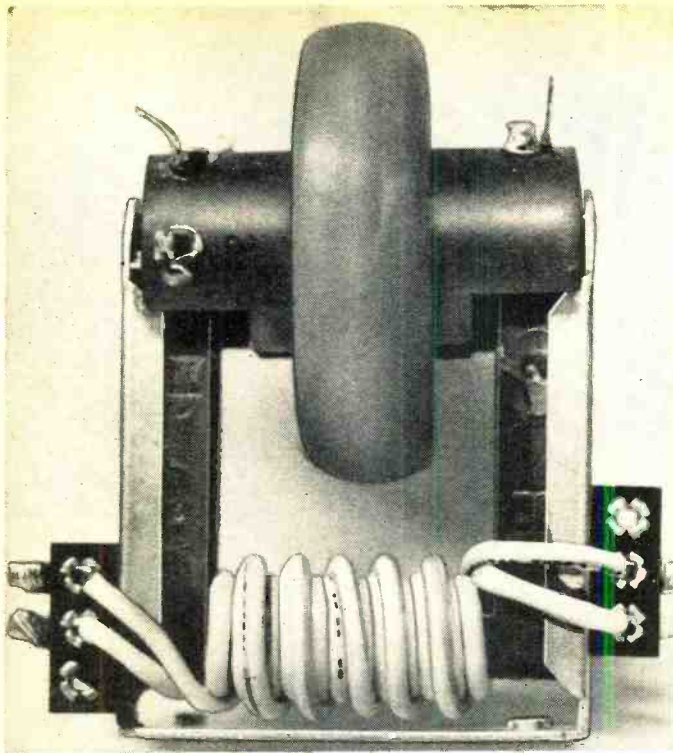


Fig. 4. The two terminal strips are affixed to the side straps of the flyback transformer and support the two ends of new coils ($L1$ and $L2$). Wrap layer of insulating tape around the core before winding the coils.

Power Supply. The circuit for the high-voltage power supply is shown in Fig. 3. For safety, the device is enclosed in a grounded metal container and the high-voltage output is taken through a feed-through insulator.

The supply is a simple transistor oscillator using extra windings on a conventional TV high-voltage horizontal output transformer. Two of these extra coils, a primary and a tickler feedback ($L1$ and $L2$ in Fig. 3), in conjunction with the transistor, form a regenerative feedback network similar to that used in receivers. When the power is turned on, current flows through $L1$ and the transistor. The magnetic field set up by this current generates a voltage in $L2$ that increases the forward bias on the emitter of $Q1$. The collector current through $L1$ then increases. Eventually, the core of the transformer saturates and the magnetic field around $L2$ stops building so that the emitter bias is reduced and the collector current drops. The process is then reversed. The magnetic field set up by the decreasing collector current produces a voltage in $L2$ that drives the transistor

to cutoff. When no current flows through $L1$, there is no voltage across $L2$ and the emitter returns to ground potential. The cycle then repeats. The oscillator frequency is near the upper end of the audible range.

The transistor is biased by $R1$, which is bypassed by $C1$. Capacitors $C2$ and $C3$ protect the transistor from static discharges.

The current through $L1$ varies from zero to about 5 amperes. Because of the turns ratio between $L1$ and $L3$, about 5000 volts a.c. is developed across $L3$. A voltage-doubler/rectifier combination ($V1$ and $V2$ with $C4$ and $C5$) raises the voltage to about 10,000 volts d.c.

Caution. Although the current is low, voltages at the 10-kV level can be very dangerous. Do not, under any circumstances, turn on this high-voltage generator unless the case is completely closed and the high-voltage feedthrough is well in the clear. When the system is turned off for any reason, always discharge the high-voltage terminal using an insulated cable, with one end secured

to ground and the other end held at the end of an insulated rod to touch the terminal.

Power Supply Construction. Remove the insulated filament winding from the flyback transformer. If there is a sponge-rubber pad between the core and the mounting bracket, remove it. Caution: the core is made of a brittle ferrite material in an epoxy binder. Therefore, do not force or twist it in any way. Gently remove the rectifier plate connector lead from the coil. Make sure that you can identify the high-voltage winding terminals.

Solder a two-lug terminal strip to each side of the mounting bracket as shown in Fig. 4. Wrap a layer of insulating tape on the bare horizontal ferrite core, feeding the tape between the core and the mounting bracket. Wind 12 turns of #18 stranded hookup wire in a close layer around the core. This forms *L1*. Solder the ends to the bottom insulated tie points of the terminal strips. If the winding does not pack tightly, remove it, and rewind with a slightly larger wire.

Wind a five-turn coil, using the same gauge wire, on top of *L1*. This forms *L2*. Solder the two ends to the top lugs on the terminal strips. Wind *L2* in the same direction as *L1* with the windings spaced evenly across *L1*.

Using the same type of wire originally used for the filament winding (removed in an earlier step), wind the two one-turn coils between the turns of *L2*. These form *L4* and *L5* and will be connected to the filaments of the rectifier tubes. Locate one end of the high-voltage winding and connect it to the nearest ground—the transformer mounting bracket will do.

Obtain a metal box, large enough to accommodate the transformer and the rectifier tubes, yet small enough to fit between the metal column and the side of the cabinet. It should be less than 10" high (including the insulator for the high-voltage feedthrough) so that the entire assembly will fit below the shelf in the cabinet.

The transistor is mounted on a heat sink using appropriate hardware and insulating material. Coat both sides of the transistor insulator with silicone heat-conducting grease. The heat sink assem-

bly is mounted at the outside lower end of the rear panel to keep it away from corona discharges set up in the high-voltage section (see Fig. 5). Appropriate holes must be drilled in the rear panel to mount the heat sink and to provide access to the transistor terminals.

The flyback transformer is mounted at one side of the power supply enclosure (see Fig. 6) so that the high-voltage and filament leads face the two rectifier tubes. The tube sockets (of the anti-corona type) for the rectifiers are mounted on ceramic insulators, one on the top and the other on the bottom of the enclosure. Mount the other components as shown in Fig. 6 and wire them, point-to-point, as shown in Fig. 3. Take care to make neat, smooth joints and avoid sharp edges to prevent corona discharges. Resistor *R2* connects from the rectifiers to the feedthrough insulator.

Checkout. Connect a 2- to 3-volt d.c. source to the battery input terminals,

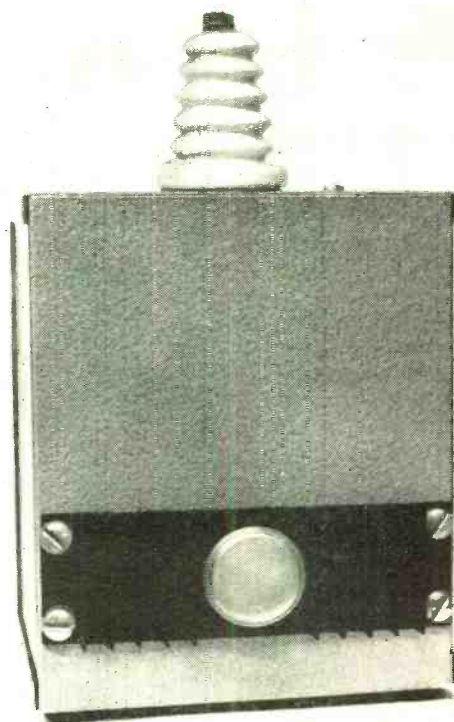
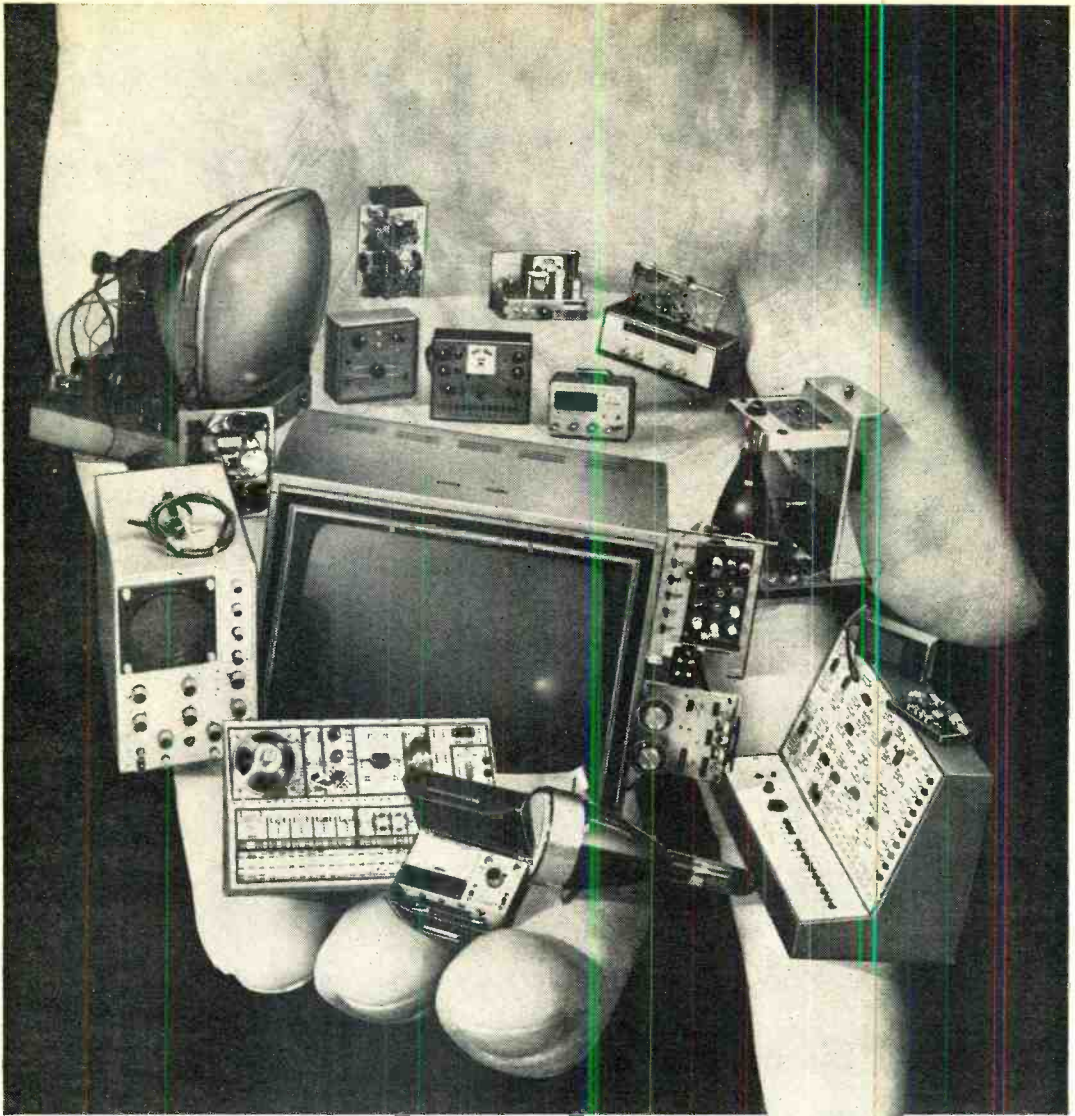


Fig. 5. The transistor is electrically insulated from its heat sink, and the heat sink is attached to the rear of the metal chassis. Make sure that no metal can contact the case (collector) of Q1.



NTS puts a whole new world at your fingertips.

NTS home training can put a whole new way of life in the palm of your hand. A new, exciting job, a much bigger income is now easily within your reach.

NTS training is something special. We provide all the kits you need for the most effective training. National Technical Schools sends kits with every course, and teaches you to build and test a

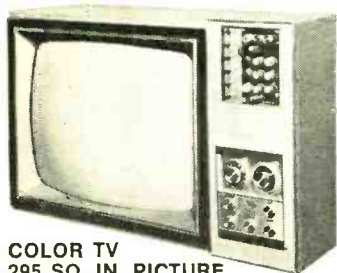
wide range of professional equipment — the same kind of equipment you'll actually use on the job. That's the NTS "Project Method" — training that's practical and in-depth. You learn everything from fundamentals to the latest innovations. From beginning to end, NTS makes it fascinating and fun to learn this way. And all you need is a little

spare time and an interest in electronics.

Each year, men are moving into important new jobs, or their own businesses, straight out of NTS electronics training. NTS is what's happening to men everywhere. Check the coupon. Take hold of the career you want most. Do it now. No obligation. No salesman will call.

We pack your electronics course with kits to make your training fast. You'll enjoy every minute of it.

NTS COLOR TV SERVICING

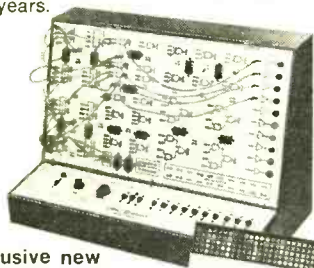


COLOR TV
295 SQ. IN. PICTURE

NTS training provides an easy way to become a professional home-entertainment service technician. You receive a big screen Color TV with many unique features. The unit even includes self servicing equipment that permits you to make all normal test operations. No additional test equipment is needed for adjusting your set. In addition you get an AM-SW radio, Solid-State radio, Field-Effect Transistor Volt-Ohmmeter, and Electronic Tube Tester. You learn about Electronic principles and trouble shooting, hi-fi, multiplex systems, stereo, and color TV servicing.

NTS COMPUTER ELECTRONICS

This is the future. And it's happening now. The number of computers will increase many times in the next few years.



Exclusive new Compu-Trainer®

If card is missing check coupon and mail for free color catalog and sample lesson. Now.



National Technical Schools

4000 S. Figueroa St., Los Angeles, Calif. 90037

Please rush Free Color Catalog and Sample Lesson, plus information on course checked below. No obligation. No salesman will call.

NTS offers a solid grounding in computer operation, wiring, data processing and programming. One of the 10 important kits included is our exclusive Compu-Trainer®. It's a fully operational computer logic trainer — loaded with integrated circuits — the first ever offered in home study. It introduces you quickly to how, what, when and why of computers ... from theory to practical servicing techniques. This unit is capable of performing 50,000 operations per second.

NTS ELECTRONICS COMMUNICATIONS

Choose from two exciting courses to get into the big-paying fields of transmitting and receiving equipment: (1) The FCC License Course. (2) The Master Course in Electronic Communications (more comprehensive, with Citizens' Band Two-Way-Radio). Either Communications program qualifies you for your FCC First Class Commercial Radio-Telephone License — NTS assures you will pass this FCC exam within six months after successfully completing your course or your tuition is refunded. Kits include an Amateur-Phone 6 Meter VHF Transceiver — NTS exclusive, 6 transistor Solid-State Radio, Volt-Ohmmeter (fully transistorized).



5 Watt AM Transmitter/Receiver

NTS AUTOMATION/ INDUSTRIAL ELECTRONICS

Let NTS put you into the age of electronic controls. Systems Automation is rapidly becoming the emphasis of modern industry. Your NTS training in automation electronics includes equipment like a 5" wide band Oscilloscope. You also get the new NTS Electronics Lab. It's an exclusive NTS experimental laboratory — a complete workshop that simplifies learning about solid-state, miniature and integrated circuits.



5" Oscilloscope

CLASSROOM TRAINING AT LOS ANGELES

You can take classroom training at Los Angeles in sunny Southern California. NTS occupies a city block with over a million dollars in facilities devoted exclusively to technical training. Check box in coupon.

NATIONAL TECHNICAL SCHOOLS

WORLD-WIDE TRAINING SINCE 1905

4000 South Figueroa Street
Los Angeles, Calif. 90037, U.S.A.

APPROVED FOR VETERANS

Accredited Member: National Association of Trade and Technical Schools; National Home Study Council.

- Master Course in Color TV Servicing
- Color TV Servicing
- Master Course in TV & Radio Servicing
- Practical TV & Radio Servicing
- Master Course in Electronic Comm.
- FCC License Course
- Master Course in Electronics Tech.
- Industrial and Automation Electronics
- Computer Electronics
- Basic Electronics

Name _____ Age _____

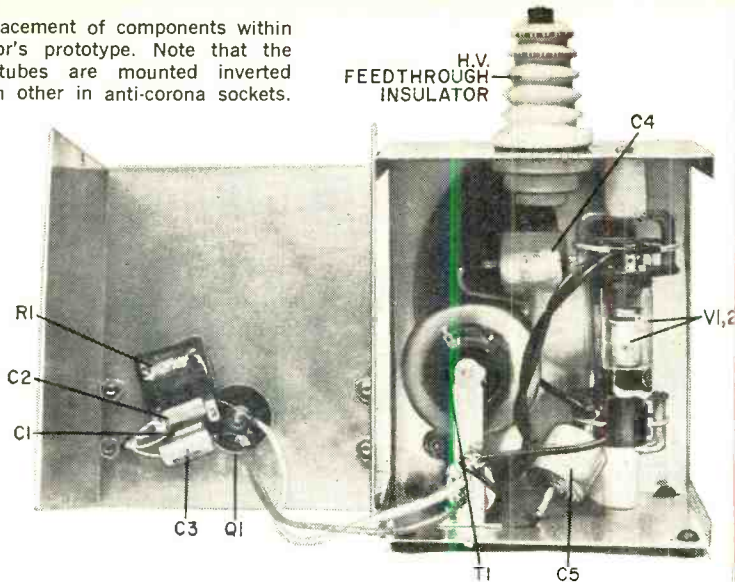
Address _____

City _____ State _____ Zip _____

- Check if interested in Veteran Training under new G.I. Bill
- Check if interested only in Classroom Training at Los Angeles

Dept. 205-060

Fig. 6. Placement of components within the author's prototype. Note that the rectifier tubes are mounted inverted from each other in anti-corona sockets.



with positive to ground. A pair of flashlight D cells will do. The circuit will oscillate with this low supply but voltage levels will be down. Try to draw an r.f. arc from the transformer high-voltage terminal using a well-insulated screwdriver. If there is no arc, even a small one, reverse the connections to *L2*. In some cases, it may be necessary to add or remove turns from *L1* to obtain the proper core saturation.

Once you know the oscillator is working, connect 12 volts d.c. to the circuit and, being extremely careful, measure the voltage at the filaments of the rectifiers. It should be between 1.2 and 1.5 volts a.c. Make sure that no part of the voltmeter or your body touches ground when making this measurement! Once filament voltage has been confirmed, shut down the power supply, discharge the high-voltage feedthrough, and assemble the metal enclosure, making sure that it is completely sealed.

As a final check, connect the circuit to a heavy-duty 2- to 12-volt power supply (such as a battery charger) capable of handling 5 amperes. Connect an ammeter in the input lead. With a 2-volt input, the ammeter should indicate about 0.5 ampere. With 12 volts input, current should be about 2 amperes. The reading could go as high as 5 amperes if the circuit is loaded with a high-voltage experiment.

DANGER! There is at least 10,000 volts present on the top of the feedthrough insulator! Treat it with the greatest respect. Don't try to draw arcs with a pencil, and don't short this terminal to ground when the supply is energized. Also, don't touch the transistor case while the supply is operating.

Shut down the power supply, discharge the high-voltage feedthrough, and place the power supply in the cabinet as shown in Fig. 7, with the battery terminals and pilot light facing front.

Mark the point on the metal column that is directly opposite the top of the high-voltage feedthrough. Drill a $\frac{1}{4}$ " hole at this point and deburr it. Obtain a length of high-voltage plastic tubing long enough to go from the top of the feedthrough to the center of the column. For still better insulation, insert another piece of $\frac{1}{8}$ " tubing inside the first one. Feed a length of #22 or smaller wire through this insulator leaving enough at one end to make a connection to the feedthrough and a small loop at the other (column) end, at the center of the crosshairs.

Attach a length of fine nichrome wire (obtained by dismantling an old wire-wound resistor) to the loop of wire at the bottom crosshair (wind the copper wire around the nichrome) and to the crosshair itself for support. Pass the nichrome

wire up through the column and attach the top end to the upper nylon crosshair, making sure that the wire is reasonably straight and does not come near the sides of the metal column. Cut off any loose end.

(Nichrome wire is used here because the high voltage produces a tiny corona which would ruin copper wire but does not harm the nichrome. Steel wire can be used, but it will eventually rust and disintegrate.)

Do not use any mechanical device to connect the nichrome wire to the high-voltage lead since this joint will have to be disassembled occasionally so that the column can be removed for cleaning. Replace the plastic cover on the bottom of the column. Place the blower container on top of the column, making sure that the exhaust is toward the front of the cabinet. Secure this can in place by wrapping tape around the seam. Make a wire connection between the metal column and the metal chassis of the power supply by soldering at both ends.

The appearance of the stack can be improved by spraying it with paint, but don't get paint in the blower mechanism or on the high voltage leads.

Line Operation. The Transcipient can be operated from a conventional low-voltage d.c. power supply such as that shown in Fig. 8. Mount the transformer on the small shelf in the cabinet and the filter capacitor on a clamp secured to the cabinet wall. A TV power socket is mounted on a small piece of metal and located on the cabinet wall so that power can be applied to the system only when the front panel is in place. A TV "cheater" supplies power to the socket and is mounted on the front panel aligned with its receptacle. The two rectifier diodes are mounted on a heat sink on the rear wall. Wire the power supply point-to-point as shown in Fig. 8.

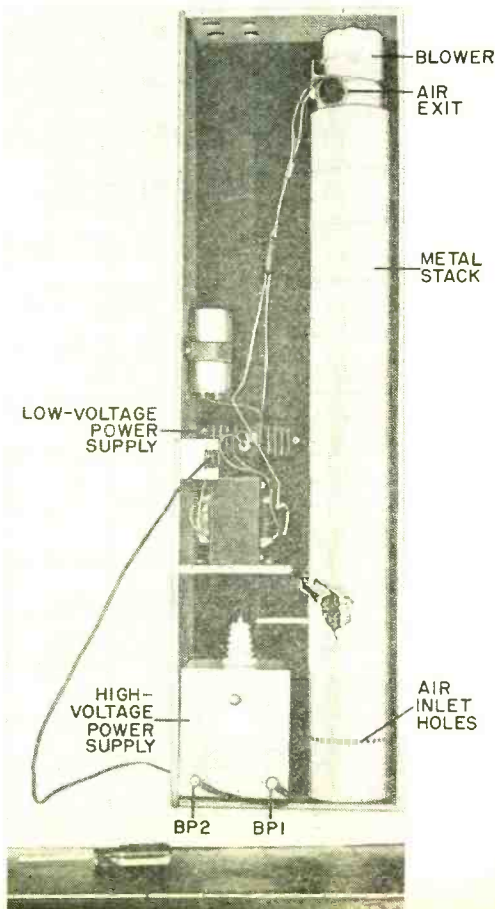
If the fan motor is of the 12-volt variety, wire it to the power supply, observing proper polarity. If the motor is 117 volts a.c., connect it in parallel with the input to the power transformer.

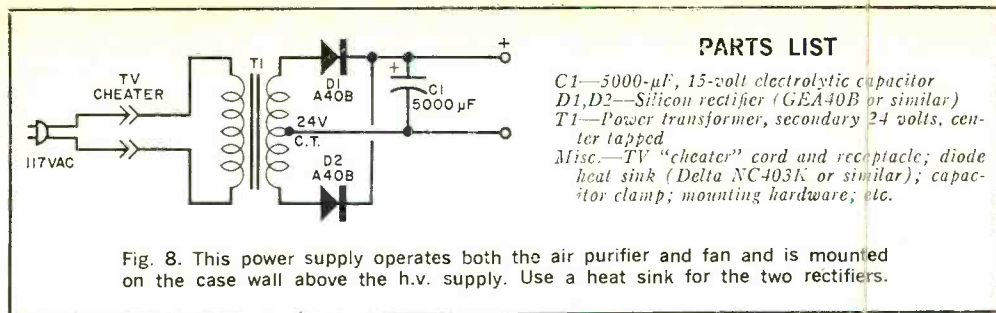
Final Assembly. The finished project should now look like the one in Fig. 7. The column, with the fan at the top, should just fit snugly within the cabinet.

It may have to be wedged if too loose; or the cabinet top may have to be hollowed out slightly if the fit is too tight. Recheck all wiring, making sure that the metal column is connected to the positive battery input (at ground) on the supply. Make sure that the high-voltage feed is in the clear and that all parts attached to the cabinet walls are on tightly.

Obtain a length of flexible vacuum cleaner hose. The hose should be covered with plastic rather than cloth to make cleaning easier. Wash the hose thoroughly, inside and out, with a good detergent and then rinse thoroughly. Cut a hole in the front of the cabinet so that the end of the hose and the exhaust on the fan can be mated. It may be necessary to make up some type of size-matching device if the two are greatly different in size. Check all dimensions, and then mount the front panel on the cabinet using a few screws to secure it.

Fig. 7. Coffee-can stack was painted before installation to make a more pleasing appearance. The four top vents provide cooling for power supply.





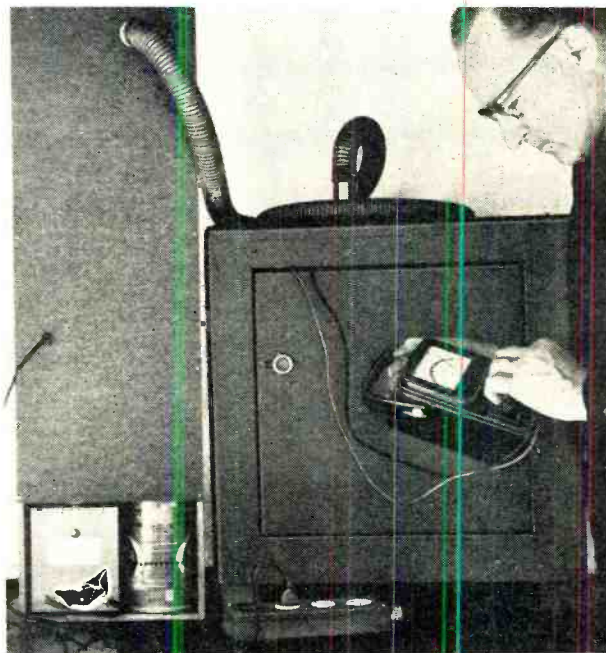
Operation. With the front panel in place and the a.c. supply connected, the blower should start up and moving air should be felt at the outlet. Hold a lighted cigarette or other source of smoke near the ring of holes at the bottom of the column. If everything is working properly, smoke will enter the column, but the air coming out will be clean with no trace of smoke.

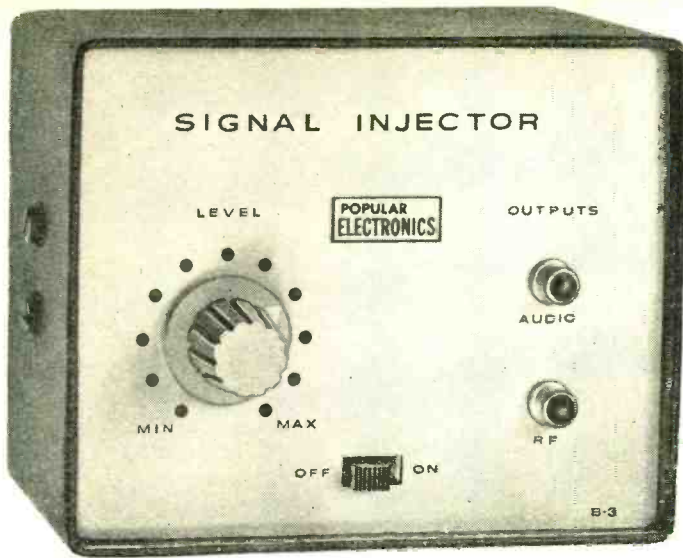
For conducting delicate experiments or for drying paint on small items, another cabinet such as that shown in Fig. 9 can be constructed. The vacuum-cleaner hose is coupled to this cabinet; and a small vent in one wall permits the air to escape from the interior. The front door can be constructed with a glass insert and a light bulb can be installed within the cabinet for viewing experiments.

When it comes to removing pollen, dust, etc. from an area as large as a room, the Transcipitor will work—to an extent. It does not have the capacity to handle a very large room; but, in a small room, with windows and doors closed, its effect is quite noticeable.

Every so often, inspect the metal column for dust accumulation. Remove the column from the cabinet, hold it over a paper sack and remove the bottom plastic cover. Shake the column gently to remove dust particles stuck to the sides. Clean the inside walls before reinstalling the column in the cabinet. The stack can be inspected from the outside by shining a flashlight through the bottom array of holes and looking into the other holes. If you can see the dirt, empty the column.

Fig. 9. The front door does not come down to the bottom of the cabinet to allow for air intake and observation of the indicator lamp. To prevent operation when the door is open, a TV “cheater” system is door operated.





Build a Signal Injector

QUICK WAY
TO CHECK
AUDIO CIRCUITS

BY DON LANCASTER

THE SIGNAL INJECTION technique, most electronics technicians agree, is the quickest way to troubleshoot radio receivers and audio equipment. Using a signal injector, he can check an entire unit with only one hookup—no matter how complex the receiver or amplifier. Time-consuming voltage or ohmmeter checks are required only when the faulty stage is located.

Whether you plan to use it on the job or at home to keep your own equipment in working order, you will find many uses for the "IC Signal Injector" described here. This Injector is basically a battery-

powered 1000-Hz multivibrator that generates square waves. The amplitude of the output square waves is continuously variable and is great enough, with the amplitude control wide open, to drive or test a loudspeaker. The Injector also provides a wide band-width r.f. signal which is extremely useful in testing AM receivers.

Construction. As you can see from the schematic diagram in Fig. 1, the circuit of the IC Signal Injector is very simple. However, since it does employ an integrated circuit with closely spaced pin leads, it is essential to use a printed circuit board from the source listed in the Parts List, or you can make your own with the aid of the etching guide provided in Fig. 2.

Install the components on the board as shown in the photo in Fig. 3, paying particular attention to the orientation of the indexing groove on IC1. Use a low-wattage, fine-pointed tool when soldering component leads to the foil pattern on

IC
EXPERIMENTER'S
CORNER

NO. 5 of 5

June, 1970

43

the PC board, and apply heat only long enough to allow the solder to flow.

Next, mount $R3$, $C3$, $S1$, and $J1$ and $J2$ on the front panel. Use $\frac{3}{8}$ "-long spacers and #6 machine hardware to fasten the circuit board to the front panel in the position shown, and interconnect with hookup wire all components and the circuit board.

Battery $B1$, two 1.5-volt D cells connected in series, can be mounted to the rear panel of the enclosure with a dual-cell holder. However, if you plan to use another type of d.c. supply (see sidebar), make the hookup wires connected to $S1$ and ground on the circuit board as long as necessary.

How To Use. To test the IC Signal Injector, close $S1$ and connect a small 3.2- or 8-ohm loudspeaker to the AUDIO jack on the front panel. Rotate LEVEL control fully clockwise; you should hear a 1000-Hz tone coming from the speaker. An

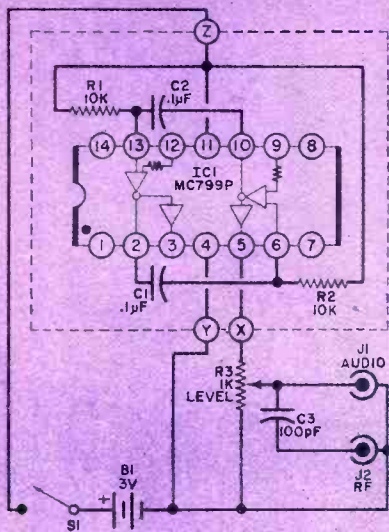


Fig. 1. One-IC circuit provides both audio and r.f. tracing signals; each output signal is continuously variable in amplitude.

PARTS LIST

- $B1$ —Two 1.5-volt D cells in series
 $C1, C2$ —0.1- μ F, 10-volt disc capacitor
 $C3$ —100-pF disc capacitor
 $IC1$ —MC799P or HEP571 dual-buffer integrated circuit (Motorola)
 $J1, J2$ —Phono jack
 $R1, R2$ —10,000-ohm, $\frac{1}{4}$ -watt resistor
 $R3$ —1000-ohm linear-taper potentiometer
 $S1$ —S.p.s.t. slide or toggle switch
Misc.—Keystone #176 battery holder; control knob; 5" x 4" x 2 $\frac{1}{2}$ " case; spacers; #6 machine hardware; hookup wire; solder; etc.
Note—The following items are available from Southwest Technical Products Corp., Box 16297, San Antonio, TX 78216: etched and drilled printed circuit board, \$1.78; complete kit of parts, including prepunched vinyl-clad case but less batteries, \$7.30, postpaid in U.S.A.

HOW IT WORKS

Integrated circuit $IC1$ in Fig. 1 is a dual inverting buffer. Each input has two outputs, one low- and the other high-level. The low-level outputs are cross-coupled to each buffer input through capacitors $C1$ and $C2$ and charging resistors $R1$ and $R2$ to form an astable multivibrator.

One high-level output is fed to level control $R3$ and AUDIO jack $J1$ as a 1000-Hz signal. Internal isolation between low- and high-level outputs prevents heavy loads—or even short circuits—from stalling or radically shifting the operating frequency of the multivibrator.

Capacitor $C3$ couples only the high-frequency energy (derived from the harmonic-rich leading edges of the square waves generated by the multivibrator) of the audio waveform to RF jack $J2$. At $J2$, there is available a series of impulses that can be used for signal injection and other AM radio receiver work.

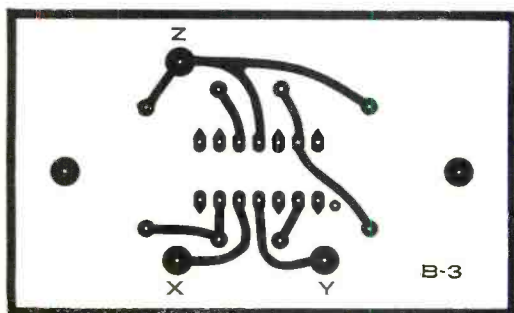
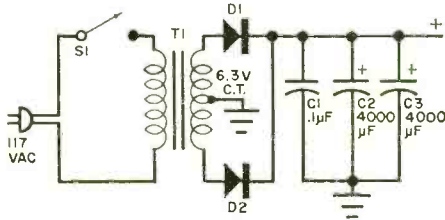


Fig. 2. Actual size circuit board etching guide is designed to accommodate components not mounted on front panel of the project. Isolated dots locate mounting holes.

IC EXPERIMENTER'S POWER SUPPLY

The low-voltage power supply whose schematic is shown here can be used with any and all of the "IC Experimenter's Corner" projects presented in this series. Note that the supply has full-wave rectification and very good filtering to supply a stable d.c. voltage source for



the IC projects. Output voltage from the supply is approximately 6.3 volts d.c.

The power supply can be assembled by any conventional method, including point-to-point wiring. Very few components are used and they are relatively small in size. Hence, the supply can be fit inside any of the enclosures suggested for the various projects.

PARTS LIST

- C1—0.1- μ F disc capacitor
 - C2, C3—4000- μ F, 15-volt electrolytic capacitor
 - D1, D2—25 PIV, 1.5-ampere silicon diode
 - S1—S.p.s.t. slide or toggle switch
 - T1—6.3-volt, center-tapped filament transformer (Stancor No. P-6134 or similar)
 - I—line cord with plug
 - Misc.—Hardware, hookup wire, solder, etc.
- Note—A kit of parts for the power supply is available at \$4.50 postpaid from Southwest Technical Products Corp., 219 W. Rhapsody, San Antonio, TX 78216.

alternate test method would be to connect the audio output of the injector to an audio system, setting the LEVEL control as needed, and listen for the tone.

The output from the RF jack on the injector is rich in harmonics to allow the checkout of the front ends in most receivers, including those that operate in the standard AM broadcast spectrum.

For example, assume you want to troubleshoot a faulty AM transistor radio receiver. First check the receiver's battery under load with a voltmeter. If it checks out good, proceed to your signal injection tests:

First inject the audio signal into the speaker, directly across the speaker terminals. If you hear the tone, the speaker is in operating order. Then, stage by stage, work back toward the front end of the receiver until the signal ceases to be heard from the receiver, at which time you will have located the faulty stage. (Note: when injecting into the audio circuits, use the audio output; for the i.f. and r.f. stages, use the r.f. output.) You should end up at the antenna input if the receiver is in perfect operating order.

If you wish to change the audio frequency of the tone, you can change the values of C1 and C2. Higher capacitance values decrease the signal frequency, and vice versa.

Current drain for the IC Signal Injector is on the order of 80 mA at 3 volts d.c., assuring long life from a battery supply, especially if you use heavy-duty alkaline cells. If you prefer a built-in power supply, however, you can build your own by referring to the schematic diagram shown in box above. Or, you can use any good bench supply capable of delivering 1.6 to 6 volts d.c. at about 100 mA for full-load operation.

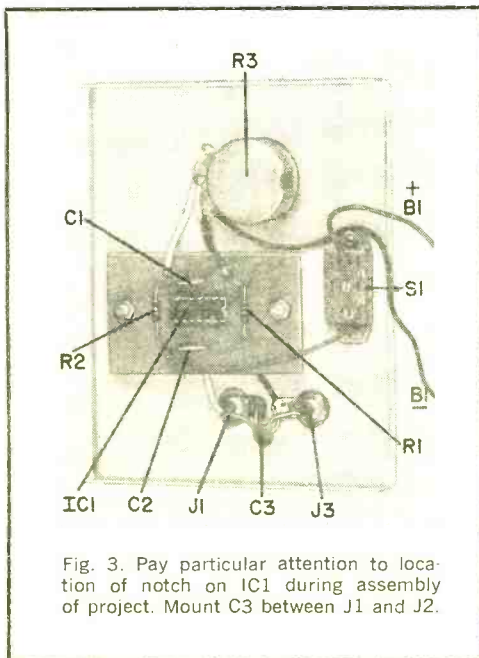


Fig. 3. Pay particular attention to location of notch on IC1 during assembly of project. Mount C3 between J1 and J2.

PHOTOCELL MOTOR CONTROL DEMONSTRATOR

*Great learning
and
teaching aid*

BY BOB KOVAL

THE MOST EFFECTIVE teaching aids and the most interesting science fair projects are working models of mechanical, electrical, or electromechanical devices. The photocell motor control demonstrator described here falls into this category. Unlike most such projects, however, it offers audience participation. Passersby are invited to turn on and off a motor themselves simply by shining a beam of light on a photocell.

By spreading out the circuit on a large $15\frac{1}{4}'' \times 24''$ piece of $\frac{1}{2}''$ -thick plywood and running the wires on the front surface of the board a twofold objective is achieved. First, the project has eye appeal (an important consideration at science fair judgments). Second, since there is no hidden circuitry on the rear of the board, it is more convenient to explain how the system operates.

How It Works. Photocell *PC1* (see Fig. 1) is connected across the emitter/base junction of transistor *Q1*. Then when light strikes *PC1*, a slight voltage is generated which causes *Q1* to conduct. This, in turn, causes relay *K1* to be energized and power is applied to the motor. Simultaneously, *K3* is energized and latched in since its circuit is completed

through the contacts of *K2*. (If the light beam is removed from *PC1*, relay *K1* will drop out.) The entire sequence takes place in just a few milliseconds, so just a quick flash of light on *PC1* is enough to operate the circuit.

To turn off the motor, a beam of light must be directed at *PC2*, which generates a voltage that causes *Q2* to go into conduction. Now, *K2* is energized, opening its normally closed contacts and de-energizing *K3*. When *K3* drops out, the motor circuit is opened, and the motor stops operating. Again, the action is almost instantaneous.

Construction. Begin by selecting a $\frac{1}{2}''$ -thick piece of clear plywood measuring $15\frac{1}{4}'' \times 24''$ (or substitute a close-grained piece of particle board, cut to the same dimensions). If you use plywood, make sure the top lamination is birch so that there will be less of a tendency for the wood to crack after it has been painted. Sand the wood to obtain a smooth, flat finish, remove all wood dust, and apply a thin coat of sealer.

When the sealer has thoroughly dried, sand and clean once more. Now paint the board with thin coats of white or light gray enamel, using as many coats as nec-

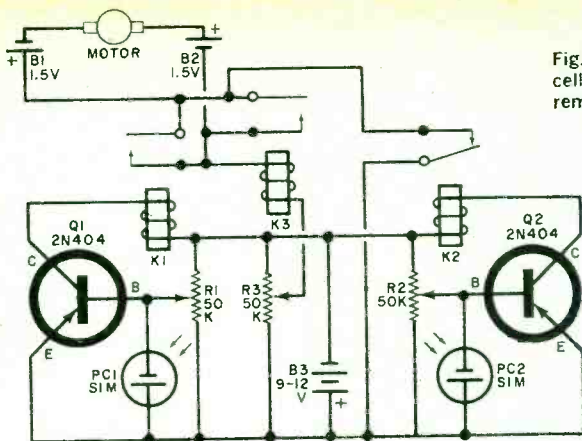


Fig. 1. Relays, operated by photo-cell-driven amplifiers, apply and remove power from the motor.

PARTS LIST

B1, B2—1.5-volt D cells (see text)
 B3—9- or 12-volt power source (see text)
 K1-K3—1000-ohm, 7-mA s.p.s.t. relay (Sigma Type 11F-1000-G/SIL)
 PC1, PC2—Solar cell (International Rectifier Corp. SIM, or similar)
 Q1, Q2—2N404, 2N1191, or SK3006 transistor

R1, R2—50,000-ohm, linear taper potentiometer
 R3—50,000-ohm miniature trimmer potentiometer
 1—24" x 15 1/2" piece of 1/2" birch plywood or close-grained particle board
 1—3-volt d.c. hobby motor
 Misc.—6-32 brass machine hardware; crimp-on solder lugs; #14 plastic-jacketed solid hookup wire; sandpaper; sealer; white or light gray paint; battery connectors (2) for B1; etc.

essary to give a hard reflective finish. Remember to sand and clean between each coat and allow sufficient time to dry.

Note that the board is painted before the holes are drilled. The reason for this is to prevent the screws from picking up paint when they are pushed through the holes.

Using the information provided in Fig. 2, drill 1/8" holes for parts mounting on the board. Drill through from the painted side so that as the drill point exits from the wood, any flaking or chipping will be on the unseen side of the board. (Note that holes for the relays are not dimensioned into the drawing since different types of relays require different mounting hole centers.)

Pass a 6-32 x 1" brass machine screw through each hole from the rear of the board, and fasten in place with machine nuts. Next, mount the motor in its appropriate location by any convenient method, and epoxy cement PC1 and PC2 in place. The size D flashlight batteries are soldered to #14 solid wire and connected to the appropriate screws with solder lugs, making a neat and sufficiently strong arrangement.

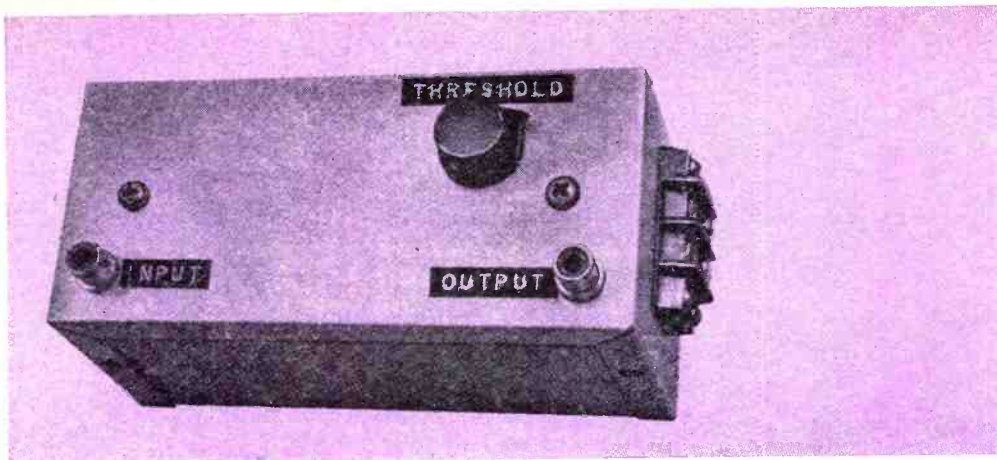
The potentiometers should be made self-supporting by soldering their con-

tacts to solder lugs (see Fig. 3) and fastening them to the screws. The leads of transistors Q1 and Q2 are simply connected to the screws directly or via solder lugs.

Wiring is best accomplished by cutting the leads to the appropriate sizes and attaching to each end a solder lug, after which the leads are simply bolted into place with machine nuts. Use #14 solid, plastic insulated wire to obtain the neatest layout and so it can be seen for a considerable distance. Remember, the bold appearance of the wire adds to the success of your project.

The power source for the transistors consists of two 9-volt batteries in parallel. No switch is provided, since the battery connector easily snaps on and off the batteries. (When the demonstrator is to be used for long periods, such as at Science Fairs, two heavy-duty 6-volt lantern batteries can be connected in series and hooked up to the circuit in place of the 9-volt batteries.) Mount the 9-volt batteries as shown, and route their wires behind the board. The dashed lines in Fig. 3 show where the battery leads terminate in the circuit.

No switch is provided in the motor power supply since the D cells supply no



Simple SCA Adapter

FM MUSIC SANS COMMERCIALS

BY WILLIAM F. SPLICHAL, JR.

MANY FM BROADCAST stations transmit a secondary frequency-modulated subcarrier that is offset from the regular carrier frequency by 67.5 kHz. This sub-carrier channel (called SCA for Subsidiary Communications Authorization) provides the listener with continuous music programming that is uninterrupted by commercials, news, weather, or other reports. The SCA should not be confused with the 38-kHz subcarrier normally used to carry the complementary channel in normal stereo FM broadcasts; it is a separate system which no home entertainment receiver is designed to receive.

Perhaps you are already familiar with the SCA broadcasts. You hear them in such places as restaurants, supermarkets, and other commercial establishments as "background" music. If you would like to receive the SCA subcarrier with your present receiver, all you need is a simple multiplex adapter that can extract the program material without interference from the "normal" program channel transmissions from the FM station.

Adding the SCA Adapter (described in this article) to your FM receiver will in no way interfere with the receiver's normal operation. If anything, it will add to the receiver's versatility by providing an extra source of entertaining music.

How It Works. Referring to Fig. 1, the frequency-modulated SCA subcarrier is introduced into the adapter through input jack *J1* where it encounters a 67.5-kHz parallel-tuned circuit consisting of radio frequency choke *RFC1* and capacitor *C3*. Then it is passed through a high-pass filter made up of *C2*, *C4*, and *RFC2*. From here, the frequency-modulated subcarrier is amplified and limited by *Q1* and *Q2*, respectively. At this point, the frequency modulation will have been converted to a series of pulses whose frequency is the same as that of the original frequency modulation.

Once amplified and limited, the signal is coupled to monostable multivibrator stage *Q3-Q4*. Here, *Q3* is normally conducting, while *Q4* is held in cutoff. Po-

tentiometer *R12* acts as a "threshold" control, allowing only the higher amplitude 67.5-kHz subcarrier signals to trigger the multivibrator. Each time the multivibrator fires, a negative pulse is generated at the collector of *Q4*.

Since the width of the generated pulse is essentially independent of the triggering rate, the average voltage level appearing at the collector of *Q4* will be directly proportional to the triggering frequency (the 67.5-kHz modulation) up

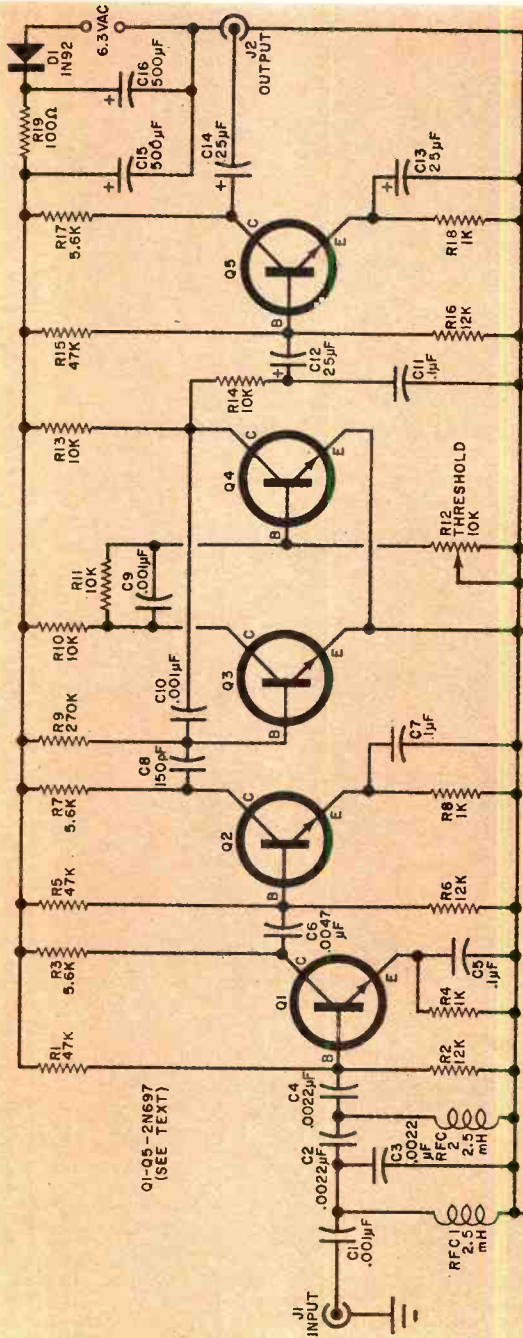


Fig. 1. Adapter circuit is almost a complete unit. All that is needed to make it totally independent is to connect a 6.3-volt, 1-ampere filament transformer, power switch, and a.c. line cord at upper right.

All resistors
1/2-watt

R1, R5, R15—47,000-ohm
R2, R6, R16—12,000-ohm
R3, R7, R17—5600-ohm
R4, R8, R18—1000-ohm
R9—270,000-ohm
R10, R11, R13, R14—10,000-ohm
R12—10,000-ohm linear-taper potentiometer
R19—100-ohm

C1, C9, C10—0.001-μF disc capacitor
C2, C4—0.0022-μF (2200-pF) disc capacitor
C5, C7, C11—0.1-μF disc capacitor
C6—0.0047-μF (4700-pF) disc capacitor
C8—150-pF disc capacitor
C12, C14—25-μF, 15-volt electrolytic capacitor
C15, C16—500-μF, 15-volt electrolytic capacitor
D1—1N92 diode
I1, I2—Phono jack
Q1, Q2—2N697 transistor (see text)

Misc.—5" x 2 1/4" x 2 1/4" aluminum utility box;
control knob; two-contact screw-type barrier block; tag strip (or printed circuit board); hookup wire; solder; hardware, etc.

PARTS LIST

- C1, C9, C10—0.001-μF disc capacitor
- C2, C4—0.0022-μF (2200-pF) disc capacitor
- C5, C7, C11—0.1-μF disc capacitor
- C6—0.0047-μF (4700-pF) disc capacitor
- C8—150-pF disc capacitor
- C12, C14—25-μF, 15-volt electrolytic capacitor
- C15, C16—500-μF, 15-volt electrolytic capacitor
- D1—1N92 diode
- I1, I2—Phono jack
- Q1, Q2—2N697 transistor (see text)

to the point where Q_1 is cut off completely all the time. This point is slightly above the audio spectrum; therefore, the multivibrator will deliver an output for the full subcarrier modulation range.

Power for the SCA adapter is derived from any 6.3-volt, 60-Hz, source. A built-in half-wave rectifier/filtering circuit, consisting of $D1$ and $C15$, $C16$ and $R19$, provide the d.c. voltage required for proper operation of the adapter.

Although the SCA Adapter so far described makes use of five commonly available *npn* silicon transistors, germanium or *pnp* transistors can be substituted. Merely change the polarities or values of a few components. The changes that must be made for transistor substitutions are given in the table on the next page.

Construction. The circuit of the SCA Adapter is really very simple, lending itself to just about any type of chassis

A NOTE ABOUT THE LAW

There is no FCC Regulation that prohibits the reception of Subsidiary Communications Authorization broadcasts for private home entertainment purposes. However, there are regulations that do prohibit the use of SCA programs to promote business (or any other reason) by commercial establishments unless such businesses are authorized subscribers and use only the SCA channel to which they subscribe.

Transistors can be installed in sockets or soldered directly to lugs. Locate a.c. filter capacitors on underside of terminal board and the barrier block at end of box.

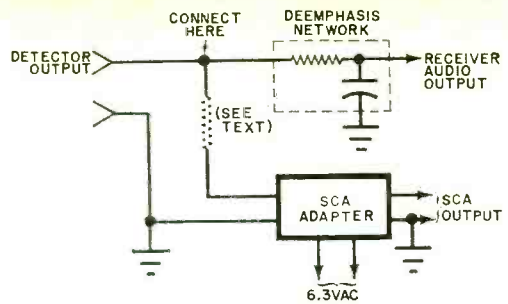
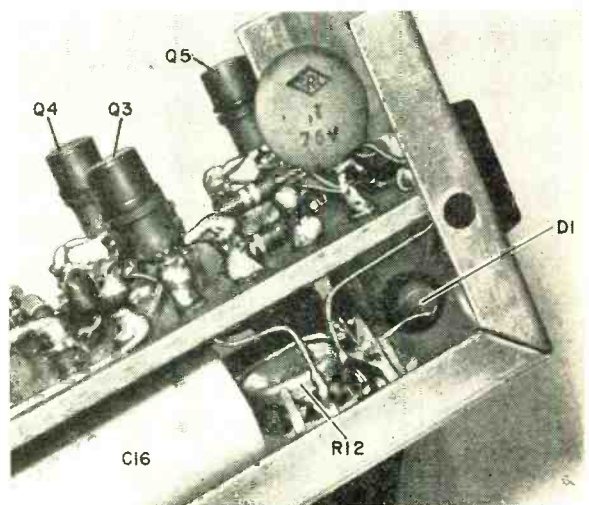


Fig. 2. For proper operation, SCA adapter must be connected between detector and deemphasis net.

construction you prefer. While the photos show the original prototype assembled on a double-row solder-terminal tag strip, which is essentially point-to-point wiring, a printed circuit board layout would have been just as appropriate for assembly.

The circuit can be assembled in any enclosure you choose. A 5" x 2 1/4" x 2 1/4" aluminum utility box was used for the prototype, with $J1$ and $J2$ mounted at opposite ends of the top surface. Threshold control $R12$ was also mounted to the top, while to one side is located a screw-type barrier block for bringing in the 6.3 volts a.c. for the power supply circuit.

Installation and Use. To operate properly, the SCA adapter must be electrically connected to your receiver. This is a simple process that can be performed in a couple of minutes.



Before digging into your receiver (or tuner), carefully study its schematic diagram to locate the detector stage and resistor/capacitor de-emphasis network. Then, study the receiver layout to locate the point indicated in Fig. 2. You will notice that the SCA Adapter's input must be connected to a point *between* the detector output and the de-emphasis network. If the connection is made *after* the de-emphasis network, no SCA signal will pass through!

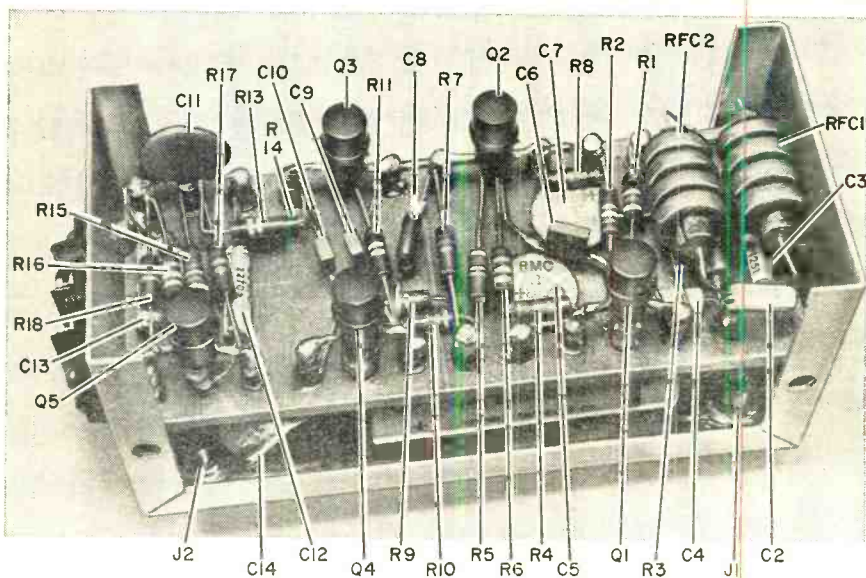
The filter (SCA Adapter) was designed to operate most efficiently with a 3000-ohm load. So, it may be necessary to couple the adapter to the receiver circuit via an isolation resistor with a value of a few thousand ohms, depending on your particular receiver.

Now, connect a twisted-pair cable between the 6.3-volt a.c. winding on your

receiver's power transformer and the screw-type barrier block on the adapter. If 6.3 volts a.c. is not available from your receiver, use a separate 6.3-volt filament transformer. Then connect a shielded audio cable from the adapter's output jack to the auxiliary (AUX) input jack on the rear apron of your receiver.

Turn on and tune the receiver to a local FM station known to be broadcasting SCA program material. Set the receiver's source switch to AUX and function switch to MONO, and adjust threshold for the clearest audio. (Note: in some receivers, when the source switch is moved out of the TUNER or FM position, the power is disconnected from the tuner. In this case, connecting the output of the adapter to the receiver's AUX input will not work—a separate amplifier will be required unless you can figure a

Although a printed circuit board or multi-lug terminal strips could be used, wiring is just as simple with a parallel-row terminal board having 13 solder lugs per row as shown here.



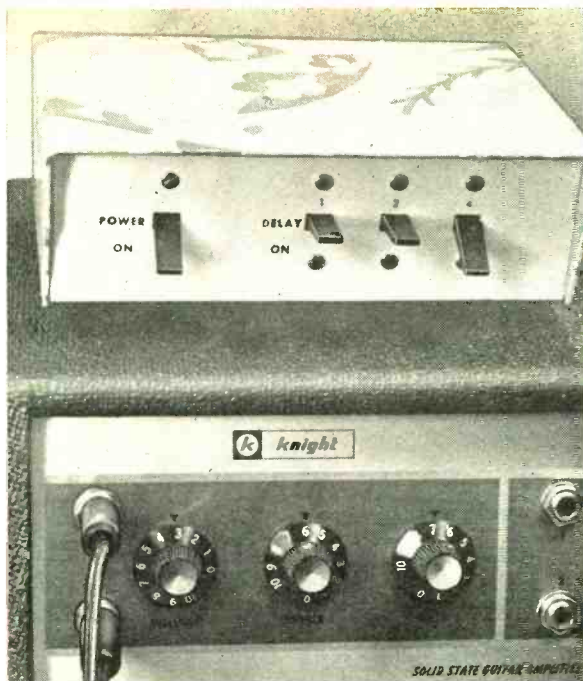
TRANSISTOR SUBSTITUTION TABLE

Transistor Type	Changes
PNP silicon	Invert polarities of D1, C12-C16
NPN germanium	Change R2, R6, R16 to 6800 ohms
PNP germanium	Combine both of the above changes

way of restoring power to the tuner when the source switch is in the AUX position.

Tuning across the dial, you may find that several SCA programs are available. This is true especially in the large cities where different types of background music are required by the subscribers. So much the better for your choice of programs.

-30-



MODIFY YOUR ELECTRONIC GUITAR SOUND

VARY "ATTACK" TIME WITH THIS DELAY UNIT

EVERY MUSICAL instrument owes its unique sound to a certain combination of inherent characteristics. For instance, the number of harmonics produced, combined with their magnitudes and phase relationships, play an important role in creating the instrument's distinctive sound.

Another important characteristic is attack time—the speed with which sound is built up after a tone is initiated. Reed instruments such as the clarinet produce sounds which can be described as "soft" because they have a relatively slow attack caused by the time it takes for the reed to build up to its maximum vibration. On the other hand, instruments such as the guitar have a very rapid attack because maximum amplitude vibration is started as soon as the string is plucked or struck.

By changing an instrument's attack, we can make it sound different and, at the same time, not like any other instrument. That is what the "Attack Delay Unit" (ADU) does for the guitar. By slowing down the guitar's attack, a brand new sound can be obtained. The effect

can also be produced by recording a guitar passage on tape and then running the tape backwards through the player. Instead of sharp, clean tones, a hard-to-describe "whoop" is heard for each note played. Although the note is on pitch, it doesn't sound like it belongs to any known musical instrument.

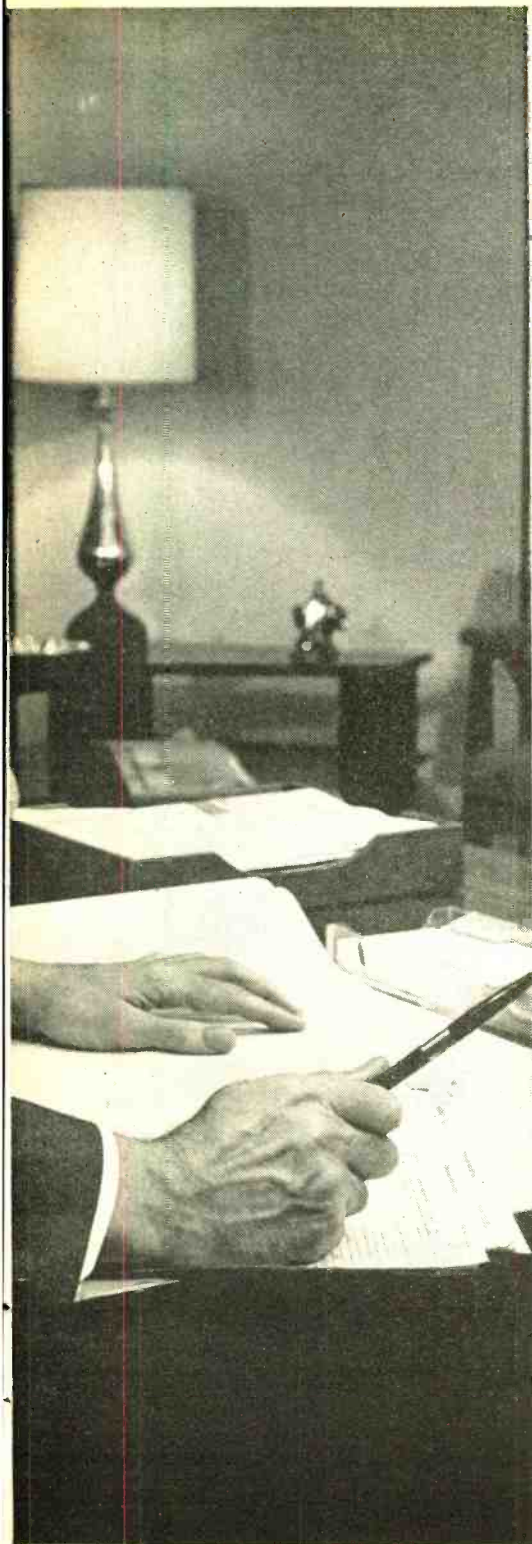
Using the ADU, attack can be delayed for a very short period so that only the sound of the pick hitting the string is eliminated or it can be delayed so that the music builds up over the length of a run. A foot control switch makes it easy to delay particular notes selectively.

Construction. The circuit of the ADU, shown in Fig. 1, is fabricated on a printed circuit board whose foil pattern is shown in Fig. 2. Once the board has been made (or purchased), install the components as shown in Fig. 2. Be sure to install the semiconductors and electrolytic capacitors correctly. Use a heat sink (such as long nose pliers) on the transistor and diode leads while soldering to avoid possible thermal damage. Also, use a low-power (35 watts) soldering iron.

**“Get more
education
or
get out of
electronics
...that’s my advice.”**



**IN-DEPTH
COVERAGE OF
SOLID STATE
ELECTRONICS
...including
integrated circuits!**



Ask any man who really knows the electronics industry.

Opportunities are few for men without advanced technical education. If you stay on that level, you'll never make much money. And you'll be among the first to go in a layoff.

But, if you supplement your experience with more education in electronics, you can become a specialist. You'll enjoy good income and excellent security. You won't have to worry about automation or advances in technology putting you out of a job.

How can you get the additional education you must have to protect your future—and the future of those who depend on you? Going back to school isn't easy for a man with a job and family obligations.

CREI Home Study Programs offer you a practical way to get more education without going back to school. You study at home, at your own pace, on your own schedule. And you study with the assurance that what you learn can be applied on the job immediately to make you worth more money to your employer.

You're eligible for a CREI Program if you work in electronics and have a high school education. Our FREE book gives complete information. Mail postpaid card for your copy. If card is detached, use coupon below or write: CREI, Dept. 1206A, 3224 Sixteenth Street, N.W., Washington, D.C. 20010.

Founded 1927



Accredited Member of the National Home Study Council



CREI, Home Study Division
 McGraw-Hill Book Company
 Dept. 1206A 3224 Sixteenth Street, N.W.
 Washington, D.C. 20010

Please mail me FREE book describing CREI Programs. I am employed in electronics and have a high school education.

NAME _____ AGE _____

ADDRESS _____

CITY _____ STATE _____ ZIP CODE _____

EMPLOYED BY _____

TYPE OF PRESENT WORK _____ G.I. BILL

I am interested in

Electronic Engineering Technology Computers

Space Electronics Nuclear Engineering Technology

Industrial Automation NEW! Electronics Systems Engineering

APPROVED FOR TRAINING UNDER NEW G.I. BILL

PARTS LIST

- C1, C12—100- μ F, 6-volt electrolytic capacitor
- C2, C4, C5—0.1- μ F disc capacitor
- C3—30- μ F, 6-volt electrolytic capacitor
- C6, C7, C10—5- μ F, 6-volt electrolytic capacitor
- C8—10- μ F, 6-volt electrolytic capacitor
- C9—2- μ F, 6-volt electrolytic capacitor
- C11, C13—0.005- μ F, disc capacitor
- C14—0.01- μ F, disc capacitor
- C15—100- μ F, 15-volt electrolytic capacitor
- C16—1000- μ F, 10-volt electrolytic capacitor
- D1, D2—1N4001 diode
- J1—J3—Open-circuit phone jack (National 2N5139 or similar)
- Q1—Q6—Transistor, pup (National 2N5139 or similar)
- Q7—Field-effect transistor (Motorola MPP102)
- R1, R3—33,000-ohm
- R2, R19—100,000-ohm
- R4, R11, R16, R17—4700-ohm
- R5, R6, R9, R14—1000-ohm
- R7—47-ohm
- R8—10,000-ohm
- R10—2.2-megohm
- R12—220,000-ohm
- R13—470-ohm
- R15—100-ohm
- R18, R22—680-ohm
- R20—47,000-ohm
- R21—50,000-ohm trimmer potentiometer (PC type)
- S1—S4—S.p.s.t. toggle switch (see text)
- T1—Power transformer, secondary, 12.6 volts at 300 mA.

All resistors
1/2-watt

Misc.—Chassis, line cord, rubber grommet, 7-
lag terminal strip, 3/4" insulated spacers (4),
rubber feet (4), wire, solder, etc.
Note—The following are available from PAIA
Electronics, P.O. Box 14359, Oklahoma City,
OK 73114: etched and drilled PC board, \$3.00,
postpaid continental U.S.A.; complete kit of
parts including PC board and case, \$19.25,
plus postage for 3 lb. Oklahoma residents add
3% sales tax.

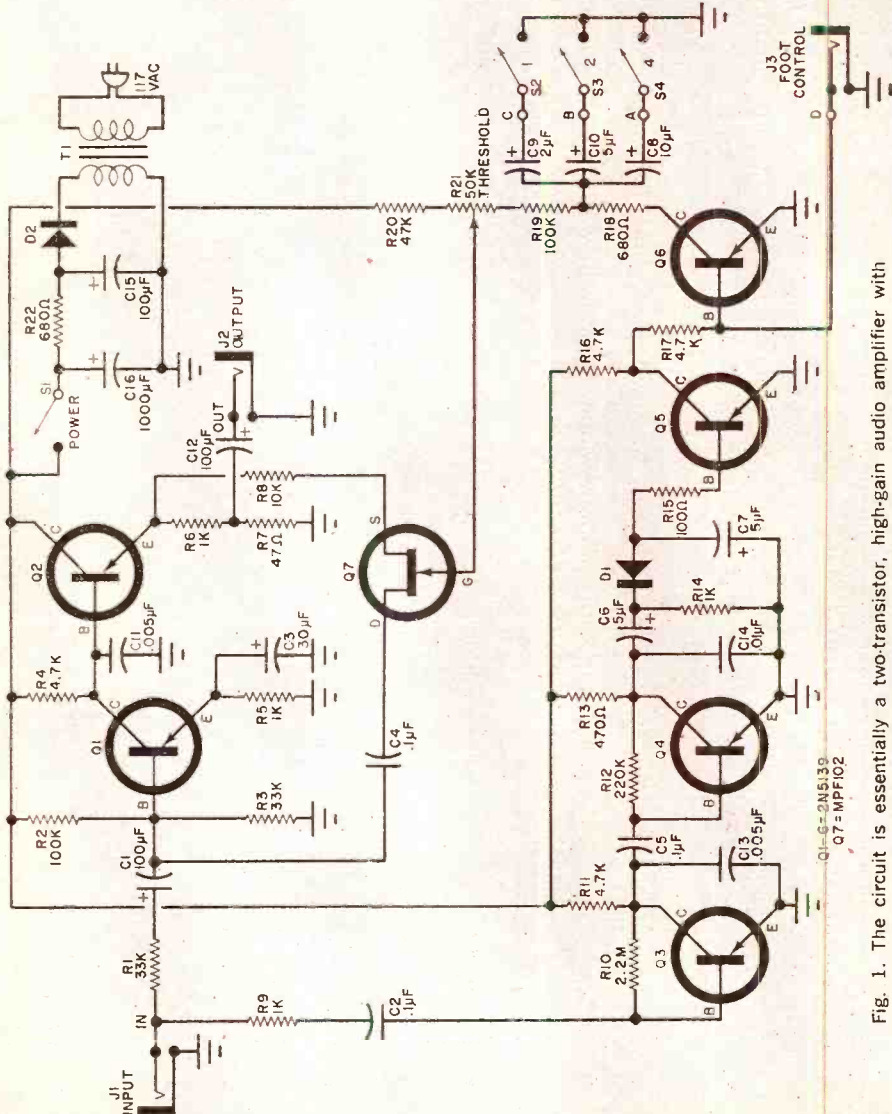


Fig. 1. The circuit is essentially a two-transistor, high-gain audio amplifier with negative feedback controlled by a FET. The remainder of the circuit generates the feedback control signal which is determined by a switch-selected capacitor.

Q1—G-2N5139
Q7—MPP102

Connect sufficiently long leads to the various external connection pads before mounting the board in the chassis.

Almost any type of metal chassis may be used as long as it will hold the PC board, the power transformer, and the associated rectifier and will permit the installation of four switches on the front and three phone jacks on the back.

The choice of switches for S_2 , S_3 , and S_4 should be made carefully. During use, it may be necessary to manipulate these

switches rapidly in various combinations so they should have large paddle-type handles and operate with a light pressure. Any type of s.p.s.t. switch may be used for power switch S_1 .

Mount the power transformer (T_1) and a seven-lug terminal strip at one end of the chassis and drill a hole in the wall for the line cord. Put a grommet in this hole. Build up the power supply and attach the positive lead to S_1 . Do not ground either side of the a.c. to the chas-

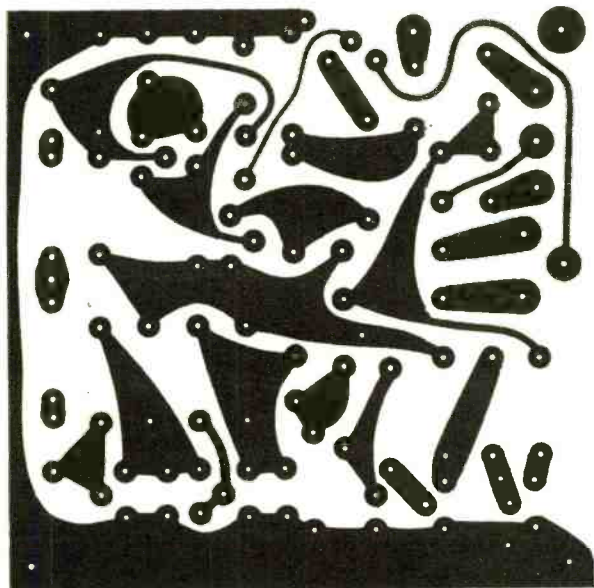
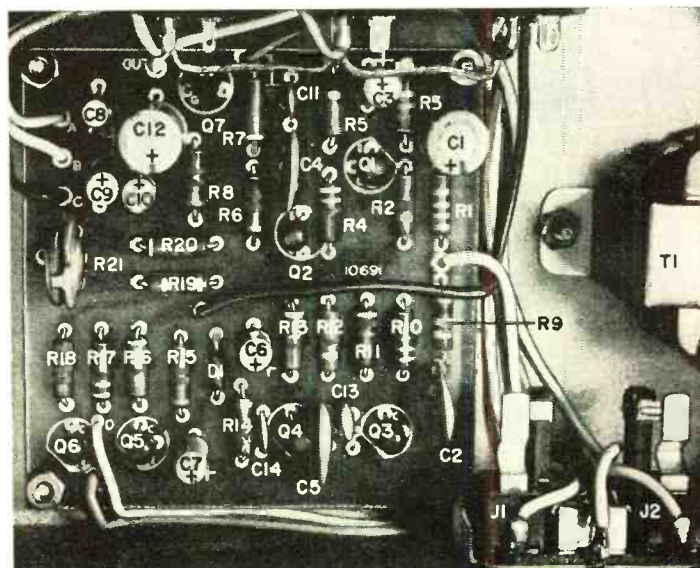
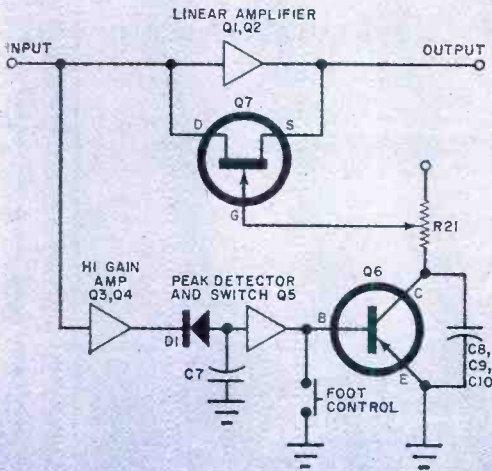


Fig. 2. The actual size foil pattern is shown at the left, while component installation is illustrated below. The PC board is mounted on four spacers, and the power supply is mounted elsewhere in the cabinet. Alternatively, the ADU can be built in an existing amplifier console, with the control switches readily accessible to user.



HOW IT WORKS



With no signal input, transistor $Q6$ is turned on and acts as a short circuit around the switch-selected capacitors $C8$, $C9$, and $C10$. The gate bias of FET $Q7$, in this case, is such that the FET is turned on and its low source-to-drain resistance results in a large amount of feedback for the linear amplifier formed by $Q1$ and $Q2$. Since this amplifier is designed for unity gain with no feedback, for all practical purposes, no input signal passes through it.

When there is an input signal, it is amplified by high-gain amplifier $Q3$ and $Q4$ and then rectified by peak detector $D1$. The resulting d.c. voltage appearing across $C7$ turns on $Q5$, which then turns off $Q6$ and allows the selected capacitor to charge. As the capacitor charges, the bias on $Q7$'s gate changes to increase its source-to-drain resistance. The increase in resistance around the linear amplifier loop decreases the feedback and causes the gain to go from nearly zero to approximately unity. The time required for this to take place depends on the capacitance value selected. Trimmer potentiometer $R21$ acts as a threshold control and sets the bias on the gate of $Q7$ when $Q6$ is on.

When the foot control switch is closed, the base of $Q6$ is shorted to ground, allowing the selected capacitor to remain charged. This holds the linear amplifier at unity gain and defeats the attack delay.

sis. Mount the three capacitor-selector switches ($S2$, $S3$, and $S4$) on the front wall and three phone jacks ($J1$, input; $J2$, foot control; and $J3$, output) on the rear wall.

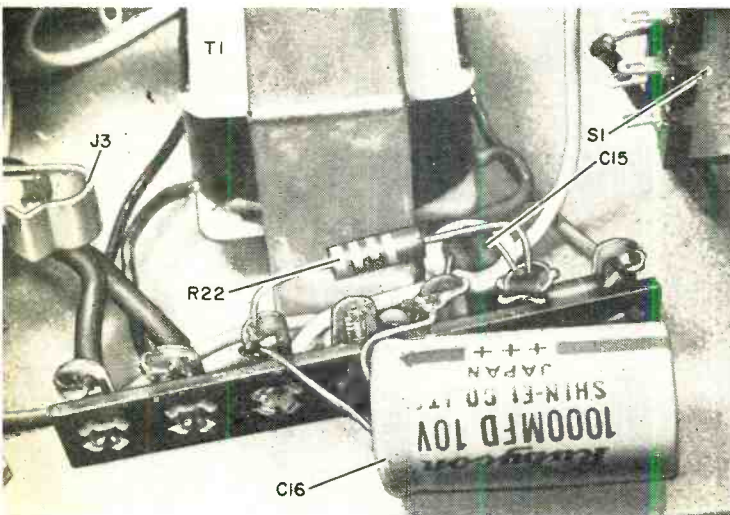
Mount the PC board on four $\frac{1}{4}$ " insulated spacers so that $R21$ will be accessible from the side. Wire the complete circuit as shown in Fig. 1. Put four rubber feet on the chassis bottom to keep it from slipping around when in use.

Setup. Prepare the unit for operation

by running a short length of cable from the output of the ADU to your amplifier input and plugging the instrument output into the ADU input. For the time being, do not use the foot control switch. Turn the ADU on and set the delay to 4.

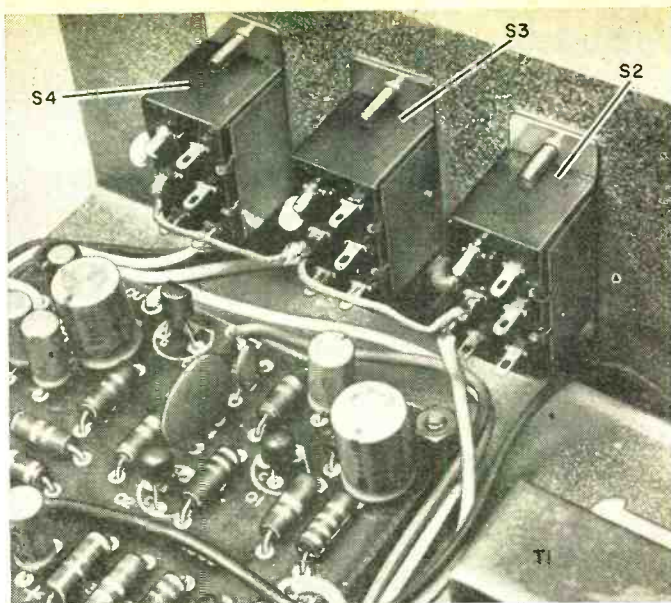
Since a certain minimum signal is required to operate the delay unit, the instrument's gain should be turned up almost all the way and the volume adjusted by using the amplifier's control.

The only thing that needs adjustment in the ADU is potentiometer $R21$. At one



The power supply is built up on a seven-lug terminal strip which also carries the input a.c. line cord. The arrangement is not critical, but make sure that neither side of the power line makes electrical contact with the chassis.

When obtaining switches for the delay selection, remember that they may be operated a considerable number of times, in various orders, and possibly in a hurry. Pick switches with long handles and smooth operation.



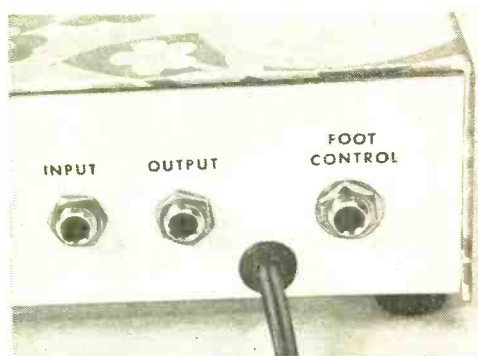
end of this pot's rotation, there is little or no delay in the instrument attack: with the opposite setting, there is no sound for an instant and then the volume will come up full. Between these two extremes, are a variety of settings which can be selected strictly as a matter of personal taste. Ideally there should be very little or no sound when the note is first struck, followed immediately by a noticeable increase in volume with a smooth glide to maximum.

Operation. The three delay switches on the ADU can be used singly or in combinations to yield up to seven different delays. The numbers above the switches represent some arbitrary unit of delay (which varies with the setting of $R21$) and may be added together to get the longer delays. For instance, if the "2" and "4" switches are down, the attack delay is 6 times longer than if only the "1" switch is down.

Since the ADU requires a short, no-signal dead time for the circuits to reset, all strings on a guitar must be silenced before the next chord or note is struck. If single notes are being played, just lifting the finger from the finger board will ordinarily accomplish the deadening, but for chords with open strings, it is necessary to deaden the strings with the palm of the strumming

hand. The resetting time is actually very short (on the order of a tenth of a second) so very rapid runs can be played with the delay still occurring on each note.

The foot control switch is a single-pole, single-throw type and can be housed in a



Phone jacks for input, output, and foot control are located most conveniently on back of chassis. Colorful vinyl cloth was used to cover prototype.

sturdy case of metal or a block of wood. The switch can be a push-on/push-off type but experience has shown that a spring-loaded, normally closed switch works best. With this arrangement, selective delay can be accomplished by pressing the switch when delay is desired and releasing it to sustain a note. ~~-30-~~

BUCK UP BASS RESPONSE WITH A SUPER WOOFER

BY ERIC PAVLAK

ONE OF THE BEST methods of getting good bass response from your stereo system is to use a super-powerful woofer in addition to your regular speaker systems. Since the very lowest bass notes, those under 100 Hz, are non-directional, a single super woofer setup will serve both stereo channels. Consequently, your regular speaker systems can have less than full bass response and still be quite satisfactory.

A super woofer, for best results, should be powered by a separate amplifier. This provides several distinct advantages over systems connected by an LC crossover network. For one thing, the independent bass amplifier (actually, it can be any amplifier with very good bass response) can be adjusted without interfering with the main amplifier. So, the volume level of the super woofer can be set in relationship to the rest of the system without introducing resistance in series with any of the speakers—a resistance that would prevent good speaker damping.

Also, a separate amplifier allows the lowest bass to be increased without upsetting the balance of the rest of the system. And it permits the use of steep-sloped filters of 18-dB/octave that would

otherwise be impractical. One further advantage of using a single super woofer is that no phasing problems exist.

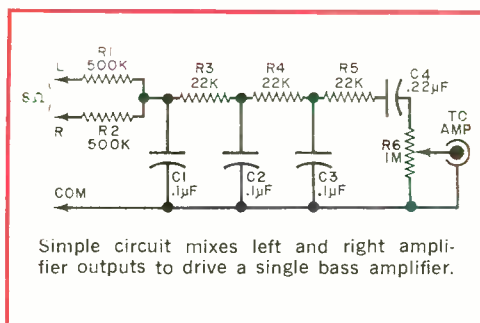
The amplifier for the super woofer should be coupled to both the right and left channel outputs of your regular amplifier. For this, you will need a circuit like that shown in the schematic diagram. This circuit is simpler than an electronic crossover network with active elements and it introduces less distortion than a passive filter which uses both capacitive and inductive elements.

Crosstalk introduced by this adapter circuit is minimal. Signal level is adjusted by control R6. When assembling the circuit, mount it inside a shielded box. Parts placement is not critical, but be sure to use shielded cable between the circuit output and the input of your super woofer amplifier.

The super woofer itself can be as big as your listening room will allow and as expensive as your budget can take. Several 12" or 15" woofers can also be used; or, better yet, you can use one of the horn-type woofers available from Altec or Klipsch.

The best place in a room to set the super woofer is in a corner. And since only the lowest frequency sounds are to be radiated, it matters little if furniture or thin draperies are located between the super woofer and listener. But be wary of standing waves which can result when large, flat surfaces are directly opposite the speaker.

A super woofer is just the thing to improve weak bass systems. Adding one is relatively simple and inexpensive yet it can provide really thunderous lows without mid-bass thumping or booming. —30—



KOOL-KEEPING KWIZ

BY CARL KOHLER

How well do you cope with life's bruises and abrasions?

IT'S A PHILOSOPHICAL fact that into every existence a little pain must crawl. The question is, "How well do you withstand the pain?" To find out, take the following pseudological test, consisting of several theoretical **Life Situations** no electronics enthusiast is likely to encounter. The test does not purport to increase your self-knowledge, but it may add to your confusion. A dubious scoring system, found at the conclusion of the test, is based on whichever of the multiple-choice reactions you instinctively and neurotically selected. No cheating now—and good luck!

Supermouth

*While attending a social gathering, you hear a loud-mouthed type bragging that his CB antenna has broken the height regulations for years, and you realize that he is unaware that another guest is the FCC Field Engineer. What would you do?

- A. Whisper a warning.
- B. Feel embarrassed for him.
- C. Belch nervously.
- D. Listen carefully as he prattles on.
- E. Ask the lout to repeat his brag to the FCC employee.

Hurry—I'm Double Parked

*A neighbor with more gall than most borrows your constant-current ohmmeter. Within an hour he brings it back, asking you to repair it so he can get on with his testing. What would you do?

- A. Graciously comply with his request.
- B. Coldly refuse.
- C. Feel stunned.
- D. Talk real dirty.
- E. Brandish a soldering iron at him.

It Is Nobler to Receive

*Quite accidentally you learn that your wife is planning to give you a costly set of living-room furniture and drapes for a wedding anniversary present. What would you do?

- A. Feel pleased.
- B. Try to talk her out of it.
- C. Give her a bound file of POPULAR ELECTRONICS project schematics.
- D. Surprise her with a collection of every other Heathkit item on the market.
- E. Sulk.

I've Gathered You Here

*Having generously agreed to share your vast knowledge of solid-state theory with an electronics club, your lecture is off to an impressive start when your mind goes blank on the whole subject. What would you do?

- A. Admit you can't remember a thing.
- B. Ask for help in getting restarted.
- C. Smoothly divert their interest to a faked-out history of electronics.
- D. Sing and dance.
- E. Sprint for the nearest exit.

I Gave at the Office

*Having worked long and hard to build your own specially modified Universal Frequency Counter, you find your wife has given it to a shut-in to take apart for the therapeutic fun of having something to do. What would you do?

- A. Consult your attorney about institutionalizing her.
- B. Report her to the Westinghouse people.
- C. Stamp your foot.
- D. Offer the shut-in some tools.
- E. Proceed with the next project—from the safety of another country.

Part 95 Violation

*You're a bachelor and you've finally succeeded in becoming chummy enough with the curvy little blonde who moved into the next-door apartment to be invited over for a friendly drink. Once there, you discover that the delectable creature is blithely operating a CB rig with a 250-watt linear. What would you do?

- A. Reprimand her sternly.
- B. Report her to the FCC.
- C. Decide to meet another girl.
- D. Drink your drink and say nothing.
- E. Teach her how to work skip on channels 24A and 24B.

But I Learned That in School

*By sheer accident your cable TV has gone berserk and channel 13 is showing "educational" stag films. What would you do?

- A. Tune to another channel.
- B. Have the cable TV send a repairman.
- C. Keep the information to yourself.
- D. Call the neighbors in for a party.
- E. Write a protesting letter to FCC Commissioner Johnson.

Wanted: One Anechoic Chamber

*After laboring diligently for weeks you've scratch-built a magnificent hi-fi stereo system with speakers and a beautiful cabinet of your own design. Just as you're ready to try it out, your mother-in-law, who is visiting you and your wife, becomes ill, and the doctor prescribes quietude—bordering on complete silence—for her recovery. What would you do?

- A. Wait with clenched teeth.
- B. Have the doctor's credentials checked out.
- C. Go on an aspirin diet.
- D. Buy her a matched set of earplugs.
- E. Write a complaining letter to "Dear Abbey".

You'll Never Get It off the Ground

*A slight acquaintance lets you talk him into installing your multi-proportional R/C system in his newly built, highly expensive model airplane—and it crashes into splinters. What would you do?

- A. Offer to replace the airplane.
- B. Buy him a cup of consolation coffee.
- C. Deride his flight dexterity.
- D. Yawn.
- E. Bill him for your ruined system.

Of Course They Could

*While casually tuning your short-wave receiver, you overhear two stations discussing a plot to kidnap the Statue of Liberty and hold it for ransom. What would you do?

- A. Call President Nixon direct.
- B. Mail an anonymous letter to the FBI.
- C. Jam their radio frequency.
- D. Fly United to Bedloe's Island to see it happen.
- E. Offer to sell a statue of Sophia Loren to the Government as a replacement.

CHECK YOUR SCORE HERE

All righty, now that you've checked the various reactions to these dismal *Life Situations*, it's analysis time. If you have mostly A reactions, it could indicate that you are Mr. Straight Arrow. Mostly B reactions might mean that you're a flexible individual. Mostly C reactions clearly indicate a warm, human

will to survive. Mostly D reactions show that you tend to have an enviable Kool indeed. If you have mostly E reactions, it's a sad hint that you are an accomplished loser. Of course, if you actually bothered to check any choices at all, you're putting us on more than we did you with this screwy thing. —30—

the Product gallery

REVIEWS AND COMMENTARY ON ELECTRONIC GEAR AND COMPONENTS

GENERAL COVERAGE RECEIVER (Heathkit GR-78)



MAYBE it's hard to believe that a kit which goes together as readily as does Heath's new GR-78 can look so attractive and also perform so well—but it's true. With its low-profile styling, handsome two-tone gray cabinet and polished aluminum bezel, this 190-kHz to 30-MHz solid-state portable receiver matches in appearance what it can do as a top-notch performer.

Within just a little more than 24 hours after its assembly and calibration—and using only the receiver's built-in 39" whip antenna—this reviewer's GR-78 had logged stations on all six continents!

Let's take a look at what makes such performance possible in a receiver costing only \$130. The two factors most important in determining the value of any general-coverage receiver are its selectivity and its useful sensitivity. The term "useful sensitivity" is significant, because the ability of a receiver to bring in weak stations is determined, not by gain alone, but by gain in the presence of a low receiver-noise level. Unless a signal can make it through the hiss or "shot noise" generated in the front end of every receiver, the signal cannot be heard, no matter how high the gain of the stages which follow.

The Important Front End. The tuner in the GR-78 uses the latest in MOSFET's* to maximum advantage, providing high gain, minimum crosstalk, and a low inherent noise level (typically 3.5 dB at 200 MHz for these transistors). It is especially well shielded and, most important of all to the average kit builder, it has short leads for minimum stray capacitance. It is by far the **easiest** tuner to assemble that we have ever seen.

Each of the tuner's four stages is wired as an assembly on a separate PC board and then plugged into its own shielded compartment. The result is a neat, factory-made appearance and high gain with high stability. Six ferrite-core pretuned coils are used in each stage since the receiver covers 190 kHz to 30 MHz in six settings of the band switch instead of the usual four or five.

The GR-78 can be aligned without instruments if necessary; but to peak it for top performance and sensitivity all you need is a calibrated signal generator and the receiver's own built-in S-meter. It isn't mentioned in the Assembly Manual, but you can zero the calibration in very close to the dial legends by zero-beating the built-in 500-kHz crystal calibrator against WWV, then zero-beating your signal generator against the calibrator. We aligned our GR-78 by this method and have found, so far, that calibration has been satisfyingly stable for a receiver in this price range. There is some slight drift for the first few minutes as the receiver "warms up," but even this would not be noticeable were it not for the GR-78's outstanding selectivity.

Latest in I.F. Amplifiers. Sensitivity is of little value without selectivity—especially on

*They are RCA's dual-gate MOSFET'S with built-in gate-protection circuits. Special back-to-back diodes are formed into the transistor pellet and connected between each of the two gates and the source electrode of the FET. These diodes shunt any transient potential exceeding ± 10 volts, thereby protecting the gates in the course of general handling and application. Thanks to the dual-gate configuration, feedback capacitance is low (high gain is obtained without neutralization), oscillator pulling is virtually nonexistent and the a.v.c. is as simple as that of a receiver using vacuum tubes.

crowded short-wave bands. An i.f. pass band only 7 kHz wide at 6 dB down, with adequately steep sides, provides this receiver with excellent selectivity. It's done with ceramic filters—four tiny plastic encapsulated units, each no larger than your little fingernail.

Not only do the ceramic filters determine the intermediate frequency and the width of the i.f. pass band, they do away with i.f. alignment forever! There are no i.f. transformers to adjust in the GR-78. The ceramic filters will remain tuned within 0.5% for at least 10 years! Intermediate frequency is 455 kHz except on the highest frequency setting of the bandswitch (18 to 30 MHz), where a double-conversion circuit is used with a first i.f. of 4.034 MHz. The oscillator for the second mixer is crystal controlled.

Other Features. The GR-78 has both a highly stable BFO and CW/SSB product detector. A MOSFET, identical to those used in the front end, is the product detector and there is no significant pulling of the BFO. Also included are a switchable series noise limiter; switchable amplified a.v.c.; a receive-standby switch; manual r.f. and a.f. gain controls; and bandspread with speed reduction tuning and a dial which can be calibrated for either the amateur bands or the international broadcast bands, as you prefer. It's as simple as selecting the appropriate decal for the bandspread dial drum.

The 9.6-volt internal battery is a high-quality nickel-cadmium rechargeable unit with a 500-mA-hr capacity, which means that, beginning with a full charge, you can

run the receiver for about eight hours at a reasonable listening level before recharging is needed. A transformer-type 120/240-volt a.c. charger is built into the receiver, and there's a separate circuit for charging from a 12- to 15-volt source—such as the electrical system of a car or boat.

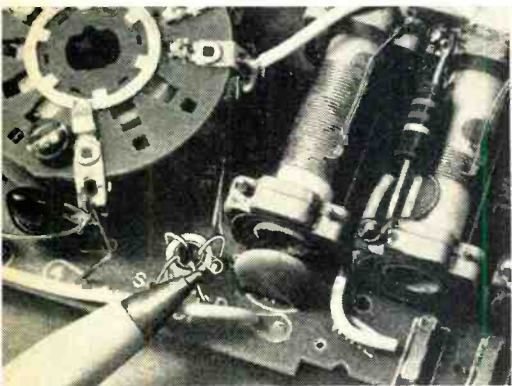
The GR-78 went together more easily than many a kit-type broadcast-band receiver this reviewer has assembled. You don't need the dexterity of a circus performer to build it—there are no hard-to-reach places for either the screwdriver or the soldering iron. Assembly instructions are clear, easily understood, and thoroughly detailed with illustrations. Heath supplies a 120-page Assembly Manual with the kit.

However, take care in soldering the trimmers to the PC boards in the tuner. There is plenty of room to accommodate the solder tabs on the trimmers, but assembly without careful attention to the positioning of the tabs can result in a short circuit to adjacent soldered connections. Look all around the tab for clearance before applying the iron.

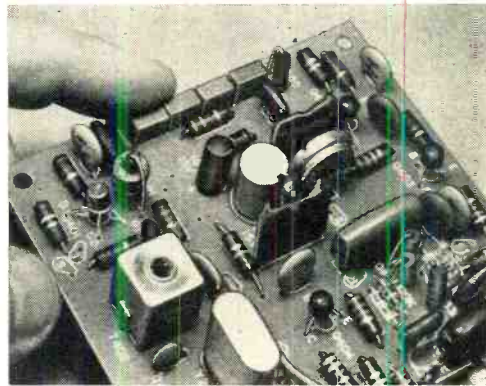
The S-meter is attached to the front sub-panel with only one screw. The meter mounting tabs are thick, so probably single-screw mounting is sufficient; but, if you'll feel better about it, you can secure the meter's other mounting tab to the subpanel with a couple of spots of plastic household cement.

The GR-78 is a lot of good receiver for the money. Conservatively designed and ruggedly built, it is a fine performer at home or on the go. (Front-view photo and ceramic-filter i.f. response curve courtesy Heath Co. MOSFET data courtesy RCA.)

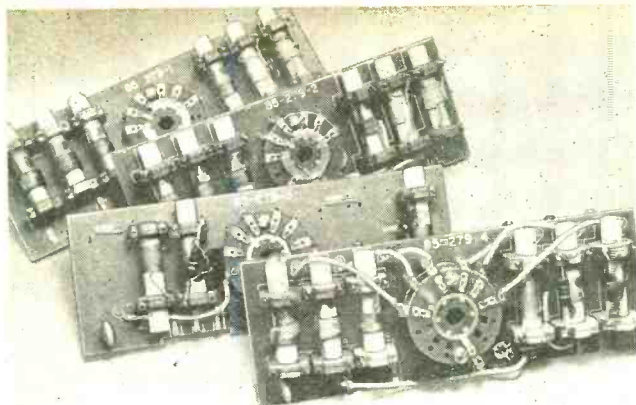
Circle No. 89 on Reader Service Page 15 or 95



Because of their sensitivity to damage from stray voltages induced by any one of a number of ways, including handling, MOSFET's come with protecting shorting rings. Rings must remain in place until MOSFET's are installed and soldered into circuit.

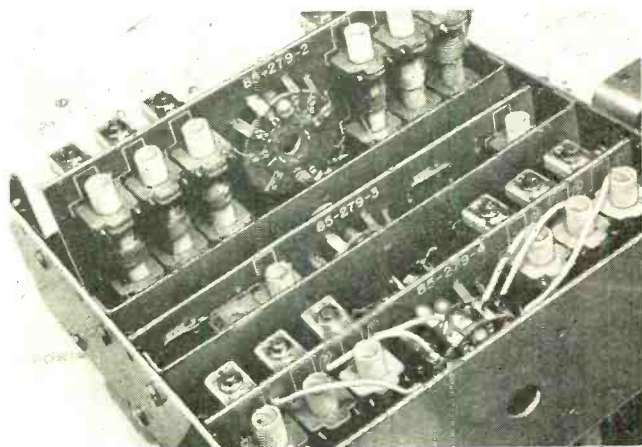


Four tiny encapsulated ceramic filters provide i.f. bandpass only 7 kHz wide at 6 dB down for excellent receiver selectivity. Capable of remaining tuned within 0.5% accuracy over period of at least ten years, these filters replace i.f. transformers.



These four printed circuit boards actually represent the band switch and tuning components in front end of GR-78. Printed circuit design slashes assembly time and virtually eliminates chances of wiring errors.

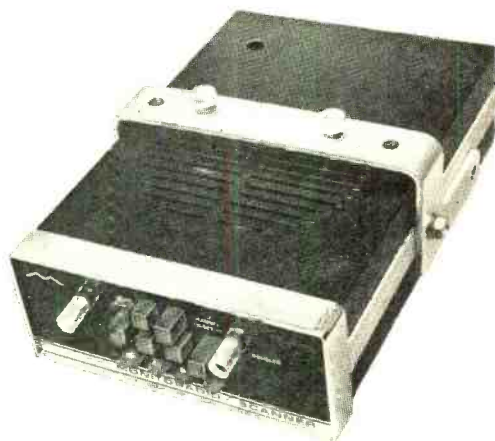
For maximum stability, band switch decks are mounted in chassis with metal shields isolating them from each other. Then shaft is installed.



REGENCY MONITORADIO SCANNER (Model TMR-4)

THE DAY of the blinking red light is upon us. Garage and gasoline service stations, volunteer firemen, newspaper reporters, and hundreds of just plain listeners are buying VHF monitor receivers. The latest innovation is the VHF radio receiver that automatically tunes (or "scans") a certain number of fixed-frequency channels. Usually these channels are set for the local police and fire departments, certain business radio services, the weather broadcaster on 162.55 MHz, etc. The scanning is fully automatic and stops to listen in on the first occupied channel. As soon as that transmission is finished, scanning resumes until another signal is picked up.

Your reviewer recently had the opportunity to set up the new Regency Monitoradio Scanner Model TMR-4. This is a modest-cost version (\$129; crystals are available at \$4.95 each) of the larger 8-channel model with the

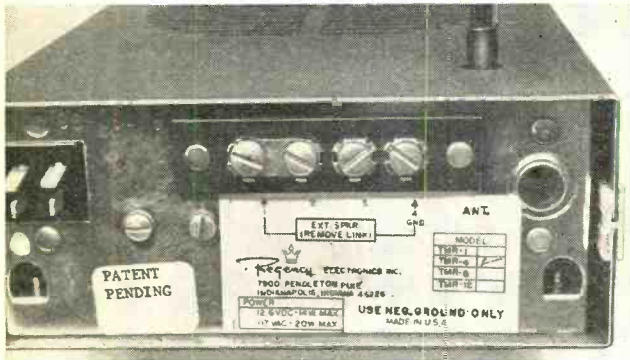


same general characteristics. The four frequencies selected included the 3 police services in the surrounding northern New Jersey area, plus the weather broadcaster KWO-35. The police frequencies were 240 kHz apart and the receiver had been "peaked" around 155-156 MHz.

Using the fully extended built-in antenna, we had no difficulty receiving all 3 base stations and all of the mobile units within 5 to 6 miles of our location. Using an outdoor antenna (cut for 155 MHz), all mobile units could be heard, as well as a variety of miscellaneous police services sharing the same frequencies—though some were 50 miles away.

Squelch action is positive and there is no "hang-on" after the received carrier goes off

Circle No. 90 on Reader Service Page 15 or 95



The TMR-4 is a compact solid-state receiver measuring only 7½" x 5½" x 2¼". Use is made of 4 integrated circuits and 23 transistors. Nine transistors and 2 of the IC's are involved in the scanning part of the circuit. A built-in speaker faces upward. An external antenna may be connected to the TMR-4 through a Motorola-type plug (extreme right). An external speaker may be added by following steps given on rear panel.

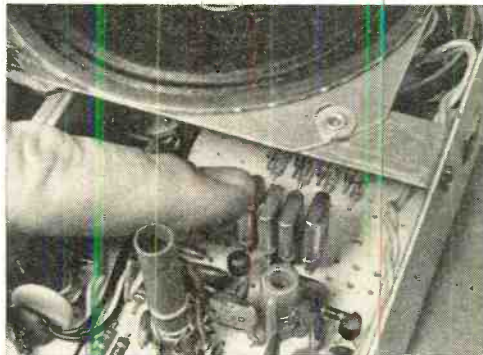


The front panel of the TMR-4 has two rotary controls (volume and squelch) and 6 pushbuttons. As the face plate indicates, the upper left button places the TMR-4 in either the fully automatic scanning mode of operation or permits the user to select any one of the 4 channels manually. In manual operation, the selector button is repeatedly depressed until the proper channel (indicated by the light) has been tuned in. The four channel pushbutton permits the user to by-pass an undesired signal or channel. When any one of the 4 pushbuttons is depressed, scanning is started; releasing the pushbutton deactivates the channel.

the air. Scanning action in the TMR-4 is rapid and the four channels are scanned about twice a second. Of course, this can be speeded up by locking out the weather station (scanning 3 channels) so that the scanning action is not immobilized by the constant carrier of KWO-35.

Besides the excellent sensitivity, there was no indication of any problems that might arise from inadequate or poor selectivity. Other channels known to be occupied and only 40 kHz away from one of the preset channels could not be heard (splatter or cross-modulation).

The TMR-4 is usable in the home or office operating from a 117-volt power line and can be installed in a mobile vehicle with a 12-volt negative-ground system.



Crystals are plugged into the TMR-4 by removing top cover. Miniature HC-18/u crystals are used with plug-in type pin leads. Crystals are easily obtained by mail order from Shepherd Industries, Overland Park, Kansas, at a price of \$4.95 each.



OPPORTUNITY MIRROR



Thoughtful Reflections On Your Future

Fourth in a Monthly Series, BY DAVID L. HEISERMAN

VA-Approved Schools

I am fully qualified for educational benefits under the GI Bill. I like the new electronics school in my home town, but found that it isn't approved for VA training. The school tells me that they can't get VA approval until they have been in operation for two years. Is this true or just a phony excuse?

● It is, indeed, true that a school must be in business at least two years before it can qualify for VA approval. The VA people have told us that even the old, well-established schools are not automatically granted approval for a new branch school until it has been set up and has been in operation for at least two years.

If the school is working toward obtaining VA approval, it would certainly indicate that the courses will meet some of the stiff standards that have been set up by your State Board of Education.

As far as the business end of the school is concerned, you can always check with your local Better Business Bureau. If the BBB has received any complaints about the school and its business operation, they'll tell you to read your contract carefully.

To Relocate, or Not to Relocate

I have just received my diploma in electronics technology from a well-known home study school. I live in a very small town, and there is only one electronics company within five miles of my home. My friends advise me to move to a large city (about 100 miles away), although I am quite reluctant to leave home. Is it true that I can earn a lot more money and will have greater job opportunities in the larger city, as opposed to working only a few miles from my present home?

● There can only be a general answer to

this question. It is certainly true that salaries are higher in and around the larger cities than in a small town. However, this in itself is misleading, because the cost of living is also much higher. I suggest that you visit the city, interview for several jobs and compare salaries. Find out where you might live and approximately how much it would cost you each month. In terms of dollar income, you will undoubtedly find it more economical to take a job in the smaller local electronics company.

The notion that people can earn more money by working in a major city does have one real advantage. Electronics firms tend to have a large turnover of employees. This means that you may have more chance to upgrade your career than working for the local manufacturer. If you are in a big hurry to advance your career and salary you should move to the city where you can probably change jobs several times in just as many years. If you are a good technician, you will be able to offset quickly the higher cost of city living by making the appropriate job changes.

If on the other hand you want to wait for opportunities to come your way, perhaps you should stay at home and build up a sound reputation and security with the one local company. Although the opportunities to advance may not come along as often, you will certainly encounter less competition when they do.

Electronics Consulting

For the past 10 years I have been employed in a highly responsible position as an electronics engineering technician. Although I don't have a college E.E. degree, I think that I have enough engineering experience to start my own consulting business. Are there any special pitfalls that I should avoid.

● There certainly are! First, you will find it necessary to clarify the exact nature of



your "consulting" business. It is impossible to call yourself an "engineer" without being duly certified as a Professional Engineer by your state government.

There are different kinds of consulting businesses that you can enter, as long as you do not pretend to be a bona fide Professional Engineer. You could, for example, open a sound system consulting firm. Such consulting firms plan music and intercom systems for homes and offices. Another consulting business might deal with computer programming. In practically every state it is not necessary to be a certified P.E. to write and sell computer programs. However, it is expected that within the near future, an examination program will be established to certify qualified computer programmers. This is being developed by the Council of the Processing Management Association. The first examinations are expected to be given in late 1970.

The problem is in drawing the fine line between "consulting" and engineering. If you want to do real engineering design, you can probably be certified as a Professional Engineer by passing the pertinent examinations in your state.

Throughout most of the country, the P.E. exams take two days to complete. The first day covers general engineering principles while the second deals exclusively with electrical engineering. You can usually take the exams as many times as necessary should you fail one part the first time—although there is a waiting time required between each examination.

Besides passing the state examination, all of your college-level education and work experience must add up to at least eight years. Many engineers take their state examinations right after graduation from a four- or five-year engineering college. Even though they pass the exams, they can not qualify for certification until they have the necessary three or four years of work experience. Your 10 years of electronics technical experience should more than fulfill this part of the P.E. requirement.

We have discussed your problem with a representative from the National Society of

Professional Engineers. It is agreed that anyone thinking about stepping into any kind of consulting business should first spend several years in someone else's consulting firm. Like any other profession, there are certain techniques and business problems, plus many unwritten rules of the game, that are not taught in engineering colleges and business schools. The most practical idea is to let someone else pay your salary while you learn the business end.

You can get more information on the consulting business by writing for the free pamphlet, "So You Want to Start a Consulting Firm" from the National Society of Professional Engineers, 2029 K Street, N.W., Washington, DC 20006.

Engineering-Level Home Study

I noticed in the article "Engineering Opportunities For You" (POPULAR ELECTRONICS, Feb. 1970) that only four schools are listed as offering engineering electronics courses through home study. Are there any other schools you can add to this list?

● Aside from the four schools mentioned in this article, five more offer engineering-level courses in electronics through home study. These are: Bell & Howell Schools and DeVry Institute of Technology, both of which are based at 4141 W. Belmont Ave., Chicago, IL 60641; Commercial Trades Institute, 1400 W. Greenleaf Ave., Chicago, IL 60626; International Correspondence Schools, Scranton, PA 18515; and National Radio Institute, 3939 Wisconsin Ave., N.W., Washington, DC 20016. The excellence of the material offered by these schools is the same as that of the schools listed in the "Engineering Opportunities For You" article.

Sleep Learning—Real or Hoax?

A friend tells me that "sleep learning" would solve my problems concerning the memorization of formulas used in electronics. I have only read one advertisement about sleep learning and wonder if it isn't a big hoax.

● About 10 years ago, sleep learning was in vogue and a dozen or so "schools" sold tape or disc recordings that repeated certain phrases while the student was asleep. Some people said that sleep learning was very effective—others ridiculed the idea.

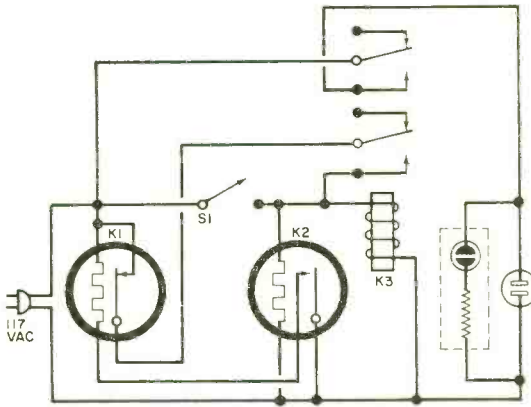
Recently two professors of psychiatry at Duke University have established that, although the brain is alert (a mother will awake at her baby's cry), it is in a state of internal communications. Memory and thinking do continue during sleep, but unless the

(Continued on page 85)

Build a LOW-COST TIME DELAY RELAY

AN INEXPENSIVE, semi-variable time delay relay is a handy item to have around if you do a lot of experimenting. While solid-state timers give excellent results, they are often more precise than required and prohibitively expensive for

After some specified time, depending on the characteristics of *K2*, the thermal relay's contacts close and supply power to the heater of *K1*. Then, when *K1*'s time delay has elapsed, its contacts open and break the circuit that latches *K3*



Thermal relays *K1* and *K2* are selected to give desired delay time. Depending on the relays, delay can be between 4 seconds and 6 minutes.

PARTS LIST

- K1*—S.p.s.t. normally closed 117-volt thermostatic relay
K2—S.p.s.t. normally open 117-volt thermostatic relay
K3—D.p.d.t. 117-volt electromagnetic relay with 10-ampere contacts
S1—S.p.s.t. normally open momentary-action push button switch
 Misc.—Neon lamp assembly with built-in current-limiting resistor; chassis- or line-cord-mounting a.c. receptacle; sockets for *K1* and *K2*; chassis; line cord and plug; hardware; wire; solder, etc.

simple experimenting and occasional use. However, commonly available and inexpensive thermostatic delay relays can be arranged in a circuit to provide the time delay or delays you would normally require.

Keeping in the low price range, it was found that a maximum of only three minutes could be obtained from any given thermal relay. However, with two thermal relays, as in the schematic diagram, you can obtain anywhere from four seconds to six minutes of delay time.

Circuit operation is easy to follow. When pushbutton switch *S1* is momentarily depressed, electromagnetic relay *K3* energizes, simultaneously delivering power to the heating element of thermal relay *K3* and the a.c. outlet. The indicator lamp lights up whenever the a.c. receptacle is "live."

closed. Relay *K3* deenergizes, and the delay cycle ends. The variable feature is not built in; it is actually a function of a combination of delay times selected for *K1* and *K2*.

Since the circuit is so simple, it can be laid out as desired during construction. The prototype shown here was built on a 5½" × 3" × 2" metal utility box to conserve space. Although the a.c. outlet is shown mounted to the rear of the box, it could just as easily have been located at the end of any desired length of twin-conductor power cable.

In use, the delay relay's power cord is plugged into an a.c. outlet, and the appliance to be operated connected via the a.c. receptacle. The delay relay is capable of handling up to 1000 watts; so a fairly high load can be safely controlled.

—30—

Join "THE TROUBLESHOOTERS"

They get paid top salaries
for keeping today's
electronic world running

Suddenly the whole world is going electronic! And behind the microwave towers, push-button phones, computers, mobile radio, television equipment, guided missiles, etc., stand

THE TROUBLESHOOTERS
—the men needed to inspect, install, and service these modern miracles. They enjoy their work, and get well paid for it. Here's how you can join their privileged ranks—without having to quit your job or go to college in order to get the necessary training.



JUST THINK HOW MUCH in demand you would be if you could prevent a TV station from going off the air by repairing a transmitter...keep a whole assembly line moving by fixing automated production controls...prevent a bank, an airline, or your government from making serious mistakes by repairing a computer.

Today, whole industries depend on electronics. When breakdowns or emergencies occur, someone has got to move in, take over, and keep things running. That calls for one of a new breed of technicians—The Troubleshooters.

Because they prevent expensive mistakes or delays, they get top pay—and a title to match. At Xerox and Philco, they're called Technical Representatives. At IBM they're Customer Engineers. In radio or TV, they're the Broadcast Engineers.

What do you need to break into the ranks of The Troubleshooters? You might think you need a college diploma, but you don't. What you need is know-how—the kind a good TV service technician has—only lots more.

Think With Your Head, Not Your Hands

The service technician, you see, "thinks with his hands." He learns his trade by taking apart and putting together, and often can only fix things he's already familiar with.

But as one of The Troubleshooters, you may be called upon to service complicated equipment that you've never seen before or *can't* take apart. This means you have to be able to take things apart "in your head." You have to know enough electronics to understand the engineering specs, read the wiring diagrams, and calculate how a circuit should test at any given point.

Now learning all this can be much simpler than you think. In fact, you can master it without setting foot in a classroom and without giving up your job!

AUTO-PROGRAMMED™ Lessons Show You How

For over 30 years, the Cleveland Institute of Electronics has specialized in teaching electronics at home. We've developed special techniques that make learning easy, even if you've had trouble studying before.

For one thing, our AUTO-PROGRAMMED™ lessons build your knowledge as you'd build a brick wall—one brick at a time. Each piece rests securely on the one that came before it.

ENROLL UNDER NEW G.I. BILL

All CIE courses are available under the new G.I. Bill. If you served on active duty since January 31, 1955, or are in service now, check box on reply card for G.I. Bill information.

In addition, our instruction is personal. When your teacher goes over your assignment, no one else competes for his attention. You are the only person in his class. He not only grades your work, he analyzes it to make sure you are thinking correctly. And he returns it the day it's received so that you can read his comments and corrections while everything is fresh in your mind.

Always Up-To-Date

To keep up with the latest developments, our courses are constantly being revised. This year CIE students are getting new lessons in Laser Theory and Application, Microminiaturization, Single Sideband Techniques, Pulse Theory and Application, and Boolean Algebra.

In addition, there is complete material on the latest troubleshooting techniques including Tandem System, Localizing through Bracketing, Equal Likelihood and Half-Split Division, and In-circuit Transistor Checking. There are special lessons on servicing two-way mobile equipment, a lucrative field in which many of our students have set up their own businesses.

Your FCC License—or Your Money Back!

Two-way mobile work and many other types of troubleshooting call for a Government FCC License, and our training is designed to get it for you. But even if your work doesn't require a license, it's a good idea to get one. Your FCC License will be accepted anywhere as proof of good electronics training.

And no wonder. The licensing exam is so tough that two out of three non-CIE men who take it fail. But CIE training is so effective that 9 out of 10 of our graduates pass. That's why we can offer this warranty with confidence: *If you complete one of our license preparation courses, you'll get your license—or your money back.*

Mail Card for 2 Free Books

Want to know more? Mail the postage-paid reply card bound here. We'll send our 40-page catalog describing our courses and the latest opportunities in Electronics. We'll also send a special book on how to get a Commercial FCC License. Both are free. If the card is missing, just send us your name and address.



CIE

Cleveland Institute of Electronics

1776 E. 17th St., Dept. PE-101, Cleveland, Ohio 44114

Accredited Member National Home Study Council
A Leader in Electronics Training... Since 1934



CIRCLE NO. 10 ON READER SERVICE PAGE



SHORT-WAVE LISTENING

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

REPORTING BY TAPE RECORDING

REPORTING to DX stations via tape recordings is a subject that has been discussed at considerable length in various club publications. Tom Meijer of *Radio Nederland*, who took over the duties of Master of Ceremonies for the "Happy Station Program" has listed certain conditions that must be met by the individual reporter who is applying for a QSL.

Foremost is that all tapes submitted must be single-track with a speed of seven and one-half inches per second. (Many reporters send double-track tapes at 3¾ in./sec.)

Tom also reminds listeners that the tape must contain such fundamental items as date, time, frequency, and enough program information in order to qualify for a QSL. In the event that any of the items cannot be included on the tape (date and time, for example) this information should be included in a separate letter enclosed with the tape.

"Happy Station" shows are presently being recorded up to seven days in advance of actual broadcast time. SWL's should not be alarmed at the belated mention of certain requests; simply send your requests earlier than you normally would have in the past.

Guide to Broadcasting Stations. A brand-new edition of this favorite British listing of long-wave, medium, and short-wave stations has just been published. Increased to 224 pages, this station/frequency listing is prepared from information collected by the BBC monitoring facilities. It is a remarkably accurate book—better than the World Radio TV Handbook—and includes a special notation showing the seasonal schedule changes of all short-wave broadcasters. Obviously, the schedule information is based on past history, but at least it gives the user a "fighting" chance of knowing whether or not a particular broadcaster has ever used a certain frequency and when (seasonally) he is likely to be back in operation. The new edition is being sold by Gilfer Associates, Inc., Park Ridge, NJ 07656 for \$2.50.

CURRENT STATION REPORTS

The following is a resume of current reports. At time of compilation all reports were as accurate as possible, but stations may change frequency and/or schedule with little or no advance notice. All times shown are Greenwich Mean Time (GMT) and the 24-hour system is used.

Albania—*R. Tirana* has been found on 11,866 kHz with s/on in Portuguese at 2130, and on 7295 kHz from 0700-0726 with English news and commentary.

Angola—CR6RF. *R. Clube de Benguela*, 5042 kHz, has been s/on at 0545 with the schedule for the day, then pop tunes non-stop at 0600. This is in Portuguese.

Antilles—Word is out that *Trans World Radio*, Bonaire, will increase the power of their 800-kHz



John Leger, WPE4KKK, Louisville, Ky., uses a Hallcrafters S-120A and a Truetone DC3972 receiver. Member of 2 DX clubs, he has logged 37 countries.

transmitter from the present 500 kW to a whopping 2 MW. (That's two million watts!) No target date for the new power has been released.

Austria—*R. Osterreich*, Vienna, is now on a new frequency of 11,925 kHz as noted at 2130-2157 in German to northern Europe. Also still well heard is 9770 kHz at 0030-0045 in English.

Belgium—Brussels presents "Belgium Speaking" in English at 2305-2315 on 11,790, 9550 and 9740 kHz and at 0050-0100 on 11,790, 6125 and 9740 kHz.

Bolivia—CP105. *R. Ibare*, Trinidad, continues to

DX ALL-ZONE AWARDS PRESENTED

To be eligible for one of the new DX All-Zone Awards designed for WPE Monitor Certificate holders, you must have verified stations in 10, 20, 30, or 40 of the radio zones of the world. The following recently qualified for and have received awards.

10 ZONES VERIFIED

Dimitur Alpiev (WPE2QXL), Syracuse, N. Y.
Ronald Nawrot (WPE3HUO), Owings Mills, Md.
Mitchell Kasso (WPE2QTK), Little Neck, N. Y.
Kevin Slater (WPE7CNF), Salem, Ore.
Ivan Wauffle (WPE2QVD), St. Johnsville, N. Y.
Arthur Bolduc (WPE1HQJ), Biddeford, Maine
Robert Brown (WPE6HKR), Yucaipa, Calif.
Edward Reichard, Jr. (WPE2QZE), Bloomsbury, N. J.
James Jankowski (WPE2QVE), Corfu, N. Y.
Sgt. George Weir (3W8PE1G), APO (South Vietnam)
Charles Clay (WPE2QWE), Climax, N. Y.
Terry Ward (WPE5EZK), El Paso, Texas
Howard Rosenberg (WPE2PQE), Queens Village, N. Y.
Joseph Perge (WPE8JKD), Newark, Ohio
John Griffin (VE6PE7V), Calgary, Alta.
John Karien (WPE3GOC), Franklin, Pa.
Tom Frisz (WPE9JRU), South Bend, Ind.
G Shadwell (VE3PE2QZ), Ottawa, Ont.
Tom Kennedy (WPE8KKE), Battle Creek, Mich.
William Castellani (WPE8KGE), Detroit, Mich.
Philip Scribani (WPE2QSY), Maspeth, N. Y.
Sheldon Carson (WPE6HMF), Glendale, Calif.
David Larrabee (WPE1HRB), Bucksport, Maine
Alan Faustner (WPE3HYK), Northampton, Pa.
Robert Rattner (WPE2RBL), Forest Hills, N. Y.
Peter Thomas (WPE9JQT), Michigan City, Ind.
Jim Townsend (WPE8KJT), Painesville, Ohio
David Porter (WPE2QSU), Cherry Hill, N. J.
Steven Fix (WPE2RAS), Rochester, N. Y.
Robert Fruehwald (WPE4KHQ), Jeffersonton, Ky.
Scott Fruehwald (WPE4KI), Jeffersonton, Ky.
Steven Brewer (WPE1HSX), Westminster, Mass.
Steve Nack (WPE3HTU), Conshohocken, Pa.
Jim Miles, III (WPE7CXI), Seattle, Wash.
Jon Love (VE6PE8D), Edmonton, Alta.
Robert Rose (VE4PE7M), Fort Garry, Man.
Angelo Casella (WPE2RAH), Staten Island, N. Y.
Todd Basche (WPE2RAR), Nutley, N. J.
Stephen Kennedy (WPE3HZZ), Newville, Pa.
Philip Creasy, Jr. (WPE3HWT), Bloomsburg, Pa.
Sam Fulp (WPE4KM), Lexington, N. C.
Richard Niles (WPE2ORB), Fort Lee, N. J.
Robert Lurie (WPE2QVQ), Howard Beach, N. Y.
James Sanders (WPE4KCH), Savannah, Ga.
Anthony Toscani (WPE3HVN), Philadelphia, Pa.
Roger Horie (WPE7COV), Mountain Home Air Force Base, Idaho
Wayne Gentry (WPE6HMR), Foster City, Calif.
Ken Brookner (WPE5EWM), Memphis, Tenn.
Maury Weiner (WPE6HPC), Palm Desert, Calif.
Jim Fox (WPE9JVS), Indianapolis, Ind.
Richard Eddie (WPE0FFT), St. Louis, Mo.
Kevin Klemam (WPE9JQV), Tigerton, Wisc.
Jack Graham (WPE2QNT), New Milford, N. J.
Michael Caditz (WPE6HW), Los Angeles, Calif.
Michael Zyda (WPE6HJL), Northridge, Calif.
Ronald Dudinski (WPE3IAF), Plymouth, Pa.
Frank Harris (WPE8JRG), Edison, Ohio
Dave Schoeller (WPE9IQO), Springfield, Mo.
Robert McLarnon (WPE1HQJ), Natick, Mass.
Tom Smith (WPE4KCP), Daytona Beach, Fla.
Robert Walker (WPE0FPO), Wichita, Kansas
Mike Witkowski (WPE9JFT), Stevens Point, Wisc.
Roy Nees (WPE7CWZ), Kent, Wash.
James Kobus (WPE7CGW), Ferndale, Wash.
Chuch Nobles (WPE4KIG), Winter Haven, Fla.
Mike Carrick (WPE0FLX), Omaha, Nebr.
Brian Hajder (WPE0FPI), Crystal, Minn.
Robert Keller (WPE7CND), Brigham City, Utah
Philip Thibodaux (WPE5FEB), Morgan City, La.
Peter Vegter (VE5PE6G), Regina, Sask.
Bill Buckley (WPE2RDI), New York, N. Y.
Roland Hamel (WPE1HEE), Waterbury, Conn.
Ted Romanow (WPE1HQH), Waban, Mass.
Tommy Buchanan (WPE4KGA), Darlington, S. C.

James Murray (WPE2RFR), Troy, N. Y.
Carroll Patterson (WPE4KHW), Decatur, Ga.
Gary Hubbard (WPE6HQA), Northridge, Calif.
Robert Galka (WPE8HWS), Tallahassee, Fla.
James Haberman (WPE9JWS), Indianapolis, Ind.
Donald Jones (WPE8KLV), Parma, Ohio
Tony D'Agostino (VE3PE2SD), Hamilton, Ont.
Marvin Van Sickle (WPE0FDP), Dubuque, Iowa
Joseph Ulrich (WPE6HGA), Los Angeles, Calif.
Henry Seidner (WPE2RE), Pearl River, N. Y.
Bradley Krohn (WPE2REA), Amherst, N. Y.
Robert Haase (WPE4KHT), Brunswick, Ga.
Wayne Randall (WPE1HFA), Danbury, Conn.
Daniel Lindley (WPE4KEA), Florence, S. C.

20 ZONES VERIFIED

Mitchell Stern (WPE2QIA), Brooklyn, N. Y.
Martin Miron (WPE8JTN), Warren, Mich.
Stefan Lai (VS6PE1H), Causeway Bay, Hong Kong
Thomas Alleman (WPE2QFR), Rochester, N. Y.
Loren Davis (WPE6HMA), Hayward, Calif.
Tom Christian (WPE7CXG), Seattle, Wash.
Tom Ziegler (WPE9JOW), Milwaukee, Wisc.
Joseph Breton (WPE1KWF), Methuen, Mass.
Michael Dopson (WPE4KCF), Enterprise, Ala.
Brian Heller (WPE2QVP), Lawrenceville, N. J.
Gary Kromer (WPE2PH), Auburn, N. Y.
Lawrence Plummer (WPE7CRV), Bellevue, Wash.
Peter Macinta (WPE2ORB), Kearny, N. J.
J. H. Mac Neill (WPE6GWX), Redwood City, Calif.
Dean Frey (VE6PE7N), Fort Saskatchewan, Alta.
Daniel Polansky (WPE2QFH), Rochester, N. Y.
Michael Lynch (WPE2QEA), Auburn, N. Y.
Lance Kimmel (WPE2QOY), Forest Hills, N. Y.
Robert Hagerman (WPE8INH), Hemlock, Mich.
Charles Loftis (WPE4KEF), Landrum, S. C.
Everett Slosman (WPE2QZB), Endicott, N. Y.
Steve Sox (WPE4KEU), Asheboro, N. C.
Charles Clay (WPE2QWE), Climax, N. Y.
Robert Scott (WPE4HHX), Kingsport, Tenn.
Nick Chinn (WPE6HKB), San Leandro, Calif.
John Adams (WPE3HXT), Beltsville, Md.
Mrs. Mildred Marshall (WPE0FIR), Devils Lake, N. D.
Donald Appling (WPE7CNG), Spokane, Wash.
Steven D'Adolf (KX6PE1B), APO (Marshall Islands)
Delbert Fant (WPE6HMY), San Luis Obispo, Calif.
Tim Ohrman (WPE3HHA), Monroeville, Pa.
Frank Swanberg III (WPE9JVD), Dolton, Ill.
Paul Metro (WPE2QZM), Colonia, N. J.
G. W. Fisher (WPE7CXZ), Longview, Wash.
Robert Fleck (WPE3DXZ), Schiller Park, Ill.
Ken Piper (WPE6GVB), Stockton, Calif.
Douglas Stark (VE3FE2OY), London, Ont.
Carroll Patterson (WPE4KHW), Decatur, Ga.
Bruce McCoy (WPE9JMY), La Porte, Ind.
Bill Potorti (WPE2QYH), Ithaca, N. Y.
Jack Dasher (WPE4KCJ), Camden Tenn.
Marvin Robbins (WPE0MW), Omaha, Nebr.
Gregory Kelley (WPE4JGI), Staunton, Va.
Kurt Leonhardt (WPE9FLI), Blue Island, Ill.

30 ZONES VERIFIED

Everett MacLeod, II (WPE1HTG), Gloucester, Mass.
Mark Connelly (WPE1HGI), Arlington, Mass.
Jeff Wilson (VE3PE2NL), Sarnia, Ont.
Tom Christian (WPE7CXG), Seattle, Wash.
Thomas Creery (WPE2PHZ), Shelton, N. Y.
Vincert Geraci (WPE1HMP), Shelton, Conn.
Richard Sawyer (WPE6CFL), San Francisco, Calif.
John Sgulletta (WPE2MFX), Bedford Hills, N. Y.
Steve Kamp (WPE5EUT), Irving, Texas
Marvin Robbins (WPE0MW), Omaha, Nebr.
Clifford McKinstry (WPE6CXS), Hampton, Va.

be heard on 4535 kHz at fair level until s/off at 0200 in all Spanish programming.

Brazil—ZYW25. *Radiodifusora Jataí, Jataí* (Goias), is on 2470 kHz and verified after five reports: no schedule or power was stated. It's audible at times around 2300 in Portuguese but does not seem to be on any definite schedule. ZY023, *R. Vitoria*, Vitoria, has settled down on 5053 kHz and is heard daily in Portuguese until s/off between 0200-0230. *R. Braganca*, Braganca Paulista (Sao Paulo), is on 2480 kHz but with a strong harmonic at times on 4960 kHz; it's been logged there after 2200 in Portuguese.

Chile—*R. Sociedade Nacional de Minería* is noted daily on 9750 kHz from 0100 with many talks and ID's in Spanish.

Columbia—Reports are being received on a super-powered station operating on 810 kHz, medium-wave. Heard evenings (local time) causing heavy QRM to WGY, Schenectady, N. Y., we have not as yet obtained a definite ID. Listed for the channel is *R. Sabatena*, Bogota; the power is said to be 250 kW. This is undoubtedly strong competition to the Antilles station on 800 kHz.

Czechoslovakia—*R. Prague* is on 5930 kHz with IS and time ticks at 0058-0100 and opens with this schedule: to US and Canada at 0100 and 0400 on 5930, 7345, 9540, 9630 and 11,900 kHz, rebroadcast to Europe at 0700 on 6055 and 9505 kHz; to Australia and New Zealand at 0700 on 9575, 11,800, 15,310, 21,485 and 21,700 kHz; Sundays to N.A. at 1400 on 15,445, 17,840 and 21,735 kHz.

Dominican Republic—HIBC. *Voz de Papagayo*, La Romana, 5030 kHz, has a most elaborate s/off at 0400 with a sad-voiced announcer, playing of "Taps", then a stirring march. A station that we've been hearing on 2500 kHz from 0000-0200 is thought in some quarters to be a second harmonic of HIBC. *La Voz del Progreso*, 1250 kHz.

Ecuador—HCJE. *Quito*, is good on 11,740 kHz with English religious programs heard at 0805 and 0410; "DX Party Line" was logged at 0230-0300. *R. Vision*, Manta, long inactive, is again on the air on 6141 kHz and heard from 0400-0430 with music, commercials and time checks in Spanish. *HCAK2. Cadena Radiodifusora Ecuatoriana*, Guayaquil, was heard from 2355-0105 on 4655 kHz with L.A. music and radio drama.

Egypt—Cairo is testing numerous channels in the 31-meter band. English news is noted on 9550 kHz at 2200; Arabic with chanting can be heard at 0000-0040 on 9860 kHz. The 9475 kHz channel is still heard well at 0230-0245 with English news and music as is 9740 kHz at 1830-2300 in Italian, French, German and English. Reports go to P.O. Box 566, Cairo, United Arab Republic.

El Salvador—YSS, San Salvador, 5980 kHz, is reportedly planning more extensive English and French programs to be aired Monday to Saturday at 0300-0330 and Sunday at 0030-0100. This will be dual to 9555 kHz.

Ethiopia—ETLF, Addis Ababa, opens at 0330 in Swahili to E. Africa on 9725 kHz, a new frequency.

Germany (East)—*R. Berlin International* is on 15,145 kHz in English to Africa until 1900 closing and requesting reports.

Gilbert and Ellice Islands—VSZ1, Betio, Tarawa, 844 kHz, seems to now be using 10 kW as indicated by increasingly better signals on the West Coast at 0600.

Guantanamo Bay—If you need this country for DX Awards, look for KG4AA in the 20-meter ham radio band; he often operates around 0000-0100 weekdays on single sideband.

Guatemala—Possibly a new frequency for *R. Nacional-La Voz de Quezaltenango* is 9680 kHz as noted from 0305 with marimba music.

Guiana (French)—Cayenne, 3385 kHz, has French from 0915 s/on; news is given at 0930. This one often fades out by about 1000.

International Waters—A good catch was that of the New Zealand Navy Survey Ship "Lachlan", call-sign ZMCU. On 8236 kHz with 250 watts, it was

noted at 0911 in contact with ZLW, Wellington. It verified in nine days by letter and by signing a prepared card.

Italy—Rome was heard in Italian to N.A. at 2300-0000 on 6010 and 9710 kHz, both unlisted channels, then shortly afterward, on 5990 and 9675 kHz, in a dual frequency move.

Mexico—XEVJ, Chilpancingo, a 250-watt station, has been heard on 2160 kHz at 1317 in Spanish. *R. Mexico* is on a new frequency of 9745 kHz, dual to 11,718 kHz at 0500 but with heavy QRM on the lower channel.

Monaco—The English test transmissions to Great Britain over *R. Andorra* on 701 kHz have been moved to *R. Monte Carlo* on 1460 kHz and are aired at 2300-0100 every Saturday-Sunday night under the name of *Radio 205*. Reports go to Geoffrey Bass, 1 Harley Street, London W1, England.

Nigeria—*Voice of Nigeria*, Lagos, was heard at 2130-2300 and at 0450-0525 with mostly English programs of music, news, commercials and time checks on 3986 kHz. Some African chanting was noted around 0450-0455.

Norway—"Norway This Week" in English is aired on Sundays to East Coast N.A. at 2000-2030 on 21,655 kHz and 2200-2230 on 11,800 kHz, at 1600-1630 to East Coast on 25,900 kHz and to West Coast on 21,730 kHz, and on Mondays to West Coast at 0200-0230 on 9610 kHz and at 0100-0430 on 9610 and 11,735 kHz.

Paraguay—An overseas source reports that this country is planning an international service with a transmitter of 100 kW. Further details as they become available.

Peru—OBX10. *R. Atlanta*, Chulucanas, 4990 kHz, can be occasionally logged under severe QRM from a Venezuelan on the same channel from 0200 with the usual L.A. format.

Portugal—A new frequency for Lisbon is 15,340 kHz as noted in Portuguese from 0445 s/on. Other frequencies reported recently include 11,870 kHz at 0200 to N.A., 11,840 kHz with English around 0245-0305, and 11,935 kHz at 0020 with "Radio Safari" using the facilities on the second Monday in each month.

Seychelles—*R. Seychelles*, Victoria, was logged on 15,265 kHz from 1536-1630 s/off with light music at 1550, "Back to the Bible" at 1600, ID, frequency, and time, in an all-English xmsn.

South Africa—*R. RSA*, Johannesburg, is now operating to N.A. at 2330-0020, 0030-0120, 0130-0220 and 0230-0320 on 9695, 9705, 11,875 and 15,220 kHz, and to Africa in English and Afrikaans at 1100-1450 on 25,790 kHz. Two other new frequencies noted include 15,249 kHz at 1805 with English news, and 15,320 kHz at 0150 with an interview-type program, also in English.

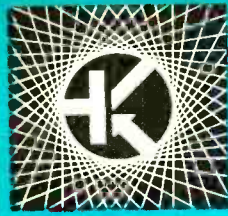
Sudan—*R. Omdurman* broadcasts at 0700-0900 and 1600-1900 on 4994 and 11,835 kHz with English usually at 1715-1800.

Switzerland—New frequencies in use by Berne include 6055 kHz in French with s/off at 2245, and 11,720 kHz at 2310-0000 s/off in Portuguese.

USSR—Two of the time stations listed last month, RID and RKM, are being noted by Your Editor. RID is usually audible around 2300-0200 and RKM around 1100-1300, both on 15,004 kHz. ID's are given every 10 minutes in slow Morse, starting with "VVV CQ CQ CQ" and sounds like it is being hand-sent. So far we have not yet located RTA on 14,996 kHz. . . . Vladivostok, 5015 kHz, was noted in the clear at 1045 in Russian with two bars of organ music and an ID at 1100, then man and woman alternating in Russian news. . . . A report to *R. Moscow* for reception of Kalinin, listed in this column last October on 15,470 kHz, brought a fast reply to one of our readers that the Soviet Union has no xmt'r's on that frequency!

Vatican City—A new frequency in use by *R. Vaticano* is 6135 kHz as noted at 2358-0015 in Spanish to L.A. dual to 11,845 kHz and a third channel which we could not copy. English news is given

(Continued on page 91)



SOLID STATE

By LOU GARNER, Semiconductor Editor

NEW PROCESS MAY REDUCE IC COSTS

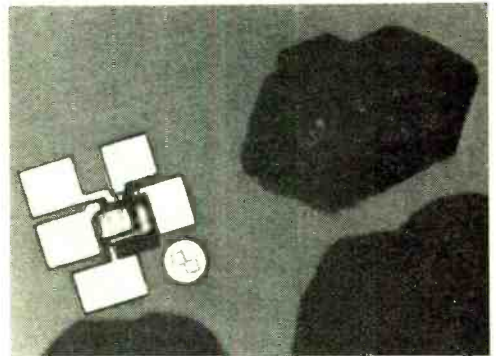
INTEGRATED CIRCUITS may be less costly in the future as a result of a new manufacturing process developed by the Bell Telephone Laboratories (BTL). Requiring fewer production steps than previous methods, the new IC fabrication technique can produce reliable, high-quality devices which are smaller than a grain of sugar.

Conventional bipolar integrated circuits require from five to seven photolithographic masking steps before the contacts to the silicon are formed. In contrast, the new circuit configuration needs only three such steps and, appropriately, is called a "Tri-Mask" (TRIM) structure. In both techniques, of course, additional processing is required to make contacts to other circuits and to protect the device from the environment.

As illustrated in Fig. 1, the new TRIM structure is based on the use of lateral transistors—devices in which injected carriers flow parallel to the surface rather than perpendicular to it. The collectors and emitters are diffused simultaneously and, therefore, need only one masking operation. Thus, all of the important transistor properties are determined by this one step.

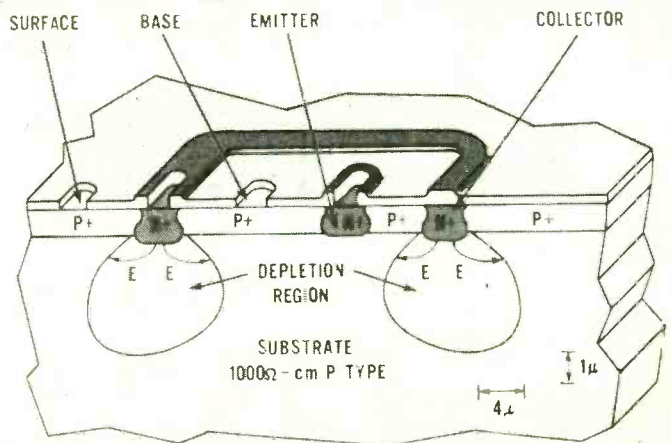
The TRIM process starts with a silicon substrate lightly doped with boron to provide general *p*-type characteristics. A shallow

p-plus base layer is diffused into the substrate. Next, silicon oxide is grown over the entire surface, then etched away selectively using the first photolithographic mask to establish the emitter and collector areas. Phosphorous-doped emitter and collector regions (*n*-type) are diffused through the *p*-type base and then all of the exposed silicon oxide is removed. Another silicon oxide layer is now grown on the surface with a second mask defining the emitter, collector, base, and surface contact holes. Metal is



TRIM technique produces high-quality IC chips that are smaller than grains of sugar (black objects).

Fig. 1. TRIM structure, based on use of lateral transistors, has collectors and emitters diffused simultaneously. It requires only one masking operation. One step determines all of transistor properties.



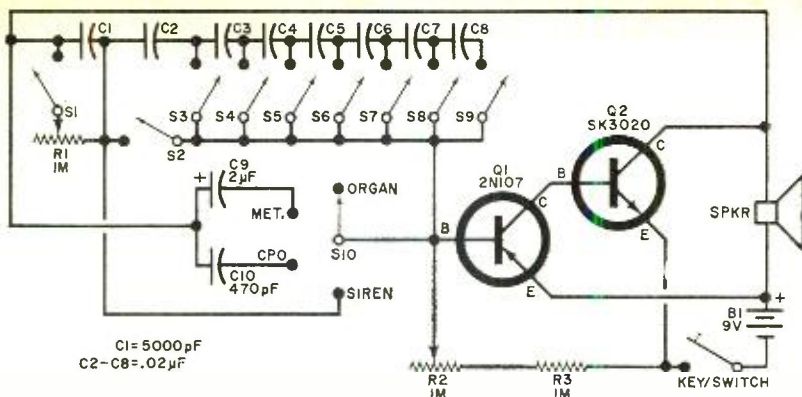


Fig. 2. Switching arrangement allows wide-range relaxation oscillator to operate as an electronic organ, metronome (and thermometer), code practice oscillator, or siren.

evaporated over the entire surface and etched away except where the third mask defines the metal conductor paths. The final contacts to external circuits are provided through beam leads, with a layer of silicon nitride providing environmental protection.

Thus far, the TRIM method has been used primarily for the fabrication of integrated circuit logic gates of the type used in computers and telephone switching system; but, conceivably, it could be used in linear devices as well. A transistor in such circuits occupies less than one millionth of a square inch.

Reader's Circuit. In developing a Science Fair project, reader Paul Serafin, WN4OEG (707 Cathy Ct., Murfreesboro, TN 37130) first selected a reader's circuit described here in March 1969. Encountering minor difficulties, he modified the design using a circuit we described in February 1966. Additional modifications and adaptations resulted in the multi-purpose project whose schematic is shown in Fig. 2. Operating, variously, as an electronic organ, a metronome (and electronic thermometer), CPO, or siren, his final design won an Honorable Mention Award at the 1969 Vanderbilt University Regional Science Fair.

Essentially a wide-range relaxation oscillator, Paul's circuit features a two-stage, direct-coupled complementary amplifier using *pnp* (Q1) and *nnp* (Q2) transistors to drive a PM loudspeaker. The circuit's operational mode and basic repetition rate (frequency range) are determined by the feedback arrangement chosen by function switch S10, while its exact operating frequency can be adjusted by bias control R2, in series with current limiting resistor R3. Switches S2 through S9 serve as the organ "keys," while S1 is used as the siren switch. Circuit

power is furnished by B1, controlled by a familiar handkey or switch.

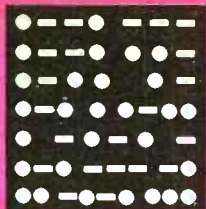
Standard, readily available, parts are used in the project. Transistor Q1 is a general purpose *pnp* transistor such as RCA's SK3020. Capacitors C1 through C8 and C10 are low-voltage ceramic or tubular paper types; C9 is a metallized paper or electrolytic unit; and switches S1 through S9 are s.p.s.t. normally open momentary push-buttons. Almost any PM loudspeaker may be used; but better results generally will be obtained with units having high-impedance voice coils (8, 16, or 45 ohms).

Neither layout nor lead dress is critical and the circuit can be assembled using any preferred construction technique. Paul assembled his display model on a three-section poster, with the schematic diagram and actual circuit in the center and an explanation of the project operation on the sides.

The circuit's performance as an electronic organ, metronome or CPO is fairly straightforward. In its "siren" mode, however, R1 must be adjusted for optimum signal with S1 closed. Finally, the circuit may be used as an electronic thermometer" by switching to the metronome mode and physically varying Q1's temperature. The output beat rate will change as Q1 is heated or cooled.

Manufacturer's Circuit. With a variety of potential applications in experimental projects as well as in commercial and industrial systems, RCA's TA5371B is a unique integrated circuit which combines light-sensitive elements and an amplifier in a single device. Two typical circuits using this unit are shown in Fig. 3. Both were abstracted from the engineering bulletin/specification brochure published by RCA describing the new device.

(Continued on page 88)



AMATEUR RADIO

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

FIELD DAY, 1970

MOST IMPARTIAL observers agree that amateur radio's ability and willingness to supply emergency communications are two of its most valuable functions. This was demonstrated dramatically when Hurricane Camille struck the Gulf Coast in the fall of 1969 and in other less publicized disasters.

On the fourth weekend of each June, "Field Day," sponsored by the American Radio Relay League, Inc., gives amateurs a chance to show and test their abilities at supplying communications under emergency conditions. Between 1900 GMT, Saturday, June 27, and 2200 GMT, Sunday, June 28, amateurs all over the United States and Canada will set up temporary, self-powered

stations in forest preserves, parking lots, athletic stadiums, etc., to contact other amateurs. Each contact made on each code or phone sub-band earns a number of points determined by the power source and the amount of transmitter power used.

Large groups may operate 20 or more transmitters simultaneously during the event; although the greatest number of entries is usually in the one-, two-, three-, four-, and five-transmitter groups. And of course there are always a few "iron-man" entries in which a single operator attempts to keep his field day station in operation during the entire period. Undoubtedly, however, the most enjoyable and valuable Field Day operations are the co-operative ven-



AMATEUR
STATION
OF THE
MONTH

Jim Rafferty, WA9UCE, 523 Buckingham, Libertyville, IL 60048, became a Novice in 1967 and was a General in three more months. His Collins KWM-1 SSB/CW transceiver is older than he, but its 175 watts fed into a Mosley TA-33-Jr., tri-band beam, 30 ft high, has worked all states and 97 countries. Jim attends Western Illinois U., where he is president of the radio club, W9YOL, and lives at the fire station where he signs WB9AZW. We are sending WA9UCE a 1-year free subscription to POPULAR ELECTRONICS for sending this month's Amateur Station Photo. You can enter by sending a clear (black and white preferably) photo of yourself at the controls of your stations and some details about your amateur career to Herb S. Brier, W9EGQ, P.O. Box 678, Gary, IN 46401.

tures in which amateurs from the newest Novice to the hoariest old timer (and their families) work to make Field Day a success.

Collecting equipment, erecting antennas, installing the equipment, and keeping a number of transmitters going around the clock under conditions that simulate an actual emergency present real challenges to any amateur club. So, starting Saturday afternoon, June 27, you can expect many bosky glens and other likely (and unlikely) spots to echo with the call "CQ Field Day" from approximately 12,000 throats and keys until the affair ends Sunday evening. Drop a request (with a stamped, business size envelope) to Communications Dept., ARRL, 225 Main St., Newington, Conn., 06111, for full Field Day rules and score sheets.



Gilbert Kunster, Jr., WB2DKZ, 225 W. 232 St., Bronx, NY 10463 needs Montana and Hawaii for his WAS certificate. His Heath "S" line and Hustler vertical antenna worked 62 countries in 6 months.

FCC and Related News. Amateur license fees are going up! In an attempt to obtain its entire budget from fees charged for license processing, the FCC proposes in Docket 18,802 to increase basic amateur license fees from \$4.00 to \$9.00 and for applications for special call signs from \$20.00 to \$25.00. The CB fee will jump from \$8.00 to \$19.00.

While April 20, the date set by the Commission for filing original comments on the docket, will have passed before you read this, we assume that the Commissioners will consider any well-reasoned "late" comments from interested parties. Most comments that we have heard claim that the increases are inflationary. We strongly suspect that the protests will not prevent the increases, but enough protests might delay the effective date.

The Commission also issued its proposals to formalize the regulations governing ama-

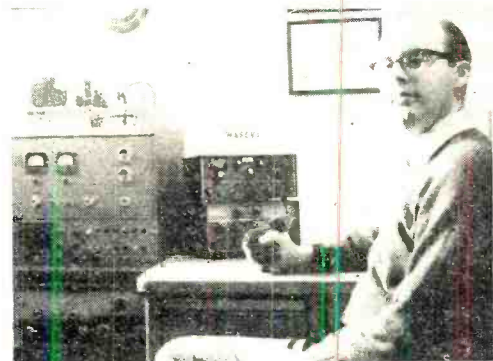
teur repeater operation on the frequencies above 50 MHz. Such repeaters receive signals on one frequency and simultaneously retransmit them on another frequency. The most important part of the new proposals limits the repeaters to 200-kHz segments in the 50-, 144-, 220-, and 430-MHz bands and also specifies the frequencies to be used to transmit to the repeater. The rest of the proposal clarifies and consolidates the informal rules that have been put into effect since repeaters became so popular.

In a recent speech, Everett G. Henry, W3BG, Chief, Amateur and Citizens Radio Division, FCC, stated that surveys of the Advanced and Extra class segments of the amateur bands show that they are not the deserted wastelands that some opponents of incentive licensing claim. Rather, they are well occupied during the popular operating hours. Some of them are rather sparsely occupied at other times, but the other parts of the bands are not overly crowded then, either.

W3BG also stated that 85% of the applicants for the Advanced license who must take the code test (Novices, Technicians, Conditionals, and brand new applicants) pass it. Also, 81% of all who take the Advanced class written exam pass it. Similarly, 80% of the applicants pass the Extra class code test; and 77% of those that get by the code also get by the Extra class written examination.

Thoughts on Silver Plating. It is common practice to silver plate UHF/VHF coils, cavities, etc., to reduce "skin effect," which increases the r.f. resistance of conductors above their d.c. values. But many UHF/VHF workers say that the results do not justify the effort.

R. S. Stone, VK5PB, reports in *Amateur* (Continued on page 86)



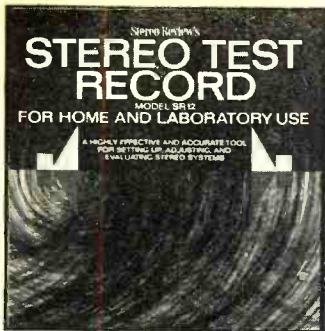
Jim Labo, WA5ZVI, Enid, OK 73701, uses an SBE-34 transceiver and Drake R4 for the "d.c." bands. His main interests are in the frequencies above 50 MHz, however, as demonstrated by VHF/UHF gear.

ENGLISH LANGUAGE NEWS BROADCASTS FOR THE MONTH OF JUNE

Prepared by **ROGER LEGGE**

June, 1970

TO EASTERN AND CENTRAL NORTH AMERICA		TO WESTERN NORTH AMERICA	
TIME-EDT	STATION AND LOCATION	TIME-PDT	STATION AND LOCATION
	FREQUENCIES (MHz)		FREQUENCIES (MHz)
7:00 a.m.	Stockholm, Sweden	8:00 a.m.	Tokyo, Japan
7:30 a.m.	Melbourne, Australia	6:30 p.m.	Melbourne, Australia
8:00 a.m.	Peking, China		Tokyo, Japan
8:15 a.m.	Montreal, Canada	7:00 p.m.	Oslo, Norway (Sun.)
12 Noon	London, England	7:30 p.m.	Johannesburg, South Africa
5:30 p.m.	Hilversum, Holland	8:00 p.m.	Madrid, Spain
6:00 p.m.	Ankara, Turkey		Moscow, U.S.S.R.
7:00 p.m.	Montreal, Canada		Peking, China
7:45 p.m.	Tokyo, Japan		Prague, Czechoslovakia
8:00 p.m.	London, England		Seoul, Korea
	Moscow, U.S.S.R.	8:30 p.m.	Tokyo, Japan
	Sofia, Bulgaria		Berlin, Germany
	Tirana, Albania		Stockholm, Sweden
8:30 p.m.	Johannesburg, South Africa		Tirana, Albania
	Stockholm, Sweden	9:00 p.m.	Budapest, Hungary
8:50 p.m.	Brussels, Belgium		Havana, Cuba
	Vatican City		Lisbon, Portugal
9:00 p.m.	Berlin, Germany		London, England
	Budapest, Hungary		Moscow, USSR (via Khabarovsk)
	Havana, Cuba		Sofia, Bulgaria
	Madrid, Spain		Tokyo, Japan
	Peking, China	9:30 p.m.	Kiev, USSR (Mon., Thu., Sat.)
	Prague, Czechoslovakia	9:45 p.m.	Berne, Switzerland
	Rome, Italy		Cologne, Germany
9:30 p.m.	Berne, Switzerland	10:00 p.m.	Havana, Cuba
	Cologne, Germany		Hilversum, Holland (via Bonaire)
	Melbourne, Australia	11:00 p.m.	Moscow, USSR (via Khabarovsk)
	Cairo, Egypt		Tokyo, Japan
10:00 p.m.	Hilversum, Holland (via Bonaire)	11:30 p.m.	Havana, Cuba
	Lisbon, Portugal		
	London, England		
	Moscow, U.S.S.R.		



THE 2 MOST IMPORTANT RECORDS IN YOUR ENTIRE COLLECTION!



New Standard in Stereo Testing! The All-New Model SR12 STEREO TEST RECORD
The most complete . . . most sophisticated . . . most versatile Test Disc available today!

Whether you're an avid audiophile who'll settle for nothing but peak performance from his stereo components . . . a casual listener who'd like more insight into the challenging world of stereo reproduction . . . or a professional technician who needs precise standards for lab testing . . . the new MODEL SR12 will be the most important disc in your entire collection. SR12 has been produced by Stereo Review Magazine for music lovers who want immediate answers to questions about the performance of their stereo systems and how to get the best possible sound reproduction. SR12 is the most complete test record of its kind—containing the widest range of checks ever included on one test disc.

MAKE THESE IMPORTANT STEREO CHECKS BY EAR . . . (NO INSTRUMENTS OF ANY KIND REQUIRED)

FREQUENCY RESPONSE — a direct warble-tone check of nineteen sections of the frequency spectrum, from 20 to 20,840 Hz • **SEPARATION** — indicates whether you have adequate separation for good stereo • **CARTRIDGE TRACKING** — devised for checking the performance of your cartridge, stylus and tone arm • **CHANNEL BALANCE** — two broad-band, random-noise signals which permit you to eliminate any imbalances originating in cartridge, amplifier, speakers or room acoustics • **HUM AND RUMBLE** — foolproof tests that help you evaluate the actual audible levels of rumble and hum in your system • **FLUTTER** — a sensitive "musical" test to check whether your turntable's flutter is low, moderate, or high • **PLUS:** Cartridge and Speaker Phasing • Anti-Skating Adjustment • "Gun Shot Test" for Stereo Spread • Multi-purpose Musician's "A" • Equal-tempered Chromatic Octave • Guitar-tuning Tones.

**FOR THE ULTIMATE IN STEREO TESTING,
7 CRITICAL TEST EQUIPMENT CHECKS . . .**

Attention professionals: Model SR12 is also designed to be used as a highly efficient design and measurement tool. In the following tests, recorded levels, frequencies, etc. have been controlled to laboratory tolerances—affording accurate numerical evaluation when used with oscilloscope, chart recorder, output meter, intermodulation-distortion meter and flutter meter.

• 1,000-Hz square waves to test transient and high-frequency response of phono pickups. • 500 to 20,000 Hz frequency-response sweep. • Sine-wave tone-bursts to test transient response of pickup. • Intermodulation test using simultaneous 400-Hz and 4,000-Hz signals. • Intermodulation sweep to show distortion caused by excessive resonances in tone arm and cartridge. • 1,000-Hz reference tones to determine groove velocity. • 3,000-Hz tone for flutter and speed tests. • Sample waveforms — Illustrating both accurate and faulty responses are provided in the Instruction Manual for comparison with the patterns appearing on your own oscilloscope screen.

FREE 8 Page Instruction Manual includes detailed instructions, charts, tables and diagrams.

Only \$4.98 each

Descriptive Booklet Enclosed includes discussion of the selections on the record, plus a complete description of each selection and the purpose behind its demonstration.

FREE

NOTE — THE STEREO DEMONSTRATION RECORD ONLY IS AVAILABLE IN YOUR CHOICE OF 33½ RPM OR 45 RPM

Both the Model SR12 Stereo Test Record and Stereo Demonstration Record are processed and pressed on a newly developed, improved vinyl. It is permanently anti-static, repels dust and dirt and promotes longer stylus wear. The use of this material is conducive to low surface noise and contributes to the production of full dynamics and frequency range. The record continually looks new, sounds new and wears longer.

The Most Spectacular Sound Exhibition of STEREO FIDELITY Ever Available on one Disc.

This record is the result of two years of intensive research in the sound libraries of Deutsche Grammophon Gesellschaft, Connoisseur Society, Westminster Recording Company and Cambridge Records Incorporated. The Editors of Stereo Review have selected and edited those excerpts that best demonstrate each of the many aspects of the stereo reproduction of music. The record offers you a greater variety of sound than has ever before been included on a single disc. It is a series of independent demonstrations, each designed to show off one or more aspects of musical sound and its reproduction. Entirely music, the Record has been edited to provide self-sufficient capsule presentations of an enormous variety of music arranged in a contrasting and pleasing order. It includes all the basic musical and acoustical sounds that you hear when you listen to records, isolated and pointed up to give you a basis for future critical listening.

WIDE RANGE OF DEMONSTRATIONS

- Techniques of Separation & Multiple Sound Sources
- Acoustic Depth
- Ambiance of Concert Hall
- Sharp Contrasts of Dynamics
- Crescendo & Diminuendo
- Very High & Very Low Pitched Musical Sounds
- Polyphony (2 or more melodies at once) With Both Similar & Contrasting Instruments
- Tonal Qualities of Wind, String & Percussion Instruments
- Sounds of Ancient Instruments
- Sounds of Oriental Instruments
- Sound of Singing Voice, Both Classically Trained and Untrained
- Plus a Large Sampling of Finger Snapping, Hand Clapping, Foot Stamping & Other Musical & Percussive Sounds.

13 SUPERB SELECTIONS

STRAUSS: Festive Prelude, Op. 61 (excerpt) DGG.
DEBUSSY: Feux d'artifice (excerpt). Connoisseur Society.
BETHOVEN: Wellington's Victory (Battle Symphony) (excerpt from the first movement) Westminster Records.
MASSAINO: Canzona XXXV a 16 (complete) DGG Archive.
CORRETTE: Concerto Comique Op. 8, No. 6, "Le Plaisir des Dames" (third movement) Connoisseur Society.
KHAN: Raga Chandranandan (excerpt) Connoisseur Society.
RODRIGO: Concert—Serenade for Harp and Orchestra (excerpt from the first movement) DGG.
MANITAS DE PLATA: Gypsy Rhumba (complete) Conn. Soc.
MARCELLO: (arr. King): Psalm XVII "The Heavens are Telling" (complete) Connoisseur Society.
PRAETORIUS: Terpsichore: La Bourrée XXXII (complete) DGG Archive.
BERG: Wozzeck (excerpt from Act III) DGG.
BARTOK: Sonata for two pianos and Percussion (excerpt from the first movement) Cambridge Records.
BETHOVEN: Wellington's Victory (Battle Victory) (excerpt from the last movement) Westminster.

RECORDS • Ziff-Davis Service Division
595 Broadway • New York, N.Y. 10012

My check (or money order) for \$_____ is enclosed.
 Please send:

_____ Stereo Review Stereo Demonstration Records at \$4.98 each, postpaid.

Check one: 33½ RPM 45 RPM

_____ Model-SR12 Stereo Test Records at \$4.98 each, postpaid.

(Outside U.S.A.—please send \$7.00 per record ordered.) New York State residents please add local sales tax.

Print Name _____ PE-6-70
 Address _____
 City _____
 State _____ Zip _____

PAYMENT MUST BE ENCLOSED WITH ORDER

OPPORTUNITY MIRROR

(Continued from page 70)

subject under study was in danger or might be rewarded (the mother example again), it is not possible to impress "new" material or learn while sleeping.

Jobs for "First Phone" Holders

I have a First-Class Radiotelephone license, but my interest is not in commercial AM or FM broadcasting. What other kinds of jobs can I get to take advantage of my First-Class FCC license?

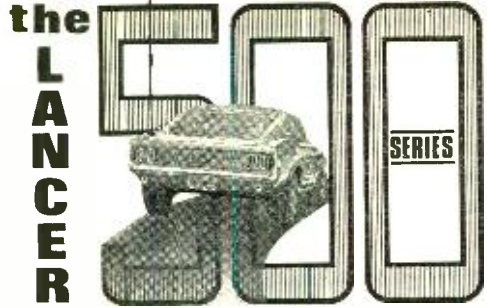
● The non-broadcasting jobs that you can get will depend upon the amount of training that you have above and beyond that required to get the First-Class license. If your training covered only the material necessary to pass the examination, you can only get a job that involves operating, maintaining and troubleshooting communications gear. There are a lot of governmental jobs of this kind currently available. Law enforcement agencies ranging from the local police to the FBI all report a shortage of qualified radio operators and troubleshooters. And, all branches of the Armed Forces also hire "first phone" men for their civilian repair facilities.

There are some private business openings and I would suggest trying taxicab companies, the local telephone company, and any other outfit that uses a lot of mobile radio gear. Put an application in with a reputable, nationwide employment agency. Many jobs for men with a "first phone" license are fee-paid.

The best jobs go to the men who have both a "first-phone" license and a solid background in general electronics technology. Almost every electronics company that designs and builds communication gear is looking for men who have an FCC license and at the same time can design solid-state logic and control circuits.

Keep your eye on the classified employment ads in your local newspaper. Visit any major airport and you'll probably find a cluster of small companies that specialize in airborne radio communications equipment. However, you'll find that the engineering electronics technician job is a lot more exciting than the plain and simple "first phone" maintenance and operation job. If you don't have the training to let you design communications and control circuits, I suggest you enroll in a home study course in electronics.

June, 1970



THREE NEW CB MOBILE ANTENNAS With 500 Watt Coil

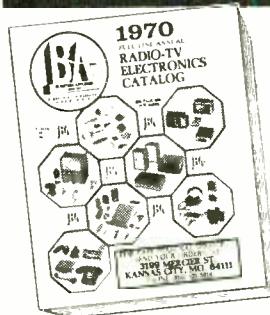
NOW AT POPULAR PRICES. Each model loaded with a SOLID-STATE high "Q" coil field tested to take up to 500 watts. Maximum legal power is assured! Mosley innovated guying device, introduced in this series, keeps antenna upright at top highway speeds.
Model 500A... With 500 watt solid-state high "Q" coil
Model 500B... With 500 watt solid-state coil, and capacity adapters
Model 500C... With 500 watt solid-state coil, capacity adapter and breaker (hinge) feature

For details see your Mosley dealer or write Factory direct, Dept 200.

Mosley Electronics Inc.

4610 N. LINDBERGH BLVD., BRIDGETON MO. 63044
CIRCLE NO. 21 ON READER SERVICE PAGE

It's yours
free



**GIANT 274 PAGE
1970
RADIO-TV
ELECTRONICS
CATALOG**

Write to:

**BURSTEIN-APPLEBEE CO.,
DEPT. PE-6 3199 MERCIER ST.,
KANSAS CITY, MO. 64111**

Name _____

Address _____

City _____

State _____ Zip Code _____

CIRCLE NO. 8 ON READER SERVICE PAGE



1970—WINTER \$1.35
ELECTRONIC EXPERIMENTER'S HANDBOOK

148 pages of the most fascinating and challenging construction projects for the electronics hobbyists. All with complete schematics, illustrations, parts list, and easy-to-follow instructions that guarantee you perfect finished products.

1970—SPRING \$1.50
ELECTRONIC EXPERIMENTER'S HANDBOOK

Another big package containing the most challenging, fun-to-build electronics projects ever! Be sure to order this one today!

1970 STEREO/HI-FI DIRECTORY \$1.35
 Giant 180 page buyer's guide listing more than 1,600 individual Stereo/Hi-Fi components by 176 manufacturers. Nine individual sections complete with specs, photos, prices—the works!

6 Vital Components

*For Knowledge...
 For Profit... For Sheer
 Electronics Enjoyment!*



1970 TAPE RECORDER ANNUAL \$1.35
 Over 130 pages covering every aspect of tape recording. Complete buyer's guide to the brands and models on the market. Expert tips on equipment—making better tapes—editing—copying—everything you want and need to know about tape recording.

1970 \$1.35
COMMUNICATIONS HANDBOOK
 148 fact packed pages for the CB, SWL or HAM. Equipment buyer's guide—photos—tables—charts—getting a license—everything to make this the world's most complete guide to communications.

1970 \$1.35
ELECTRONICS INSTALLATION & SERVICING HANDBOOK
 Covers all 8 areas of consumer electronics servicing—all the tricks of the trade in one complete guide. The industry's "how-to" book for installing and servicing consumer electronics equipment.

AMATEUR RADIO

(Continued from page 82)

Radio, Melbourne, Australia, that work done by Alan Fowler of the Australian Post Office Research Department, indicates that these "doubting Thomases" may be right. He says that, unless that silver plating is nearly 100% pure, its resistance becomes excessively high. Furthermore, not only is it difficult to keep the plating solution clean; but commercial platers usually add contaminants called "silver brites" to obtain a bright finish. Compounding the difficulty, many silver-plated electronic components are also gold plated to inhibit corrosion. Gold brighteners also increase the resistance of gold plating sharply—and its resistance is greater than copper or silver.

VK5PB (who is a professional plater) recommends skipping silver plating entirely. Instead, buff the material to a smooth, shiny surface; electroplate it with copper (even if the material is copper to begin with); polish again; and lightly flash with pure gold to inhibit corrosion.



Gary Kent, WNØSZY, Eddyville, IA, 52553, is waiting for his General license. His Heathkit DX-60B, Drake 2B, Hy-Gain 18-AVQ have worked 34 states.

\$1,000,000 TVI Suit—Final Report. As we reported previously, the \$1,000,000 TVI suit against "Grid" Gridley, W4GJO, has been withdrawn. Legal costs were \$6,500, of which \$5,200 were covered by contributions. Further contributions may be sent to the Sarasota Amateur Radio Association, P.O. Box 3323, Sarasota, Fla. (Tx Florida Skip)

NEWS AND VIEWS

Ron Del Buono, WA2JUI, 415 41 St., Union City, NJ 07087, collected over 450 QSL cards as a Novice! His best Novice DX was Spain, but he is most proud of his card from WA6UUL at the San Diego Naval Base. Ron used a Hallicrafters S-120 receiver and a Heathkit DX-20 as a Novice. He is

ZIFF-DAVIS SERVICE DIVISION • Dept. W
 595 Broadway, New York, N.Y. 10012

Please send me the annuals I've checked below:

- 1970 Electronic Experimenter's Handbook-Winter
- 1970 Electronic Experimenter's Handbook-Spring
- 1970 Stereo/Hi-Fi Directory
- 1970 Tape Recorder Annual
- 1970 Communications Handbook
- 1970 Electronics Installation & Servicing Handbook

I am enclosing \$..... My remittance includes an additional 25% per copy for shipping and handling (Outside U.S.A. all magazines are \$2.00 per copy, postpaid.)

PE-6-70

print name _____

address _____

city _____

state _____

zip _____

PAYMENT MUST BE ENCLOSED WITH ORDER

now using a Heathkit Sixer on 6 meters . . . **Ken Sobel, WN2MQI**, 1560 E 102 St., Apt. 3-G, Brooklyn, NY 11236, worked 22 states his first three weeks on the air and expected to pass the General exam during Easter vacation. He uses a DPZ "Vacationer" window-mounted antenna in conjunction with a Heathkit DX-60B transmitter and HR-10B receiver on 15 meters. The antenna is 4 1/2 feet long and 30 feet high . . . Across country, **Dave Wetherbee, WN6GTE**, uses an Ameco AC-1 transmitter and R-5A receiver in conjunction with a Gotham V-80 vertical antenna. Dave has three states confirmed after a few days on the air and is studying hard for his General ticket.

The Medical Amateur Radio Council, Ltd., will hold its 4th Annual meeting in Chicago at the Sheraton-Blackstone Hotel on June 25 at the time of the American Medical Association Meeting. Reservations at \$7.50 can be obtained from Joseph J. Boris, P.O. Box 229, Manchester, CT 06040. The MARCO nets meet on 14.280 kHz at 0200 GMT and on 7260 kHz at 0100 GMT. Last September, the MARCO net, with help from the International Missionary Radio Net, obtained 10 ampoules of D-lantoin needed for a 3-year-old ill with encephalitis in Lima, Peru, and put them on a plane in Miami. The drugs arrived in time, and the child was recovering how to use her muscles in February.

Ray Hich, WN8FMZ, 446 Alameda Ave., Youngstown, OH 44501, was so excited when his license arrived that he fell down the stairs getting to his radio shack. Picking himself up, it took him a month to work 16 states and Canada on 40 meters.



Don Babcock, WB4KUZ Titusville, FL 32780, likes to ragchew and he is also a member of the local Radio Amateur Civil Emergency Service (RACES).

A Heathkit HW-16 transceiver drives Ray's 40-meter vertical antenna, and he has plans for a 15-meter beam . . . **R. H. Mattox, W9ADT/MM, SS Green Bay** (5457 Hatch Lane, West Palm Beach, FL 33406, when he's home) has been a ham for over 35 years. He has also been a disc jockey and engineer for AM and FM BC stations, teacher of code and radio engineering, seaman, etc. The shipboard equipment includes a Heathkit SB-300 receiver, SB-400 transmitter driving an SB-200 linear amplifier to 1000 watts input into a Hy-Gain 14-AVQ vertical antenna. On shore, Bob signs WB41PP. Get him to tell you how he was blown 100 miles out to sea on his honeymoon, spending 35 hours lashed to the tiller of the 34-ft ketch. By the way, the captain of the *Green Bay* is WA5TKV, thanks to Bob's tutoring . . . **Faris Howat, WN2GJM**, 115 Ocean Ave., Brooklyn, NY 11225, alternates between a homebrew 10 watt and a Heathkit DX-60V transmitter. His antenna is a Hy-Gain 14-AVQ vertical, and his receiver is a Drake 2C. It all adds up to 41 states and 10 countries. When Faris gets his code speed built up a little more, he will go for his Advanced ticket. As he already holds 2nd class Commercial Radiophone license with Radar endorsement, he isn't too worried about the theory. Being in the U.S. Navy may explain the radar endorsement . . . **C. D. Anandasegar, VU2AI/W2**, Box 253, Manasquan, NJ 08736, first got on the air in Madras, India, using a 25-watt, home-built transmitter to feed a folded dipole antenna. He received on a BC-342 and worked over 80 countries. Anand is in the United States for electronics training and has been operating under the Indian/USA reciprocal operating agreement through the cooperation of Charles, W2AIW. The best time to catch Anand is on weekends on 20 meters . . . **James W. Andrews, WN8FRQ**, 4240 Otis Dr., Dayton, OH 45416, feeds his 40-meter dipole with a Drake 2-NT transmitter and receives on a Drake 2C. Jim has worked 11 states and is president of the Miami Valley SWL Association . . . **Daniel Roy, WN1MJC**, 19 Standard Ave., West Warwick, RI 02893, has separate dipoles for the 80-, 40-, and 15-meter Novice bands. He operates them in conjunction with a Heathkit DX-60B transmitter and a Realistic DX-150 receiver. Dan wants to start an amateur radio club at his high school and would appreciate advice from officials or members of established clubs.

Jim Labo, WA5ZVI, 1700 Mosher Dr., Enid, OK 73701, was KH6FKB in Hawaii for six months before becoming WA5ZVI. He was thrilled at working 45 Novices in 12 states on 15 meters, but his big frustration was being unable to convince many of them that his call was KH6FKB, not K6FKB. Jim uses an SBE-31 transceiver on 15 meters, but he is now a VHF man with homebrew or kit gear for 50, 144, 220, and 432 MHz.

Good luck on Field Day. Keep your "News and Views" pictures, and club bulletins coming to P.O. Box 678, Gary, Ind. 46101. *73, Herb, W9EGQ*

Good luck on Field Day. Keep your "News and Views" pictures, and club bulletins coming to P.O. Box 678, Gary, Ind. 46101. 73, Herb, W9EGQ

ADDED MOBILE POWER WHEN YOU NEED ADDITIONAL COVERAGE FOR CLEAR COMMUNICATIONS



170 WATT INPUT

Complete with remote power switch and indicator control panel plus mounting brackets.

FCC TYPE ACCEPTED
Parts 89, 91, 93

\$129.95
12 VDC

SMALL PACKAGED MOBILE POWER LINEAR R.F. POWER AMPLIFIER

Covers greater distances with increased transmit power. Can be used with SONAR BR20, FM40 or any similar FCC approved equipment with 1-15 watt output. Designed with top performance and dependable service when you need it. Automatic standby/transmit switching • Covers 25-50MHz range • transistorized power supply — negative ground • Used on amateur 28MHz for FM-AM-SSB. Small, compact, rugged design. Size: 2"H x 3"W x 8"D. Wt. 3 lbs. 12 VDC

SONAR RADIO CORP., 73 Wortman Avenue, Bklyn, N.Y. 11207
Please send information on Model BR 2906 Linear Amplifier.

Dept. 849

Name
Address
City State Zip

CIRCLE NO. 30 ON READER SERVICE PAGE

Olson ELECTRONICS FREE Catalog

Fill in coupon for a FREE One Year Subscription to OLSON ELECTRONICS' Fantastic Value Packed Catalog — Unheard of LOW, LOW PRICES on Brand Name Speakers, Changers, Tubes, Tools, Stereo Amps, Tuners, CB, and other Values. Credit plan available.

NAME _____
 ADDRESS _____
 CITY _____ STATE _____
 GIVE ZIP CODE _____

If you have a friend interested in electronics send his name and address for a FREE subscription also.

OLSON ELECTRONICS

DEPT. IF 260 S. FORGE STREET, AKRON, OHIO 44308

CIRCLE NO. 23 ON READER SERVICE PAGE



KITS FEATURED IN

POPULAR ELECTRONICS

AND FROM OTHER SOURCES

Psychedelic Strobe Light	\$17.50
LII Tiger Amplifier (40w)	\$37.50
Tiger Amplifier (80w)	\$50.00
Super Tiger Amplifier (100w)	\$75.00
FET Preamp (less power supply)	\$42.50

Prices plus postage and insurance

Also:

Psychedelia I Color Organ, Sonolite,
 Nixie Readouts, Frequency Counters,
 Sports Timers, Ultrasonic Alarm, etc.

WRITE FOR **FREE CATALOG**

Southwest Technical Products

219 (PE) W. Rhapsody
 San Antonio, Texas 78216

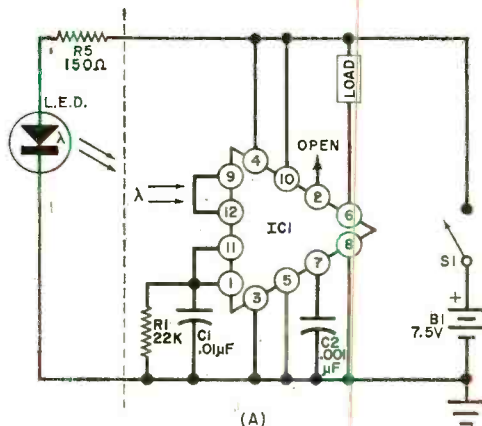
CIRCLE NO. 31 ON READER SERVICE PAGE

SOLID STATE

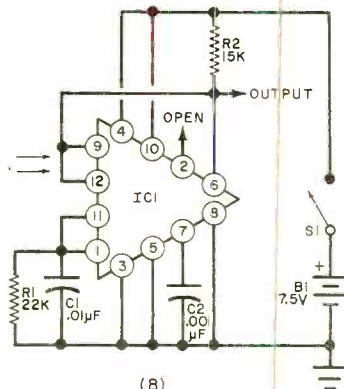
(Continued from page 80)

The TA5371B is a developmental IC consisting of a photosensitive section and a power amplifier on a single monolithic silicon chip assembled in a modified TO-5 package fitted with a transparent window. The light-detector portion includes two photosensitive Darlington pairs connected in parallel, while the amplifier is a direct-coupled multi-stage circuit using seven *n*pn transistors, four diodes, and ten fixed resistors.

Depending on external connections, the TA5371B can be used either as an amplifier providing a linear output signal or as a sensitive light-actuated switch with two outputs. One output (terminal 6) supplies power to the load when the photosensitive elements are illuminated, while the other (terminal 2) furnishes current in the absence



(A)



(B)

Fig. 3. New RCA TA5371B IC is shown in circuit (A) connected as light-actuated on/off switch. In circuit (B), same IC is used as a linear amplifier.

POPULAR ELECTRONICS

of light. Designed for operation on a 7.5-volt d.c. power source, the device can furnish up to 100 mA output. Its peak sensitivity is to infrared light at 7250 Angstroms, but it responds to visible light as well.

An on/off switching action is provided by the circuit shown in Fig. 3A. In operation, the load is energized when light strikes the sensitive elements located between pins 9 and 12. A reverse action—load energization in the absence of light—can be obtained by connecting the load to pin 2 with 6 open. A gallium-arsenide light-emitter diode (LED), RCA type 40598A, may be used as the controlling infrared source, and will provide greater sensitivity than an incandescent source.

The linear amplifier arrangement (Fig. 3B) may be used in test equipment or communications applications. In practice, the output signal developed across load resistor *R2* can be coupled to a high-impedance voltmeter, to an output amplifier and speaker system, to an oscilloscope, or to other instrumentation, depending on system requirements.

In both circuits, all resistors are half-watt types and the capacitors low-voltage ceramic or tubular paper units. The switching circuit's load can be a tone source, such as a Mallory Sonalert, or a moderately sensitive 6-volt electromagnet relay. If a relay is used, however, a small diode should be connected across its coil to absorb the transient pulse voltages generated during switching (anode to pin 6).

While conventional construction and wiring techniques may be used for assembling either of the two circuits, reasonable care in regard to layout and lead dress is necessary to prevent feedback and instability due to the amplifier's inherently high gain. Signal leads must be kept short and direct. RCA, in fact, suggests that the external components (*R1*, *R2*, *C1*, *C2*, etc.) be connected directly to the appropriate IC terminals.

Device News. Motorola Semiconductor Products Inc. (P.O. Box 10912, Phoenix, AZ 85036) has announced the production of an integrated circuit UFH duplexer. Identified as type MCH5890, the unit is essentially a solid-state s.p.d.t. switch designed to operate at frequencies between 400 and 500 MHz with inputs of up to 40 watts.

Although primarily a transmit/receive switch, the new device also can be used as a monitor network in a transmitter, as a sampling unit in an a.f.c. or a.g.c. circuit, or in similar communications applications. With a typical 0.1-dB transmit-mode insertion loss and 25-dB transmit-mode isolation figure, the MCH5890 is supplied in a

THE WORLD'S MOST ADVANCED HIGH FIDELITY AMPLIFIER



SINCLAIR IC-10

actual size

The Sinclair IC-10, the world's first monolithic integrated circuit high fidelity amplifier and preamp, is now available for professional or hobby applications. The silicon chip contains 13 transistors, 3 diodes and 18 resistors. This rugged device is encapsulated in plastic and bonded to a supporting heat sink bar. The IC-10 is a true high fidelity amplifier possessing distinct advantages over conventional types, the most important of which are freedom from thermal runaway and a very low distortion level. The IC-10 may be used with batteries or with the PZ-7 regulated power supply (which will drive 2 IC-10's to rated output). As an audio amplifier the IC-10 requires only the addition of tone controls, speaker and a power source. A 32 page manual which gives engineering data, circuit diagrams and suggestions for applications in addition to audio is supplied free with each IC-10.

SPECIFICATIONS

Output: Class AB, 10 watts peak, 5 watts RMS
Distortion less than 1% at full output
Load impedance: 3-16 ohms
Response: 5 Hz to 100 kHz \pm 1 dB
Gain: 110 dB (100,000,000 times)
Supply voltage: 8-18 volts DC
Sensitivity: 5 mv. Input impedance adjustable externally up to 2.5 meg ohms.

PLEASE SEND ME:

IC-10's @ \$12 ea. + 35c postage

PZ-7 Power Supplies @ \$14.95 ea. + 75c shipping

FREE AUDIONICS Catalog

Total enclosed: \$

AUDIONICS, INC., Dept. P-6
9701 S.E. Mill, Portland, Ore. 97216

Name _____

Address _____

City _____

State _____ Zip _____

CIRCLE NO. 5 ON READER SERVICE PAGE

POPULAR ELECTRONICS SUBSCRIBER SERVICE

Please include an address label when writing about your subscription to help us serve you promptly. Write to: P.O. Box 1096, Flushing, N.Y. 11352
CHANGE OF ADDRESS: Please let us know you are moving at least four to six weeks in advance. Affix magazine address label in space to the right and print new address below. If you have a question about your subscription, attach address label to your letter.

TO SUBSCRIBE: Check below.
 5 yrs. \$21 3 yrs. \$15
 1 yr. \$6 New Renewal

Specify: Payment enclosed
You get 1 extra issue per year as a BONUS!
 Bill me later.

If you have no label handy, print OLD address here.

name _____

city _____

address _____

please print

zip code _____

← AFFIX LABEL →

print name _____ 0396

address _____

city _____

state _____ zip code _____

Add'l postage: \$1 per year outside U. S., its possessions & Canada

SOLID STATE

(Continued from page 89)

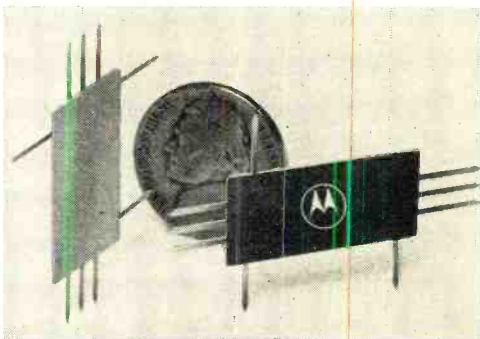
thin plastic-ceramic package measuring $\frac{1}{2}$ " by 1" overall.

An interesting solid-state "relay" has been developed by Ebeko of Urloffen, West Germany. Featuring an integral four-transistor direct-coupled amplifier, the unit employs a conventional electromagnetic input coil. Instead of operating a mechanical armature, however, the coil acts to control the resistance of a Hall-effect indium-antimonide element. The Hall-effect resistor, in turn, adjusts the amplifier's bias to provide output switching, with one driver transistor used as the normally off and another as the normally on contact. Suitable for use in d.c. as well as pulsed a.c. circuits, the new relay has the advantages of virtually unlimited life, fast, bounceless, arless operation, and excellent input/output isolation.

Field-effect transistors capable of handling 10 to 12 watts at 2 GHz have been developed by Siliconix, Inc. (1140 W. Evelyn Ave., Sunnyvale, CA 94086) as the first products in a planned line of microwave semiconductor devices. Future products will include additional special purpose FET's and bipolar devices as well as both multiplier and tuning varactors.

A line of "Magnistors" at prices within the reach of the serious experimenter is being offered by the Hudson Corp. (Box 867, Manchester, NH 03105). A Magnistor is a silicon planar transistor which has two collectors and a single emitter, with its construction so arranged that an external magnetic field gives a lateral motion to the charge flow from the emitter, causing a differential change in the relative collector currents. Used as magnetic sensors, these devices can be employed in test and control applications. Unit prices range from

\$3.50 for the HM 111 B to \$5.00 for the HM 111 G, although there is a minimum order requirement of \$30.



The Motorola MCH5890 is a UHF duplexer integrated circuit for the frequencies from 400 to 500 MHz.

Transitips. Engineer Bob Botos of Motorola Semiconductor Products Inc., has passed along some very worthwhile tips for anyone concerned with minimizing feedback and oscillation problems when working with linear integrated circuits. He points out that linear monolithic IC's, even if specified for audio applications, are potential r.f. amplifiers and, therefore, must be treated with respect and care.

Good r.f. breadboard techniques must be observed, with both signal carrying and power supply leads kept short and direct to minimize distributed inductances and feedback capacities. In addition, bypass and frequency compensation capacitors, where used, should be connected directly to the device's leads (or socket terminals). Naturally, ground loops must be avoided.

According to Bob, improper breadboard techniques can result not only in frustration but in a tendency to blame the IC's manufacturer for producing poor-quality merchandise.

—Lou

New Products from THE PHASE CORPORATION

FOUR TRACE PRE-AMP

Convert any single trace scope to display four separate signals at the same time without any internal modifications.



\$34.95

All Solid State
FET Input
Center & Gain
Controls for each
Channel
1 Megahertz/
channel
bandwidth

Kit with Custom cabinet (Model A1KC) \$34.95; wired & tested (Model A1W) \$54.95

Send Check, Money Order, or ask us to bill your BankAmericard or Master Charge. We pay all postage. Dealer inquiries invited.

TEST OSCILLATOR

Generates all three functions.

SAW: 0.1HZ
—100KHZ
SQUARE: 0.05HZ
—50KHZ
PULSE: 0.1HZ
—100KHZ



\$34.95

All Solid State
FET & Unijunction
Circuitry
Calibrated ranges
Portable &
Compact

Kit with Custom Cabinet (Model O1K) \$34.95; wired & tested (Model O1W) \$54.95

Send Check, Money Order, or ask us to bill your BankAmericard or Master Charge. We pay all postage. Dealer inquiries invited.

THE PHASE CORPORATION, ELECTRONICS DIVISION, MEDFORD, MASS. 02155

CIRCLE NO. 25 ON READER SERVICE PAGE

SHORT-WAVE LISTENING

(Continued from page 78)

SHORT-WAVE CONTRIBUTORS

Bill Jarvis (WPE1GEP), Wakefield, Mass.
 Richard Pendleton (WPE1HMV), E. Braintree, Mass.
 Bob Raymond (WPE1HOE), Bradford, Mass.
 Joseph Smith, Jr. (WPE1HRA), Saugus, Mass.
 Rick Mills (WPE1HSA), Berwick, Maine
 Andy Emars (WPE1IIVQ), Willimantic, Conn.
 Bill Feidt (WPE2AM), Lanham, Md.
 John Banta (WPE2PIU), Bay Shore, N. Y.
 Bob Arnold (WPE2QPR), Canastota, N. Y.
 Paul Wolcott, Jr. (WPE2QVL), Linwood, N. J.
 T. R. Dieber (WPE2QVT), Summit, N. J.
 Bradley Krohn (WPE2REL), Amherst, N. Y.
 John Brandt (WPE2REL), Brooklyn, N. Y.
 Bennett Pine (WPE2KER), Brooklyn, N. Y.
 Michael Fallarino (WPE2KFC), Catskill, N. Y.
 Neil Berman (WPE2RGC), Brooklyn, N. Y.
 George Sprout (WPE3GAW), Reading, Pa.
 Larry Gilboy (WPE3HVL), Pitsston, Pa.
 Bill Martin (WPE3HZI), Wilmington, Del.
 Fred Heutte (WPE3IBI), Brookland, Md.
 Grady Ferguson (WPE3IBC), Charlotte, N. C.
 John Carson (WPE4JZB), Durham, N. C.
 Bruce Roberts (WPE4KAH), Wayne-boro, Va.
 M. F. Dressler (WPE4KII), Jack-sonville, Fla.
 Guy Fisher (WPE4KIK), Cape Coral, Fla.
 Sam Fulp (WPE4KIM), Lexington, N. C.
 John Leger (WPE4KJK), Louisville, Ky.
 Alan Parker (WPE5FFF), New Orleans, La.
 John Wheeler (WPE5FFS), San Angelo, Texas
 Charles Bennett (WPE5SW), Sumrall, Miss.
 Walter Schivo (WPE6AFN), San Francisco, Calif.
 Jim Young (WPE6EVA), Wrightwood, Calif.
 Wallace Glavich (WPE6EJX), Eureka, Calif.
 Richard Loustau (WPE6HPS), Woodland Hills, Calif.
 Robert Hymes (WPE6HWW), Palo Alto, Calif.
 David Williams (WPE6CWW), Astoria, Ore.
 Anthony Marks (WPE7CYO), La Grande, Ore.
 Wayne Benkinney (WPE8EEI), Flint, Mich.
 R. D. Bolling (WPE8EJX), APO (Qui Nhon, Vietnam)

George Smith (WPE8KJJ), Grand Rapids, Mich.
 Tom Kennedy (WPE8AKE), Battle Creek, Mich.
 Bruce Call (WPE8KKR), Akron, Ohio
 Bob Smith (WPE8KKY), Grand Rapids, Mich.
 Bill Brown (WPE8KNI), Corunna, Mich.
 Ben Mancine (WPE8KNJ), S. Euclid, Ohio
 Gerry Dexter (WPE9HDB), Lake Geneva, Wisc.
 Robert Zilmer (WPE9IIV), Milwaukee, Wisc.
 Jim Siers (WPE9JNS), Franklin Park, Ill.
 Jerry Reichman (WPE9JFG), Chicago, Ill.
 John Hedstrom (WPE9JTG), Wheaton, Ill.
 David Speerle (WPE9JUH), Plymouth, Ind.
 Mike Rogers (WPE9JWC), Glencoe, Ill.
 Robert French (WPE9JVA), Fort Wayne, Ind.
 Robert Muckey (WPE9JNS), Rockford, Ill.
 Arthur Nelson (WPE9JYG), Rockford, Ill.
 A. R. Niblack (WPE9KMI), Vincennes, Ind.
 John Beaver (WPE9OAE), Pueblo, Colo.
 Gary Lovegren (WPE9OAV), St. Paul, Minn.
 Art Burke (WPE9OFO), Topeka, Kan.
 Carl Larson (WPE9OJA), Mount Ayr, Iowa
 Jack Perolo (WPE9PIC), Sao Paulo, Brazil
 Mark Paul (WPE9PIG), Chomedey, Que.
 Jeff Wilson (WPE9PEI), Sarnia, Ont.
 Paul Cau (WPE9PEOZ), St. Catharines, Ont.
 Anthony D'Agostine (WPE9PE2SD), Hamilton, Ont.
 Leo Cellini (WPE9PE2SK), Hamilton, Ont.
 Ken Asmus (WPE9PE7W), Winnipeg, Man.
 Les Hughes (WPE9PEIHI), S. Burnaby, B. C.
 Shawn Daniels, St. Louis, Mo.
 Homer Fort, Midland, Texas
 Bruno Haineault, Montreal, Que.
 Harold Honnold, Modesto, Calif.
 Jon Jay-oe, Baltimore, Md.
 Kirk Kelpitke, Wausau, Wisc.
 Capt. P. Lefevre, Carcavelos, Portugal
 Cass Lewart, Holmdel, N. J.
 William Milus, Plymouth Meeting, Pa.
 Garry Murch, Tewksbury, Mass.
 Jim Slight, Kansas City, Mo.
 Robert Tomaine, Jermyn, Pa.
 Dan Tschopp, Humble, Texas

(Continued on page 92)

This is the BOOK that ALL... tells ALL... about TV antennas & home TV systems! (And it's free!)



Write today for your free copy of the giant 1970 Winegard Catalog offering the world's finest selection of TV and FM Antennas, Mounts, Amplifiers, Wire — plus everything you need for a home TV outlet system. Professional or do-it-yourselfer, you'll learn more about the new Winegard products that can bring you sharper, clearer TV and FM reception. Mail coupon now for your free copy.



Winegard
ANTENNA SYSTEMS

3022-5 Kirkwood Street • Burlington, Iowa 52601

Please send your free catalog to:

NAME _____

ADDRESS _____

CITY _____

STATE _____

ZIP _____

I'm a Dealer

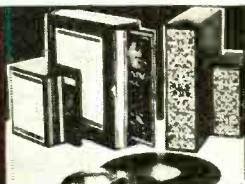
Do-It-Yourselfer

CIRCLE NO. 32 ON READER SERVICE PAGE

DELUXE RECORD AND TAPE CASES

Plus *Free* cataloging forms

- Padded back
- Dust proof
- Gold embossed



Decorative and sturdy cases constructed of reinforced fiberboard—covered in rich leatherette to keep your records and tapes from getting damaged. Available in choice of five decorator colors. Record and Tape Cases lend themselves handsomely to the decor of any room. Padded back (in your color choice) is gold tooled in an exclusive design. Sides in standard black leatherette to keep them looking new after constant use. Extra with each case ordered you will receive, free of charge, a specially designed cataloging form with pressure sensitive backing for affixing to side of case. Enables you to list the records to help you locate your albums. Cases are available in three sizes for 7", 10" and 12" records. Center divider separates records for easy accessibility, holds an average of 20 records in their original jackets. Tape case holds 6 tapes in original boxes.

Ziff-Davis Pub. Co. • Dept. SD • 1 Park Ave. • N.Y., N.Y. 10016

My remittance in the amount of \$ _____
 Quantity Is enclosed for the Cases indicated below.
 _____ Tape Case at \$4 ea., 3 for \$11, 6 for \$21.
 _____ 7" Record Case at \$4 ea., 3 for \$11, 6 for \$21.
 _____ 10" Record Case at \$4.25 ea., 3 for \$12, 6 for \$22.
 _____ 12" Record Case at \$4.25 ea., 3 for \$12, 6 for \$22.

ADD \$1.00 PER ORDER FOR SHIPPING AND HANDLING.

Check color choice for back of case (sides in black only):

- Midnight Blue Red Spice Brown
 Pine Green Black PE-6-70

Name _____

Address _____

City _____

State _____

Zip _____

PAYMENT MUST BE ENCLOSED WITH ORDER

SHORT-WAVE LISTENING

(Continued from page 91)

on 9645 kHz at 2055-2105 and around 0055 on 6175 and 11.725 kHz. Numerous reports received within the past few days also list 9615, 9690 and 15.285

kHz as having English church news during that 0050 xmsn.

Vietnam (North)—V. of Vietnam, Hanoi, now runs an English time slot on 10.042 kHz at 2300-2330 for American Forces in South Vietnam with usual slanted propaganda, some old American pop records and the voice of "Hanoi Hattie".

Clandestine—Radio Nordsee International is being reported on 6210 kHz at 2120-2300 with rock music and anmt's in English and German.

DX COUNTRY AWARDS PRESENTED

To be eligible for one of the DX Countries Awards designed for WPE Monitor Certificate holders, you must have verified stations in 25, 50, 75, 100, 125, or 150 different countries. ("Letters of Certification" will be issued to those who have over 150 countries verified in steps of 10.) The following DX'ers recently received their awards for 25 countries.

25 COUNTRIES VERIFIED

Howard Rosenberg (WPE2PQE), Queens Village, N. Y.

Lewis West, Jr. (WPE4JYL), Charlotte, N. C.

David Perry (WPE2QFK), Pleasant Valley, N. Y.

Dennis Davenport (WPE9JLT), Edwardsville, Ill.

Edward Sue (WPE1HMA), Brookline, Mass.

John Ward (WPE1HJH), Springfield, Mass.

Horace Steinhauer (VE3PE2JO), Kenora, Ont.

Jack Dashper (WPE4KJC), Camden, Tenn.

E. F. P. Lloyd (VE7PE1ED), N. Vancouver, B. C.

David Galletly (WPE2QH), Sound Beach, N. Y.

T. R. Wieber (WPE2QVT), Summit, N. J.

Richard Moore (VE3PE2NZ), London, Ont.

Michael Dopson (WPE4KCF), Enterprise, Ala.

Steve Swift (WPE7CVV), Olympia, Wash.

Barry Lavine (WPE2QHM), Elmira, N. Y.

James Ziegler (WPE9JOW), Milwaukee, Wisc.

Robert Olszewski (WPE8KFW), Toledo, Ohio

Loren Davis (WPE6HMA), Hayward, Calif.

Fred Parkinson (WPE2QTW), Hewlett, N. Y.

Charles Loftis (WPE4KEF), Landrum, S. C.

John Burda, Jr. (WPE8KAO), Willard, Ohio

Joseph Cooper (WPE2QHT), Milwaukee, Wisc.

David Yoder (WPE0EZU), Denton, Kansas

Everett Slosman (WPE2QZB), Endicott, N. Y.

Craig Seufert (WPE1HNS), Newtown, Conn.

Gregory Martin (WPE8KFL), Wyoming, Mich.

Walter Robison (WPE2RAK), Bellmawr, N. J.

Daniel Laurier (WPE2QHF), Walton, N. Y.

Glenn Tamasi (VE7PE1DY), Vernon, B. C.

Ron Taylor (WPE9JSA), Benton, Ill.

Richard Lewis (WPE5BST), Blackfoot, Idaho

David Lubar (WPE9JFD), Elmwood, Ill.

Donald Asp (WPE6HGY), Tustin, Calif.

Willie Martin (WPE5FBJ), Blytheville Air Force Base, Ark.

Thomas Gongaware (WPE5HWU), Latrobe, Pa.

Joel Bahl (WPE9JFY), Worth, Ill.

Charles Albertson (WPE7CWI), Spokane, Wash.

Clayton Ruth (WPE9JGY), Munster, Ind.

Michael Schackner (WPE1HSJ), Pawcatuck, Conn.

John Limbach (WPE4KCV), Fayetteville, N. C.
David Winfree (WPE4KBA), Jupiter, Fla.
Curtis Philips (WPE3HNS), Hellertown, Pa.
James Maker (WPE4HB), Tampa, Fla.
David Weinberger (WPE3HVN), Philadelphia, Pa.
Mrs. Mildred Marshall (WPE0FIR), Devils Lake, N. D.

Robert Byers (VE3PE2PX), Ganoquo, Ont.
Ronald Richmond (WPE3JH), Alexandria, Ind.
Alan Macnaughton (VE3PE2PP), Kitchener, Ont.
Warren Flack (WPE4KEL), Atlanta, Ga.
Stanley Starks (WPE8KDR), Midland, Mich.
Thomas Blossom (WPE9FHQ), Fort Wayne, Ind.
Kim Stenson (WPE1HPU), Wilmington, Vt.
John Adams (WPE3HXT), Beltsville, Md.
Dennis Sheppard (WPE4JTH), Stone Mountain, Ga.

Dimitur Alipiev (WPE2QXL), Syracuse, N. Y.
Mitchell Kasso (WPE2QTK), Little Neck, N. Y.
Ivan Waufile (WPE2QVD), St. Johnsville, N. Y.
Gary Marks (WPE2QZK), Tonawanda, N. Y.
James Jankowski (WPE2QVE), Corfu, N. Y.
Timothy Genwick (WPE9ILO), Brookfield, Wisc.
Charles Clay (WPE2QWE), Climax, N. Y.
Anthony Baleno (WPE3HWY), Verona, Pa.
Bruce McCoy (WPE9JMY), La Porte, Ind.
Keith Fritzinger (WPE3HSW), Shillington, Pa.
Brian Heller (WPE2QVP), Lawrenceville, N. J.
Michael Garrett (WPE8KBA), Grosse Pointe Park, Mich.

Joseph Perge (WPE8JKD), Newark, Ohio
Lawrence Plummer (WPE7CRV), Bellevue, Wash.
Thomas Porzio (WPE2PXI), Butley, N. J.
Randy Curtis (WPE0FKE), Omaha, Nebr.
Ken Piper (WPE6GV), Stockton, Calif.
James Hurst (WPE3HWP), Vienna, Md.
Dave Denbow (WPE6HJT), Claremont, Calif.
Ronald Del Buono (WPE2PYJ), Union City, N. J.
Steve Smith (WPE5FAU), El Dorado, Ark.
Ronald Nawrot (WPE3HUO), Owings Mills, Md.
Tom Frisz (WPE9JRU), South Bend, Ind.
Christopher Martin (WPE1HRG), Naugatuck, Conn.
George Shadwell (VE3PE2QZ), Ottawa, Ont.
Robert Rattner (WPE2RBL), Forest Hills, N. Y.

NEW/CB TRANSCEIVER SOLID STATE PRE-AMP



- Improves CB Base Station Performance
- Works on tube or transistor equipment
- No Modification to CB unit
- On-the-air sign automatically lights when transmitting

Model PCB with built-in power supply, transfer relay, connecting cables, wired and tested..... **\$59.95**

Write for free literature



AMECO / DIVISION OF AEROTRON, INCORPORATED
P. O. BOX 6527 • RALEIGH, NORTH CAROLINA 27608

CIRCLE NO. 1 ON READER SERVICE PAGE

Edes Matsukado (KH6PE3Z), Honolulu, Hawaii
 Robert Frieden (WE4KIA), Norfolk, Va.
 Thomas Phillips (WE1HQE), Rutland, Vt.
 Alan Silver (WE6HNW), Los Angeles, Calif.
 Richard Thompson (WE3HQW), Suislaw, Md.
 Chris Goodwin (WE3HXB), Ridley Park, Pa.
 Edward Horne (VE7PE1DA), Watson Lake, Yukon
 Frederick Webster (WE2PRD), Seacucus, N. J.
 J. Arthur Frederick (WE3FWX), New Kensington, Pa.

Steve Legler (WE0FKU), Lawrence, Kansas
 David Peters (WE5HDM), Modesto, Calif.
 Robert Shumaker (WE8KBE), Southfield, Mich.
 Raymond Fortman (WE2PLW), Grand Island, N. Y.

Andre Lavigne (VE2PE1NO), La Salle, Que.
 G. Clinton Myers (WE4KEO), Atlanta, Ga.
 James Milburn (WE5FDO), Baton Rouge, La.
 Ralph Collins (WE2RBO), FBO, New York, N. Y.
 Jerry Smith (WE5FCX), Longview, Texas
 Richard Sheehan (WE9JOV), Park Forest South, Ill.

Ted Romanow (WE1HQH), Waban, Mass.
 Gary Smith (WE1HRP), Torrington, Conn.
 Paul Metro (WE2QZM), Colonia, N. Y.
 Nick Chinn (WE6HKB), San Leandro, Calif.
 Mike Witkowski (WE9JFT), Stevens Point, Wisc.
 Peter Heindel (WE6GLR), Waukegan, Ill.
 Philip Scribani (WE2QSY), Maspeth, N. Y.
 Joseph Williams (WE9JKD), Milwaukee, Wisc.
 Tom Felton (VE7PE1EA), Vancouver, B. C.
 David Lavin (WE5FCY), Corpus Christi, Texas
 William McGraw (WE3HRM), Burgettstown, Pa.
 Joseph Molon (WE1HSC), Torrington, Conn.
 Frank Swanberg III (WE9JVD), Dolton, Ill.
 Roger Horie (WE7COV), Mountain Home Air Force Base, Idaho

Bill Potorti (WE2QYH), Ithaca, N. Y.
 Larry Wood (WE0FNY), Potosi, Mo.
 Ken Edl (WE9JPU), Franklin Park, Ill.
 Matthew Shifman (WE2RAZ), E. Brunswick, N. J.

Alan Carpenter (WE8JXS), Fairmont, W. Va.
 Donald Appling (WE7CNG), Spokane, Wash.
 Bud Nation (WE6HJA), Mill Valley, Calif.
 G. W. Fisher (WE7CXZ), Longview, Wash.
 Richard Wells, Jr. (WE2QHY), Wayne, N. J.
 Debart Fant (WE6HMY), San Luis Obispo, Calif.

James Brenner (WE2OUL), Nutley, N. J.
 Dennis Wolfs (WE0ERJ), Waterloo, Iowa
 Jack Graham (WE2QNT), New Milford, N. J.
 Lloyd Zeidner (WE2ORC), Bayside, N. Y.
 Richard Mayer (WE2QOJ), Bronx, N. Y.
 James Tracz (WE9JRD), Morton Grove, Ill.
 Roger Boyd (WE4KEK), Valdosta, Ga.
 Ray Good (WE9BAK), River Forest, Ill.
 Robert Bacal (VE2PE1NK), Montreal, Que.
 Richard Gee (VE7PE1EG), Victoria, B. C.
 Arthur Bolduc (WE1HQU), Biddeford, Maine
 Robert Mc Larnon (WE1HQL), Natick, Mass.
 Scott Fruehwald (WE4KIH), Jeffersonstown, Ky.
 Robert Sylvester (WE5FEW), Metairie, La.
 Robert Halprin (WE2QZU), Fair Lawn, N. J.
 Wayne Mitchell (WE2PVI), Elmont, N. Y.
 Jim Townsend (WE8KJT), Painesville, Ohio
 Robert Fruehwald (WE4KHQ), Jeffersonstown, Ky.

Philip De Silva (WE5CHD), Bremerton, Wash.
 Robert Keller (WE7CND), Brigham City, Utah
 Lt. Paul Steen (WE2RBA), FPO (Guam)
 Bill Buckley (WE2RDI), New York, N. Y.
 Steven Solomon (WE2QTM), Saddle Brook, N. J.

Steve Houston (WE4KDC), Knoxville, Tenn.
 Dave Porter (WE2QSU), Cherry Hill, N. J.
 James Sanders (WE4KCH), Savannah, Ga.
 Homer Ingber (WE4JY), Durant, Fla.
 Philip Thibodaux (WE5FEB), Morgan City, La.
 Greg Raymond (WE1HRW), Bradford, Mass.
 Tommy Buchanan (WE4KA), Darlington, S. C.
 Marcus Bernan (WE2QXO), Montclair, N. J.
 Rick Schiffer (WE3HLL), Franklin, Pa.
 James Murray (WE2RFR), Troy, N. Y.
 Barry Gelb (WE2QZY), Flushing, N. Y.
 Dwight Snyder (WE9JHY), Farmersville, Ill.
 Graham Chloupek (WE6FZE), Oakland, Calif.
 Daniel Lindley (WE4KEA), Florence, S. C.
 G. Alan Hickrod (WE9JJI), Bloomington, Ill.
 William Cangemi (WE2PII), Staten Island, N. Y.
 Ronald Carnes (WE2RBB), Spotswood, N. J.
 Edward Svec (WE2RFN), College Point, N. Y.
 Andrew Finick, Jr. (WE9JPP), Highland, Ind.
 Mark Androw (WE9JUJ), Lincolnwood, Ill.

Build this magnificent Schober Theatre Organ

for only
\$1730!



*Includes finished walnut console. Amplifier, speaker system, optional accessories extra. Only \$1256 if you build your own console.

You couldn't touch an organ like this in a store for less than \$3500—and there hasn't been a musical instrument with this vast variety of genuine Theatre Organ voices since the days of the silent movies! If you've dreamed of the grandeur of authentic big-organ sound in your own home, you won't find a more satisfying instrument anywhere—kit or no kit.

You can learn to play it. And you can build it, from Schober Kits, world famous for ease of assembly without the slightest knowledge of electronics or music, for design and parts quality from the ground up, and—above all—for the highest praise from musicians everywhere.

Send right now for your copy of the full-color Schober catalog, containing specifications of the five Schober Organ models, beginning at \$499.50. No charge, no obligation—but lots of food for a healthy musical appetite!

The *Schober* Organ Corp., Dept. PE-34
 43 West 61st Street, New York, N.Y. 10023

- Please send me Schober Organ Catalog and free 7-inch "sample" record.
- Enclosed please find \$1.00 for 12-inch L.P. record of Schober Organ music.

NAME _____

ADDRESS _____

CITY _____ STATE _____ ZIP _____

CIRCLE NO. 29 ON READER SERVICE PAGE

DISCOVER HIDDEN TREASURE

WITH A JETCO ELECTRONIC METAL DETECTOR

A powerfully sensitive instrument—detects gold, silver, coins, relics, etc. Fully tested—transistorized—guaranteed.

Send for Free Catalog

\$29.95
up

JETCO, P.O. Box 132 PEM, Huntsville, Texas 77340

STEREO TAPE TRANSPORT

7" reel—2 speeds—pause control made for famous manufacturer—50 to 15,000 Hz—with rec/play and erase heads, without case. Send m.o. or check for \$19.50 to:

STEREO CENTER

218 Columbia St., Utica, N.Y. 13502
 \$2.50 for prepaid shipping and insurance.



OPERATION ASSIST

Through this column we try to make it possible for readers needing information on outdated, obscure, and unusual radio-electronics gear to get help from other P.E. readers. Here's how it works: Check 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 postcard to Operation Assist, POPULAR ELECTRONICS, One Park Avenue, New York, N.Y. 10016. Give maker's name and model number of the unit. If you don't know both the maker's name and the model number, give year of manufacture, bands covered, tubes used, etc. State specifically what you want, i.e., schematic, source for parts, etc. Be sure to print or type everything legibly, including your name and address. Do not send an individual postcard for each request; list all requests on one postcard. Because we get so many inquiries, none of them can be acknowledged. POPULAR ELECTRONICS reserves the right to publish only those items not available from normal sources.

Crosley Model 51 Receiver. Schematic and tubes needed. (John Von Dollen, 820 Ambrose Dr., Salinas, CA 93901)

National NC-183D receiver. Operating manual needed. (A. G. Barry, 538 E. Samford Ave., Auburn, AL 36830)

MusiCraft Model MS 30-30 stereo basic amplifier. Schematic needed. (Wm. Jachim, 8338 Baker Ave., Chicago, IL 60617)

Scott Marine Radio Model SLRM receiver. Schematic needed. (Joseph Talley, 163 Charles Circle, Seaford, VA 23428)

Montgomery Ward Model 62-297 "Airline" receiver. Schematic needed. **Heathkit Model 0-9 oscilloscope.** Schematic and calibration info needed. (Peter Rebuzzini, 78 Tanners Marsh Rd., Guilford, CT 06437)

RCA Model RC-6108 AM-FM radio. circa '31. Schematic and operation manual needed. (Eric Urscher, 620 10th Ave., Huntington, WV 25701)

Triumph Model 841 oscillograph. Instruction book and schematic needed. (Leo Bellarts, 1920 State St., Everett, WA 98201)

Noreico Model EL 3541/54B tape recorder. Instruction manual needed. (Donald Rubin, 3919 Bancroft Rd., Baltimore, MD 21215)

Motorola Model LO3-F3 FM receiver. Manual needed. (R. Bell, 20146 Beachcliff, Rocky River, OH 44116)

Realtone Model VT-2466 TV. Operating manual and schematic needed. (Bruce Friedman, 21 Stuyvesant Oval, New York, NY 10009)

Atwater Kent Model 60. Speaker needed. **Philco radio chassis type 89 (or 19 series).** Schematic needed. (Delmar Pond, 11 Stevens Court, Exeter, NH 03833)

Precision Apparatus Model 920 tube and set tester. Instruction manual and schematics needed. (Mike Morrow, 506 Manchester Dr., Chattanooga, TN 37415)

Lysco Model 600 CW transmitter. Schematic and parts list needed. (Stephen Smith, 2011 Broad St., New Castle, IN 47362)

Revere Model T-100 tape recorder. Schematic needed. (George Dewey, 512 N. Shore Dr., Crystal Lake, IL 60014)

Precise Model 300 oscilloscope. Schematic needed. (R. Argun, 8595 Blvd., Levesque, Laval, P.Q. Canada)

Motorola Model KM 202R vibrasonic. Schematic needed. (Cris Holmes, 1723 Orchard, Fresno, CA 93703)

Kadette Model 36 by International Radio Corp. Schematic needed. (Terry Shotts, 18009 Marden Ln., Sandy Spring, MD 20860)

Brunswick Model 5KR. Schematic and 1-UX71A, 2-UX226 tubes needed. (Larry Fahr, 1103 Hampton Circle, Elmira, NY 14904)

Dynatron Radio Model 1000 monitor oscilloscope. manufactured in 1949. Schematic needed. (T. Felton, 3697 W. 15th Ave., Vancouver 8, B.C. Canada)

Zenith Model 55119 shortwave receiver. Source for parts needed. (Bob Patton, 2800 Elm, Parsons, KS 67357)

Globe Scout Model 680 transmitter. Schematic and instruction manual needed. (Ken Countess, 110 Sycamore Circle, Stony Brook, NY 11790)

Hallicrafters Model S-76. Alignment data and operating manual needed. (John Davis, 2607 Colgate Ln., Lake Worth, FL 33460)

Heathkit AR-2 receiver **Setchell Carlson Model 416 radio-intercom.** Schematics needed. (John Moran, 605 N. Maple Ave., Cookeville, TN 38501)

E. H. Scott Model 800 5761 console receiver. Schematic and operating manual needed. (S. Petrie, 1925 Newell Ave., Walnut Creek, CA 94598)

RCA Model T4-8 receiver. Schematic, manual and source of tubes needed. (Gary Lueck, 692 4th Ave., Newport, MN 55055)

Eico Model 315 signal generator kit. Manual, operating instructions and schematic needed. **Sentinel (RCA) Model IUG22C TV receiver.** Schematic, alignment data needed. (Dan Houser, 3393 Greenwich Rd., Norton, OH 44203)

Satellite FM receiver (channel A) to match FM-10T transmitter. Schematic needed. (Bruce Weinel, Box 691, 5115 Margaret Morrison St., Pittsburgh, PA 15213)

Terco Model RA-150 amateur transmitter. Schematic, operating manual, and source for plug in coils needed. (Stephen Farkaly, 2653 S. St. Louis Ave., Chicago, IL 60623)



DIRECT FREQUENCY DIALING

International Short-Wave Broadcast RECEIVER

No more guesswork in identifying stations. Set dial at a station's frequency and if conditions permit you'll hear it everytime...

- Ultra-precision tuning dial accuracy, SW and standard AM Broadcast
- Crystal lattice filter for adjacent station rejection and good AF response
- Dual conversion • Solid state AF output • S-meter • Preselector gives superior sensitivity by peaking antenna and RF stages • Crystal-controlled H. F. Oscillator stability • Amplified AVC constant AF output • Price \$299.00

Write for free Brochure

R. L. DRAKE COMPANY • Miamisburg, Ohio 45342

CIRCLE NO. 14 ON READER SERVICE PAGE

POPULAR ELECTRONICS READER SERVICE PAGE

free information service:

Here's an easy and convenient way for you to get additional information about products advertised or mentioned editorially (if it has a "Reader Service Number") in this issue. Just follow the directions below... and the material will be sent to you promptly and free of charge.

1. On coupon below, circle the number(s) that corresponds to the key number(s) at the bottom or next to the advertisement or editorial mention that is of interest to you. (Key numbers for advertised products also appear in the Advertiser's Index.) Print or type your name and address on the lines indicated.

2. Cut out the coupon and mail it to: POPULAR ELECTRONICS, P.O. Box 8391, Philadelphia, PA 19101.

note: If you want to write to the editors of POPULAR ELECTRONICS about an article on any subject that does not have a key number, write to POPULAR ELECTRONICS, One Park Avenue, New York, N.Y. 10016. Inquiries concerning circulation and subscriptions should be sent to POPULAR ELECTRONICS, P.O. Box 1096, Flushing, N.Y. 11352.

POPULAR ELECTRONICS

P.O. BOX 8391
PHILADELPHIA, PA. 19101

VOID AFTER JULY 31, 1970

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 _____

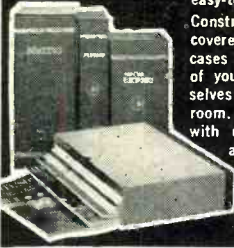
CITY _____ STATE _____ ZIP CODE _____

6Nb

Deluxe POPULAR ELECTRONICS MAGAZINE CASES

DESIGNED TO HOLD A FULL YEAR'S COPIES

These decorative cases are just what you've been looking for to keep your copies of Popular Electronics Magazine in easy-to-find order.



Constructed of reinforced fibreboard and covered in rich leatherette, these durable cases guard against soiling and tearing of your magazines while lending themselves handsomely to the decor of any room. The magazine cases are available with embossed gold lettering in either all black or attractive maroon back with black sides.

**\$3.50 ea., 3 for \$10, 6 for \$19
FULLY GUARANTEED!**

Ziff-Davis Publishing Co., Dept. SD

1 Park Ave., N.Y., N.Y. 10016

Please send me _____ Popular Electronics Magazine

Files as checked below:

All black, gold embossed

Maroon back, gold embossed/black sides

NAME _____

ADDRESS _____

PE-6-70

CITY _____

STATE _____

ZIP _____

Enclosed is \$_____ at \$3.50 per case,
3 for \$10, 6 for \$19 (Quantity prices apply for combination orders of more than one title). Orders outside U.S.A. \$4.50 ea., 3 for \$13, 6 for \$25.

(Payment must accompany order)

ABOUT YOUR SUBSCRIPTION

Your subscription to POPULAR ELECTRONICS is maintained on one of the world's most modern, efficient computer systems, and if you're like 99% of our subscribers, you'll never have any reason to complain about your subscription service.

We have found that when complaints do arise, the majority of them occur because people have written their names or addresses differently at different times. For example, if your subscription were listed under "William Jones, Cedar Lane, Middletown, Arizona," and you were to renew it as "Bill Jones, Cedar Lane, Middletown, Arizona," our computer would think that two separate subscriptions were involved, and it would start sending you two copies of POPULAR ELECTRONICS each month. Other examples of combinations of names that would confuse the computer would include: John Henry Smith and Henry Smith; and Mrs. Joseph Jones and Mary Jones. Minor differences in addresses can also lead to difficulties. For example, to the computer, 100 Second St. is not the same as 100 2nd St.

So, please, when you write us about your subscription, be sure to enclose the mailing label from the cover of the magazine—or else copy your name and address exactly as they appear on the mailing label. This will greatly reduce any chance of error, and we will be able to service your request much more quickly.

VECTOR-CIRCUIT QUIZ ANSWERS

(Quiz appears on page 30)

- 1-B In a series circuit containing only resistance, the current is in phase with the applied voltage.
- 2-F In a parallel circuit, there are three currents and a single voltage, which is used as the reference vector (directed horizontally to the right). The current in an inductor lags the voltage across the inductor by 90 degrees. The current into a capacitor leads the voltage across the capacitor by 90 degrees. The total circuit current is the difference between the branch currents.
- 3-J The current is used as the reference vector. The voltage drops across the capacitor and resistor add vectorially to equal the applied voltage.
- 4-H The applied voltage is the reference vector. The current in the circuit lags the voltage by 90 degrees.
- 5-G The applied voltage is the reference vector. The two branch currents add vectorially to equal the circuit current.
- 6-A The current is used as the reference vector. The voltage drops across the resistor and inductor add vectorially to equal the applied voltage.
- 7-I The current is the reference vector. The voltage drops across the inductor and capacitor are 180 degrees out of phase, and the difference between them is equal to the applied voltage.
- 8-E The applied voltage is the reference. The leading currents in each branch are in phase and add to equal total circuit current.
- 9-D The applied voltage is the reference. The two branch currents add vectorially to equal total circuit current.
- 10-C The applied voltage is the reference. The current in the inductor leads the applied voltage by 90 degrees.

TAKE ONE



new literature

To obtain a copy of any of the catalogs or leaflets described below, simply fill in and mail the coupon on page 15 or 95.

A new leaflet, Form No. 7260, recently issued by *Nortronics Co., Inc.*, is written to show the owner of a tape recorder how to determine whether or not his tape head is worn enough to warrant replacement. The leaflet describes the company's "Look-Touch-Listen" test, which gives the visible, aural, and tactile indicators on tape head wear. Worn heads, or heads where the gap has widened, tend to lose their effectiveness in reproducing high frequency sound clarity; worst of all, the deterioration takes place so gradually that the listener is usually unconscious of the change. In view of this, the leaflet recommends periodic head examination even if there is no active dissatisfaction with the performance of the tape recorder.

Circle No. 75 on Reader Service Page 15 or 95

A new company, *Antenna Corporation of America*, is offering to distributors a complete line of TV and FM receiving antennas that are suitable for color and monochrome TV. The antenna line will be marketed under the name "Citation." The VHF-UHF-FM antennas include a number of features, such as tetrapole collector elements, dual-action director/reflector screen, and die-cut impedance collators. Also being offered are electronic accessories, including set couplers, solid-state preamplifiers, booster couplers, and matching transformers. A complete-line brochure is available from ACA.

Circle No. 76 on Reader Service Page 15 or 95

An easy-reference brochure featuring the company's entire line of home entertainment products is available from *Koss Electronics, Inc.*, manufacturer of stereo headphones and accessories. The catalog, P/N11-1351, lists and describes Koss' exclusive electrostatic line of three stereo headphones and six dynamic models. Included also is a listing of accessories, encompassing remote control stations, connector box, monitoring adapter, extension cables and cords, and a high-impact plastic stereophone carrying case with sponge liner.

Circle No. 77 on Reader Service Page 15 or 95

June, 1970

It costs only



New Easy Dispenser Pak 60/40 18 S.W.G.*

1/100 of 1¢ more



Latest PC (Printed Circuit) Pak
60/40 Extra Thin 22 S.W.G.—.028"*

per solder joint to know you are using the world's finest cored solder

* Each only 59¢ per package at your dealer.



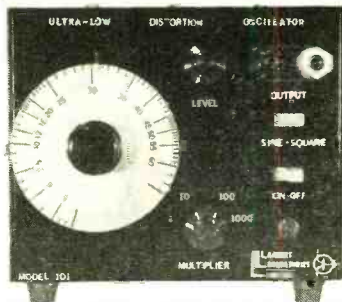
MULTICORE SALES CORP., WESTBURY, N.Y. 11590

CIRCLE NO. 22 ON READER SERVICE PAGE

IMPROVED

ULD Sine Wave Oscillator

Now with Square Wave Output



As Appeared
in Oct. 1969
POPULAR
ELECTRONICS

Frequency Range—5HZ to 60KHZ in Four Ranges.
Distortion—0.2% or less at 5 to 100 Hz.
Output Range—0-3 volts E.M.S., open load.
Square Wave Rise & Fall Times—70 N. Sec. or less.
CHASSIS PUNCHED & SILK SCREENED
Price—Kit LL101K2 Wt. 4 lbs. \$64.95
Wired & Tested \$89.50

IMMEDIATE DELIVERY

Also Available—R-E Pulse Generator
(As announced in Feb. '70 Radio Electronics)
Freq. Range—100HZ to 1MHZ, variable delay & width
Double pulse mode 5V into 50 Ohm, 10V open
Rise & Fall Times—20 n Sec. or less
Separate level controls for Pos. & Neg. outputs.
MANY MORE FEATURES
Price—Kit LL103K1—Wt. 10 lbs. \$150.00
Wired & Tested \$215.00
N.Y.S. Residents Add 6% Tax.
Please Include Postage



48 WASHINGTON ST., WESTFIELD, NEW YORK 14787
716-326-2833

CIRCLE NO. 19 ON READER SERVICE PAGE

INDEX

TO VOLUME 32

JAN.-JUNE 1970

AMATEUR RADIO

Amateur Radio (Brier)	
An Oscar from Russia?	81 Jan.
News from Australia	99 Feb.
Want to go to the Moon?	85 Mar.
Visiting Hams	95 Apr.
New Use for Smog!	81 May
Field Day, 1970	81 June
Frequency Standard, 500/50-kHz (Johnson)	63 May
Standard, Build the 100-kHz (Lancaster)	56 Apr.
Voxor, Build the (Hirschfeld)	81 Feb.

AUTOMOTIVE ELECTRONICS

Automatic Vehicle Burglar Alarm (Meyerle)	59 Apr.
Time Out, Build the (Stayton)	52 Jan.

CITIZENS BAND RADIO

Two-Way Reactions (Reese)	
Big Year for CB	79 Jan.
Exclusive Channel 9	97 Feb.
Planning Better Programs	93 Mar.
Channel 9: Use or Abuse?	93 Apr.
Voxor, Build the (Hirschfeld)	81 Feb.

CONSTRUCTION

Add-On Squarer, Build the (Bongiorno)	51 May
Aquarium Heater, Electronic (Jarvin)	60 Jan.
Automatic Vehicle Burglar Alarm (Meyerle)	59 Apr.
Beginner's Signal Generator (Tooker)	47 Mar.
Buck Up Bass Response with a Super Woofer (Pavlak)	62 June
D.C. Transformer, Build a (Colt)	35 Mar.
Digital Logic Microlab, Build the (Lancaster)	27 Apr.
Electronic Guitar Sound, Modify your (Simanton)	53 June
Frequency Standard, 500/50-kHz (Johnson)	63 May
Frisky Four Speaker System, The (Weems)	43 Apr.
Laser Beam Communicator (Knowles)	27 May
Laser Holography, Do It Yourself (Knowles)	27 Jan.
Loaded Dice, A Pair of (Weems)	40 Jan.
Metronome Timer, One Second (Mongieri)	58 Feb.
Micro'Lign Generator (Robbins)	48 Apr.
Micro-Sensitive Schmitt Trigger (Tooker)	64 Jan.
Motion Detector, One-Step (Meyer)	57 Mar.
No-Bounce Pushbutton, Build the (Lancaster)	51 Mar.
Numeric Glow Tube DCU, Build (Lancaster)	33 Feb.
Numitron Readout (Wood)	73 Mar.
Omni-Eight Speaker System (Weems)	69 Feb.
Overload Protection, Electronic (Keith)	54 Mar.
Photocell Motor Control Demonstrator (Koval)	46 June
Photographic Wash Tester, Build a (Brosnac)	65 May

SCS Signal-Squaring Adapter (Tooker)	65 Jan.
Security I, Build (Pina)	27 Mar.
Shift Register, Build a (Lancaster)	43 May
Signal Injector, Build a (Lancaster)	43 June
Simple SCA Adapter (Splitch)	49 June
Standard, Build the 100-kHz (Lancaster)	56 Apr.
Super Flash (Couch)	48 May
TC Switch—For Remote Control (Bechtold)	52 Apr.
Thumpa-Thumpa Box, The (Simanton)	53 Feb.
Time Delay Relay, Build a Low-Cost (Stayton)	71 June
Time Out, Build the (Stayton)	52 Jan.
Touch-A-Tone, The (Rakes)	66 Mar.
Transcipitor, Build a (Boyd)	31 June
Two-Way "Waverly" Alarm, Build the (Lancaster)	29 Feb.
Voxor, Build the (Hirschfeld)	81 Feb.
Waa-Waa, The (Simanton)	45 Jan.

DEPARTMENTS

Electronics Library	
14 Jan., 14 Feb., 116 Mar., 14 Apr., 16 May, 12 June	
Letters From our Readers	
8 Jan., 8 Feb., 8 Mar., 8 Apr., 8 May, 8 June	
New Literature	
12 Jan., 16 Mar., 16 Apr., 14 May, 97 June	
New Products	
22 Jan., 22 Feb., 22 Mar., 22 Apr., 22 May, 22 June	
Operation Assist	
100 Jan., 103 Mar., 104 Apr., 87 May, 94 June	
Out of Tune	
Build a Capacitance Meter (Oct., 1969, p. 66)	9 Jan.
Psychedelia I (Sept., 1969, p. 27)	13 Feb.
Experimenters' Loser (Dec., 1969, p. 27)	13 Feb.
Electronic Aquarium Heater (Jan., 1970, p. 60)	14 Mar.
Two-Tone "Waverly" Alarm (Feb., 1970, p. 29)	105 Apr.
The Touch-A-Tone (Mar., 1970, p. 66)	88 May
Numitron Readout (Mar., 1970, p. 73)	88 May
One-Step Motion Detector (Mar., 1970, p. 57)	88 May
Build Security I (Mar., 1970, p. 27)	88 May
Tips And Techniques	74 Apr.

EDUCATION

Engineering-Level Opportunities for You (Burawa)	76 Feb.
Opportunity Mirror (Heiserman)	
79 Mar., 83 Apr., 77 May, 69 June	

FEATURE ARTICLES

Aquarium Heater, Electronic (Jarvin)	60 Jan.
Bamboo Missionary Broadcaster (Kimberley)	61 Feb.
Dehumming Small Receivers (Ives)	75 Apr.
Design Your Own Printed Circuits (Burawa)	59 May
Electronics Geography Quiz (Haskett)	42 Apr.
Engineering-Level Opportunities for You (Burawa)	76 Feb.
Experiment with Gravity, An (Appleby)	66 Jan.
First Person DX'ing (Cushen)	74 Feb.
Getting to Know the UJT (Tooker)	69 Apr.
Great Electron-Pedantic Project, The (Kohler)	48 Feb.
Hobnobbing with Harbaugh	34 Mar.
Interference from Left Field (Arnold)	44 Mar.
Kool-Keeping Kwiz (Kohler)	63 June
Laser Beam Communicator (Knowles)	27 May
Laser Holography, Do It Yourself (Knowles)	27 Jan.
LSI Gives Semiconductors a "Trip" Quiz (Bell)	32 Feb.
Motion Detector, One-Step (Meyer)	57 Mar.
No Snow in June (Manser)	27 June
Security I, Build (Pina)	27 Mar.
Time Delay Relay, Build a Low-Cost (Stayton)	71 June
Transcipitor, Build a (Boyd)	31 June
Vector-Circuit Matching Quiz (Balin)	30 June
Waa-Waa, The (Simanton)	45 Jan.

HI-FI/STEREO AND AUDIO

Buck Up Bass Response with a Super Woofer (Pavlak)	62 June
Electronic Guitar Sound, Modify your (Simonton)	53 June
Frequency Standard, 500/50-kHz (Johnson)	63 May
Frisky Four Speaker System, The (Weems)	43 Apr.
Loaded Dice, A Pair of (Weems)	40 Jan.
No Snow in June (Monser)	27 June
Omni-Eight Speaker System (Weems)	69 Feb.
Signal Injector, Build a (Lancaster)	43 June
Simple SCA Adapter (Splichal)	49 June
Stereo Scene, The	
Quadrasonic (Four-Channel) Stereo (Lincoln)	67 Jan.
Magnetic Tape: Handle with Care (Dodson)	85 Feb.
True Hi-Fi Speaks for Itself (MacDonald)	82 Mar.
Thumpa-Thumpa Box, The (Simonton)	53 Feb.
Touch-A-Tone, The (Rakes)	66 Mar.
Waa-Waa, The (Simonton)	45 Jan.

OPTOELECTRONICS

Laser Beam Communicator (Knowles)	27 May
Laser Holography, Do It Yourself (Knowles)	27 Jan.

PHOTOGRAPHY

Laser Holography, Do It Yourself (Knowles)	27 Jan.
Metronome Timer, One Second (Mangieri)	58 Feb.
Photographic Wash Tester, Build a (Brosnac)	65 May

PRODUCT GALLERY

PC Board Kit	71 Jan.
"Stoi-A-Tape" Carry-Pac	71 Jan.
LMB Equipment Cabinet	93 Feb.
Kedman Screw-Holding Screwdrivers	93 Feb.
Sharpening Heathkit Color TV	93 Feb.
Allied Ham Band Receiver A-2516	93 Feb.
Digital Design Program	76 Mar.
Regency Imperial II CB Transceiver	76 Mar.
Hallicrafters Star Quest S-120A Receiver	76 Mar.
Eico Semiconductor Curve Tracer	77 Apr.
Heathkit AR-29 Stereo Receiver	77 Apr.
Phase Corp. Four-Trace Pre-Amp	77 Apr.
RCA Integrated Circuit Kits	77 Apr.
Continental De-Soldering Tool	77 Apr.
Mosley SWV-7 Antenna	67 May
Delta Ultrasonic Alarm	67 May
Caringella Metal/Mineral Locator	67 May
Heathkit GR-78 Receiver	65 June
Regency TMR-4 Monitoradio	65 June

SCIENCE FAIR PROJECTS

Beginner's Signal Generator (Tooker)	47 Mar.
Digital Logic Microlab, Build the (Lancaster)	27 Apr.
Laser Beam Communicator (Knowles)	27 May
Laser Holography, Do It Yourself (Knowles)	27 Jan.
Photocell Motor Control Demonstrator (Koval)	46 June
Security I, Build (Pina)	27 Mar.
TC Switch—For Remote Control (Bechtold)	52 Apr.
Thumpa-Thumpa Box, The (Simonton)	53 Feb.
Touch-A-Tone, The (Rakes)	66 Mar.
Waa-Waa, The (Simonton)	45 Jan.

SHORT-WAVE LISTENING

Bamboo Missionary Broadcaster (Kimberley)	61 Feb.
Dehumming Small Receivers (Ives)	75 Apr.
English-Language News Broadcasts to North America (Legge)	76 Jan., 92 Mar., 94 Apr., 76 May, 83 June

First Person DX'ing (Cushen)	74 Feb.
Short-Wave Listening (Bennett)	
The Bootleggers Are Active	77 Jan.
Eddie Startz—The End of an Era	101 Feb.
International Reply Coupons	95 Mar.
DX on the Broadcast Band	97 Apr.
Scattered Notes from Our Desk	83 May
Reporting by Tape Recording	76 June
Standard, Build the 100-kHz (Lancaster)	56 Apr.

SOLID-STATE CIRCUITS

Add-On Squarer, Build the (Bongiorno)	51 May
Automatic Vehicle Burglar Alarm (Meyerle)	59 Apr.
Beginner's Signal Generator (Tooker)	47 Mar.
Digital Logic Microlab, Build the (Lancaster)	27 Apr.
Electronic Guitar Sound, Modify your (Simonton)	53 June
Frequency Standard, 500/50-kHz (Johnson)	63 May
Getting to Know the UJT (Tooker)	69 Apr.
Laser Beam Communicator (Knowles)	27 May
Laser Holography, Do It Yourself (Knowles)	27 Jan.
Micro-Light Generator (Robbins)	48 Apr.
Micro-Sensitive Schmitt Trigger (Tooker)	64 Jan.
Motion Detector, One Step (Meyer)	57 Mar.
No-Bounce Pushbutton, Build the (Lancaster)	51 Mar.
Numeric Glow Tube DCU, Build (Lancaster)	33 Feb.
Numitron Readout (Wood)	73 Mar.
Overload Protection, Electronic (Keith)	54 Mar.
SCS Signal-Squaring Adapter (Tooker)	65 Jan.
Security I, Build (Pina)	27 Mar.
Shift Register, Build a (Lancaster)	43 May
Signal Injector, Build a (Lancaster)	43 June
Simple SCA Adapter (Splichal)	49 June
Solid State (Garner)	
What's in Store for 1970	83 Jan.
Cassettes Enter Video Scene	104 Feb.
IC's in Consumer Products	97 Mar.
Newest Control Device is Ceramic	86 Apr.
Optoelectronics—A Growing Field	79 May
New Process May Reduce IC Costs	79 June
Standard, Build the 100-kHz (Lancaster)	56 Apr.
Super Flash (Couch)	48 May
TC Switch—For Remote Control (Bechtold)	52 Apr.
Thumpa-Thumpa Box, The (Simonton)	53 Feb.
Touch-A-Tone, The (Rakes)	66 Mar.
Two-Way "Waverly" Alarm, Build the (Lancaster)	29 Feb.
Voxor, Build the (Hirschfeld)	81 Feb.
Waa-Waa, The (Simonton)	45 Jan.

TEST EQUIPMENT

Add-On Squarer, Build the (Bongiorno)	51 May
D.C. Transformer, Build a (Colt)	35 Mar.
Micro-Light Generator (Robbins)	48 Apr.
Numeric Glow Tube DCU, Build (Lancaster)	33 Feb.
Numitron Readout (Wood)	73 Mar.
Overload Protection, Electronic (Keith)	54 Mar.
Shift Register, Build a (Lancaster)	43 May
Signal Injector, Build a (Lancaster)	43 June
Standard, Build the 100-kHz (Lancaster)	56 Apr.

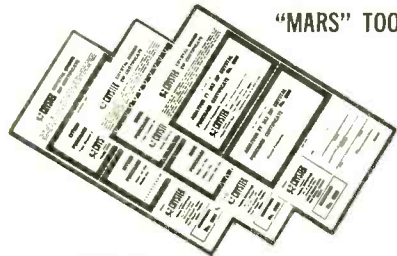
Back Issues. A limited quantity of back issues are available from the Ziff-Davis Service Division, 595 Broadway, New York, NY 10012. Each issue costs 65¢, postpaid.

CONTROLLED
QUALITY
CRYSTALS by

CRYSTEK

The "On-Channel" Crystals

"MARS" TOO!



NOW **ZIP-ORDER** CRYSTALS

Your dealer has new, fast, direct-factory ZIP Order Purchase Certificates to enable you to get CRYSTEK CB, Monitor Amateur, and Mars freq. Crystals mailed direct to you promptly. Ask about them.

CRYSTEK formerly Texas Crystals
Div. of Whitehall Electronics Corp.

1000 Crystal Drive
Fort Myers, Florida 33901

4117 W. Jefferson Blvd.
Los Angeles, California 90016

CIRCLE NO. 13 ON READER SERVICE PAGE

NEW 'Safety' SOUND ALERT

12 Volt
neg ground
only.



Automatically detects outside horns, sirens, bells, whistles, and other emergency signals, warning occupants within the vehicle that an unusual sound is taking place outside that could be hazardous. Silent in standby. Emits 2800 Hertz tone on alert which overrides interior noises such as radios, air conditioners, heaters and motors.

Test-proven, quality crafted Sound Alert is shock proof up to 50 G's, water proof, dust proof, and withstands temperature extremes - 80°F to 160°F. Installs in minutes with ordinary hand tools.

COMPLETE UNIT GUARANTEED

Send check or money order

Only **\$49.95**

GRAYTRONICS MFG. CO.

PAT. APPLIED FOR

P. O. BOX 7095 / DEPT. PE 6 / ROANOKE, VIRGINIA 24019

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 and Electronic Technology curricula both available. Associate degree in 29 months. B.S. obtainable. G.I. approved. Start September, February, Darius, campus. High school graduate or equivalent. Catalog.

VALPARAISO TECHNICAL INSTITUTE
DEPARTMENT PE, VALPARAISO, INDIANA 46383



WHOLESALE TO ALL

Breadboard Kits—"RF" Kits—"PC" Kits—Perf. Phenolic Board Copper Clad Board—Cowl Type. Electronic Cabinets—Heat Sinks Solid State Hobby Kits—Solderless Connectors—Hardware Kits Transistor Sockets and many more items. Send for free catalog from: H. M. C. Sales, P. O. Box 276—Santa Susana, California 93063.

LIBRARY

(Continued from page 14)

ing and logic circuits, etc. And each circuit illustrated is complete, accompanied by at least one schematic diagram and parts list.

Published by TAB Books, Blue Ridge Summit, PA 17214. Hard cover. 384 pages. \$17.95.

BIOLOGICAL ENGINEERING

edited by Herman P. Schwan

With the emergence of biological engineering programs both here and abroad, the need for a comprehensive textbook in this area has become great. Fortunately, this need is now met by this compilation of recent outstanding contributions to bioengineering by eminent authorities in the field. Some of the contributions include hemodynamics, electrocardiography, absorption of ultrasound data, biological control mechanisms, and mathematical models of excitation and propagation in nerves. Throughout the book, the emphasis is on fundamentals.

Published by McGraw-Hill Book Co., 330 West 42 St., New York, NY 10036. Hard cover. 556 pages. \$18.50.

CIRCUIT THEORY: An Introduction To The State Variable Approach

by Ronald A. Rohrer

This book places classical network analysis within the framework of modern system theory. In addition to mathematical manipulations, considerable attention is given to motivational approaches. For the student with elementary knowledge of circuits and linear algebra, the overall aim of the book is to provide the sophistication necessary to understand the current literature on network theory. Studies of interest to the serious student are listed in a bibliographic listing in the appendix at the end of the book.

Published by McGraw-Hill Book Co., 330 West 42 St., New York, NY 10036. Hard cover. 314 pages. \$14.50.

LEARN ELECTRONICS THROUGH TROUBLESHOOTING

by Wayne Lemons

Based on a successful high school training program, this book provides a new and practical approach toward the understanding of electronics theory. A thorough grasp of the subject is achieved through the technique of actually solving practical troubleshooting problems. Two appendices, containing such valuable data as color-code charts, schematic symbols, reactance tables, typical electronic circuits, etc., are included in the rear of the book.

Published by Howard W. Sams & Co., Inc., 4300 West 62 St., Indianapolis, IN 46268. Hard cover. 624 pages. \$9.95.

POPULAR ELECTRONICS

ELECTRONICS MARKET PLACE

COMMERCIAL RATE: For firms or individuals offering commercial products or services. \$1.15 per word (including name and address). Minimum order \$11.50. Payment must accompany copy except when ads are placed by accredited advertising agencies. Frequency discount: 5% for 6 months; 10% for 12 months paid in advance. **READER RATE:** For individuals with a personal item to buy or sell. 70¢ per word (including name and address). No Minimum! Payment must accompany copy.

GENERAL INFORMATION: First word in all ads set in bold caps at no extra charge. All copy subject to publisher's approval. Closing Date: 1st of the 2nd month preceding cover date (for example, March issue closes January 1st). Send order and remittance to: Hal Cymes, POPULAR ELECTRONICS, One Park Avenue, New York, New York 10016.

FOR SALE

FREE! Giant bargain catalog on transistors, diodes, rectifiers, SCR's, zeners, parts. Poly Paks, P.O. Box 942, Lynnfield, Mass. 09140.

GOVERNMENT Surplus Receivers, Transmitters, Snooperscopes. Radios. Parts, Picture Catalog 25¢. Meshna, Nahant, Mass. 01908.

ROCKETS: Ideal for miniature transmitter tests. New illustrated catalog. 25¢. Single and multistage kits, cones, engines, launchers, trackers, rocket aerial cameras, technical information. Fast service. Estes Industries, Dept. 18, Penrose, Colorado 81240.

LOWEST Prices Electronic Parts. Confidential Catalog Free. **KNAPP**, 3174 8th Ave. S.W., Largo, Fla. 33540.

EUROPEAN and Japanese bargains catalogs. \$1 each. Dee, 10639E Riverside, North Hollywood, Calif. 91602.

MUSIC LOVERS, CONTINUOUS, UNINTERRUPTED BACKGROUND MUSIC FROM YOUR FM RADIO, USING NEW INEXPENSIVE ADAPTOR. FREE LITERATURE. ELECTRONICS, 11500-Z NW 7th AVE., MIAMI, FLORIDA 33168.

WE SELL CONSTRUCTION PLANS. TELEPHONE: Answering Machine, Speakerphone, Carphone, Phonevision, Legal Connector, Auto Dialer, Central Dial System. **TELEVISION:** \$35.00 Color Converter, Tape Recorder, 3DTV. \$25.00 Camera. **DETECTIVE:** Infinity Transmitter, Tail Transmitter, Police Radar Detector. **HOBBYIST:** Electron Microscope, 96 Hour Tape Music System, Ultrasonic Dishwasher, Radar-Oven, Electronic Tranquilizer. Plans \$4.95 each. **COURSES:** Telephone Engineering \$39.50, Detective Electronics \$22.50, Anti-Detective Electronics \$27.50. **NEW SUPER HOBBY CATALOG AIRMAILED \$1.00.** Don Britton Enterprises, 7906 Santa Monica Blvd., Hollywood, Calif. 90046.

WEBBER LAB's. Police & Fire Converters. Catalog 25¢. 72 Cottage Street, Lynn, Mass. 01905.

INVESTIGATORS, LATEST ELECTRONICS AIDS. FREE LITERATURE. CLIFTON, 11500-L NW 7th AVE., MIAMI, FLORIDA 33168.

LINEAR AMPLIFIERS: "Hawk"—25 watts output—\$59.95; "Hornet"—50 watts—\$98.50; "Raider"—100 watts—\$139.95; "Maverick-250"—250 watts—\$244.95; AM/SSB. "Scorpion" 50 watt 12 volt mobile—\$99.95; "Bandit II" 100 watt mobile—\$169.95. 20 35 megacycles. (Illegal Class D 11 Meters.) Dealer inquiries invited. D & A Manufacturing Co., 1217 Avenue C, Scottsbluff, Nebraska 69361.

ELECTRONIC PARTS, semiconductors, kits. **FREE FLYER.** Large catalog \$1.00 deposit. **BIGELOW ELECTRONICS,** Bluffton, Ohio 45817.

RADIO—T.V. Tubes—33¢ each. Send for free catalog. Cornell, 4213 University, San Diego, Calif. 92105.

LOWEST prices on parts. Recording tape. Free catalog. U.S. Inquiries. Discount House, 4424 James Street, Vancouver, B.C., Canada.

JAPAN & HONG KONG DIRECTORY. Electronics, all merchandise. World trade information. \$1.00 today. Ippano Kaisha Ltd., Box 6266, Spokane, Washington 99207.

ULTRA-SENSITIVE AND POWERFUL METAL DETECTORS—join the many who are finding buried coins, minerals, relics and artifacts. Don't buy till you see our **FREE** catalog of new models. Write Jetco, Box 132-PE, Huntsville, Texas 77340.

LASER parts catalog 60¢. Moynihan, 107 North Brighton, Atlantic City, New Jersey 08401.

PSYCHEDELIC catalog. Posters, lighting, etc. Send 25¢ for handling to Hole In The Wall, 6055PE Lankershim, North Hollywood, Calif. 91606.

THE ART OF DE-BUGGING—\$5.95. TRON-X PUBLICATIONS, P.O. BOX 38155, HOLLYWOOD, CALIFORNIA 90038.

CONSTRUCTION PLANS: LASER . . . \$2.00. Listening Devices—two F.M. Mike Transmitters . . . \$1.00. Tail Transmitter . . . \$1.00. Sound Telescope . . . \$2.00. Infinity Transmitter . . . \$2.00. Equipment and kits available. Howard, 20174 Ward, Detroit, Michigan 48235.

COMPONENTS? Kits? Hardware? Free catalog! Truvue Paks, Box 275, Chelsea, Mass. 02150.

SENCORE TEST EQUIPMENT UNBELIEVABLE PRICES. FREE CATALOG AND PRICE SHEET. FORDHAM RADIO, 265 EAST 149TH STREET, BRONX, N.Y. 10451.

ELECTRONIC ignition, various types. Free literature. Anderson Engineering, Epsom, N.H. 03239.

AMATEUR SCIENTISTS, Electronics Hobbyists, Experimenters, Students . . . Construction Plans—all complete, including drawings, schematics, parts lists with prices and sources . . . Laser-Build your own coherent-light optical laser. Operates in pulsed mode. visible light range—\$6.00 . . . Radar—Build your own ultrasonic doppler radar. Detect motion of people, automobiles, even falling rain drops. Transistorized, uses standard small 9-volt battery—\$4.00 . . . Long-Range "Sound Telescope"—This amazing device can enable you to hear conversations, birds and animals, other sounds hundreds of feet away. Very directional. Transistorized. Uses 9V battery—\$3.00 . . . Or send 25¢ coin (no stamps) for complete catalog. Other items include Psychedelic strobes, light shows, robots . . . 38 different projects. Technical Writers Group, Box 5994, State College Station, Raleigh, N.C. 27607.

MECHANICAL, ELECTRONIC devices catalog 10¢. Greatest Values—Lowest Prices. Fertik's, 5249 "D", Philadelphia, Pa. 19120.

CLEARANCE SALE rectifiers, transistors, 1000's other items. Catalog 15¢. General Sales Company, 254 Main, Clute, Texas 77531.

DIAGRAMS—Radios \$1.50, Television \$3.00. Give make and model. Diagram Service, Box 1151PE, Manchester, Conn. 06042.

SEMICONDUCTORS and parts catalogue free over 100 pages. J. & J. Electronics, Box 1437, Winnipeg, Manitoba, Canada. U.S. Trade directed.

SPACE-AGE TV CAMERA KIT! Terrific for Experimenters. Industry, Education. Solid-state. Only \$116.95! Starter kits: \$18.95 up. Plans 25¢ up. Catalog **FREE.** Phone: 402-987-3771. Write: **ATV RESEARCH,** 1301 Broadway, Dakota City, Nebr. 68731.

EXCITING LISTENING! POLICE—FIRE—AIRCRAFT—SHORTWAVE calls on your broadcast radio! Free catalog. Salch Company, Woodboro 24, Texas 78393.

CONVERT any television to sensitive, big-screen oscilloscope. Only minor changes required. No electronic experience necessary. Illustrated plans, \$2.00. Relco-A33, Box 10563, Houston, Texas 77018.

BURGLAR ALARM SYSTEMS and accessories. Controls, bells, sirens, hardware, etc. **OMNI-GUARD** radar intruder detection system, kit form or assembled. Write for free catalog. Microtech Associates, Inc., Box 10147, St. Petersburg, Florida 33733.

PRINTED CIRCUITS. Magazine projects and experimental. Free listing. Vico, Box 1590, Los Angeles, Calif. 90053.

POLICE-FIRE RADIO DISPATCHER CALLBOOKS! EXCLUSIVE, OFFICIAL LISTINGS: CALLSIGNS, FREQUENCIES! LATEST REVISIONS, NATIONWIDE, CATALOG, SEND STAMP. COMMUNICATIONS, BOX 56-PE, COMMACK, N.Y. 11725.

COMPREHENSIVE design of IC circuits, schematically illustrated article covering every aspect of IC circuit design, send \$3.00. Solid State Tekneex, Rt 1, Doniphan, Mo. 63935.

MUNTZ Car Stereo C870 \$49.00 Postage paid. A&D Electronics, 828 Post Road, Warwick, Rhode Island 02888.

AMAZING Offer! Photoelectric Devices! Schematic information and photoell. Only \$1.00! Photoelectronics 321 West 58 Place, Merrillville, Ind. 46410.

TEST Set Directory, four volumes cover military, Commercial units: 1,500 pages, \$5.78. Gordon White, 5716 N. King's Highway, Alexandria, Va. 22303.

ELECTROSENSING—Autoresetting alarm systems for automotive vehicles. Free literature. Totaltron, 36 Quirk Street, Watertown, Mass. 02172.

NEW SEMICONDUCTOR LIGHT EMITTING DIODES—bright red lights replace light bulbs. Typical life 100 years. Operate at 1.65 volts, 50 milliamps. Order 2 for \$2.98 NOW. Data sheet and instructions included. Monsanto Company, Hobby Section, 10131 Bubb Road, Cupertino, California 95014.

NEW! PHONE PATCH with automatic switch. Now you can record those important conversations automatically. ONLY \$19.95. Chelco Electronics, 11835 Wilshire Blvd., Los Angeles, Calif. 90025.

FIBERGLASS Circuit Board—save 50%—4" by 18" piece \$1.50. Andrew, Pike St., Lemont, Pa. 16851.

LIGHTNING PROTECTION HANDBOOK, \$1.00. Dusina Enterprises, 571 Orange, Melbourne, Fla. 32901.

BURGLAR and Fire Alarm Systems and supplies. Installation Manual and catalog \$1.00. Refunded first order. Electronic Sentry Systems, P.O. Box 8023A, Sacramento, California 95818.

ATWATER Kent Data, schematics, for most models; \$2.00. Harnco, Box 5, Staunton, Va. 24401.

EXCITING Listening! Police—Fire—Emergency calls on your broadcast radio, \$19.95 up! Also crystals—receivers, Scanners, dualband High/Low. Brochures 10¢. Salch Company, Woodsboro 41, Texas 78393.

"EASY Ways to Improve TV Reception" \$1.00 (no stamps), GJM Electronics, Dept. P, Box 218. Goleta, California 93017.

PRINTED Circuits, make your own, fast cheap. Complete instructions \$1.00. Logue, Box 82, Bayville, New York 11709.

SHOCK your friends, Miniature High Voltage Transformer, uses Pen Cell, \$2.49. E.J.C., Box 721, Tarpon Springs, Florida 33589.

NEW!! Elenco LR-6 Bi-Lateral linear amplifier 150 watts output, variable receive boost, \$149.95. (Illegal for Class D CB use.) Elenco, Dept. A, Wabash, Ind. 56992.

TERMINAL Strips, 4 Lug, 100 for \$1.20 plus 30¢ Postage handling. Helm, 212 Stewart, Angola, Indiana 46703.

LEARN TO REPAIR T.V. TUNERS: High Earnings. Introduction, Contents, two sample lessons, details of complete course, many plans, twelve "tricks", all for \$1.00 refundable. Frank Bocek, Box 833, Redding, California 96001.

STROBES, color organs, the incredible Strobot. New! Heavy-Duty CD ignition. Electric candles for flameless candle-light. Remote (wireless) switch for anti-prowler system. Touch switch for space-age lamps, lights. Assembled and Kits. Send 25¢, specify interest. Teletronics, Box 1266 A, South Lake Tahoe, California 95705.

COLOR ORGANS, 2000 WATTS, \$19.95 postpaid. **MONEY-BACK GUARANTEE.** Cybulski, Box 31174, Washington, D.C. 20031.

COMP-U-KIT. Computer micro-circuits, a unique inter-connection method, and a book which tells all about computer logic. Free illustrated literature. Scientific Measurements, C105, 9701 Kenton, Skokie, Illinois 60076.

RELAYS sell for less than \$1.00 each. Steppers sell for \$2.50. DC power supplies sell for 50¢ each. These and many more are listed in our 10¢ catalog. Large quantities of all items. Send 10¢ to: Gust & Company, Box 24081, Edina, Minnesota 55424.

ELECTRONIC COMPONENTS, 25 pound assortment, \$9.95. Hazleton Scientific, Hazel Park, Mich. 48030.

TRANSISTOR ANALYZER: identifies PNP/NPN, silicon-germanium; measures gain/leakage, two ranges; \$14.95. Rich-Tex, Box 964, Richardson, Texas 75080.

ROUTER bits, 1/4" shank, Hi-speed, used, excellent condition, \$2.50 dozen, postpaid. Lillian's, Box 17165PE, Chicago, Illinois 60617.

MC790P \$2.00. MC724P, MC789P \$1.05. Write for catalog. Hal Devices, Box 365Z, Urbana, Illinois 61801.

PLANS AND KITS

SURVEILLANCE DEVICES IN KIT FORM: Telephone Transmitter, FM Spy Transmitter, Telephone-Recorder Actuator, Tail Transmitter, Bug Detector. Complete Kits Send \$15.00 each. **ELECTRONIC SECURITY SYSTEMS**, 1101 West Rosecrans Avenue, Gardena, California 90247.

BUILD color organs, computers, stereos, alarms, slide-synchronizers. Catalog. Workshop, 33E Cain, Plainview, New York 11803.

FAMOUS Quad Antenna Kit for FM \$9.95. Postpaid U.S.A. Rose Electronics, Box 3245, Vero Beach, Florida 32960.

OSCILLOSCOPE IMPROVEMENT KITS. High speed Triggersweep eliminates sync problems. Dual-trace FET switch displays two waveforms together. **SOLID-STATE SERVICES**, P.O. Box 901, Cupertino, California 95014.

CIRCUITS for 32 electronic projects, R.F., audio and gadgetry complete plans \$1.00. P.M. Electronics, Inc., Box 46204, Seattle, Wash. 98146. Dealer inquiries invited.

INTEGRATED CIRCUIT KITS: COMPUTER, OPTOELECTRONICS, AUDIO. Catalog free. **KAYE ENGINEERING**, Box 3932-A, Long Beach, California 90803.

BUILD C.B. Quad for under \$15.00. Send \$2. for complete, easy to follow instructions. Quad, P.O. Box 5461, Mobile, Ala. 36605.

"DISTANCE Crystal Set Construction" Handbook—50¢. "Coil Winding"—50¢. Catalog. Laboratories, 2612-L Butano, Sacramento, Calif. 95821.

ALLWAVE Radio Kit, Tube, Transistor included \$5.00. Headset \$2.50. Ekeradio, Box 131, Temple City, California 91780.

ELECTROSLLEEP Therapy Apparatus plans solid state. \$2.00. Andrew, Pike St., Lemont, Pa. 16851.

TRANSISTOR Projects: Simple, high-performance circuits for all applications. Free catalog: EDI 1918B 49 Street East, Palmetto, Florida 33561.

BUILD powerful crystal radio. Easy to build. Complete plans. Send \$4.95 cash, check, money order. Radio, 239 Eaton Road, Charlotte, N.C. 28205.

THREE channel color organ kit \$7.50. Power Supplies \$2.75. Catalog. Murphy, 204 Roslyn Ave., Carle Place, N.Y. 11514.

TELEPHONE accessory plans: \$12 answering/message taking machine; \$3 recorder actuator, lifting receiver starts recorder; \$10 burglar/fire protector, automatically dials operator—delivers prerecorded message. (Above prices indicate construction cost, excluding recorders.) \$5 undetectable ringer. Plans \$3.50 each. Four for \$11. Hillary, 161 Bonad, Chestnut Hill, Mass. 02167.

LIGHTBAR PLANS. Poorman's circuit. Makes 500W of colored lights flash in rhythm to music. \$1.65. DATEC, Box 5203, Fullerton, California 92632.

HIGH FIDELITY

FREE! Send for money saving stereo catalog # P6E, lowest quotations on your individual component, tape recorder, or system requirements. Electronic Values, Inc., 200 W. 20th St., New York, N.Y. 10011.

HI-FI components. Tape Recorders, at guaranteed "We Will Not Be Undersold" prices. 15-day money-back guarantee. Two-year warranty. No Catalog. Quotations Free. Hi-Fidelity Center, 239 (P) East 149th Street, New York 10451.

LOW, Low quotes: all components and recorders, HiFi, Roslyn, Penna. 19001.

TAPE RECORDERS, Hi-Fi, components, Sleep Learning Equipment, tapes. Unusual Values. Free Catalog. Dressner, 1523R, Jericho Turnpike, New Hyde Park, N.Y. 11040.

STEREO COMPONENTS at low discount prices. Send for our low quotes today and our cartridge trade-in specials (Shure, ADC, Pickering, Empire, etc.). Send \$1.00 for our discount catalog. **DEFA ELECTRONICS**, 2207 Broadway, New York, N.Y. 10024.

DIAMOND NEEDLES AND STEREO CARTRIDGES at low, low prices for Shure, Pickering, Stanton, Empire, Grado and ADC. Send for free catalog and price sheet. We will be happy to quote on any cartridge—Magnetic, Ceramic or Crystal. All merchandise brand new and shipped **PREPAID**. **LYLE CARTRIDGES**, Dept. P, 265 East 149 Street, Bronx, New York 10451.

SHERWOOD crossover sale. Brand new factory sealed cartons 12DB per octave—8-16 OHMS 600 Hz—\$8.50, 800 Hz—\$6.50, 3500 Hz—\$4.50—Guaranteed. Cash with order. Musicraft, 48 E. Oak Street, Chicago, Illinois 60611.

WANTED

CASH PAID! Unused tubes, electronic equipment. Barry, 512 Broadway, NYC 10012.

QUICKSILVER, Platinum, Silver, Gold, Ores Analyzed. Free Circular. Mercury Terminal, Norwood, Mass. 02062.

TUBES

TUBES "Oldies". latest. Lists free. Steinmetz, 7519 Maplewood, Hammond, Indiana 46324.

RECEIVING & INDUSTRIAL TUBES, TRANSISTORS. All Brands—Biggest Discounts. Technicians, Hobbyists, Experimenters—Request **FREE** Giant Catalog and **SAVE!** ZALYTRON, 469 Jericho Turnpike, Mineola, N.Y. 11501.

TUBE Headquarters of World! Send 10c for Catalog (tubes, electronic equipment) Barry, 512 Broadway, N.Y.C. 10012.

THOUSANDS and thousands of types of electronic parts, tubes, transistors, instruments, etc. Send for Free Catalog. Arcturus Electronics Corp., MPE, 502-22nd St., Union City, N.J. 07087.

TUBES—Lowest world prices. Foreign-American. Obsolete, current. Receiving, special purpose, transmitting tubes. Send for tube and parts catalog. United Radio Company, 56-P Ferry St., Newark, N.J. 07105.

RADIO & T.V. Tubes—33c each. Send for free list. Cornell, 4213 University, San Diego, Calif. 92105.

TAPE AND RECORDERS

BEFORE Renting Stereo Tapes try us. Postpaid both ways—no deposit—immediate delivery. Quality—Dependability—Service—Satisfaction—prevail here. If you've been dissatisfied in the past, your initial order will prove this is no idle boast. Free Catalog. Gold Coast Tape Library, Box 2262, Palm Village Station, Hialeah, Fla. 33012.

RENT 4-Track open reel tapes—all major labels—3,000 different—free brochure. Stereo-Parti, 55 St. James Drive, Santa Rosa, Ca. 95401.

AMAZING DISCOUNTS on famous brand high fidelity stereo components. No small wonder that we have set new sales records each year since 1959. Write. Arkay Electronics, 1028-03 Commonwealth, Boston, Mass. 02215.

STEREO TAPES, save 20,30% and more. postpaid anywhere U.S.A. We discount batteries, recorders, tape/cassettes, 80-page catalog 25c. **SAXITONE TAPES**, 1776 Columbia Road, N.W., Washington, D.C. 20009.

CASSETTE and 8-track blanks, language tapes, dozens of accessories and recorders. Literature 25c. **CASSETTES UNLIMITED**, P.O. Box 13119-P, Pittsburgh, Pa. 15243.

OLD radio programs on tape. 6 hours for \$8.00. Catalog 50c. Don Maris, 1926 Cherokee, Norman, Okla. 73069.

REPAIRS AND SERVICES

TV Tuners rebuilt and aligned per manufacturers specification. Only \$9.50. Any make UHF or VHF Ninety day written guarantee. Ship complete with tubes or write for free mailing kit and dealer brochure. JW Electronics, Box 51C, Bloomington, Indiana 47401.

PERSONALS

MAKE FRIENDS WORLDWIDE through international correspondence. Illustrated brochure free. Hermes, Berlin 11, Germany.

INVESTIGATORS, LATEST ELECTRONIC AIDS. FREE LITERATURE. CLIFTON, 11500-K NW 7th AVE., MIAMI, FLORIDA 33168.

INSTRUCTION

LEARN ELECTRONIC ORGAN SERVICING at home all makes including transistor. Experimental kit—trouble-shooting. Accredited NHSC. Free Booklet **NILES BRYANT SCHOOL**, 3631 Stockton, Dept. A, Sacramento, Calif. 95820.

1400-PC. GLASS FIBER OPTIC KIT

It's FUN!

It's Educational!

It's Gifty!



\$5.50 ★ Make light "pipes"
★ Dazzling displays
★ Triggers photo & infra-red cells

OPTICAL SCIENTIFIC BREATHTHRU! Allows "hair thin" glass fibers (2 ft. long) to transmit & receive cold light energy of any color by internal reflection. Bundled, jacketed, it guides, shapes, projects light around corners, walls, even in circles, triggering such devices as light sensitive transistors, diodes, etc. **1400-PC. KIT** **ACTS** like wire. Only one's imagination controls its 1000's of uses. **FREE!** 12-pc. necessary kit, with "how-to-do booklet."

- \$25 SURPRISE PAK: transistors, rect. diodes, etc. ... \$1
- 50 GERMANIUM GLASS DIODES, 1N34, 1N48 no test ... \$1
- 40 TOP HAT SILICON RECTIFIERS, no test/asst values \$1
- 25 EPOXY RECTIFIERS, silicon asst, no test ... \$1
- 40 PRECISION RESISTORS, 1/2-2W, 1% asst values ... \$1
- 30 TRANSISTORS, rf, af, audio, osc, no test ... \$1
- 60 TUBULAR CONDENSERS, to .5mf to 1KV, asst ... \$1
- 50 DISC CONDENSERS, to .05mf npo, temp coef, asst ... \$1
- 30 POWER RESISTORS, to 25 watts, to 21K ohms ... \$1
- 10 VOLUME CONTROLS, to 1 meg, switch too! ... \$1
- 10 ELECTROLYTICS, to 100mf, tubulars too, asst ... \$1
- 50 RADIO & TV KNOBS, asst'd colors & styles ... \$1
- 10 TRANS-TOR ELECTROLYTICS, to 100mf, asst values \$1
- 50 COILS AND CHOKES, rf, af, ant, osc, peaking, etc ... \$1
- 65 HALF WATERS, to 1 meg, 5% popular values too ... \$1
- 2 FIELD EFFECT TRANSISTORS, n channel, hobby ... \$1
- 10 PANEL SWITCHES, toggle, slide, micro, rotary ... \$1
- 3 "SUN" BATTERIES, for 100's of lite sens proj's ... \$1
- 5 "IBM" COMPUTER BOARDS, many trans, diodes, ... \$1
- 40 "MICRO" CONDENSERS, for transistor circuitry ... \$1
- 50 TERMINAL STRIPS, 1 to 8 lug types ... \$1
- 4 PHOTO ELECTRIC CELLS, hi. imp., schematic ... \$1
- 40 "TINY" RESISTORS, 1/10W, 5% too! to 1 meg ... \$1

ADD POSTAGE, avg. wt: 1/2 lb. CATALOG 10c

POLY PAKS P.O. BOX 942E
LYNNFIELD, MASS.
01940

CIRCLE NO. 26 ON READER SERVICE PAGE

FCC First Class License in six weeks—approved for Veterans Training. Write Elkins Institute, 2603B Inwood Road, Dallas, Texas 75235.

R.E.I.'s famous (5) week course for the First Class Radio Telephone License is the shortest, most effective course in the nation. Over 98% of R.E.I. graduates pass F.C.C. exams for 1st class license. Total tuition \$360.00. Job placement free. Write for brochure. Radio Engineering Incorporated Schools, 1336 Main Street, Sarasota, Florida 33577—or 3123 Gillham Road, Kansas City, Missouri 64109—or 809 Caroline Street, Fredericksburg, Virginia 22401—or 625 E. Colorado Street, Glendale, California 91205.

DEGREE in Electronics Engineering earned mostly by correspondence. Free brochure. Dept. G-9, Grantham School of Engineering, 1505 N. Western Ave., Hollywood, California 90027.

LEARN WHILE ASLEEP, Hypnotize! Strange catalog free. Auto-suggestion, Box 24-ZD, Olympia, Washington 98501.

PLAY ORGAN OR GUITAR EASILY! AMAZING METHOD! FREE INFORMATION. KEGLEY, 1016-PE KELLY, JOLIET, ILLINOIS 60435.

FCC FIRST CLASS LICENSE THROUGH TAPE RECORDED LESSONS at home plus one week personal instruction in Detroit, Washington, San Francisco, Seattle or Los Angeles. Our nineteenth year teaching FCC license courses. Radio License Training, 1060D Duncan, Manhattan Beach, Calif. 90266.

MATHEMATICS. ELECTRONICS. Satisfaction guaranteed. Free brochure. Indiana Home Study, Dept. PE, Box 1189, Panama City, Florida 32401.

HIGHLY effective home study courses in Electronics Engineering Technology and Electronics Engineering Mathematics. Earn your Degree. Write for Free Descriptive Literature. Cook's Institute of Electronics Engineering, (Dept. 15), P.O. Box 10634, Jackson, Miss. 39209. (Established 1945).

EARN College degree at home. Many subjects. Florida State Christian College, Post Office Box 1674, Fort Lauderdale, Florida 33309.

MEMORIZE: "1970 TESTS—ANSWERS" for FCC FIRST AND SECOND CLASS LICENSE. Plus "Self-Study Ability Test." **PROVEN.** \$5.00. Command, Box 26348 P, San Francisco 94126.

CASSETTE tape repairs. Instructions \$1.00. J&M, 2249 W. 111 Place, Chicago 60643.

INVENTIONS WANTED

INVENTIONS wanted. Patented/ unpatented. Global Marketing Service. 2420-P 77th. Oakland, Calif. 94605.

FREE "Directory of 500 Corporations Seeking New Products." For information regarding development, sale, licensing of your patented/ unpatented invention. Write: Raymond Lee Organization, 230-GR Park Avenue, New York City 10017.

INVENTORS: Protect your ideas! Free "Recommended Procedure". Washington Inventors Service, 422T Washington Building, Washington, D.C. 20005.

PATENT SEARCHES, including copies of related United States Patents. Inventors, attorneys, manufacturers use our "World-Wide" Airmail service Free: "Invention Record" form and "Information Every Inventor Needs", Hayward Company, 1029HR Vermont, Washington, D.C. 20005.

PATENT Searches including Maximum speed, full airmail report and closest patent copies, \$6.00. Quality searches expertly administered. Complete secrecy guaranteed. Free Invention Protection forms and "Patent Information," Write Dept. 9, Washington Patent Office Search Bureau, 711 14th Street, N.W., Washington, D.C. 20005.

FREE PAMPHLET: "Tips on Safeguarding Your Invention." Write: United States Inventors Service Company, 501-H Thirteenth Street N.W., Washington, D.C. 20004.

INVENTORS! Don't sell your invention, patented or unpatented, until you receive our offer. Eagle Development Company, Dept. P, 79, Wall Street, N.Y., N.Y. 10005.

INVENTOR'S IDEAS—Have an idea? Quad-i Inc., through its international network of consultants, locates and works with inventors and their ideas. Quad-i evaluates, classifies, offers developmental and marketing services and then exposes marketable ideas to industry and investors through computer systems. Call or write Quad-i Inc., P.O. Box 1457, Harrisburg, Pennsylvania 17105, (717) 761-2271.

BOOKS

FREE catalog aviation/electronic/space books. Aero Publishers, 329PE Aviation Road, Fallbrook, California 92028.

"UNUSUAL" Books! Catalog 10¢! International, PE, Box 7798, Atlanta, Georgia 30309.

FREE book prophet Elijah coming before Christ. Wonderful bible evidence. Megiddo Mission, Dept. 64, 481 Thurston Rd., Rochester, N.Y. 14619.

BOOKS for every interest! Free details. Reed Company, West Kingston, Rhode Island 02892.

GOVERNMENT SURPLUS

JEEPS Typically From \$53.90 . . . Trucks From \$78.40 . . . Boats, Typewriters, Airplanes, Multimeters, Oscilloscopes, Transceivers, Electronics Equipment. Wide Variety, Condition. 100,000 Bid Bargains Direct From Government Nationwide Complete Sales Directory and Surplus Catalog \$1.00. (Deductible First \$10.00 Order). Surplus Service, Box 820-J, Holland, Michigan 49423.

GOVERNMENT Surplus How and Where to Buy in Your Area. Send \$1.00 to: Surplus Information PE, Headquarters Building, Washington, D.C. 20036.

MAGAZINES

BACK DATE MAGAZINES! Send needs. Midtown, Box 917-PE, Maywood, N.J. 07607.

HYPNOTISM

FREE Hypnotism, Self-Hypnosis, Sleep Learning Catalog! Drawer H400, Ruidoso, New Mexico 88345.

"MALE-FEMALE HYPNOTISM" EXPOSED, EXPLAINED! "SECRET METHOD"—THEY NEVER KNOW! \$2, RUSHED. GUARANTEED! ISABELLA HALL, SILVER SPRINGS, FLORIDA 32688.

AMAZING self-hypnosis record releases fantastic mental power. Instant results! Facts free. Write: Forum (AA5), 333 North Michigan Avenue, Chicago 60601.

HYPNOTIZE PERFECT STRANGERS—EITHER SEX—SUCCESSFULLY! Secret Methods—they never know! Illustrated Course and 10 inch Hypnodisk \$2.00. **RESULTS ABSOLUTELY GUARANTEED!** Dr. H. Arthur Fowler, Box 4399, Woodbury, New Jersey 08096.

REAL ESTATE

FREE . . . New 224-page Summer Catalog! Describes and pictures hundreds of farms, ranches, town and country homes, businesses coast to coast! Specify type property and location preferred. United Farm Agency, 612-EP West 47 Street, Kansas City, Mo. 64112.

CLASSIFIED ADVERTISING ORDER FORM

Please refer to heading on first page of this section for complete data concerning terms, frequency discounts, closing dates, etc.

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

Words { @ 70¢ (Reader Rate) } = \$ _____
 { @ \$1.15 (Commercial Rate) }

Insert _____ time(s) Total Enclosed \$ _____

NAME _____

ADDRESS _____

CITY _____ STATE _____ ZIP _____

Signature _____

WORD COUNT: Include name and address. Name of city (Des Moines) or of state (New York) counts as one word each. Zip Code numbers not counted. (Publisher reserves right to omit Zip Code if space does not permit.) Count each abbreviation, initial, single figure or group of figures or letters as a word. Symbols such as 35mm, COD, PO, AC, etc., count as one word. Hyphenated words count as two words.

PE-670

MAGNETS

MAGNETISM (100) page script newly discovered magnetic principles (\$3.00). Jesse Costa, Box 26, Waquoit, Mass. 02536.

PHOTOGRAPHY—FILM, EQUIPMENT, SERVICES

SCIENCE Bargains Request Free Giant Catalog "CJ"—148 pages—Astronomical Telescopes, Microscopes, Lenses, Binoculars, Kits, Parts. War surplus bargains. Edmond Scientific Co., 300 Edscorp Bldg., Barrington, New Jersey 08007.

RECORDS

POPULAR organ albums factory direct. Concert Recording, Lynwood, Calif. 90262.

OLDIES—45RPM original hits. Over 4000 available. Catalog 25¢. C & S Record Sales, Box 197, Wampsville, N.Y. 13163.

SPECIAL interest records available, produced by the editors of the world's leading special interest magazines. Send for free catalog. Record Catalog-PE, Ziff-Davis Publishing Company, One Park Avenue, New York, N.Y. 10016.

PRINTING

FREE LITERATURE: Address labels, business cards, printing. Rubber Stamps. JORDAN'S, 552 West O'Connor, Lima, Ohio 45801.

EMPLOYMENT INFORMATION

FOREIGN and **USA** job opportunities available now. Construction, all trades. Earnings to \$3,000.00 monthly. Paid overtime, travel bonuses. Write: Universal Employment, Woodbridge, Conn. 06525.

BUSINESS OPPORTUNITIES

RAISE Rabbits for us on \$500 month plan. Free details. White's Rabbitry, Mt. Vernon, Ohio 43050.

PIANO TUNING learned quickly at home. Tremendous field! Musical knowledge unnecessary. GI Approved. Free Information. Empire School, Box 327, Miami, Florida 33145.

ELECTROPLATING Equipment and supplies. All types for home workshops and industrial. Send \$2.00 (refundable) for equipment guide formulas, operating data, catalog. HBS Equipment Division 90, 3543 East 16th, Los Angeles, California 90023.

I MADE \$40,000.00 Year by Mailorder! Helped others make money! Start with \$10.00—Free Proof. Torrey, Box 318-N, Ypsilanti, Michigan 48197.

FREE BOOK "999 Successful Little Known Businesses" Work home, Plymouth 445-L, Brooklyn, N.Y. 11216.

\$200.00 DAILY In Your Mailbox! Your opportunity to do what mail-order experts do. Free details. Associates, Box 136-J, Holland, Michigan 49423.

MAKE BIG MONEY raising chinchillas, rabbits, guinea pigs for us. Catalog—25¢. Keeney Brothers, New Freedom, Pa. 17349.

ADDRESSERS (Commission Mailers) wanted. Everything Supplied. Details, 25¢. Smyre's, Box 953-ZD, Newark, N.J. 07101.

SPARE Time Cash—Sell Advertising Book Matches—every business a prospect—no investment—no experience needed to build steady repeat business. Daily Cash commission in advance. Write today. We'll send your sure-fire selling kit by return mail. Dept. T-670 Superior Match Co., 7530 S. Greenwood, Chicago, Illinois 60619.

FREE CATALOGS. Repair air conditioning, refrigeration. Tools, supplies, full instructions. Doolin, 2016 Canton, Dallas, Texas 75201.

AREA distributors, Agents wanted. Sell and distribute transelectric detectors. New product, no competition. Receives light signals performing many functions. Any light source. Portable, battery operated. Write Allan Mawhinney, 1744 Fairdale, Escondido, Calif. 92025.

PROFITS are big when you assist us in distribution of excellent material we supply. Competent people needed at once. Request details. Carboni-Ternes, Multi-Mail, 115 Garner Road, Lilburn, Georgia 30247.

MAKE money in mailorder, join "THE ASSOCIATION". Details 10¢. Satterfield, 3882 Via Cristobal, Campbell, California 95008.

BIG EARNINGS selling Hertel Bibles. New 3-dimension cover, finest reference edition sells fast. Demonstrator furnished. Big commissions. International Book, Dept. PE, Box 118, Wichita, Kansas 67201.

MAKE Big Money raising Hybrid red worms at home. Small investment; easily raised, easily sold. Complete instructions, send \$2.00 to Surveys, P.O. Box 69127, L.A., California 90069.

ADOPT AN IMPORT—Increase your firm's sales potential. Or start new business or part-time venture. Our newsletter lists hundreds of new foreign products offered direct by foreign manufacturers. Free details. International Intertrade Indexer, Box 636, Newark, New Jersey 07101.

MAKE \$1.00 per sale selling engraved metal Social Security plates. Free sample kit. ENGRAVA-PLATES, Dept. 22, 3386 Phillips, Jacksonville, Florida 32207.

SPORTS ACTION FILMS

POPULAR ELECTRONICS READERS BUY FILMS—Prove it!—Send 50¢ for Catalog Super 8/8mm—Save \$1.50 on purchase. SPORT-LITE FILMS, Dept. PE, 20 North Wacker Drive, Chicago, Illinois 60606.

SHORTWAVE LISTENING

TOP-SECRET! Classified frequencies: spies, NASA, military, many more—\$1.00. EDI, 1918B 49th Street E., Palmetto, Florida 33561.

DX REPORT FORMS. SWL \$3.00 per hundred DX Log Forms \$3.00 per hundred. Special DX information packet 50¢. Minimum order \$3.00 plus 25¢ handling. N.Y. orders include Sales Tax. O'Connell's, 329P Water Street, Binghamton, New York 13901.

SWL RECORD SHEETS. Samples case. 50 for \$2.10. TRAUBTRONICS, Box 231, Farmland, Ind. 47340.

MUSICAL INSTRUMENTS

30% DISCOUNT any name brand musical instrument. Free catalog. Freeport Music, 127-N Sunrise Highway, Freeport, N.Y. 11520.

TREASURE FINDERS

GOLD, SILVER, RELICS! Located with powerful Detectron Metal Detectors. Free information. Terms. Detectron, Dept. PE-6, Box 243, San Gabriel, California 91778.

TREASURE FINDER locates buried gold, silver, coins, treasures. 5 powerful models. \$19.95 up. Free catalog. Relco-A33, Box 10839, Houston, Texas 77018.

TREASUREPROBES—Patented transistorized detector signals "dig" by earphone "beeping". 5" search head. PC board, two colpitt oscillators improve stability. Kit \$15.95, assembled \$18.88, with speaker \$24.88. 60 day guarantee. Send for Free Bibliography, "Treasure Maps and Books of U.S." Treasurehouse, PE-60, Tennant, N.J. 07763.

FREE TREASURE GUIDE! Fact-filled collectors edition; send 50¢ for postage. Also request free literature on ultrasensitive, professional Fisher Detectors. FISHER RESEARCH, Dept. PE-6, Palo Alto, California 94303.

TREASURETRON high-performance metal locators. Free catalog. EDI, 1918B 49th Street E., Palmetto, Florida 33561.

RUBBER STAMPS

RUBBER ADDRESS STAMP \$2.00. SIGNATURE \$3.50. FREE CATALOG. JACKSON, BOX 443-G, FRANKLIN PARK, ILL. 60131.

MISCELLANEOUS

WINEMAKERS: Free illustrated catalog of yeasts, equipment. Semplex, Box 12276, Minneapolis, Minn. 55412.

JAPAN'S PUBLICATIONS GUIDE Business, pleasure, education. \$5.00. INTERCONTINENTAL, CPO 1717, Tokyo 100-91.

KEEP PACE WITH SPACE AGE! SEE SPACE FLIGHTS, LANDINGS CLOSE UP!

AMAZING SCIENCE BUYS for FUN, STUDY or PROFIT

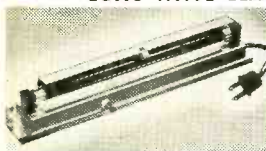
PSYCHEDELIC LIGHTING HANDBOOK



100 information packed pages! Fully explains latest in psychedelic lighting equipment, techniques, developments. Covers all facets of psychedelic light—show projection including strobes, black lights, projectors, crystals, organic slides, mirrors, color organs, polarized color, light boxes. MusicVision; etc. Shows how to "psychedelize" parties, musical groups, shows or how to set up "electric trips" for parties, gatherings. 11" x 11" looseleaf paper for 3 rings.

Stock No. 9100AV \$3.00 Ppd.

LONG-WAVE BLACKLIGHT FIXTURE



Extremely versatile, compactly designed, long wave (3200-4000 angstroms) black light (ultraviolet) fixture. Has 6-watt, 110-V lamp with built-in filter—eliminates harmful shorter wave ultraviolet rays. Use to identify minerals, fungi, bacteria—check for surface flaws, oil and gas leakage—perfect for displays with fluorescent paper, paints, chalk, crayons, trace powder, etc. Adjustable aluminum reflector. Mount vert., horiz., or on corner. 10" L. 1 1/2" W. 1 1/2" H.

Stock No. 70.364AV \$12.50 Ppd.
Stock No. 60.124AV REPLACEMENT BULB \$4.50 Ppd.

NEW \$99.50 HELIUM-NEON LASER!



Completely assembled, instant-starting w/three times power output of comparable models. Steady, ripple-free light of moderate (safe) power. Particularly useful for studies, experiments in holography, interferometry, diffraction, optical alignment. Simple and safe to use. The 4 1/2 lb. unit reaches 75% power in 2 secs.; full power, typically 0.5 milliwatt (0.3 mW minimum) in 3 mins. Beam divergence only 2 milliradians: 2 cms at 40 feet.

Stock No. 79.004AV \$99.50 Ppd.

3-CHANNEL COLOR ORGAN BARGAIN!



Create tremendous variety of unusual & beautiful lighting effects with this low-cost, top-quality 1500-watt unit (500 W. per channel). Compare with others selling for twice the price. Has pilot light, plus individual sensitivity controls and channel indicator lights. Can operate ten 150 W "spots" or 200 Christmas lights. Uses reg. house current—attaches to audio source w/KC-type phono plug. 5 1/2" x 6 3/4" x 2 1/4". 2 1/2 lbs. Thermal

setting plastic case. 6-ft. cord. Including complete instructions.
Stock No. 71.223AV \$34.95 Ppd.

STEREO MICROSCOPE—TERRIFIC BUY!



American made. High powered. Direct measurement. Up to 3" working distance—wide 3-dimensional field. Used in production, research, hobby, for inspections, counting, checking, assembling. 2 sets of objectives on rotating turret. Standard pair of wide field 10X and finer Eyepieces give 23 power and 40 power clear, sharp, erect image. Helical rack and pinion focusing. Interpupillary distance adjustable. 10-day free trial.

Stock No. 85.056AV \$99.50 FOB.

SPECIAL VISUAL EFFECTS PROJECTOR SET



Dazzling, avant-garde visual effects. Fantastic variety. Incredibly beautiful. Special package offer contains all necessary apparatus. Create floating, exploding, fiery bursts of color like "Symphony of Spheres", "Chromatic Starbursts", "Crystal Starburst". Features 35mm 500 W. fan cooled projector, produces big image at short distance. Accepts two 9" diam. wheels (Dyed Kaleidoscope & Hexiscope). 2 cylindrical accessories (8" Colored Cloud & 5" Hexiscope) w/six internal

mirrored walls. Perfect for entertaining, parties, photographs. Complete instructions.
Stock No. 71.212AV \$79.50 Ppd.

Order by Stock No.—Check or M.O.—Money-Back Guarantee
EDMUND SCIENTIFIC CO., 300 EDCORP BLDG., BARRINGTON, N.J. 08007

WRITE FOR GIANT FREE CATALOG "AV"



Completely new edition. New items, categories. Illustrated. 118 easy-to-read pages packed with 4000 unusual items. Dozens of electrical and electronic parts, accessories. Enormous selection of Astronomical Telescopes, Microscopes, Binoculars, Magnifiers, Magnets, Lenses, Lasers, Prisms. Many war surplus items for hobbyists, experimenters, workshops, factory. Write for catalog "AV." Include 21¢.

ORDER BY STOCK NUMBER • SEND CHECK OR MONEY ORDER • MONEY-BACK GUARANTEE
EDMUND SCIENTIFIC CO., 300 EDCORP BUILDING
BARRINGTON, NEW JERSEY 08007

CIRCLE NO. 15 ON READER SERVICE PAGE

POPULAR ELECTRONICS

JUNE 1970

ADVERTISERS INDEX

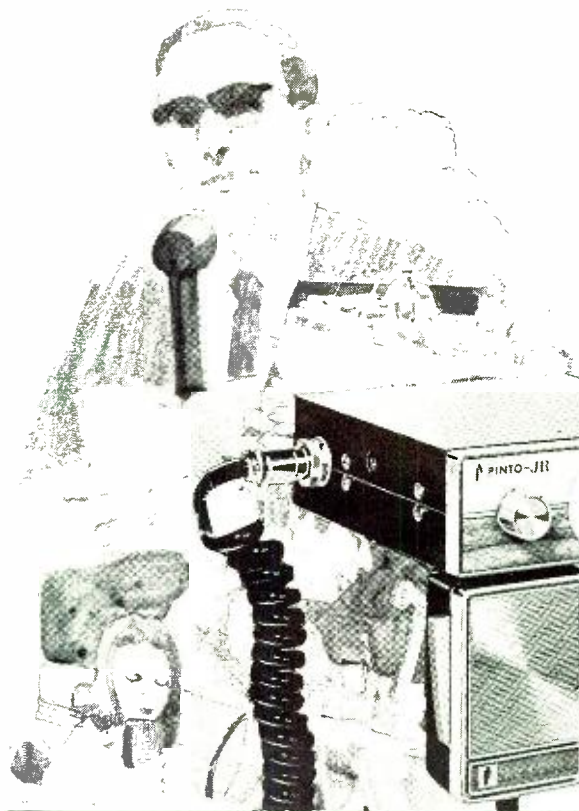
READER SERVICE NO.	ADVERTISER	PAGE NO.
1	AMECO, Div. of Aerotron, Inc.	92
2	Argos Products Co.	14
5	Audionics, Inc.	89
6	BSR (U.S.A.), Ltd.	10
7	Bowman Electronics	13
8	Burstein-Applebee Co.	85
9	C/P Corp.	5
	CREI, Home Study Div., McGraw-Hill Book Co.	54, 55, 56, 57
10	Cleveland Institute of Electronics	72, 73, 74, 75
11	Communications Div., DYNASCAN CORP.	11
12	Courier Communications	12
13	Crystek	100
14	Drake Company, R.L.	94
15	Edmund Scientific Co.	106
4	Electro-Voice, Inc.	FOURTH COVER
	Graytronics Mfg. Co.	100
17	Heath Company	16, 17
	Houle Mfg. Co.	100
	Jetco	93
18	Lafayette Radio Electronics	14
19	Lambert Laboratories	97
20	Midland International	7
21	Mosley Electronics, Inc.	85
22	Multicore Sales Corp.	97
	National Radio Institute	SECOND COVER, 1, 2, 3
	National Technical Schools	36, 37, 38, 39
23	Olson Electronics	88
24	Pearce-Simpson	25
3	J.C. Penney	THIRD COVER
25	Phase Corp.	90
26	Poly Paks	103
27	RCA Electronic Components & Devices	23
	RCA Electronic Components & Devices	26
	RCA Institutes, Inc.	18, 19, 20, 21
28	Sams, Howard W. & Co., Inc.	6
29	Schober Organ Corp.	93
30	Sonar Radio Corp.	87
31	Southwest Technical Products	88
	Stereo Center	93
	U.S. Army	9
	Valparaiso Technical Institute	100
32	Winegard Antenna Systems	91
33	Xcelite, Inc.	8

CLASSIFIED ADVERTISING 101, 102, 103, 104, 105

Printed in U.S.A.

POPULAR ELECTRONICS

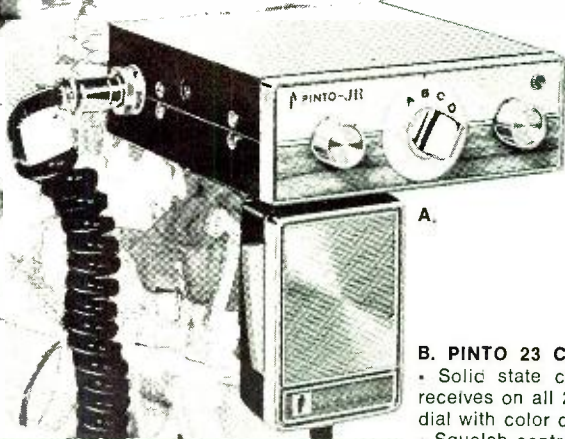
Right now... CB talk is cheap!



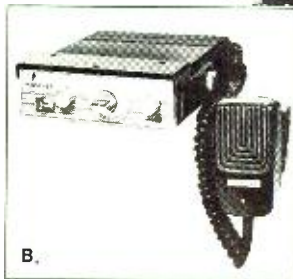
CLOSEOUT!

A. PINTO JUNIOR CB TRANSCEIVER — Budget priced and perfect for the CB'er with 2 cars • Solid state circuitry... no tubes to blow out • Transmits and receives on 6 channels • Microphone/speaker combination • Built-in range boost • Compact, slimline styling • F.C.C. type accepted.

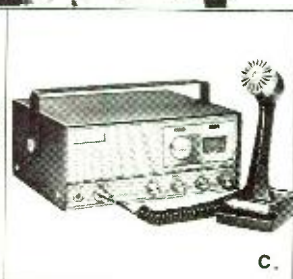
SAVE \$30!
originally \$89
NOW \$59



B. PINTO 23 CB TRANSCEIVER — \$129 • Solid state circuitry • Transmits and receives on all 23 channels • Illuminated dial with color coded channels • S meter • Squelch control • PA system • External speaker jack • Sensitive hand microphone • Wood grain vinyl over steel • F.C.C. type accepted.




B.



C.

C. PINTO 23 BASE STATION — \$159 • Solid state circuitry... no waiting for warm up • Transmits and receives on all 23 channels • Illuminated dial with color coded channels • Variable automatic noise limiter • Base station microphone • 2 power cords • Wood grain vinyl finish over steel • F.C.C. type accepted.

Use Penneys Time Payment Plan

Pinto Transceivers manufactured exclusively for Penneys by  HITACHI of Japan.

Penneys AUTO CENTER

There's a Penneys Auto Center with CB near you!

CIRCLE NO. 3 ON READER SERVICE CARD

www.americanradiohistory.com

Cancel Noise 8 Ways!



625SKK* — \$98.00

625TRSKK* — \$141.50



NEW
607 — \$58.00



NEW
620 — \$70.00



602FTR* — \$75.00

*F.A.A. Approved

205STCKK* — \$57.50

603TR* — \$147.00

List prices less normal trade discounts.

E-V Intelligibility. It's the essential ingredient in voice communications. As field tests prove (and lab tests confirm) the Electro-Voice noise cancelling microphones perform best when the going gets toughest. E-V offers better cancellation over a wider range of frequencies, with a special advantage over common (and troublesome) low frequency noise.

But improved signal/noise ratio is just part of E-V superiority. E-V dynamics offer as much as 50% less total harmonic and IM distortion when compared to reluctance types, a clear advantage in critical voice communications.

And E-V hand-held models have improved RF shielding, a new positive-detent switch (you know when you're on the air), high impact

Cyclac® cases, and a host of other features. Indeed, the Model 602FTR is one of the few civilian products of any type to earn a military designation (M-109) with no more significant change than a new nameplate.

Your choice of dynamic, transistorized, or carbon models in hand-held or handset form. Plus the handsome new Model 607 stud-mounted, or Model 620 with unitized dispatcher stand. It's the widest array of noise-cancelling microphones offered today. All from your local E-V microphone specialist. Write today for free catalog. It's the first step (and the last word) in improved communications.

ELECTRO-VOICE, INC., Dept. 602P
630 Cecil Street, Buchanan, Michigan 49107

high fidelity systems • tuners, amplifiers, receivers • public address loudspeakers
microphones • phono needles and cartridges • aerospace and defense electronics

Electro-Voice®
A SUBSIDIARY OF GULTON INDUSTRIES, INC.

CIRCLE NO. 4 ON READER SERVICE CARD

www.americanradiohistory.com