

CB/SCANNER "Switch-A-Band" You Can Build It!

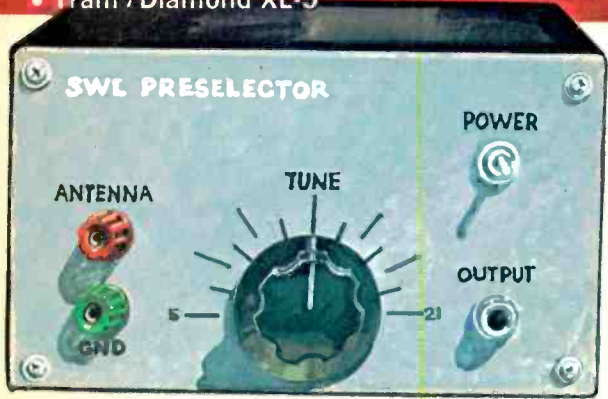
Elementary Electronics

02342
 SEPTMBER-OCTOBER 1976
 \$1.00
elementary Electronics

FOR BEGINNERS
UNDERSTANDING RADIO RECEIVERS
 OUR BASIC COURSE

CB TEST REPORTS
 Our lab checks out-

- E. F. Johnson Messenger 132
- Nuvox CB-7000
- Realistic Navaho TRC-57
- Regency CR-123
- Tram /Diamond XL-5



SHORTWAVE PRESELECTOR

12 69 6608 DEAZ21M
 KEN DEARS
 221 MOYE PL
 PITTSBURGH
 PA 15210

nal-grabbing project that
 gle conversion receivers.

an Become A
PEAKER
MS
BEER
OVERNIGHT!



Select the woofer, midrange, and tweeter for an inexpensive cabinet kit custom-designed to your musical and price tastes!

BUILD OUR MARK TIME INDICATOR

Counts up or down to 9,999,999 seconds or minutes—great for track or rally events.



And there's a heck of a lot more!

- ✓ **Op Amp Tester** - checks out baggy bargains
- ✓ **CB Buzzin' Bee** - a honey of a new CB column
- ✓ **Computer Readout** - our Microcomputer Column
- ✓ **Endangered DX** - stations that'll bite the dust
- ✓ **Antique Radio** - testing old radio tubes

TEST OUT

The home outlet tester that you can build today and possibly save your home and life as well!



Have you ever asked yourself, "Can I make it in Electronics?"



CIE may be the answer if you have a technical aptitude and a serious desire to get ahead.

Right now, you're reading a technical magazine with articles that require a certain amount of electronics know-how. And that says a couple of things about you.

First, you're involved in Electronics . . . on the job, or as a hobby.

Second, you obviously realize the importance of staying up-to-date on the latest technical applications and developments. Reading a technical magazine *helps*, but it takes more than that to get you where *you* want to be . . . if you're serious about Electronics.

How can you afford

. . . *not* to continue with your electronics training?

You know the answer to that as well as we do.

To achieve continuing success, you have to keep building more knowledge into the Electronics background and experience you already have. You have to sharpen the tech skills you've already got and add new ones.

And one of the most logical ways for you to get what you need is to seriously consider an in-depth electronics training program that could help you achieve your ambitions in Electronics.

How can you afford

. . . the time and trouble of going back to school?

An excellent and *convenient* way for you to develop and expand your electronics knowledge is to "let the *school* come to *you*."

CIE's independent education plan does just that. Because we can effectively train you with an "education by mail" electronics training program that makes sense. And it makes sense for these reasons:

You can master *career* Electronics without missing one day of work. Without sacrificing one paycheck! Because you study in your free time . . . setting the study pace that best fits your schedule. *You* decide when and where *you* want to study. So you can go right on enjoying your leisure time because there are no *rigid* classroom schedules to be met. *You're* in control!

How can you afford

. . . the expense of the additional education you need?

A lot depends on which CIE course best fits your educational goals and background. We have a variety of electronics courses at beginner, intermediate, and advanced college-level. And there's a convenient payment plan available for every course. But, one way to evaluate your investment in CIE is this . . . you can *graduate* from CIE for about the cost of one year's tuition at some colleges or universities.

How can you afford

. . . to learn Career Electronics from anyone other than an electronics *specialist*?

If you are *serious* about your career in Electronics, you owe it to yourself to investigate *the* home study school that devotes its entire curriculum and instructional efforts to Electronics. That's CIE — Cleveland Institute of Electronics.

We have *specialized exclusively* in Electronics education-by-mail for more than 40 years. Just Electronics. Nothing else. And, the courses we offer today are the result of these years of teaching experience and proven methods of training . . . all based on the expert guidance of our



specialized Electronics Instruction Staff. Our lessons reflect this specialized experience. No frills. No unnecessary fancy stuff. Instruction is thorough . . . designed to meet the demands of electronics employers.

Each CIE course is built on the principle that the best way for you to *learn* and *retain* what you've learned is to *explain*; then to *check* your understanding; then to *reinforce* your comprehension with practical applications. In some courses, you will perform experiments and tests with your CIE Experimental Electronics Laboratory using authentic electronic components and gear. And, if you select a course that includes Color TV technology, you will not only build and keep a big screen Color TV which features digital circuitry . . . you'll also learn how to troubleshoot your TV.

The course you select will be a complete educational program, designed by *experts* to give you the best in Electronics independent home-study education. It will not be a "snap" course. No easy exams. It will make you work . . . and think. So that when you've earned your CIE Diploma, you'll *really* know your stuff.

In education just like in the "real world" of Electronics, your success depends on you and the effort you make. That's a real plus in CIE independent home-study . . . you build a strong foundation of self-discipline. And *that* pays off!

How can you afford . . . to stop now?

There is a lot more to CIE than this advertisement can tell you. And because you're looking for the *best*, we think it's well worth your while to find out what CIE is

all about. Detailed Courses of Study outlines. In-depth training programs in Electronics Technology, Broadcasting, Industrial, Color TV, Engineering, and 1st Class FCC License preparation. Special CIE Student Services.

All this information is available to you, FREE, when you mail the card or coupon to us. For your convenience, we'll try to have a school representative contact you to review the benefits of CIE training and assist in course selection. And as soon as we hear from you, we'll mail a complete package of information, including our school catalog, G. I. Bill details, special FCC License information. All the facts you need to start your Electronics career program with CIE.

Send TODAY for CIE'S FREE information.

CIE **Cleveland Institute of Electronics, Inc.**
 1776 East 17th Street, Cleveland, Ohio 44114
Accredited Member National Home Study Council

Yes, I want your FREE school catalog and career information package today. EL-71

I am especially interested in:

<input type="checkbox"/> Electronics Technology	<input type="checkbox"/> Industrial Electronics
<input type="checkbox"/> FCC License Preparation	<input type="checkbox"/> Electronics Engineering
<input type="checkbox"/> Color TV Maintenance	<input type="checkbox"/> Other _____
<input type="checkbox"/> Mobile Communications	_____

Print Name _____

Address _____ Apt. _____

City _____

State _____ Zip _____ Age _____

Check box for G.I. Bill information. Veteran On Active Duty

elementary electronics

Dedicated to
America's
Electronics
Hobbyists
Including Electronics Digest®

YOU CAN BUILD IT DEPARTMENT

- ☆ 43 Mark Time Indicator—uses any standard calculator to read out seconds, minutes, or whatever—up to 190 years or so!
- ☆ 59 Test Surplus Op Amps with the Go-NoGo Tester—this money saver goes together in a few hours
- ☆ 65 AC Outlet Will Get You If You Don't Watch Out—build this one for safety around the house
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September-October 1976
Volume 16, No. 5



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ELEMENTARY ELECTRONICS is published bi-monthly by Davis Publications, Inc. Editorial and Executive offices: 229 Park Ave. So., New York, NY 10003; all subscription orders and mail regarding subscriptions should be sent to P.O. Box 2600, Greenwich, CT 06830. One-year subscription (six issues)—\$6.50; two-year subscription (12 issues)—\$13.00; three-year subscription (18 issues)—\$19.00; and four-year subscription (24 issues)—\$25.00. Add 67 cents postage for each year for U.S. possessions and Canada; \$1.34 each year, all other countries. For change of address, please advise 4 to 6 weeks before moving. Send us your current mailing label with new address. Advertising offices: New York, 229 Park Avenue South, 212-673-1300; Chicago, 520 N. Michigan Ave., 312-527-0330; Los Angeles; J. E. Publishers' Rep. Co., 8732 Sunset Blvd., 213-659-3810. Second-class postage paid at New York, NY and at additional mailing office.

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BUILD 20 RADIO

and Electronics Circuits

PROGRESSIVE HOME RADIO-T.V. COURSE

Now Includes

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

- ★ No Knowledge of Radio Necessary
- ★ No Additional Parts or Tools Needed
- ★ EXCELLENT BACKGROUND FOR TV
- ★ SCHOOL INQUIRIES INVITED
- ★ Sold In 79 Countries

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

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

You will learn how to build radios, using regular schematics; how to wire and solder punched metal chassis as well as the latest development of Printed Circuit chassis.

You will learn the basic principles of radio. You will construct, study and work with RF and AF amplifiers and oscillators, detectors, rectifiers, test equipment. You will learn and practice code, using the Progressive Code Oscillator. You will learn and practice trouble-shooting, using the Progressive Signal Tracer, Progressive Signal Injector, Progressive Dynamic Radio & Electronics Tester, Square Wave Generator and the accompanying instructional material.

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

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

THE KIT FOR EVERYONE

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

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

PROGRESSIVE TEACHING METHOD

The Progressive Radio "Edu-Kit" is the foremost educational radio kit in the world, and is universally accepted as the standard in the field of electronics training. The "Edu-Kit" uses the modern educational principle of "Learn by Doing." Therefore you construct, learn schematics, study theory, practice trouble shooting—all in a closely integrated program designed to provide an easily-learned, thorough and interesting background in radio. You begin by examining the various radio parts of the "Edu-Kit." You then learn the function, theory and wiring of these parts. Then you build a simple radio. With this first set you will enjoy listening to regular broadcast stations, learn theory, practice testing and trouble-shooting. Then you build a more advanced radio, learn more advanced theory and techniques. Gradually, in a progressive manner, and at your own rate, you will find yourself constructing more advanced multi-tube radio circuits, and doing work like a

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

THE "EDU-KIT" IS COMPLETE

You will receive all parts and instructions necessary to build twenty different radio and electronics circuits, each guaranteed to operate. Our Kits contain tubes, tube sockets, variable, electrolytic, mica, ceramic and paper dielectric condensers, resistors, tie strips, hardware, tubing, punched metal chassis, Instruction Manuals, hook-up wire, solder, selenium rectifiers, coils, volume controls and switches, etc.

In addition, you receive Printed Circuit materials, including Printed Circuit chassis, special tube sockets, hardware and instructions. You also receive a useful set of tools, a professional electric soldering iron, and a self-powered Dynamic Radio and Electronics Tester. The "Edu-Kit" also includes Code Instructions and the Progressive Radio and Electronics in addition to F.C.C. Radio Amateur License training. You will also receive lessons for servicing with the Progressive Signal Tracer and the Progressive Signal Injector, a High Fidelity Guide and a Quiz Book. You receive Membership in Radio-TV Club, Free Consultation Service, Certificate of Merit and Discount Privileges. You receive all parts, tools, instructions, etc. Everything is yours to keep.

PRINTED CIRCUITRY

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

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

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



Reg. U. S. Pat. Off.

Training Electronics Technicians Since 1946

FREE EXTRAS

• SET OF TOOLS

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

SERVICING LESSONS

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

FROM OUR MAIL BAG

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

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

Robert L. Shuff, 1524 Monroe Ave., Huntington, W. Va.: "Thought I would drop you a few lines to say that I received my Edu-Kit and was really amazed that such a bargain can be had at such a low price. I have already started repairing radios and phonographs. My friends were really surprised to see me get into the swing of it so quickly. The Trouble-shooting Tester that comes with the Kit is really swell, and finds the trouble, if there is any to be found."

Progressive "Edu-Kits" Inc., 1189 Broadway, Dept. 580DJ Hewlett, N.Y. 11557

Please rush me free literature describing the Progressive Radio-TV Course with Edu-Kits. No Salesman will call.

NAME

ADDRESS

CITY & STATE ZIP

PROGRESSIVE "EDU-KITS" INC.

1189 Broadway, Dept. 580DJ Hewlett, N.Y. 11557

CIRCLE 9 ON READER SERVICE COUPON

Hey, look me over

Showcase of New Products

Darkroom Exposure Meter.

PixTronics' new Model 200 Super Sensitive Electronic Darkroom Meter is used to determine the correct exposures of all black-and-white and color negatives for printing enlargements. The Model 200 is simple to utilize with any enlarger and its use eliminates the need for constantly making costly and time-consuming test strips. The unit works on 110 volts AC, measures 6¾ by 5¼ by 2¼ inches, weighs 2½ pounds, and is supplied with its own plug-in easel probe. The probe has two apertures (½-in. and ¾-in.) taking care of all exposure requirements. The 4½-inch illuminated dial of the meter makes it easy to read the scales in the dark. The meter has three sensitivity ranges for reading photographic negatives of any density. It also has a Sensitivity Control for making the necessary reference reading of a test negative for quick-and-easy exposure determination of any new negative. The Sensitivity Control is also utilized in conjunction with



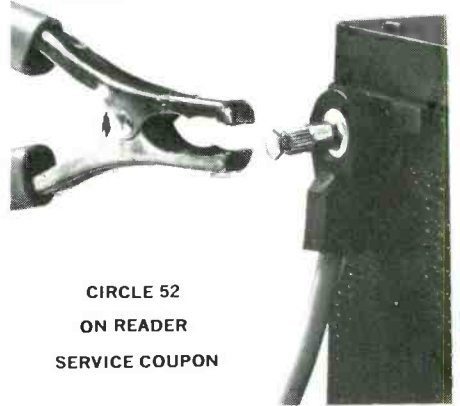
CIRCLE 51 ON READER SERVICE COUPON

the Easel probe to find the correct paper grades for black-and-white projection printing. The Model 200 sells for \$87.50. Two accessory probes, priced at \$10.50 each, are also available. A special density probe and a simple pin-hole light box provide a practical, inexpensive, and accurate way to read directly the density of any negative. A regular probe, cylindrical in shape, 5/8-inch diam. by 2 inches along with 3-foot cable, is available for ground glass photography and many other applications. For more information, please write to PixTronics, Dept. NREE, 681 East 46th Street, Brooklyn, New York 11203, or Circle No. 51 on the Reader Service Coupon.

Battery Connector

Falcon Enterprises has released a new replacement, terminal stud for side-terminal batteries. Falcon's new stud has

an extended length that provides for easier booster cable hook-up. An added feature allows auxiliary power hook-up for accessories and tune-up instruments. This power take-off feature is not possible with stock-terminal studs. The long, terminal studs fit all standard side-terminal batteries and replacement cables (all G.M. cars from 1969 to date). The studs are plated for corrosion resistance and



CIRCLE 52
ON READER
SERVICE COUPON

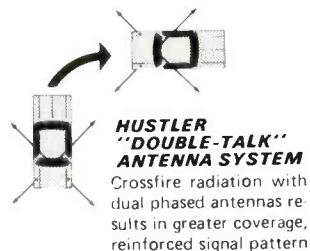
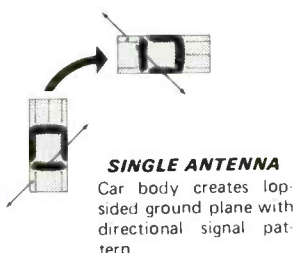
are skin-packed on attractive display cards, 2 per card, complete with auxiliary terminal screws, which are ideal for CB installations. The studs sell for only \$1.49 a pair. For more info, write to Falcon Enterprises, Inc., 3960 S. Marginal Rd., Cleveland, OH 44114.

High-Power Stereo Amp Kit

The new Heathkit AA-1640 stereo power amplifier eliminates most audible

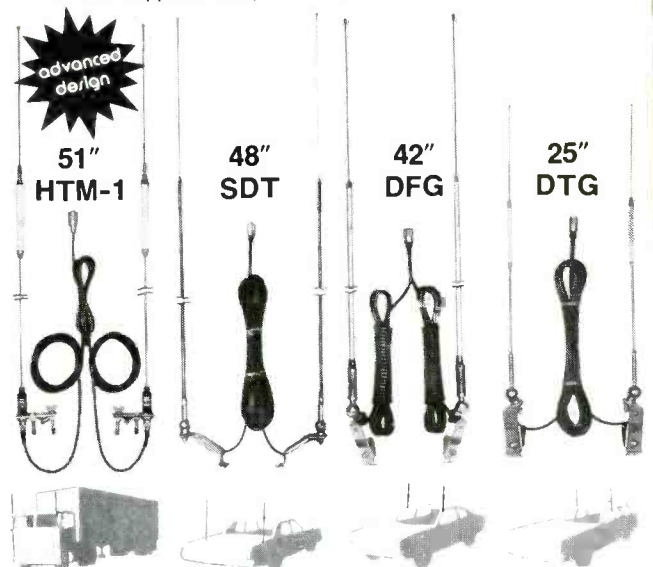
BE FOREMOST with the **HUSTLER** "DOUBLE-TALK" antenna system

Join the thousands of CB'ers who communicate longer, louder, while traveling over the miles with the Hustler "Double-Talk" mobile antenna system. Guaranteed superior performance over a single antenna installation — more uniform signal pattern because of uniquely detailed phasing design, more consistent communications with virtually no fading or blind spots when changing direction in travel.



CHOOSE FROM FOUR POPULAR VERSIONS

All are supplied ready for easy installation and operation



**new-
tronics
corporation**

15800 commerce park drive,
brook park, ohio 44142

HUSTLER

Available from all distributors
who recognize the best!

CIRCLE 12 ON READER SERVICE COUPON

ELEMENTARY ELECTRONICS/September-October 1976

www.americanradiohistory.com

Other CB's might have this Wireless Module concept by 1978. Royce has it now!

This is no ad talk about "new, improved..."

This is no "add-on" feature on the same old transceiver.

This is no minor event in the world of CB.

Because only Royce has the Wireless Module concept. And, it is the biggest CB technological breakthrough since the transistor!

You don't have to be an engineer to figure out why. Truly wireless module assembly almost guarantees less chance of failure.

No hand soldered connections to vibrate loose promises reliability over the years—on rugged country roads or off.

Quality starts with the components—and we use only the finest. The modules in our Wireless Models are assembled by automation to assure you of uniform quality on every set off the line.



Royce's Wireless Module concept adds up to what you want: Reliability! Peak power! Maximum range!

Follow the new leader now! See all 6 Royce Wireless models at your Royce dealer's soon! And, write for facts on these models, other innovative Royce CB's, antennas and accessories.

Royce Wireless Model 1-653. 23 channel mobile transceiver features Amplified Automatic Gain Control (AAGC) which helps pull in weak stations, minimizes overload from nearby stations. Phase Lock Loop (PLL) integrated circuit offers reliable 23 channel operation with only 3 crystals. Large S/RF meter indicates incoming and output signal strength. Pushbutton ANL and PA/CB switches. LED Transmit Light.

Royce Wireless Model 1-662. 23 channel mobile CB channel selection with digital readout dial system + bright/dim switch. Vol-U-Mike permits receiver volume adjustment from mike. Phase Lock Loop adds reliability, accuracy. Large S/RF meter checks incoming signal strength, RF output power. Pushbutton Automatic Noise Limiter and PA/CB switches. LED Transmit Light. Continuous RF gain and fine tuning controls.

Model 1-653

Model 1-662



Royce



Follow the new leader!

Royce Electronics Corporation
1746 Levee Road
North Kansas City, Mo. 64116
Call: (816) 842-7505 • Telex: 426-145

CIRCLE 15 ON READER SERVICE COUPON

HEY, LOOK ME OVER

forms of distortion. For example, to eliminate clipping distortion, the AA-1640 has massive power reserves; 200 watts RMS per channel into 8 ohms with less than 0.1% total harmonic distortion from 20-20,000 Hz. Intermodulation distortion remains under 0.1% even at full power; hum and noise are an inaudible 100 dB below full output. Frequency response is -1 dB from 7 Hz to 50 kHz and -3 dB from 5 Hz to 100 kHz. All these are minimum, guaranteed specifications according to Heath. Special ballistic circuitry makes the optional back-lighted meters unusually useful. They

monitor the power output directly in watts from 0.2 to 200 watts into 8 ohms and in decibels from -30 to 3 dB. Weighing in at over 58 pounds, the AA-1640 is very ruggedly constructed. The 16 output transistors are mounted on two 6-pound, diecast heatsinks. This extremely heavy-duty design is said to increase reliability and to eliminate the need for a ventilating fan even when the AA-1640 is used as a PA amplifier. The basic AA-1640 kit sells for \$439.95 and the AAA-1640-1 meters sell for \$69.95. When the amplifier and meters are purchased together, the total price is \$20 less, or \$489.95. The 1976 Heathkit Catalog contains more information on



CIRCLE 31 ON READER SERVICE COUPON

the AA-1640 and over 350 other electronic kits. Free copies of the catalog are available from Heath Company, Benton Harbor, MI 49022.

Monitor With a Memory

Tennelec has introduced its new MCP-1, the radio scanner with an unlimited search capability. The MCP-1 is actually a mini-computer operating off a tiny microprocessor and is one of the first applications of the microprocessor in the consumer field. By utilizing the MCP-1's exclusive search mode, it is possible to locate frequencies in use in an area without having to first consult a frequency directory or a codebook. The MCP-1 can be commanded to search out unknown frequencies and then store in memory those the listener wishes to hear again. To search out unknown or unlisted frequencies, any frequency is



CIRCLE 53 ON READER SERVICE COUPON

entered within a band coverage and an "Enter Search" button is pushed. The MCP-1 then searches through all 256 channels, at a rate of 10 channels per second. When the scanner pauses on a frequency on which there is action and which the listener will want to hear again, that frequency can be entered in memory on the channel in view by pushing an "Enter Search Frequency" button. Other sections of band coverage can be searched by using the "End Search" button, advancing to another channel, and then putting in a new "starting" frequency, at which point the process of searching through 256 different channels begins again. If the desired frequencies are already known, the listener can punch in the frequencies he wants the MCP-1 to scan. Up to 16 different frequencies can be stored in memory at one time. In all, there are about 16,000 low, high, and UHF band frequencies that the MCP-1 is capable of receiving. The MCP-1 operates without crystals and has super-selective dual filters which help screen out station overlap for optimum audio reception. Price of the MCP-1 is \$399.95. For further information, contact Consumer Products Division, Tennelec, Inc., 601 Turnpike, Oak Ridge, Tennessee 37830.

Checklist of Books for the Libraries of Technicians, Hobbyists & Students

BRAND-NEW BOOKS, JUST PUBLISHED

- C.Ber's Handy Atlas/Dictionary. 64 p. \$1.95
- C.Ber's Handy Manual. 48 p. \$1.50
- Build Your Own Working Robot. 238 p. 83 il. \$6.95
- VHF/UHF Fire, Flood, Ham Scanner Servicing \$6.95
- C.Ber's Handybook of Simple Hobby Projects. \$3.95
- The Electronic Musical Instrument Manual. \$6.95
- VEGA. 350 p. 265 il. \$5.95
- Impedance. 196 p. 90 il. \$5.95
- Fire & Theft Security Systems—2nd Ed. 192 p. \$5.95
- How to Repair Home Laundry Appliances. \$5.95
- Engine Maint./Repair: The Chrysler Family Concrete & Masonry. 392 p. 213 il. \$5.95
- Troubleshooting With Dual-Trace Scope. 224 p. \$5.95
- How to Subcontract Your Home. 196 p. 63 il. \$4.95
- Practical Home Constr./Carentry Hdbk. 438 p. \$5.95
- Music Scoring for TV & Movies. 266 p. 166 il. \$12.95
- Numbers: Shortcuts & Pastimes. 294 p. 80 il. \$6.95
- CB Schematic Servicing Manuals, each 200 p. \$5.95
- 1. Kris, Browning, Hy-gain, J. C. Penney, (Pinto) Vol. \$5.95
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The Stereo One by Finney is an automobile FM signal booster designed to help eliminate signal fade and flutter associated with weak signal FM reception. A unique electronic circuit design allows the Stereo One to be used with



any auto AM/FM radio without any adverse effect on normal AM/FM reception.

The circuit more than triples the received signal to provide crisp, clear FM reception in fringe signal areas. Even in strong-signal metropolitan areas the Stereo One will not overload, thus making the unit useful under all receiving conditions.

The Stereo One is a two-piece unit with an amplifier which mounts close to the car radio.

It has a small on/off control switch which self-mounts on the dash in any convenient location. The control switch also has an LED On indicator light.

The Stereo One sells for \$24.95. For additional information, write to the Finney Company, 34 W. Interstate St., Bedford, OH 44146.

In-Circuit Tester

A new battery-operated automatic semiconductor tester by B&K-Precision features a HI/LO power drive that enables the user to accurately test a broad range of semiconductors. The new compact unit, designated the Model 510, permits rapid in and out-of-circuit testing of bipolar transistors, FET's, SCR's, and



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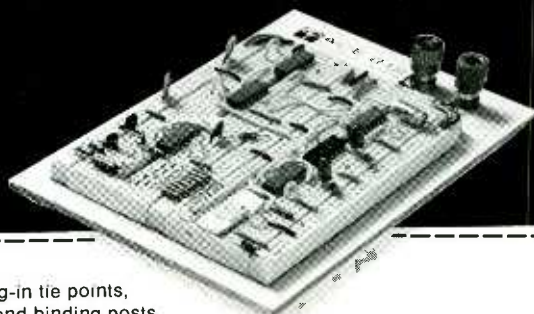
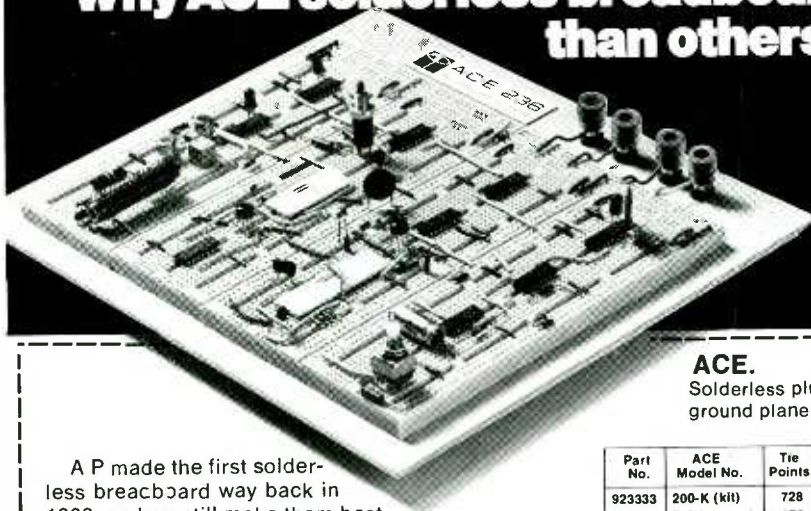
monolithic and hybrid Darlington. The LO power drive provides a positive Good/Bad indication plus automatic identification of base, collector, and emitter leads. The HI power drive position is used to test semiconductors in circuits with shunt resistances as low as 10 ohms and shunt capacitances as high as 25 uF.

A complete transistor test can be made in nine seconds or less. The Good/Bad test and automatic lead identification can be made as quickly as one can turn the six-position test switch through one cycle. Out-of-circuit tests also can be made rapidly using the Mini-Lock test clips or the built-in test socket. The Model 510 measures 6 $\frac{1}{2}$ -in. by 3 $\frac{3}{4}$ -in. by 1 $\frac{3}{4}$ -in. and weighs one pound, less batteries. The tester uses four "AA" cells for hundreds of hours of testing. A flashing LED indicator on the panel serves as a reminder to turn the unit off when not in use. The instrument is supplied complete with three color-coded Mini-Lock test clips and carrying case. The Model 510 is priced at \$90.00, less batteries. For additional information, contact any authorized B&K-Precision distributor or write B&K-Precision, Dynascan Corp., 6460 W. Cortland Ave., Chicago, IL 60635.

Stripper

Here is a new concept in wire stripping made possible by the Alpha Wire Corporation. Called the Alpha Plastic-Blade Stripper, it uses space-age plastic Stilan blades. The cutting edges are harder than insulation, but softer than copper. This enables them to strip the insulation from wire or cable without any damage to the conductors and without separating them. The new hand wire stripper removes the insulation from

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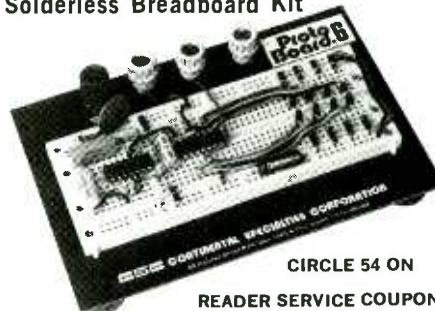
twisted pairs, multi-conductor cable, ribbon cable, twin-lead antenna wire, electrical cable, automobile wiring, lamp cord, and telephone wires, just as quickly and easily as it does from ordinary hook-up wire, all without separating the conductors. The new stripper offers the following advantages over models with metal blades. The wires being stripped



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do not have to be carefully positioned between the stripper blades. Also, a number of different wires can be stripped at the same time. This is the only hand stripper that requires no adjustment for wire sizes, type, or number of conductors. The tool strips any size wire from AWG 12 through AWG 28 with just about any type of insulation. The plastic blades are made from *Stilan*, a patented polymer, which is remarkably tough material originally developed for aerospace applications. The Alpha Plastic-Blade Stripper lists at \$39.95, supplied with three sets of blades. For further information, contact Alpha Wire Corp., 711 Lidgerwood Avenue, Elizabeth, NJ 02707.

Solderless Breadboard Kit



CIRCLE 54 ON
READER SERVICE COUPON

Continental Specialties has introduced Proto-Board 6, probably the lowest priced solderless breadboard kit on the market today. This compact kit can be assembled in minutes and offers six 14-pin DIP IC capacity for basic breadboarding, testing, and building applications. Selling for only \$15.95, the American-made PB-6 includes one QT-47S solderless breadboarding socket, two QT-47B Bus Strips, four 5-way binding posts, a metal ground and base plate, rubber feet to prevent scratching work surfaces, all nuts, bolts and screws, plus complete easy-assembly instructions. The PB-6 lets the user test and build circuits without soldering or patch cords; all interconnections between components are made with common #22 AWG hook-up wire. This quality breadboarding kit includes 630 component tie points at less than 2.5¢ each. It measures 6-in. long by 4-in. wide, and is available off-the-

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Joe Higgins
National Safety Sheriff

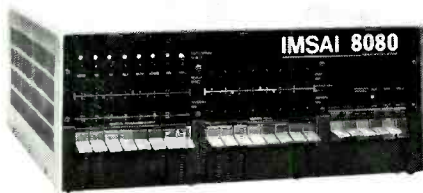
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HEY, LOOK ME OVER

shelf from local distributors or directly from Continental Specialties Corp., 44 Kendall Street, P.O. Box 1942, New Haven, CT 06509, or 351 California Street, Box 7809, San Francisco, CA

Hobby Computer

A new full-fledged programmable digital computer for hobbyists, the IMSAI 8080, is priced at \$599 unassembled and \$931 assembled. The IMSAI 8080 is constructed around an anodized aluminum card cage and a printed-circuit mother board. The mother board accommodates the front panel and up to 22 plug-in cards for memory and I/O interface devices. The lucite front panel has eight extra program-controlled LEDs as well as paddle switches backed up



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by debouncing circuits. The 8080 can be expanded to a powerful system with 64K bytes of memory plus a floppy-disk controller with its own on-board 8080 microprocessor and a DOS. A wide variety of input/output devices including an audio tape cassette, printer, video terminal, and teletypewriter can be used with the 8080. These peripherals will

function with an 8-level priority interrupt system. BASIC software is available in 4K, 8K, and 12K, obtainable in PROM. For complete information, write to IMS Associates, Inc., 1922 Republic Avenue, San Leandro, CA 94577.

Stereo Snooze

A new concept in personal stereo enjoyment is the Stereopillow, which offers the intrinsic advantages of headphones without the discomfort. Because there is nothing clamped on the listener's ears, Stereopillow is exceptionally comfortable and allows one to converse and to hear normal room sounds, such as a telephone ringing. It connects to the speaker outputs of any stereo amplifier or receiver, and the listener can enjoy high sound levels without disturbing other people. From the outside, the Stereopillow is a full-size polyurethane foam decorator pillow which is scientifically contoured to support the listener's head. A pair of equalizer circuits built into the pillow adjust the bass and treble re-



CIRCLE 59 ON READER SERVICE COUPON

sponse for each channel. The standard removable covering on a Stereopillow is washable gold velour. A custom cover can easily be made from any fabric to complement any room decor by following directions included with every Stereopillow. With a suggested price of \$79.95, Stereopillow is less expensive than many high quality stereo headphones. For further information, write to Yeaple Corp., 1255 University Ave., Rochester, NY 14607.

Music Looks Good

Translate music into pulsing, swirling starbursts of light with the new Heathkit TD-1006 Color Organ. Just connect the TD-1006 to the speaker leads of any sound source except AM radio. Without affecting the sound, special circuitry divides the audio signal into four frequency bands. Each band controls 35 brilliantly colored lights—red for bass, blue for low midrange, green for upper mid-range and amber for treble—140 lights in all! The colors pulsate as each band changes intensity, creating spokes of color that seem to whirl and change brightness to the beat of the music. The unusually wide 25 dB dynamic range of the circuitry provides an exciting display with all kinds of music—rock, pop, jazz, easy listening, or classical. The blackout front panel complements any room and the beautiful walnut-grained vinyl case

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The new Gold Line Car Stereo noise filter effectively suppresses noise reaching the speaker of your car's radio or tape deck through the power input line.

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Prevents noise in your radio caused by electrical systems such as battery charging, air conditioning, voltage regulators and power accessories.

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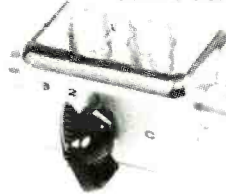
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CIRCLE 24 ON READER SERVICE COUPON

Experience is the best teacher. You might settle for any CB first time around. Understandably. A lot of people think they're all pretty much alike. But you'll soon discover that, like everything else, there are exceptions.

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Talk to Cobra. And you know you're punching through. One glance at the

29's over-sized illuminated meter tells you just how much power you're punching out and pulling in. For voice modulation the DynaMike delivers at 100%. Same way with power: The 29 transmits at maximum power levels.

Sooner or later you'll get a Cobra. And you'll get engineering and craftsmanship second to none. Performance that will make your first CB seem obsolete. Reliability and durability that have set standards for the industry. Above all, you'll get power. The power to punch through loud and clear like nothing else. Because when it comes to CB radio, nothing punches through loud and clear like a Cobra.



Punches through loud and clear.

Cobra Communications, Products of Dynascan Corp.
1801 W. Belle Plaine, Chicago, Illinois 60613

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Old Radio Treasures

There's a rare old radio waiting for you somewhere. Here's how to have year-round fun discovering valuable old sets in your attic, local swap meet or antique barn. You'll enjoy McMahon's fascinating books, true collector's references.



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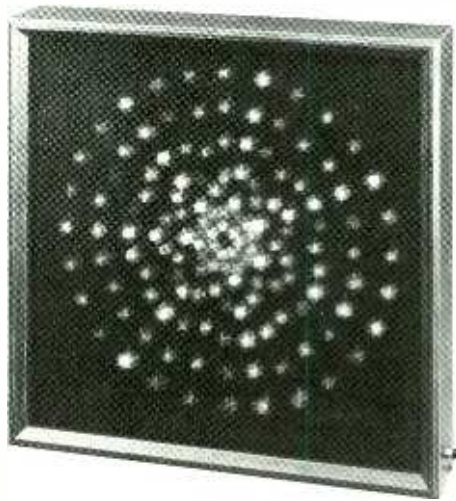
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CIRCLE 31 ON READER SERVICE COUPON

is just 4½-inches deep, so you can even hang the TD-1006 on your wall. The TD-1006 sells for just \$79.95, mail order. For more information and a free copy of the 1976 Heathkit Catalog write to the Heath Company, Benton Harbor, MI 49022.

Microcomputer

The "Familiarizer," a new approach to learning microprocessing theory and operation, has been introduced by EBKA Industries. The Familiarizer is a complete microcomputer system, with its own hexadecimal keyboard and display built into a single printed circuit board. No Teletype or other terminal is required. With the addition of a power supply, it becomes a complete, simple-to-operate



CIRCLE 60

ON READER SERVICE COUPON

microcomputer. The total package, including self-teaching hardware and programming manuals containing step-by-step instructions, offers a practical, low-cost introduction to micro-processing combined with "hands-on" experience. The heart of the EBKA Familiarizer is a MOS Technology 6502 microprocessor, an eight-bit processor that can address up to 65K bytes of memory. On-board memory consists of 1K bytes of RAM

for user programs and two eight-bit input and output ports. A 256-byte monitor program, supplied in one 1702A erasable PROM, and an on-board terminal replaces more complex lights and switches to permit simple loading, examination, running, debugging, and modification of programs. To store programs in PROM, the PC board is designed to accept three additional 1702A PROMS (768 bytes). A low-cost PROM programmer is also available, as well as add-on memory, interface and special function cards to expand the capabilities of the Familiarizer in easy, inexpensive stages. The Familiarizer is available in either kit form, containing all parts, manuals and documentation for \$229, or completely assembled for \$285. Optional power supply is available at \$58. For more information, write to EBKA Industries, Inc., 6920 Melrose Lane, Oklahoma City, OK 73127.

Beyer Dynamic Infraphone System

Sometimes we have to think twice before we realize the value in some new electronic product. Other times a new gadget finds instant acceptance because it fills some unusual need. A new device that seems to fit both categories is the Beyer Dynamic Infraphone system. Some will feel it's an idea with nowhere to go. Others will find it an ideal solution to private TV or hi-fi listening.

The Infraphone System is a monophonic wireless headphone device that transmits sound on an unseen—infrared—light beam. The heart of the system is the IS76 transmitter which has six infrared transmitting elements (enough to cover an average-size room) and a charging system for the NiCad batteries used in the headphone receivers. The transmitter's carrier frequency is 95 kHz, FM-modulated by audio from a TV, record player or hi-fi set. The FM signal is radiated on an infrared light beam of 930 nanometers—a light frequency unseen by the human eye.

Automatic level control built into the transmitter insures nearly-optimum modulation without limiting the modulating signal's dynamic range.

The transmitter's signal can be received over an area of 100 or more square feet by either of two special headphone receivers. One receiver is Beyer's DT 444 infrared headphones, which include volume control and built-in rechargeable NiCad battery (charged from transmitter as required—every 12 or so hours of use). The other receiver accepts most standard headphones, and may be worn on one's belt or in a pocket.

Overall sound quality is quite good using the DT444 headphones. The IE76 receiver feeding Beyer DT302 headphones produced adequate sound—not as good as the high fidelity of the DT444s.

Beyer's Dynamic Infraphone system is distributed by the Revox Corp. and selected high fidelity and professional products dealers. For additional information circle number 70 on the Reader Service coupon.

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CIRCLE 1 ON READER SERVICE COUPON

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Learn design, installation and maintenance of commercial, amateur, or CB communications equipment.

The field of communications is bursting out all over. In Citizens Band alone, class D licenses grew from 1 to over 2.6 million in 1975, and the FCC projects about 15 million CB'ers in the U.S. by 1979. That means a lot of service and maintenance jobs . . . and NRI can train you at home to fill one of those openings. NRI's Complete Communications Course covers all types of two-way radio equipment (including CB), AM and FM



Transmission and Reception, Television Broadcasting, Microwave Systems, Radar Principles, Marine Electronics, Mobile Communications, and Aircraft Electronics. The course will also qualify you for a First Class Radio Telephone Commercial FCC License or you get your tuition back.

Learn on your own 400-channel digitally-synthesized VHF transceiver.

You will learn to service all types of communication equipment, with the one unit that is designed mechanically and electronically to train you for CB, Commercial and Amateur communications: a digitally-synthesized 400-channel VHF transceiver and AC power supply. This 2-meter unit gives you "Power-On" training. Then we help you get your FCC Amateur License with



special instruction so you can go on the air.

The complete course includes 48 lessons, 9 special reference texts, and 10 training kits. Included are: your own electronics Discovery Lab, Antenna Applications Lab, CMOS Frequency Counter, and an Optical Transmission System. You'll learn at home, progressing at your own speed, to your FCC license and into the communications field of your choice.

NEW CB SPECIALIST COURSE NOW OFFERED



NRI now offers a special course in CB Servicing. You get 37 lessons, 8 reference texts, your own CB Transceiver, AC power supply and multi-meter . . . for hands-on training. Also included are 14 coaching units to make it easy to get your commercial radio telephone FCC license—enabling you to test, install, and service communications equipment.

NRI offers you five TV/Audio Servicing Courses

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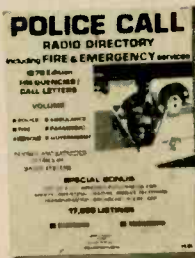
CIRCLE 34 ON READER SERVICE COUPON

22



BOOKMARK
BY BOOKWORM

Tune In the Cops. The 1976 *Police Call Radio Directory* has been completely revised and expanded, and is packed with information on law enforcement, fire, rescue, and other Public Safety two-way radio stations. Arranged alphabetically, each of the 113,000 listings includes frequency, call sign, type of station, and location of trans-



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mitter. The listings are cross-indexed by frequency and the book contains a table of all FCC VHF and UHF two-way radio frequency assignments. Included assignments are public safety, industrial, transportation, mobile telephone, broadcast, and marine. Thirty thousand listings have been added or amended since publication of the 1965 edition. A new feature is the inclusion of supplemental details on many major systems, such as the new New York City Police radio network. *Police Call Radio Directory* is an invaluable reference for two-way radio professionals and hobbyists. It is published in nine separate volumes, each covering a different geographical area of the Continental United States. Published by Hollins Radio Data, P.O. Box 35002, Los Angeles, CA 90035.

Transistor-Transistor Logic. TTL Cookbook, by Donald E. Lancaster explains what transistor-transistor logic (TTL) is, how it works, and how to use it. In Chapter 1, the basics of TTL are given: what it is, how to inter-connect it, how to power it, etc. Chapter 2 is a catalog of TTL



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devices, giving physical and electrical specifications of all devices mentioned in the book. Logic is covered in Chapter 3, starting with the basics and progressing to the more-advanced logic systems. One-input logic, two-input logic, tri-state logic, data-selector logic, and more are covered. Gate and timer circuits are discussed in Chapter 4. Succeeding chapters take up

clocked logic, JK and D-type flip flops and applications, counters and counting techniques, shift-register circuits, noise generators, and rate multipliers. The final chapter discusses a number of practical applications, including digital counter and display systems, an events counter, an electronic stopwatch, a digital voltmeter, and other digital instruments. In this completely illustrated book, the author suggests several TTL projects that the reader may wish to try, relying on his own resources. For more information on this book and others, write to Howard W. Sams & Co., Inc., 4300 W. 62nd Street, Indianapolis, IN 46206.

Kit Guide. *The Catalog of Kits* describes over 800 kits and where to get them. It includes kits for burglar alarms, greenhouses, needlepoint pillows, furniture. Kits are large and small, and for nearly every purpose. It lists unique sources coupled with fascinating product descriptions.

**THE CATALOG
OF KITS**



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Within its covers you can also find helpful hints on how to build and buy wisely, lists of foreign sources, do-it-yourself clubs, and an index. The book is available from Athena Books Limited, Box 26, Carlstadt, NJ 07072. Be sure to add 75¢ for postage and handling.

Mini Reviews

Op Amp Circuit Design & Applications by Joseph Carr, published by Tab Books, Blue Ridge Summit, PA 17214. Build projects while learning IC circuit design at the same time. Soft cover, 282 pages, \$6.95.

World Radio TV Handbook 1976-30th Anniversary Edition, edited by J. M. Frost, published by Cardfont Publishers Ltd. The authoritative source of information about broadcasting and TV stations worldwide. Soft cover 560 pages, \$10.95. Available in U.S. from Gilfer Associates, Inc., 52 Park Ave., Park Ridge NJ 07659.

Microprocessor / Microprogramming Handbook by Brice Ward, published by Tab Books, Blue Ridge Summit, PA 17214. A practical guide to microprocessor construction, operation, programming, and applications. Soft cover, 293 pages, \$6.95.

Confidential Frequency List by Robert B. Grove, published by Gilfer Associates, Inc., 52 Park Ave., Park Ridge, NJ 07659. 24 categories of frequencies for RTTY press, U.N., Interpol, Military, etc. Soft cover, 80 pages, \$5.45.

Handbook of Electronic Testing, Measurement, and Troubleshooting by Matthew Mandl, published by Reston Publishing Co, Inc., P.O. Box 547, Reston, VA 22090. Covers all aspects of test instrument usage and application. Hard cover, 287 pages, \$16.95.

FROM THE COMPANY WHO'S NUMBER ONE IN CAR SPEAKERS, A GREAT LINE OF CB EQUIPMENT.

Even though you may not have heard of the Sparkomatic name, you've probably been listening to the Sparkomatic sound for the past eight years. That's how long we've been number one in car speakers. And now that we've put that kind of experience into CB, you're going to hear a lot more about us. Because we have everything in CB equipment to fit anything on wheels.

Beginning with converters. If you're just starting out in CB you'll be interested in our CB-10 converter. This easy to install unit converts any AM radio into an all channel CB receiver so you can listen to what CB is all about.

Or, if you're already well into CB, use it to monitor a particular channel while you use your transceiver for the regular action. We also have a CB-11 converter which has the added feature of a 23 channel selector knob.

We make CB transceivers to fit your price range and needs. And whether it's one of our basic mobile rigs like our CB-1123, or a multi-featured base station like the CB-5000, they're all engineered with the same Sparkomatic know-how.

And once you've got a Sparkomatic transceiver, you should back it up with one of the many antennas we make for your specific application.

Like our SA-204. It gives you three full inches of whip adjustment for optimum tuning instead of being limited to the usual 3/4 inch. Other antennas can't give you the lowest SWR (standing wave ratio) like this one can. And because



it's pre-wired with a plug-in connector for goof-proof installation, you know you'll get all the performance that's built into your CB radio.

Our motorized SA-301 is the retractable antenna that's completely retractable. It looks like a regular radio

antenna so no one will know your car is CB equipped. Yet, it has everything going for it like lock-in tuning and efficient top loaded coil. And it's engineered for AM, FM and stereo, as well as CB.

Our SA-22 is perfect for mounting on station wagons, campers, vans, and cars without conventional trunks. We even have a clip-on (SA-10) or magnet mount (SA-11), which you can easily attach or remove in seconds.

And now that you're all set in CB, you should look into an external speaker. For a few bucks more you can improve greatly on intelligibility.

And nothing is better designed for this purpose than our SK-35CB with the exclusive Sparkomatic Tone Purifier™ slide control which brings in the message the way you want to hear it. And to add another dimension to the fun of owning CB, our Public Address speaker, the SK-50CB is a must.

Engineering, design, dependability, value, selection... you'll get it all with Sparkomatic CB equipment.

Sparkomatic Corporation, Milford, Pa. 18337, CB Equipment Automotive Speakers Car Radios Competition Shifters Mechanics Creepers

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CIRCLE 21 ON READER SERVICE COUPON

OUT OF PHASE

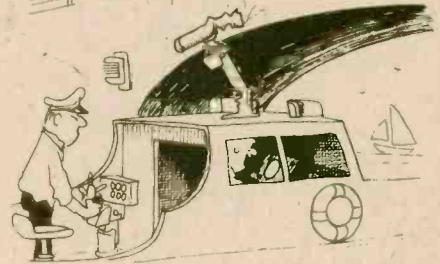
By Jack Schmidt



"I've installed 17 speakers . . . they cancel each other out!"



"Nice job on the rear speaker installation—the stop lights keep time with the music!"



"... radar contact!"



"Sure you heard us on the VHF monitor . . . but Head Bear has been broadcasting dummy calls!"



"You turned the radar beacon off because it was interfering with your TV reception???"



"I cleaned all the tape today. They're still in the dryer!"

**CB or not CB.
With RCA, that's not the question.**



TRUCKIN' IN THE NEWS



... Geri Ann Atherton of Sacramento, California has proved up and down the highways of California, Oregon, Washington, and Nevada that she can



handle a big-rig truck down the highway with ease. As a result, Geri has been named "Queen of the Road for 1976." She learned to drive a truck from her husband, Craig, and has hauled a variety of different loads, in-

cluding motorcycles, sugar, and soap products. The Athertons are a CB family. They owned four CB rigs prior to the Queen of the Road contest. One of Geri's prizes is a Radio Shack TRC-56 deluxe 23-channel CB radio, and she says she's thrilled to have her own CB set at long last. Stack them eights, Geri!

1975 Queen of the Road
Linda Jernigan co-drives an interstate truck with husband Bill. She often talks to their two children using this Realistic CB set.

Queen of the Road for 1976, Geri Ann Atherton, receiving a Realistic telephone-type 2-way CB radio and a copy of Radio Shack's new CB Book from J. Michael Wood, Radio Shack Sales Promotion Manager.



... Thousands of truck drivers from all over the country attended the Truck Week '76 exhibition which took place in Chicago's McCormick Place, June 21-26. Activities included discussions of how to deal with the energy crisis in the trucking industry, how to reduce operating costs, how industry regulation and government legislation affect the trucking industry and the national economy. The Third International Truck and Equipment Exhibition displayed the products of over 200 companies who provide truckers with parts and equipment—including several suppliers of CB equipment. Mercy sakes alive, good buddies, looks like they had themselves a convention! ■



The question becomes which RCA model.

Because when you compare our models with all others in their class, you'll see that RCA's solid state CB transceivers offer you exceptional quality and outstanding performance at a price that's right.

The 23-channel RCA Mobile CB two-way radio Model 14T100 has 4 watts maximum power output, LED transmit light, automatic level control, plus PA and external speaker jacks. Its S/Rf meter does double duty: input signal strength plus relative transmitting power.

RCA's deluxe 23-channel Mobile CB two-way radio Model 14T200 offers the same features as the 14T100 plus a few important extras. A delta-tune switch to improve reception when stations being received are slightly off-frequency; modulation light to show relative modulation level, and an ANL switch to reduce bothersome noise interference.

See the new CB Co-Pilot at your RCA Distributor. Or contact RCA Distributor and Special Products Division, Cherry Hill, Camden, N.J. 08101 (Phone: 609-779-5764).

CIRCLE 14 ON READER SERVICE COUPON

RCA CB Co-Pilot

Instant CB Antennas

Now you see 'em, now you don't.

The beauty of Antenna Specialists temporary CB antennas is that they can be mounted and unmounted in seconds without leaving a trace. That can be important for security, or if you rent or change cars frequently.

Our model MS178 magnetic mount has powerful ceramic magnets that grip firmly to flat metal surfaces even at highway speeds. And it won't scratch the paint. A detachable, in-line mini-connector permits antenna removal without disturbing the cable. An economy magnetic mount, the M-440 provides the same instant mounting features. Quick, convenient mounting on the rain gutter is easy with our MR131. Its heavy duty spring loaded gutter clamp grabs like a vise, yet releases with just a squeeze. Don't settle

for less than the best. Take advantage of our 20 years experience. Look for the Stripes of Quality.



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MS178

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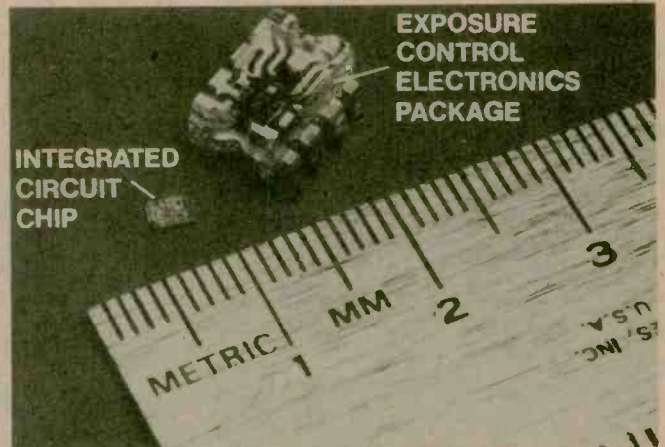
newscan

Electronics in the News!

New Instant Pictures

New easy-to-use Kodak instant cameras and a film for self-developing color prints based on reversal color imaging techniques produce instant prints with a high degree of color fidelity. Processing of the instant prints, which are litter-free, takes place outside the camera in daylight or room light. An image begins to appear in a minute or two and development is essentially complete in about eight minutes. An elegant Kodak Satinluxe finish protects the prints from smudges and fingerprints.

Proper exposure control is important in every photographic situation. To measure just enough light for a proper exposure and then to expose the film through one of two apertures, over a range of time from 1/20 to 1/300 second, involves precise light readings and sophisticated controls.



Tiny chip monitors all exposure functions including aperture selection and continuous shutter speeds from 1/20 second to 1/300 second. It also computes battery condition on command and activates a low-light signal which tells the picture-taker when to use flash.

In Kodak instant cameras, the light is measured and the shutter controlled automatically by an exposure control electronic package containing an integrated circuit chip. This device measures how much light should fall on the film and then makes sure that it does. On the chip is a silicon photosensor that reads the light reflected from the subject. If there isn't enough light for adequate exposure, the device relays information to the viewfinder, where a red low-light signal turns on to tell the picture-taker to use flash. Once the flip-

(Continued on page 30)

CIRCLE 6 ON READER SERVICE COUPON

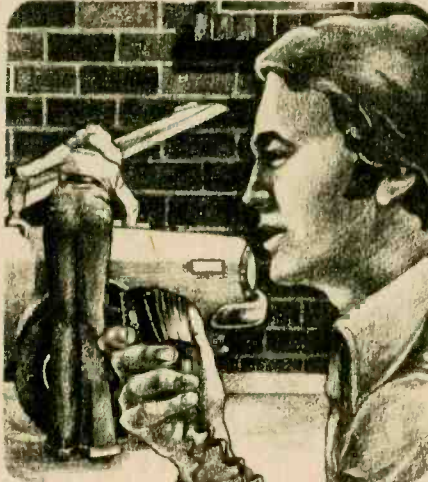
ELEMENTARY ELECTRONICS/September-October 1976

3 ways to get more mileage out of your CB radio

(and stay out of trouble with the FCC)



Keep your transmissions static-free and within the law.



Use your CB radio thoughtfully and wisely.



Learn new ways to use CB, and stay up to date on rules and procedures.

KNOW YOUR EQUIPMENT

CB RADIO CONSTRUCTION PROJECTS—Build meters, oscillators, adapters, monitors—and save a small fortune. Parts lists are featured for 18 projects to help you extend your range to the legal limits, reduce interference, and more. \$3.95

99 WAYS TO IMPROVE YOUR CB RADIO—Stop generator whine, regulator rasp, and other sources of noise and interference. Discover how to clean, troubleshoot, repair, and align equipment. This recently updated edition shows you what to buy and what to build. \$3.95

CB RADIO ANTENNAS—A good antenna lets you use to the utmost the transmission power allowed by the FCC. With this complete, up-to-date guide, you can save money by installing and improving base or mobile antennas yourself. \$4.50

CB RADIO ACCESSORIES—Here's a book full of valuable information about CB accessories ranging from speakers and mikes to emergency power sources. This abundantly illustrated guide will help you boost performance and range, while limiting static and interference. \$4.50

Build a library of these low-cost books—fill out and mail your coupon today!



GET INVOLVED

CITIZENS BAND RADIO HANDBOOK—This manual is for everyone who is seriously involved in CB radio. Useful information on licensing and equipment, servicing hints, a glossary, and a 25-page section on FCC rules are included. \$5.50

FROM CB TO HAM BEGINNER—Broaden your involvement with 2-way radio. Have fun—talk to other continents as a ham. This book offers the technical know-how you need to put your station on the air. \$4.75

Easi-Guide to CB RADIO FOR TRUCKERS—Now—in plain English—read how CB rigs can make the trucker's life more convenient. It's like having an "expert" in your cab—feeding you tips on equipment, licensing, rules, and more. \$3.50

BUILD YOUR KNOWLEDGE

QUESTIONS & ANSWERS ABOUT CB OPERATIONS—Deepen your CB know-how with 187 answers in this book. You'll find your answers fast, because they're grouped in five sections: uses, rules, procedures, equipment, and installation. \$3.75

Easi-Guide to CITIZENS BAND RADIO—Learn or brush up on the basics of CB radio the easy way—through conversational text and 170 photographs. This fun-to-read guide is packed with CB information you can really use. \$3.50

ABC's OF CITIZENS BAND RADIO—How to get your license, avoid FCC citations, choose and install equipment, and more. Even if you lack electronics know-how, this revised edition can help you get more out of CB radio. \$4.25

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CIRCLE 2 ON READER SERVICE COUPON

LATEST CB RULES CHANGES



The exact text of the changes of the FCC Rules and Regulations: Part 95—Citizens Radio Service (commonly called Citizens Band) is given below. It will be some time before the Government Printing Office can issue a revised and up-to-date issue of the Rules and Regulations. So keep this copy of **ELEMENTARY ELECTRONICS** next to your copy of the FCC Rules and Regulations for reference. The changes listed below are now in effect!

The following changes occur in Section 95.15:

Delete the old paragraph (b) and insert new paragraph (b) given below:

(b) All formal applications for Class C or Class D new, modified, or renewal station authorizations shall be submitted to the Commission's office, Box 1010, Gettysburg, Pa. 17325. An application for a temporary permit shall be made by completing and making the certifications required by FCC Form 555-B. Applications for Class A station authorizations, applications for consent to transfer of control of a corporation holding any citizens radio station authorization, requests for special temporary authority or other special requests, and correspondence relating to an application for any class citizens radio station authorization shall be submitted to the Commission's Office at Washington, D.C. 20554, and should be directed to the attention of the Secretary. Applicants for Class A stations in the Chicago Regional Area, defined in § 95.19, shall submit their application to the Commission's Chicago Regional Office. Applications involving Class A or Class D station equipment which is neither type approved nor crystal controlled, whether of commercial or home construction, shall be accompanied by supplemental data describing in detail the design and construction of the transmitter and methods employed in testing it to determine compliance with the technical requirements set fourth in Subpart C of this part.

Insert new paragraph (d) given below:

(d) A temporary permit may not be

held by an applicant already holding a Class D station license.

Alter original paragraph (d) to read "(e)."

Alter original paragraph (e) to read "(f)."

The following changes occur in Section 95.19:

Insert new paragraph (b) given below:

(b) FCC Form 555-B, *Temporary Permit, Class D Citizens Radio Station*. This form shall be used when application is made for a temporary permit.

Alter original paragraph (b) to read "(c)."

Alter original paragraph (c) to read "(d)."

Alter original paragraph (d) to read "(e)."

You're up-to-date on Part 95. 73's! ■



CB is making news all over the country and we'd like to keep you up-to-the-minute on the latest developments. But we'll need your help. Got a funny story about an experience you've had with CB radio? How about an exciting or unusual experience? Send us short (400-500 words) personal accounts of your experiences with CB. Pictures can make or break a story, so whenever it's possible, include at least one black and white glossy photo of CB in action. If you're talking about a CB gathering, get pictures of the highlights. If you're talking about an emergency or a crisis where CB played a role, get pictures to go along with your account. Even if it's a funny story, if you can, get a funny photo to illustrate it.

We'll compile the best of what we receive and we'll publish it in **ELEMENTARY ELECTRONICS'** regular column **CB Buzzin' Bee** (see page 69). We'll pay up to \$25 for each item used. Submit your stories to **CB's Buzzin' Bee**, **ELEMENTARY ELECTRONICS**, 229 Park Ave. South, New York, N.Y. 10003. Keep your eyes open, your pencils writin', your cameras shootin', and we'll get the column buzzin'—come on . . .

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PEARCE-SIMPSON

DIVISION OF GLADDING CORP.

CIRCLE 46 ON READER SERVICE COUPON

NEWSCAN

(Continued from page 26)

flash is inserted, the low-light signal is cancelled. During flash exposure, the same silicon photosensor reads the light reflected from the subject.

The integrated circuit package also provides the master control for the camera's exposure system. It measures the light reflected from the scene, and it controls the lens opening and shutter time. The shutter blades and the diaphragm are controlled by a single electromagnet. This is unusual since these functions require two electromagnets in most electronic shutters. The integrated circuit package also responds to the print (Lighten/Darken) control to extend control of exposure to situations requiring manual corrections.

When the user presses the shutter release, the exposure control package first decides whether the lens aperture should be f/11 or f/16. If the scene is bright, it chooses f/16; and as the shutter release is further depressed, the shutter opens to expose the film at 1/300 second or longer as required. If the scene requires f/11, the shutter operates between approximately 1/80 second and



engages the exposed print and moves it into the nip of the two rollers. The 1/20 second. The shutter is reset on return of the shutter release button to its initial position. At the factory, final light adjustment is made by passing a strip of acetate with increasing level of capacity over the photosensor until the electronic circuit is calibrated. The strip is then cemented in place and the excess removed. Electronic potentiometers are not necessary.

rollers then burst the activator pod and drive the print out of the camera.

In the EK6 cameras, a clutch is engaged when the user pushes the shutter release button. A high-speed motor runs at 17,000 rpm to eject the exposed print from the camera in approximately three seconds. A timing mechanism within the camera counts the number of revolutions of the rollers to provide for full ejection of the print and then electrically brakes the motor to an almost instantaneous stop. Two replaceable batteries are used, one for the electronics, and one for the drive motor. Depress a Battery Test button and a LED will light up indicating the batteries are okay.

There is much more to the Kodak Instant cameras. Get the full story by visiting your local photographic dealer for literature.



A little screwdriver twist from his master, Tom Clayton, and a pat on the back from his "half-brother" is practically all that is necessary for Robbie, the robot, to demonstrate his "inborn" programmed talents. A voice-controlled system prompts Robbie into action. No written requests, please.

This Robot Lives

Mothers, fathers, and children the world over would enjoy a friend like Robbie the Robot. He is so handy to have about the house. Robbie can help mother by making snacks of toast and percolated coffee. He can amuse the children by answering questions and playing logical games. He can comfort baby by singing a lullaby and rocking the cradle. And with a bit of surgery

As the camera ejects the exposed print, the advancing film transport slip Robbie will be able to help father relax with a game of Nim.

Mr. Tom Clayton, of Elizabeth West, Australia, built Robbie to amuse his children. Mr. Clayton is an electronic servo-systems engineer working on the design of naval guided missiles. He made the robot in his spare time in about six months using bits and pieces. Robbie's body is an old washing machine tub, his head is a cake tray, and his arms are heating ducts from a car.

(Continued on page 80)

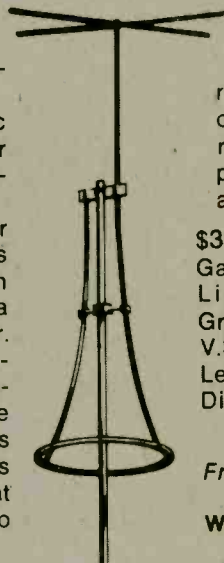
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CIRCLE 7 ON READER SERVICE COUPON

IF YOU'RE NOT DESIGNING WITH A CSC PROTO-BOARD, LOOK AT ALL YOU'RE MISSING.

Utility—Models are available with or without built-in regulated power supplies (fixed or adjustable).

Economy—Eliminate heat and mechanical damage to expensive parts. Save money by re-using components.

Versatility—Use with virtually all types of parts, including resistors, capacitors, transistors, DIP's, TO-5's, LED's, transformers, relays, pots, etc. Most plug in directly, in seconds.

Durability—All Proto-Board models are carefully constructed of premium materials, designed and tested for long, trouble-free service.

Expandability—Proto-Board units can be instantly inter-connected for greater capacity.

Visibility—All parts are instantly and easily visible, for quick circuit analysis and diagramming.

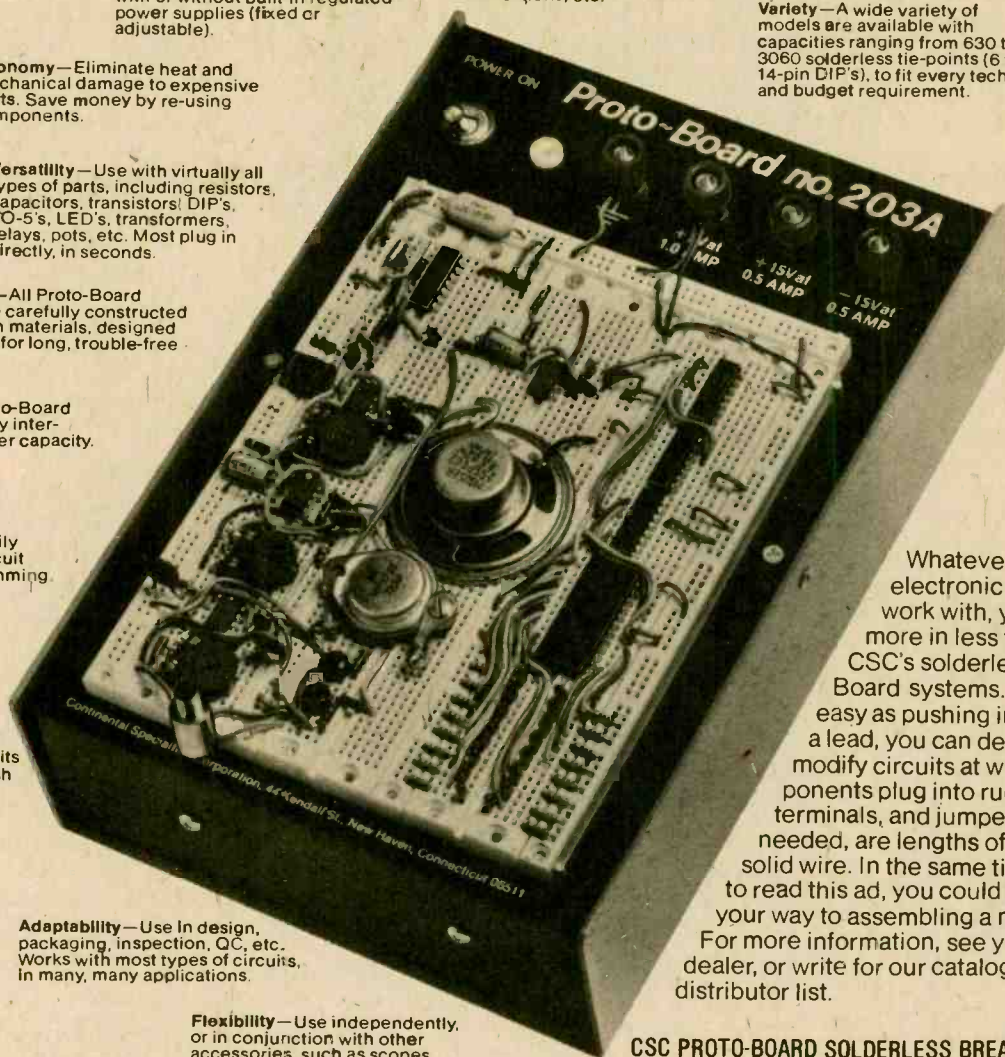
Speed—Assemble, test and modify circuits as fast as you can push in or pull out a lead. Save hours on every project.

Adaptability—Use in design, packaging, inspection, QC, etc. Works with most types of circuits, in many, many applications.

Flexibility—Use independently, or in conjunction with other accessories, such as scopes, counters, CSC Proto-Clip™ connectors, Design Mate™ test equipment, etc. One Proto-Board unit can serve a thousand applications.

Accessibility—All parts are instantly and easily accessible, for quick signal tracing, circuit modifications, etc.

Variety—A wide variety of models are available with capacities ranging from 630 to 3060 solderless tie-points (6 to 32 14-pin DIP's), to fit every technical and budget requirement.



Whatever type of electronic circuits you work with, you can do more in less time with CSC's solderless Proto-Board systems. As fast and easy as pushing in or pulling out a lead, you can design, test and modify circuits at will. Components plug into rugged 5-point terminals, and jumpers, where needed, are lengths of #22 AWG solid wire. In the same time you took to read this ad, you could be well on your way to assembling a new circuit. For more information, see your CSC dealer, or write for our catalog and distributor list.

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PB-103	2250	24	59.95	Even larger capacity; only 2.7¢ per tie-point
PB-104	3060	32	79.95	Largest capacity; lowest price per tie-point
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CIRCLE 38 ON READER SERVICE COUPON

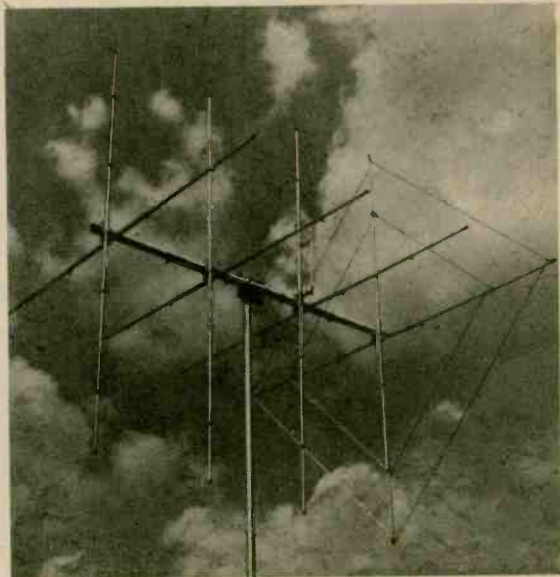
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CIRCLE 35 ON READER SERVICE COUPON

DX central reporting

A world of SWL info!

BY DON JENSEN

□ DXers have their own special jargon, a combination of abbreviations, acronyms, "buzz" words, and "in" language. In this regard, they aren't much different from any other special interest or hobby group. However, to the uninitiated outsider DX jargon is largely unintelligible, but to experienced short-wave listeners it's just part of the game. (Hey, did you ever get together with a passel of philatelists or a bunch of beer can collectors? Now those guys I *don't* understand!)

Why the special DXer lingo? Part of the answer focuses on the shorthand aspect of the jargon. It is a lot more convenient to say, or write, "GMT" rather than spell it all out; Greenwich Mean Time. And "SWL" is a lot snappier than "shortwave listener."

I suspect that another reason is that, way deep down, we all like to add a bit of mystique to any hobby or other interest we are deeply devoted to. If that sounds strange, so be it. But rather than fight it, you might as well learn the lingo, DX-ese, so you, too, will know what's going on.

Here at DX Central we try to stick to a few of the simpler abbreviations and jargon words; like the aforementioned GMT and kHz (for kilohertz). But if you're a member of one of the various hobby DXing clubs (if you're not, and you're serious about your SWLing, you should be) you've probably had a full dose of this special DX language.

Here's a typical news item from a DX club bulletin:

"4926, Colombia, Em. Meridiano 70, 0035-0102*v SS, lively LA mx, EE & SS anmts at s/off, asks ofrrpts and off w/NA."

Freely translated, this means there is a Colombian station on 4,926 kHz, *Emissora Meridiano 70* by name, which was heard from 0035 hours Greenwich Mean Time until it signs off at about 0102 Greenwich Mean Time. The asterisk means the sign off (when the asterisk proceeds, rather than follows a time reference, it indicates sign *on* time)—the small letter "v" indicates the sign off time varies a bit from day to day.

(Continued on page 94)

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CIRCLE 5 ON READER SERVICE COUPON



**Ask Hank,
He Knows!**

Boooooooom

I would like to offer a solution to the problem of electric fuel pump noise in R.L.'s Vega. First, remove the gas tank to get to the top of the fuel pump. From the "hot" terminal of the fuel pump, solder a .001 micro-farad capacitor to ground. Also, solder another .001 mf capacitor from the fuel gauge terminal to ground. Then replace the tank in the reverse procedure of removal. I have tried all kinds of external capacitors with no success at all. Do it my way and you'll clean up the noise in Vegas and Toyotas.

—L. M., Roper, NC

Old Hank suggests you empty the fuel tank first and eliminate all gasoline vapors. I once knew a garage man who put a pint of alcohol into the tank, sloshed it around and emptied it. He said alcohol fumes don't explode. Me? I'd fill the tank with water.

Instant CB License

Our company uses 3-channel walkie-talkies for warehouse to office communications. Lately I've been hearing strange CB call signs like KBG07312. Now the rules say three letters and four numbers for a CB call. Has the FCC used up all the possible four-number call signs?

—D. M., Newark, NJ

No, what you are hearing are the new temporary call signs. They all start with the letter "K." The next two letters are the operator's initials and the five digits, or numbers, are his zip code number from his home address. If you know of anyone who is filing for his CB license, ask him to call his local FCC office for details or look into the July/August 1976 issue of ELEMENTARY ELECTRONICS.

Electron Pollution

There is a blemish on the CRT (cathode ray tube) of my oscilloscope. Can you tell me what caused this?

—S. A., San Rafael, CA

It's a burn spot. The electron beam continues to be generated by the hot filament and residual focusing voltages aiming the intense beam at the same spot each time you turn off the scope. This is common with old units. Do what I do: twist the focus control to fuzz the beam before you turn it off. This will prevent the spot from
(Continued on page 40)

Got a question or a problem with a project—ask Hank! Please remember that Hank's column is limited to answering specific electronic project questions that you send to him. Personal replies cannot be made. Sorry, he isn't offering a circuit design service. Write to:

**Hank Scott, Workshop Editor
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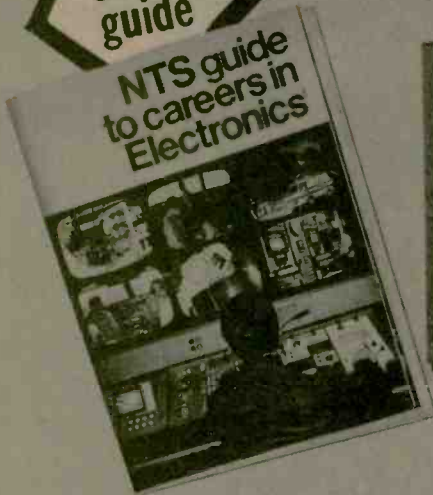
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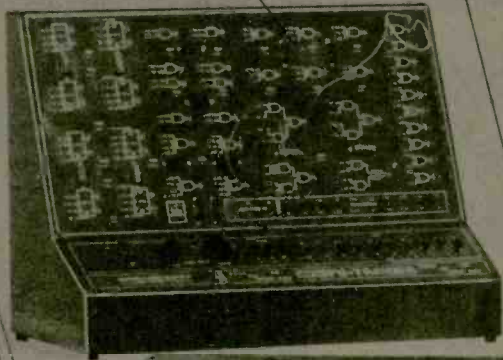
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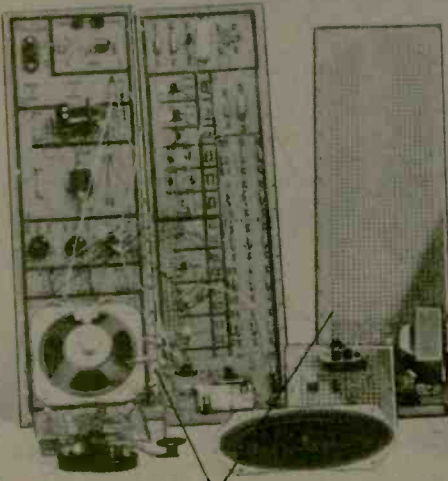
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ASK HANK, HE KNOWS!

(Continued from page 34)

forming. Once the spot appears it cannot be removed, because the spot is the point where the phosphor evaporated off the inside surface of the CRT.

Ear Trouble

The audio output from my receiver is low. Would the "DX in Comfort" head-phone adapter (page 80, November, December 1975 ELEMENTARY ELECTRONICS) pep it up?

No. It's a passive circuit that actually burns up power. Your problem is in the

New INTERNATIONAL broadband amplifier

MODEL 150-299



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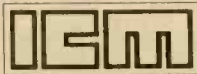
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receiver. It should deliver enough signal to pop the cans right off your head.

The Improbable Dream

I own two Bearcat III scanners, both have 8 channels each and operate in the 150-174 and 450-470 MHz band. My problem is I would like to combine them so they would work on the same principle of a 16 channel scanner, scanning together instead of two separate units. Who can help me?

—J.N., Rochester, NY

Try your local monitor radio dealer who may offer you a trade-in.

Any Way You Like It

Can you tell me if the base 1 and base 2 orientation in a UJT (unijunction transistor) is essential, or if base 1 and base 2 are interchangeable?

—W.H., Peninsula, OH

It's okay to switch them if you wish. Think of them as an audio amplifier with two input jacks on the same channel.

Double Trouble

Hank, I have two questions. 1. When you use someone else's CB rig, whose call sign do you use—yours or his? 2. Where can I get a complete and accurate listing of the 10-code and a good book on CB slang?

—M.F., Bellevue, NE

1. You must use the call sign of the station's owner who has posted the necessary identification at the transmitter. If you have a copy of your license in your pocket, then you may use your call. 2. Look for copies of our 1976 CB BUYERS GUIDE, CB LINGO, or CB DIGEST. We may have a few at the office, if you can't find any of the newsstand!

Struck Down by Part 95

I have a problem. I have a CB radio with a burned-out modulation transformer. The manufacturer no longer carries the parts for this old set. How do I fix it?

—F.K., Cohasset, MA

You don't, because it's against the FCC rules. Only a technician with at least a 2nd class radio telephone license can repair the rig. You see, the modulation transformer is considered part of the transmitter circuit.

More Power to You-

Is it possible to increase the input power of an AM receiver and how can it be done?

—C.M., Key Largo, FL

You can't increase the power of an AM receiver, or any receiver for that matter. What you want to do cheaply is deliver more signal to it! Invest in a long-wire antenna and an AM pre-selector or pre-amplifier.

Old Fashioned CB

Should I hold off until the 50-channel sets are available or should I settle for the old fashioned 23-channel rigs?

—L.K., Austin, TX

What do you mean by "old fashioned?" That's what is in vogue today and don't

believe those wild rumors about 40 and 50 channel sets. I know a guy who is holding out for 3-D TV for the last two years because he read about it in a magazine article. Get on CB today, the old fashioned way, and enjoy the third world of two-way communications.

Help 'Em Out

Okay, readers, lend a hand to those who need it. Below are listed names and addresses of readers who need assistance. If you can help, write to them:

Δ Schematic for and specs for Barker & Williamson 5100 shortwave transmitter; Robert Ferguson, Stone End Lodge, Sunapee, NH 03782.

Δ Copy of manual and schematic for Hallicrafters S-38E shortwave receiver; Robert Fraser, 50 Todd Rd., Cohasset, MA 02025.

Δ Schematic of General Motors 150-A radio/phono; Charles Ball, Route 3, Box 618, Proctorville, OH 45669.

Δ Schematic and alignment info on AM/FM (RO 59-01-00, 700771-2) Magnavox tuner; Joseph N. Petric, 333 Water St., Apt. D-4, Kerrville, TX 78028.

Δ Schematic for Stromberg-Calsion, serial #153096; Bernard J. Venasse, 135 Sherbourne St., Toronto, Ont., Canada M5A-2R5.

Δ Manufacturer's address for Proton Magnetofon stereo, model 94; Fred Freeman, 233 Water St. No., Cambridge (G), Ontario, Canada N1R-3B9.

Δ Schematic for Dewald R1050 CB transceiver; Grant L. Jackson, 3002 No. 12th St., Tampa, FL 33605.

Δ Schematic for Hallicrafter SX42 shortwave radio; George C. Deems, 416 Sleepy Hollow Rd., Richmond, VA 23229.

Δ Diagram and service data for Contact 23 CB transceiver; Thomas L. Weatherly, Route 2, Box 189B, Burlington, NC 27215.

Δ Knight KG-221 VHF receiver plus crystal calibrator to mate with Knight R-100A receiver; Lee Randall, P.O. Box 746, Kingston, TN 37763.

Δ Two 1LN5 and two 1LD5 vacuum tubes, will swap with other tubes; Jacques Guertin, 129 Mountain St., Aylmer, Que., Canada J9H-4A7.

Δ Schematic for Atwater-Kent "Tunomatic" W900 receiver; John J. Hagen, Jr., 1348 Washington St., Carlton, MA 02021.

Δ Magnetic recording wire for Webster-Chicago 80-1 wire recorder; Stephen Walrabenstein, Box 82, RR #1, Clifton, IL 60927.

Δ Schematic for General Electric G-99 radio; Keith Thomas, PSC Box 4851, Robins AFB, GA 31098.

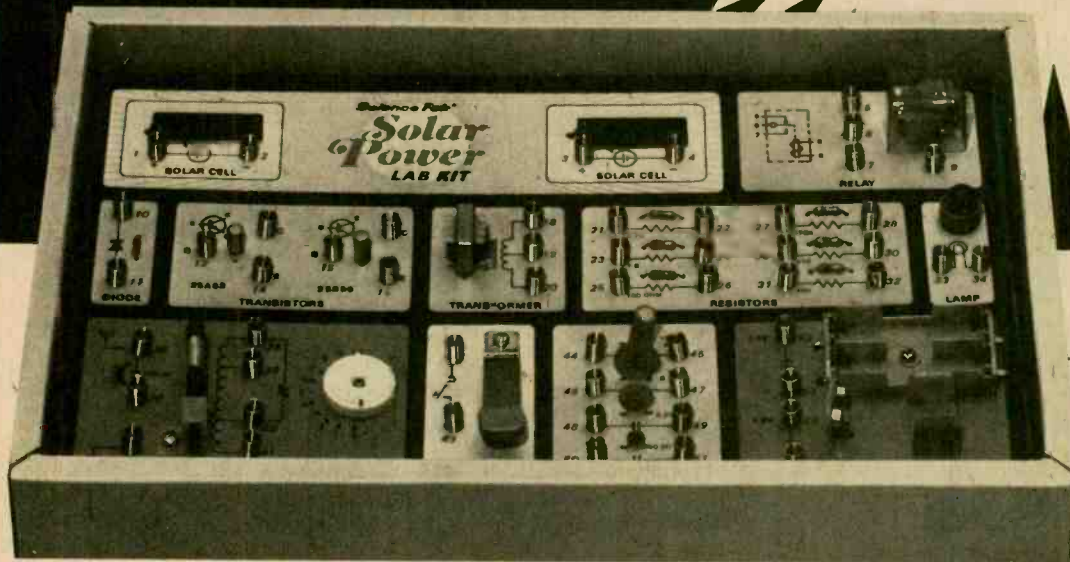
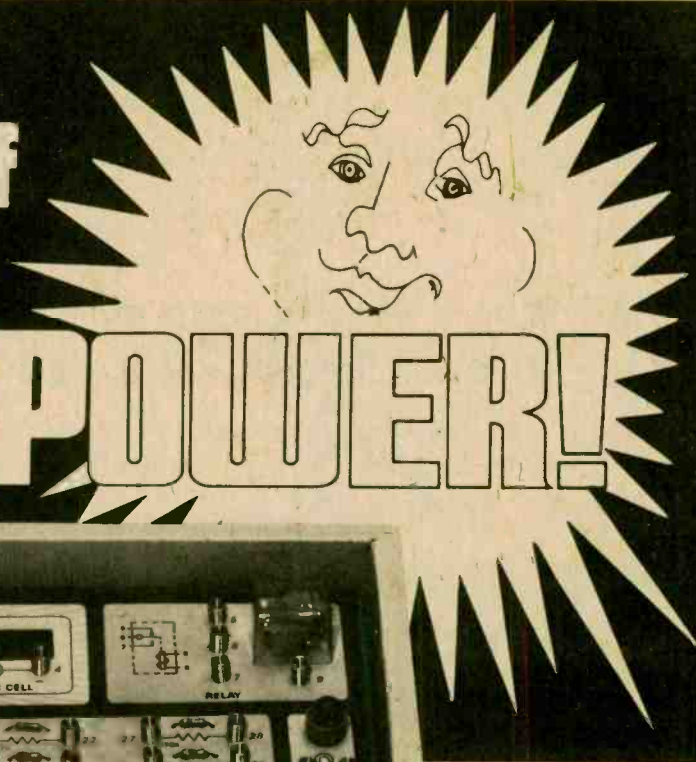
Δ Schematic for Sun oscilloscope, model SS-1 (made in 1960-1); Lee Goodwin, 677 West Ave., H-8, Lancaster, CA 93534.

Δ Schematic and service data for Philco 41-295 4-band receiver; Marty Jackson, 20 Colfax Ave., Midvale, NJ 07465.

Δ Information on "FM-1000" tube in Philco 46-1213 AM/FM/SW receiver; Paul Salzigor, 30 E. Northside Dr., Battle Creek, MI 49017. ■

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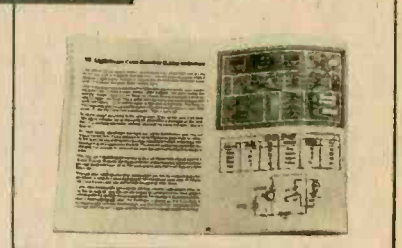
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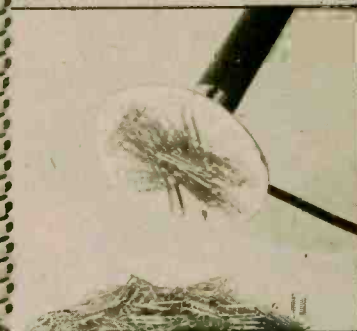
magnetic mount on any ferrous metal flat surface. A non-rubber mounting pad



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equally easy to tuck your ears out of sight. Which helps to avoid another kind of rip-off when your car, truck or camper is unattended. A Signal Kicker magnetic mount on your vehicle is a secure solution. See for yourself.

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MARK TIME INDICATOR USES YOUR OWN CALCULATOR



Time seconds, minutes, hours, or what-have-you--or count up or down to 9,999,999--with this inexpensive adaptor for common calculators.

by Robert Way

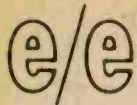
□ BUILDING THIS MARK TIME INDICATOR is an easy way to get an event timer using a pocket calculator as the readout device. You can use any low-cost calculator (or a better one) that you happen to own with *Mark Time Indicator* (which we'll call *MTI* from here on). *MTI* drives the calculator to read minutes, seconds, or half-minutes/seconds, as well as many other intervals you can readily program it to indicate. Your calculator continues to work just as it did before, and is connected to *MTI* only by a small jack you install in the calculator. When not in use as part of *MTI* you disconnect the calculator by just pulling out the jack.

In addition to using *MTI* to clock off seconds or minutes it can be set to a predetermined number of seconds (or minutes) and subtract them one at a time or ½-sec. or ½-min.) until it gets down to zero. Further, it can even work with negative numbers, clocking as many as you want,

starting at zero and going toward -9,999,999—one at a time! It can also add in increments of 2, 3, 5, or any other amount you choose, clocking away at any of the four time intervals you desire.

This means your *MTI*, if set to count minutes, one at a time, could count for 9,444 days, or 190 years—provided the batteries were replaced with an AC-powered supply. Since it's unlikely most readers will want to count such periods of time we've settled for internal batteries as the power source.

MTI's Advantages. A digital interval timer usually costs several dollars per digit to build, and involves assembling a time base, counters, latches, drivers, and the readout (display) device. But it's easy and inexpensive to build *MTI* if you have a pocket calculator such as the Radio Shack EC-220 which has the auto-constant feature (most calcu-



MARK TIME INDICATOR

lators do). MTI finds many uses in the darkroom, at sporting events, for timing long distance calls, cooking eggs, or even guarding against sunburn at the beach. Some of the advantages and features of MTI are:

- It's portable, and battery-operated.
- It has a capacity that's very large: 9,999,999 seconds, or minutes.
- It counts either up or down.
- The time interval can be interrupted and restarted, without going back to zero, plus other operating variations.
- You can choose any of four timing intervals via switches (many more, by internal adjustment).
- Accuracy is close to one percent.
- It's easy to build—only four ICs, six resistors, and two capacitors.

You have to make just one simple modification to the calculator, and that doesn't affect the normal operation of the calculator in any way.

Check Your Calculator. Before making the single modification you need to use your calculator as the readout for MTI, you should double-check that your calculator has the auto-constant feature (most do) which is necessary to let it work as part of your MTI.

To verify the calculator's counting operation, proceed as follows:

Press the + and 1 keys, and then press the = key several times. After the first time you should get an increase in the number displayed by one each time you press the = key. To read upward starting at zero, enter -, 1, +, 1, = to read 0. Now pressing = will count up by one, but it will start at 0.

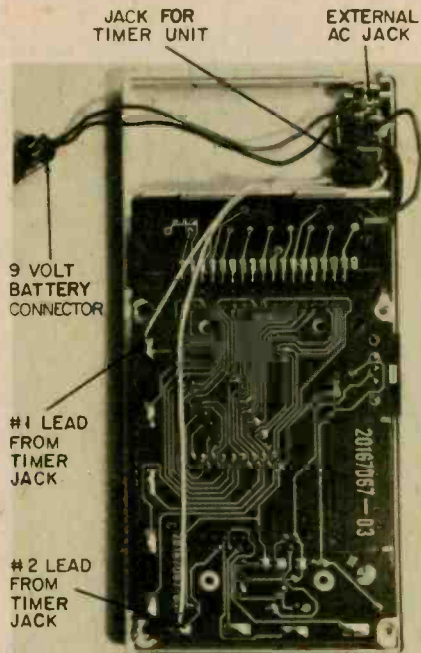
To make the calculator count down, enter any number, then press the - and 1 keys. Now each time you press the = key, the calculator display will count down one digit at a time. All of the above steps take less time to perform than to describe, and after playing with your calculator for a few minutes you won't even have to think about the sequence. The timer circuits in the MTI electronically complete the = operation each second, half-second, minute or half-minute.

If the above steps all work out on your calculator you may be assured your calculator will work as the readout for MTI. Go ahead now with the simple modification to your calculator so it can display the time intervals as they are ticked off by MTI.

Calculator Modification. Modification requires merely adding a subminiature phone jack which is connected to two terminals of the circuit board inside the

calculator. These are the terminals which connect to the = key on its keyboard.

If you have a Radio Shack EC-220 calculator you can follow these modification steps exactly. If you are adding the jack to some other calculator the steps may be slightly different but the result is the same—to put the terminals of the small phone jack in parallel with



Radio Shack EC-200 calculator, back removed, showing the two leads which are paralleled with = key going to small jack for MTI. Note that IC3 mounts on a smaller board (or DIP mount, with pins bent flat). Main board is Radio Shack's 276-151.

the terminals connecting to the = key of your calculator.

Slide off the battery cover, and remove and disconnect the battery. Unscrew the four Philips screws from the back and remove the back from the main body. Locate the rows of large solder tabs along the left and bottom edges of the circuit board (see photo). There are 5 of these tabs along the left edge, corresponding to the 5 horizontal rows of calculator keys, and 4 tabs along the bottom edge, corresponding to the 4 vertical rows of keys. Solder a 6½-in. length of insulated hookup wire to the left-hand tab along the bottom, and a 4-in. wire to the other top terminal. Be sure to connect these two wires as described, and as shown in the schematic diagram. If they are reversed you won't hurt anything, but MTI won't work. Similarly, if the two wires which go from the MTI to the tiny plug which mates with the jack in your calculator are reversed, it won't work. So be careful with the connections.

Finally, mount the jack to the top cover of the calculator, just beneath the AC power jack (as shown in the top right-hand corner of the photo) by drilling a 5/32-in. hole in the top cover and bolting it on with the nut provided with the jack. This is best done by temporarily dislodging the wires connected to the AC adapter jack, positioning the added jack beneath it to locate the hole to be drilled, and drilling from the circuit board side. Reconnect and replace the battery, and replace the back cover. Solder two 10-in. lengths of insulated wire to the subminiature phone plug, insert it in the jack, and turn on the calculator. Set up the calculator to count, as previously described, and touch the loose ends of the plug wires together; each time the wires make contact, the calculator display will increase by 1. This completes the calculator modification, and the calculator can be set aside until you complete your MTI.

Other Calculators. If you're working with a calculator other than the one shown in our modification, determine which of the two leads from the = key is the more positive (or less negative). Be sure to connect the more positive one to the center connector of the subminiature phone plug.

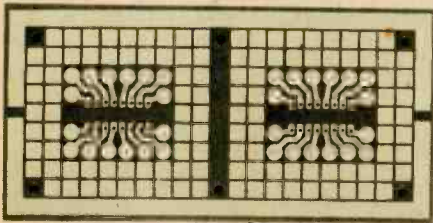
How MTI Works. The timer circuit starts when capacitor C1 (or C2, depending on the position of switch S2) is discharged, and the output of IC1 (at pin 3) is low. At the beginning of a timing cycle (initiated by pressing S3), the output at pin 3 goes high, and C1 (or C2) starts to charge up toward the battery voltage (6 volts) through R1, R2, and R3 (or R4, R5, and R6). When the charge on C1 equals 2/3 of the battery voltage, pin 7 of IC1 goes to ground and the capacitor discharges through R2 & 3, or R5 & 6. At this instant the voltage at pin 3 goes low. When the charge on C1 has fallen to 1/3 of the battery voltage, the cycle repeats. Hence the timing cycle consists of C1 alternately charging and discharging between 1/3 and 2/3 of the battery voltage. However, at the very first cycle the capacitor is at ground potential and must rise from 0 volts to 2/3 of the battery voltage, while on succeeding cycles C1 only has to charge from 1/3 to 2/3 of the battery voltage.

IC1 Runs Continuously. With switch S2 in the upper position IC1 puts out 120 pulses-per-minute (ppm). These pulses, every half-second, are counted in IC2, a divide-by-ten counter, and also by IC3, a divide-by-12 counter. When 60 pulses are counted, pin 9 of IC3 goes high, and a half-minute pulse is passed through IC4 to the calculator, if S4 is in the lower position a one-

minute pulse is fed to IC4 and thence to the calculator.

If switch S2 is in the lower position, R4, R5, and R6 cause IC1 to send out pulses at the rate of 120 pps (pulses-per-second) and half-second pulses occur, after 60 counts, at pin 9 of IC3. One-second pulses appear at pin 9 of IC3 after 120 counts.

Starting and stopping MTI is accomplished by S3, which grounds or ungrounds pins 2 and 3 of IC2 and 6 and 7 of IC3, which are the reset-to-zero terminals of the counters. The counters count when these pins are grounded, and are inhibited from counting (and reset to 0) when these pins are allowed to go high (are ungrounded). Note that S3 is a DPDT switch—since only one set of contacts is needed for the timer circuit, the other contacts are available to switch an external device simultaneously with starting and stopping the time. The author uses this set of contacts to turn his enlarger on and off precisely when the timer is started and stopped.



Experimenter's printed circuit board from Radio Shack is convenient mount for MTI's parts, which go on the blank, (non-foil side of board. When you mount the components trace all connections carefully, referring frequently to schematic diagram.

Since both terminals of J1 (at the calculator) are above ground potential during switching, connecting either of them directly to the output of IC3 would interfere with the counting action. IC4 provides the necessary electrical isolation between the calculator and IC3.

Opto-Isolator. IC4 is an opto-isolating device consisting of two parts. First there is a light-emitting diode (LED) which produces light pulses when it is driven by pulses of current from terminal 8 or 9 of IC3. These light pulses fall on the base of a light-sensitive transistor in IC4, whose output is taken from terminals 4 and 5 of IC4. Actually there is no "output" from 4 and 5 of IC4. It is built so that light rays from the LED in it fall on the base of the transistor, biasing it *On* or *Off*. When the LED is *Off* (or dark), the emitter-to-collector resistance of the transistor is extremely high (effectively an open circuit). When the LED is energized,

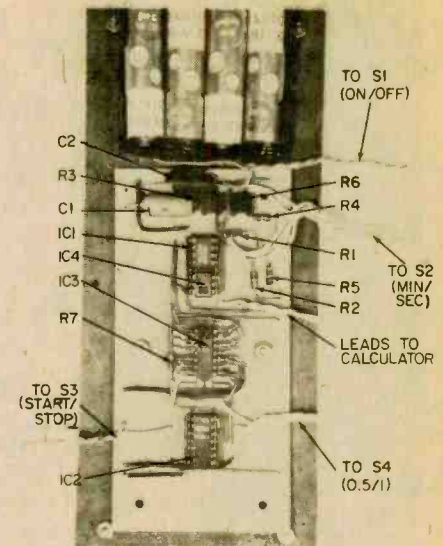
the emitter-collector junction resistance drops to a moderately low value (around 1000 ohms). This emitter-collector junction acts like a diode, and if voltages of the proper polarity are applied to the emitter and collector, current will flow through the junction. In other words, it will act like a closed switch. Since the transistor in the opto-isolator is NPN, a positive voltage must be applied to the collector and a negative voltage to the emitter. In the case of the Radio Shack EC-220 calculator = key leads, both of the voltages are negative (as measured with respect to the battery + terminals, which is the ground for this calculator). However, one of these voltages is less negative (more positive) than the other, and that one is connected, through the plug, to the collector of the isolator transistor, and the other, more negative, voltage goes to the emitter.

Other Calculators. The MTI output circuit as shown (using Opto-isolator IC4) works well with the Radio Shack calculator and others with = keys having similar voltages. However, some calculators have been found to require a small relay in place of IC4. If this should be the case (checking first to be sure that the Opto-isolator is clocking signals out properly) you can substitute either of two relays for IC4, as shown in the Parts List.

One is a standard mechanical relay sold by Radio Shack. The other is smaller, and costs less, but is not as readily available. It's a low-voltage, low-current relay made in the shape of a little cylinder about 1-in. long by 3/8-in. in diameter, and has stiff wire leads, about 3/4-in. long projecting from either end—these are the SPST contact connections of the relay. At one end of the cylinder, one white and one black stranded wire, about 2 3/4-in. long protrude—these are the relay coil connections. Assemble the relay and diode in place of IC4, using the IC socket for convenience. R7 is eliminated, too.

Construction. The circuit of MTI is built on a Radio Shack experimenter's circuit board, with the parts placed as shown. The etched side of this board, in addition to solder tabs for the IC pins, has several rows of large square solder tabs, and 2 bus strips for power Vcc and ground. The various components in MTI are connected by being soldered to the same square tab, or via jumper wires soldered between the tabs. These jumpers are visible in the photo. All the ICs are oriented so that pin 1 is at the upper left as viewed in the photo.

The connections between pins 2 and 6, and between 4 and 8 of IC1 were made by burning the insulation off the



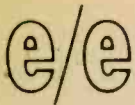
The four ICs, two capacitors, and six resistors mount easily on the non-foil side of circuit board. Trace out connecting leads between the parts carefully.

ends of short lengths of varnish-insulated #28 wire, bending them into a "U" shape and inserting the ends of the "U" into the appropriate holes from the top of the board before soldering in the IC socket. IC3 is mounted to a separate mini-board, which has an adhesive backing, permitting it to be stuck to the main board. If the Calectro board shown in the prototype is not available you may substitute the Radio Shack printed circuit board listed.

It's a good idea to use stranded hookup wire to connect the switches and the phone plug to the printed circuit board because it's much less likely to break from the flexing and handling it must take during construction and adjustment. Also note that switch S4 must have a middle position which is *Off*.

The timer case was made of light sheet aluminum, pop-riveted to short lengths of aluminum angle iron. The bottom of the case was a piece of masonite, and the circuit board, battery case, and a set of rubber feet mounted to it with size 4-40 hardware. However, the case is not essential. You can build the circuit on the printed circuit board listed in the Parts List, or even breadboard it if desired, and place the calculator on the bench beside it for connecting it to MTI.

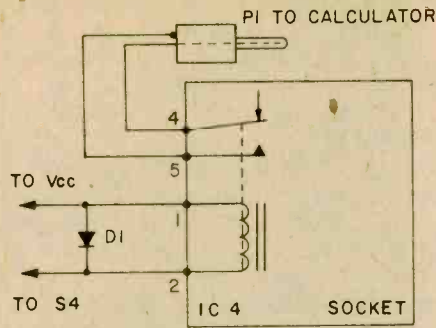
Calibration. When construction is finished plug in the batteries and plug the subminiature phone plug into the calculator's jack. Press the + and 1 keys of the calculator and the *Start* button on MTI. R3 and R6 must be adjusted so the IC1 produces output pulses at intervals of 0.5 second and 1/120 second, respectively. The divider chain (IC2-



MARK TIME INDICATOR

IC3) will function if it is wired correctly. The best way to adjust R3 and R6 is with a frequency counter, but another method will suffice if no counter is available. To adjust R3 without a frequency counter, place S2 in the upper (min.) position and temporarily connect a jumper wire between pin 3 of IC1 and the center terminal of S4, thus bypassing IC2 and IC3. MTI will now count by half-seconds, and you can use the following method of calibration.

You'll need a clock or watch with a sweep-second hand, and some patience. Set R3 to its midrange and start the timer. With the calculator display and the sweep-second hand both within your field of view, note the calculator readings at the beginning and end of 30 seconds (60 counts). Better to let



Some calculators may require a small relay in place of IC4. Assemble relay and diode right in socket otherwise used for IC4.

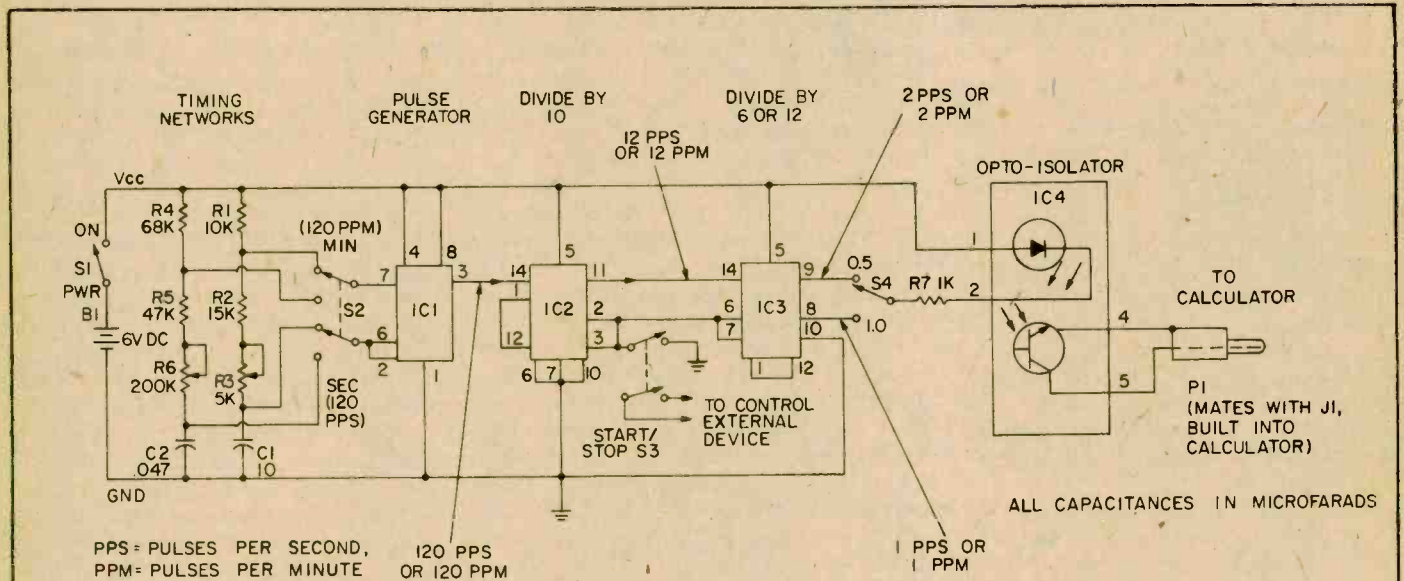
the timer run continuously than to try to start and stop it for a 30-second period because your own reaction times will add some definite fractions of a second to the interval you're trying to time. Note whether the timer is running fast or slow, and rotate R3 no more than a quarter of an inch, and

time another 30 seconds. It will take several tries to determine which way R3 must be turned to slow down or speed up MTI. When you find the R3 position that makes your timepiece and MTI agree pretty well, try several more adjustments at a one-minute period.

After something like a dozen adjustments my MTI gained less than 1 second in 2 minutes, an error of under 1 part in 120. In a subsequent check with a frequency counter, the period measured 0.994 seconds (frequency of 1.006 Hz). This reading varied ± 1 count about every 30 seconds.

When R3 has been adjusted and the jumper wire is removed, half-minute and one-minute pulses are obtained, according to the position of S4. Now you can proceed with the adjustment of R6.

Place S2 in the lower (sec.) position and use the sweep-second hand procedure. (Continued on page 100)



PPS = PULSES PER SECOND, PPM = PULSES PER MINUTE

NOTES:

PPS = PULSES PER SECOND, PPM = PULSES PER MINUTE
ALL CAPACITANCES IN MICROFARADS

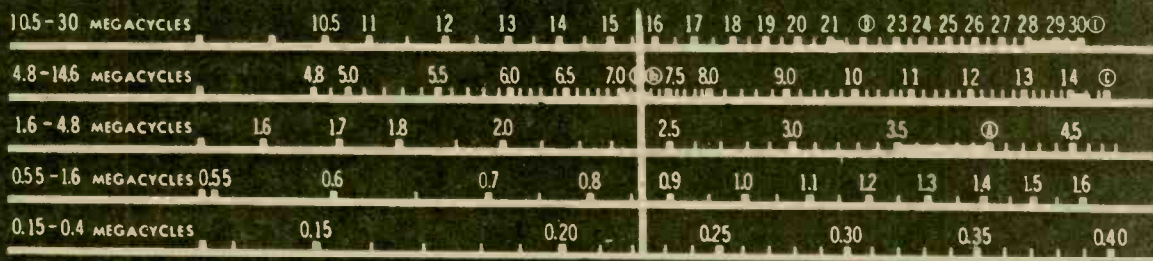
PARTS LIST FOR MARK TIME INDICATOR

- C1—10- μ F, 15-V or more electrolytic capacitor (Radio Shack 272-1002 or equiv.)
- C2—0.047- μ F, 50-V or more disc capacitor (Radio Shack 272-1052 or equiv.)
- IC1—555 Timer chip, TTL (Radio Shack 276-1723 or equiv.)
- IC2—7490 divide-by-10 counter chip, TTL (Radio Shack 276-1808 or equiv.)
- IC3—7492 divide-by-12 counter chip, TTL (Radio Shack 276-1819 or equiv.)
- IC4—Opto-isolator chip, TTL (Radio Shack 276-1723 or equiv.)
- D1—General purpose diode for shunting coil or relay. (Radio Shack 276-1620 or equiv.)
- R1—10,000-ohm, 1/2-watt resistor (Radio Shack 271-000 or equiv.)
- R2—15,000-ohm, 1/2-watt resistor (Radio Shack 271-000 or equiv.)
- R3—5000-ohm miniature potentiometer (Radio

- Shack 271-217, Allied Electronics 854-6127, or equiv.)
- R4—68,000-ohm, 1/2-watt resistor (Radio Shack 271-000 or equiv.)
- R5—47,000-ohm, 1/2-watt resistor (Radio Shack 271-000 or equiv.)
- R6—500,000-ohm potentiometer (Radio Shack 271-221, Allied Electronics 854-6180, if 200K not available)
- R7—1000-ohm, 1/2-watt resistor (Radio Shack 217-000 or equiv.)
- RY1—SPST electromagnet relay, 6-9 VDC coil, resistance 500 ohms, current 8-12 mA, (Radio Shack 275-004 or equiv.), or miniature reed relay SP-37A, available from Meshna Electronics, Box 62, E. Lynn, MA 01904.
- S1—SPST toggle switch (Radio Shack 275-324

- or equiv.)
- S2—DPDT toggle switch (Radio Shack 275-1546 or equiv.)
- S3—Push-on, push-off DPDT switch (Radio Shack 275-1561 or equiv.)
- S4—SPST, center-off switch (Radio Shack 275-325 or equiv.)
- Misc.—Experimenter's printed circuit board (Radio Shack 276-151 or equiv.), miniature phone plug (Radio Shack 274-289 or equiv.), miniature phone jack (Radio Shack 274-275 or equiv.), 16-pin DIP socket (Radio Shack 276-1998 or equiv.), 14-pin DIP socket (Radio Shack 276-1999 or equiv.), mini-mount IC board (Calectro J4-784 or equiv.), battery holder for four AA cells (Radio Shack 270-391 or equiv.), AA cells (four required—Radio Shack 23-468 or equiv.)

THE SECRETS OF SPLIT-FREQUENCY DX



There's good medium-wave DXing on the standard broadcast band if you know where to look—and when.

by C. M. Stanbury, II

IT'S A SAFE BET that if you're into electronics at all, you have fooled around with DX (long distance) reception of medium wave AM broadcast stations. And you probably thought it quite an accomplishment when a station from the opposite side of the continent showed up on your dial, at least until you heard about other DXers who have logged 50 or more countries on the regular AM broadcast band. How do they do it? Simple, they chase stations from the other side of the continent which lie between some of the 10 kHz channels assigned to U.S. broadcasters by the FCC. For example, if this evening you tune to 1265 kHz, chances are at least 50/50 you will hear *Radio Paradise* on tiny St. Kitts in the West Indies—because no other station in the world operates on exactly that same frequency!

Caribbean Mini-States. St. Kitts is one of nine "associate states" which formerly made up the British Leeward and Windward Island colonies. Britain still controls their defense and foreign policies but all "states" have the power to license radio stations—and on split frequencies if they wish. Needless to say, any group interested in reaching an international audience on the AM broadcast band in this part of the world is likely to approach one or more of these governments for permission to set up a station. Since Caribbean locations are not bothered by ionospheric disturbances, they are especially attractive as broadcasting sites. In fact tropical locations benefit from such disturbances because they reduce interference from upper and mid latitude stations.

Radio Paradise is an American-owned religious station: a great deal of the money going into international broadcasting all over the world these days is raised by evangelical organizations. *Radio Paradise* broadcasts entirely in English and its schedule includes a number of programs also heard on U.S. AM broadcast and shortwave stations. The operation began in the mid 1960s as PJD2 on the Dutch island of St. Maarten with 5 kw. It switched to the present 50 kw St. Kitts transmitter just

before Christmas of 1972 and, according to a report aired by *Radio Sweden*, a further power boost is now in the works. If that happens, U.S. stations on 1260 and 1270 kHz may have something to complain about.

A second split-frequency station which the novice DXer can look for is *Caribbean Radio Lighthouse* at St. Johns, Antigua on 1165 kHz. This is another religious station which went on the air with 10 kw late in the summer of 1975. It should be especially good in the east except in the Wheeling, West Virginia and Montgomery, Alabama areas.

Both *Radio Paradise* and *Caribbean Radio Lighthouse* are audible in many parts of the U.S. on the simplest of receivers. But if you own a communications-quality receiver, or something approaching it, you should also try for *Radio Grenada* on 535 kHz, *Radio Dominica* on 595 kHz, *Radio Montserrat* on 885 kHz, and *Radio Anguilla* on 1505 kHz. Each of these stations is owned by its respective government.

Central America. Another major split-frequency operation in this hemisphere with extensive English language programming is *Radio Belize* on 834 kHz. Although it has only 20 kw as compared with *Radio Paradise's* 50 kw, *Radio Belize* is just as widely heard because there is less adjacent channel interference. At night in the continental U.S. and Canada, DXers only have to contend with WCCO, 830 kHz, Minneapolis, and WHAS, 840 kHz, Louisville. Belize is the former colony of British Honduras and currently a British dependency, as are the Caribbean

Glossary of DX Terms

DX—Distant and/or difficult to hear radio stations.

DXing—Listening to such stations as a hobby.

Medium Wave—The band of frequencies found on your regular AM radio dial, 540 to 1600 kHz.

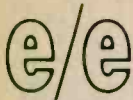
Split Frequency—The frequencies between the 10 kHz channels assigned by FCC for use by U.S. broadcasters.

Communications Receiver—A receiver designed for reception of voice or code signals from stations operating in the various communications services from 1.6 to 30 MHz, i.e. marine radio, point-to-point, land mobile, amateur and international broadcasting.

Adjacent Channel Interference—Undesired signals received on one frequency from a transmitter operating on a frequency immediately above or below.

Ionospheric Disturbance—Change in the part of the earth's outer atmosphere (ionosphere) that affects transmission and reception of radio signals.

QSL—A card or letter used to confirm listener's reception reports. Also exchanged by radio amateurs to confirm contacts with each other.



DX Secrets

mini-states. Belize would be fully independent if it were not for neighboring Guatemala's claim to the territory. Because of this situation, *Radio Belize*, a government station, could provide some very newsworthy listening in the near future.

But the most interesting split-frequency station of all is the one now calling itself *Radio Million*. The station is well-named as it uses a million watt transmitter near San Jose, Costa Rica and is the most powerful standard broadcast station in the western hemisphere. Its story began in the mid 1960s when a Texas broadcaster purchased pioneer San Jose station *La Voz de La Victor* and contracted with Continental Electronics (best known as a supplier of high-powered transmitters for military purposes) and its Costa Rican subsidiary ELCOR for supply and construction of the present megawatt out-

SPLIT SIX SPECIAL

The first half dozen split frequency stations that every novice DXer should concentrate on first.

East of the Mississippi kHz Station	West of the Mississippi kHz Station
625 Radio Million, San Jose, Costa Rica	625 Radio Million, San Jose, Costa Rica
834 Radio Belize, Belize City	655 Radio Nacional de El Salvador, San Salvador, El Salvador
1265 Radio Paradise, Basse Terre, St. Kitts	655 Pyongyang, North Korea
1525 Radio Peking, Urumchi, China	834 Radio Belize, Belize City
1554 Radio France, Nice, France	1265 Radio Paradise, Basse Terre, St. Kitts
1586 Western Germany Radio, Langenberg, G.F.R.	1475 Voice of Malaysia, Sabah, Malaysia

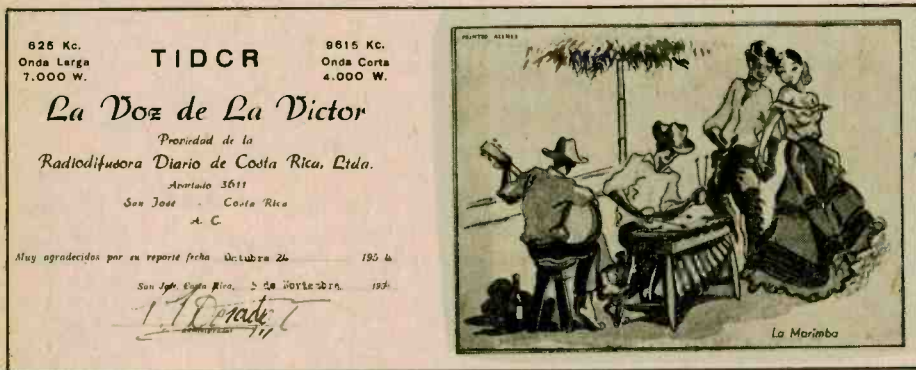
let. *La Voz de La Victor* tested its newly acquired super power for about three years entirely in Spanish and without any visible means of support such as commercials or listener supported religious programming. At the end of 1969 some English religious pro-

gramming was aired on a trial basis, then the whole operation disappeared from sight.

But during the first half of this decade ELCOR continued to hold down 625 kHz with its own station, *Radio Omega*, which first used 2.5 kW and then a 50 kW transmitter, while Continental tried to negotiate the sale or lease of the megawatt. As "Omega" means the end, or the ultimate, *Radio Omega* was certainly well named in light of what came next. *Radio Million* made its first official broadcast this year during the early a.m. hours of March 8. It was a test conducted in cooperation with two DX organizations, the International Radio Club of America and the National Radio Club. The broadcast consisted of ID tapes in English, Spanish, and Portuguese.

This was a major milestone in DX history. It is the first time that a million watt standard AM broadcast station is known to have put on a program especially for DXers. In 1971 a similar transmission from *Voice of America*, Okinawa on 1178 kHz was reported, but *VOA* subsequently denied making any sort of special transmission for a radio club. What happens now with *Radio Million*? Tune in and find out.

More Latin American Splits. Even with only 2.5 kW, *Radio Omega* was occasionally heard in Canada and the U.S. on communications quality receivers. And when it went to 50 kW, *Radio Omega* became almost as widely heard as *Radio Paradise* and *Radio Belize*. The truth is that there are so many Spanish speaking split-frequency stations which you might log that we could fill a book with them. Elsewhere in Central America, for example, you could go after *Radio Nacional de El Salvador* on 655 kHz, *Radio Aeropuerto Internacional*, San Pedro Sula, Honduras on 1085 kHz, and *Radio*



Colorful folder shown above is the QSL confirmation sent out by *La Voz de la Victor* in Costa Rica a few years back. It was a forerunner of *Radio Omega*, whose QSL is shown below, with one from Belize, (formerly British Honduras).

radio Omega 625 kc.

Date: October 30, 1974

Dear Mr. Stanbury:

Thank you very much for your report on our Radio OMEGA, 625 KHz.

At present, we are working with a 2.5 KW transmitter manufactured by our head company, Electronic Corporation, San Jose, Costa Rica. In two or three weeks, though, we will be substituting this small equipment for a 50 KW transmitter, also manufactured by ELCOR. Consequently, we would appreciate any reports on Omega, in a month or so.

We are pleased to inform you that the 1,000,000 watt transmitter which operated in our frequency, 625 KHz., belongs now to Continental Electronics from Dallas, Texas. Should you be interested any further, we would be willing to furnish additional information since ELCOR, who acted as subcontractor in this mega-watt project, is very well acquainted with its details.

Very truly yours,
[Signature]

From:
Celina de Jimenez
Director, Radio OMEGA

RADIO BELIZE
GOVERNMENT BROADCASTING SERVICE

Belize City,
British Honduras

Dear Sir,
This is to verify correct.
We are transmitting
k/cs. with a
with a power
We thank you

Paraiso, at Paraiso (pronounced "Para-ee-so"), Honduras on 1163 kHz, after *Caribbean Radio Lighthouse* signs off at 2100 EST, and until *Radio Paraiso* itself goes off at 2200 EST.

In South America one can DX all the way to the equator, and beyond, depending upon your receiver. Some of the better prospects include *Radio Nacional del Peru* at Lima on 854 kHz (a potential Latin American hot spot), *Radio Suceso* Guayaquil, Ecuador on 995 kHz, and *Radio Caaguazú*, Coronel Oviedo, Paraguay on 645 kHz. The later operates all night.

Transoceanic DX. We have already mentioned the *VOA's* 1178 kHz Okinawa megawatt transmitter, and this can be heard on the west coast of North America with a comparatively good receiver. But there are other powerful Asian splits which can be heard on much simpler receivers. Topping the list are the North Korean outlets on 655 and 877 kHz. The power for these is unknown (the Pyongyang government won't even verify their reception) but it is probably somewhere in the 500-1000 kW range. Others to watch for include the Soviet home service relay at Vladivostok on 1376 kHz, and the 600 kW, 1475 *Voice of Malaysia* relay broadcasting to the Philippines, and Indonesia from the Malaysian state of Sabah on the island of Borneo.

Okinawa, North Korea and Vladivostok have probably been logged in eastern North America but circumstances were such that none of the DXers involved (including the author) were able to positively confirm what they heard. But one far east split which is definitely heard east of the Mississippi around sunset is *Radio Peking's* megawatt relay in western China (Urumchi state) which beams programs to the Soviet Union on 1525 kHz. The Russians operate several high powered transmitters of their own around 1525 kHz designed to interfere with *Radio Peking* and these are also heard in North America.

Finally, there are at least three European splits which regularly punch their way through to east coast AM dials. They are West Germany's *Westdeutscher Rundfunk* (WDR) 800 kW transmitter at Langenberg on 1586 kHz, the 300 kW *France-Inter* station at Nice on 1554 kHz, and *Emisora Nacional de Radiodifusao* at Lisbon, Portugal with 135 kW on 665 kHz. These three stations operate all night European time which means they might be heard anytime during the evening EST—depending again, as with all split-frequency DX, upon the listener's local interference picture. ■

e/e
checks
out the...



PIONEER TP-900 FM STEREO CAR RADIO

□ Most auto tape players are pretty much alike—that is, within the same price range they generally have the same features and performance, and many of them are just about identical. But if you try to add an FM radio to the tape player to provide full-function car listening enjoyment, the performance is often less than good because the FM section is not much better than a cheap AM radio.

Now comes a surprise—and it's a pleasant one. Those who want high fidelity listening which approaches what they have in their own home component setups need look no further than the nearest Pioneer auto-stereo display—because Pioneer has combined an extremely sensitive high-performance FM stereo radio with a good 8-track tape player. Designated the TP-900, this new Pioneer car set actually outperforms many high-fidelity component tuners and receivers presently in home use.

Tape Player Features. Getting the tape player out of the way first, you'll find it has two generally uncommon features for an auto 8-track. The first is *Fast Forward*, which permits you to skip ahead—if you want to listen to a selection near the end of the program you don't have to listen to everything before the desired selection. The second unusual feature is *Repeat*. If you want to hear one program track repeated, just press the *Repeat* switch and the program will play continuously until you release the switch or turn off the player.

FM Radio Section. Moving on to the FM radio section we find performance that puts many a home receiver to shame. It has a measured IHF sensitivity of 0.6 uV at the 75 ohm coaxial input, and full limiting is attained with only 1.4 uV. Great? Yes, but there's

more to come. Full 60 dB of quieting is attained in the mono mode with 1.8 uV, a signal level most stereo car radios can't even receive, let alone receive as dead quiet. As for stereo, 55 dB quieting—which is the hi-fi standard for *excellent* stereo reception in the home—is attained with only 32 uV input!

This means that as the FM reception fades up and down you will hear *very good to excellent* reception on the Pioneer TP-900. If the signal level should start to fade below the level that produces excellent stereo reception, the radio automatically switches to mono so the high frequency noise components are blended, and therefore unheard. Automatic stereo switching took place at 17 uV—obviously much higher than the minimal 1.8 uV that produces noise-free mono reception. The worse-case stereo separation measured 34 dB, which though not as high as the 40+ dB we've come to expect from high-performance home tuners, is still greater than the almost 30 dB separation required by the FCC for the stereo transmitters. An FM mute keeps interstation noise from *grinding* in your ears.

To resolve the problem of overload and cross-modulation caused by excessively high signal levels received when you drive near an FM transmitter, the TP-900 has a *DX-Local* sensitivity switch that provides optional 20 dB attenuation ahead of the RF amplifier.

Finally, the FM selectivity is not only excellent for an auto radio, it is excellent by home hi-fi standards. Through the use of crystal IF filters the TP-900 is virtually immune to alternate channel interference under normal operating conditions—when you tune in a station you hear only that station, not some

(Continued on page 91)

YOU CAN BECOME A LOUDSPEAKER SYSTEMS DESIGN ENGINEER OVERNIGHT

Take one low-priced cabinet enclosure kit, select two or three speaker drivers plus a crossover network from a jam-packed catalog, and assemble your very own Mark I loudspeaker system in a couple of hours.

by Herman Johnson

YOU CAN FURTHER ENJOY the kit habit by assembling your own speaker enclosure kit the way you like it. That's right! It's all possible because Radio Shack's 40-1960 enclosure kit includes adaptors permitting a wide choice of driving units (woofer, tweeter, and midrange) and crossover networks. The enclosure is easy to assemble and looks as good as any speaker you will find in any high fidelity store or audio salon. The finish is wood grain vinyl that will take more punishment and mishandling without showing it than a real wood-finished cabinet. The kit accommodates a great variety of drivers to make widely differing systems. This is due to the design of the speaker baffle board with cutouts which may be changed using adaptors and covers for each of the openings. All hardware (nuts, bolts and screws), assembly and mounting instructions, and a sub-baffle for mounting a grille cloth are included

in the kit. The instruction manual supplied illustrates some of the combinations of drivers which can be used with the enclosure. This article explains a few details not covered explicitly in the manual, and lists the components for three recommended sets of components which will give good sound when used with this enclosure kit.

What's included. When you open the kit package, you'll see that the cabinet parts, speaker baffle and back closure panel are all made of particle board. The cabinet material and the baffle are $\frac{3}{8}$ -in. thick. The back panel is $\frac{1}{2}$ -in. board. You should seal all of the machine-cut panel edges and cut-outs in the baffle and edges of the back with clear resin sealer to prevent flakeoff because cut edges of particle board are soft and flaky. Also seal inside the front groove (baffle recess), the recessed edge for the back panel and the surfaces of the 45-degree mitre cuts that form the cabinet corners. The cabinet parts, top, bottom, and sides are joined into one piece, held together by the vinyl veneer. When you fold the cabinet to its rectangular shape (see Fig. 1 of the instructions), you should tape all of the outside corners with masking tape to reinforce the 90-degree bends of the vinyl, while you are handling the pieces. The corners must open up for insertion of the speaker baffle into the groove. It is best to prepare the baffle for speaker mounting before it is inserted into the cabinet.



10-inch
woofer driver



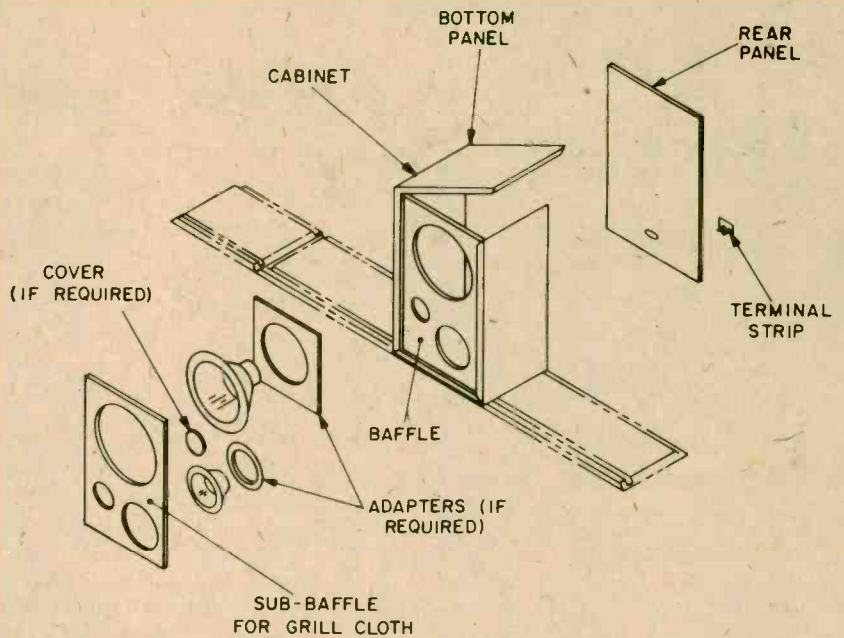
Level control



4-inch midrange driver

The speaker baffle has pre-cut openings of 11-, 5-, and 3-in. diameters for woofer, midrange, and tweeter drivers, respectively. Two adapters are furnished to fit over the 11-in. opening for mounting an 8- or 10-in. woofer and two are supplied for mounting 4- or 5-in. midrange units. A 4-in. blanking cover is included to close the tweeter opening if necessary. All of the adapters are made of 1/8-in. hardboard. The inside dimensions of the cabinet are 13-inches wide, by 22 1/4-inches high, by 8 3/4-inches deep—a volume of almost 1 1/2-cubic feet. This volume is a bit small for a 12-in. driver considering the units available to the home constructor. Hence, my recommendation is to install an 8- or 10-in. woofer in the large opening using one of the adapters. The adapter cut-outs have been punch-cut, so it is a good idea to smooth their cut edges with sandpaper.

Mounting drivers. You should mount all the components on the front baffle board—from the front, and seal up the back of the cabinet by gluing it in place permanently. This will ensure that the enclosure remains airtight. Front mounting the drivers instead of screwing them to the back of the front baffle has two advantages. The drivers displace a bit less volume inside the enclosure when mounted this way, and they are much easier to remove for checking or replacement, if replacement should be required. Sufficient space is available between the front of the enclosure and



Exploded view of Radio Shack 40-1960 universal speaker enclosure kit. Various adapter plates permit variety of different size drivers to be used (Note that the drivers shown here are not included in this loudspeaker enclosure kit).

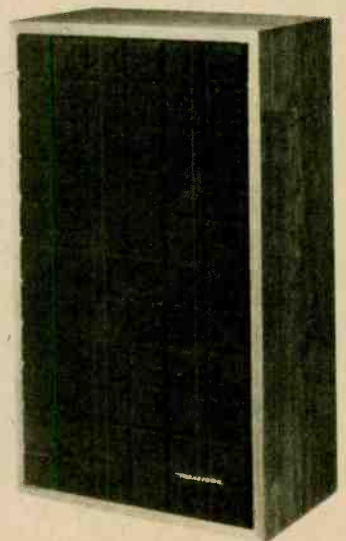
the baffle for mounting adapters on the front face of the baffle, and to clear the grille material.

Small nails are supplied in the hardware package with the suggestion that adapters be centered over the openings and nailed to the baffle. However, nails do not hold in particle board as well as screws and centering an adapter over an opening is easier said than done. A better way is to screw the adapter to the baffle through holes located 45-degrees away from the pre-punched speaker mounting holes in the adapters. Particle board is smooth-faced on both sides while hardboard is smooth-faced one side, embossed on the other side. The smooth faces butted together will provide a good seal for air-tightness, when secured by four (4) screws.

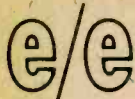
Horn tweeter



Adjustable crossover



Completed speaker system

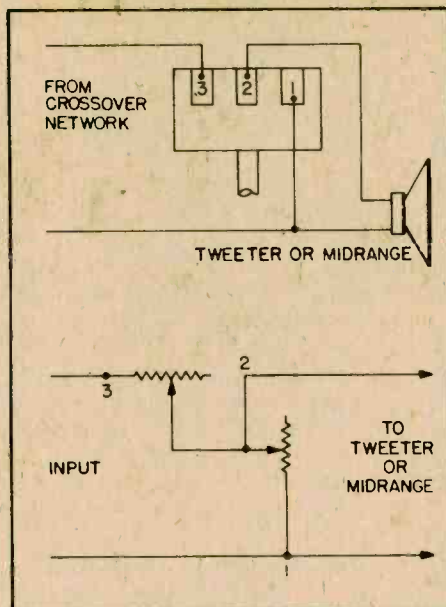


LOUDSPEAKER KIT

3-way systems. For a 3-way speaker system, one of the two round adapters permits mounting a 4- or 5-in. midrange speaker in the 5-in. diameter opening in the baffle. Or, a 6-in. midrange unit can be mounted in this opening. One adaptor has a 7-in. outside diameter with a 3 $\frac{5}{8}$ -in. cut-out, while the other adaptor has a 9-in. outside diameter with a 4-in. cut-out. Preparation of either of these adaptors is identical except that the hole centers should be 6-inches apart at 45 degrees from the prepunched speaker mounting holes. Since these parts are round, it is a bit more difficult to locate the hole centers for mounting to the baffle. The important thing to observe is to keep the four holes one-half-inch outside the baffle opening and 90 degrees apart. A penciled layout on paper placed over the round adapter will permit making the hole locations accurate. Mark one of the four holes to insure they line up correctly.

Midrange tones are the easiest to reproduce, and that is one reason even small 4- or 5-in. cones can do a good job with this part of the audio spectrum as part of a three-driver system. At high volume levels these units are often so loud compared to the woofer and the tweeter that they overbalance those drivers. That's why a midrange control is often installed to lower the midrange sound level.

Figure 2 in the instructions shows how to mount a horn tweeter or a cone tweeter, depending on how much money you've decided to spend and the kind of



Top sketch shows how to connect a level control for adjusting output of a tweeter or midrange driver. Lower diagram is schematic of same. May also be used to control remote speaker system volume.

sound you prefer. The tweeter opening is a 3-in. opening which will take many dome tweeters and plenty of the smaller cone units which are on the market. The horn tweeter which is one of our choices unfortunately won't mount from the front here, but it can be accessible through the woofer opening.

2-way systems. For 2-way systems, the 3-inch opening is covered up with the 4-inch cover by four screws or securely, glued. The 5-in. opening is then used for the tweeter because it provides space for front mounting, similar to the previously-described mounting for woofer and midrange components. The $\frac{1}{4}$ -in. hard board ring centers the unit and moves the mouth of the horn back flush with the face of the 7-in. adaptor. All speaker components should, whenever possible, be mounted with their front faces flush with the front face of the baffle, to avoid the tunnel effect caused by the thickness of the baffle. Most high-quality tweeter units can be mounted directly on an adapter.

General. It is good practice to drill a pilot hole for each screw, drive the screw in part way to start threads and then remove the loose displaced material around the hole. This is very important when sandwiching parts together, (hard board to particle board). Holes drilled through the material must also be cleaned, particularly on any side that is to be mated to the face of another material. A countersink turned by hand does the job nicely.

Caulk all joints with a non-hardening

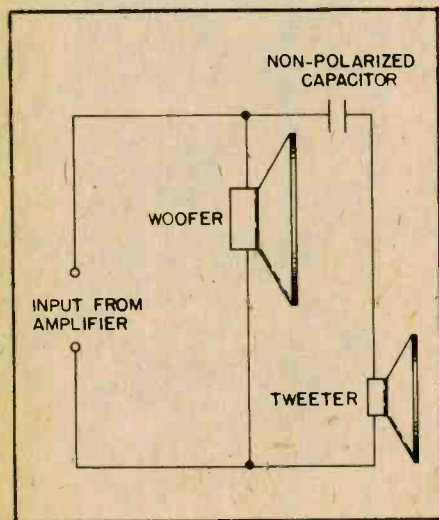
compound such as Mortite to make it air tight. The back can be made air tight, for removal, by installing $\frac{3}{8}$ -in. (self-stick) weather stripping to the recess provided.

At least 50 percent of the surface area inside the cabinet should be lined with one-in. glass wool (common grade fiberglass insulation) on the top, one side and one the back. The purpose of this acoustic damping is to eliminate any midrange reflections that might introduce unwanted coloration to the reproduced sound. Spots of glue will hold the fiberglass in place.

Front Grille. Cut your grille cloth material about 2 inches longer and wider than the sub-baffle that is furnished in the kit, and staple it to the back. Glue one-in. square pieces of hard board or card board in the upper corners of the baffle for mounting the Velcro retainers for the grille. Or if you prefer, a sculptured foam grille is available (Radio Shack No. 40-1946). You can cut it to fit over the entire length and width of the cabinet if desired to obtain a "modern" look.

Stiffen Rear Panel. The only weak part of this cabinet is the $\frac{1}{2}$ -inch back panel. The back should be reinforced by sandwiching a piece of $\frac{3}{8}$ or $\frac{1}{2}$ -in. Celotex (building board) 12 $\frac{3}{8}$ by 21 $\frac{5}{8}$ -in., centered on what will be the inside face of the back. Liberally coat both surfaces with glue (furnished in the kit) and weight it down until dry. High acoustic power is generated inside an enclosure at high, sound volume levels, that will cause a $\frac{1}{2}$ -in. back to vibrate. A buzzing panel colors and absorbs low frequency sound. The Celotex reduces the volume slightly but it stiffens the back. Drill a small hole through the Celotex when you mount the terminal strip on the back for wiring.

If you want to experiment, you can try using a 12-in. woofer with as low a free-air resonance as possible, and comple-



Two-driver speaker system, with simplest possible crossover network—a capacitor to block lows from the tweeter.



Enclosure kit with drivers on baffle board, ready to close up.

ment it with the tweeter and mid-range driver suggested in the list at the top of the next page. The crossover network in that list has nominal crossover frequencies of 500 and 330 Hz, so just about any woofer will be good for use with these two other drivers (tweeter and mid-range). Consult the specs of the woofer maker carefully before you purchase any woofer other than those listed here.

Three good systems. Three loud-speaker systems which can be put together in this enclosure are described in the paragraphs which follow. They are not by any means the only groups of components you could put together, but they are made up from driver units which are readily available and which have been tested to see that they work well together.

System 1. Radio Shack's enclosure instructions suggest a basic two-way system which uses a 10-inch woofer (Radio Shack 40-1331, priced around \$17) connected in parallel with a horn tweeter (Radio Shack 40-1274, priced about \$16). The tweeter is more efficient than the woofer, but use of a one μ F non-polarized capacitor (Radio Shack 272-996) in series with the tweeter pushes the crossover frequency up rather high, and reducing the output of the tweeter. Thus the two speakers are fairly well matched. Low-frequency sound is good at low volume levels and the high frequencies are excellent.

System 2. An improved system using the same woofer and tweeter as in System 1 can be assembled by adding

a 4-in. full-range speaker (Radio Shack RS-40 1197, priced at \$10) to handle the mid-frequencies. The three drivers are connected using a crossover network (Radio Shack number 40-1339, listed for \$10) in place of the simple one- μ F capacitor of system number one. A plastic cover must be installed over the back of the 4-in. unit to isolate its cone from the acoustic power generated by the woofer. A flanged plastic dessert bowl large enough to clear the back of the 4-in. unit is ideal. Screw it to the baffle with four 6 x $\frac{3}{8}$ -in. self-tapping screws. A tiny hole must be punched in the side of the cover for hook-up wire. The network provides frequency division at 500 and at 3300 Hz. Hook-up instructions provided with the enclosure permit this hookup with or without controls for midrange and tweeter output. It is recommended that the crossover network be installed inside the cabinet on the bottom near one side to clear the woofer. Access to controls (if used) can be had by removing the woofer adapter. Once the controls are set it is not likely that they will need to be changed. Power handling is up to 20 watts. This is an excellent system for home use at low volume levels.

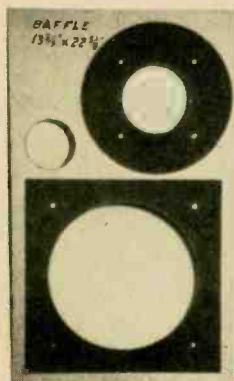
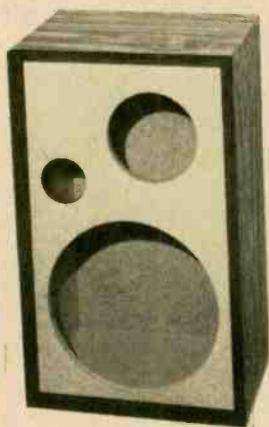
System 3. System 2 can be improved so that it will handle considerably more power by substituting a heavier woofer for the one used in Systems One and Two. This is a heavy-duty Philips woofer which costs \$28, about \$12 more than the first woofer. However, you can save money on this sys-

MATCHED LOUDSPEAKER COMPONENTS

System One	
10-inch woofer, Radio Shack 40-1331	\$15.95
Horn tweeter, Radio Shack 40-1274	\$16.95
1- μ F non-polarized capacitor, Radio Shack 272-996	\$.69
System Two	
Woofer and tweeter same as above	
Add 4-inch cone for midrange (Radio Shack 40-1197)	\$ 9.95
Use 3-way crossover network in place of 1- μ F capacitor (Radio Shack 40-1339)	\$14.95
System Three	
Improve System One or Two by substituting heavy-duty woofer, Norelco AD10100/W from McGee Radio, 1901 McGee St., Kansas City, Mo. 64108	\$39.95 each two for \$64.00
Universal speaker enclosure kit, Radio Shack 40-1960	\$24.95
Level control for midrange and/or tweeters, Radio Shack 40-980	\$ 3.89
Optional sculptured grille, w/easy-mount Velcro attaching tabs, Radio Shack 40-1946	\$ 5.95

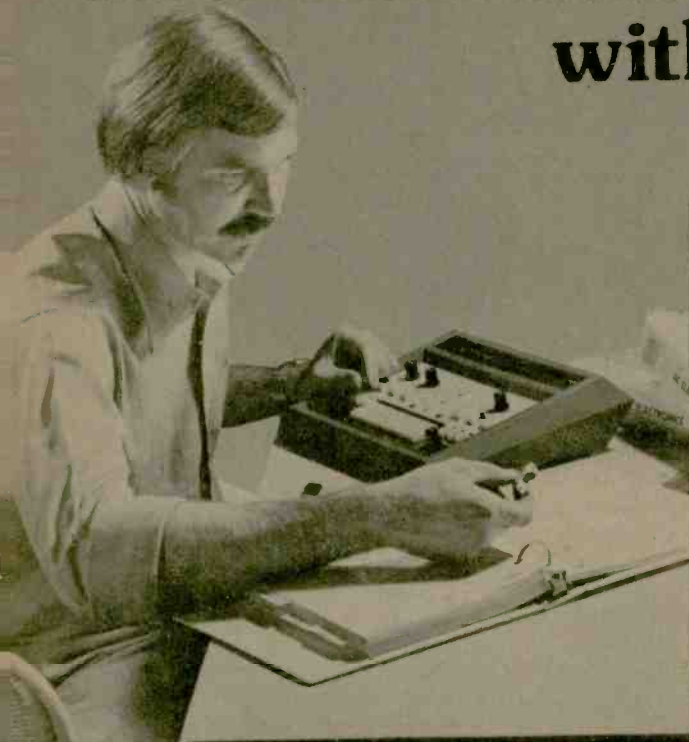
tem by using a less expensive tweeter (Radio Shack 40-1909, \$6.00).

There are many other good woofers, tweeters, and midrange drivers which can be mounted in this enclosure kit. The better the drivers, the better will be the sound you get, provided you match the volume level of the drivers using the level controls. Above is a list of some of recommended components for installation in the enclosure. ■



Left photo shows completed enclosure kit without drivers installed, and without any of the adapters which are supplied. Next is the front baffle with adapter for the 12-inch woofer opening to permit use of a 10-inch woofer, and an adapter to permit use of a 4-inch midrange in the 5-inch opening. Right hand picture shows how the optional sculptured grille snaps into place, using Velcro push-on holders which attach to board with staples. Remaining picture shows baffle with the drivers installed in adapters.

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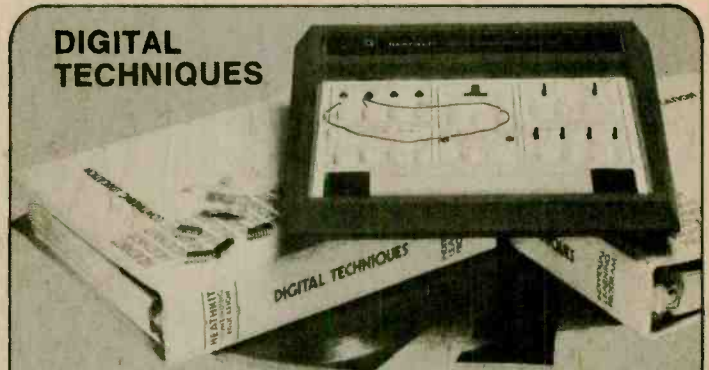
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Elementary Electronics CL-606

CB XCVR CHECKOUT



- E. F. Johnson Messenger 132
- Nuvox CB-7000
- Realistic Navaho TRC-57
- Regency CR-123
- Tram Diamond XL-5

Beginning with this issue, ELEMENTARY ELECTRONICS will regularly publish test reports on current CB transceivers. Only those models with FCC type acceptance and now on dealers shelves will be included in CB Xcvr Checkout. We do not test prototypes or one-of-a-kind sets because the perform-

ance of the final production model you purchase might well be different from that of the tested unit. Those CB transceivers which are "stock standard" have been thoroughly tested and checked, and you can depend on our test results and reports before you put your money on the counter.

If you don't find the particular unit you are interested in reported on here, check the newsstands for the 1976 CB BUYERS GUIDE which contains reports on more than 120 different CB transceivers, or look for the next edition of the CB YEARBOOK which will be on the stands in mid-November, 1976.



CIRCLE 48 ON READER SERVICE COUPON

• **E. F. JOHNSON MESSENGER 132**
\$259.95 (E. F. Johnson Co.)

General Description: A 23-channel AM desk-intercom styled transceiver for mobile, base, PA operation. Has telephone type handset. Power supply 12 VDC with negative ground and 117 VAC. Overall dimensions are 4½-in. h x 13-in. w x 8¼-in. d. Front panel controls and switches for Channel Selector, Volume, Squelch, Handset/Speaker, PA/CB. Standard accessories are microphone, all crystals, mobile mount, DC power cable.

Receiver Section Test:

Input Sensitivity	1.3 μ V
Adjacent Channel Rejection	58 dB
Image Rejection	17 dB
AGC Action	9 dB
Input Level for S9	50 μ V

Transmitter Section Test:

RF Output	3.6
Modulation to 85%	yes
Relative Sensitivity for 85% Modulation	-21 dB
Modulation Limited to 100%	yes

Editorial Remarks: The Johnson Messenger 132 has a relative reading S-meter, internal transmitter tuning, ex-

ternal/PA speaker jack, S/RF output meter. Push-to-talk switch on handset. Lifting handset can mute speaker. ■

• **REGENCY CR-123**

\$359.00 (Regency Electronics, Inc.)

General Description: A 23-channel AM/SSB transceiver for mobile, PA operation. Variable tuning ± 600 Hz provided (clarifier). Power supply 12 VDC with positive or negative ground. Overall dimensions are 2½-in. h x 7½-in. w x 10½-in. d. Front panel controls and switches for Channel Selector, Volume, Squelch, Clarifier, AM/LSB/USB, PA/CB, Noise Blanker, Local/DX. Standard accessories are microphone, all crystals, mobile mount, DC power cable.



CIRCLE 47 ON READER SERVICE COUPON

Receiver Section Test:

Input Sensitivity	2.0 μ V
Adjacent Channel Rejection	48 dB
Image Rejection	48 dB
AGC Action	9 dB
Input Level for S9	100 μ V

Transmitter Section Test:

RF Output	3.8 watts
Modulation to 85%	yes
Relative Sensitivity for 85% Modulation	-17 dB
Modulation Limited to 100%	yes

Editorial Remarks: The Regency CR-123 has a relative reading S-meter,

internal transmitter tuning, double conversion, external and PA speaker jacks, S/RF output meter. ■



CIRCLE 49 ON READER SERVICE COUPON

• **NUVOX CB-7000**

\$179.95 (Nuvox Electronics Co.)

General Description: A 23-channel AM transceiver for mobile, PA operation. Delta tuning ± 800 Hz provided. Power supply 12 VDC with positive or negative ground. Overall dimensions are 2 7/16-in. h x 6½-in. w x 9½-in. d. Front panel controls and switches for Channel Selector, Volume, Squelch, Delta Tune, PA/CB, ANL. Standard accessories are microphone, all crystals, mobile mount, DC power cable.

Receiver Section Test:

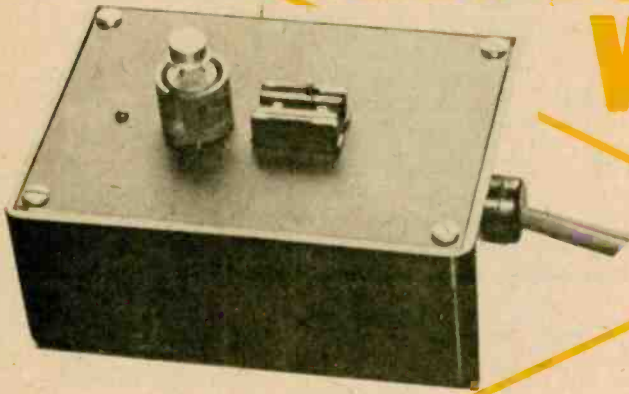
Input Sensitivity	0.8 μ V
Adjacent Channel Rejection	47 dB
Image Rejection	38 dB
AGC Action	3 dB
Input Level for S9	320 μ V

Transmitter Test Section:

RF Output	3.7 watts
Modulation to 85%	yes
Relative Sensitivity for 85% Modulation	-20 dB

(Continued on page 96)

TEST SURPLUS OP AMPS WITH THE GO/NO GO TESTER



You can build this money saver in a few hours and turn 10-cent surplus op amps into units worth bucks!

by R. M. Stitt

MOST ELECTRONIC DEVICES can be divided into either analog (linear) or digital circuitry. *Digital circuits* operate largely by means of switches—which are most of the time in one of two quite different states (high or low, plus or minus, or one of two substantially different voltage levels). *Analog, or linear, circuits* generally function by amplification (or reproduction) of signals in as nearly an exact manner as practical. That is, signals within the circuit(s) are changed, amplified, or transformed according to an infinitely small series of changes of one or more input signals. This is the kind of circuit which we most often run into outside of digital devices, and it is in these circuits that the operational amplifier is most frequently used.

Operational amplifiers were developed into practical devices in the Fifties, and first found their applications in scientific and industrial instruments, where their ability to amplify, add, subtract, multiply, or divide by precise quantities was valuable. Those op amps used vacuum tubes, of course, and required the usual accompanying capacitors and resistors. With the coming of integrated circuitry in the Sixties op amps began to appear in chip form, and today op amps are used in circuits almost as readily as individual transistors.

How Op Amps Work. If you're new to operational amplifiers, which everybody calls op amps, you can get a good basic course in how they work and what they can do by reading articles ELEMENTARY ELECTRONICS has run in the past couple

of years—"Op-Amp and Diode Circuits," pages 47-50, Nov./Dec. 1974, and "Op-Amp Insights," Sept./Oct. 1975.

Briefly, an op amp has two inputs, one output, and plus and minus power supplies (most often +15 and -15 volts). The inputs are called the plus and the minus input, or the inverting input and the non-inverting input. If the op amp is to be used as a simple amplifier the non-inverting input (usually) is grounded. In addition, the op amp has feedback from the output to the inverting input, and the amount of feedback is precisely controlled, generally by careful selection of the value of the feedback resistor. The amount of feedback determines the amount of gain of the op amp in any particular circuit.

In recent years, then, op amps have become one of the most important building blocks in many circuits. They are produced in IC form at low cost, and are readily available on the surplus market, often for less than 10 cents a piece, in quantities, and *untested—as is*.

When you buy a bunch of op amps at a good price from surplus houses, most of them will turn out to be perfect, and you can use them as well as if they'd been bought from the factory, individually sealed and guaranteed (at much higher prices, of course). It's therefore necessary to have an easy way of testing op amps before they're put into working devices.

One way to test an op amp is to plug it into a typical circuit, feed it a signal and observe both the input and output signals on an oscilloscope. Since this takes a fair amount of time (and a generator as well as a 'scope), a simple plug-it-in, go/no-go tester has been developed by this writer, and you can make one just like it at low cost, in just a few hours. When you've finished it you'll know a fair amount about how op amps work and how to test them.

And you'll be able to make each test in three to five seconds apiece, using this handy instrument.

How It Works. The circuit of the op amp tester may be broken down into five sections, as follows: power supply, voltage divider, test circuit, error amplifier and display circuit.

The operation of these sections can best be understood if the following paragraphs are studied in conjunction with the schematic diagram.

Power Supply. This is a conventional supply, consisting of a small power transformer (T1), which is the only part of the instrument not actually mounted on the printed circuit board. The low-voltage secondary of T1 feeds the bridge rectifier D1-D4. The bridge is shown here arranged differently from the customary one. But comparing its actual connections with the usual arrangement you will see that they are the same. This drawing has the advantage that it's easier to trace out the current flow to see the complete path for current flow from *both* sides of the center-tapped secondary, at *all* times.

Voltage Divider. By tapping off the power transformer secondary winding we can obtain a 60-Hz sine wave signal for use as a test signal. The effective voltage is 18 volts, which must be dropped to 0.06 volts. This is accomplished by using a simple voltage divider, R3 and R4.

Test Circuit. The *Device Under Test*, DUT, is placed in the circuit as an inverting amplifier. In an ideal inverting op amp, the output is described by the simple formula:

Output voltage = -input voltage times
R8 divided by R7.

Put another way,

$$V_{out} = -V_{in} \times R8 \div R7.$$

With the values in this circuit, this would be -(0.06) times 1 megohm

e/e OP AMP TESTER

divided by 10,000 ohms, or -6 volts.

Notice that the output is the negative (inversion) of the input. This inversion is important in the operation of the tester, as is explained farther on.

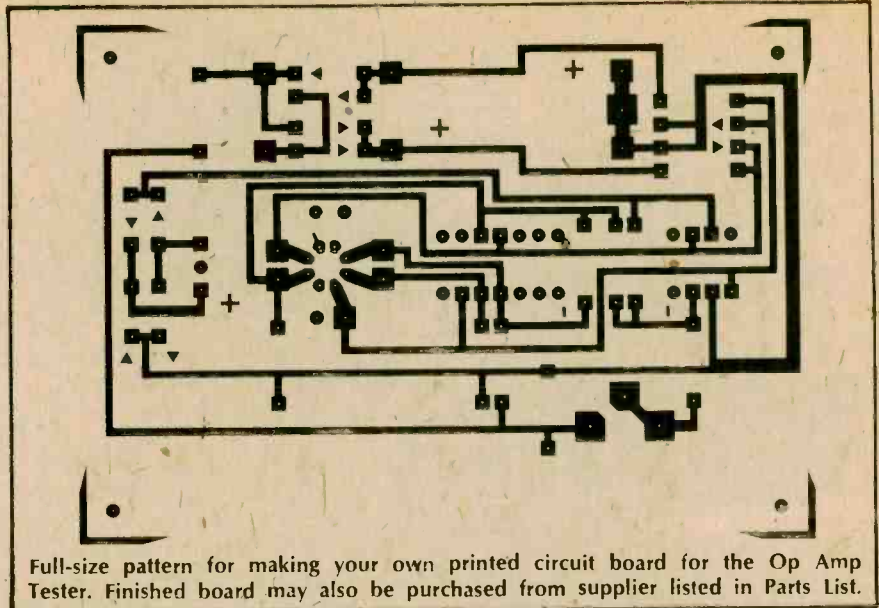
Error Amplifier. The error amplifier in this circuit is a *summing* amplifier—it sums (adds together) the two signals applied to the junction of R9, R10, which come from output of the DUT and from R6, respectively. In other words these two signals are mixed together, where they add (or in this case, cancel, if the DUT is working properly). The summing amplifier is made up of IC1, R5 (or J1), R6, R9, and R10.

Display Circuit. The display circuit consists of diodes D3 through D6, and indicator LED 1. Diodes D3-D6 make up a full wave bridge rectifier (just like the bridge rectifier circuit in the power supply) which converts positive or negative signals, which are present at the display circuit input, into positive signals (just the way the bridge in the power supply converts AC into positive DC) which will turn on indicator LED 1. If bridge D3-D6 receives a positive input, current flows through D5, LED 1, and D8, and diodes 6 and 7 are reverse-biased. If the display circuit receives a negative signal, current flows through D7, LED 1, and D6, while diodes D5 and D8 are reverse-biased. The current through LED 1 is limited by the components inside IC1, the op amp, which is part of the test circuit.

How the Circuit Works. The input signal which comes from the voltage divider (R3 and R4) is applied to the DUT through resistor R7. The same signal is also applied to the error amplifier through resistor R6. The DUT inverts this signal and amplifies it. The amount of amplification is equal to $-R8/R7$, which is 100, since R8 is one megohm (a million ohms) and R7 is 10,000.

This is stated, for op amps, as V/V, a way of expressing gain. It means volts of output for each volt of input. If a circuit has 100 volts of output for each volt of input, it is said to have a gain of 100V/V. The error amplifier sums the voltage divider signal with the signal from the output of the DUT. The signal at R6 is amplified by a gain of -100, since R6 is 10,000 ohms, and R10 is one megohm. The signal at R9 is amplified by a gain of -1, the minus sign indicates a signal inversion.

If the DUT is working properly there will be no error (the two signals will exactly cancel out) at the output of the error amplifier, IC1. This is because the



Full-size pattern for making your own printed circuit board for the Op Amp Tester. Finished board may also be purchased from supplier listed in Parts List.

input to the error amplifier at R9 will exactly cancel the input to the error amplifier at R6.

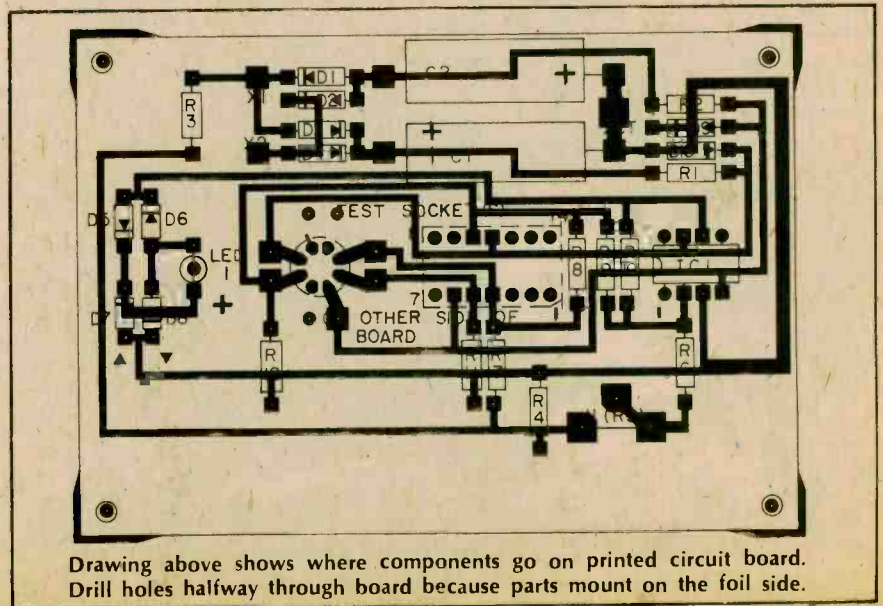
Output Current. The DUT must be able to supply output current equal to at least V_p/R_t , which means, where V_p is the peak output voltage of the DUT, and R_t is the load on the DUT output (R8, R9, and R12 in parallel), we get 6V divided by 1,790 ohms, which is 0.0034 amperes, or 3.4 milliamps. If the DUT cannot supply at least 3.4 mA, an error signal will be developed, and the LED indicator will go ON, telling us that the DUT is faulty.

Input Voltage Offset. This is the input voltage required to provide zero output voltage in the absence of intentional signal input on the + or - inputs of the op amp under test. It will appear as an error signal at the output of the DUT, amplified by the gain of the test circuit, plus one; $1 + R8/R7$. An error voltage of 4V will appear at the output of the DUT when the input voltage

offset exceeds 40mV.

Input Bias Current. In an ideal op amp, no bias current flows between the two input terminals. In actual amplifiers, however, there is always some current flow between them. This current is similar to the base current which flows when a bipolar transistor is used as the input of an amplifier, or the gate current when an FET is used at the input of an amp. In this circuit input bias current will flow through R8, and will show up at the output of the DUT as an error signal. Bias flow from the positive input will cause a voltage drop across R11 which will be amplified by an amount equal to the gain: $1 + R8/R7$ which is 1,000,000 divided by 10,000 plus 1; or 101. This signal will appear at the output of the DUT as an error signal.

A bias current of 4 microamps will cause an error signal at the output of the DUT if R7 and R11 are equal, and $R8 = 1$ megohm. Notice also, if the bias



Drawing above shows where components go on printed circuit board. Drill holes halfway through board because parts mount on the foil side.

currents at the input terminals of the DUT are equal, they tend to cancel, and no error signal is developed. Thus, only mismatches of input bias currents are treated as errors in this test circuit.

For the test circuit to work properly the actual values of resistors R6 through R10 must be pretty close—5 percent resistors at least, or resistors of greater tolerance which have been measured and found to be within 5 percent or better of the nominal value.

With an overall test gain of 100 or less, the 5 percent components specified will be adequate. In this case, jumper J1 is installed, and R5 will equal zero ohms. If higher test sensitivity is desired, then closer matching is required. This is accomplished by reducing R6 from its nominal value of 10K to, say, 8K and adding an adjustable resistor, R5 of about 3K ohms in series with it so that a closer match can be achieved by adjusting R5. When R5 is used, it can be adjusted by placing an op amp known to be good into the test socket and adjusting R5 to the center of the range in which failure indicator LED 1 stays off.

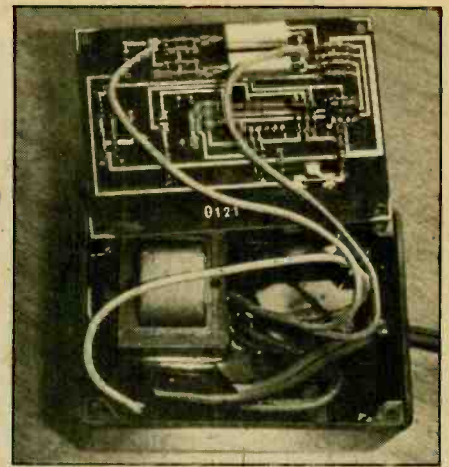
Errors at the output of the DUT will be amplified by the error amplifier at a gain of one (R10/R9) and will drive the display circuit. When the error at the output of the error amplifier, IC1,

exceeds the forward voltage of LED 1 plus the forward voltage of the bridge diodes, LED 1 will turn on, indicating a bad DUT. This occurs at about 4 volts. The following DUT deficiencies can contribute to the error signal.

Open Loop Gain. If the open loop gain of the DUT is not adequate to accurately amplify the input signal, an error signal will develop. A gain error approximately equal to 3.0 V will be developed if AOL of the DUT is equal to 200.

Output Voltage Amplitude. The output of the DUT must swing at least as much as the amplitude of the input signal multiplied by the gain of the test circuit. If it does not, an error signal will be developed. Since R7 equals 10,000 ohms, and R8 is one million ohms, we get 1,000,000 divided by 10,000, or 100 times 0.06. This equals a swing of ± 6.0 volts.

Stability. An unstable amplifier will oscillate even if it has no external signal input. This oscillation will directly cause an error signal. Op amps tend to be more stable at higher gains, and tend to be least stable at unity gain. So, this is not really a very strenuous stability test circuit, and op amps which are stable in this test circuit may not be in lower gain circuits. On the other hand any op amp which is supposed to be un-



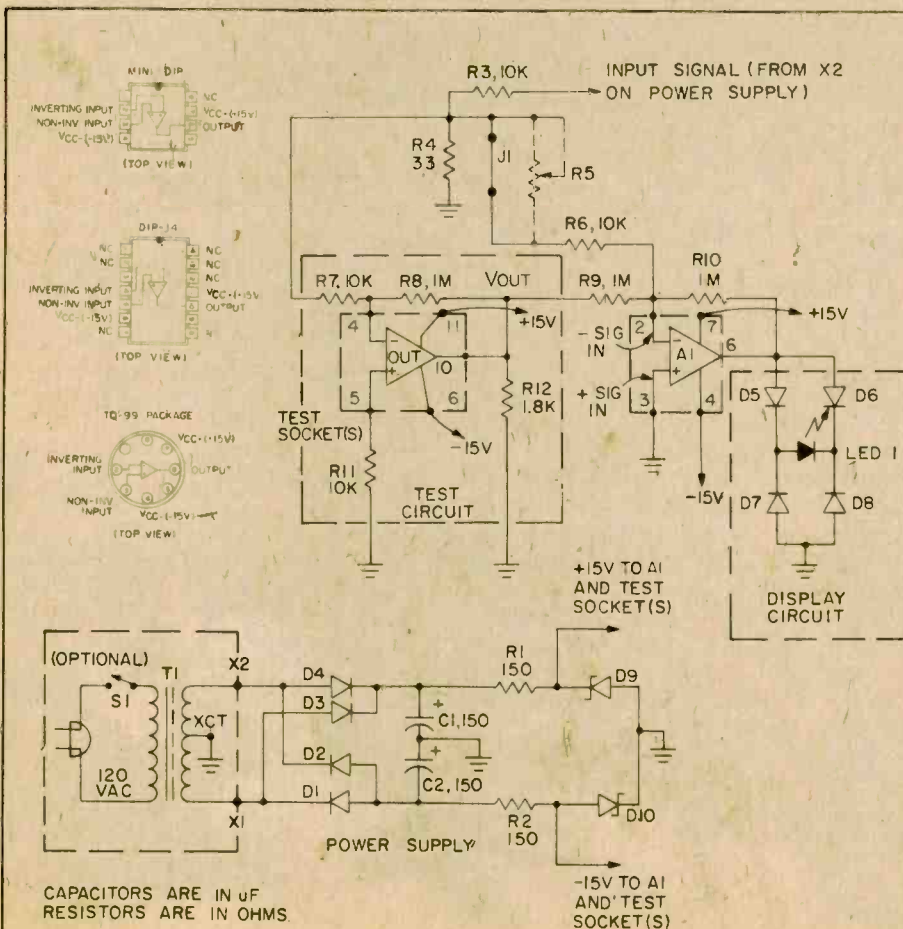
Tester show front panel inverted. Foil side mounts components. Secure transformer with epoxy or potting mix.

conditionally stable and is not so in this circuit, is certainly defective. Some experimenters may want to put a switch on the tester so that the DUT can be momentarily placed into a unity gain configuration for more exhaustive stability testing. This would be done by opening the inputs to R6 and R7. This would place the DUT in a non-inverting gain of one with a one megohm resistor in the feedback, and the input tied to ground through R11 (10

(Continued on page 91)

PARTS LIST FOR OP AMP TESTER

- C1, 2—150- μ F, 16-V electrolytic capacitors (Radio Shack 272-1006 or equiv.)
- D1-4—Bridge rectifier diodes, one amp, 50-V PIV or more (Radio Shack 276-1101 or equiv.)
- D5-8—Diode rectifiers, general purpose, for display LED, 1 amp or more (Radio Shack 276-1621 or equiv.)
- D9, 10—Zener diodes, 15-V, 1-watt or more (Radio Shack 276-564 or equiv.)
- IC1—LM741 mini-dip Op Amp (Radio Shack 276-007 or equiv.)
- LED 1— $\frac{1}{8}$ -in. diameter LED (or any convenient small size) (Radio Shack 276-042 or equiv.)
- R1, 2—150 ohms, $\frac{1}{4}$ - or $\frac{1}{2}$ -watt, 5% resistors (Allied Radio 824-1226 or equiv.)
- R3, 6, 11—10 Kohms, $\frac{1}{4}$ - or $\frac{1}{2}$ -watt, 5% resistors (Allied Radio 824-1552 or equiv.)
- R4—33 ohms, $\frac{1}{4}$ - or $\frac{1}{2}$ -watt resistor (Allied Radio 824-1130 or equiv.)
- R5—1000 ohm potentiometer; optional—see text. (Radio Shack 271-227 or equiv.)
- R8, 9, 10—1 megohm, $\frac{1}{4}$ - or $\frac{1}{2}$ -watt, 5% resistors, (Allied Radio 824-1877 or equiv.)
- R12—1800 ohms, $\frac{1}{4}$ - or $\frac{1}{2}$ -watt resistor (Allied Radio 824-1393 or equiv.)
- T1—Power transformer, 120 VAC primary, 30 V center tapped secondary, 100 milliamp or more (Radio Shack 273-1386 or equiv.)
- Misc.—Case, any convenient size (about 5-in. by 2 $\frac{1}{2}$ -in. by 1 $\frac{1}{2}$ -in. or more (Radio Shack 270-233 or equiv.); 14-pin Op Amp socket (Radio Shack 276-027 or equiv.); TO-99 Op Amp socket (Allied Radio 750R0960 or equiv.) Printed Circuit Board (undrilled) \$2.95 postpaid, from Techniques, Inc., 236 Jackson St., Englewood, N.J. 07631.



CAPACITORS ARE IN μ F
RESISTORS ARE IN OHMS

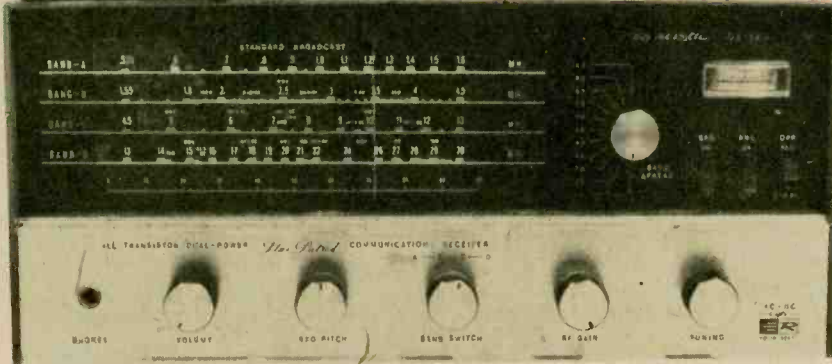
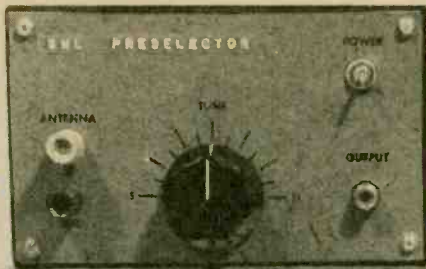
+15V TO A1
AND TEST
SOCKET(S)

-15V TO A1
AND TEST
SOCKET(S)

This Piggyback SWL

Add 20 dB of valuable signal-grabbing power

by Herb Friedman W2ZLF



BACK BEFORE EVERYTHING came in transistorized subminiature packages, virtually all serious SWLs and radio amateurs used a preselector ahead of the main receiver. No, not a preamplifier, we said a *preselector*. A preamplifier simply provides amplification, usually over a broad range of frequencies. With early single-conversion receivers, and the new solid-state high performance, budget-priced, single-conversion receivers, a preamplifier amplifies the image signal interference along with the desired signal. But a preselector, that's a whole 'nother thing. A preselector is a tuneable, high-Q preamplifier that passes only the desired signal frequency, and usually provides considerable attenuation at the image frequency.

Unfortunately, preselectors have so much gain and sensitivity they had to be built like the Rock of Gibraltar in a cabinet almost as large as the rock itself

in order to avoid self-oscillation. Many preselectors were as large as the boat anchors we used to call receivers, so like those old tube-type boat anchors, the preselector went the way of the Dodo.

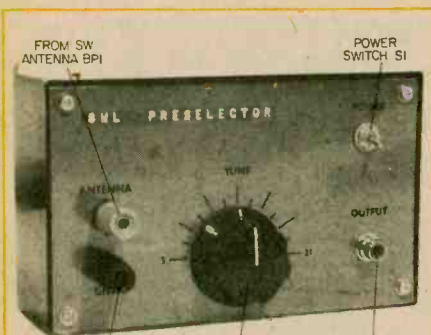
But a preselector can still give a receiver a good solid kick in the antenna terminals, often digging out signals where you thought none existed. And the preselector can still reduce image interference in those inexpensive solid-state receivers that have terrific sensitivity and great stability, but poor image rejection because they're only single-conversion. What's that? You've got no room for a big boat anchor? Who mentioned anything about size? Using up-to-date technology and components, the same as you've got in that new receiver, you can build a rock-stable preselector that's got more selectivity than those old monsters, will work off an ordinary transistor radio 9-volt battery (or a lightweight line-powered supply) and will provide enough extra front-end selectivity to practically *squash* image interference in single-conversion receivers. Best of all, you can make the whole thing so small it can be glued right to the back of a sub-miniature tuning capacitor—hence the name—"Piggyback Preselector." The unit shown in the schematic and photographs provides from two to three S-units extra sensitivity (about 12 to 20 dB extra gain), depending on the particular receiver it's used with.

The Design. Input coil L1 is home-brewed on a toroid form. Since toroids have exceptionally high Q the input tuning is razor sharp—sharp enough to attenuate the image frequencies. In fact,

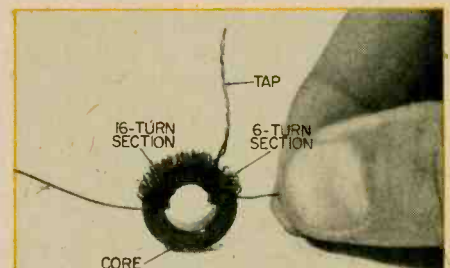
if this unit is tuned to 10 MHz while the receiver is tuned to 20 MHz virtually no signal will pass through the preselector into the receiver. On the other hand, when the preselector is tuned to the desired frequency it can really snatch signals up out of the noise level.

Don't worry about static signals blowing Field Effect Transistor Q1 because it's a special type with built-in protection diodes from the gates to the source and drain. In normal operation the diodes are inactive, and Q1's input impedance is extremely high and does not load down L1. Transistor Q2 acts as a matching device and power amplifier, providing a low impedance output for the input of the associated receiver.

Both L1's input impedance and the preselector's output impedance have been adjusted so the unit delivers good performance with every combination of antenna and receiver. While it might be



Plastic cabinet may be used but the front panel should be aluminum or other metal. Input (BP1) and output (J1) connections must be kept apart.



A toroid coil is the easiest home-brew because neatness doesn't count. If the turns aren't spaced just so, or the turns unwind a bit as you make the coil, it won't make any difference. Just spread the turns so they take up about one-half of the form. Don't spread turns to take up entire form.

Preselector Will Make You a Pro in One Evening

possible to get slightly improved overall performance by specific tailoring of the input and output for a given antenna type and receiver, we make no recommendations and suggest you build the model as described with no changes or substitutions. Only if you cannot obtain the specified Q1 should you try a substitute, and a 40673 is suggested. The 40673, however, might require some experimentation with the values of R1 and R2. The correct values provide approximately 5 mA to Q1 and 1 mA to Q2. Bear in mind, however, that we suggest the unit be assembled exactly as described.

The unit shown covers the SWL frequencies from approximately 5 to 21 MHz, actually reaching the top of the 15-meter amateur band. To get optimum coverage of the 15-meter band one turn can be removed from L1 (we'll explain this later). This modification will provide a greater 15 meter adjustment range for tuning capacitor C1.

C1 is a sub-miniature tuning capacitor with a long shaft and a plastic dust cover over the stator and rotor plates. (It is available from Radio Shack as No. 272-1341. Do not substitute a similar capacitor that has a calibrated tuning knob and lacks the dust cover. The shaft on the specified capacitor also provides the panel mounting while the dust cover is the support for the rest of the project.)

Construction. We built the entire preselector, except the transistor radio battery which supplies the power, on a special type of perf board which has circles on the back of each hole to facilitate soldering and securing the components in place. We recommend, however, that you make a printed circuit board from the layout shown, unless you are somewhat experienced in point-to-point wiring. The location of the components on the circuit board is shown in another drawing.

You'll have no special assembly problems as long as you follow the parts layout shown in the photographs. The unit will be completely stable and free of birdies and dead spots as long as the input is at one end of the board and the output is at the other end. But if you re-arrange the layout and get the input and output within an inch or so of each other it will almost certainly

oscillate, and fail to work.

Mark off the approximate location of the tuning capacitor on the circuit board and then complete the board assembly, including the power, input and output wires. These can be about six inches long.

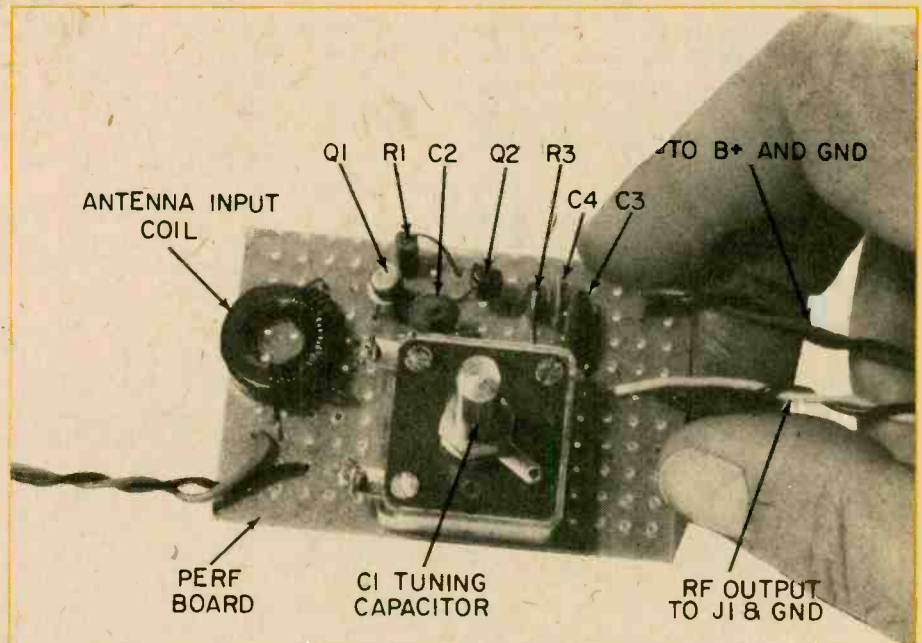
Toroid Assembly. L1 presents no winding problems as even sloppy assembly will work—that's the nice part about toroid coils. Use solid, enameled #24 copper wire to wind the coil. Clamp about three feet of wire in a vise and pull gently on the free end until the wire goes dead slack. By thus taking the spring out of the wire you make it so it won't unwind as you make the coil. Wind six turns, tightly, around the toroid core and bring the end out about two inches. Fold the wire back to the core, forming the ground tap, twist the wires a few times to secure them, and then wind sixteen additional turns in the same direction as the first six. Using a knife or razor, scrape the insulation from the wire ends and the tap. Then tin the wires and the tap with solder. Spread the turns so they are roughly equal-spaced, using about one-half the total core. Do not spread the turns to

take up the entire core, as is usually suggested. This time, half way is best.

This coil will give frequency coverage with this tuning capacitor about 5 MHz to 21 MHz—just about to the top of the amateur 15 meter band. If you want to be able to tune through 15 meters with tuning capacitor C1, eliminate one turn of the coil's longer winding—make it 15 turns. Do not make any changes to the initial six turn winding. This is the antenna winding and remains the same.

Board Construction. Assemble the perf board circuit as shown—everything except C1. Using silicone rubber adhesive such as G.E.'s RTV, cement the circuit board to the back of C1. After the adhesive has set (overnight), connect C1 across L1's secondary. Make certain C1's rotor, which connects to the tuning shaft, is wired to L1's grounded tap. Use an ohmmeter to determine C1's ground (shaft) terminal if you can't tell by looking. But don't guess; if you guess wrong the tuning will change when you remove your hand from the tuning knob.

Okay, it's all wired. What will you do with the piggyback preamplifier? Since the total current drain is about



The completed preselector ready for installation in a cabinet. The circuit board cements to the back of the tuning capacitor. Note that L1 is flat against the board and all wiring to other parts is also installed on the board. Board may be perf-type shown, or, recommended for beginners, the printed circuit type described in text.

e/e PIGGYBACK SWL PRESELECTOR

5 mA you can use an ordinary transistor radio battery for a power supply and shove the whole thing into a plastic utility cabinet as shown. Just as long as the front panel is aluminum (or other metal) a plastic cabinet can be used.

If you don't like using battery power you can use a slightly larger cabinet and assemble the power supply shown in the schematic. But remember, you only need a 5-mA capacity, so keep T1 small. If you end up using a standard filament transformer for T1 the cost might exceed several years' supply of batteries.

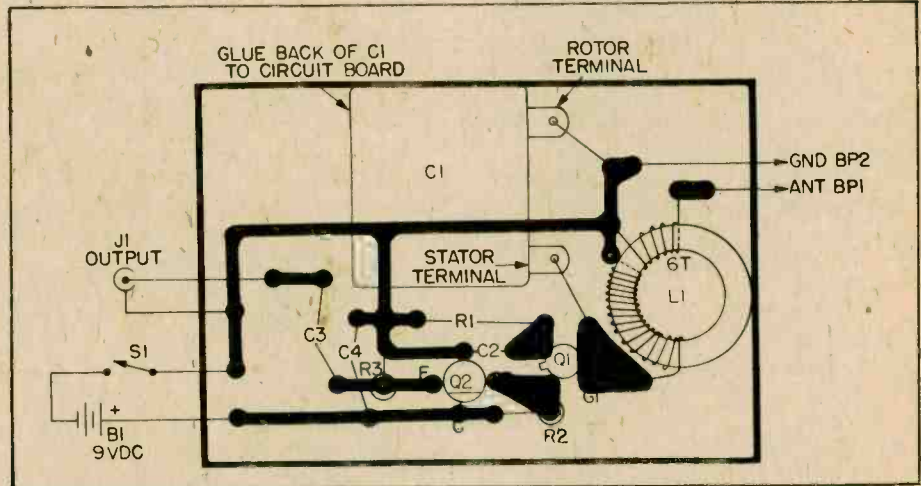
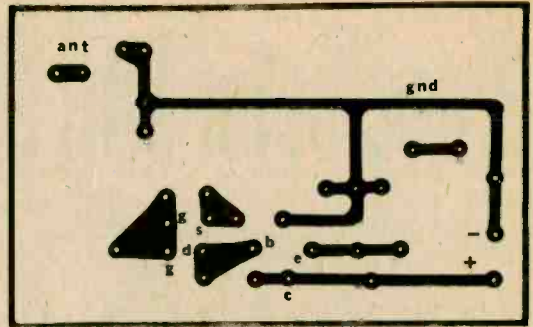
Final Connections. Use some kind of coaxial output connector for J1. Even a standard phono jack can be used. Use coaxial cable such as RG-58 or RG-59 between the preselector and receiver and keep it as short as possible.

If you have a *longwire* or *random* antenna use 5-way binding posts for the input (remember, the antenna post must be insulated from the panel). If you have a coaxial antenna system eliminate the ground binding post and substitute a coaxial connector for BP1. This connector can also be the phono type.

Calibrate! The tuning is so sharp the preselector must be tuned near the desired frequency or you might not hear anything at all in the receiver. Use whatever calibrations on the panel you find necessary to put the preselector tuning inside the ballpark. After a signal is tuned in on the receiver, peak it with the preselector. If the receiver has an antenna trimmer or tuning control make certain you also peak the signal with the trimmer.

If some local signals come in strong enough to overload the unit, just detune it slightly to reduce its sensitivity and get rid of the overload.

Full-size layout for printed circuit board (foil side up) is shown here.



If you use the printed circuit board shown above you can locate the various components on the board by means of this drawing. Parts side is shown.

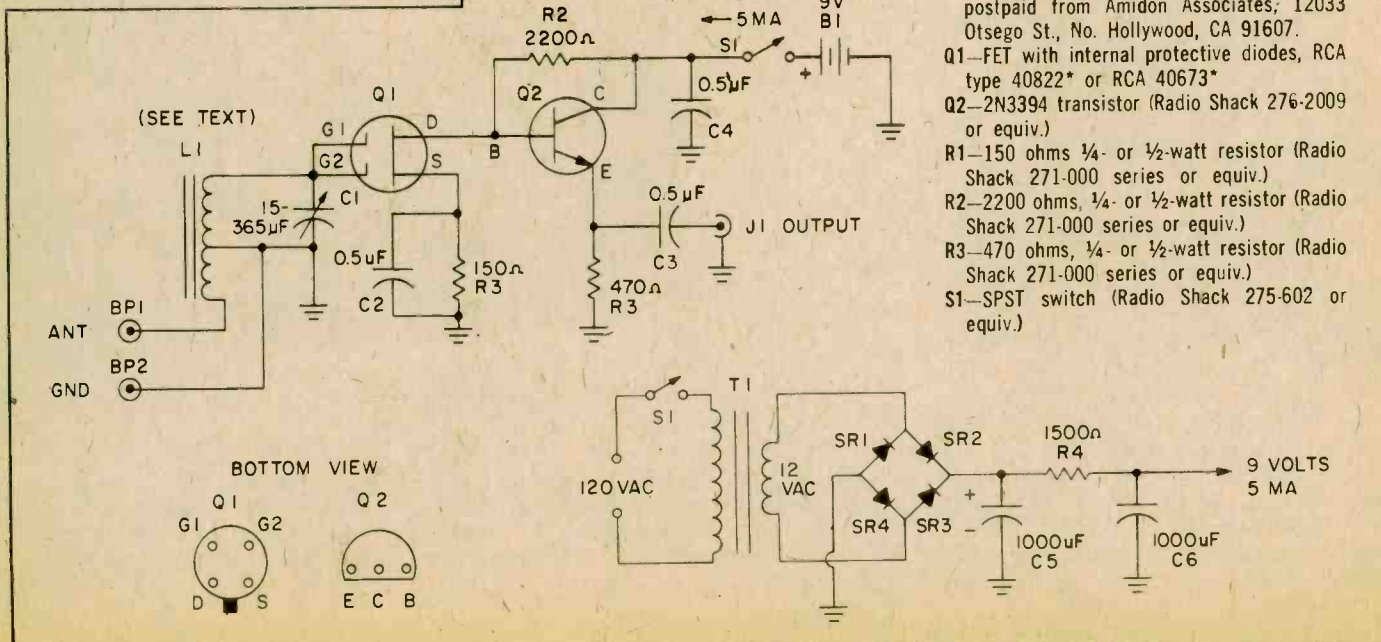
PARTS LIST FOR PRESELECTOR POWER SUPPLY

- C5, C6—1000 uF 15 VDC capacitor (Radio Shack 272-958 or equiv.)
- R4—1500 ohms, 1/2-watt resistor (Radio Shack 271-000 series or equiv.)
- SR1 through SR4—Silicon rectifier bridge, 50 PIV (Radio Shack 275-1151 or equiv.)
- T1—Power transformer 12-VAC secondary (Radio Shack 273-1385 or equiv.)

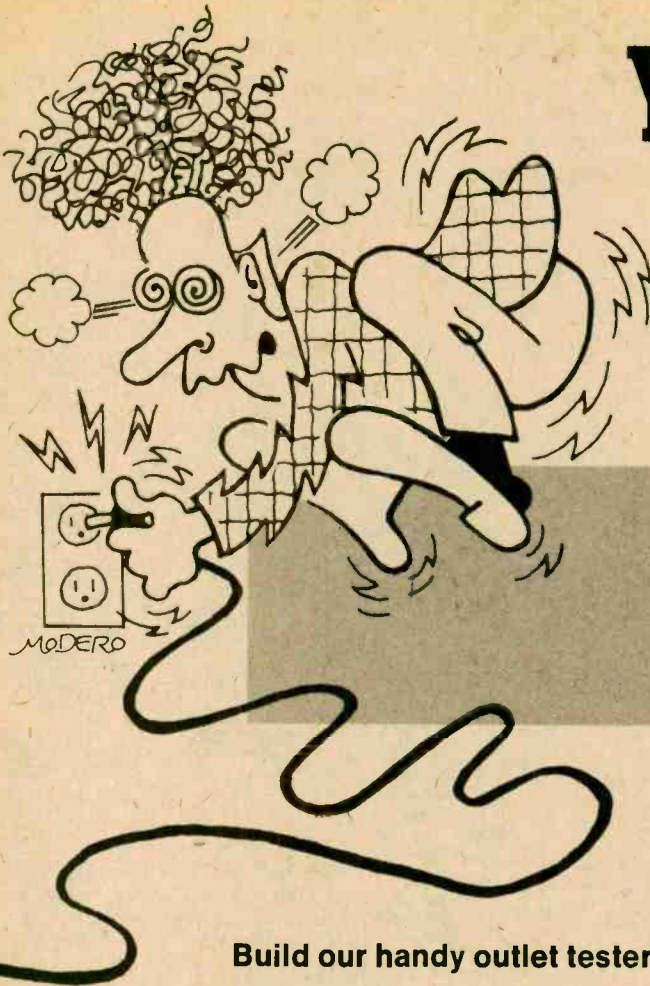
*Available at industrial distributors of RCA solid-state products.

PARTS LIST FOR SWL PRESELECTOR

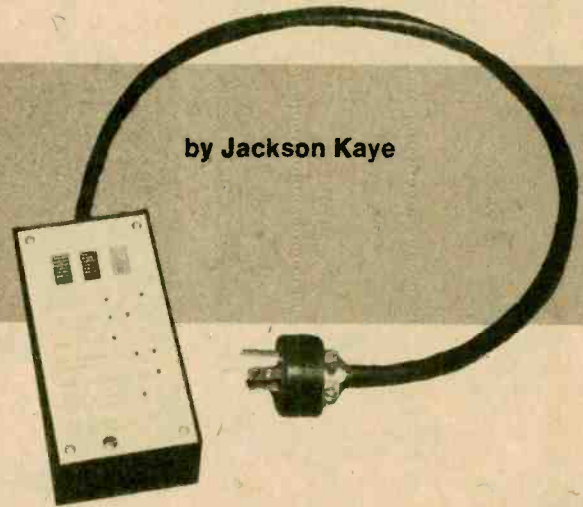
- B1—9VDC transistor radio battery (Radio Shack 23-464 or equiv.)
- BP1, BP2—5-way binding posts (Radio Shack 274-661 or equiv.)
- C1—365 pF subminiature variable tuning capacitor (Radio Shack 272-1341)
- C2, 3, 4—0.01 or 0.5 uF ceramic disc capacitors, 100 VDC (Radio Shack 272-131 or 134)
- J1—Phono input jack (Allied Radio 38-3400 or equiv.)
- L1—Amidon T68-2 toroid coil form, \$1.75 postpaid from Amidon Associates, 12033 Otsego St., No. Hollywood, CA 91607.
- Q1—FET with internal protective diodes, RCA type 40822* or RCA 40673*
- Q2—2N3394 transistor (Radio Shack 276-2009 or equiv.)
- R1—150 ohms 1/4- or 1/2-watt resistor (Radio Shack 271-000 series or equiv.)
- R2—2200 ohms, 1/4- or 1/2-watt resistor (Radio Shack 271-000 series or equiv.)
- R3—470 ohms, 1/4- or 1/2-watt resistor (Radio Shack 271-000 series or equiv.)
- S1—SPST switch (Radio Shack 275-602 or equiv.)



Your AC Outlet Will Get You If You Don't Watch Out!



by Jackson Kaye



Build our handy outlet tester and check 'em out in seconds!

□ The convenient, apparently very friendly, three-prong AC power outlet in your home may *kill* you! Yes, it sits in the wall waiting for you to plug in a power tool or household appliance complete with three-prong plug, you trusting to all of its safe outward appearances and ending up shocked to death's door.

The three-slot AC power outlet offers considerable protection to appliance users provided the outlet is connected correctly to the AC lines. But we all know hardly anybody is going to pull all the outlets from their wall boxes in one's home and check the wiring—it's too much work. And what about your

neighbors, relatives and friends who don't know what to check or what to do! You don't want to pull their outlets also?

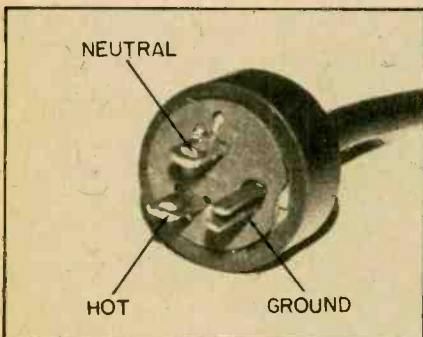
The obvious answer is a "quickie" test set that you can plug in safely to a wall outlet to give you a visual indication that the outlet is wired correctly. That's what Test-Out, a handy self-contained visual indicator, does in seconds and you can build it cheaply.

What It Does. Test-Out is a neon bulb indicating device that is plugged into the wall outlet. When the indication is normal, the outlet is wired correctly and you can so unplug it and go to the next outlet. When the indication is other than normal, the color-coded neon indication lets you know what's wrong and tells you what to do to make it safe.

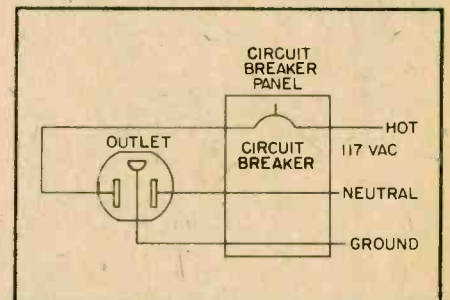
The AC outlet is where it's all at, so you have to know about its wiring hookup before you proceed. This drawing shows the wiring of typical outlet. In your home almost all of the outlets are in-wall installations with the wall plate flush against the wall and duplex outlet plastic mold protruding slightly. The three wires in the box connect to the outlet—the black (hot) wire to the brass screw, the white (neutral) wire

to the chrome-plated screw, and the green or bare (ground) wire to the green-painted screw. When wired in this fashion, the outlet is connected as shown at upper right, page 66.

A lamp connected to the hot terminal and to either remaining slot, neutral or ground, will be illuminated. This is exactly what happens in Test-Out. When Test-Out is plugged into an outlet that is correctly wired, both the



The business end of a line cord. Prong wiring must match outlet's for safety.



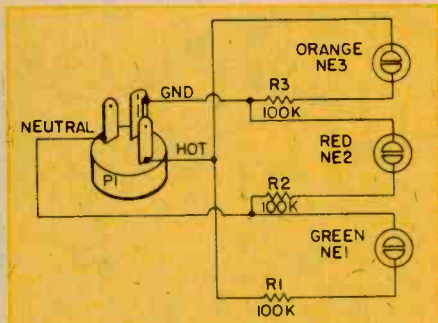
Here's how your house's wiring diagram would look if it had only one outlet.

green and orange lights come on. See the schematic diagram on the next page. Trace the circuit for yourself. Now imagine that the outlet into which Test-Out is plugged has the *hot* and *neutral* wires reversed. The *green* and *red* lights will come on. This is a common wiring

e/e TEST-OUT

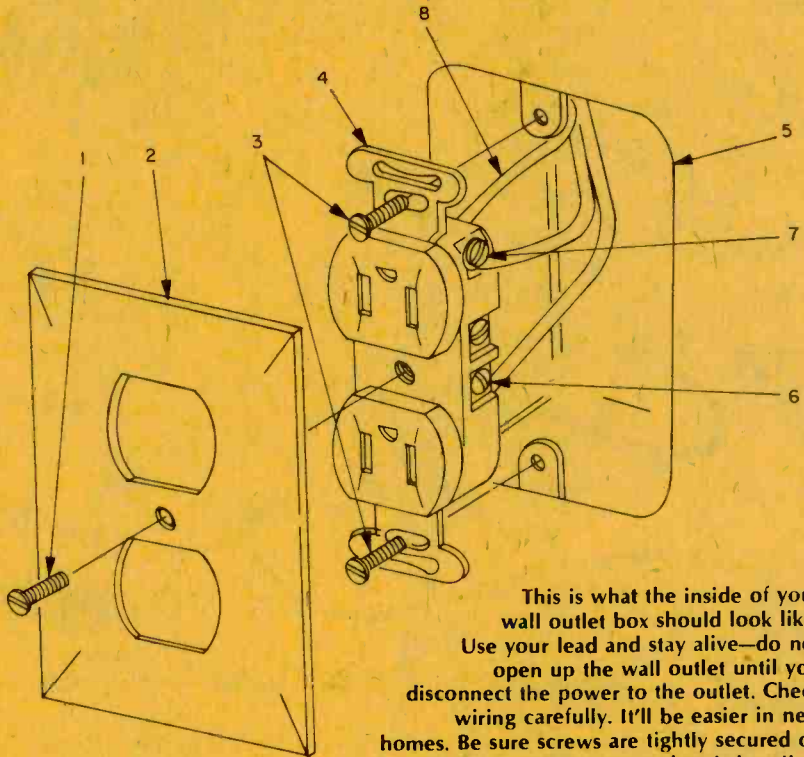
fault, and should be corrected whenever it occurs. Some other less common, but still dangerous wiring faults or bad connections Test-out can detect in a wall outlet are: *open ground* circuit, *hot and ground connections reversed*, *open neutral* connection, *neutral connection hot* while the *hot* connection is *open*, and *hot open* or no-power. Each possible fault has its own light pattern

- 1—Cover plate screw
- 2—Cover plate
- 3—Outlet mounting screws
- 4—Outlet
- 5—hole for box in wall
- 6—White wire connected to chrome-plated screw
- 7—Green or bare wire connected to green screw
- 8—Black wire connected to brass screw (screw not shown)

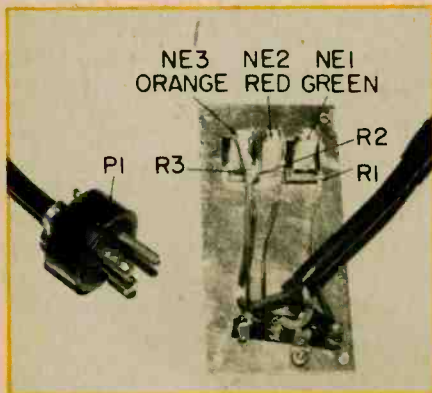


PARTS LIST FOR TEST-OUT

- NE 1-3—Neon lamp indicator with 100,000-ohm, ½-watt current-limiting resistor (Radio Shack 272-338 or equiv.)
- P1—AC line plug, 3-pronged.
- R1-3—100,000-ohm limiting resistor (supplied with neon lamp indicators under Radio Shack #272-338)
- Misc.—Plastic case with aluminum cover, approx. 5-in. x 2½-in. x 1½-in. (Radio Shack #270-233 or equiv.); heavy duty, 3-wire rubber-covered line cord about 3-ft. long; 3-terminal strip; hardware; wire; solder; etc.



This is what the inside of your wall outlet box should look like. Use your lead and stay alive—do not open up the wall outlet until you disconnect the power to the outlet. Check wiring carefully. It'll be easier in new homes. Be sure screws are tightly secured on the wire leads and the cover plate is installed.



Wiring is simple, but don't rush ahead. Wire neatly and recheck wiring carefully.

indication which is given in the Table. When you make your own Test-Out unit, copy the Table and paste it on the case for rapid trouble and correction information.

Assembly of Test-Out. Building Test-Out is as simple as stepping in a bucket. The black plastic case with aluminum cover measures approximately 5 x 2½ x 1½-in. and has three rectangular neon lamp sets with external limiting resis-

tors mounted on the aluminum cover, with the green lens on the left, red in middle, and orange (amber) at right. A hole is drilled in the box for the heavy-duty line cord to pass. The line plug is also heavy-duty type with built-

in wire clamp. Overbuilding here is important because the line cord and plug will take considerable pulls and strain in the normal course of using Test-Out. Don't get cheap material here! A three-terminal strip will make wiring easier (see photo).

Paint the aluminum cover any light color and screw cover to box when wiring is complete. Check unit by applying power first to hot prong and neutral prong on the plug. The green light should go on. Now switch the neutral connection to the ground prong. The orange light should come on. Lastly, the power leads should be connected across the neutral and ground leads—the red light should come on. If all is well, Test-Out is ready for work after the handy-reference Table is copied and cemented on Test-Out's aluminum panel.

Put Test-Out to work at once. You will be surprised how many outlets are improperly wired. Be sure to throw off the circuit breaker before rewiring an outlet. ■

AC OUTLET FAULT TABLE			
WHAT IT MEANS	GREEN	ORANGE	RED
WIRING OKAY	●	●	⊙
HOT & NEUTRAL REVERSED	●	⊙	●
OPEN GROUND	●	⊙	⊙
HOT & GROUND REVERSED	⊙	●	●
OPEN NEUTRAL	⊙	●	⊙
NEUTRAL IS HOT HOT IS OPEN	⊙	⊙	●
HOT OPEN OR NO POWER	⊙	⊙	⊙
BULB ON	●	BULB OFF ⊙	



COMPUTER READOUT

by Steve Gray, Computers Editor

What's In a Computer Kit?

□ In our first *Computer Readout* column, in the May-June *ELEMENTARY ELECTRONICS*, we began looking into what a microcomputer kit is, using the popular MITS Altair 8800 as an example. We examined the CPU and Display/Control boards and then took a long look at programming the 8800, because how much memory you have will determine whether you'll have to program in machine language, or can move up to assembly language or even to BASIC. Now let's find out why.

Memory. A third board is needed to complete the basic circuitry of the Altair 8800—memory. You buy as much memory as you need (or can afford). If you're a real computer nut and enjoy



The hand is inserting a memory board in the slots this side of the CPU board in an Altair 8800. Power supply is at left, Display/Control board at right.

writing short programs (or even long ones) in machine language, all 0's and 1's, then 2K of memory (2,000 bytes) would be enough.

If you'd rather program with mnemonics, such as LDA, STA and JMP, then you buy an assembler program from MITS. The assembler is also stored in memory, and takes up 5500 bytes of memory, so if you want to write programs of any real length, you'll need at least 8K bytes of memory.

If you prefer to "drive a car rather than tinker with it," then you may want to use BASIC, a high-level language, which will perform in a single instruction, $LET C = A + B$, what took 14 machine-language instructions to do. That BASIC instruction will store the sum of A and B in memory location C, which is determined by the BASIC interpreter, all by itself, thus taking care

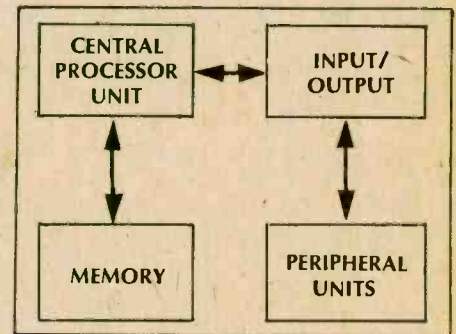
of much housekeeping. If you want to print out the answer, or look at it if you're using a video terminal, you write PRINT C. Or you can combine both steps by writing a single BASIC instruction, PRINT A + B.

There are three BASIC interpreters for the Altair 8800, requiring 4K, 8K, or 12K bytes of memory, with the 8K and 12K versions providing more and more features than the 4K BASIC. The 8K BASIC interpreter, which turns $LET C = A + B$ into machine language for the 8800, takes up 6K bytes of memory, so you'd need at least 8K bytes of memory altogether to have any memory for your own use, in writing programs.

A Terminal. The Altair 8800 can be programmed entirely from the front-panel switches, and the results can be read out from LEDs. But some programs would take hours to enter into the 8800 via switches, so you'll need a terminal, such as a Teletype, or the MITS Comter II terminal, or the Southwest Technical Products CT-1024 (also known as the TV Typewriter II). With a Teletype, you can enter a program from either the keyboard or via punched paper tape. With the Comter II or CT-1024, you can enter the program into the computer via the keyboard, or much faster by using a cassette. To enter the 8K BASIC interpreter into the Altair 8800 takes 12 minutes if you use punched paper tape, and 4 minutes for cassette.

If you're using a Teletype, the program results are printed out. The Comter II has a one-line, 32-character display on which you can read the answer. The Southwest CT-1024 can be hooked up to your TV set, using it as a video terminal, to display, simultaneously, 16 lines with 32 characters per line.

Interfaces. A terminal isn't connected directly to the computer. As the simplified block diagram shows, an input/output interface is needed, to adapt one to the other. Some microcomputers include one or more interfaces as part of the basic system, built into the main circuit board. The MITS interfaces are separate; the 88-2SIO serial card is



used to connect the Altair 800 to video terminals and certain other terminals; the 88-ACR interface allows you to connect an Altair 8800 to any medium-quality (or better) cassette recorder.

What It Costs. The 8800A is the current version of the 8800, with several internal improvements. The 8800A kit is \$539; assembled, \$775. Memory boards from 1K to 16K bytes are available; the 4K dynamic memory board is \$195 kit, \$295 assembled. For the 88-2SIO interface, \$148 kit, \$180 assembled; for the 88-ACR interface, \$138 kit, \$195 assembled. If you buy an 8800 with 4K of memory and an I/O board from MITS, the 4K BASIC software (on paper tape or audio cassette, whichever you need) is \$60; when bought alone, \$150. The 8K BASIC, bought with an 8800, 8K of memory, and I/O, is \$75, and the 12K Extended BASIC software, bought with an 8800, 12K of memory, and an I/O board, is \$150.

If you're working only with assembler, and you buy an 8800 with 8K of memory, and I/O, the assembler (plus some other programs) is \$75.

The MITS Comter II terminal kit is \$890, or \$1050 assembled. The Southwest Technical CT-1024 terminal kit, less cabinet and power supply, is \$175; there are various options and interfaces.

To give you a comparison, the Southwest Technical M6800 computer kit, based on the Motorola 6800 MPU, with serial interface and 2K bytes of memory, is \$395. There are several dozen other microprocessors, available in kit form or wired, or both, and we'll be discussing many in issues to come.

e/e COMPUTER READOUT

Not For Beginners. Although the MITS manual for the Altair 800 is ¾-inch thick, and goes into quite a lot of detail, it does not, nor do any of the computer-kit manuals, tell you as much as a Heathkit manual does. The Altair 8800 manual provides simple drawings that show where the parts go; for instance, a position on the CPU board will be marked "P," and just below the drawing you're told that "P is a 7404." The opposite page gives general information on how to install an IC, but not on an IC-by-IC basis. There are no elaborate drawings that show exactly what each component looks like, as in a Heathkit manual. The simpler the manual, the lower the cost of the kit.

Some microcomputer kits consist of little more than a schematic and a bag of parts, which is one way of keeping costs down. As of this writing, no computer-kit manufacturer is using a *solder mask*, a thin layer of plastic that's silk-screened onto the printed-circuit board, with holes in it to permit soldering only at the required points. You'll find this on all the Heathkit PC boards.

Computer-kit manufacturers expect a certain amount of experience on the part of a person who intends to build a computer or a terminal. The Southwest Technical brochure for the CT-1024 terminal says, "Our instructions have been written for the individual who has built up electronic projects before, knows how to recognize the various components, and is experienced at printed circuit board soldering. Although the instructions include step-by-step assembly details, schematics, wiring diagrams, and a theory of operation, they have not been written for the beginner."

Nevertheless, as one kit manufacturer told me, "For every person who can wire a computer kit, there are ten trying it who can't." Another manufacturer says, "At least half the people buying kits are not qualified to build them. From the kits that are sent back, it's obvious that most people don't know how to solder, don't even know how to put components on boards. Resistors get all jumbled up. Our literature says the builder should have a couple of years of experience in electronics, but people just don't believe that."

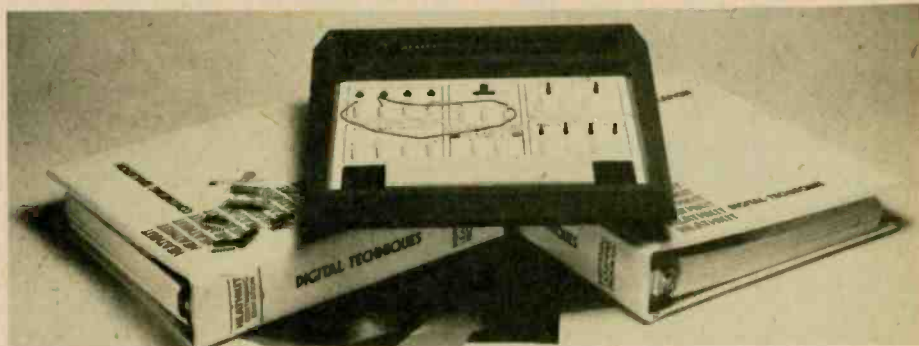
The experimenter who knows little or nothing about electronics, but who insists on trying to build a computer kit, should be prepared to ship his computer to New Mexico or Texas or wherever, perhaps several times, so that

the manufacturer can get it working, and should also be prepared to pay quite a bit for MITS or Southwest or Imsai or whoever to get it into working condition.

But if you'd like to save yourself all that trouble, then take some time to learn basic electronics, especially digital electronics, because even if you can get a computer to work without any previous experience, how are you going to fix it when it breaks down? And how are you going to, for instance, align the MITS 88-ACR audio-cassette interface, whose manual says that if an oscilloscope is available, it should be used for the alignment?

Heath has developed several excellent courses for the electronics beginner, including one on Digital Techniques. For \$109.95 (mailorder) you get an experimenter/trainer breadboard, and a 44-part course with 24 experiments with logic circuits, flip-flops, registers, sequential and combinational logic, etc.

In addition to knowing something about computer hardware before you start building a kit, it would also be to your advantage to know something about computer software, or program-



Heath's course in Digital Techniques includes an experimenter/trainer breadboard, programmed instruction with 24 experiments, parts, and recorded lectures.

ming. The manual that comes with the Southwest Technical Products 6800 microcomputer kit (which we'll be discussing in detail in a future issue) has an introduction that says, in part, "The SWTPC microprocessor computer system is a complex and sophisticated piece of equipment. This manual assumes that you have a basic knowledge of digital computer operation and some knowledge of, or experience with, machine language and assembled programming. We realize that many customers will not have this type of background. It would be impossible to provide a complete course in computer design and programming with this kit. Instead of one manual, we would probably have a ten-volume set if we attempted to provide this background information."

For more information, including prices, write to the manufacturers listed below, or circle their numbers on the Reader Service Coupon.

MITS, 2450 Alamo SE, Albuquerque, NM 87106, or Circle 75 on Reader Service Coupon.

Southwest Technical Products Corp., Box 32040, San Antonio, TX 78284, or Circle 74 on Reader Service Coupon.

Heath Company, Benton Harbor MI 49022, or Circle 31 on Reader Service Coupon.

Last-Minute Data. MITS recently announced the Altair 8800b, which has several improvements over the 8800A, including a redesigned front panel, longer and flat switch handles, and five new front-panel functions.

One of the new switches permits display of the contents of the accumulator (which performs the arithmetic and logical operations), or will load the contents of the eight data-input switches directly into the accumulator. Another new switch allows you to output the accumulator contents to an input/output device, or from an I/O device into the accumulator. The fifth new function

is slow, which will cause a program to be executed at about 5 cycles per second, for debugging.

Internal changes include a ribbon cable (instead of individual wires) to connect the front-panel switches and LEDs to a bus-interface board that is completely new.

The basic 8800b will be \$840 in kit form, \$1100 assembled, and is compatible with all previous 8800 boards, which are still the same price. MITS will continue to manufacture the 8800A, at the same prices quoted earlier in these pages.

Next Issue. In our next issue, we'll start examining hobby microcomputers in detail, with a close look at a kit that has some novel features. Join us in the November-December ELEMENTARY ELECTRONICS for a hands-on report. ■



BY CHRISTINE BEGOLE, KFC3553

□ You've got KFC3553, Buzzin' Bee here, do you copy?

CB is making news all over the country and we'd like to keep you up-to-date on the latest developments. But we'll need your help. Got a funny story about an experience you've had with CB radio? How about an exciting or unusual experience? If so, I'd sure like to hear from you, because personal accounts of CB experiences are what this column's all about. Send me short personal accounts of your experiences with CB and in each issue of ELEMENTARY ELECTRONICS I'll publish the best of what I receive. Pictures can make or break a story; so whenever it's possible, include at least one black and white glossy photo of CB in action. If you're talking about a CB gathering, get pictures of the highlights. If you're talking about an emergency or a crisis where CB played a role, get pictures to go along with your account. And now, on with the news...

Ramblin' Redskin Rides the Range

"Stick 'em up," is not just cowboy or CB lingo—it's also what you do with self-adhesive stickers, bumper stickers, and patches from the Rambling Redskin. Three of the Redskin's many



products, which just arrived here at the office addressed to me, are shown here and I understand that these are just a small sample of the huge array that is available. You can get all the details from the Rambling Redskin himself at Dept. DM-1, P.O. Box 564, North Bergen, NJ 07047. Incidentally, Rambling Redskin is the handle for S. Russel, a man who's been called that since 1958 when CB radio was born.

Bears' Diet Expands

It used to be that "feeding the bears" meant only one thing: on-the-spot payment of a fine or a ticket collected from a state police officer. Nowadays though, paying your speeding ticket isn't the only way you can keep your local Bears "fed."

"Feeding the Bears" currently also refers to passing information to police on accidents,

drunken or reckless drivers (also known on the CB waves as D.W.I.'s—people who Drive While Intoxicated), hazardous road conditions, and the like.

Mayfield Village, Ohio is a small community on the far east side of Cleveland whose police department is discovering that this aspect of CB radio is helping them do a better job. Police Chief William Shortle said the addition of CB radio to police cruisers in Mayfield has led to a marked increase in arrests and assists. "Truckers have learned that we monitor channels 10 and 19, and they regularly post us on problem areas," he commented. "Highway 271 runs through Mayfield Village," he explained, "and although our surveillance strip is only 3½ miles long, a lot can and does happen on this section of the road."

The things that happen often go beyond the routine accident reports and hazardous driving warnings. A Mayfield Villager recently used her CB to inform police that the man who was test driving the car she was selling had neglected to bring it back. The police caught him. Another CBER reported a couple who had pulled off the road to allow what started as a domestic argument to blossom into a full-scale war. Police also hear about road fires, juveniles bombing cars from a bridge, narcotics deals, illegal hunting—the list goes on and on.

Although Mayfield Village operates on low band police radio, CB has proved its value as a supplemental system that helps get officers where they are needed—fast. "Some of the CB calls originate in communities to our north or south," Chief Shortle said, "and by the time the offender reaches our town, we're ready."

It all boils down to this: your local Bears don't have to starve just because you're a law-abiding driver who doesn't incur fines from the police. You can feed the Bears by giving them useful information—you'll be happier, they'll be happier, and your community will be a safer, more secure place to live.

CB Thieves Scamper in Springfield, Illinois

Sgt. Chris Kratzer, Director of the Crime Prevention Bureau in Springfield, Illinois, writes us to report that an effective CB identification program has been instituted in the Springfield metropolitan area. Recently, he says, five autos were parked side by side at a local motel. All five autos were equipped with CB radios and the antennas were visible. During the night, three of the five autos were broken into and the radios taken. The cars broken into were not participating in our program. The other two cars contained radios which had been engraved with identification numbers, registered with the Sheriff's Office, and the cars were marked with window and bumper stickers that advertised their participation in our program. These two cars were not touched by the CB thieves.

Springfield's CB Identification Program con-

sists of four basic steps: (1) Engraving the unit with the owner's driver's license number and the abbreviation of the state in which the license was issued. The serial number of the equipment is also engraved because the serial number applied at the factory is usually easily removed. (2) The same information as described above is written on the equipment with an ultraviolet marker. (3) Records are maintained at the Sheriff's office of all units which have been engraved. (4) The participant is given bumper and window stickers to apply to the car which will contain the CB unit. The stickers warn thieves that the CB equipment is registered with the Sheriff's Office.

Since the program was initiated, 3,000 CB radios have been engraved. This constitutes about ten percent of the total number of CB radios estimated to be owned in the area. Sgt. Kratzer hopes to increase the number of participants in the program to at least sixty percent

**We Have
Joined . . .**

OPERATION IDENTIFICATION

All items of value on these premises have been marked for ready identification by Law Enforcement Agencies.

SANGAMON COUNTY SHERIFF'S DEPT.

of CB radio owners in the area. As we go to press, CB thefts in the area have been reduced from an average of 9-10 CB thefts per week to an average of 1-2 CB thefts per week. That's an 80% reduction, and with increased participation, Sgt. Kratzer hopes to reduce these averages.

The Crime Prevention Bureau has made every effort to make the benefits of the program available to as many people as possible. The Bureau sends representatives to local CB Coffee Breaks to provide the engraving equipment, the stickers, and additional information. It looks like the publicity is paying off. Both CBERs and CB thieves are becoming increasingly aware that CB equipment which is permanently marked can be traced to the original owner, and is much harder to sell or fence.

And last but not least, the Crime Prevention Bureau has future plans too. They include attempting to get the program operating on a national level, and convincing the CB manufacturers to stamp their serial numbers into the radio case rather than simply applying paper or plastic serial number stickers which can be easily removed.

Some Short Shorts

In Fort Worth, Texas the highway department is letting a lot of ingenuity creep into its sign language. As motorists approach a stretch of road construction, a unique sign issues its own Smokey report and warns both CBERs and non-CBERs to slow down. Take a look at the picture and you've just got to admit that those Texas Rangers have got a sense of humor that's wall-to-wall and treetop tall.

You may be interested to know that your editor-in-chief, Polish Ham, recently became an

(Continued on page 96)

THE ENDANGERED



Alert short-wave listeners can bag these stations now—but not for long.

by Harry L. Helms, Jr.

HAVE YOU HEARD Panama, Surinam, Swan Islands, Hong Kong, or Reunion on shortwave lately? You haven't? Don't feel too badly, buddy, because no one else has either! These are just some of the countries that formerly operated on shortwave but do so no longer. DXers who are relatively new to the hobby can only look on in envy as DXers who have been in the hobby longer proudly display their verifications from these countries. Other countries such as South Vietnam, Angola, Lebanon, and Cambodia are still on the air, but just try and get a QSL

out of any of them now! Sad to say, veteran DXers have often heard and verified countries that the newcomer won't be able to hear or verify no matter how expert he becomes in the DXing hobby!

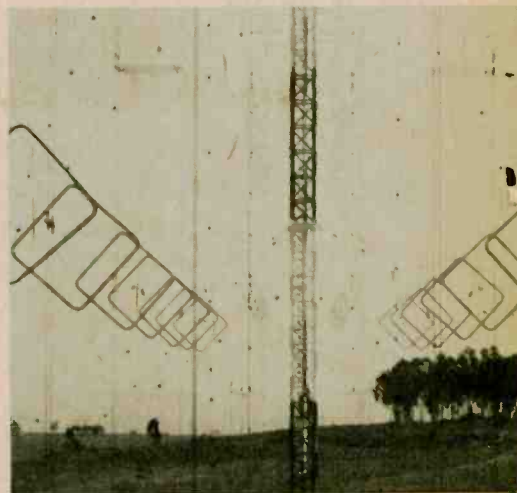
But dry your tears, my friend. The international shortwave scene is a dynamic one. New countries are coming on that the old-timers never had a chance to hear or verify. Moreover, there are several shortwave outlets that can be heard and verified today that may very likely not be around in the near future. These are the "endangered species" of shortwave, and the alert DXer can bag these stations now and get the QSLs from them while they're still available. In a few years you too can turn a new DXer green with envy with *your* collection of QSLs from "extinct" catches!

Start Close to Home. Canada offers several private shortwave broadcasters whose future is doubtful. In 1973, CJCX-6010 kHz, in Sydney, Nova Scotia—gave up shortwave operation due to the competition and interference from higher powered broadcasts. Other private broadcasters in Canada face similar problems, plus the possibility of declining listenership on shortwave. The message here is clear—hear and verify them now.

Fortunately, Canada's three remaining private shortwave stations operate 24 hours a day on their frequencies, allowing for good North American reception after the Europeans leave the air. Try at approximately 0500 to 1300 GMT for the following: CFRX, Toronto, on 6070 kHz; CFCX, Montreal, on 6005 kHz; CHNX, Halifax, Nova Scotia, on 6130 kHz. In addition, the Canadian Broadcasting Corporation operates two 49-meter outlets, both on 6160 kHz. CKZN operates from 0930 to 0500 GMT at St. John's, Newfoundland and CKZU is on the air 1400-



View from the top of a curtain antenna which comprises part of the Deutsche Welle's Sines relay station in Portugal.



SPECIES OF DXing

ENDANGERED SPECIES LIST OF SHORT WAVE STATIONS

ARGENTINA *Radiodiffusion Argentina al Exterior*, Buenos Aires. English to North America from approximately 0315 to 0345 GMT on 9690 kHz. Future depends on resolution of political situation in Argentina, often erratic verifier but has been responding reasonably well of late.

CANADA Private broadcasters: CFRX Toronto 6070 kHz; CFX Montreal 6005 kHz; CHNX, Halifax, Nova Scotia 6130 kHz; all 24 hours and excellent verifiers. *Canadian Broadcasting Corporation* stations: CKZN 0930-0500 GMT St. John's, Newfoundland; and CKZU 1400-0905 GMT Vancouver, British Columbia; both on 6160 kHz and excellent verifiers.

ETHIOPIA ETLF, *Radio Voice of the Gospel*, Addis Ababa. Religion from 1715-2030 GMT with English 1945-2030 on 11830 kHz. New government in Ethiopia may give in to pressure to end ETLF's Arabic language Christian broadcasts to the Middle East.

GAMBIA *Radio Gambia*, Bathurst. 4820 kHz, 0625 GMT sign on, BBC news relay at 0700. Scheduled to leave air by end of 1976. Excellent verifier.

INDONESIA *Radio Republik Indonesia* regionals, such as Yogyakarta on 5046 kHz, Surakarta on 4932 kHz, Gorontalo on 4900 kHz, and Jakarta on 4775 kHz. Usual reception times 1130 GMT to local sunrise. Indonesian talks and music. Irregular and unpredictable verifiers. All due off by sometime 1977.

MALAYSIA *BBC Far Eastern Relay*, Tebrau. 1100-1500 GMT on 9740 kHz and 1100-1330 GMT on 11750 kHz, English. Excellent verifier; report to London and request site be specified. Rumored to be closed sometime by 1977.

PORTUGAL *Deutsche Welle* relay at Sines. 7285 kHz 0440 to past 0700 GMT in various East European languages. Report to Cologne; excellent verifier. Future quite uncertain—depends on tilt of eventual Lisbon government.

RYUKYU ISLANDS *Voice of America* relay, Okinawa. 1100-1500 GMT on 6010 and 7165 kHz; and 1100-1200 GMT on 1178 kHz; in English. Relay may be a bone of contention between China and both the United States and Japan.

SRI LANKA *Voice of America* relay, Colombo. 0100 to 0330 GMT in English on 7110, 15185, and 11740 kHz. Also in English at 1300-1800 GMT on 7110 and 15185 kHz; at 1300-1500 GMT on 11935 kHz; and at 1500-1800 GMT on 11715 kHz. Low power, 35 kw. May soon be replaced or given to Sri Lanka government. Excellent verifier; as all VOA stations, much easier to QSL than Sri Lanka Broadcasting Corp.

TAIWAN *Voice of Free China*, Taipei. English to North America 0200-0350 GMT on 15125 and 15345 kHz. Usually good verifier although sometimes erratic. Future clouded due to insistence of mainland China that Taiwan must eventually be reunited with the mainland.

0905 GMT from Vancouver, British Columbia. Since both of these stations operate on the same frequency, positive station identifications are a must! Budget cuts in the Canadian Broadcasting Corporation's appropriations jeopardize these two stations, especially since there is already a Northern Service by the CBC for isolated areas.

Argentina is a nation that is undergoing political upheaval as of this writing. It is also the home of a well-

heard external service, *Radiodiffusion Argentina al Exterior*. Established by the late Juan Peron, *RAE* features English programming from 0315 to approximately 0350 GMT on 9690 kHz. Argentina will retain some shortwave broadcasting, it seems safe to say, regardless of the outcome of its current turmoil; whether or not it will carry English or readily verify is another matter. Better get it now!

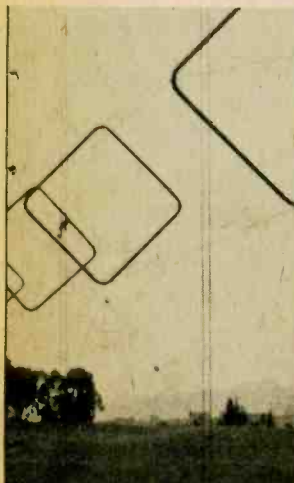
On the Other Side of the Pond. Portugal has been in the news quite a bit since 1974, when a military coup deposed the remnants of the old Salazar regime. While the final form of govern-

ment that will eventually rule Portugal is unknown as of this writing, the indication is that the government will have a socialist tilt, which puts a cloud over all non-governmental broadcasters.


In late 1975 the Portuguese government nationalized all private medium wave broadcasters. Exempted from this order were all foreign relay stations, but this could change at any moment. A particularly vulnerable target might be the Sines relay of *Deutsche Welle*, West Germany, which is used primarily for transmissions to Eastern Europe (due to propagational advantages). Try for it from 0440 to past 0700 GMT on 7285 kHz in various East European languages such as Bulgarian and Romanian. Reports go to *Deutsche Welle* headquarters in Cologne.

Africa has a target to shoot for with a definite deadline: Gambia will leave shortwave altogether by the end of 1976! This small West African nation operates on 4820 kHz with barely three kilowatts, yet is often heard at 0625 GMT sign on, followed by some English and African chanting, with a relay of BBC news at 0700. They are a good verifier, so act now!

Ethiopia has also undergone a politi-



Against the African sky, the curtain array antenna of Radio Voice of the Gospel stands. From this antenna, programs go out to Africa, the Mideast, and Asia.



A technician at Radio Voice of the Gospel, Addis Ababa, Ethiopia, plays back a tape recording.

cal shakeup, and is under increasing pressure from Arab neighbors because of the presence of ETLF, *Radio Voice of the Gospel*, in its capital city of Addis Ababa. ETLF is a major supplier of Christian broadcasts to the Moslem Middle East, and as such faces a rocky future. Try for it on 11830 kHz with religious broadcasts 1715-2030 GMT, with English scheduled 1945-2030. They are an excellent verifier.

Asia Is Active. 1975 brought several changes in the broadcasting scene, with South Vietnam, Cambodia, and Laos undergoing many changes as a result of the new regimes in those countries. Three new countries where major changes could be in the offing are Taiwan, Malaysia, and Indonesia.

Malaysia is the home of the *BBC* Far Eastern Relay at Tebrau. Problems here include the desire of the Malaysian government to avoid offending China and the *BBC's* own financial pinch. 1976 could very well be the last year for the Tebrau relay. It is heard in English from 1100-1500 GMT on 9740 kHz and at 1100-1330 on 11750.

Taiwan is in a precarious position due to the growing number of nations that recognize the People's Republic of China and the adamant insistence of the mainland nation that Taiwan be returned eventually to the People's Republic of China. Taiwan's *Voice of Free China* can be heard with English programming at 0200-0350 GMT on 15125 and 15345 kHz, with reception often best in the summer months.

Indonesia has scads of low-powered local shortwave stations that provide exotic listening and good DX for North American listeners. Alas, this situation is about to change, as the government is phasing out the local shortwave stations, with a target date of late 1977 for removal of all local stations from shortwave. After this date, only the official *Voice of Indonesia* will be left for DXers.

Several of these local stations can be heard in North America, although best reception is in the western part of the continent. Here is a sampling of widely-heard Radio Republik Indonesia locals: Yogyakarta, Java on 5046 kHz; Surakarta, Java on 4932 kHz; Gorontalo, Sulawesi on 4900; and Jakarta, Java on 4775 kHz. These stations usually feature a variety of Indonesian talks and music, and are audible from approximately 1100 GMT to your local



Some adjustments are made by the station engineers at the Voice of America's transmitter plant at Colombo, Sri Lanka.



Transmitter control room technician adjusting equipment of the Okinawa relay station, Voice of America Radio, Ryukyu Islands

sunrise, with many stations signing off at 1600 GMT. And if you think that hearing these stations is a challenge, just wait until you try to get a QSL out of them! Many listeners use such exotic techniques as Indonesian language reports to extract verifications from these stations.

Even the "Voice" May Get Squelched. *Voice of America* reception is not always routine. *VOA* has a relay station at Colombo, Sri Lanka consisting of three transmitters, each rated at 35 kilowatts. The *VOA* is reported to be searching for a new relay site in the Indian Ocean area, with the isolated island of Diego Garcia being a frequently mentioned candidate. The *Voice of America* Public Information Office, on the other hand, denies that it is searching for a new relay site in the Indian Ocean area. The Information Office acknowledged, however, that the *VOA's* operating agreement with the Sri Lanka Broadcasting Corporation expires in May 1976. The *VOA* expects that the agreement which allows them to broadcast in Sri Lanka will be renewed. There are no guarantees in situations like this, however. Thus, we'll all have to wait and see what the outcome is. Tune for Sri Lanka *VOA* broadcasts at 0100 GMT sign-on until 0330, in

English on 7110, 15185, and 11740 kHz. On 7110 and 15185, English broadcasts may also be heard at 1300-1800 GMT.

A question mark must also be assigned to the *VOA* relay on Okinawa in the Ryukyu Islands. Recently returned to the Japanese government, the Ryukyus are well located for broadcasts to the Chinese mainland. The Japanese, however, have been concerned over the *VOA* Chinese broadcasts due to Japan's desire to improve Japanese/Chinese relations. The United States has promised that the *VOA* relay will seek to avoid provocation in its Chinese programs. Such an assurance may not prove to be enough for future Japanese governments, and the Ryukyu relay could be included in future American/Chinese negotiations. Try for it on 7165 and 6010 kHz at 1100-1500 GMT, and on 1178 kHz at 1100-1200 GMT, for its English broadcasts.

Don't Wait! Patience is a virtue, except where DXing is concerned. You must DX while you can, and these targets may go "pfft!" in the near future. They're all possible, even on simple equipment, so start tuning! And the verifications you'll receive may be common now, but they'll be collectors items in the future. ■

Glossary of DX Terms

Band—A segment of frequencies designated by international agreement for use by a certain type or group of stations. There are short-wave broadcast bands, amateur radio bands, etc.

DX—Distant radio signals

DXing—Listening to distant radio signals as a hobby.

GMT—Greenwich Mean Time, a universal time reference used by DXers. GMT is equivalent to EST+5 hours, CST+6 hours, MST+7 hours and PST+8 hours.

kHz—Kilohertz, a unit of frequency measurement 1,000 cycles per second.

Medium waves—The frequencies between about 540 kHz and 1600 kHz, the standard AM radio band.

SWL—Shortwave listener, a DXer who favors the shortwave bands for his hobby listening.



CB NEW PRODUCTS



e/e puts together in one neat package some of the newest CB rigs, antennas and accessories for you to use in CB contacts this year!



CIRCLE 64 ON READER SERVICE COUPON

CB Converter. Sparkomatic's new CB Converter has an all-metal case that acts as a shield to cut down ignition and motor noise. The unit, Model CB-10, has a built-in static collector for quieting, and a sensitivity control for sharper channel adjustment. This CB converter fits all cars, boats, campers, and trucks. It fits under the dash and the package includes everything needed for quick, simple installation. An On-Off power control automatically switches off AM reception when the CB converter is activated, and a red "pilot light" lets you know it is in operation. Priced at \$24.95. For further information on this product and other Sparkomatic equipment, write to Sparkomatic Corp., Milford, PA 18337.

CB Power Supply. The compact Model 13-110 regulated 12-volt DC power supply which allows you to convert mobile CB transceivers to base station usage, is now available from the Breaker Corporation. Powerful enough for SSB rigs, the Model 13-110 has a built-in pilot light and Off-On switch. The unit will serve as a satisfactory 12-volt battery replacement for virtually any automotive equipment requiring up to 2.5 amps continuous current and up to 5 amps temporary surge. The output voltage is 12-14 VDC regulated from a 120 VAC 50-60 Hz line and has a circuit breaker for protection against sustained overloads. The unit is U/L listed and sells for \$32.95. For further information, contact Breaker Corp., 1101 Great Southwest Parkway, Arlington, TX 76011.



CIRCLE 68 ON READER SERVICE COUPON



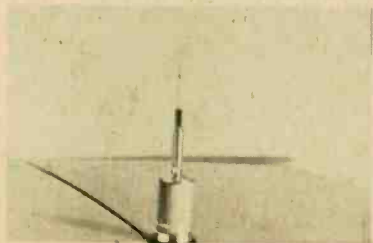
CIRCLE 66 ON READER SERVICE COUPON

24-Carat Contact. For the CBer who has everything, there is now a 24-carat gold-plated version of the Wren D-104 microphone handle, especially designed to simplify keying the Astatic D-104 microphone. The Astatic microphone is keyed with a push-to-talk switch which runs parallel to the long microphone shaft. The user almost has to make a fist, and hold his hand in this fatiguing position, to use the microphone. The Wren D-104 handle, however, adapts easily to the Astatic microphone—without having to disassemble the unit—and allows the user to key the microphone with a light touch of the finger. The 24-carat gold-plated Wren D-104 microphone handle is offered at a price of \$37.50. It is also available in the original heavy chrome-plated version at a recommended retail price of \$14.95. Further information on the Wren D-104 microphone handle is available from Wren House Electronics, Inc., 1438 Brook Drive, Downers Grove, IL 60515.

CB Power Mike. The CB-73 Double-Header, a hand mike with several unique features by Telex, has a built-in, battery-powered IC amplifier with variable gain control. The user can "tune" the mike to his CB radio for maximum output at normal speech and thereby can avoid distorted transmissions. The special Double-Header feature provides selectable noise cancellation. To take full advantage of noise cancellation it is necessary to talk directly into the mike opening with the mike very close to the lips. But the Telex CB-73 can also be used as a standard power mike at some distance from the mouth. A switch at the top of the mike lets the user instantly select the desired transmission mode. The CB-73, housed in an aviation style case, will sell at \$39.95. Get all the facts from Telex, 9600 Aldrich Ave., So., Minneapolis, MN 55420.



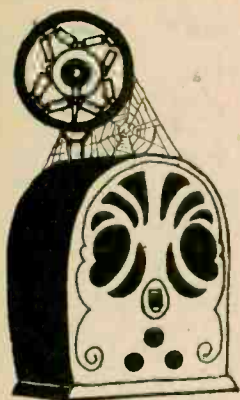
CIRCLE 60 ON READER SERVICE COUPON



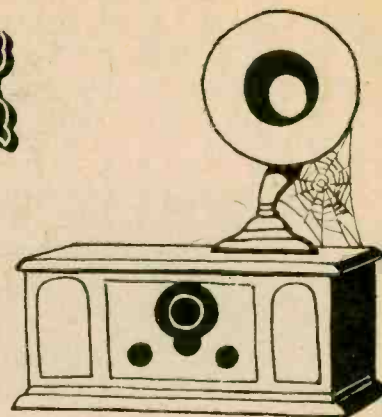
CIRCLE 65 ON READER SERVICE COUPON

Big Momma's New Low Profile. The famous "Big Momma" mobile CB antenna by Antenna Specialists is now available with a new low profile design. The new model, M-510, incorporates the same "Big Momma" super coil made famous in the original model, M-410. This heavy-duty loading coil is specially designed for super coolness, durability, and maximum performance. The antenna, which is equipped with an in-line connector, can be permanently mounted on the trunk with no holes, using the handy "Quick Grip"® trunk lid mount. It also converts easily for rooftop mounting. The manufacturer's suggested list price is \$36.95. For further specifications, contact The Antenna Specialists Co., 12435 Euclid Avenue, Cleveland, Ohio 44106.

(Continued on page 86)



ANTIQUE RADIO CORNER



by James A. Fred

□ Hello! out there in Radioland. If you haven't made plans to go to the AWA annual conference, now is the time to do so. It will be held in Canandaigua, NY on October 1 and 2. I am looking forward to being there this year and hope to see many of you there, too. You will meet over 300 other collectors, attend a flea market, hear speakers talk about radio and wireless history, and find out the best methods to use when restoring old radios. You can visit the AWA Museum in East Bloomfield (just a 15-minute drive away), and see more ancient radio and wireless gear than you ever dreamed of. Your visit to the National Historical AWA Conference will be an experience you will remember the rest of your life.

As you may already know the prices of Vintage Radio books, published by Morgan McMahon, have all increased. Costs for labor, paper, ink, and binding have increased, as has the cost of postage to mail the books.

A reprint of the 16-page users manual for the Radiola III, a radio receiver, is now available for \$2.00 postpaid from

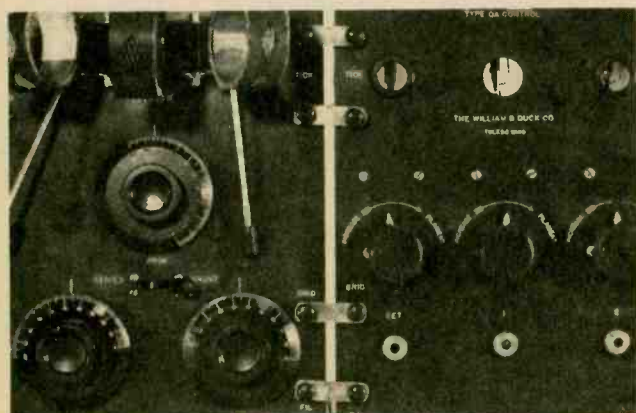
Antique Radio Press, P.O. Box 42, Rossville, IN 46065. It will be very helpful to any owner of the Radiola III A and will increase your enjoyment of the radio set.

IHRS Establishes a Permanent Display. The Indiana Historical Radio Society has removed its display from the Indiana State Museum in Indianapolis and is in the process of setting up a permanent display in Auburn, Indiana. Auburn, Indiana, about 25 miles north of Fort Wayne, is the home of the Auburn - Cord - Dusenberg Automobile Museum. Here on display are over 30 of the most exotic automobiles ever made in the United States. The museum is established in the very same building that once housed the corporate offices and showroom of the Auburn-Cord Company. It is a well preserved building with beautiful chandeliers hanging from the ceiling of the main display room. A graceful marble staircase leads to the second floor where the IHRS display will be established. The IHRS will provide all the material as well as show-cases to hold the radios and other artifacts from the "Golden Age of Radio".

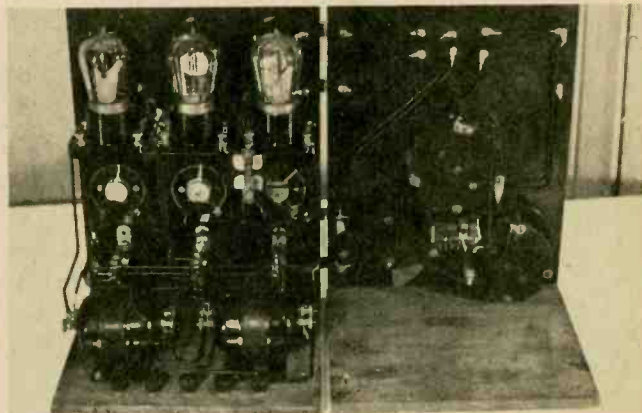
All visitors paying admission to the Auburn-Cord-Dusenberg Museum will be allowed *free* access to the radio display during regular museum visiting hours.

Troubleshooting Tips. Many readers have written to me requesting information on how to troubleshoot particular models of radios. I am sure this information would be useful only to the few owners of the radios in question. Instead I am going to write about troubleshooting old battery radios. This information will be general in nature and will benefit all collectors.

If you intend to be a serious collector you will want to learn how to do simple repairs to your radio equipment. You will first need some basic tools such as long-nosed pliers, side-cutting pliers, a 6-inch adjustable wrench, several sizes of screwdrivers, and a good pocketknife. You must learn to solder and buy a soldering iron. I do not own a soldering gun, never have, and probably never will. A pencil soldering iron with several replaceable tips suits me best. An inexpensive volt-ohm-meter is a must. Most of these items can be obtained at



A beautifully-restored W. B. Duck receiver. Left is tuner section, right contains detector and amplifier stages. Owned by George Hauske, Wheaton, Illinois.



This rear view of the William B. Duck three-tube receiver shows carefully routed bus-bar wiring. Note meter jacks under the filament controls at left center.

your local Radio Shack store or by mail from a Radio Shack catalog. You will find their advertisements in this issue of **ELEMENTARY ELECTRONICS**.

You will use the volt-ohm-meter (VOM) mainly for 2 purposes. One, to measure continuity (a continuous circuit) in tube filaments, speaker coils, transformer windings resistors, etc. Two, you can measure the voltages of batteries and power supplies, and tell if capacitors are good or bad.

Using the VOM. To measure continuity use the circuit shown. Set the meter selector switch to ohms, connect the leads from the meter to the wires or binding posts on the speaker, transformer, etc. The meter pointer should move upscale. Try the different resistance ranges until your meter tells you how much resistance you have in the device you are testing. If you get no reading on any resistance range, the circuit is open. If you get a zero resistance reading you have a very low resistance or a short circuit. Audio transformer windings will have resistance readings from a few hundred ohms to several thousand ohms. Tube filaments have very low resistances. Old radio speakers (1924-1928) will read 1000 to 2000 ohms. Headphones of the 20s and 30s will also read 1000 to 2000 ohms. If you find a recently-made pair of headphones that read three to six ohms, they are of the dynamic speaker type and aren't suitable for use with old radios. If you find a pair of recently made headphones with infinite resistance they are probably of the crystal type and not suitable for use with old radios.

To measure filament continuity refer to the drawings shown of tube bases. Normally the larger pins (if there are two diameters) are the filament pins. The exceptions are shown. The lower

the filament operating voltage the lower the resistance. In fact some of the tubes may show zero resistance. Very seldom do you find a short circuited filament, the usual defective filament is open. There is one caution to be observed when checking tube filaments. Some tube filaments, namely the 30, 32, 34, V99, and X99 draw currents of only .06 amperes. Some ohmmeters draw current in excess of 0.1 amperes. This amount of current will burn out the filaments of the tubes listed above. If you cannot determine the current flowing in your ohmmeter circuit the safest thing to do is to use only the highest resistance range.

For the beginner I recommend a small VOM like the Radio Shack 22-027 which sells for \$8.95. The meter will easily fit into your pocket since it is only 3 1/2 by 2-5/16 by 1 1/4 inches in size. The meter has 8 ranges; AC & DC volts: 0-150, 0-1000; resistance: 0-100,000 ohms; and direct current of

0-150 milliamperes. The meter movement takes only 1 mA (.001 ampere) to deflect full scale. This would make it safe to use with any vacuum tube.

Another reason you need a VOM is to measure voltages of batteries and power supplies. Simply set the VOM to its highest voltage range and place the test prods across the voltage source, observing the correct polarity. If the meter doesn't deflect to half scale, change the range switch to the next lowest range. The meter will be more accurate near the center of each scale so take your reading in this region whenever possible. Remember that batteries deliver direct current (DC), and your home electrical receptacle delivers alternating current (AC). If you are in doubt as to what kind of current you are measuring, read the label on the power source very carefully.

Detect Faulty Capacitors. Another important use for your VOM is to de-

(Continued on page 94)

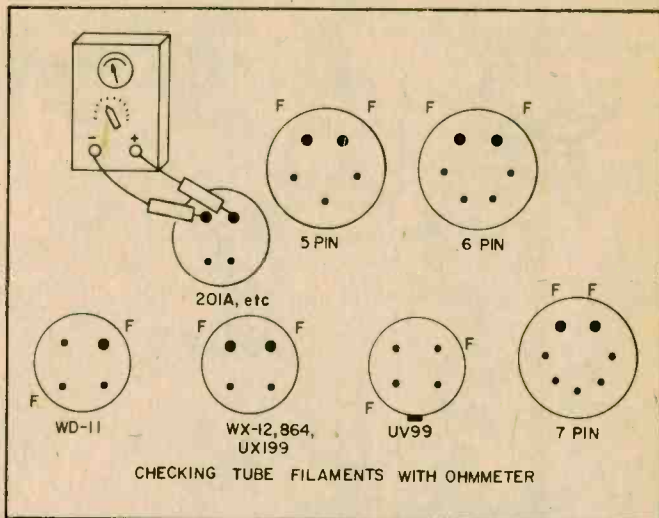
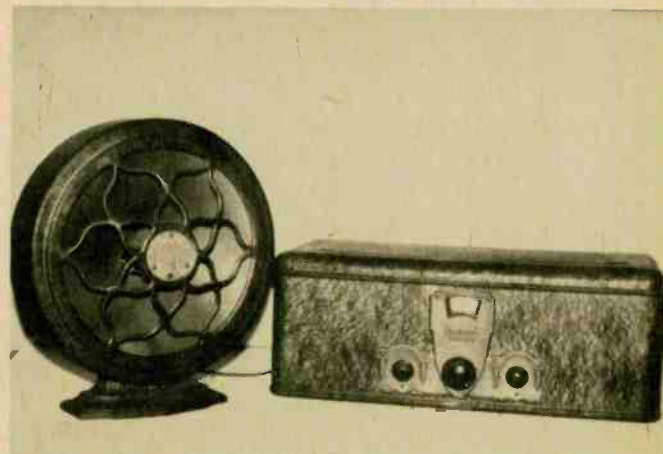


Diagram shows several popular antique tubes which cannot be checked in modern testers. Usual failure was burned-out filaments.



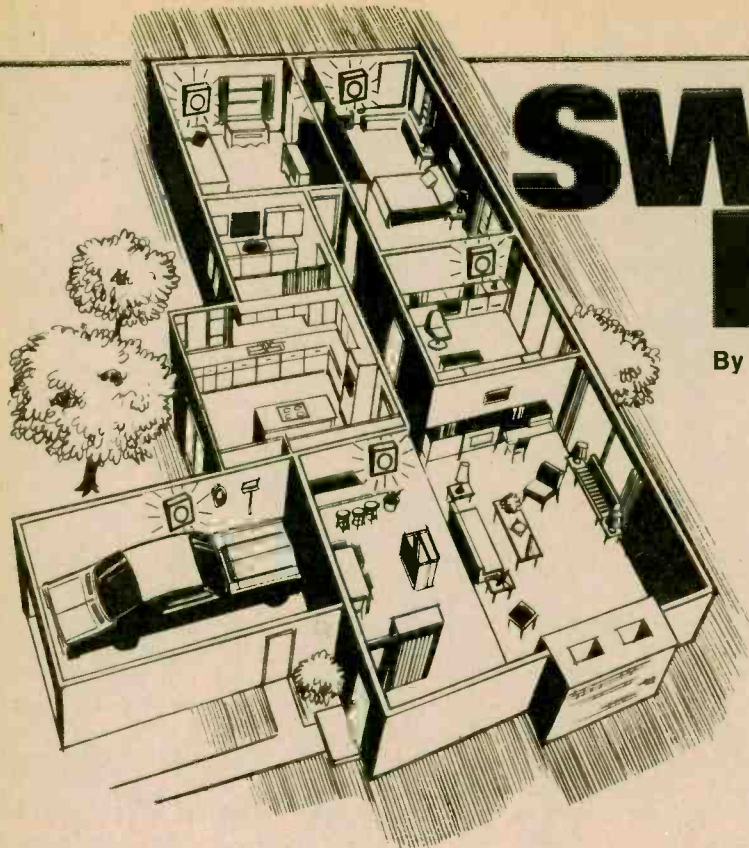
In addition to the antique radio gear usually seen at these meets, there was test equipment on sale at the Indiana Historical Radio Society's flea market.



This Crosley Gembox was one of the very earliest radios to be powered directly from the AC power line. The speaker was also very early—replacing earlier headphones.

SWITCH-A-BAND

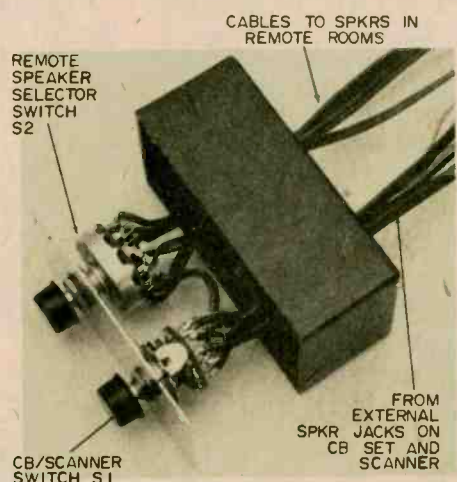
By Jorma Hyppia



SWITCH-A-BAND LETS YOU HEAR CB talk or monitor radio talk (Fire, Police, Aero, etc.) from your scanner set anywhere in your home, as well as over outdoor speakers at your front door or patio, or anywhere else you want to install them, such as the garage or near the sandbox or swimming pool. In addition, you can call anyone in these places using the PA (public address) feature of your CB set when you need to communicate with them in a hurry—for example when there's a telephone call in the kitchen for someone in the basement or outdoors. You can even yell at stray dogs digging up your flower beds, or tell unwanted salesmen that you don't want whatever it is they're selling—or tell them you can't talk to them because there's nobody at home! You can do all this the way I do, without moving from your easy chair,

once you've installed your Switch-A-Band system. Of course you *will* have to move from that ol' rockin' chair a little bit at first, while you're actually setting up and installing your Switch-A-Band.

Switch-A-Band provides instant



The two selector switches mount in small metal enclosure with cables coming from CB and scanner radios, and going to remote and main speakers going out rear. Terminal strips (optional) at rear would make wiring more convenient, but would add a bit to the expense.

switching to permanently-installed speakers in the living room (the "main" speakers), kitchen, garage workshop, son's room, rear terrace and the front door area. I also have a branch line to the basement where a roving single

speaker can be plugged into any one of four outlet jacks located in the office, art studio, photo darkroom, and game room. Use of a roving speaker cuts down initial installation costs by making one speaker do the job of four.

If you have a CB transceiver but not a scanner radio, you can dispense with the CB/Scanner selector switch and just connect your CB set's *External Speaker* jack to the X and Y terminals of the Remote Speaker selector switch. See the schematic diagram.

If you use a selector switch which has more terminals than you actually need for the remote speakers you can easily block the switching action to prevent switching to unused terminals on the switch.

CB/Scanner Selector Switch. This 4-pole, 3-position switch feeds the output of either the CB set or the scanner radio into the remote speaker system. Although it may look a bit complicated the first time you look at it, you'll find it's really quite logical and easy-to-understand after you study the diagram for a few minutes.

Note that this switch has four terminals, 1, 2, 3, 4, in the center of the switch, as viewed from the rear, surrounded by 12 other terminals around the outside. The four terminals in the middle are switched, each one to one



For remote listening in rooms with cabinets or boxed-in areas like kitchen cupboards these flush-mounting speakers work well.

or another of four sets of three outside terminals each. For example, center terminal 1 is in contact, depending on the position of the knob which turns the switch, with either contacts 5, 6, or



Three-position switch on left is at NOR(mal) position in center when no remote speakers are needed. Remote speaker in use is indicated by letters around knob of switch at right. CB set is on shelf at left.

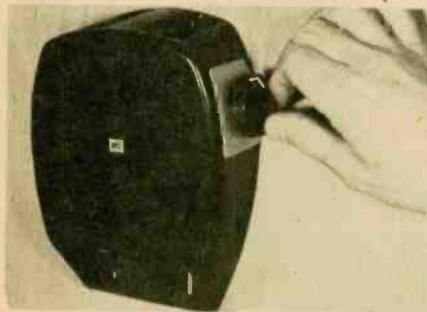
It lets you monitor your CB or scanner all through the house 24 hours a day.

7. The arrows in the schematic diagram show which terminals are connected when the switch is in its CB/Remote position.

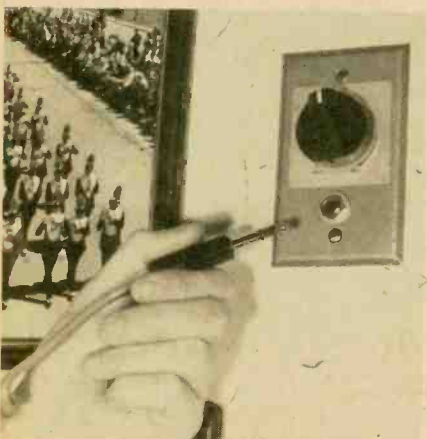
A two-conductor cable leading from the *External Speaker* jack on the rear of the CB set goes to terminals 1 and 2—the output of the scanner radio is similarly connected to terminals 3 and 4. When the switch is in its normal (center) position no signal is fed to the Remote Speakers selector switch. Signals from the CB set and scanner go to small separate speakers at this



Compact outdoor/indoor speaker has 4-in. cone which is moisture-resistant. Mounts on screw or nail anywhere.



Surface-mount speaker in its own enclosure may have optional volume control.



Volume control and stereo headphone jack mount readily on receptacle plate, connect to speaker mounted higher on wall.

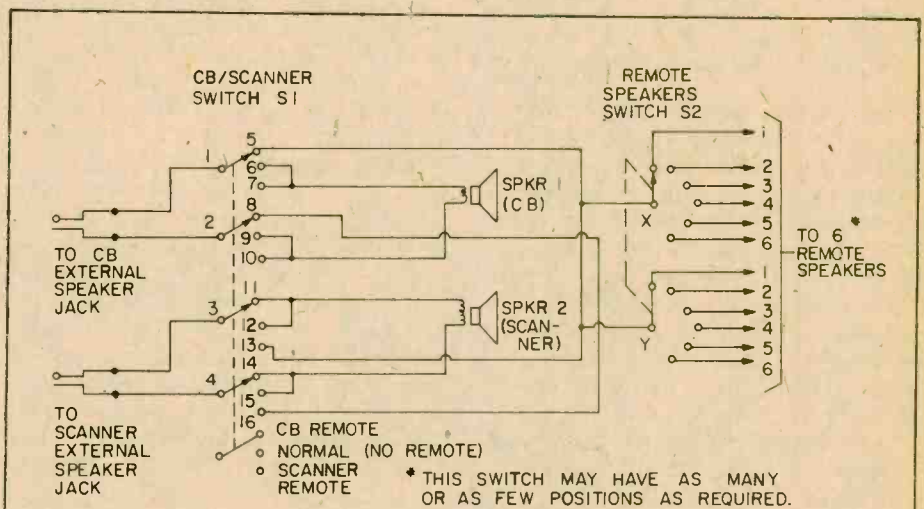
base (main listening) location. These are required because the built-in speakers in the two radios are silenced when the extension speaker jacks are in use. Although these also are "remote" speakers, in one sense, I refer to them as "main" speakers to differentiate them from the true remotes in locations outside the room.

Remote Speaker Selector Switch. 2-pole, 6-position switch S2 routes the signals from terminals X and Y to remote speakers which are connected to the six pairs of terminals labeled 1 through 6.

In my Switch-A-Band the number 3 terminals of S2 lead to four outlet jacks J1 through J4, in the basement of the house instead of to a single speaker. These outlet jacks are in the office, art

studio, photo lab, and the game room. The jacks are wired in parallel, as shown in the diagram. Choose a layout which keeps the wires as short as possible. Do *not* install permanent speakers at each (or even two) of these locations. To do so without connecting them to separate positions on selector switch S2 would result in paralleling the speakers and the audio output stage of the CB set or scanner would feed into too low an impedance, and might easily burn up the output stage (or at least blow out the protective fuse in the set, if it has one).

Use only one roving speaker to carry about and plug into whichever one of the four (or more, if desired) outlets you're going to be working near for a while. Permanent speakers are installed



PARTS LIST FOR SWITCH-A-BAND

J1-J4— $\frac{1}{4}$ -in. phone jack, mono, open-circuit (Radio Shack 274-280 or equiv.)

J5—Optional phone jack, stereo, closed circuit (Radio Shack 274-376 or equiv.)

P1, P2— $\frac{1}{4}$ -in. phone plugs, mono, (Radio Shack 274-1536 or equiv.)

S1—4-pole, 3-position rotary switch, non-shorting (Allied Electronics 851-1543 or equiv.)

S2—2-pole, 6-position rotary switch, non-shorting (Radio Shack 273-1386, Allied Electronics 851R1496, or equiv.)*

*Your local Radio Shack or other supplier may have speaker switches designed to switch several pairs of remote stereo speakers. These often come already mounted in a small metal box with convenient screw terminals for making connections. One of these may be suitable in place of the S2 switch listed above.

SPKR 1, 2—5-in. diameter surface-mount speaker, in enclosure (Radio Shack 12-1842 or equiv.)

Misc.—Aluminum switch enclosure 5-in. x 2-in. x 2-in. or larger (Radio Shack 270-238 or equiv.);

20-gauge, 2-wire speaker cable (Radio Shack 278-1387 or equiv.; 24-gauge, 2-wire speaker cable (Radio Shack 278-1509 or equiv.); volume control, 8-ohm L-pad (Radio Shack 40-980 or equiv.); barrier terminal strip, optional, for making convenient connections to speakers (Radio Shack 274-659, 274-670, etc., according to number of terminals needed.)

ADDITIONAL SPEAKERS

Depending on where the remote speakers are to be used, the following are recommended:

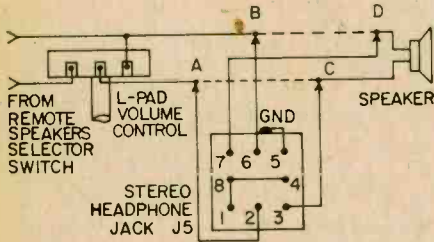
For mounting in cabinets, closet doors, or similarly—5-in. diameter flush-mounting speaker (Radio Shack 12-1841 or equiv.)

For surface mounting—5-in. diameter, with own enclosure (Radio Shack 12-1842 or equiv.)

For outdoor use—4-in. diameter outdoor/indoor speaker, with own enclosure, moisture-resistant cone (Radio Shack 40-1227 or equiv.)

e/e Switch-A-Band

at all other house locations. The weather-resistant speakers on the patio and near the front door are mainly for public address use, to call people in from the yard, to turn away salesmen, or to shoo away stray dogs. Of course the patio and front door speakers can also be used to monitor the CB and scanner radios.



Wiring an L-pad volume control to a speaker is easy using upper left part of diagram above. To add headphones, wire rear of Radio Shack jack 274-376 as shown. It will silence speaker when using phones.

Volume Controls. Another feature of my Switch-A-Band system is the use of volume controls at selected locations. I added an 8-ohm L pad to the roving remote speaker, and also to the speaker permanently installed in our son's room. In the latter the speaker was mounted up toward the top of a wall, so the volume control was placed in a box down lower, where it can be operated from the bed or a chair. Of course, these L pads are optional.

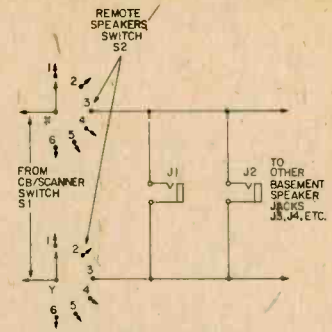
Miscellaneous Equipment. 20-gauge speaker wire was used through the

Switch-A-Band system, to avoid loss of power in the fairly long runs of wire throughout the house. Lighter wire (24-gauge) would be acceptable for remote locations only 15 or 20 feet away, but heavier wire never hurts, and it costs only a little bit more. The two selector switches which are the heart of the Switch-A-Band setup mount easily in a mini-size utility case.

To let our son monitor late at night without disturbing us I mounted a stereo headphone jack on the same small panel along with the volume control. This automatically disconnects his wall speaker when he plugs in his stereo headphones. We used a stereo jack even though the audio signals from the CB and scanner radios are mono, because he had stereo headphones.

Switch-A-Band works fine with any standard automobile or replacement-grade loudspeakers four or five inches in diameter. These units are 3.2 to 8-ohms (nominal) and will work with any CB and scanner radios when connected to the *External Speaker* jack. Using better-quality speakers here is foolish, because we're concerned only with reproducing voice frequencies, not high fidelity music.

Which Speakers? I used these speakers: 5-in. surface mount automobile units in the main living room area, in the garage, and for the roving basement speaker (Radio Shack 12-1842) because they have their own small enclosures. In the kitchen and our son's room 5-in. flush-mounting auto speakers worked out well. And on the patio and near the front door we found that a pair of 4-in. surface-mounting units made for indoor/outdoor use are fine.



Any number of jacks may be wired in parallel in the various basement (or other) rooms to accommodate a "roving" remote speaker which you then carry about when working in various locations.

One final tip. When you use Switch-A-Band as a public address system—by turning your CB set to its PA position—you should get sound only from the remote speakers because plugging into the CB set's *External Speaker* jack usually turns off the set's built-in speaker. If your set doesn't work this way, and the built-in speaker keeps on working even when the *External Speaker* jack is being used, thus causing a feedback howl, there's a trick you can use to silence the built-in speaker. Get hold of a "Y" audio connector and wire it to plugs which will fit into both the *External Speaker* jack and the *PA* jack. Then connect the remaining, third leg of the "Y" connector the input leads from the number 1 and 2 terminals of the CB/Scanner selector switch. This will disable the CB set's built-in speaker and prevent acoustic feedback.

Once you've installed your Switch-A-Band you will undoubtedly find other ways to make use of it. Enjoy! ■

Newsan

(Continued from page 31)

Tom has a simple explanation for everything Robbie does. The robot is basically controlled by a computer that Tom built himself and housed in Robbie's body. In one of Robbie's legs is a tape recorder. Wires run through his other leg to his base, where there are electric motors and a car battery.

Robbie is mounted on wheels, and can be operated by car battery. The car battery allows him to move about freely, but because of the risks of corrosion and leakage, Tom usually uses an extension cord to plug Robbie into the AC line.

An electric socket is mounted on Robbie's base. An ordinary toaster can be plugged in and activated by a spoken



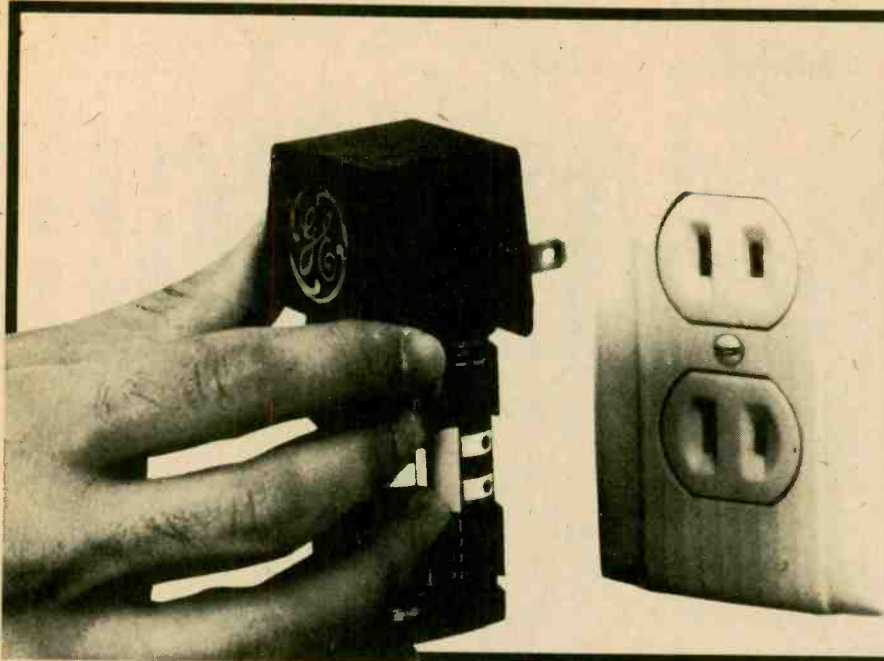
Robbie serves drinks to his master, Tom Clayton, but he hasn't yet been programmed to share same with Tom. In fact, the only thing Robbie needs to survive is electricity—a car battery, or AC house current—either will do.

command. A built-in timer in Robbie switches off the current before the toast is burnt. When a percolator is plugged in and the request made for "coffee, please," the computer alters the time switch to allow the coffee to brew for the correct length of time.

The tape recorder in Robbie's leg is most likely to be asked. A spoken question activates the computer, which then searches for the most appropriate answer on the tape. A request for a lullaby brings forth a pre-recorded song.

When strangers are introduced, Robbie's eyes light up, lights on his body flash, and motors whirr before he tells Tom, "My sensors detect only friendly aliens." He shakes hands with the "aliens" and tells them, "I am pleased to meet you." He adds, "Of course, I use the word pleased loosely. Pleasure

(Continued on page 92)



GOT THE POOPED-BATTERY BLUES?

A thousand-and-one overnight recharges are now convenient with GE's NiCd charging system

□ Do the batteries in your pocket calculator poop out just when you're calculating your share in the family's million dollar lottery ticket? Did the flashlight fail in the middle of the last power failure? Or maybe you're not a stockholder in Burgess or Eveready, and you're tired of the endless purchase of batteries for those never-ending battery-powered devices you get as gifts.

Whatever your battery problems, many of them can be solved by General Electric's latest *Ni-Cd* (NiCad) battery system.

NiCad Advantages. As you know, NiCad (nickel cadmium) batteries (or cells) have three important characteristics: First, NiCad can deliver very high surge currents, relative to their size, which permits devices such as photographic strobe lights to work more efficiently (the strobe unit recycles much faster). Second, and more important, NiCads can be recharged about 1000 times, which, even including the

pennies-per-day recharging, means sharply reduced battery operating costs—even when you include the higher initial price of these NiCad batteries. Third, and most important, NiCads can be kept on a "trickle" charge so a spare set can be maintained at all times in a fully charged, ready-to-use condition.

The General Electric system gives you the most convenient way to utilize NiCad batteries for home, office and business use. The heart of this system is the BC-3 charger, which is a center-tapped power transformer in a compact case having molded-in snap terminals and an AC plug. The BC-3 charger simply plugs into any convenience outlet. Any of three optional battery holders can be attached to the snap terminals on the BC-3 charger and each holder contains the rectifier diode for converting the transformer's AC output to the DC required for charging the batteries; holder MC-2 accommodates two C-cells, holder MD-3 accommodates two D-cells, and holder MA-1 accommodates four AA-cells.

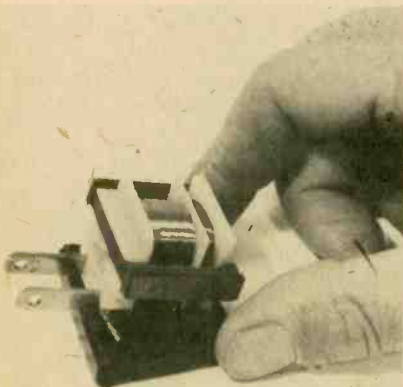
The BC-3 charger always charges at least two NiCad cells—it cannot handle just one, as the circuit continuity is

made through the two cells in the holder. When AA NiCad cells are charged the holder's snap terminals automatically provide the proper connection for two cells and the correct charging current.

How to Stay Charged Up. All NiCad batteries take 16 hours for full charge and can be left permanently on charge to keep a fresh set available. Both the C and D cells take the same charge rate and have the same capacity of 1.2 ampere-hour, so if you use the cells in a homebrew project you can use C-cells to conserve space with no reduction in available current capacity in comparison to the D-cells.

Each item is available as an individual component so you buy only what you need. Presently, the NiCad battery holders are blister packaged with two C, D, or AA cells. The cells are also available individually so once you have the charger and basic holder/battery package there is no additional expense other than for the batteries themselves.

The GE NiCd battery system, as well as extra NiCad cells, are sold nationally in hardware, variety, electronics stores, and wherever batteries are sold. ■



Inside view of NiCd charger shows transformer. Rectifier diodes are not visible.



GE NiCd battery-charging system includes charger (at right) and snap-on holders for three different sizes of batteries commonly used—C, D, and AA (penlight).

METER

learn exactly how they work—by Charles Green, W6FFQ

form (C) to these supports. We used our electric glue gun, but epoxy cement, Elmer's glue, Pliobond, or similar adhesives can be used with equal success.

Now you're ready to cement the magnet and moving coil assembly supports to base (A). Pieces D, E, G, and I are made from 1/4-inch plywood. First step is to cement D and E in their respective locations and fasten the magnet in place. The magnet used in our unit has a mounting hole. If the magnet you use isn't drilled at the bottom center of the U to allow a bolt to go through it to hold the magnet in place, it too can be cemented to D and E.

At this point the main support block (H) should be readied for cementing. But first you must notch it out so that piece I can be properly fastened to it.

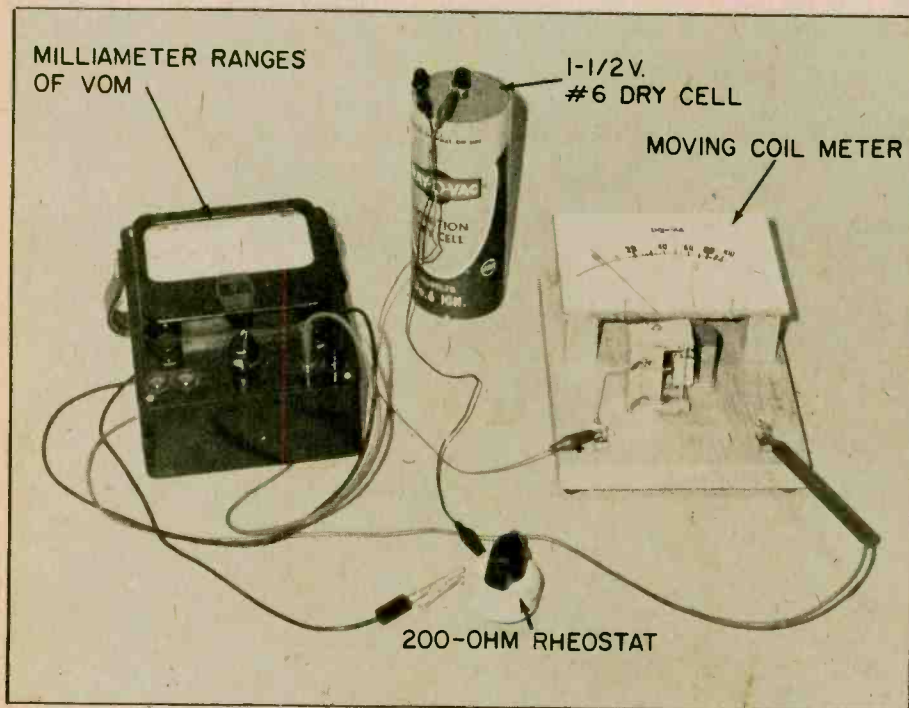
Hold H on the base (A) near piece E and mark H so that the top of the notch will be even with the top of E. The notch should be about 1/4-inch deep. The best way to determine its depth is to hold piece G in position at the top of H and place piece I so that its notched end is even with the notched end of G. Mark the depth of the notch in block H based on the position of the end of piece I that will be inserted in the notch where its end is matched with piece G as mentioned above. Be sure that the notch in block H is cut square so that the surface of piece I will be square with the surface of block H where I is cemented in place. The notches in the free ends of I and G are required only to hold the rubber band in position. Cement block H in position, and also piece G to

block H as shown in drawing.

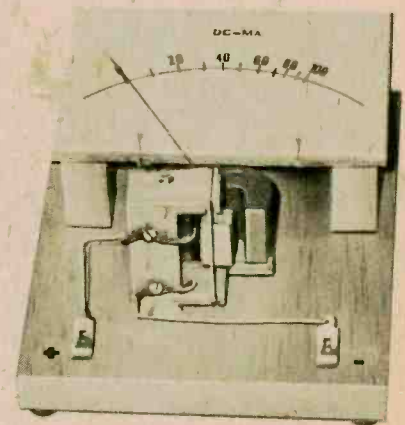
The form block J for the moving coil is made from balsa wood, which is lighter in weight than any other wood and therefore contributes to the sensitivity of the instrument. Cut a notch in the center of J as shown in our drawing. The rubber band (L) is cemented in this notch. We used a rubber band approximately 6 3/4 x 3/8 x 1/16 inch. The coil is made in two sections by winding 25 turns of #38 enameled magnet wire on one half of J and by repeating this winding process in the same direction on the other half of J. Put a touch of cement to the ends of each coil to hold the wire in place and have 6-inch lengths of the start and finish of the 2-section coil for future connection to it. Mount the coil assembly by stretching the rubber band over pieces G and I, centering it vertically within the height of the pole pieces of the magnet.

Now for a Pointer. Straighten out a 4 3/4-inch length of #18 gauge bare copper wire and then form it as shown in the drawing. The pointer is cemented into the notch in block J so that it rests near the O end (left side) of the scale platform. Piece F is used to make final O rest position adjustments after a scale has been cemented in position.

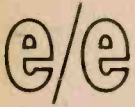
Fasten two double solder lugs to block H; these are intermediary connecting points for the two wires from the coil. Form a helix like a hairspring with each of these leads so that they will wind up as the coil assembly moves clockwise. Solder the end of the wire from the top helix to the top lugs and the bottom helix to the bottom lugs. Mount two Fahnestock clips or binding posts along the front edge of the meter baseboard and connect them to the solder lugs on H, using #18 solid base wire. Since meter polarity is determined



A volt-ohmmeter is very helpful in calibrating the Moving Coil Meter project. If you don't have a VOM handy, try a 0-100 mA milliammeter in the same circuit.

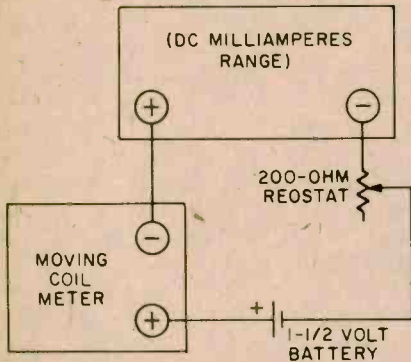


Here's how your finished MCM will look. Its innards are very similar to a bought meter.



MOVING COIL METER

VOM OR MULTIMETER



Any 0-100 mA or higher milliammeter will test your MCM just as well as a VOM or multimeter, provided its accuracy is fairly good.

by magnet polarity and the direction of current flow, established by how the coil is wound, the correct polarity markings of the meter should be determined when you calibrate the instrument.

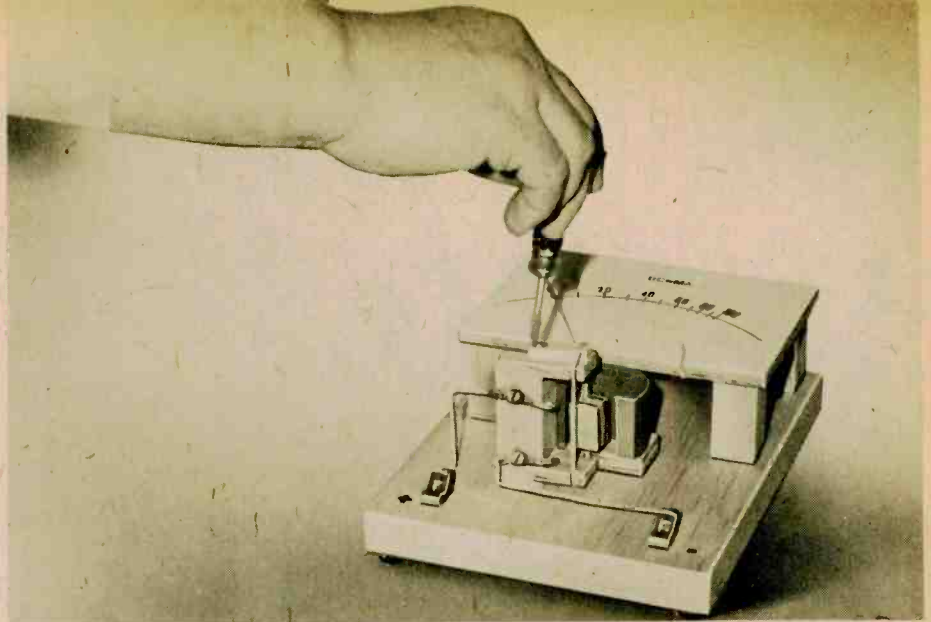
Calibration. In order to calibrate this instrument, you'll need a potentiometer having roughly 20 ohms resistance, a 1 1/2-volt battery and a DC milliammeter, preferably a multi-range one available as part of a VOM.

Now you are ready for the calibration scale that's mounted on the platform C made during the framework construction. The scale is drawn on a piece of heavy white paper (U) which will be cemented to the platform after the calibration marks have been drawn. (Rub-on numerals, such as DataK, make a neat scale.) Temporarily fasten this white paper (U) to platform C, draw an arc as shown in the photo and place a mark on the left-hand side for a zero reference point.

Connect a 1 1/2-volt battery, a 200-ohm potentiometer (used as a rheostat) a multimeter set on DC milliamperes ranges (or a milliammeter), and the moving coil meter you have just built, as shown in the calibration diagram.

Set the potentiometer for maximum resistance and at the start use the highest milliamperes range of the multimeter. If the pointer on your moving coil meter deflects to the left, below the established 0 point, reverse connections to it and then mark the binding posts + and -. Use the connection diagram to determine their polarity markings after connecting the meter so that the pointer moves to the right.

Slowly turn potentiometer to reduce resistance in the circuit and note the readings of the multimeter milliamperes range selected. Mark your moving coil



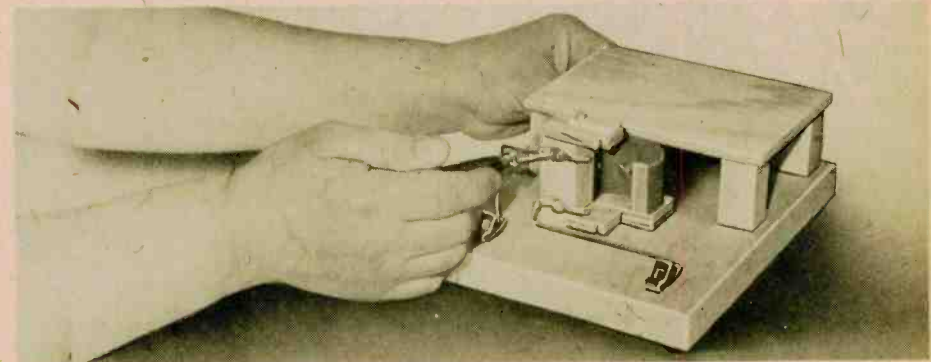
To zero the pointer of your Moving Coil Meter project, all you need to do is loosen the screw as shown, and move the wooden block, thus repositioning the coil assembly.

PARTS LIST FOR MOVING COIL METER

- A—6 x 7 x 3/4-inch white pine
- B—3/4-inch square x 1 1/2-inch white pine (4 required)
- C—4 x 5 x 1/4-inch plywood
- D—1 1/4 x 1 x 1/4-inch plywood (see text)
- E—1 3/4 x 1 x 3/8-inch plywood
- F—3/8 x 1 x 3/16-inch white pine with end notch
- G—3/4 x 1 1/2 x 1/4-inch plywood with end notches
- H—3/4-inch square x 2-inch white pine (see text)
- I—3/4 x 7/8 x 1/4-inch plywood with end notches
- J—1/2-inch square x 3/4-inch balsa wood with slot
- K—Alnico magnet
- L—Rubberband (see text)
- M—Meter pointer (#18 copper wire—see text)
- N—50 turns #38 enameled magnet wire (see text) (Radio Shack #278-011, #32 gauge wire, may be substituted)
- O—Five #4 x 1/2-inch wood or sheet metal screws
- P—Solder lugs (6 required) (Radio Shack #64-3029 or equiv.)
- Q—Fahnestock clips (2 required) (Radio Shack #270-393 or equiv.)
- R, S—8-32 x 1 or 1 1/4-inch machine screw and nut
- T—4 rubber bumpers
- U—4 x 5 1/2-inch heavy white paper for meter scale
- Misc.—Hookup wire, 200-ohm rheostat, 1 1/2-V. battery, VOM or DC milliammeter

meter with the same readings shown on the milliammeter. We divided the 0-100 scale into 10 mA divisions. In the manufacture of DC moving coil meters spring tensions, spacing and coil weight are carefully controlled so that these meters are linear. For this reason commercial milliammeters have uniform spacing between divisions. Our moving coil meter doesn't have such uniformity because of the variations in the rubber band used for suspension and tension, and because it's difficult to maintain accuracy of positioning the various pieces and to be assured of the strength of magnetic field developed by the magnet. Once you have established the calibration points they can be considered accurate.

Now that you have marked the scale in pencil you can remove it from the platform and apply the permanent markings. Permanently fasten the scale in position and stand back to admire your work. If you used reasonable care in following the instructions, you'll have good reason to be proud of your handiwork. ■



Assembling this moving coil meter is an excellent project for anyone who is handy with tools—and it teaches you how instrument (panel) meters work to measure voltage, as well as current in most electronic circuits.



Kathi's CB Carousel

by Kathi Martin, KGK3916

□ Nobody, present company excepted, likes to see an unexpected success, it seems. In sports and politics, and even in horse racing, unexpected success often breeds hostility. And so it is with CB radio's rapid rise, as this hottest sector of consumer electronics—even hotter than calculators, or that previous all-time sky-rocket, home television—shatters the industry's preconceived notions. In fact, CB radio's rocketing record has just about rescued the electron-

gave two hoots what happens on the amateur bands. Matter of fact, if Mr. Miller would read back a few issues he would find that in an "emergency test" of CB vs. 2-meter repeater I showed how 2-meter repeater far outclasses CB for emergency service. Unfortunately, the average Jane (or Joe) cannot use the ham's 2-meter repeater systems so CB is the next best thing.

As for CBers becoming hams—so what? One has nothing to do with the other—yet almost every second letter I get is from some ham whose club is training people allegedly turned off by CB radio. If I added up the totals of all the CBers that ham clubs claim to be training there would be over a million hams by now. Yet actually there are not many more licensed radio amateurs today than the 250,000 or so there were 15 years ago. The number of hams hasn't begun to keep up with the in-

crease in the general population during these years.

Also, according to my figures, there are more ex-Little League baseball players who are in Ham club classes than there are little Leaguers who made the major leagues this year, so I guess Little Leaguers are being turned off of baseball. That's the kind of logic I get in the mail!

A Marine/CB Radio Set. On to more immediate things now—like the Regency CR-240 CB/Marine transceiver. Yes, it's a CB rig specifically designed for boaters. Since just about any mobile transceiver can be used on a boat you might ask me, "What makes the Regency CR-240 a marine model?" Well, if you look carefully at the photograph of the front panel you'll see a switch labeled *CB*, *Hail*, *Fog Horn* and *Alert Horn*, and a lever switch labeled *DX* and *Local*. It's those two switches that makes the CR-240 a marine rig. To start with, *Hail* is simply the marine term for P.A. (public address), and in fact the P.A. jack on the rear apron has a paste-on sticker that says *Hail*. Okay, you can put a paper sticker on any rig's P.A. output, but how about that *Fog Horn*? The *Fog Horn* position produces a five-second blast once every fifteen seconds. This *blast* comes from the hailer circuit which delivers 10 watts output to a P.A. horn, and that sound can carry for miles across the water. (Most CB rigs have less than four watts available from the P.A. output.) If you don't already have a fog horn on your boat, or you're using one of those manual compressed-gas devices to sound the alarm, the CR-240 puts you at least one leg up on water safety.

Next there's the *Alert Horn* which is activated when the microphone's PTT switch is pressed. It puts out an ear-piercing screech sure to raise the hackles on anyone's neck. Any time a water skier swings out on a collision course with your boat the alert horn will get

(Continued on page 89)



Regency's CR-240 marine radio is a CB set with features usually found only on more expensive marine-band radios. It's noise-blanking circuit is really a whole 'nother receiver for super-noise reduction.

ics business from a mini-depression. If it wasn't for CB there might be a lot of folks out looking for jobs today!

As the number of applications the FCC receives each month approaches the magical million mark I get more and more letters of complaint each month—and many of them make little sense to me. Of the rational letters mixed in with the other kind I got last month, one from Robert Miller, Emergency Coordinator for the ARRL (Amateur Radio Relay League) deserves a public reply. Among other things Mr. Miller says, "There seems to be enough conflict already between the Citizens Radio Service and the Amateur Radio Service, and articles like Kathi's certainly don't help matters. . . ." Elsewhere he says almost 50% of the local amateur radio club's students are CBers that have become disenchanted with CB radio.

There has *never* been a conflict between the CBer and amateur. Rather, it was the amateurs who picked on the CBer. I never knew or met a CBer who



Control features on the Regency CR-240 marine radio are what you'd expect on a high-quality transceiver, with addition of Hail, Fog Horn, and Alert Horn capabilities. These are selected by the center knob on the front panel, between the Volume and Squelch controls. Rear panel shows antenna jack at right, with external speaker jack (for listening to CB reception) next to it. Hail speaker would be a P.A. horn mounted top-side. It can be heard hundreds of yards away when sounding Fog or Alert Horn.



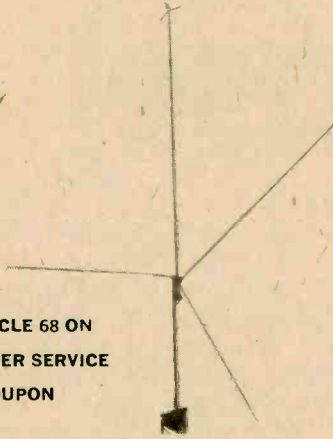
CIRCLE 72 ON READER SERVICE COUPON



CB NEW PRODUCTS



e/e puts together in one neat package some of the newest CB rigs, antennas and accessories for you to use in CB contacts this year!



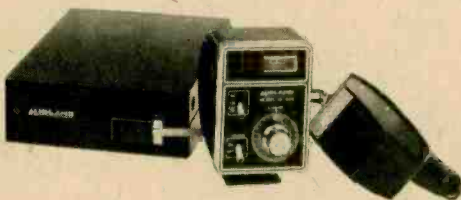
CIRCLE 68 ON
READER SERVICE
COUPON

5/8 Wave CB Base Antenna. The Model 11-103 antenna now offered by the Breaker Corporation features full 5/8 wave radiation and 100 mph wind survival with the use of a long taper-swaged element and radial top hat configuration. The radial top hat and ground plane radials produce a co-linear phase relationship that achieves the lowest angle of radiation. All of the signal energy is propagated along the horizon for the greatest possible range. The antenna also develops the maximum omnidirectional gain of 4 db. The Model 11-103 features a unique built-in static arrester to reduce atmospheric noise and minimize lightning hazard. VSWR is less than 1.2:1 over the entire CB range. Taper-swaged seamless tubing eliminates droop and the ribbed, heavy gauge 12-inch metal mast bracket provides two sturdy points of support to any mast up to 1 5/8-inches in diameter. Input impedance is 50 ohms at the SO-239 connector which is embedded in a moisture-safe housing to prevent electrical failures. The connector mates with a standard PL-259 Plug. Sells for \$42.95. Write the Breaker Corporation, Marketing Dept., 1101 Great Southwest Parkway, Arlington, Texas 76011 for further information on this advanced 5/8 wave antenna plus Breaker's new Freedom Line of CB mobile antennas for cars, trucks, and RV's.

CB Base Station with Fail-Safe Circuitry. A compact 23-channel Citizens Band AM transceiver is being offered by SBE. It's the SBE-30CB Trinidad II AM base station which provides full power output. Automatic fail-safe circuitry switches the unit from normal 117 VAC to battery operation in the event of a power failure. In fact, it can also be operated with a 12-volt car battery. The Trinidad II can be switched from base station operation to virtually any mobile application. Featuring contemporary styling to complement its advanced engineering technology, the Trinidad II is designed with a tilt-up control panel, back-lighted channel identification numbers, and illuminated dual-purpose meter which indicates both transmitter power output and incoming signal strength. In addition to squelch, volume, and channel selection controls, the Trinidad II also provides the user with a PA function. The unit is supplied with a dynamic microphone with coil cord and four-conductor plug. It sells for \$214.95. For further information, write SBE, Dept. P, 220 Airport Blvd., Watsonville, CA 95076.



CIRCLE 62 ON READER SERVICE COUPON



CIRCLE 67 ON READER SERVICE COUPON

Modular Mobile CB. Midland's newest 23-channel, full-power CB mobile transceiver, Model 13-955, comes in a three-section modular design. A compact control head, just 4-in. high, 2 3/4-in. wide and 4 1/2-in. deep, contains the lighted 23-channel tuning dial, dual function signal/power meter and TX light, as well as power switch, PA/External CB switch, and the unit's built-in speaker. The External CB switch directs CB reception to optional PA speaker. The plug-in microphone holds volume and squelch controls to give maximum operating convenience. While the third module, the main circuit unit can be mounted in a car's trunk, on firewall, dash, or any remote and inconspicuous location available, the control head is attached to a versatile mounting bracket by means of a single screw for easy removal. The bracket is reversible, so the control head can be placed on transmission hump, under dash, or even overhead. Connection between these modules is made by a 20-foot aircraft quality multi-conductor cable.

The 13-955 puts out full 4.0 watts of output power. The receiver is dual conversion superheterodyne type with tuned RF stage, active automatic gain control and built-in automatic noise limiter. Twenty-three channel operation is achieved through a precision Phase Lock Loop (PLL) synthesizer that utilizes only three crystals. Operation is on 12 volts DC, positive or negative ground, by means of Midland's Omni-Power system. The 13-955 sells for \$229.95. For more information, write to Midland International Corp., P.O. Box 1903, Kansas City, MO 64141.

(More on page 75)

E/E BASIC COURSE IN ELECTRICITY & ELECTRONICS

RECOMMENDED THEORY FOR ALL CB OPERATORS



This series is based on BASIC ELECTRICITY/ELECTRONICS, Vol. 1, published by HOWARD W. SAMS & CO., INC.

HOW RADIO RECEIVERS WORK

WHAT YOU WILL LEARN. When you have finished reading this article you will have learned what the parts of a radio receiver are, how they are similar to the parts of a radio transmitter, and how they separate the incoming radio frequency carrier waves (the carrier medium) from the audio frequency sound waves, which are the desired signal. You will also have learned that the important parts of the receiver are similar to the parts of a transmitter. Finally, you will have learned that CB Radio transceivers make use of this similarity of parts of the transmitter and receiver to make most CB sets into what are called transceivers.

A RADIO RECEIVER

The block diagram for a radio receiver similar to the one in your home shows its major parts and how they feed the signal from antenna to loudspeaker.

The purpose of the radio receiver is to convert the amplitude modulation on the carrier back to its original sound. As the carrier increases in ever-widening circles on leaving the transmitter antenna—like ripples in a pool—its energy decreases in amplitude. The increasing circumference of the circles causes power in the waveform to be distributed over an ever-increasing area. By the time the signal reaches the receiver antenna it is rather weak, usually around a few thousandths or millionths of a volt. The receiver, therefore, must amplify the received signal to a level that will operate the speaker within the hearing range of the human ear. The receiver must also extract the audio component (the **envelope**) from the carrier. The carrier brings the signal to the receiver, but has no function in reproducing the audio frequency in the receiver.

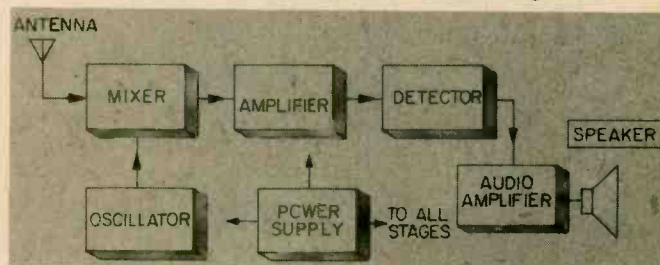
Receiver Circuits

The Power Supply—Each receiver has a power supply. Its purpose is to convert 115 volts AC from an electrical outlet to DC voltages that will operate the receiver properly.

The Antenna and Mixer—Radio frequency carrier waves from all stations within range of a receiver appear at the antenna of the receiver. When you turn the dial of your radio to a specific station, you adjust the electronic components of the **mixer** input so that the receiver will accept a particular carrier frequency and reject all others. The received carrier enters the mixer to be amplified. CB radio receivers, as well as other

sets which need to be very sensitive because they must receive very weak signals (from weak transmitters, or from transmitters which are distant), must have an additional stage between the antenna and the mixer. This stage is called an RF (radio frequency) amplifier.

Typical Radio Receiver Block Diagram



QUESTIONS

- Q1. What part of the received radio wave does the receiver convert back into original sound?
- Q2. A radio wave decreases in power as the circumference of its area increases. What is the approximate amount of voltage that enters the receiver antenna?
- Q3. The _____ converts AC to DC voltages required to operate the receiver circuits.
- Q4. A single broadcast frequency appears at the input of the (antenna, mixer).
- Q5. CB radio receivers feed the incoming RF signal directly from the antenna to the mixer stage (true, false).

ANSWERS

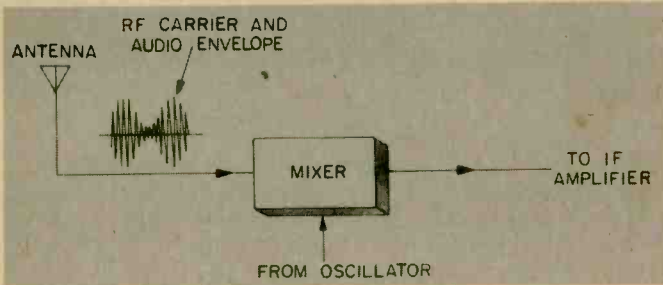
- A1. The **amplitude modulation** (or audio envelope).
- A2. **A few thousandths or millionths of a volt.**
- A3. The **power supply** converts AC to DC voltages required to operate the receiver circuits.
- A4. A single broadcast frequency appears at the input of the **mixer**.
- A5. CB receivers feed the incoming RF signal directly from the antenna to the mixer stage. **False.**

The Oscillator—The receiver oscillator is similar to its counterpart in the transmitter. Both generate a signal of constant frequency and amplitude. The purpose of the receiver oscillator is slightly different, however. It is designed to generate a frequency that is a constant number of kilocycles above the carrier frequency regardless of the transmitting frequency the receiver is tuned to. Tuning the dial changes the value of the electronic components in the frequency-generating part of the oscillator at the same time it adjusts the frequency-



determining components of the mixer (In CB sets the channel selector changes the frequency-determining components). The arrangement is such that the oscillator will always be tuned 455 kHz above the frequency of the carrier being accepted by the mixer. The output of the oscillator is fed to the mixer.

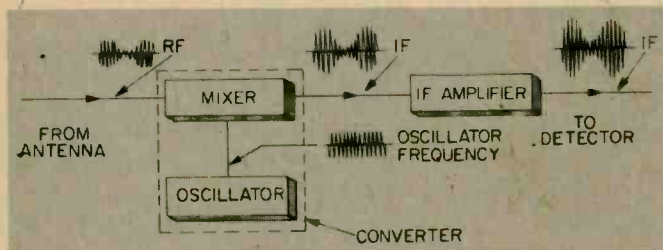
Antenna and Mixer Stage



In CB sets the frequency to which the oscillator is tuned is often two to 11 MHz above (or below) the incoming RF carrier frequency, instead of 455 kHz.

The Mixer—The carrier and oscillator frequencies combine in the mixer stage and four different frequencies appear at the output. One of these four is the **difference** between the oscillator and the carrier frequencies, and is usually 455 kilocycles. The other three are rejected by the next stage. The mixer and oscillator together are called the **converter**.

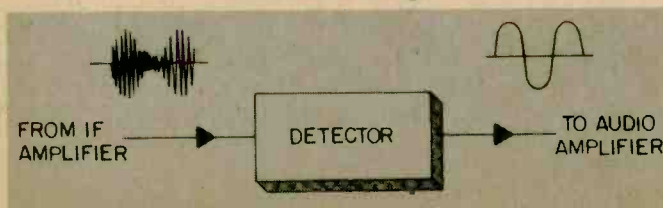
Mixer, Oscillator, and IF Amplifier



The IF Amplifier—The abbreviation for **intermediate frequency** is **IF**. In most home receivers the IF is 455 kHz. Amplifying a single frequency in the IF circuit is much easier and causes less distortion than if it were necessary to tune this amplifier to each of the many station frequencies. The only purpose of this stage is to amplify the IF (which still retains the original audio frequency) and pass it on to the detector.

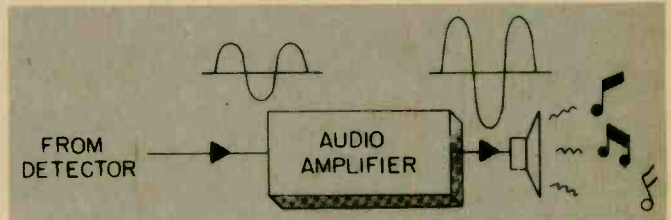
The Detector—The purpose of the **detector** is to remove the audio component from the IF waveform. The audio envelope is the same (although reversed) at the top of the waveform as it is at the bottom. The detector circuit is so designed that it accepts only the audio frequency at the top and rejects the IF frequency in the waveform.

Detector Stage



The Audio Amplifier—The final circuit in the receiver amplifies the AF fed to it by the detector. The amount of amplification can be varied by the volume-control knob on the front of the receiver. The output of the audio amplifier is applied to the speaker voice coil, causing the speaker cone to reproduce the sound that originated at the studio.

Audio Amplifier and Speaker



QUESTIONS

- Q6. The _____ removes the AF from the IF waveform.
- Q7. The oscillator develops a signal at a constant _____ and _____.
- Q8. A converter combines the functions of _____ and _____.
- Q9. The IF (intermediate frequency) of most home AM sets is (455, 680, 1041) kHz. CB sets often have IF amplifiers set for (2-11, 5-20) MHz.

ANSWERS

- A6. The **detector** removes the AF from the IF waveform.
- A7. The oscillator develops a signal at a constant **amplitude** and **frequency**.
- A8. A converter combines the functions of **mixer** and **oscillator**.
- A9. The IF of most home AM sets is 455 kHz. CB sets often have IFs set at 2-11 MHz.

FREQUENCY MODULATION

The transmitter and receiver with which you have just become familiar employs amplitude modulation (AM) to carry the audio. Another method of superimposing audio on a carrier is called **frequency modulation (FM)**. Its process is quite different. The two are compared in the drawing.

Both AM and FM start out with a carrier frequency and an audio frequency (sound originating in the studio). In amplitude modulation, as you already know, the sound is superimposed on the carrier frequency (which is constant) by varying the carrier **amplitude** in conformance with the voltage and frequency of the audio.

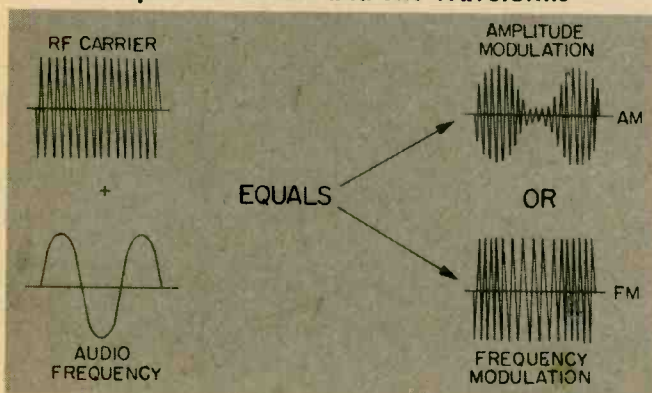
In FM, however, the audio is mixed with the RF in such a way that the carrier **frequency** is varied in accordance with the amplitude of the sound. As the audio cycle goes positive, the RF carrier frequency increases. When the audio cycle goes negative, carrier frequency decreases. The sum of the two changed frequencies in one audio cycle is still equal to the original carrier frequency.

One of the advantages of frequency modulation is its freedom from distortion. Noise and other forms of distorting voltages in the atmosphere or receiver are added to amplitude modulation. Since FM does not depend on changing amplitude to carry audio, noise

has little or no effect on it. This is part of the reason for the clarity of sound that you get from an FM receiver.

CB sets for many years (1958 until the early 70s) used AM to carry the audio information. Now, in order to get more distant reception, and to get more stations into a given amount of radio frequency spectrum, CB sets which use single sideband transmission are being manufactured. This is more complicated than ordinary AM, or even than FM. It is a special kind of AM, and will be used increasingly in the future, as more and more CB sets keep going on the air and crowding the radio spectrum. For a more detailed discussion of how AM, FM, and Single Sideband (SSB) work, see *ELEMENTARY ELECTRONICS* issues of January/February 1976 (pages 65-68) and March/April (pages 73-76).

Comparison of AM and FM Waveforms



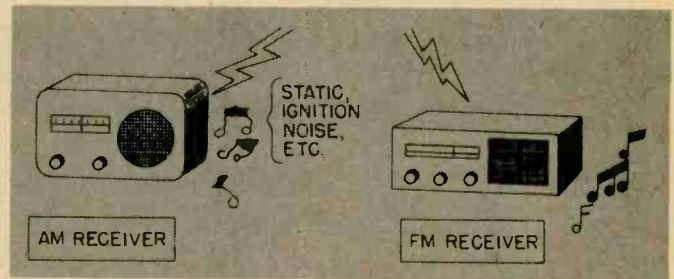
QUESTIONS

- Q10. In AM, the carrier _____ changes to match the audio.
- Q11. In FM, the carrier _____ changes to match the audio.
- Q12. An FM receiver is (more, less) subject to atmospheric noise than an AM receiver.
- Q13. Single sideband (SSB) transmission is a special kind of (AM, FM) which has some advantages over standard amplitude modulation.

ANSWERS

- A10. In AM, the carrier **amplitude** changes to match the audio.
- A11. In FM, the carrier **frequency** changes to match the audio.

Noise Has Little Effect on FM



- A12. An FM receiver is **less** subject to atmospheric noise than an AM receiver.
- A13. Single sideband (SSB) transmission is a special kind of **AM (amplitude modulation)** which has advantages over regular AM.

WHAT YOU HAVE LEARNED

- All carrier signals within range are picked up by the receiver antenna. The tuning control on the front of the receiver adjusts the input of the mixer or converter stage so that only the desired station carrier frequency is received. At the same time, it adjusts an oscillator to generate an IF above the carrier frequency. Carrier and oscillator frequencies are joined in the mixer or converter and the difference between the two, the intermediate frequency, is amplified and fed to the IF amplifier. Here the signal and its audio component are further amplified. The next stage (detector) extracts the audio component and passes it to the final stage (audio amplifier). The audio is amplified and fed to the speaker, causing the cone to reproduce the sound that originated at the studio.
- Amplitude (AM) and frequency (FM) modulation are two methods of transmitting audio on a carrier. When AM is used, the amplitude of the carrier varies according to the loudness (amplitude) and frequency of the audio. In FM, the frequency of the carrier is varied instead of the amplitude. FM transmissions are less bothered by atmospheric and receiver noises.
- Single Sideband (SSB) is a special kind of AM which has the advantage of being received over greater distances than standard AM signals of the same power. It also uses up less space in the radio frequency spectrum, so a given amount of frequency spectrum can accommodate more transmitters.

This series is based on material appearing in Vol. 1 of the 5-volume set, *BASIC ELECTRICITY/ELECTRONICS*, published by Howard W. Sams & Co., Inc. @ \$22.50. For information on the complete set, write the publisher at 4300 West 62nd St., Indianapolis, Ind. 46268.

Kathi's CB Carousel

(Continued from page 85)

a lot more attention than waving your arms or shouting at him would.

The *DX-Local* switch reduces the sensitivity of the receiver's RF amplifier so signals coming from only one or two miles don't overload the front end. This helps avoid distortion and

cross-modulation. By reducing the RF sensitivity you also reduce the interference from co-channel signals coming from the other end of the lake, or from the marina down the coast.

Other than the special marine features I've just described the Regency CR-240 is much like any other hi-performance mobile rig. It is powered from 12-volts DC with either positive or negative ground and features a

combination S/RF-output meter, double conversion, a bandpass IF filter for a high degree of adjacent-channel rejection, and a side-chain RF-noise blanker.

Side-Chain Noise Blanker. This is a sophisticated way of eliminating a great deal of the noise which otherwise would come through along with the desired signal. It's the most effective way yet

(Continued on page 91)

LITERATURE LIBRARY

301. Get acquainted with the new *EICO* products, designed for the professional technician and electronics hobbyist. Included in brochure are 7 IC project kits, *EICO*'s "Fonealds," security products and many varied kits.

302. *International crystal* has illustrated folders containing product information on radio communications kits for experimenters (PC boards; crystals; transistor RF mixers & amplifiers; etc.).

303. See brochures on *Regency's* 1977 line-up of CB transceivers & scanner receivers (for police, fire, weather, & other public service emergency broadcasts).

304. *Dynascan's* new *B & K* catalog features test equipment for industrial labs, schools, and TV, servicing.

305. Before you build from scratch, check the *Fair Radio Sales* latest catalog for surplus gear.

306. Get *Antenna Specialists'* catalog of latest mobile antennas, test equipment, wattmeters, accessories.

307. Want a deluxe CB base station? Then get the specs on *Tram's* super CB rigs.

308. Compact is the word for *Xcelite's* 9 different sets of midget screwdrivers and nutdrivers with "piggyback" handle to increase length and torque. A handy show case serves as a bench stand also.

310. *Turner* has two booklets on their Signal Kracker antennas. They give specifications and prices on their variety of CB base and mobile line. Construction details help in your choice.

311. *Midland Communications'* line of base, mobile and hand-held CB equipment, marine transceivers, scanning monitors, plus a sampling of accessories are covered in a colorful 18-page brochure.

312. The *EDI (Electronic Distributors, Inc.)* catalog is updated 5 times a year. It has an index of manufacturers literally from A to X (ADC to Xcelite). Whether you want to spend 29 cents for a pilot-light socket or \$699.95 for a stereo AM/FM receiver, you'll find it here.

313. Get all the facts on *Progressive Edu-Kits* Home Radio Course. Build 20 radios and electronic circuits; parts, tools, and instructions included.

315. *Trigler Electronics* has a complete catalog of equipment for those in electronics. Included are kits, parts, ham gear, CB, hi fi and recording equipment.

316. Get the *Hustler* brochure illustrating their complete line of CB and monitor radio antennas.

317. *Teaberry's* new brochure presents their complete lines of CB and marine transceivers and scanners for monitoring police, fire and other public service frequencies.

318. CBers, *GC Electronics'* 16-page catalog offers the latest in CB accessories. There are base and mobile mikes and antennas; phone plugs; adaptors and connectors; antenna switchers and matchers; TVI filters; automotive noise suppressor kits; SWR power and FS meters; etc.

319. *Browning's* mobiles and its famous Golden Eagle base station, are illustrated in detail in the new 1977 catalog. It has full-color photos and specification data on Golden Eagle, LTD and SST models, and on "Brownje," a dramatic new mini-mobile.

320. *Edmund Scientific's* new catalog contains over 4500 products that embrace many sciences—and fields.

321. *Cornell Electronics'* "Imperial Thrift Tag Sale" Catalog features TV and radio tubes. You can also find almost anything in electronics.

322. *Radio Shack's* 1977 catalog colorfully illustrates their complete range of kit and wired products for electronics enthusiasts—CB, ham, SWL, hi-fi, experimenter kits, batteries, tools, tubes, wire, cable, etc.

323. Get *Lafayette Radio's* "new look" 1977 catalog with 260 pages of complete electronics equipment. It has larger pictures and easy-to-read type. Over 18,000 items cover hi-fi, CB, ham rigs, accessories, test equipment and tools.

327. There are *Avanti* antennas (mobile & base) for CB transceivers and scanner receivers, fully described and illustrated in a new 16-page full-color catalog.

328. A new free catalog is available from *McGee Radio*. It contains electronic product bargains.

329. *Semiconductor Supermart* is a new 1977 catalog listing project builders' parts, popular CB gear, and test equipment. It features semiconductors—all from *Circuit Specialists*.

330. There are over 400 electronic kits described in *Heath's* new catalog. Virtually every do-it-yourself interest is included—TV, radios, stereo & 4-channel, hi-fi, etc.

331. *E. F. Johnson* offers their CB 2-way radio catalog to help you when you make the American vacation scene. A selection guide to the features of the various messenger models will aid you as you go through the book.

332. If you want courses in assembling your own TV kits, *National Schools* has 10 from which to choose. There is a plan for GIs.

334. *Sprague Products* has L.E.D. readouts for those who want to build electronic clocks, calculators, etc. Parts lists and helpful schematics are included.

335. The latest edition of *Tab Books'* catalog has an extensive listing of TV, radio and general servicing manuals.

337. *Pace* communications equipment covers 2-way radios for business, industrial and CB operations. Marine radiotelephones and scanning receivers are also in this 18-p. book.

338. "Break Break," a booklet which came into existence at the request of hundreds of CBers, contains real life stories of incidents taking place on America's highways and byways. Compiled by the *Shakespeare Company*, it is available on a first come, first serve basis.

342. *Royce Electronics'* new full-color catalog updates information on their CB transceivers (base, mobile, handheld). It also describes new product lines—CB antennas and a VHF marine radiotelephone.

344. For a packetful of material, send for *SBE's* material on UHF and VHF scanners, CB mobile transceivers, walkie-talkies, slow-scan TV systems, marine-radios, two-way radios, and accessories.

345. For CBers from *Hy-Gain Electronics Corp.* there is a 50-page, 4-color catalog (base, mobile and marine transceivers, antennas, and accessories). Colorful literature illustrating two models of monitor-scanners is also available.

350. Send for the free *NRI/McGraw Hill* 100-page color catalog detailing over 15 electronics courses. Courses cover TV-audio servicing, industrial and digital computer electronics, CB communications servicing, among others. G.I. Bill approved, courses are sold by mail.

352. Send for the free descriptive bulletin from *Finney Co.* It tells all about their new auto FM radio signal booster (eliminates signal fading).

353. *MFJ* offers a free catalog of amateur radio equipment—CW and SSB audio filters, electronic components, etc. Other lit. is free.

354. A government FCC License can help you qualify for a career in electronics. Send for information from *Cleveland Institute of Electronics*.

355. New for CBers from *Anixter-Mark* is a colorful, 4-page brochure detailing their line of base station and mobile antennas, including 6 models of the famous Mark Heliwhip.

356. Send for *Continental Specialties* new breadboarding prototest devices. They vary in prices from a mini-budget kit at \$19.95. Featured is the new logic monitor, giving information on what it does, how it works, and how to use it.

357. *Dage Scientific Instruments* offers a 16-page booklet on how to build an electronic thermometer with control. Included is an introductory course on thermocouples, schematics and many applications.

ELEMENTARY ELECTRONICS

Box 1849, G.P.O.
New York, NY 10001

September/October 1976

Void after February 17, 1977

Please arrange to have the literature whose numbers I have circled below sent to me as soon as possible. I am enclosing 50¢ for each group of 10 to cover handling. (No stamps, please.) Allow 4-6 weeks for delivery.

H6B151

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315	316	317	318	319	320	321	322	323	327	328	329
330	331	332	334	335	337	338	342	344	345	350	352
353	354	355	356	357							

NAME (print clearly)

ADDRESS

CITY

STATE

ZIP

Kathi's CB Carousel

(Continued from page 89)

developed to reduce undesired noise pulses, and it costs more than other methods, as you might expect. It's actually a complete RF amplifier/receiver which is tuned to a frequency right next to the CB band, but where there are no actual stations transmitting. Since the frequency it's tuned to is very close to the CB band it receives exactly the same noise pulses that the CB band does. This RF amplifier/receiver amplifies the noise pulses, and then feeds them to the main receiver in exactly opposite phase to cancel the noise out, leaving just the main (desired) signal. It literally punches holes in the output of the main receiver, of the same size and shape (but opposite phase) thereby cancelling out the noise which would otherwise come through the receiver's speaker, interfering with the other station's signal and making it hard to understand.

Another feature is a tone control switch that cuts in a filter for the high audio frequencies when receiving. Often just the elimination of the higher frequencies makes it easier to copy a signal through a constant background noise—the type of noise that cannot be eliminated by a blanker or limiter.

Performance Plus. The CR-240's per-

Pioneer TP-900

(Continued from page 49)

stronger station from an adjacent channel.

The TP-900 is designed for 4-ohm speakers, and it delivered 2.4 watts RMS per channel into a 4-ohm load at the verge of clipping; a power level typical of higher quality auto radios and tape players.

Extra Features. The set has separate bass and treble controls—unusual for car radios—a loudness contour equalizing switch (to compensate for the loss of apparent bass sound at reduced volume), and a six-to-one ratio vernier tuning dial drive which makes precise FM station tuning convenient even when you're driving over rough roads. It also has a special T-connected coaxial cable which lets you use the same antenna for both this FM set and your old AM set which you listened to before you got this one.

The TP-900 measures 7½-in. wide x 3-in. high x 7⅞-in. deep. It is supplied with a multi-position gimbal bracket, a good selection of screws and nuts, a grounding cable, and a mounting strap.

formance checked out first rate all the way. The receiver section sensitivity measured 0.5 uV for 10 dB S+N/N (signal plus noise-to-noise ratio), while the adjacent-channel rejection and image/spurious rejection were 60 dB on the button. AGC action measured 8 dB over the entire input signal range from 2 to 10,000 uV. A 63 uV input signal produced an S9 reading on the meter, each S-unit representing a change in signal strength of 6 dB.

The transmitter delivered 3.7 watts RF output to a 50-ohm load. Modulation sensitivity for 85% modulation was -21 dB, and 100% modulation limiting was provided. This limiter is one of the best I've run across. It is really a fast-acting compressor that maintains almost a constant-level modulation regardless of your voice level—which can range from a whisper to a shout—and it does this with almost no increase in distortion. It looked so good on the 'scope that I loaned the rig out to a friend just so I could hear the transmitted signal. It was great—with superb, crisp modulation—the type of signal that's really wall-to-wall.

With CB transceivers now being advertised for as little as \$69.95 the CR-240's price tag of \$239.00 might look a little high, but it's worth every cent. When you pay for quality here, you get quality. For additional information on the Regency CR-240 circle number 72 on the Reader Service coupon. ■

About the only fault we could find with this car radio was the absence of convenient connectors for the battery and speaker connections. These were terminated in standard automotive clips, which may not fit your particular power terminals or speakers. However, you can get matching terminals at most automotive supply stores, or simply cut off the terminals and splice the wires directly.

With this one minor problem solved, you'll find the Pioneer TP-900 is a solid breakthrough in automobile stereo listening. It's the next best thing we've seen to home-style high fidelity—for one's car.

For additional information, circle number 71 on the Reader Service coupon. ■



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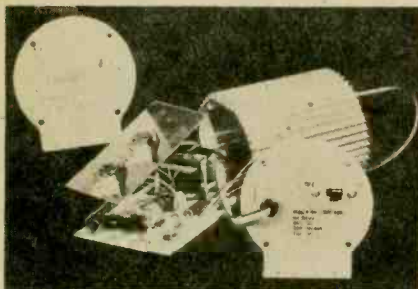
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NewsScan (Continued from page 80)

is a human feeling with which I am not familiar."

When Robbie is plugged into the family's television set, an automatic noise level control cuts out commercials which are louder than the program. Mr. Clayton has a manual over-ride in case Robbie reacts during a segment of any show which may be louder than normal.

Robbie plays a form of the old Chinese game of Nim in which two players take turns picking up one, two, or three objects from a pile of twenty-one. The player forced to take the last object is the loser.

Robbie plays the game with small sockets in a row around his neck. A probe housed next to the far right socket is moved the desired number of spaces. A light on Robbie's chest indicates the one, two, or three spaces he wants the human challenger to advance the probe on his behalf. Robbie almost always wins, but sometimes, if one plays a perfect game, it's possible to beat him. **It's All in the Glass**

Two corporate giants worked together to develop Corning's new "Mark IV"

glass bulbs. The new glass components are lighter, stronger, less bulky, self-aligning, less costly, and will be used by Zenith for color television picture tubes.

The glass bulbs have a radically different configuration from those currently manufactured. The two principal glass parts in a TV bulb are the funnel and the panel or faceplate. The major change in the new faceplate is the absence of a heavy glass skirt around the edge. It's made by an improved pressing process.

OP AMP TESTER (Continued from page 61)

Kohms). The error amp would be disconnected from the voltage divider and would just look for any voltage output at the DUT which exceeded 4V divided by R10/R9 (or just 4V if R9 = R10).

With the circuit values shown, the DUT is tested for the following approximate conditions:

Open Loop Gain	200V/V (min.)
Output Voltage Swing	±6V
Output Current	±5mA
Input Voltage Offset	40mV (max)
Input Bias Current	±4uA (max)
Stability	Good at gain of 100.

While these test conditions are good for general purpose testing, an unlimited number of test parameters can be programmed by altering the component values.

Two test sockets are provided, wired in parallel, so that practically any op amp with standard pin configuration can be tested easily whether it is in a TO-99, 14 pin DIP, or mini-DIP. Op amps requiring external phase compensation can also be tested. In these cases, the phase-comp components are plugged into the socket not occupied by the DUT. Never plug in two op amps at the same time.

Construction. Neither parts layout nor lead dress is critical. When using the printed circuit board shown here, be certain that holes for the components are drilled at least half way, but not all of the way through the board. Bend the leads of the components and clip them flat so that the bodies of the components lie about 1/32-in. above the board, supported by the leads. Carefully solder the components in place. Take care when soldering the components not to get them too hot. Use a low wattage soldering iron and rosin core solder.

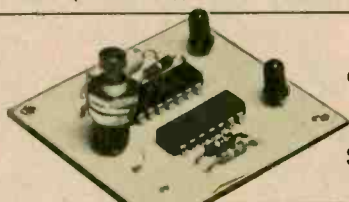
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Here's What CB Magazine (May 1976) Has to Say About Our "One-Hander" —

"On the road, it performed beautifully. The 60 dB of adjacent channel rejection was a particular plus in the test area... In my opinion, this radio is one of the best innovations in mobile communications in many years. Having all of the operating controls built into the mike frees the driver from having to reach for the next channel or looking for the volume control while paying attention to traffic."

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Antique Radio Corner

(Continued from page 77)

tect leaky or shorted electrostatic capacitors. There are two basic types of capacitors: electrolytic and electrostatic. Electrolytic capacitors are usually larger physically and have greater capacities. Their capacity usually runs from 4 to 10,000 mfd., and they will have positive (+) and negative (-) leads. Determining the good and bad electrolytic capacitors is beyond the scope of this article plus the fact that the old pre-1927 battery radio did not use them.

Electrostatic capacitors come in many sizes, shapes, and constructions. There are mica, ceramic, tubular, mylar (a registered trademark of the DuPont Company), and metallized foil, just to name some of them.

To measure leakage you will need a variable voltage power supply that puts out DC. First thing you should do is set the power supply voltage to the exact rated voltage of the capacitor under test, and then set the VOM DC voltage range to measure this voltage. Connect the capacitor in series with the positive terminal of the power supply and your VOM will read the power supply voltage. If you get any kind of a DC reading through the capacitor throw it away and use a new one. If you want peak performance from your radio. When we get to AC radio trouble shooting we will explain this procedure in detail.

Use Your Eyes. One of the best indicators to use when troubleshooting is your eyes. Observation will show up most of the problems found in the old battery radios. Start with the batteries or power supply. Are they delivering the proper voltages, are the connecting wires or cable in good condition, are the binding posts clean and tightened properly? If in doubt take your VOM and measure the voltages at the end of the cable or at the binding posts. If everything checks okay here, look at the tubes and see if the filaments are lighted. Most tubes are bright enough to see a glow in a darkened room. If there is no glow check the filaments for continuity. Check the tube pins and socket contacts for corrosion, and see that they are making good contact. If the tube filaments check out well, turn the filament rheostats and see if the voltages measured at the tube socket change as you rotate the rheostat knob. There should be at least a 1-volt change between minimum and maximum rotation.

If you cannot get a station with the filament rheostat turned to the clock-

wise end of rotation check your antenna and ground. When you touch the antenna wire to its binding post you should get a click in the speaker or headphones. If you get only a weak sound from a nearby station one or more of the tubes may be weak. If you have tubes that you know are good substitute them for the tubes in the radio. If you have no spare tubes then you must take them all out and have them tested. Don't waste your time going to the corner drugstore to use their tube tester. It is only made to test the more recent TV type tubes. You will need to find an old time radio repairman with an old tube tester. If you have any had tubes you will have to get new or good used ones. Weak reception accompanied by a rasping, scratchy, fuzzy noise may be caused by a bad capacitor or a grid leak that has too little resistance. The grid leak should have a resistance of .5 to 5 megohms. The inexpensive VOM will not measure a resistance this high. If you doubt the grid leak take it to a TV set repairman he will have an ohmmeter that will measure it. The only other components to check are the tuning coils, audio transformers, and speaker. You can use the ohmmeter in your VOM to test those parts as described above.

Other VOM Applications. You can use your voltmeter to measure the voltage on the plate of each tube. Put the negative lead to B- and touch the positive lead to the plate terminal on each socket. If the plate voltage of the proper value is there, the set should be able to play. Another cause of a weak or non-playing radio can be shorted plates in the tuning condenser. Observation should detect a problem here. As a last resort disconnect all the leads to the stator (the plates that don't move) of the condenser, connect one lead of an ohmmeter to the stator and the other lead to the rotor. Rotate the condenser slowly, watching the meter carefully. If the plates touch anywhere the hand on the meter will deflect. A good condenser will measure infinity resistance between the fixed and movable plates. Plates that touch will cause static in the speaker and cause the stations to cut in and out.

There are a lot of obscure, once-in-a-lifetime troubles that pop up now and then. However the preceding instructions will allow you to find and correct 90% of the problems found in the old 3- to 6-tube battery radios.

Help Out Your Editor. Here is your chance to lend a helping hand to a fellow collector. Charles Graham, Technical Editor of ELEMENTARY ELECTRONICS magazine, is looking for a

Kaydette radio made by International Radio Corp., Ann Arbor, Michigan. The Kaydette Jr. was probably the first true portable. The advertisements showed it being placed in an overcoat pocket. I believe the radio used a 6F7 and a 12A7 in a reflex circuit. If any reader has a set of this type or knows where there is one please contact Mr. Graham in care of ELEMENTARY ELECTRONICS magazine.

So long for now, I'll see you next issue with more collector news, technical information, book reviews, and other interesting information to help you in your radio collecting hobby.

In July/August issue of ELEMENTARY ELECTRONICS Antique Radio Corner, on page 58 a few words were omitted, in the second paragraph of the third column. The complete sentence there should have read, "The thorium inside the filament is forced to the surface in a process called "boiling." ■

DX Central Reporting

(Continued from page 92)

Continuing to translate, "S" means the program announcements were in Spanish and the program consisted of lively Latin American music. There were English (EE) and Spanish announcements at sign off when the station asked listeners for reception reports. The program left the air after the playing of the Colombian national anthem.

A good argument for the use of DX-esc, no? It takes about five times as much space to spell this message out in detail.

Some of the SWLanguage was borrowed from amateur radio operators, who, it's believed, took the "words" from the old-time telegraphers. For example there is the symbol, "73," which means, roughly, goodbye, when used to conclude a letter to an SWL buddy. Another ham bit borrowed by DXers, and seen more in print than used orally, is "hi," which indicates laughter. Often you will see "hi" following a comment intended to be humorous. (It has always struck me that if you have to add a "hi" the comment probably wasn't very funny anyway.)

Other symbols that originated with hams and commercials radiotelegraph operators are the Q-code combinations: QRM (interference from other stations, that is, Man-made); QRN (Nature-caused interference—atmospheric noise or static); QTH (address or location); and QSL (verification of reception).

Some abbreviations used by listeners

(Continued on page 98)

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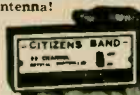
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\$13.95—add \$2.00 for postage and handling.



KUHN ELECTRONIC PRODUCTS CO.
1801 Mills Ave., Norwood, Ohio 45212

CB XCVR Checkout

(Continued from page 58)

Modulation Limited to 100% yes
Editorial Remarks: The Nuvox CB-
7000 has an S-meter that reads 6 dB
per S-unit, internal transmitter tuning,
double conversion, external and PA
speaker jacks, S/RF output meter. ■



**CIRCLE 32 ON
READER SERVICE COUPON**

● **REALISTIC NAVAHO (TRC-57)**

\$399.95 (Radio Shack)

General Description: A 23-channel
AM/SSB transceiver for mobile, base,
PA operation. Variable tuning ± 1.5
kHz provided. AC only digital clock.
Power supply is 12 VDC with positive
or negative ground and 117
VAC. Overall dimensions are 5 4/5-
in. h x 13 3/4-in. w x 11 1/5-in. d.
Front panel controls and switches in-
clude Channel Selector, Volume,
Squelch, RF Gain, Clarifier, SWR
Calibrate, AM/LSB/USB, PA/CB,
ANL, Noise Blanker, and Clock
Switches. Standard accessories are
microphone, all crystals, mobile
mount, AC and DC power cables.

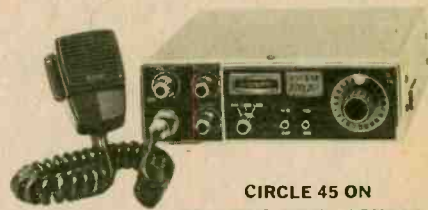
Receiver Section Test:

Input Sensitivity 1.0 μ V AM
Adjacent Channel Rejection 60 dB
Image Rejection 43 dB
AGC Action 11 dB
Input Level for S9 100 μ V

Transmitter Section Test:

RF Output 3.6 watts AM
Modulation to 85% yes
Relative Sensitivity for 85%
Modulation -40 dB
Modulation Limited to 100% yes

Editorial Remarks: The Navaho has
an S-meter reading of 4-5 dB per S-
unit, internal transmitter tuning, dou-
ble conversion, external and PA
speaker jacks, headphone jack, 12/
24 hour digital clock, S/RF output
meter, and SWR meter. ■



**CIRCLE 45 ON
READER SERVICE COUPON**

● **TRAM DIAMOND XL-5**

\$329.95 (Tram/Diamond Corp.)

General Description: A 23-channel
AM/SSB transceiver for mobile, PA
operation. Variable tuning ± 1.2 kHz
provided. Power supply is 12 VDC
with positive or negative ground.
Overall dimensions are 2 1/4-in. h x
7 1/2-in. w x 10-in. d. Front panel con-
trols and switches include Channel
Selector, Volume, Squelch, Clarifier,
AM/LSB/USB, Noise Blanker, PA/
CB. Standard accessories are micro-
phone, all crystals, mobile mount, DC
power cable.

Receiver Section Test:

Input Sensitivity 0.6 μ V AM
Adjacent Channel Rejection 56 dB
Image Rejection 50 dB
AGC Action 6 dB
Input Level for S9 32 μ V

Transmitter Section Test:

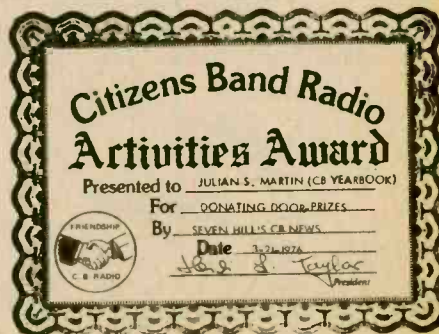
RF Output 4 watts AM
Modulation to 85% yes
Relative Sensitivity for 85%
Modulation -26 dB
Modulation Limited to 100% no

Editorial Remarks: The XL-5 has
an S-meter reading of 6 dB per S-
unit, internal sealed transmitter tun-
ing, double conversion, external and
PA speaker jacks, and S/RF output
meter. ■

CB Buzzin' Bee

(Continued from page 69)

Award winner. When Seven Hills City (Worcester,
Massachusetts) held a Spring CB Jamboree and
coordinator Heidi Taylor asked whether we
could provide some door prizes, the Polish Ham
sent up some copies of e/e's sister publication,
CB YEARBOOK. Apparently the YEARBOOKS were
a big hit—just feast your eyes on the award
certificate that the Ham received by return
mail. What a way to stack them eights, Heidi.



(Continued on page 100)

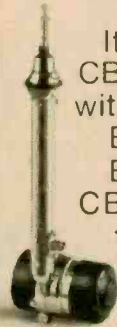
Switch to the CB antenna that beats the Citizens Bandits.



Now you
see it.



Now they
don't.



It's no wonder people are worried about CB thefts. All a thief has to do is spot a car with a CB antenna and he has his target.

But he can't spot ours.

Because the TennaPower Disappearing CB Electric Antenna hides inside the fender when it isn't being used.

But there's no hiding from it when it's up. Because it performs like gangbusters.

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And our Disappearing CB Electric Antenna gives you this big, exclusive advantage: it's made by Tenna. We're the world leader in electric car antennas. Because we've built over 5 million disappearing electric car radio antennas for GM, Ford, Chrysler and Rolls Royce.

So buy the TennaPower Disappearing CB Electric Antenna at a dealer near you who sells CB or car stereo. You can ask him about installation or you may want to do it yourself.

Then beat the Citizens Bandits with the CB antenna thieves can't see. We think you can see why.

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Corporation 
Cleveland, Ohio 44128

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**FRIENDS DON'T LET FRIENDS
DRIVE DRUNK.**



U.S. DEPARTMENT OF TRANSPORTATION - NATIONAL HIGHWAY TRAFFIC SAFETY ADMINISTRATION

DX CENTRAL

(Continued from page 94)

are of their own making and seem to have simply occurred for no good reason except brevity. A number of them are formed by adding the letter "x" to the initial letter of common hobby words. This has resulted in things like DX (listening to distant stations), RX (receiver, not a doctor's prescription), Tx (transmitter), Wx (weather), Nx (news broadcast), MX (music), and the newest X-rated word, not yet in widespread use, PX (program).

Don't look for too much logic in the coining of some of this shortwave language. As in the example above, SS designates Spanish-speaking. Okay, so far, so good. But throwing logic to the wind, hobbyists extended the pattern so that EE indicates English-speaking; FF, French-speaking; GG, German-speaking and so on, right through VV for Vietnamese.

Some letter groups mean one thing when capitalized, another when in lower case. AM means amplitude modulation, the transmission mode used by most shortwave broadcasters you will hear. But a.m. means, and there's no surprise here, morning, and Am. stands for American.

Usually new abbreviations are coined to meet a recognized need. Some become widely used and understood, while others never seem to catch on, probably because they weren't really needed. Now and again, here at DX Central I receive a letter from a reader that is so filled with home-brew abbreviations that it is unintelligible. So I suggest sticking to the tried and true.

Here are some of the more-useful bits of DX-ese:

A = approximate, usually as in approximate frequency, e.g. 9,745A kHz.

ancr = announcer

BCB = broadcast band, the medium waves, 540-1600 kHz.

CE = chief engineer

condx = conditions of reception

DXer = one who listens to distant stations as a hobby

f/o = fadeout (of signal)

GSTQ = God Save the Queen, British national anthem

ID = identification announcement

kw = kilowatt

LV = La Voz de (The Voice of . . . ; Spanish station identification)

MHz = megahertz, a thousand kilohertz

NA = national anthem or North America, depending on context

QSB = fading of signal

R = radio

sked = schedule of broadcasts

verie = a QSL or verification

The Good and Bad. DXers considered it a real blow when, late in April, there was a surprise announcement that effective May 1, Radio Zealand would cease shortwave broadcasting.

A short time earlier, it seems, RNZ had been shifted to the control of the New Zealand government's foreign ministry and that department claimed it faced a shortage of funds to run the overseas shortwave service. Some listeners, here and Down Under, feel there was internal politicking involved in the shutdown, and for a while at least, it looked as if yet another country had gone silent.

As this is written there has been no formal change in the policy, but listeners are again hearing shortwave programs from New Zealand. Thus far they have been relays on shortwave frequencies of the New Zealand Broadcasting Commission's domestic medium wave programs.

There is no way of knowing now whether these shortwave relays will continue; whether the foreign SW service of Radio New Zealand will be restarted, or whether all shortwave transmissions from "ZL" land will be ended again.

Not so good, however, is the news from the Voice of America. For years, many SWLs have managed to add new countries to their QSL list thanks to the VOA. That was possible, of course, because the VOA maintains a powerful set of relay stations around the world.

It was possible to log the West African country of Liberia by hearing—and QSLing—the VOA relay station located near Monrovia, the Liberian capital. And many listeners added Okinawa to their verified list of countries on the strength of their receptions of the Voice's relay station on that Pacific island. Announcements at the beginning and end of transmissions indicated the location of the station, relay or state-side.

Now, however, it will be difficult to get such verifications from the Voice of America which show, on the QSL card, the location of the transmitter. This word has been received from Ruth Walter, public information officer for the VOA:

"The VOA has simplified its station identification procedure. Stations now sign on with a few bars of the 'Yankee Doodle' interval theme followed by the announcement. 'This is the Voice of America, Washington, D.C. signing on.' It is planned eventually to use

a single, standard identification throughout the VOA system. . . . I hope you will call this to your listeners' attention since we no longer will be QSLing by transmitter site."

What this all means is that it will be more difficult, without specific announcements, to know whether the VOA program you're listening to is being broadcast from Stateside transmitters, such as Greenville, N.C., or from one of the VOA's overseas relay points, like the Philippines, Greece or Liberia. And, even if you do determine the transmitter site, the QSL you receive from the VOA will no longer note that information on the card.

Backtalk. A bit of poetry is right on top of this month's stack of mail.

"Just a short note to let you know, that no matter how far we go, one eye's lookin' ahead, the other's on a radio. We truck along from east to west, through hours of delight, and some of stress."

"But seriously," writes Myrton Smith, a 26-year-old truck driver from Medford, MA, thanks for a Dyno-Mag!

Myrton is a CBer—bet that comes as no surprise to the rest of you readers—but the Baby Buzzard, (his CB handle) also digs shortwave listening. And that's a big 10-4, good buddy!

Morrie Goldman, Chicago, writes DX Central to tell us about a new book called "Beyond Shortwave." This 32-page goodie is an introduction to monitoring stations in the "world above 30 MHz," a "world" that contains TV and FM DXing and the growing field of VHF and UHF action band monitoring.

Morrie notes the booklet is available for \$1.25 postpaid from Worldwide TV-FM DX Association, Box 163, Deerfield, IL 60015.

Kind words from Brooklyn, NY SWL, Michael P. Ricca: "Your article, Unraveling the Mystery of Radio Swan, (e/e, May-June 1976) was terrific! It is nice to see investigative journalism at work for SWLs. I hope you'll give us more of it in the future.

"I'd like to suggest a future article on DXing signals from outer space? One of the newest scientific fields is radio astronomy which, in part, involves trying to communicate with civilizations on other planets. Most scientists in this area seem to believe that there are, in all probability, many planets in the universe that support intelligent life. What do prominent radio astronomers feel about the possibilities of receiving a signal from outer space below 30 MHz?"

(Continued on page 100)

THE GREAT SHOOTOUT ON TV

The U.S. Navy estimates that \$97.5 million have been saved by using a unique system called Air Combat Maneuvering Range (ACMR) to train military aviators for air-to-air combat. ACMR allows military aviators flying high performance jets to duel in mock dogfights without firing live ammunition or shooting down costly targets. With ACMR, the trainees are coached by instructors from the ground who see their every move on television-like screens. Flight safety conditions, such as speed, altitude, angle of attack, and "G" loads, are also observed.

The system records a mock-combat flight as it is happening. When the flight is concluded, aircrews return to either Miramar Naval Air Station, California, or to the Marine Corps Training Center, Yuma, Arizona, where instructors review the flight with each student and point out his weaknesses or strong points.

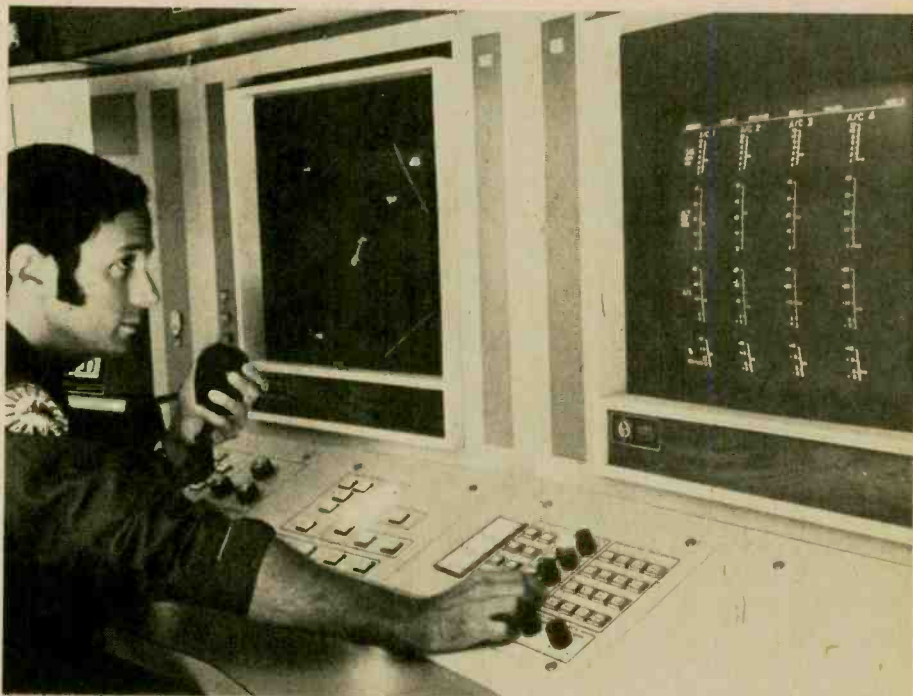
A major feature of the system allows pilots to simulate actual missile firings without expending costly, live ammunition. However, improved pilot proficiency and safety are the primary assets of the system.

Before ACMR became operational in January 1973, pilots found it difficult to recall details of their training performance. Today, as a result of the system, every detail of each flight can be reviewed and discussed with each trainee upon return to the ground.

Each month, more than 100 missions have been flown on the 30-mile range located over the desert at Yuma, Arizona. Several thousand missile simulation firings have been made. Before ACMR, it was difficult to teach pilots how their missiles would react as the opponent's aircraft maneuvered to evade an attack. As a result, more hits are scored than before.

With ACMR training, crewmen understand the missile firing envelope or at what range the weapon is lethal. Pilots also develop confidence in themselves, the aircraft, and their weapons knowing that 85-90 per cent of their shots will be on target.

Aside from training, the system is also used for research and development. It is used to evaluate flight characteristics of new aircraft and will be employed on several future aeronautical projects.



The line at the right is the earth's horizon. ACMR is used to train pilots to dogfight in real combat conditions while instructors monitor their every move on displays such as the one shown here.

A unique capability of ACMR allows ground instructor pilots to look out the cockpit of a supersonic aircraft to view what a pilot sees. A close look shows that Aircraft One has his opponent in his sights.

DX Central Reporting

(Continued from page 99)

Reportedly, Mike, there is project on the drawing boards to eavesdrop on radio signals from outer space—assuming there are such things. It is said that to capture any signals from civilizations up to 100 light years away, it would take a massive array of thousands of linked antennas, each about 100 feet in diameter, arranged across an area up to 20 miles in width. This isn't the sort of project that could be tackled by the average SWL, to say the least.

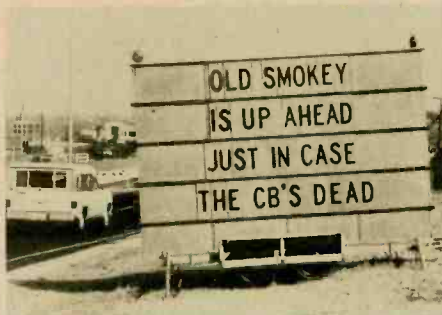
If you're interested in more on the subject and what Earthlings are doing about trying to transmit radio signals to the folks "out there," you can find it in the new 4th edition of *Better Shortwave Reception*, by William I. Orr and Stuart D. Cowan. It is available from Radio Publications, Inc., Box 149, Wilton, CT 06897. ■

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CB Buzzin' Bee

(Continued from page 96)



Speeding motorists entering a dangerous construction area near Fort Worth found this warning sign erected by the Texas State Highway department to slow 'em down for safety's sake. Photo courtesy of Radio Shack.

And while we're talking about what's new with our editors, here's a tidbit about your CB Editor, Kathi Martin. Kathi wrote First Lady Betty Ford last spring when Mrs. Ford first got her CB license to send her a congratulatory note on joining the CB clan. And First Mama sent a big 10-4 flying back to our editorial offices. First Mama writes, "A big 10-4 and many thanks for thinking of me. I am proud to be included among CBers who have joined together in a common network of mutual support, assistance, and friendship. This is KNF5933 sending all good numbers your way along with my wishes for a good day today and a better day tomorrow." All you biscuitburners down DC-way, keep your ears on and you may copy First Mama yourself!

Well, that's about it. This here's Buzzin' Bee pulling the big switch for now. Remember what I said at the start of this column: I'm waiting to hear from all of you in CB land. Keep your eyes open, your pencils writing, your cameras shooting, and we'll get this column buzzing. Stack them eights. We gone and bye. ■

Mark Time Indicator

(Continued from page 46)

ure to obtain 0.5-second and one-second pulses.

If an oscilloscope is available, R6 can be adjusted very quickly and accurately. Set up the scope to display one cycle of the 60-Hz line frequency, either by means of the scope's own test jack if it has one, or by connecting it to the secondary of a low-voltage transformer. Carefully note where the beginning and end of this sine wave trace are on the scope face. Then, without readjusting the scope's horizontal gain or sweep controls, connect it to pins no. 1 and 3 of IC1. Vary the scope's positioning controls to center the trace, and the vertical gain and sync controls as appropriate. Now adjust R6 until two square waves of the IC1 output occupy exactly the same distance on the scope face as the sine wave did. R6 is now adjusted. While this method is not as exact as using a frequency counter, it will get you within half a cycle.

Programming Your MTI. To program the calculator to count, proceed as follows:

To Count Up:

1. Place S4 in the *Set* (center, off) position.
2. Press —, 1, +, and 1 (or —, 0.5, +, and 0.5, if desired).
3. Place S4 in the desired position.

Step 3 will cause the calculator read-out to go to 0, and MTI is now ready to count as soon as S3 is pressed.

To Count Down:

1. Place S4 in the *Set* position.
2. Press the calculator keys for a

number one digit higher than the timing period desired. That is, to time 15 seconds, enter the number 16.

3. Press —, 1, (or —, 0.5).

4. Place S4 to 0.5 or 1.0.

Step 4 will cause the calculator to display the desired number (15 in our example), and the calculator is ready.

Since the calculator display does not automatically clear when the timer is stopped, any timed interval can be interrupted and restarted. This is convenient if you are part way through a timed operation and have to stop (to answer the telephone, maybe) and want to pick up where you left off.

Timing Variations. Several operating variations are possible. Timing ranges can be changed during a timed interval. For instance, if 20 seconds is to be timed, the first 15 seconds could be timed with the timer in the 1-second position, and the last 5 seconds in the 0.5-second position.

Since the calculator will count by negative numbers as well as by positive numbers, it is possible to time two intervals consecutively without having to re-initialize the calculator. For example, if you want to time one event for 10 seconds, and then another event for 20 seconds, you can enter —10, and count up from —10 to 0 for the first event, and from 0 to 20 for the second. Or, you can enter 10, and count down from 10 to 0 for the first event, and from 0 to —20 for the second event.

Still another possibility is counting by numbers other than 0.5 and 1. The calculator will count by 5s, 10s, 100s, or any other number, although the time period between any two counts will always be one of the ranges determined by timer switches S2 and C4. ■

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Nylon, white cable connectors, ass't. factory over-run. No PNP's! Mixed in barrels. Cat.No. 9L3324

BARREL KIT #158 MAGNIFIED MAN-3'S
15 for \$1.98
Cosmetic rejects famous style MAN-3. 7-seg. silicon, axial built-on magnifier. Factory discontinued line. 100% material. Cat.No. 9L3325

BARREL KIT #159 MODULAR SWITCHES
25 for \$1.98
Centralized "push-ON" switches. TV-makers excess. Dpdt, 6pdt, etc. Brand new. Cat.No. 9L3150

BARREL KIT #159 MODULAR SWITCHES
25 for \$1.98
Centralized "push-ON" switches. TV-makers excess. Dpdt, 6pdt, etc. Brand new. Cat.No. 9L3150

BARREL KIT #25 METAL CAN TRANSISTORS
100 for \$1.98
Includes TO-18, TO-18A, etc., assorted 2N numbers. Unmarked only. Cat.No. 9L2603

BARREL KIT #26 PLASTIC TRANSISTORS
100 for \$1.98
Type TO-18 (TO-18A), all manufacturers. Mixed in barrels. Cat.No. 9L2604

BARREL KIT #30 PREFORMED RESISTORS
250 for \$1.98
We got barrels of 1/4 and 1/2 watters for pc use. You'll get even amount. 100% 1/4, 100% 1/2 watters. Cat.No. 9L2608 100% good

BARREL KIT #31 METALLIC RESISTORS
100 for \$1.98
Made mostly by Corning; the finest resistor made. Mostly 1/2 watters. 1% to 5% tol. & a barrel of values. Cat.No. 9L2609

BARREL KIT #32 TRANSISTORS WITH A HOLE IN IT
50 for \$1.98
Can't name factory but we bought barrels of 25 watters in marked numbers of raw factory stock. Cat.No. 9L2431

BARREL KIT #33 NEON LAMPS
40 for \$1.98
Famous NE-2's. All prime, but factory made millions and barrel'ed 'em. Your advantage. Cat.No. 9L2613

BARREL KIT #36 GERMANIUM DIODES
200 for \$1.98
Famous maker, popular item. Never grows old. But this is the way the RE-TESTERS buy 'em from the factories. Cat.No. 9L2614

BARREL KIT #37 1 AMP "BULLET" RECTIFIERS
100 for \$1.98
Famous style, ass'd. voltages, axial leads. Includes all types of voltages to 1KV. Cat.No. 9L2615

BARREL KIT #39 2N3055 HOBBY TRANSISTORS
15 for \$1.98
100% good. From factory to you, these fellows! Mixed in barrels. 2N3055. We have 10 barrels. Cat.No. 9L2617

BARREL KIT #40 PNP HIGH-POWER TRANSISTORS
20 for \$1.98
Popular Germanium TO-3 case units, now available at "good ole barrel" prices. Cat.No. 9L2618 100% good

BARREL KIT #46 G.E. 3.3 WATT AMPLIFIERS
25 for \$1.98
Hobby type, factory full-outs, we purchased them in barrels. These are unknown. Cat.No. 9L2624

BARREL KIT #50 SIGNAL SILICON DIODES
200 for \$1.98
Includes many, many types of switching, signal silicon types, all axial leads. Some may be zeners. Cat.No. 9L2628

BARREL KIT #53 JUMBO RESISTOR PAK
100-pc. \$1.98
Assortment metal films, precision, carbon, metal oxide powers, from 1/4 watt to 7 watts. Color coded & 100% good. Wt. 310.

BARREL KIT #58 SLIDE SWITCHES
30 for \$1.98
All shapes, sizes, spat, apdt, momentary, etc. Irregularly shaped shop pak for 100's of switching projects. Cat.No. 9L2726 100% good

BARREL KIT #59 POWER TRANSISTORS
40 for \$1.98
15 watt Bendix B-1000 metal transistors, none all good, purchased from a prester, have millions of 100% good. Cat.No. 9L2727

BARREL KIT #60 DTL'S IC'S
75 for \$1.98
This is prime barrel material. Who wants DTL's? 930, 936, 946's. Your gain is our loss. They're marked too. Cat.No. 9L2728

BARREL KIT #61 POLYSTYRENE CAPS
100 for \$1.98
Finest caps made. As a gamble we bought 10 barrels from factory, mixed values; all good. Cat.No. 9L2729

BARREL KIT #65 MIXED READOUTS
15 for \$1.98
Factory returns - such numbers as MAN-4's, MAN-T's, MAN-3's, 11 barrels & no time to re-buy! Cat.No. 9L2733 Untested

BARREL KIT #75 4 WATT ZENERS
150 for \$1.98
Factory out of biz! Amazing offer: 6, 8, 10, 12 to 15V. Vented, hermetically sealed glass cap. Double plug. Cat.No. 9L2740

BARREL KIT #76 1-WATT ZENERS
100 for \$1.98
Factory same as 400-mw's. Never-to-see-again offer, 6, 8, 10, 12, 15V, vented glass. Double plug. Cat.No. 9L2741

BARREL KIT #77 "BROWN" BODY TRANSISTORS
40 for \$1.98
G-E D-10 series; has voltage, Darlington, hi-current, npn's. Factory line discontinued. Power tabs. Cat.No. 9L2742 Untested

BARREL KIT #78 "RED" BODY TRANSISTORS
40 for \$1.98
D-12 series; you test - go into your own biz! High current, hi-V. NPN. Cat.No. 9L2743 Untested

BARREL KIT #81 SUBMINI RESISTORS
200 for \$1.98
PC, upright type, color coded, 1/2 watt. Ass't values. Came to us in a barrel. Cat.No. 9L2746

BARREL KIT #83 LM-340T UNTESTED VOLTAGE REGULATORS
40 for \$1.98
Factory rejected them for length of leads. May include 5, 6, 8, 12, 15, 18, 24 volt. Power tab. Cat.No. 9L2635

BARREL KIT #86 HOBBY LEDS
40 for \$1.98
Wow! A Litronics dump of all kinds of mixed discrete LED's, shapes, colors, good, poor, etc. Cat.No. 9L2859

BARREL KIT #87 NATIONAL IC BONANZA
100 for \$1.98
Factory dumps into barrels. Types 8000, 7400 series, DTL's, ROM's, registers, clock & calc. chips, linears, etc. Cat.No. 9L2858 Untested

BARREL KIT #88 LITRONICS LED READOUTS
10 for \$1.98
747's, 727's, singles, tri-ples, etc. 33 to 0.6. Bought from factory, all mixed; have fun! Cat.No. 9L2861

BARREL KIT #93 HALF WATTERS
200 for \$1.98
Resistor factory tried to fool us by mixing 100% color-coded resistors in barrel. But value is there. 4 oz. Cat.No. 9L3046

BARREL KIT #99 PHOTO ELECTRIC CELLS
10 for \$1.98
Ass't. GE types, CDS types, Mixed by factory. Big job for us to separate. 100% good. Cat.No. 9L3052

BARREL KIT #101 RESISTOR SPECIAL
200 for \$1.98
Includes: 1/4, 1/2, 1/2, 1, 2-watt, carbon, 8 oz. 100% good. Cat.No. 9L3054

BARREL KIT #104 SLIDE VOLUME CONTROLS
10 for \$1.98
Used in hi-fi, volume control maker unload. Ass't. values, what a buy. Worth 1/2 ea. We've got barrels of 100% material.

BARREL KIT #107 SQUARE OHMS
60 for \$1.98
Factory people are sometimes "square" when they topple prime square ohms mix 'em up in barrels. Ass't. values watts. Wt. 1 lb.

BARREL KIT #108 TO-18 PLASTIC TRANSISTORS
40 for \$1.98
Includes: PNP, NPN, 2N-3638, 2N3641, 2N3600 series, etc. Untested, but guaranteed to a 60% yield.

BARREL KIT #109 TERMINAL STRIPS
150 for \$1.98
Wide ass't. of terminal strip connectors, from 1 contact up. Strip manufacturers barrel dump in your gain. Wt. 1 lb. Cat.No. 9L3136

BARREL KIT #110 SUPPRESSOR DIODES
50 for \$1.98
Keeps ignition noises out axial. Untested, but the of your capt., car, industrial, etc. Double plug. Cat.No. 9L3137

BARREL KIT #112 AXIAL ELECTROS
40 for \$1.98
Truly factory (barrels) by mixing 'em in factories do all of us a favor. WUT A BUY! Ass't. capacities and voltages. Cat.No. 9L3227

BARREL KIT #112 AXIAL ELECTROS
40 for \$1.98
Large mfr dumped 100's of lbs into barrels. Includes 741's, LM-390's, 703, 697, 655, 658 - but who knows? Factory to you. All mixed, you test. Wt. 1 lb. Cat.No. 9L3245

BARREL KIT #114 DARLINGTON TRANSISTORS
40 for \$1.98
TO-92, a Motorola dump, unknown numbers, but high yield to good darlington. Retesters didn't get 'em! You will. 9L3285

BARREL KIT #114 RCA PHONO PLUGS
40 for \$1.98
1,000,000 RCA phono plugs for this one. You hi-fi-ers know what they are 100% material. Look at the price. 9L3293

BARREL KIT #114 DARLINGTON TRANSISTORS
40 for \$1.98
TO-92, a Motorola dump, unknown numbers, but high yield to good darlington. Retesters didn't get 'em! You will. 9L3285

BARREL KIT #114 RCA PHONO PLUGS
40 for \$1.98
1,000,000 RCA phono plugs for this one. You hi-fi-ers know what they are 100% material. Look at the price. 9L3293

BARREL KIT #115 MOLEX SOCKETS
200 for \$1.98
100% good. Calculator maker dump! We got a sillon of 'em. Used for IC sockets, etc. Cat.No. 9L3144

BARREL KIT #116 RUTTONS 'N FEEDTHRU'S
100 for \$1.98
Truthfully worth a small fortune! Ass't. but-ton-feedthru cap! HAMS TAKE NOTE! RF IJIF, etc. Wt. 1 lb. Cat.No. 9L3141

BARREL KIT #118 MINI SCRS
50 for \$1.98
UNBELIEVABLE! TO-92 Plastic SCRS in barrels... rite from factory, includes all voltages up thru 200 vrs. 9L3135

BARREL KIT #118 MINI SCRS
50 for \$1.98
UNBELIEVABLE! TO-92 Plastic SCRS in barrels... rite from factory, includes all voltages up thru 200 vrs. 9L3135

BARREL KIT #133 C-MOS IC'S
60 for \$1.98
Deliberately thrown in barrels, so we can't test 'em! The famous C14000 series, how good? Who knows? Who cares? It's only 3c ea. Cat.No. 9L3257

BARREL KIT #138 PANEL SWITCHES
30 for \$1.98
Did you hear of OAK? Another 80pt maker barrelled all types of rotaries, electric, slides, etc. 9L3268

<p>BARREL KIT #1 SN7400 DIP IC'S 75 for \$1.98 Marked 14 and/or with 16 pin dips, may include gates, registers, flip flops, counters. Who knows? GUARANTEED SATISFACTION! Cat.No. 9L2415 Untested.</p>	<p>BARREL KIT #2 LINEAR OP AMPS, DIP'S Un tested 75 for \$1.98 May include 700's, 741's, 703's, 660 series, 656 includes marked and unmarked. Cat.No. 9L2416</p>	<p>BARREL KIT #3 1N4148/914 SWITCHING DIODES 100 for \$1.98 You never saw this before. Imagine famous switching diodes at these prices! Cat.No. 9L2418 Untested.</p>	<p>BARREL KIT #4 "4000" RECTIFIERS 100 for \$1.98 These are the famous micro miniature rectifiers of the 1N4000 series. May include 25, 50, 100, 200, 400, 600, 800 and 1000 volters. Cat.No. 9L2417</p>	<p>BARREL KIT #5 SCRS, TRIACS, QUADRACS 40 for \$1.98 All the famous plastic power tab type. Raw factory stock! All the 10 amp type. Cat.No. 9L2419 Untested.</p>
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<p>BARREL KIT #30 PREFORMED RESISTORS 250 for \$1.98 We got barrels of 1/4 and 1/2 watters for pc use. You'll get even amount. 100% 1/4, 100% 1/2 watters. Cat.No. 9L2608 100% good</p>	<p>BARREL KIT #31 METALLIC RESISTORS 100 for \$1.98 Made mostly by Corning; the finest resistor made. Mostly 1/2 watters. 1% to 5% tol. & a barrel of values. Cat.No. 9L2609</p>	<p>BARREL KIT #32 TRANSISTORS WITH A HOLE IN IT 50 for \$1.98 Can't name factory but we bought barrels of 25 watters in marked numbers of raw factory stock. Cat.No. 9L2431</p>	<p>BARREL KIT #33 NEON LAMPS 40 for \$1.98 Famous NE-2's. All prime, but factory made millions and barrel'ed 'em. Your advantage. Cat.No. 9L2613</p>	<p>BARREL KIT #36 GERMANIUM DIODES 200 for \$1.98 Famous maker, popular item. Never grows old. But this is the way the RE-TESTERS buy 'em from the factories. Cat.No. 9L2614</p>
<p>BARREL KIT #40 PNP HIGH-POWER TRANSISTORS 20 for \$1.98 Popular Germanium TO-3 case units, now available at "good ole barrel" prices. Cat.No. 9L2618 100% good</p>	<p>BARREL KIT #46 G.E. 3.3 WATT AMPLIFIERS 25 for \$1.98 Hobby type, factory full-outs, we purchased them in barrels. These are unknown. Cat.No. 9L2624</p>	<p>BARREL KIT #50 SIGNAL SILICON DIODES 200 for \$1.98 Includes many, many types of switching, signal silicon types, all axial leads. Some may be zeners. Cat.No. 9L2628</p>	<p>BARREL KIT #53 JUMBO RESISTOR PAK 100-pc. \$1.98 Assortment metal films, precision, carbon, metal oxide powers, from 1/4 watt to 7 watts. Color coded & 100% good. Wt. 310.</p>	<p>BARREL KIT #58 SLIDE SWITCHES 30 for \$1.98 All shapes, sizes, spat, apdt, momentary, etc. Irregularly shaped shop pak for 100's of switching projects. Cat.No. 9L2726 100% good</p>
<p>BARREL KIT #61 POLYSTYRENE CAPS 100 for \$1.98 Finest caps made. As a gamble we bought 10 barrels from factory, mixed values; all good. Cat.No. 9L2729</p>	<p>BARREL KIT #65 MIXED READOUTS 15 for \$1.98 Factory returns - such numbers as MAN-4's, MAN-T's, MAN-3's, 11 barrels & no time to re-buy! Cat.No. 9L2733 Untested</p>	<p>BARREL KIT #68 2 WATTERS 100 for \$1.98 Nobody seems to want 'em! So many suppliers don't count, but throw 'em in the barrel. It's a 1/1 gold mine! All marked. Cat.No. 9L2735</p>	<p>BARREL KIT #71 CAPACITOR SPECIAL 100 pcs. \$1.98 Emptied stockrooms into barrels of mylars, poly's, mica's, malded, plastic, ceramics, discs, etc. Nifty 100% good. Cat.No. 9L2738</p>	<p>BARREL KIT #75 4 WATT ZENERS 150 for \$1.98 Factory out of biz! Amazing offer: 6, 8, 10, 12 to 15V. Vented, hermetically sealed glass cap. Double plug. Cat.No. 9L2740</p>
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<p>BARREL KIT #93 HALF WATTERS 200 for \$1.98 Resistor factory tried to fool us by mixing 100% color-coded resistors in barrel. But value is there. 4 oz. Cat.No. 9L3046</p>	<p>BARREL KIT #99 PHOTO ELECTRIC CELLS 10 for \$1.98 Ass't. GE types, CDS types, Mixed by factory. Big job for us to separate. 100% good. Cat.No. 9L3052</p>	<p>BARREL KIT #101 RESISTOR SPECIAL 200 for \$1.98 Includes: 1/4, 1/2, 1/2, 1, 2-watt, carbon, 8 oz. 100% good. Cat.No. 9L3054</p>	<p>BARREL KIT #104 SLIDE VOLUME CONTROLS 10 for \$1.98 Used in hi-fi, volume control maker unload. Ass't. values, what a buy. Worth 1/2 ea. We've got barrels of 100% material.</p>	<p>BARREL KIT #107 SQUARE OHMS 60 for \$1.98 Factory people are sometimes "square" when they topple prime square ohms mix 'em up in barrels. Ass't. values watts. Wt. 1 lb.</p>
<p>BARREL KIT #109 TERMINAL STRIPS 150 for \$1.98 Wide ass't. of terminal strip connectors, from 1 contact up. Strip manufacturers barrel dump in your gain. Wt. 1 lb. Cat.No. 9L3136</p>	<p>BARREL KIT #110 SUPPRESSOR DIODES 50 for \$1.98 Keeps ignition noises out axial. Untested, but the of your capt., car, industrial, etc. Double plug. Cat.No. 9L3137</p>	<p>BARREL KIT #112 AXIAL ELECTROS 40 for \$1.98 Truly factory (barrels) by mixing 'em in factories do all of us a favor. WUT A BUY! Ass't. capacities and voltages. Cat.No. 9L3227</p>	<p>BARREL KIT #112 AXIAL ELECTROS 40 for \$1.98 Large mfr dumped 100's of lbs into barrels. Includes 741's, LM-390's, 703, 697, 655, 658 - but who knows? Factory to you. All mixed, you test. Wt. 1 lb. Cat.No. 9L3245</p>	<p>BARREL KIT #115 MOLEX SOCKETS 200 for \$1.98 100% good. Calculator maker dump! We got a sillon of 'em. Used for IC sockets, etc. Cat.No. 9L3144</p>
<p>BARREL KIT #114 DARLINGTON TRANSISTORS 40 for \$1.98 TO-92, a Motorola dump, unknown numbers, but high yield to good darlington. Retesters didn't get 'em! You will. 9L3285</p>	<p>BARREL KIT #114 RCA PHONO PLUGS 40 for \$1.98 1,000,000 RCA phono plugs for this one. You hi-fi-ers know what they are 100% material. Look at the price. 9L3293</p>	<p>BARREL KIT #116 RUTTONS 'N FEEDTHRU'S 100 for \$1.98 Truthfully worth a small fortune! Ass't. but-ton-feedthru cap! HAMS TAKE NOTE! RF IJIF, etc. Wt. 1 lb. Cat.No. 9L3141</p>	<p>BARREL KIT #118 MINI SCRS 50 for \$1.98 UNBELIEVABLE! TO-92 Plastic SCRS in barrels... rite from factory, includes all voltages up thru 200 vrs. 9L3135</p>	<p>BARREL KIT #133 C-MOS IC'S 60 for \$1.98 Deliberately thrown in barrels, so we can't test 'em! The famous C14000 series, how good? Who knows? Who cares? It's only 3c ea. Cat.No. 9L3257</p>

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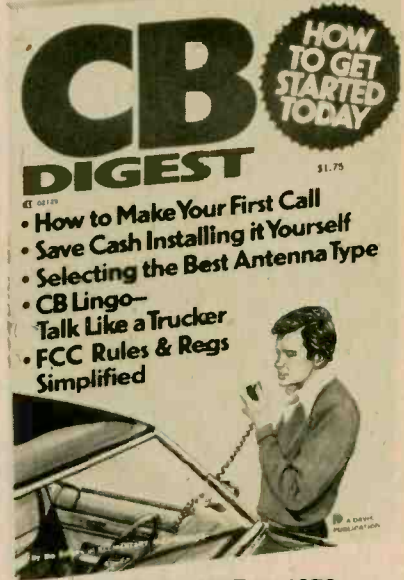
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3. **Accountants.** Greater use of accounting information in business management, changing tax systems, and growth of large corporations all point to excellent opportunities for accountants. People planning a career in accounting should have an aptitude for mathematics. Neatness and accuracy also are necessary. Employers seek applicants who handle responsibility and work with little supervision. Employment of accountants is expected to increase rapidly through the mid-1980's as businesses and government agencies continue to expand in size and complexity.

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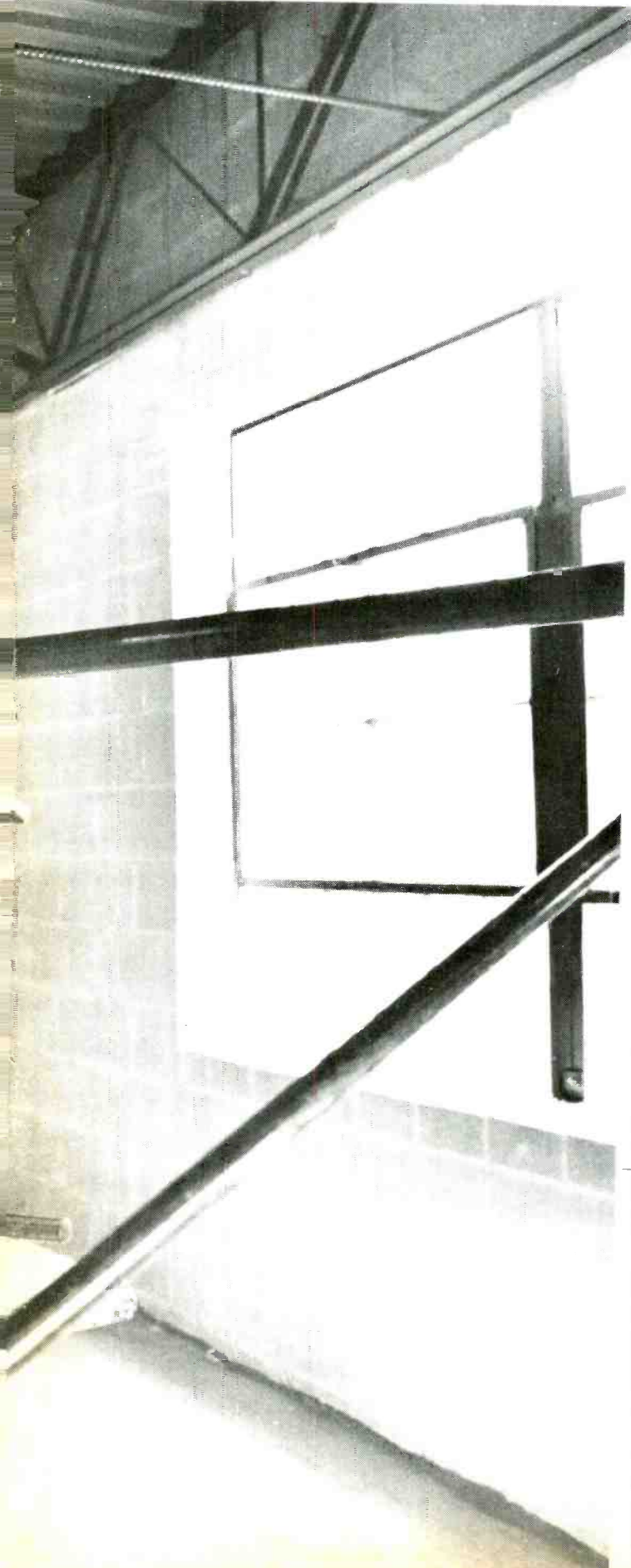
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*Bureau of Labor Statistics, *Occupational Outlook Handbook*, 1974-75 edition.

Electrician

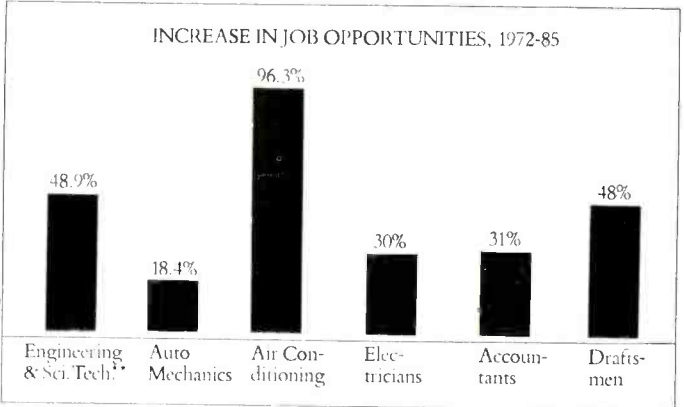


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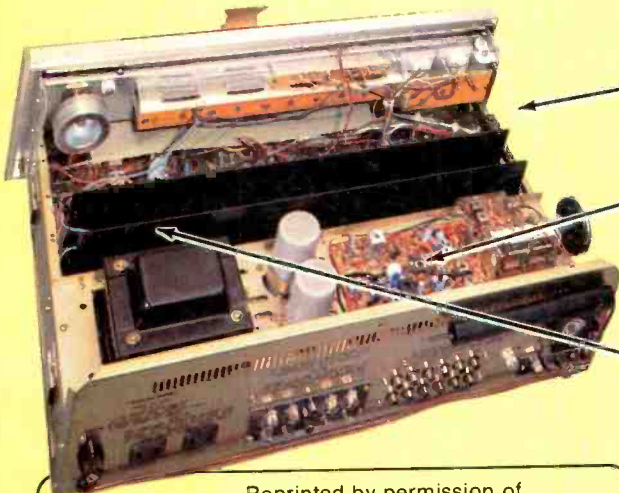
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