TAKING ON TRANSISTORS—Our Introductory Course

elementary Electronics

Get RADIO-ACTIVE
- Build Signal Snare
- Shine with Solar Swinger
- Be Your Own FM Broadcaster
- Cure Bad Ham Habits

THE NEW EDISONS

'OGETHER 'HIRD EAR und servant

SH'IBLE REPORTS
- Heath Active Audio Processor
- Palomar BCB Loop Antenna
- Redco Frequency Counter
- SOL-20 Home Computer Kit
FOR THOSE OF YOU WHO ARE HAVING SECOND THOUGHTS ABOUT YOUR FIRST CB.

Move up to the all-new Cobra 29GTL. It's the third generation of the trucker-proven Cobra 29. And like the 29 and the 29XLR before it, it advances the state of the art.

Transmitter circuitry has been refined and updated to improve performance.

Receiver circuits have been redesigned to include dual FET mixers, a monolithic crystal filter and a ceramic filter to reduce interference and improve reception.

By improving the transmitter circuitry the 29GTL keeps you punching through loud and clear. By incorporating new features for better reception everything you copy comes back loud and clear.

So if you're having second thoughts about your first CB, make your next CB the Cobra 29GTL.

We back it with a guaranteed warranty and a nationwide network of Authorized Service Centers where factory-trained technicians are available to help you with installation, service and advice.

But more important than that, we sell it at a price you won't have second thoughts about.

Punches through loud and clear.

Cobra Communications Products
DYNASCAN CORPORATION
6460 W. Cortland St., Chicago, Illinois 60635

WRITE FOR COLOR BROCHURE

EXPORTERS: Empire • Plainview, N.Y. • CANADA: Atlas Electronics • Ontario

CIRCLE 6 ON READER SERVICE COUPON
The Great Breakthru!

Computer Engineered
Duo-Phased Performance!

NEW LONGER RANGE!
NEW TALKPOWER!
NEW STRENGTH!
NEW MOUNTS!

Black or White!

Shakespeare's computer engineered Two Load™ Antenna doubles the advantage of both base and top loaded antennas. Base loading means low SWR. Top loading gets the signal out! With loading coils stacked and co-phased in the vertical mode, the Shakespeare Two Load™ multiplies your signal in all directions. power up to get out over the top of nearby interference. power down to ensure superior performance and low SWR.

Big New Bonus in Reach and Range

TIP LOAD. The top loading coil is completely encased in Shakespeare's exclusive fiberglass process. No bulge, no lump, no exposed coil. And the sleek, thin design stays erect at highway speeds.

BASE LOAD. The Shakespeare base loaded coil is your booster... promising extra performance and delivering a true power match.

PLUS... the new sculptured chromed trunk mount that has Detroit cheering. With built-in electronics. A moulded rubber shield to protect your car's finish. And the new Spin-Off/On Feature lets you laugh at the guys at the car wash. The stud is stainless... the housing sealed... making the entire unit moisture proof and completely corrosion resistant!

Shakespeare

under $30.

Shakespeare Company / Manufacturers of Communications Antennas, Marine Electronics, Fishing Tackle, Industrial Fiberglass, Lighting Poles, Wonderthread and Specialized Monofilaments, Self-Equipment, Automotive Products, Saddlery and Equestrian Accessories.
THE STAFF

Editor-in-Chief
Julian S. Martin
Managing Editor
Alan H. Rose, K2RHK
Technical Editor
Gordon Sell, KBDA1464
Associate Editor
Lee Lensky, KA2DKT
Citizens Band Editor
Kathi Martin, KGK3916

Editorial Assistant
Cynthia McClean, KBKF3780

Workbench Editor
Hank Scott
Art Director
Elof Sogn
Associate Art Director
David Pindar
Assistant Art Director
Michael Vessio
Cover Art Director
Irving Bernstein
Art Editor
Joe Groom
Art Assistants
Celeste Barbera
Leslie Wallant
Della Nobbs
Advertising Director
Ralph Vega
Production Director
Carl Bartee
Production Manager
Carole Dixon
Production Assistant
Annette Simon
Newsstand Circulation Director
Don Gabree
Subscription Circulation Director
Robert V. Enlow
Subscription Circulation Manager
Eugene S. Swanson
Marketing Director
James C. Weakley

President and Publisher
Joel Davis
Vice President and General Manager
Leonard F. Pinto
Vice President and Treasurer
Victor C. Stabile, KBP0681

ISSN: 0013-595X

ELEMENTARY ELECTRONICS is published bi-monthly by Davis Publications, Inc. Editorial and executive offices: 380 Lexington Ave., New York, NY 10017; all subscription orders and mail regarding subscriptions should be sent to P.O. Box 2630, Greenwich, CT 06830. In U.S.A. and possessions, one-year subscription (six issues) $6.95; two-year subscription (12 issues) $12.95; three years (18 issues) $18.95; and four years $23.95. Elsewhere, add $1.00 postage for each year. For change of address, please advise 8 to 10 weeks before moving. Send us your current mailing label with new address. Advertising offices: New York, 380 Lexington Ave., New York, N.Y. 10017, 212-557-9100; Chicago, 520 N. Michigan Ave., 312-527-0300; Los Angeles, J. E. Publishers' Rep. Co., 8732 Sunset Blvd., 213-659-3610. Applications to mail at con-
trolled circulation rates are pending at N.Y., N.Y. and Sparta, Illinois. Copyright 1979 by Davis Publications Inc.

RADIO ROUND-UP

43 Wireless Microphones—be the first broadcast station on your block
46 Signal Snare—tune those stations into your shack like Grandpa did
61 How Not to Be a Liar—rip those bad operating habits in the bud!
65 Solar Swinger—chases the radio clouds away
73 Antique Radio Corner—on insuring those priceless antiques

SPECIAL FEATURE—THE HISTORY OF ELECTRICITY

68 The New Edisons—after one hundred years of light, what's next?

NEAT AND NIFTY CONSTRUCTION PROJECTS

35 The Third Ear— transistorized servant follows your every command
51 Space Cushion Timer—helps you avoid that next bumper bender
72 Washer Watcher—never another dirty windshield

COMPUTER TIPS

70 Simply Basic—keep track of all those record albums
77 Computer Readout—how a computer instructs itself

THE WIDE WORLD OF SHORTWAVE LISTENING

48 DX the BBC World Service—this is the British Broadcast Empire
63 Curing Receiver Images—keep your receiving circuits clean

KEEPING UP WITH CB

75 Kathi's CB Carousel—Kathi programs the Pace 8117
76 CB XCVR Checkout—four more of the most interesting rigs get the going-over

ROUGHING UP SOME NEW EQUIPMENT

50 e/e Checks Out the ... Reeco RFC 50 Frequency Counter
54 e/e Checks Out the ... SOL-20 Personal Computer Kit
55 e/e Checks Out the ... Palomar Broadcast Band Loop Antenna
59 e/e Assembles the ... Heath Active Audio Processor

OUR REGULAR DEPARTMENTS

9 Hey, Look Me Over—the newest products that it was worth waiting for
24 DX Central—our resident DX-perl goes over some pertinent points
28 Newsclips—some very interesting developments
30 Bookmark—by Bookworm
32 Hi-Fi Reports—our audio editor equips a disco
79 Basic Course—hurry up and get started on transistors
95 Literature Library
98 Ask Hank, He Knows—Hank fixes everything

AUTHORS IN THIS ISSUE

Homer Davidson, Bruce Evans, Thomas Fox, James A. Fred, Charles Green, Larry Friedman, Jorma Hyypia, Don Jensen, Kathi Martin, Brian Rogers, Hank Scott, Gordon Sell, Walter Sikonowiz, C. M. Stanbury, Thomas Sundstrom, Martin Weinstein, Tom Williams, and the ELEMENTARY ELECTRONICS editorial staff.

Cover photo by Dave Niedo
"If you're going to learn electronics, you might as well learn it right!"

"Don't settle for less. Especially when it comes to career training... because everything else in your life may depend on it. That's why you ought to pick CIE!"
You've probably seen advertisements from other electronics schools. Maybe you think they're all the same. They're not!

CIE is the largest independent home study school in the world that specializes exclusively in electronics.

... Meet the Electronics Specialists.

When you pick an electronics school, you're getting ready to invest some time and money. And your future depends on the education you get in return.

That's why it makes so much sense to go with number one... with the specialists... with CIE!

There's no such thing as bargain education.

If you talked with some of our graduates, chances are you'd find a lot of them shopped around for their training. Not for the lowest priced but for the best. They pretty much knew what was available when they picked CIE as number one.

We don't promise you the moon. We do promise you a proven way to build valuable career skills. The CIE faculty and staff are dedicated to that. When you graduate, your diploma shows employers you know what you're about. Today, it's pretty hard to put a price on that.

Because we're specialists, we have to stay ahead.

At CIE, we've got a position of leadership to maintain. Here are some of the ways we hang onto it...

Our step-by-step learning includes "hands-on" training.

At CIE, we believe theory is important. And our famous Auto-Programmed® Lessons teach you the principles in logical steps.

But professionals need more than theory. That's why some of our courses train you to use tools of the trade like a 5 MHz triggered-sweep, solid-state oscilloscope you build yourself—and use to practice troubleshooting. Or a beauty of a 19-inch diagonal Zenith solid-state color TV you use to perform actual service operations.

Our specialists offer you personal attention.

Sometimes, you may even have a question about a specific lesson. Fine. Write it down and mail it in. Our experts will answer you promptly in writing. You may even get the specialized knowledge of all the CIE specialists. And the answer you get becomes a part of your permanent reference file. You may find this even better than having a classroom teacher.

Pick the pace that's right for you.

CIE understands people need to learn at their own pace. There's no pressure to keep up... no slow learners hold you back. If you're a beginner, you start with the basics. If you already know some electronics, you move ahead to your own level.

Enjoy the promptness of CIE's "same day" grading eyele.

When we receive your lesson before noon Monday through Saturday, we grade it and mail it back—the same day. You find out quickly how well you're doing!

CIE can prepare you for your FCC License.

For some electronics jobs, you must have your FCC License. For others, employers often consider it a mark in your favor. Either way, it's government-certified proof of your specific knowledge and skills!

More than half of CIE's courses prepare you to pass the government-administered exam. In continuing surveys, nearly 4 out of 5 CIE graduates who take the exam get their Licenses!

For professionals only.

CIE training isn't for the hobbyist. It's for people who are willing to roll up their sleeves and go to work... to build a career. The work can be hard, sure. But the benefits are worth it.

Send for more details and a FREE school catalog.

Mail the card today. Or, call 1-800-CIE-1776 (in Ohio) or 1-800-421-5748. And receive your FREE school catalog—include your name and address. Mail it today. Sometimes, it takes a few days to receive your mail catalog. But it's worth the wait.

Mail the card or the coupon or write CIE (mentioning name and address) at: 1776 East 17th Street, Cleveland, Ohio 44114.

Patterns shown on TV and oscilloscope screens are simulated.
These new **Persuader Antennas**

low profile, extra long whip deliver performance equal to, or better than anything else on the road!

There’s a hand-wound, hand-tuned coil in the cup...

a major advance in antenna technology from the Antenna Pros field tested and field proven by thousands of CBers

**Only $34.98** suggested retail. Compare with K-40 at $38.50 or any other antenna. You’ll see there’s no comparison.

**5 year guarantee**

Materials and workmanship of PERSUADER ANTENNAS (Models 13505 & 17605) are guaranteed for a full five years if this antenna is installed by the dealer and a full three years if this antenna is installed by the consumer. Any part that fails within the guarantee period will be replaced absolutely free provided the registration card has been completely filled out and returned to Antenna Incorporated.

A word from the Old Pro:

When you buy this antenna, my reputation... built over 38 years in the antenna business... will be riding on your roof. I’m confident that the Persuader Antennas will persuade you... you’ve chosen the Best.

M.R. Friedberg, President
Antenna Incorporated

In stock at your dealer now...
or call the Antenna Hotline...1-800-447-4700.
(Illinois: 800-322-4400; Sorry, no Hotline service in Alaska or Hawaii)

Charge to Visa or Master Charge... and we’ll have your nearest dealer ship your Persuader Antenna promptly, in the mount and color of your choice. Hotline orders add $1.50 for shipping and handling. Applicable local taxes extra. Allow 2 to 4 weeks for delivery.

The family of fine antennas from the fine antenna family.
These features will persuade you...
The Persuader™ Antenna Is Your Best Antenna Choice

60" Stainless Steel Tapered Whip...and No Spring

The super-long whip increases the aperture of the antenna. This increases
• the signal capture area on reception
• the transmit signal and radiation intensity at the horizon
• bandwidth to well over a 40-channel capability
The .125" diameter whip is tapered, so shock is distributed evenly. There's no spring to stretch, break, or bend the whip away from the straightest possible upright position.

Exclusive coil-in-cup design

Loading of most low-profile antennas is by a simple printed circuit board that can't be tuned and will eventually burn out. These new Persuader antennas are completely pre-assembled and pre-tuned and feature an actual hand-wound, hand-tuned copper wire loading coil tested with 500 watts, rated at 100 watts continuous. It's even more efficient than our base-loaded coils because it's wound to a larger diameter, with fewer turns.

This unique design also involves fewer mechanical and electrical connectors—fewer resistive contacts between loading coil and cable terminations—less chance for dust, moisture or road gunk to contaminate the contacts.

This concept has been field tested by thousands of CBers in our Model 13503 (shorter whip, plain white cup). Your good buddies will tell you everything we say about it is true.

Available with Trunk-Lip or Magnet Mount

for performance:
• SWR of 1.5:1 or less across all 40 AM and SSB channels
• Shunt-fed loading coil is DC grounded for quiet performance; bleeds off static from rain, snow, air particles. Performance is virtually identical to body mounted antennas
• Center-root placement of magnet mount provides your most uniformly omnidirectional signal. (Can also mount on trunk lid)
• Unique Antenna Incorporated design provides capacitive coupling. Aluminum plate puts the ground potential right at the mounting surface.

for convenience:
• Magnet and trunk lip, the two easiest installations! Place the antenna where you want it, plug the cable into the transceiver. No holes to drill. Readily removed for anti-theft protection. Magnet mount supplied with 12" RG-58-U coaxial cable with PL-259 type connector; trunk lip mount with 17" of cable.

for magnet mount adherence:
Heavy-duty 2½" magnet in plastic cup with soft rubber gasket. Holds at top highway speeds of 55 mph. (Trunk lip mount recommended for vinyl roof cars.) Since it won't walk, it won't detune! "Oil-can" effect of cup, resting on gasket, provides a larger magnet plane than if the magnet itself were touching the surface—yet there's less weight on the car, less scratch potential.

All magnet mount benefits are standard...not an extra-cost accessory!

30 MHz. Priced at $695 (including probes) the Model 517 features automatic selection of chopped or alternate operation in dual trace mode depending on sweep speed selected. The Model 517 is ideal for TV, VCR, audio and video maintenance and repair, as well as design and troubleshooting of most digital logic circuits. The Model 515 offers most of the features of the Model 517 in a lower-priced ($495 including probe) single trace version well suited to servicing and hobby applications. TV sync separators are built-in for easy locking to complex TV video wave forms at any sweep speed and, like the Model 517, it provides x-y operation for vectorscope measurements. For all the facts, write to the Hickok Electrical Instrument Co., 10514 Du Pont Ave., Cleveland, OH 44108.

Mighty Mite

Radio Shack's Realistic STA-7 AM/FM stereo "mini" receiver delivers 10 watts per-channel RMS into 8 ohms over 20-20,000 Hz with a 0.5% total harmonic distortion. The low-profile receiver features an equalization (EQ) circuit which produces high-fidelity sound from the latest "in-ear" headphones. This exclusive design also involves fewer mechanical and electrical connectors—fewer resistive contacts between loading coil and cable terminations—less chance for dust, moisture or road gunk to contaminate the contacts.

This concept has been field tested by thousands of CBers in our Model 13503 (shorter whip, plain white cup). Your good buddies will tell you everything we say about it is true.

Available with Trunk-Lip or Magnet Mount

for performance:
• SWR of 1.5:1 or less across all 40 AM and SSB channels
• Shunt-fed loading coil is DC grounded for quiet performance; bleeds off static from rain, snow, air particles. Performance is virtually identical to body mounted antennas
• Center-root placement of magnet mount provides your most uniformly omnidirectional signal. (Can also mount on trunk lid)
• Unique Antenna Incorporated design provides capacitive coupling. Aluminum plate puts the ground potential right at the mounting surface.

for convenience:
• Magnet and trunk lip, the two easiest installations! Place the antenna where you want it, plug the cable into the transceiver. No holes to drill. Readily removed for anti-theft protection. Magnet mount supplied with 12" RG-58-U coaxial cable with PL-259 type connector; trunk lip mount with 17" of cable.

for magnet mount adherence:
Heavy-duty 2½" magnet in plastic cup with soft rubber gasket. Holds at top highway speeds of 55 mph. (Trunk lip mount recommended for vinyl roof cars.) Since it won't walk, it won't detune! "Oil-can" effect of cup, resting on gasket, provides a larger magnet plane than if the magnet itself were touching the surface—yet there's less weight on the car, less scratch potential.

All magnet mount benefits are standard...not an extra-cost accessory!
New from NRI!
25” color TV that tunes by computer, programs an entire evening’s entertainment.

Just part of NRI's training in servicing TV, stereo systems, video tape and disc players, car and portable radios.
Only NRI home training prepares you so thoroughly for the next great leap forward in TV and audio...digital systems. Already, top-of-the-line TV's feature digital tuning, computer programming is appearing, and new digital audio recording equipment is about to go on the market.

NRI is the only home study school to give you the actual "hands-on" training you need to handle servicing problems on tomorrow's electronic equipment. Because only NRI includes this designed-for-learning, 25" diagonal color TV with electronic tuning, built-in digital clock, and computer programmer as part of your training. With this advanced feature, you can pre-program an entire evening's entertainment...even key lock it in to control children's viewing.

As you assemble it, you learn how digital tuning systems work, how to adjust and service them. You work with the same advanced features used in the new programmable TV's and video tape recorders. It's exclusive NRI training that keeps you up with the leading edge of technology.

Exclusive Designed-for-learning Concept

The color TV you build as part of NRI's Master Course looks, operates, and performs like the very finest commercial sets. But behind that pretty picture is a unique designed-for-learning chassis...the only such unit in the world. Rather than retrofit lessons to a hobby kit or an already-built commercial set, NRI instructor/engineers have designed this television so each step of construction is a learning experience.

As you build it, you perform meaningful experiments. You see what makes each circuit work, what it does, how it interacts with other circuits. You even introduce defects, troubleshoot and correct them as you would in actual practice. And you end up with a magnificent, big-picture TV with advanced features. One you can sell or use in your home.

Also Build Stereo, Test Instruments

That's just a start. You demonstrate basic principles and circuits on the unique NRI Discovery Lab® then apply them as you assemble a fine AM/FM stereo receiver, complete with speakers. You also get practical experience as you build your own test instruments, including a 5" triggered sweep oscilloscope, CMOS digital frequency counter, color bar generator, and transistorized volt-ohm meter. Use them for learning, use them for earning as a full- or part-time TV, audio, and video systems technician.

Complete, Effective Training Includes Video Systems

Using NRI's exclusive methods, you learn far more than TV servicing. You'll be prepared to work with stereo systems, car radios, record and tape players, transistor radios, short-wave receivers, PA systems, musical instrument amplifiers, electronic TV games, even video tape recorders and tape or disc video players. Your training covers just about every kind of electronic entertainment equipment available now or in the near future.

And because NRI has unmatched experience gained in over 60 years and a million students worth of training, your course is designed for ease of learning and practical utility. You need no previous experience of any kind. Starting with the basics, exclusive "bite-size" lessons cover subjects thoroughly, clearly, and concisely. "Hands-on" experiments reinforce theory for better comprehension and retention. And your personal NRI instructor is always available for consultation, ready with explanations, answers, and advice.

Send for Free Detailed Catalog...

No Salesman Will Call

Get all the facts on this exciting course and its potential for you by mailing the postage-paid card today. Our free 100-page catalog includes color photos of all kits and equipment, complete lesson plans, convenient time payment plans, and information on other electronics courses. You'll also find out about NRI's new Computer Technology Course that includes your personal microcomputer. Or Complete Communications with 2-meter transceiver that gets you ready for opportunities in broadcasting, 2-way radio, microwave, and other growing fields. If card has been removed, write to:

NRI Schools
McGraw-Hill Continuing Education Center
3333 Wisconsin Ave.
Washington, D.C. 20016
The "mobile moonraker" by Avanti

OUTPERFORMS THEM ALL...

Outperforms all top, center, or base loaded antennas tested including K-40, A/S, Firestik, Hustler and Hy-Gain.

WE GUARANTEE IT!

Get the facts. See your Avanti dealer or write for details.

Avanti antennas
AVANTI RESEARCH and DEVELOPMENT, INC.
340 Skidmore Avenue, Addison, IL 60101 • (312) 626-9100

The mobile

Avanti engineered to transmit further—give clearest reception! Low S.W.R. across 40 channels!

Tapered whip helps signal "Flutter"!

Non-magnetic chrome-plated base

Bolted-socket antenna mounting!

Mechanically tested, high strength, 5/8 J.I.S.

Weatherproofing prevents moisture and expands to accommodate almost all directions.

Constant high performance!

Solid copper coil windings—deliver all the power you need to transmit!

Silver-plated connector mounting—low resistance—corrosion proof—Condon-proof!

"O" ring seals prevent moisture and water leakage!

Heavy-duty 1/2" plastic deep-grooved neoprene bushings—can't pull loose.

Strong connector safety catches prevent breakage or pullout.

S.S.M. Antenna

S.S.M. offers a complete line of antennas

Avanti engineered for maximum performance and available only from Avanti.

Created of the famous Moonrakers • PDL II • Astro-plane

Astron Beam • Sigma II • Saturn

Avanti Scan + Mobile Racers

S.S.M. Antenna

S.S.M. offers a complete line of antennas

Avanti engineered for maximum performance and available only from Avanti.

CREATORS OF THE FAMOUS MOONRAKERS

(Circle 44 on Reader Service Coupon)

NOW...

Add-on Mini-Disc for the TRS-80

Dual and triple drives also available.

only $399.00

PERCOM DATA COMPANY, INC.
DeLey • 318 Barnes • Garland, TX 75042
Phone: (214) 272-3421

To Order Call 1-800-527-1592

(Continued from page 9)

HEY, LOOK ME OVER

Power Pumper for Car

Added to the J.I.L. "Power Pumper" line of high-powered car stereo units is the Model 633 AM-FM-MPX/Cassette unit which incorporates a special power boost switch that enables the unit to deliver a full 20-watts RMS per channel maximum, for big, home-stereo-like sound. The tuner section features an FET front end and a phase-lock-loop circuit in the multiplex for top broadcast reception and excellent FM-stereo separation. A Local/Distance switch and FM muting are also incorporated. Model 633 offers automatic reverse, push button eject, locking rewind and fast forward, and tape direction indicator. Adjustable shafts simplify in-

CIRCLE 42 ON READER SERVICE COUPON

stallation. It's priced at $244.95. For complete information, write J.I.L., Department P, 737 West Artesia Blvd., Compton, CA 90220.

S-100 Video Board

SSM (formerly Solid-State Music) has introduced the VB2, an I/O-controlled video interface board. The VB2 has its own keyboard input port, so there is no need for another I/O board for either keyboard or video display. The hardware-controlled cursor for line feed, carriage return, backspace, and clear-screen frees up valuable memory space. The display is 64 by 16, and features all upper case letters as well as numbers and symbols, and is switch-selectable for white-on-black or black-on-white. VB2 is available in kit form, priced at $149.95. For further information contact SSM, 2116 Walsh Avenue, Santa Clara, CA 95050.

Prototyping Board

A new prototyping circuit board, bus and shape compatible with Altair and IMSAI microcomputer boards, holds up to seventy 14- or 16-pin DIPs or any combination of DIP sockets with 0.3-, 0.4-, 0.6-, or 0.9-inch lead spacing. Designed by Vector Electronic Company as their "ANY DIP" Plugboard, the Model 8804 board's convenient power and ground-plane network makes it ideal for "homebrew" computers or custom-interface construction. The 5.3-inch by 10-inch by 0.062-inch board has 100 (50 each side) card-edge contacts on 0.125-inch centers to accommodate an S-100 bus organization. Two 100-hole rows of individual 0.1-inch spaced pads across the top of the board, permit additional input/output, via ribbonwire assemblies, inexpensive wrap posts may be fabricated by inserting Victor's T46-5-9 wrapped-wrap pins into the holes. One corner of the 8804 may be used for a low-profile heat sink with two regulators in TO-220 packages. 8804 Plugboards are priced at $21.95 singly, and $19.76 each in quantities of five or more. Write to Vector Electronic Company, 12460 Gladsone Avenue, Sylmar, CA 91342, for further information.

CIRCLE 46 ON READER SERVICE COUPON

(Continued on page 16)

ELEMENTARY ELECTRONICS/May-June 1979
The "Edu-Kit" offers you an outstanding PRACTICAL HOME RADIO COURSE at a rock-bottom price. The "Edu-Kit" is designed to train you in radio, television, and other electrical and electronic fields, and to make you a useful member of the rapidly growing field of electronics. You can be trained at home, in your spare time, at your own rate. You will learn in a practical, hands-on manner. You will learn by doing. Therefore, you construct, study and work with real radio receivers, transmitters, and other electronics equipment. You will learn the principles of radio construction, and learn and practice code, using the Progressive Code Oscillator. You will learn and practice troubleshooting, the Progressive Dynamic Radio & Electronics Tester, Square Wave Generator and the accompanying instructional material.


Absolutely no previous knowledge is necessary. The "Edu-Kit" is the product of many years of teaching and engineering experience. The "Edu-Kit" will teach you the basic principles of radio, and you will construct, study, and work with real radio receivers, transmitters, and other electronics equipment. You will learn the principles of radio construction, and learn and practice code, using the Progressive Code Oscillator. You will learn and practice troubleshooting, the Progressive Dynamic Radio & Electronics Tester, Square Wave Generator and the accompanying instructional material.


Absolutely no previous knowledge is necessary. The "Edu-Kit" is the product of many years of teaching and engineering experience. The "Edu-Kit" will teach you the basic principles of radio, and you will construct, study, and work with real radio receivers, transmitters, and other electronics equipment. You will learn the principles of radio construction, and learn and practice code, using the Progressive Code Oscillator. You will learn and practice troubleshooting, the Progressive Dynamic Radio & Electronics Tester, Square Wave Generator and the accompanying instructional material.


Absolutely no previous knowledge is necessary. The "Edu-Kit" is the product of many years of teaching and engineering experience. The "Edu-Kit" will teach you the basic principles of radio, and you will construct, study, and work with real radio receivers, transmitters, and other electronics equipment. You will learn the principles of radio construction, and learn and practice code, using the Progressive Code Oscillator. You will learn and practice troubleshooting, the Progressive Dynamic Radio & Electronics Tester, Square Wave Generator and the accompanying instructional material.

HEY, LOOK ME OVER
(Continued from page 14)

Oscilloscope Kit
A new, low-cost, DC-to-5 MHz Dual Trace Oscilloscope kit, the Heathkit IO-4205, features a vertical input sensitivity of 10 mV/cm, a stable triggering circuit for solid waveform displays, seven calibrated time bases from 200 μs/cm to 0.2 μs/cm, a regulated vertical amplifier, and horizontal sweep circuit power supplies. Other IO-4205 features include a partial mu-metal shield, an extra-bright 5-inch flat-screen CRT, and a lightweight durable cabinet with flush-mounted handle for easy carrying and "stackability" with other instruments. All controls and inputs are front panel-mounted for simple, convenient operation. It sells for $259.95 FOB Benton Harbor, MI. For more information on the new, low-cost IO-4205 Dual Trace Oscilloscope kit, send for the latest Heathkit catalog. Write Heath Company, Department 570-130, Benton Harbor MI 49022.

2-Meter Yagi Antennas
Two models of the new Star Tracker series of Hustler 2-meter rotatable beam antennas are 5 and 11-element matching system for 1.5:1 or better SWR. At resonance, SWR is typically 1.1:1. This system provides for optimum energy transfer without sacrificing gain or pattern control. Each model can be easily mounted for vertical or horizontal polarization for station-to-station VHF DX work. The Star Tracker is a 144-inch center-mounted 11-element beam. Optimum 'element spacing provides a forward gain of greater than 15 d. Front-to-back ratio is greater than 27 d over the 4 MHz bandwidth. Half-power beamwidth is normally 36°. Hustler furnishes all stainless steel hardware and the corrosion-resistant steel clamps. There are no mounting holes in the elements or boom, thus providing extra-strength. The suggested list price of the Model ST-5 is $39.95. The Model ST-11 is $59.95. For further information on these or any Hustler products, write to New-Tronics Corporation, 15800 Commerce Park Drive, Brookpark, OH 44142.

Hand-Held CB
A 40-channel, hand-held CB transceiver, the Dyna-Com 40, made by Lafayette Radio, is a full-powered unit, priced at $149.99. The Lafayette Dyna-Com 40 incorporates full five-watt input at the final amplifier with an iLED (light emitting diode) channel indicator, and digital Phase Lock Loop (PLL) circuitry. Other features are a full-time range boost circuit that concentrates more audio power into the sidebands for greater transmission range, squelch control, automatic gain control, automatic noise limiter, S/RF power meter, battery condition indicator, and an external microphone input jack. Lafayette Radio Electronics Corp. sells nationwide through 140 company-owned stores, an extensive direct-mail operation and nearly 300 associate stores and authorized dealers.

What You See is What You Get
Sparkomatic's new car stereo graphic equalizer/booster amplifier enables the traveller to "see" the amplifier response shaped by the various tone controls on the unit. The AcoustaTrac GE-500 pro-

Model ST-5 is a compact, 54-inch, 2-meter beam with 5 optimum-spaced elements. Forward gain is greater than 10 dB and the front-to-back ratio is greater than 22 dB over the antenna's 4 MHz bandwidth. Half-power beamwidth is normally 50°. The Model ST-11 Star

CIRCLE 1 ON READER SERVICE COUPON
CIRCLE 2 ON READER SERVICE COUPON
CIRCLE 45 ON READER SERVICE COUPON
CIRCLE 4 ON READER SERVICE COUPON
CIRCLE 5 ON READER SERVICE COUPON
adjust for tone, an illuminated flexible rod changes its shape in conformance with the control movement. The GE-500 contains integrated circuitry for maximum reliability, wide frequency response, and 40 (20 + 20) watts of undistorted RMS stereo power. Other features include slide controls that infinitely adjust five different frequency bands, a front-to-rear fader control, a power indicator light, and an audio by-pass switch. The unit can be used with all tape decks and radios and with all speakers that have a power handling capability of 15 watts or greater. Suggested retail price is $89.95. Get all the facts direct from the Sparkomatic Corp., Milford, PA 18337.

On-the-Run Convenience
Courier has added a new mobile AM/SSB transceiver to their line. The Courier Galaxy is a straight-forward under-dash unit with features designed with the operator in mind. It has controls for noise blanker, SWR calibration, clarifier, mic and RF gain and PA capability. The Galaxy also has a large LED channel indicator and a three-in-one SWR calibration, and S/RF meter. One popular feature is a channel 9 priority switch that allows selection of channel 9 without tuning the dial. Its suggested retail price is $279.95. For more information write to Fanon/Courier Corporation, 990 South Fair Oaks Avenue, Pasadena, CA 91105.

TRS AM/SSB BASE
This handsome looking AM/SSB base station transceiver from TRS is a full-function CB with a complete set of controls. The TRS Challenger Model 1400 has separate S and SWR meters, digital channel indicator, and a built-in digital clock/timer. The 1400 also features RF gain control, switchable noise blanker, adjustable squelch, ANL, Delta tuning and tone control. According to TRS the Model 1400 puts out 4 watts RMS on AM and 12 watts PEP on SSB. The modulation is limited to 100 percent and spurious and harmonic suppression is -60 dB. The manufacturer claims an AM sensitivity of 0.7 uV and an SSB sensitivity of 0.3 uV. It operates on 117 VAC. Retail is $599.95. For more information write to TRS Marketing Inc., 137 East Savarona Way, Carson, CA 90746.

CB/VHF Marine Antenna
Antenna Specialists' new ASM-107 dual band VHF/CB marine antenna is now in limited production. The ASM-107 is a 17-foot fiber-glass whip capable of simultaneous high performance on both VHF (156-163 MHz) and CB (all 40 channels). What makes it possible is an electronic isolation coupler which separates the signals and feeds the two transceivers. The advantages of the ASM-107 are extra safety and the convenience of two separate two-way radio systems aboard without the work, hassle, and cost of drilling extra holes, mounting extra hardware, running an extra coax cable, and buying two antennas. Sells for $149.95. For more details on the ASM-107 and the complete A/S marine products line, contact The Antenna Specialists Co., 12435 Euclid Avenue, Cleveland, OH 44106.

Organized Sound
Shakespeare Marine Electronics has a deck hailer, called the Shakespeare Sound Center, that is designed to provide convenience of pushbutton switch selection for every functional demand; 10 mV/cm vertical sensitivity calibrated in 11 steps—in a 1-2-5 sequence up to 50 V/cm with variable control; and a 17.5 nanosecond rise time. Bandwidth is DC to 20 MHz, Sweep speed for the LBO-507 is 0.5 uSec/cm, 18 steps in a 1-2-5 sequence up to 500 mS/cm with variable control. The LBO-complete with low capacitance probe and terminal adapter. Get the complete specs 507 is priced at less than $500 and is direct from Leader by writing to Leader Instruments Corp., 151 Dupont St., Plainview, NY 11803.

3½ Digit DVM
The new 3½ digit Model 3300 digital VOM just introduced by the Triplett Corp. features an extra-visible 1.3-in. high digital LED readout display with Polarity Indica-

CIRCLE 80 ON READER SERVICE COUPON
CIRCLE 70 ON READER SERVICE COUPON
CIRCLE 78 ON READER SERVICE COUPON
CIRCLE 79 ON READER SERVICE COUPON
CIRCLE 81 ON READER SERVICE COUPON
CIRCLE 71 ON READER SERVICE COUPON
The LIFESCREEN III in projection system gives you all the enjoyment and excitement of the $4000 systems. Our new injection molded Tron Ex lens (F/1.9) produces an amazing image that is over 3 times brighter than most nationally marketed big-screen TVs—including Sony. And the Tron Ex delivers clear 2-D images on to the screen edge for better overall clarity. Our light-weighting Extron LS-50 screen is 6 times lighter than most movie screens, because the molded parabolic contour reflects extraneous light, concentrating a directionally selective TI-Image for clearer, colorful viewing. The LIFESCREEN III plans provide exact dimensions to fit the 13" Toshiba (model C3899), but they can be modified to fit most 12"-16" portables. Pre-constructed LIFESCREEN III tent housings available for most TVs. Enter the components catalog below.

**COMPLETE PACKAGE $219**

**LIFESCREEN II**

The self-contained protection system that uses any transistor portable TV (12"-16") — requires only a 4 feet of floor space — use readily against any wall and simply beauty to the decor of any room. Includes Tron-Ex F/1.9 lens, Extron LS-50 screen, two front surface mirrors, and building plans for the cabinet.

**COMPLETE PACKAGE $83.85**

**EXTRON GUARANTEES EVERYTHING:** the protection quality, accuracy of description and availability of components described in this ad. After building your LIFESCREEN PROJECTION SYSTEM, if you are not satisfied for any reason, return all components to EXTRON for instant refund.

**LARGER SCREENS FOR LIFESCREEN I AND LIFESCREEN III SYSTEMS CAN BE ORDERED FROM OUR CATALOG.**

Please send the items checked below.
- ONE COMPLETE SET OF LIFESCREEN I PLANS $19.00
- ONE COMPLETE SET OF LIFESCREEN II PLANS $19.00
- ONE COMPLETE SET OF LIFESCREEN III PLANS $19.00
- COMPLETE LIFESCREEN I PACKAGE $219.00
- COMPLETE LIFESCREEN II PACKAGE $399.00
- COMPLETE LIFESCREEN III PACKAGE $1319.00
- EXTRON COMPONENTS CATALOG (Applicable toward any purchase) $1.00

All prices F.O.B. factory — Call readers add 6% sales tax.

**TOTAL $**

**CIRCLE 9 ON READER SERVICE COUPON**

**FREE SWITZ CATALOG**

**Audio—Computers**

**Kits & Assembled**

**CIRCLE 18 ON READER SERVICE COUPON**

**HEY, LOOK ME OVER**

The new DVOM sells for only $175.00, complete with long life Ni-Cad batteries and AC Adaptor Charger plus test probes with safety boots. The Triplet II 3300 is a safety-conscious design with no exposed metal parts and it includes a high energy 2A/600 V fuse for ample overload protection. A fused probe provides for both high energy and normal use circuit protection. Over-range is indicated by a blinking display and a low battery warning is included. DC polarity is automatic with indication directly on the readout display. Full details on the new Model 3300 DVOM. and its complete line of accessories may be obtained at leading electronic distributors, or write to Triplet Corporation, Bluffton, OH 45817 or call (419) 358-5015.

**50 MHz Logic Probe**

Dynascan's new B&K-Precision logic probe is capable of measurements from DC to 50 MHz. The new probe, Model DP-50, is a multi-family device that is compatible with TTL, DTL, RTL, HTL, CMOS, and high-noise immunity logic (HINIL). Three bright LED indicators display pulse presence and high and low logic states. The DP-50 will continue to indicate pulse presence through its maximum frequency of 50 MHz. For high-speed or intermittent pulses, the DP-50 offers a memory mode to "freeze" and store the pulse display. In the pulse mode, short-duration pulses are "stretched" for a clear visual indication. Input impedance is 2 megohms in all modes. The DP-50 is overload protected and will withstand ±50 VDC at the input. Reverse polarity protection for the power leads is also 50 volts. Sells for $50.00. For additional information, contact B&K-Precision, 6460 W. Cortland St., Chicago, IL 60635.

**Two Meters in a Fist**

The YAESU amateur radio hand-held transceiver, Model FT-202R, provides 1-watt performance in a lightweight, completely portable package on 2-meter FM. With the flexibility of six crystal-controlled channels (three installed), the unit may be powered with eight nicad AA cells, or seven alkaline dry batteries, to provide 1 watt output. Options include external speaker, microphone, battery charger and leather carrying case. The FT-202R comes with the "Rubber Ducky" antenna, dummy battery, vinyl carrying case and shoulder strap, and sells for $199.00. Bat
"HOT" NEW BOOKS FOR MICRO-COMPUTER PROS!

The latest in micro-computer books that people waited in line to buy!
Now available by mail for the first time.

How to Buy & Use Minicomputers & Microcomputers
By W. Barden, Jr.
Explores the basics; covers hardware, software, peripheral devices, programming languages & techniques; use for fun or profit! 240 pgs. #21351 ... $9.95

Microcomputer Primer
By M. Waite & M. Pardee
Explains it all: central processing unit, memory, input/output interfaces, programs. Discusses well-known models & shows how to program your own. 224 pgs. #21404 ... $7.95

Basic Primer
By M. Waite & M. Pardee
Covers BASIC fundamentals, program control, organization, functions & variations. With a game program & data on numbering systems & ASCII character codes. 192 pgs. #21586 ... $8.95

How to Program Microcomputers
By W. Barden, Jr.
Examines assembly-language programming of 8080, MC6800 & MCS6502 models. Explains concepts, operation & architecture. With precanned operations. 256 pgs. #21459 ... $8.95

Fundamentals of Digital Computers (2nd Ed.)
By D. Spencer
Explains computers, programming, hardware, BASIC, FORTRAN & COBOL languages, advanced concepts & computer center operation. 320 pgs. #21534 ... $9.95

The 8080A Bugbook*: Microcomputer Interfacing and Programming
By Rony, Larsen & Titus
Emphasizes the computer as a controller. Covers basic & advanced tasks of computer interfacing. BUGBOOK* is a registered trademark of E&L Instruments, Inc., Derby, Conn. 06418. 416 pgs. #21447 ... $10.50

DBG: An 8080 Interpretive Debugger
By C. Titus & J. Titus
How to use DBG (a software debugging package) to develop & test programs. With documented hexadecimal & octal listings. 112 pgs. #21530 ... $4.95

Introductory Experiments in Digital Electronics and 8080A Microcomputer Programming and Interfacing
By Rony, Larsen & Titus
Covers basic gate thru microcomputer interrupts, with hardware & software examples. Experiments re: breadboarding, circuits, etc. over 416 pgs. each. Book 1: #21550 ... $12.95. Book 2: #21557 ... $10.95. Both: #21552 ... $20.95

NCR Data Communications Concepts
By NCR Corp.
Explores concepts, techniques & limitations of data communications: telephone-based & others. 206 pgs. #21548 ... $6.95

NCR Data Processing Concepts Course
By NCR Corp.
Intro to data processing, computers & digital logic. Covers input/output devices, memories, control. 256 pgs. #21547 ... $7.95

Understanding CMOS Integrated Circuits (2nd Ed.)
By R. Melen & H. Garland
Begins with basic digital ICs; covers semiconductor physics, CMOS fabrication technology & design, & advanced CMOS applications. 144 pgs. #21596 ... $5.95

Transistor-Transistor Logic (2nd Ed.)
Discusses digital logic & different types of logic circuits used in the TTL functional class. With block diagrams, schematics, logic truth tables. 288 pgs. #21572 ... $6.95

SAVE 10% when you order 3 or more!
Examine any book(s) at NO RISK for 15 Days!

Clip Out—Mail Today!

YES—Please send me the book(s) indicated below. If I'm not completely satisfied, I may return any or all within 15 days of receipt for full credit or refund. Add sales tax where applicable:

- [ ] 21534 $ 21552
- [ ] 21531 $ 21558
- [ ] 21404 $ 21536
- [ ] 21548 $ 21547
- [ ] 21586 $ 21550
- [ ] 21551 $ 21598
- [ ] 21459 $ 21572

I have checked 3 or more titles and deducted my 10% savings.

Name
(Please Print)

Address

City State Zip Code

Total: $ _____

Check Money Order

Visa/BankAmericard

Exp. Date

Account No.: ________ (Master Charge only)

Interbank No.: ________

Signature

Minimum credit card purchase: $10.00

MAIL TO:

Howard W. Sams & Co., Inc.

4300 W. 52nd St.

Indianapolis, IN 46206

Prices subject to change 6 months after issue date.
See The Newest In Quality Electronics You

Custom Car Accessories like the Heathkit GC-1406 Digital Quartz Car Clock shown, or it's companion car clock with trip timer and stopwatch functions for the rally enthusiast, are easy and fun to build. And you have the quality and dependability in custom car accessories you can show-off with pride. Now you can choose one of these fine car clocks, a windshield wiper delay, a deluxe mobile sirens and P.A. system, an ultrasonic intrusion alarm, an electronic speed control or a cable-to-camper intercomm — all in money-saving kit form you can build, service and install yourself.

Super Coinshooter! The GD-1190 is Heath's finest metal locator with adjustable discrimination and push-button tuning that rejects junk and finds coins.

For Treasure Hunters! The Heathkit GD-348 finds buried metal objects with it's sophisticated "induction-balance" system. The tone from the built-in speaker grows louder as you pinpoint your find — or you can use the tuning meter or optional headphones.

Radio Control Gear You Can Depend On! From the leader in R/C development. See this new 6-channel, open gimbal transmitter with Heath's instant plug-in frequency change feature...all Heath firsts...plus sensational savings on complete systems and R/C Starter Sets.

A Super-Accurate Digital Alarm. The ideal choice for a "first kit" — with snooze feature, AM and PM indicator, 12 or 24 hr. format and pleasant green-blue digital display. Budget priced, too.

A Doorbell That Plays Your Favorite Tune! A fun way to greet guests with any 16-note tune you program — and you can even add remote speakers!

Low-Cost Home Security with this Heathkit GD-500 Photoelectric Lamp Switch. Turns your lamps on at dusk — off at daylight, for that "lived-in" look when you're away from home.

Learn To Service and Maintain Your Car's Electrical System with this newest Heathkit Automotive Electrical Continuing Education Program. Think of the money you'll save when you really understand how your car's electrical system works and how you can service it. This 4-part self-learning program takes you through electrical principles, starting and charging systems and accessories and body electrical...all at your own pace and at lowest cost.

Learn How To Use Electronic Test Instruments with this Heathkit self-learning program. A progressive 4-part program using Heath's famous programmed instruction with audio and visual aids for maximum efficiency. Learn to use electronic meters, oscilloscopes, frequency generators and special measuring instruments.

Build Your Own Custom Stereo And Get Heath Quality Plus System Savings! Choose from Heath's complete line of quality audio products for the kind of custom sound reproduction you want...from the newest and finest professional rack-mounted components to a full range of super-value components including: receivers, tuners, amplifiers, pre-amps, custom control systems, speakers, and name-brand turntables and cartridges — all available individually at low catalog prices or at money-saving system discounts.

Choose from the nearly 400 quality Heathkit products for home or business, including the world's finest values in amateur radio equipment, complete personal computing systems and educational programs.

Every Heathkit product is backed by world-famous technical service and counsel-plus sales and service facilities for 54 Heathkit Electronic Centers* coast-to-coast (*units of Schlumberger Products Corporation).

See the white pages of your phone directory.
See and read about the most exciting electronic products around — all in easy-to-build, money-saving kit form — from Heath; world leader in kit electronics. From the first computerized personal weather station to the first computerized color TV you can program for an entire evening's viewing, Heath leads the way in sophisticated, quality electronics. And every Heathkit product comes with their world-famous step-by-step instruction manual that makes building any Heathkit product fun and easy. So send for your Heathkit catalog today and choose from nearly 400 fully illustrated and described kits that will give you the pride and satisfaction of saying, "I built it myself!"

Building Heathkit products is a great family affair. There's nothing better for family fun and education...and you always end up with top-quality equipment at low kit prices.

...all in this FREE CATALOG — get yours now!

If card or coupon is missing, write:
Heath Company, Dept. 139-530
Benton Harbor, Michigan 49022

SEND FOR YOUR FREE COPY TODAY!

Heath Company, Dept. 139-530
Benton Harbor, Michigan 49022

Please send me my FREE Heathkit Catalog. I am not now receiving your catalogs.

Name

Address

City State

CL-690 Zip
Radio Moscow is trying to cover all the bases in its attempt to increase its English-speaking audiences, especially those right here in North America.

Faithful and diligent SWLs have, no doubt, already noted that it is now possible to hear English programs from Radio Moscow around the clock, thanks to the new World Service, instituted last fall to fill around the former evening services to North America.

The expanded World Service, in direct competition with the British Broadcasting Corp. and the Voice of America, has a heavy emphasis on news and current events.

It is said the expansion was made possible by the addition of two dozen half-million-watt shortwave transmitters. However, reliable sources indicate that these high powered monsters really have been on line for a number of years. Supposedly the first of the French-built Thomson-CSF transmitters was heard as far back as mid-1974.

One Million Watts? And I wouldn’t be too surprised to find the Russians are hooking up pairs of these high wattage units in tandem to sock out a million watts per!

Closer to home, though, it will be possible to hear Radio Moscow English programs on your favorite hometown AM radio station!

American stations are being offered the opportunity to broadcast, via tape recordings, honest-to-goodness Radio Moscow English programs.

Gheli A. Shakhov, editor-in-chief of Radio Moscow, in a letter to U.S. radio stations, offered to provide free tapes of some of the better known—SWLs at least—programs and featurettes of good ol’ R.M.

These include the familiar “Moscow Mailbag” program, the 15-minute show featuring the pugly and personable Joe Adamov and his answers to listeners’ letters. Another program offered is Vladimir Pozner’s views on domestic and foreign policy, “Moscow Meridian.” Other shows known to DXers featuring USSR folk music and comic strips on Russian science are occasionally aired.

Though the offering is said to be without cost to the stations, Shakov made it clear that after airing the tapes, the stations are expected to return them to Radio Moscow.

Detente Tuning. In concluding, Editor Shakov expressed his wishes for “fruitful cooperation between your radio station and Radio Moscow.”

According to United Press International, at least one AM station in Illinois, WSDX in Sterling accepted the program offer.

If other stations across the United States follow suit, R.M. will have managed to expand its program audiences to far more than SWLs.

AWR Expanding. Many shortwave listeners are familiar with the programs of Adventist World Radio, the voice of the Seventh-day Adventist Church. Since 1950, AWR programs have been aired, during purchased time, by the transmitting facilities of the Sri Lanka Broadcasting Corp., Sri Lanka, of course, is the former Ceylon, the large island off the southern tip of India.

And since 1971, AWR programs have been broadcast, under a similar arrangement by the German-owned shortwave facility called Radio Trans Europe Sines, Portugal.

Now, however, Adventist World Radio is expanding its operations with its own facilities in Guatemala. The project began last August and shortwave, medium wave and FM transmitters were expected to be operational this year. The AM-FM outlets may already be on the air, with the shortwave transmitter in Guatemala, planned for “international outreach,” to be on the air by mid-year.

An even more ambitious AWR project was approved at the Seventh-day Adventist annual council in Washington, D.C., last October. That program, to begin also in 1979, though probably not to be completed this year, calls for four shortwave transmitters to be located at a site in Liberia, West Africa.

The AWR international transmitters will be of 250 kilowatts, two of 100 kilowatts and a single 50,000 watt SW unit. A medium wave station will serve local Liberian audiences.

DX Programs. Ambrosio Wang Apo, DX editor of Radio Exterior de Espana in Madrid, Spain, whom a number of North American DXers had the opportunity to meet at the Association of North American Radio Clubs (ANARC) convention sponsored by Radio Canada International in Montreal last summer, recently announced an expanded DX program.

Radio Exterior de Espana’s DX programs from Madrid will include, he notes, announcements about the most important news of other stations with DX programs, such as changes in times and frequencies, new services, contests and meetings or anniversaries.

The station’s DX program in English is, at this writing, aired every Sunday, 2115 to 2130 GMT, and is repeated an hour later, on 6,100, 7,275, 9,505 and 11,755 KHz.
BEARCAT® SCANNERS ANNOUNCE AMERICA'S ONLY 50-CHANNEL, MICRO PROCESSOR CONTROLLED SCANNER. IT SEARCHES, STORES, REMEMBERS AND ALL BUT THINKS FOR YOU.

The new Bearcat 250. An unbelievable advancement in no-crystal scanning.

Bearcat's new, 250 is fully synthesized for punch-in programming. It searches, stores, and recalls every bit of programming, on a vast, 50-channel spectrum. Automatically. Unbelievable? Read and believe.

CRYSTAL-LESS. Micro processor controlled. Brings in every local frequency, automatically, without a crystal.

50 CHANNELS. Scans up to 50 channels in banks of 10 each. Scans any combination of banks at the touch of a button.

SEARCH/STORE. Seeks out and stores up to 64 active local public service frequencies automatically.

SEARCH/RECALL. Retrieves stored frequencies for simple entry into scan program.

PRIORITY CHANNEL. Samples a designated priority frequency on channel 1 every two seconds.

DIGITAL CLOCK. A genuine LED quartz crystal digital clock. Shows hours, minutes, seconds.

5-BAND COVERAGE. Low, high, UHF, UHF-T, Plus 2 meter amateur ham band, and other UHF frequencies.

COUNT. Transmissions on each frequency counted automatically to determine which are most active.

SCAN/SEARCH LOCKOUT. A unique feature. Not only locks out channels while scanning, it also eliminates unwanted frequencies while searching.

AND MUCH MORE! Selective Scan Delay Direct Channel Selection, Scan Speed Control, Automatic Squelch, Track Tuning Circuitry, Front-Mounted Speaker, Decimal Display, Quality Construction, AC/DC. UL listed, FCC Certified.

THE INCREDIBLE, NEW BEARCAT 250 SCANNER. LEADING THE WAY TO REAL EXCITEMENT.

Copyright 1978, Masco Corporation of Indiana.

CIRCLE 30 ON READER SERVICE COUPON
Portable Miniscopes for Electronic Professionals on the Go!!

The standout oscilloscope development of the decade!!!

Now—single & dual trace models. Compare the performance, then compare the price.

MS-15  $318  MS-215  $435
• 15-megahertz bandwidth. • Accuracy—3% full scale.
• Internal, line or external trigger. • Batteries and charger/transformer unit included. • Graticule: 4 x 5 divisions, each division 0.25". • Weight: Less than 3 lbs with batteries. • Size: 2.9" H x 6.4" W x 8.0" D.

NLS products are available from Nationwide Electronic Distributors. Send for our brochure today!

Non-Linear Systems, Inc.
Originator of the digital voltmeter.
Box N, Del Mar, California 92014 Telephone (714) 735-1134

CIRCLE 34 ON READER SERVICE COUPON

for the Experimenter!
INTERNATIONAL CRYSTALS and KITS

OF-1 OSCILLATOR
$4.48
GB.

The OF-1 oscillator is a resistor/capacitor circuit providing oscillation over a range of frequencies by inserting the desired crystal.
2 to 25 MHz, OF-1 LO, Cat. No. 005906. 20 to 60 MHz, OF-1 HI, Cat. No. 035109. Specify when ordering.

.02% Calibration Tolerance
EXPERIMENTER CRYSTALS
MC 6/4 (U Heber)
$5.22
GB.

Cat. No. 3 to 20 MHz — For use in OF-1 LO
031300 Specify when ordering.

3 to 60 MHz — For use in OF-1 HI
031310 Specify when ordering.

MIX-1 Transistor RF Mixer
3 to 20 MHz, Cat. No. 035106
20 to 170 MHz, Cat. No. 035108
$5.80 ea.

BAX-1 Transistor RF Amp
3 to 20 MHz, Cat. No. 035102
20 to 170 MHz, Cat. No. 035103
$5.80 ea.

BAX-1 Broadband Amp
20 Hz to 150 MHz, Cat. No. 035107
$6.06 ea.

International Crystal Mfg. Co., Inc.
10 North Lee Oklahoma City, Oklahoma 73102

CIRCLE 13 ON READER SERVICE COUPON

The American Heart Association
WE'RE FIGHTING FOR YOUR LIFE

DX CENTRAL
11,840 kHz.

June in Minneapolis. The mention of the hang-up 1978 convention of the Association of North American Radio Clubs in Montreal last summer reminded me to remind you readers that the '79 gathering of listeners from across the continent is scheduled for the weekend of June 22-24 in Minneapolis, Minn.

This convention will be hosted by the Minnesota DX Club in cooperation with the Department of Speech-Communication of the U. of Minnesota.

Kim Andrew Elliott, convention chairman, has indicated among the special events planned is a special ANARC television program, Saturday, June 23, at the Minneapolis campus of the U. of Minnesota.

For details, drop a note to ANARC Executive Secretary Dave Browne, care of Association of North American Radio Clubs, 55 North Madison Avenue, Pasadena, CA 91101. Be sure to include a stamped, self-addressed envelope so Dave can send you the data on how to register for the ANARC '79 Convention.

Down the Dial. (Times in GMT, frequencies in kHz) . . . . . 610—National Broadcasting Service, the voice of Trinidad and Tobago, in the West Indies, tapped its transmitter power from 10 kilowatts to 50 kilowatts. Some east coast broadcast band listeners have reported improved reception, as a result, prior to sign off at 0400 . . . 4,720—The Spanish-speaking station you may log here late at night has been fooling some SWLs for a long time. The reason is that it doesn't belong here at all.

It is a harmonic (the 8th multiple, to be exact) of the medium wave outlet of La Voz de Cuba which operates on 590 kHz . . . . . 5,055—Costa Rica in Central America is one Latin country that many SWLs are hunting for. Try the outlet of Faro del Caribe, which translates as the Lighthouse of the Caribbean, TIFC, a religious station. You will find it in English prior to its 0400 sign off . . . . 9,620—Radio Yugoslavia is not the most commonly heard of the many European shortwave stations. But you can hear it broadcasting in English at 2200 . . . . 11,642—Looking for Radio Pakistan? Try this frequency at 1815 for English programming . . . . 17,800—The Voice of Chile has been reported here at 0115 with political commentaries in English. (Credits: Bob Foxworth, NY; Ernest Behr, ONT.; Wade Smith, MA; Richard McVicar, ONT.; Dean White, IL; National Radio Club, Membership Center, P.O. Box 118, Poquonnock, CT 06064; North American SW Association, P.O. Box 13, Liberty, IN 47353)
Meet Super Grip II, the great new test clip from A P Products.

New "duck bill" contacts are flat, won't roll off IC leads.
Open-nose construction enables probe at IC leg.
Pin rows are offset for easy attachment of probes.
Contacts are gold-plated phosphor bronze. "Contact comb" construction separates contacts with precision. No shorts.
Heavy-duty, industrial-grade springs for firm contact pressure—and a good grip when pulling ICs. They'll keep their spring indefinitely. No intermittents.
Steel pivot pin. Engineering-grade thermoplastic body molded around contact pins. Made to last.
New button-head pins keep probes from sliding off. (Straight pin models for logical connections.)

The new A P Super Grip II is, without question, the best way there is to trouble-shoot DIP ICs.
You get positive contacts. No intermittents. No shorts. Ever.
So it's endlessly useful to you—and it's built to stay useful Indefinitely.
Try one. You'll find 8, 14, 16, 16 LSI, 18, 20, 22, 24, 28, 36 and 40-pin models at your nearby A P store. (Make sure it's your A P store.)

Need the address? Call (toll-free) 800-321-9668. And ask for our complete A P catalog, The Faster and Easier Book.

Faster and Easier is what we're all about.
Ceramic Braid

In steel and glass plant furnaces and aboard America's new space shuttle, the Enterprise, a new material is solving many heretofore hard-to-handle heat problems—protecting vital cables, wires, meshes, tubes and hoses in high temperature environments. And a World War II uniform company is fabricating the product.

In addition to protecting materials against temperatures up to 2,600 degrees F for extended periods of time, SF2600, braided ceramic sleeving offers short term protection up to 3,000 degrees F. The sleeving retains its strength at elevated temperatures.

This "space age" insulating material, 3M Ceramic Fibers, is being fabricated in the form of protective sleeving by Santa Fe Textiles, Inc., Santa Ana, California. Specific applications for this new insulation, which Santa Fe calls SF2600, include protecting cables from open flames and shielding thermocouple wires as they measure the heat in ovens.

In addition, the sleeves protect hoses from molten metals in steel plants, guard fire control systems, insulate furnace components to cut down on heat loss and serve as the sleeving over wire mesh for gaskets on the Enterprise.

In the home, braided ceramic sleeving can be used as a gasket around the doors of self-cleaning ovens. This material also is being used to insulate heaters, hair dryers, coffee makers and other home appliances.

Adding Memory With a Laser

A new approach to storing data in computers, using a tunable dye laser, is described in a U.S. Patent awarded to scientists at IBM's San Jose Research Laboratory. Based on a photochemical process called "hole burning," the technique greatly increases the amount of information that can be packed into a given space.

In the system described by the patient, each unit (called a "bit") of computer data is identified by its location in the frequency spectrum as well as by its location in two- or three-dimensional space. Potentially, many hundreds or even thousands of the "frequency coded" bits could be stored at a single, microscopically small region in space. The size of these regions could be as small as the "diffraction limit" of a laser beam, a dimension in the order of one micrometer (1/25,000 of an inch).

The invention depends on the use of a laser that can be tuned—like adjusting the station selector on a radio—so that it emits light of various colors.

IBM research scientists have invented a new approach to storing computer data that uses a variable-color laser beam to induce chemical changes in selected molecules of a storage material. By changing the frequency of the laser light, it becomes possible to select many hundreds or thousands of different molecular groups from the same sample of storage material. Each molecular group can be associated with a unit of computer data. This technique, called "photochemical hole-burning," offers the potential for storing data at much higher densities than can be achieved with other storage technologies known today. In the photograph, inventors (from left) Dietrich Haarer, George Castro and Roger Macfarlane are shown adjusting an apparatus that projects the light from a laser onto a sample of a photoreactive material.

Work on the new storage technique is still at a very early stage of research. "We have a long way to go before this can be made into a technology," says Dr. George Castro, manager of the IBM San Jose laboratory's physics and electronics department. "So far we are investigating a variety of potential storage materials and trying to understand the temperature limitations of the phenomena. We still have to address the many unsolved problems that have prevented other optical methods of storage from becoming technologies. In fact, optical methods of storing information were expected to lose an important advantage, namely that of high storage density, as the storage densities in the existing magnetic recording technologies approach optical limits in the next decade. Hole burning breathes new life into optical storage by theoretically extending that density a few orders of magnitude."
Don't buy any turntable before you see the new direct-drive Realistic® LAB-500. It's already switched many an audiophile to Radio Shack's 22-year-old Realistic brand. The specs tell you why.

- **Speed accuracy** of ±0.0005% just 1.5 seconds after start-up, wow and flutter of 0.025%, rumble of only -70 dB (DIN B). This kind of performance is superior to some broadcast and disco equipment, and is made possible by a massive 12-5/8" 3.1-lb. platter resting directly atop a 12-pole brushless DC servomotor controlled by a quartz oscillator and PLL circuitry. But there's still more to recommend the LAB-500. Like all Realistic turntables, the price includes dust cover and cartridge. And the cartridge is our best, made by Shure, factory mounted in an integrated headshell for minimum mass and precision tracking even at 3/4 gram. Audio response is a linear 20-20,000 Hz. The automatic arm-return is tripped optoelectronically — assuring no change in record speed even at the end of the disc. Out-front controls, including electronically actuated cueing, make operation easy.

- There are single-play/repeat and anti-skate controls, too.

All this, including the $49.95 value cartridge and hinged cover and low-profile walnut vinyl base, for 259.95*.

By Realistic. Sold only at Radio Shack!

* Retail price may vary at individual stores and dealers.
For Project Builders. A Beginner's Guide to Making Electronic Gadgets by R. H. Warring is a new project-by-project self-training course in modern electronic circuits and devices. It has a thorough introduction to the fundamentals, lots of easy-to-read build-it instructions, and plenty of detailed circuit diagrams! The book explores every modern circuit type and device, and then shows how to use the information learned to create more complicated and sophisticated circuits. Step-by-step instructions, backed up by circuit diagrams, show how to build a wide range of devices using all the latest semiconductors and miniature components like transistors, resistors, FETs, capacitors, etc. You can build circuits like audio oscillators, transistor radio boosters, DC amplifiers, stroboscopes, tuned amplifiers, band pass filters, RF and IF amplifiers, Hartley oscillators, telephone amplifiers, light-operated oscillators and output stages. Published by Tab Books, Blue Ridge Summit, PA 17214.

Optofun. Optoelectronics—the world of light, lasers, lenses and science-fiction devices—a world that's completely unfolded in

Data transmission circuits, has been added to the Bugbook Reference Series. Edited by Titus, Titus, Larsen, and Rony, the text contains practical and useful information for electronic data processing technicians, communications engineering students, and computer hobbyists. The book concentrates on the properties and limitations of real transmission performance. The book discusses filters, equalizers, and other corrective devices from the user's point of view, and explains the use and testing of modems and other terminal equipment. ASCII codes and detailed guides to interpretation of communications circuit specifications are presented. Review questions stressing key concepts are included. Published by E&L Instruments, Inc., 61 First St., Derby, CT 06418.
NEW!

WHY CUT? WHY STRIP? WHY SLIT?

WHY NOT...

JUST WRAP

- AWG 30 Wire
- 0.25" Square Posts
- Daisy Chain or Point To Point
- No Stripping or Slitting Required
- Built In Cut Off
- Easy Loading of Wire
- Available Wire Colors: Blue, White, Red & Yellow

$14.95*

<table>
<thead>
<tr>
<th>COLOR</th>
<th>PART #</th>
<th>U.S. LIST PRICE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blue</td>
<td>JW 1 B</td>
<td>14.95</td>
</tr>
<tr>
<td>White</td>
<td>JW 1 W</td>
<td>14.95</td>
</tr>
<tr>
<td>Yellow</td>
<td>JW 1 Y</td>
<td>14.95</td>
</tr>
<tr>
<td>Red</td>
<td>JW 1 R</td>
<td>14.95</td>
</tr>
</tbody>
</table>

REPLACEMENT ROLL OF WIRE 50 FT.

- Blue: R-JW-B $2.98
- White: R-JW-W $2.98
- Yellow: R-JW-Y $2.98
- Red: R-JW-R $2.98

OK MACHINE & TOOL CORPORATION 3455 CONNER ST., BRONX, N.Y. 10475 (212) 994-6600/TELEX 125091

MINIMUM BILLING $25.00 / ACO SHIPPING CHARGE $2.00 / NEW YORK CITY STATE RESIDENTS ADD APPLICABLE TAX.

CIRCLE 29 ON READER SERVICE COUPON
Extend your listening distance with FINCO'S new Highest gain AUTO FM AMPLIFIER

FINC0'S self contained top of the line Auto FM Amplifier with variable gain control
- Increases Signal up to 16 Times
- Will Not Overload in Strong Signal Areas
- Provides Crisp, Clear FM Reception
- Switch for FM and AM Reception
- No Adverse Effect on AM Reception
- Extends FM Reception Range
- L.E.D. Indicator Light
- Linear Potentiometer Gain Control
- SOLID State - Dual MOSFET Circuitry

Write for Catalog - No. 20-857, Dept EL-56
FINCO, Inc. The Finest in All Electronic Independent Service!
34 West Interstate Street, Bardstown, Ohio 44146
(216) 232-0161
CIRCLE 31 ON READER SERVICE COUPON

Don't Smoke

WRITE NOW FOR McGEE'S BIG SPEAKER CATALOG
1001 BARGAINS IN
SPEAKERS—PARTS—TUBES—HIGH FIDELITY COMPONENTS—RECORD CHANGERSTape Recorders—Kits—Everything in Electronics
1901 McGee Street, Kansas City, Missouri 64108

Be a LOCKSMITH!
EARN WHILE YOU LEARN Send for FREE BOOK
Locksmithing Institute, Dept. 1470-059 Little Falls, N.J. 07424

Realistic STA-2100

CIRCLE 32 ON READER SERVICE COUPON

REALISTIC STA-2100

Realistic STA-2100 is a real, earth shaking AM/FM receiver that pumps out 120 watts, and Kenwood's KD-5070 automatic record player is specifically designed to minimize the effects of external shock and vibration.

A pair of performers that can keep in step with the demands of disco.

By Gordon Sell

With the booming popularity of disco 'dancing', disco music and disco parties many people are converting basements and spare rooms into discos, complete with flashing lights and high-power audio systems. The nationwide popularity of disco was recently brought home to me in a letter from a reader in Eugene, Oregon. He and a friend had rented a large old house together and wanted to use the giant living room for disco parties. They were trying to find a system that was high powered, yet rugged and easy to use in the often confused environment of a party.

In such a situation you need the power to drive four speakers at high levels—at least an 80-plus watt-per-channel (that's only 40 watts per channel with four speakers) receiver or power amp in order to avoid clipping at disco sound levels. Another consideration is more mechanical. Turntables are very sensitive to vibration, so try to put your system on something solid. A shaky or hollow cabinet can pick up vibrations that will give a turntable fits. Try to isolate it from the floor.

It was with these types of situations in mind that I chose the two units for lab testing in this issue. The Realistic STA-2100 is a real, earth shaking AM/FM receiver that pumps out 120 watts, and Kenwood's KD-5070 automatic record player is specifically designed to minimize the effects of external shock and vibration.

Realistic STA-2100. This receiver is conservatively FTC-rated at 120 watts per channel RMS into 8 ohms but when we cranked it up to take-off power (clipping level) on the test bench it went to 135 watts without batting an LED. At this power the frequency response is flat (+0/-1 dB) from 20 to 20000 Hz, with distortion (THD) no higher than 0.12 percent; just right for a disco.

The STA-2100 has plenty of nice features for the audiophile: dual phonograph inputs, one of which is adjustable for sensitivity; inputs for two tape systems and outputs for four speakers. There are level adjust controls for bass, midband and treble. The bass level is switch selectable for turnover frequencies of 150 Hz or 300 Hz, and the treble turnover frequencies can be selected at 3000 or 6000 Hz. It's almost like having a built-in five-band equalizer. The FM de-emphasis is adjustable for Dolby and non-Dolby signal sources.

The FM tuner features excellent selectivity and relatively broad 'center' tuning. The signal-to-noise ratio measures 73 dB. The high fidelity sensitivity on mono is 9 µV (60 dB quieting) while the stereo sensitivity is 80 µV (55 dB quieting). Full limiting is attained with 3.4 µV. At standard test level the stereo frequency response with 75 µSec de-emphasis measures +0.2/-1.2 dB from 20 to 15000 Hz. With 25 µSec de-emphasis it is +0.3/-0.5 from 20 to 20000 Hz. The AM tuner performance is about average for a receiver in this price range. In the amplifier section the stereo separation is 55 dB and the magnetic input hum and noise measures -63 dB.

Almost everyone who has listened to the STA-2100 is impressed with the clean sound in the midrange. All in all this receiver is an excellent buy for any hi-fi buff at $599.95.

Kenwood KD-5070. With this turntable the old adage 'steady as a rock' is more than just a figure of speech. The base is made from a composite of chunks of limestone, limestone powder, glass powder and polyester resin. This compression-molded into marble-like material that attenuates vibrations in the turntable base. The shock and vibration resistance is considerably su-
can you be bribed?

You get a $35.21 bribe when you try only 10 DAK ML90 high energy cassettes for only $2.19 each!


The new DAK ML90 starts another new technology. A technology of extreme reliability and protection from high frequency losses.

Later we are going to offer you a valuable bribe, if you will test these cassettes, risk free; so read on!

YOUR TIME IS PRECIOUS

Imagine yourself just finishing recording the second side of a 90 minute cassette with raised or torn, loaded ridges coated with graphite formulation, graphite. Tape is wound around the capstan, your recorder may be damaged and you've just wasted 90 minutes of your time and perhaps recording FM.

I'm sure this is one experience we all dread, and is one of the main reasons to buy name branded guaranteed tape you can count on.

Enter DAK. We manufacture over one million units of cassette tape each month, and many of our cassettes are used for high speed duplication, which causes more cassettes to fail than any other use.

When we first started, DAK's cassettes failed, just like many others. So we installed over $20,000 worth of high speed duplication equipment at our factory and set out to design the perfect cassette.

FAILURE

Failure after failure. We substituted, remade, tested and tested the over 20 parts of our cassette, and checked everyone else's cassettes. Finally after over 6 years we positively linked cassette failure or the prevention of failure to the slip sheets, or liners in the cassette.

We were not alone. Scotch, TDK, and several others must have been doing the same research because they have also been coming out with special improved slip sheets.

MOLYSULFIDE

A new chemical named moly sulfide, that reduces friction within the cassette several times better than graphite gave us success.

We developed polyester slip sheets with raised or torn, loaded ridges coated with a unique formulation of moly sulfide and graphite.

The tape ran more smoothly than ever before within the cassette. The new formulation is also much tougher than the graphite formulation, so it is extremely resistant to wear.

Static electricity within the cassette was drastically reduced by the low friction, and easily bled off, so its tendency to erase very high frequencies was drastically reduced. A very important consideration for often played tapes.

The moly sulfide formulation gives both superior electrical and mechanical performance, thus it has formed the basis for the birth of the new DAK ML cassette.

MAXELL IS BETTER

Yes honestly, if you own a $1000 cassette deck like a Nakamichi, the frequency response of Maxell UDXL is superior to DAK and you just might be able to hear the difference.

DAK ML has a frequency response that is flat from 40cps to 14,500cps ± 3db. Virtually all cassette recorders priced under $600 are flat from 40cps to about 12,000cps, so we have over 2000cps to spare, and you'll probably never know the difference.

No apology. We feel that we have equalled or exceeded the mechanical reliability of virtually all cassettes and offer one of the best frequency responses in the industry. Maxell UDXL is truly the Rolls Royce of the industry, and DAK is the 100% US made Cadillac or Corvette!

Price DAK manufactures the tape we sell, you avoid paying distributor and retailer mark ups. While Maxell UDXL 90s may sell for $3.50 to $4.50 each, DAK ML90s sell factory direct to you for only $2.19 each.

YOU WIN

You are paying less for the '10 90 minute cassettes than you would pay for the bribes we are offering if you went to a Radio Shack Store.

CHECK THE VALUE OF THE BRIBES AT RADIO SHACK

Think of it, 10 six foot hook up cords with RCA plugs at each end. Whether you use the cords now, or when you buy new equipment, those of us who are tape recorder nuts, never seem to have enough. Radio Shack sells six foot cords for $1.89 each.

You will find dozens of uses for this deluxe battery eliminator AC adaptor around your home or office, 4 voltages, 3, 4.5, 6 and 9 volts. 4 plugs will fit virtually any calulator, radio, or battery operated recorder we have seen. You'll save a lot of money on batteries. Radio Shack sells a similar 4 volt adaptor for $9.95.

The deluxe 12oz can of spray head cleaner will clean your tape heads for years to come. The handy snorkel included, can reach just about any tape head, even 8trk heads. Radio Shack does not sell a large 12oz can, but 12oz from them costs $6.36.

The Radio Shack prices are not list prices, but the actual prices you would pay when you walk in the door.

WE WIN TOO

Customers like you are very valuable in the form of future business. We anticipate receiving over 6000 orders and 4500 repeat customers from this advertisement. We are betting you will buy our cassettes again, and we are putting our money where our mouth is!

TRY DAK ML90 FREE

We want you to try these high energy cassettes on your own recorder without obligation for 30 days. If you aren't 100% satisfied for any reason, simply return the tapes and bribes to DAK for a full refund.

To order your 10 DAK ML90 minute high energy cassettes and receive your $35.21 bribe with your credit card, simply dial toll free 800, 423-2636, (In Calif, call 213-984-1569) or send your check for $21.90 plus $3 for postage and handling for each group of 10 cassettes and bribes to DAK. (Calif. residents add 6% sales tax).

DAK unconditionally guarantees all DAK cassettes for one year against any defects in material or workmanship.

Why not order an extra group of 10 DAK ML90 cassettes for yourself or a friend? We'll add one free ML90 cassette to reach additional 10 you buy and of course you get all 3 bribes with each group of 10 tapes.

DAK INDUSTRIES INCORPORATED

DEPT: EE

Call TOLL-FREE (800) 423-2636
In California Call (213) 984-1569
10845 Vanowen St., North Hollywood, CA 91605

CIRCLE 39 ON READER SERVICE COUPON
Test semiconductors without testing your patience.

The real value of using a semiconductor tester should be time savings. B&K-PRECISION semiconductor testers are designed for maximum speed and reliability to save you more time than any other testers.

B&K-PRECISION semiconductor testers are proved as highly cost effective answers to the needs of testing discrete semiconductor devices. Recently, they were evaluated by America's best known manufacturer of expensive test instruments and the $310 Model 530 compared favorably with a $30,000 custom test system! B&K-PRECISION has a model for most every application.

The B&K-PRECISION Model 530 is one of the most versatile semiconductor testers available and can actually perform more tests on more devices than any instrument in its price class. Features include: Exclusive patented fT measurement circuit...Non-destructive breakdown voltage testing...Automatic lead and polarity identification, in- or out-of circuit...Measurement of beta and gm...Aural and visual test indications...Testing of new power FET's. CSA listed. $310

For value, the Model 520B industrial semiconductor tester is tough to beat. Dynapeak® circuitry with high/low drive allows the 520B to work in-circuit where others won't...A complete test takes about 9 seconds...Identifies all leads of transistors and SCR's and polarity...CSA-listed version available..."Good device" indicated visually and aurally. $175

At only $97, the Model 510 offers Dynapeak® test method reliability with pocket-size portability...LED test result indicators...Tests all types of transistors, FET's and SCR's...Digital stability never needs calibration...Complete with case and leads. $97

When applications demand analysis of the characteristic curves of semiconductor devices, the B&K-PRECISION Model 501A is the cost-effective answer...Displays characteristic curves for all semiconductor devices on most any scope...Non-destructive breakdown voltage tests...Simulates actual operating conditions...Internal calibration source...Current limiting protects device under test. $198

Start testing semiconductors faster now. See your local distributor for immediate delivery.
For many creatures on this earth, two ears are the norm. The two-eared arrangement does more than allow listening to your mother-in-law and wife at the same time. Thanks to some special neural circuitry (which, among other things, performs phase and magnitude comparisons between left and right ear signals) a two-eared individual can quite accurately tell where a sound is coming from. You know how marvelously well the present system works, but think of the possibilities afforded by a third ear.

Wait a second now; no one is advocating surgery as a hobby (à la Frankenstein). The Third Ear in this instance is a versatile, electronic, sound-actuated control system. It can spy on your friends, mind the phone, babysit, thwart would-be burglars and much more. Later on, the Third Ear's applications will be explored in detail, but first let's examine its circuit.

The Circuit. The heart (better yet, the eardrum) of the Third Ear is a tiny module, the ETCO S-210U sound trigger. This little device originally formed the nervous system of an electronic turtle. The species is now extinct, unfortunately, but its innards are available as a great surplus bargain. As you can see from the schematic, the S-210U contains a crystal microphone, a transistor amplifier, and an SCR. The module's black lead goes to the minus side of a battery, while the red and green leads will be shorted together in this application. The shorted leads connect to one side of a low-resistance load (like a relay), and the opposite end of the load goes to battery positive. Sound picked up by the microphone is amplified by the transistor and fed to the SCR's gate. If the sound is sufficiently loud, the SCR latches in a conducting state, thus drawing a relatively large current through the connected load. Power must be removed in order to turn off the device again.

A more versatile system should operate in either of two modes, latch or pulse. After the first triggering impulse of sound, the latch-mode system remains active. A pulse-mode system, on the other hand, remains active only for some pre-determined time interval after triggering. It then returns to its inactive state, where it rests until re-triggering occurs. Then, the process repeats itself.

Construction. Adding pulse-mode capability to the S-210U is a simple matter. All it takes is some auxiliary circuitry to sense the latching of the SCR and to unlatch it again after a user-selected time delay. Unlatching an SCR can be accomplished by opening a switch in series with the anode or closing a switch to short the anode and cathode together. The latter method is the one used in the Third Ear, but before getting any further into that, there are a few easy modifications that must first be made to the S-210U.

The pictorial diagram shows the four necessary modifications in detail. First, remove the 5000-ohm trimmer by unsoldering it. This device is unusual in that it has two mounting pins, not three. Wire a 2500-ohm potentiometer in series with a 680-ohm resistor so that the net resistance is a minimum (680 ohms) when the pot is fully clockwise. The two wires from the pot/resistor combination should be soldered into the holes vacated by the 5000-ohm trimmer. This new pot will function as the Third Ear's sensitivity control (with maximum sensitivity in the clockwise position).

The second modification requires that the 0.1-µF disc capacitor in the upper left-hand corner of the S-210U be unsoldered. In the holes vacated by the capacitor, install and solder a jumper of bare, solid hookup wire.

The third step is to cut the red wire...
Finally, unsolder the 32-uF electrolytic capacitor from the board, and replace it with a similar unit having a higher working voltage; 16 VDC or higher. In general, your replacement may have a value anywhere between 22 and 47-uF, with 33-uF being about optimum. Remember that since you are dealing with electrolytic devices, the orientation must be correct. In the pictorial you can see that capacitor positive (+) must be pointing upward.

Now, let's see how the modified S-210U mates with the rest of the circuitry in our Third Ear. As the schematic diagram shows, the green and black leads of the module are its only connections to the external circuitry. Capacitor C2 bypasses the module's supply leads in order to keep the sensitivity high, while R1 isolates C2 to reduce its effects on the performance of the rest of the circuit. Whenever the module's SCR latches into conduction (due to sonic triggering), current will be drawn through relay K1 and the LED1/R2 combination. As a result, the normally open relay contacts will close, and the LED will light simultaneously. These two conditions will persist as long as the SCR remains latched.

Note how switch S3 selects either the normally open (N.O.) or normally closed (N.C.) contacts of K1. This allows a load to be turned on or off, respectively, when the circuit is activated. Diode D1, connected across K1's coil, is normally reverse-biased (not conducting). When the SCR is forced to unlatch, however, K1's coil generates an inductive kickback voltage which could cause trouble if D1 were not there to clip it.

In order to see how unlatching is accomplished, let's assume that the SCR in the module is initially unlatched, and that mode switch S2 is closed in its "pulse" position. Since the SCR is not conducting, the voltage at the green lead of the module must be high (about 7 volts above ground). This potential drives sufficient current through R3, D2 and D3 into the base of transistor Q2 to ensure that Q2's collector is conducting current heavily. This prevents the voltage on C3 from rising, and nothing of interest happens.

Suppose, however, that a sound triggers the module into conduction. The potential of the green lead drops to less than one volt, which is less than the 2-volt minimum needed to turn on the D2/D3/Q2 combination. Consequently, Q2's collector no longer conducts current, and the potential across capacitor C3 rises as charging occurs through R5 and R6. The rate of ascent is controlled by potentiometer R5; higher resistance causes the potential on C3 to climb more. Eventually, the voltage on C3 will reach a critical level, at which point unijunction transistor Q3's emitter-to-base 1 impedance will break down to a very low level. This rapidly discharges C3 and causes the appearance of a voltage spike across resistor R8.

This voltage spike drives current through R4 into the base of transistor Q1. As a result, Q1's collector conducts current heavily, thus shorting the module's green and black leads together. This deprives the SCR of anode current, causing it to unlatch. Because the voltage spike lasts only a brief instant, less than 0.1 second, Q1 soon loses base drive and ceases to conduct. When this happens, current can no longer activate K1 or LED1, and both will remain off until another sound triggers the module. As you can see, the circuit has returned to the state it was in at the beginning of this discussion.

If mode switch S2 had been opened to its "latch" position, no current would have been able to flow through R5 and R6 to charge C3. Since the charging of C3 is an essential part of the unlatching process, it is clear that the module would have remained latched indefinitely. In fact, in the latch mode, the only way to reset the circuit to its inactive state is by opening power switch S1 for at least five seconds.

This pictorial diagram shows all the modifications that are needed on the S-210U module. The 32 uf capacitor should be replaced by one with a 16-VDC or higher voltage capacity.
The above schematic shows the circuit of the S-210U. The module can be obtained from the company listed in the parts list. This gives the various capacitors time to discharge completely, thus ensuring that the circuit will be inactive when S1 is again closed. Similarly, should you wish to manually unlatch the module in the pulse mode before the time delay elapses, the same procedure applies. In the prototype's pulse mode, duration control R5 was able to produce time delays between 9 and 130 seconds. The actual control range obtained in your model is likely to be somewhat different because of variations in the characteristics of Q3 and C3. Further information can be found in the parts list.

**PARTS LIST FOR THE THIRD EAR**

- **C1** - 100-μf electrolytic capacitor, 16 VDC
- **C2** - 22-μf electrolytic capacitor, 16 VDC
- **C3** - 470-μf electrolytic capacitor, 16 VDC
- **D1, D2, D3** - 1N914 diode
- **J1** - panel mount AC socket
- **R1** - 33-ohm, 1/2-watt resistor
- **R2** - 1,000-ohm, 1/2-watt resistor
- **R3** - 18,000-ohm, 1/2-watt resistor
- **R4** - 220-ohm, 1/2-watt resistor
- **R5** - 100,000-ohm linear-taper potentiometer
- **R6** - 10,000-ohm, 1/2-watt resistor
- **R7** - 470-ohm, 1/2-watt resistor
- **R8** - 100-ohm, 1/2-watt resistor
- **R9** - 1,000-ohm, 1/2-watt resistor
- **R10** - 680-ohm, 1-watt resistor
- **S1** - SPST slide switch
- **S2, S3** - SPDT slide switches
- **Misc.** - case, battery holders, batteries, knobs, hookup wire, etc.

Note: E2101 is available from ETCO Electronics, Dept. K, Old Country Shopping Ctr., Plattsburgh, NY 12901

---

**GOT PARTS PROBLEMS? SOLVE 'EM WITH HOBBY MART, PAGE 89.**

- **LED1** - small red LED
- **MOD1** - ETCO SU-210 sound trigger module
- **Q1** - 2N3904 NPN transistor
- **Q2** - 2N2646 unijunction transistor
- **R1** - 33-ohm, 1/2-watt resistor
- **R2** - 1,000-ohm, 1/2-watt resistor
- **R3** - 18,000-ohm, 1/2-watt resistor
- **R4** - 220-ohm, 1/2-watt resistor
- **R5** - 100,000-ohm linear-taper potentiometer
- **R6** - 10,000-ohm, 1/2-watt resistor
- **R7** - 470-ohm, 1/2-watt resistor
- **R8** - 100-ohm, 1/2-watt resistor
- **R9** - 1,000-ohm, 1/2-watt resistor
- **R10** - 680-ohm, 1-watt resistor
- **S1** - SPST slide switch
- **S2, S3** - SPDT slide switches
- **Misc.** - case, battery holders, batteries, knobs, hookup wire, etc.
Train with NTS for the
MicroComputers, digital
the first name

MicroComputers

The world of electronics is daily becoming more challenging. Technology is growing more specialized, and the importance of digital systems increases every day. Test instruments, home entertainment units and industrial control systems are all going digital. And now, NTS training programs include a wider choice of solid-state and digital equipment than ever before offered in any home study course:
Advanced NTS/Heath digital color TV (25" diagonal with optional programming capability), NTS/Heath microcomputer, digital test equipment, digital stereo receiver (70 watts per channel), NTS compu-trainer, plus much more state-of-the-art equipment to make your training exciting and relevant.

The equipment you receive with NTS training programs is selected to provide you with a solid background in electronic systems. Kits and lessons are designed to work together to demonstrate electronic principles and applications. The kit-building not only shows you how electronic hardware functions, but how various circuit designs accomplish different purposes. Your lessons guide you through any number of experiments associated with many projects. This is the Project-Method, and it works.

Step-by-step, you learn how and why digital electronics has become a part of our world, and the even bigger role it is sure to play in the future.

Whether you are looking for training in Consumer, Commercial, or Industrial electronics, NTS offers fourteen courses, some basic, many advanced, in several areas of electronics. An all-new full-color NTS catalog shows you what each course covers,
electronics of the future.

systems and more...from in home study.

and every piece of equipment included. Send for it today, and see for yourself what's really happening in electronics training technology at NTS. Find out how much has changed, and what new directions the field is taking. You'll probably want to be a part of it.

It's free. Just mail the card or coupon. Today.

NO OBLIGATION. NO SALESMAN WILL CALL. APPROVED FOR VETERAN TRAINING.

NATIONAL TECHNICAL SCHOOLS

TECHNICAL-TRADE TRAINING SINCE 1905
Resident and Home-Study Schools
4000 South Figueroa St., Los Angeles, Calif. 90037

Send for FREE Color Catalog and Sample Lesson.

☐ Color TV Servicing
☐ B & W TV and Radio Servicing
☐ FCC License Course
☐ Electronic Communications
☐ Electronics Technology
☐ Audio Electronics Servicing
☐ Digital Electronics
☐ MicroComputers/MicroProcessors

Name ____________________________
Address ____________________________
Apartment Number ____________________
City ____________________________
State __________________ Zip ______
☐ Check if interested in G.I. Bill information.
☐ Check if interested ONLY in classroom training in Los Angeles.
**THE THIRD EAR**

Furthermore, any leakage within C3 will exert yet another influence on the time delay; the leakier the capacitor, the longer the charging time. With this in mind, it is wise to use a new, high-quality electrolytic capacitor for C3.

**Power Supply.** Power for the Third Ear comes from five “D” cells in series, yielding 7.5 volts. Electrolytic capacitor C1 keeps the power supply’s impedance low. Inactive, the Third Ear draws only 2 millamps, but current consumption jumps to 22 mA when the circuit is active. At these small rates of discharge, “D” cells will last a long time. Some readers might prefer to see the Third Ear powered by an AC supply; however, transformers hum at 60 Hz, and the Third Ear is sensitive enough to be triggered if a transformer is mounted inside its case. If you want to use an AC supply, a 6- to 9-volt DC unit will work well, but it must not be mounted inside the Third Ear’s case.

**Construction.** Construction is easy because you don’t need to worry about the layout; anything will do. A PC board is not absolutely necessary, but if you like to give your projects a professional look, use the PC patterns provided.

You should test LED1’s sensitivity before wiring it into the circuit. Bargain LEDs especially may not be sensitive enough to be used here. Hook your LED in series with a 1000-ohm resistor, and connect the combination to a 7.5 VDC source. (Get the polarities right.) If you do not obtain an easily visible red glow, try another LED. Red LEDs are more sensitive than green or yellow ones, so stick with red.

When wiring duration control R5, make sure you obtain maximum resistance in the fully clockwise position. This will then give you a maximum time delay.

When building your Third Ear, you would be better off with slide switches. When a toggle is snapped quickly, the click of the switch can activate your system, regardless of the sensitivity setting. Slide switches require very little operating force and are practically silent.

The contacts of relay K1 are rated for a load of up to one amperes, which is more than adequate for most applications. Sometimes, however, you may wish to control a high-power load, such as a flood lamp. One method of doing this would be to substitute a relay with a higher contact rating for K1, but high-current, good-quality relays are expensive. Besides that, all relays are, especially with high-power loads, so a relay’s lifetime under such conditions is limited. A cheaper, better solution is the high-power interface. Note that the triac controls the AC load, but the relay contacts control the triac. In this way, the relay contacts carry only the small gate current of the triac, and your Third Ear remains isolated from the AC line (and shock hazards) by the relay. Choose a triac with a current rating high enough for your load, and heat sink it. Mount the triac and heat sink in a well-ventilated plastic case to prevent accidental shocks.

**Checking it Out.** After construction is complete, you should check out the operation of your project. Set your Third Ear into the pulse mode, with R5 set for a minimum duration, and sensitivity control R9 placed at the midpoint of its range of rotation. Now, turn on power switch S1. LED1 should flash momentarily as power is applied. Snap your fingers directly in front of the microphone, and note the length of time that LED1 stays illuminated.

Next, rotate the duration control to maximum. Snap your fingers, and again make a note of how long LED1 stays illuminated.

Finally, turn the power switch off, and flip S2 to the latch mode. After five seconds, re-apply power. Snapping your fingers should now cause the LED to light and stay lit for as long as power is applied. You can do some experimenting with the sensitivity control, too. In the prototype, operation at maximum sensitivity was impossible because even the faintest ambient noise would trigger the circuit.

The applications for the Third Ear are only limited to the uses your imagination can find, and with its switching flexibility, it can control almost anything you may wish to operate around the home or office.
LET'S FACE IT! Wireless microphones have an "image" problem. There are people who still think of wireless mikes as merely toys or party-time novelty items, while other folk invariably associate these miniaturized electronic marvels with the nefarious bugging activities of cloak-and-dagger CIA agents, and with gum-shoe private eyes prying into other people's affairs for monetary gain. Such activities do go on, yet the fact remains that there are virtually endless applications for wireless microphones that are entirely legal and unquestionably ethical.

Regular readers of ELEMENTARY ELECTRONICS of course need not be reminded that there are proper and improper uses for just about anything, from dynamite to every conceivable variety of electronic gear. But just in case a reader loses his copy of EE, and it falls into the wrong hands, we hasten to append this warning: FCC rules clearly prohibit the use of wireless microphones for eavesdropping on the conversation of unsuspecting people. Getting caught at wireless snooping could lead to federal prosecution. Moreover, the citizen whose privacy has been violated is very likely to file a king-sized civil suit for damages.

Using the Mike. A wireless mike system can be a very handy electronic watchdog. You can hear the baby cry, respond to a call from a bed-ridden patient, or run for the telephone or door when either bell rings. Just plant your mike in the appropriate location and take your portable, battery-powered radio wherever you go into the house, or even outdoors, to know what's going on inside.

Having problems with intruders? Perhaps only the seasonal kind that splatter hard-to-remove raw eggs all over your patio bricks? Put a mike out in the yard as an effective early-warning system. On the farm, put the mike in the hen house to help catch that wiley four-footed intruder that has been eluding capture for so long.

When you install that new TV antenna, take a portable radio up on the roof. As you rotate the antenna, another person watching the TV screen down below can use the wireless mike to tell you when the picture is clearest. And what about the housewife who can't bear to miss that next episode of her favorite soap opera, yet absolutely must spend some time down in the laundry? She can put the mike in front of the turned-on TV and at least hear whether Mary will actually leave John to start cooking for Harry.

Countless other applications for wireless microphones relate to such broad activities as business, leisure-time activities, sports and education. Use your system as a hot-line, tag sale communicator, public speaking aid, or a secret prop during a magic show or other amateur theatrical performance.

Microphones have come a long way. Compared to this Prohibition era monster, AMC's Micro-Mini-Mike is truly microscopic. Its transmitter operates on FM in the 88 to 108 MHz band. It sells for $18.95, including battery. Circle 73 on Reader Service Coupon.

You can even hook your receiver to a tape recorder to obtain permanent records of your personal transmissions. Just plug the speaker output on your portable radio to the auxiliary input of a tape recorder. You can then wander anywhere in the house and dictate information onto tape.

It's an easy way to make an inventory of personal possessions without lug gaging around the whole tape recorder.

Choose Optimum Range. Our experience indicates that the factory-built wireless mikes have substantially greater range than the kit jobs. In some applications you need that extended reach, but in other situations it could be a handicap. If your home is on a large property, the more powerful mikes are best. But if your neighbors live only a few feet away, you may be better off with a mike having a limited range for two reasons: To keep from annoying your neighbor, and to keep your personal broadcasts truly personal.

As you read the following comments about our performance tests, bear in mind that many variable factors can materially influence the quality of transmission. The quality of your FM radio can be as important as the quality of the microphone you choose, for example. Even the physical orientation of the receiving radio can affect the clarity of reception. So, inevitably, you will have to do some practical experimenting to get the most from your system.

Our informal range tests were made in the following manner. An old manual darkroom timer was used to pro-
The Micro FM, from MLI, is the smallest unit we have found. It features a built-in on/off switch, obviating the removal of the battery when it’s not in use. Circle 74 on Reader Service Coupon.

The Micro Mini Mike. (AMC Sales; $18.95 plus $1.50 postage and handling), Model WM-F2, measures 2¼ inches by ½ inches by ¾ inches (less than one cubic inch!), yet it has one of the longest transmission ranges. The manufacturer says the range is up to 100 feet indoors and 300 feet outdoors. The tough aluminum case is black-anodized for durability, and the 1.3-volt mercury battery (included in the purchase price) is claimed to provide from 60 to 80 hours of continuous use. The mike is continuously tunable to any frequency between 88 and 108 MHz—the full FM broadcast band.

Semiconductors in the mike include an FET, one IC, one diode, and three silicon transistors. The modulation bandwidth is ±100 kHz and the field strength is 50 microvolts/meter at 50 feet (open area). It incorporates an electret microphone, has a permanently attached ¼-wavelength flexible wire antenna (29 inches long), and has FCC type approval.

The first thing we liked about this compact little marvel is the slide switch which helps prolong the life of the battery without the need to remove it. We were equally impressed by performance. With the receiver volume set only one-eighth of maximum, the noise could be monitored anywhere in the house, even throughout the basement area. By turning the receiver volume gradually to maximum, clear pick-up was possible everywhere on the one acre of property. The test was made at 108 MHz, because the manufacturer recommends you start from this end of the FM band in the search for the first quiet zone.

Micro Mini Mike. (AMC Sales; $18.95 plus $1 postage and handling), Model WM-F2, measures 2¼ inches by ½ inches by ¾ inches (less than one cubic inch!). This second-smallest factory-built mike features a durable black metal case, 1.3-volt mercury battery, 27-inch flexible wire antenna, and the following semiconductors: one FET, two diodes, two transistors, and one IC. It has FCC type approval. Frequency deviation is ±100 kHz/MHz and field strength is put at 50 uV/m at 50 feet.

The manufacturer specifies a range of up to 100 feet indoors and 300 feet outdoors. Battery life is said to be from 60 to 80 hours. It can be tuned anywhere in the 88 to 108 MHz FM band.

Tuning to 103 MHz seemed to produce better results than at 108 MHz. By turning the receiver volume to about halfway to maximum, the transmitted noise signal could be heard anywhere inside the house. By turning the radio volume to maximum, reception could be extended to a short distance outside the house, about 25 feet from the mike. The microphone was judged to have a somewhat more limited range than the feisty little Micro FM already discussed. On other drawbacks is the lack of an on/off switch necessitates physical removal of the battery when the mike is not being used. Nonetheless, this mike was judged to be a good buy provided these limitations can be accepted, and a preferred mike if your home is close to neighbors and you need a limited range to ensure privacy of your in-house broadcasting.

TECH FM Wireless Microphone, Model WEM-16 (Formula International; $16.50) is in a different class from the two “Micro” mikes just discussed, if only because of its relatively large size. This mike is 6½ inches long and has a front-end diameter of just under one inch.

This three-transistor (one FET) mike features an omni-directional electret condenser type microphone element, a pentile single-cell power source, a 24” flexible cord antenna, attractive black-and-chrome casing, plus an on/off switch. Specifications include: frequency range from 88 to 108 MHz, radiation field intensity less than 15 uV/m at 100 m; maximum frequency tolerance ±75 kHz, and a current drain of 3mA maximum.

The oscillating frequency of this microphone is set at 90 MHz at the factory, but you can easily tune to any other frequency in the FM band by means of a coil accessible through a small hole near the switch. Battery life is put at about 100 hours.

With the receiver volume set at about one-fourth of maximum, the test noise could be heard anywhere inside the house, including the basement. By increasing the radio gain, excellent reception was obtained everywhere on the one-acre lot; sound quality was judged very good. If the larger size is no handicap, this mike should handle any domestic transmission conditions with ease.

FM Transmitter Kit (Formula International; $6.95) requires the soldering of about 17 components, including...
The FM Transmitter Kit, by Formula International, costs $6.95, less battery. Circle 75 on Reader Service Coupon.

Radio Shack's AM Broadcaster costs $7.95, and includes everything except battery. Circle 32 on Reader Service Coupon.

A good example of how the manufacturer's claims can be misleading. The increase in performance that Ramsey Electronics claims is no different from that of the Micro Mini Mike found at Radio Shack.

This is an example of how the manufacturer's claims can be misleading. The increase in performance that Ramsey Electronics claims is no different from that of the Micro Mini Mike found at Radio Shack.

The 2- to 3-foot long antenna wire, to a 1 inch by 1/2 inch PC board. The component locations are marked on the PC board, albeit with somewhat blurred printing. However, if you start with the resistors, you should have no difficulty orienting the various parts. Helpful diagrams as well as a schematic are provided, but there are no step-by-step instructions. It's assumed you know how to read resistor value codes. Tip: when installing the coil, insert the leads bridged by a purple line into holes 1 and 2.

The manufacturer suggests you first test the assembled circuit with an ammeter, but this should not be necessary if the assembly has been done with care, especially being sure that the three transistors are oriented correctly. This kit comes with a small electret microphone and a battery cable, but you must provide the 9-volt battery.

This wireless unit was tested at 108 MHz. With the radio volume set at about halfway to maximum, the test noise could be heard in all parts of the house, including the basement. There was some "reach" into yard areas, to a distance of about 35 feet from the mike. The range was found to be roughly comparable to that of the factory-assembled Micro Mini Mike sold by AMC. The cost is lower, but you have the problem of finding a suitable case to contain the PC board and the much larger 9-volt battery. The mike otherwise seems suitable for use in areas where a limited range is desired.

The sound quality seemed a bit more ragged than that obtained with the AMC mike, which has the benefit of a metal case for shielding to minimize body capacitance effects.

Super Sens FM-2 Mike Kit (Ramsey Electronics, $4.95) requires soldering about 16 components, including a short 5 inch to 10 inch antenna wire, to a PC board measuring 1 inch by 1/2 inches. There are no identifying mark-

ings on the PC board, but a clear diagram, good parts identification list, and a schematic of the circuit make the assembly easy. It should be noted that the kit does not include a microphone element, battery connector, or a 9-volt battery. You must find these locally. The manufacturer states that you can use a crystal, ceramic, or dynamic microphone. The crystal type is the most sensitive, but the dynamic type offers better fidelity. It's claimed that the microphone works with a power supply of 3 to 9 volts, the higher voltage being preferable. You are cautioned that the antenna affects the transmitter frequency, therefore close movement next to it should be avoided.

The main problem encountered with this wireless kit concerned difficulty of tuning it to the desired FM frequency, mainly because body capacitance effects were very pronounced. Getting a hand near the antenna was unavoidable when adjusting the tuning coil. When proper response was obtained with the receiver during the tuning operation, it was immediately lost when the hand was moved away. Thus it appeared necessary to tune in "bits-and-pieces" making minor adjustments and then removing the hand to see if the frequency was locked in properly.

The mike was tested first with an electret microphone, and then with a crystal mike cartridge. The crystal seemed to give somewhat better results although we did not succeed in getting performance comparable with that of any other wireless discussed in the above sections.

Science Fair AM Broadcaster (Radio Shack, cat. no. 28-209, $7.95) is the only AM transmitter found on the market. The price includes everything you need, except a 9-volt battery. Assembly of the components on a 4 1/4 inch by 6 inch board requires no soldering because all connections are made to spring-type fasteners that plug into holes in the board. The tuning coil is made by winding 34 turns of wire around a plastic frame measuring 3 inches by 4 1/2 inches, which is then mounted vertically at one edge of the main component board. The transmitter utilizes a crystal microphone, three transistors, a tuning capacitor, choke coil, modulation transformer, and several capacitors and resistors, all of which are clearly identified.

The manufacturer claims broadcast range can be as much as 40 feet under ideal conditions. The author managed transmission over a somewhat shorter range indoors. There is no critical coil tuning required. Just set your AM to any unused frequency and rotate the tuning knob on the components board to match the frequency.

Because of the limited range, and especially because of the bulk of this wireless, the Broadcaster cannot be put into the same class for comparison with the FM mikes already discussed. It's not intended to be a working mike, but a Science Fair educational kit. As such, it meets all claims made for it.

Manufacturers of Wireless Microphones

A.M.C. Sales, Inc.
Box 928
Downey, CA 90241

Formula International, Inc.
12603 Crenshaw Blvd.
Hawthorne, CA 90250

MLI Industries
50 Hunt Street
Watertown, MA 02172

Radio Shack
500 One Tandy Center
Fort Worth, TX 76102
(Buy from local stores)

Ramsey Electronics
P.O. Box 4072
Rochester, NY 14610

Elementary Electronics May-June 1979

45
An amplifier stage that is used at two widely separated frequencies (such as RF and audio) is called a reflex amplifier. This type of amplifier circuit was used in the early days of radio because of its economical use of the then expensive vacuum tubes. Later, during the depression period of 1934 to 1937, reflex circuits were used in small home radios. When transistors first became popular, two transistor radios were manufactured in Japan and sold here for very small prices. These transistor circuits employed reflex amplifiers, usually in a TRF type of receiver with a crystal diode detector. One transistor was employed as a reflex RF amplifier and first audio stage, and the second transistor was used as the audio power amplifier.

You can experiment with the reflex circuit by building our simple one-transistor Reflex Receiver project. The circuit employs a j-FET as a tuned RF amplifier and also as a stage of audio (after the signal is detected by a germanium diode). The circuit is laid out on breadboard style for easy construction.

The Reflex Action. The reflex circuit is a system in which an amplifying device (transistor or vacuum tube) is made to function at both RF (or IF) and audio frequencies. As commonly used, the signal is amplified by the device, detected, and the resultant audio signal fed back into the same device for further amplification. Such a circuit has two inputs (one for each type of signal frequency) and two outputs, with filtering necessary to split the two sets of signals.

Look at the signal flow block diagram of the one-transistor Reflex Receiver project. This is a diagram of a typical reflex circuit. Signals are amplified at RF frequencies and then fed through a signal splitter to a crystal diode detector. The detected output is filtered and coupled back through the tuned circuit to the amplifier, where the signal is now at audio frequencies. The audio frequencies are amplified and fed through the signal splitter to the low-pass filter and to the headphones.

As shown in the block diagram and the schematic, radio signals are coupled through J1 and C1 to the tuned circuit of C3/L1 and on the gate of the field-effect transistor (j-FET) Q2. C2 places the bottom end of L1 and the rotor of C3 at RF ground. R3 supplies the bias for Q2, and C8 is the RF/AF bypass capacitor. R1 functions as the Q1 gate DC return and audio input load. As the amplified RF signals from the drain of Q1 are coupled through C9 to R5 and detector D1, C7 is connected in shunt with the RF output of Q1 and is used to adjust the RF gain of the j-FET.

The detected audio signal is fed through the RC filter composed of R4, C5, and C6 to the volume control R2. The audio is then coupled through C4 to the junction of R1, C2, L1, and C3. C2 presents a low impedance to RF, but has a high impedance to audio. L1 has a high impedance to RF, but has a low impedance to audio. The two types of signals (RF and audio) are therefore applied directly to the gate of Q1, each being amplified therein.

The amplified audio signal at the drain of Q1 is coupled through L2 to the J2 headphone jack. L2 serves as both a component of the low-pass filter (L2/C10) and as an RF load for the signal splitting action of C9 to D1. L2 is chosen to have a high value of reactance over the broadcast band and serves to broadly tune the D1 detector circuit over the range of 550 kHz to 1500 kHz.

The DC power for the circuit is supplied by an external 6-volt battery (or DC power supply), and C11 serves as an audio filter for the power input.

Construction. The receiver, as shown in the photos, is built on a 6-inch long by 3/4-inch wide by 2-inch high plastic box with a perf-board section installed on top. Most of the components are mounted on the perfboard with push-in solder terminals. The input and output connectors, J1 and J2, are mounted on the front and rear of the box. The 6-volt battery, or power supply, is connected via two leads fed through a hole in the rear of the box. The tuning capacitor C3 is mounted directly on the perfboard with machine screws, and the volume control R2 is mounted on a small bracket made from sheet aluminum that is also installed on the perfboard.

Begin construction by cutting a perfboard section to size to fit the top of the box. Locate corner holes to fit the threaded molded screw retaining extrusions located inside the top corners of the box. Mount C3 on the perfboard in the location shown in the photo of

![Signal Snare Diagram](image-url)

This block diagram shows how the signal is amplified as AF and RF, then split and fed back to the tuned LC circuit. The low-pass filter separates the amplified audio signal.
the top of the receiver. The capacitor used in our model had threaded holes in the bottom for easy mounting with machine screws and washers to lift up the stator insulating panels from contact with the board surface. If your capacitor does not have these mounting holes, the capacitor can also be mounted by a small bracket cut from sheet aluminum to fit front mounting holes. Cut a bracket to fit R2 and mount it on the front of the perfboard in the general location shown in the photos. Use an internal toothed lock washer between the R2 mounting nut and the bracket surface to prevent accidental movement of the volume control.

Mount the remainder of the components on the perfboard with push-in solder terminals in the locations shown in the top of the board photo. The locations are critical, so follow the layout of our receiver model. Install a solder lug on the frame of the tuning capacitor C3 for connection to the rotor.

Wire the board components as shown in the schematic and keep the connecting leads as short and direct as possible. L1 is mounted with two push-in terminals soldered to the coil connecting lugs.

Install the headphone jack J2 on the box front and the antenna/ground jack, J1, on the rear of the box as shown in the photos. Cut a hole in the rear of the box for the battery leads and complete the wiring of the perfboard with the interconnecting leads to the box components. Install lugs on the battery leads to fit your battery terminals. The leads on our model extend approximately 10 inches from the box, but the lead lengths are not critical and can be any convenient length to fit your particular installation. To minimize accidental breakage, the battery leads should be stranded wire (preferably color coded; red for positive and black for negative).

Testing Your Reflex. For best results, an outdoor antenna and a good ground should be connected to J1 (center connector to the antenna and the outer shell to ground). Inasmuch as the Reflex Receiver project only uses a simple tuned circuit, you may have some problems with overloading on strong local stations. C1 value can be changed to adjust the antenna loading. Small capacitance (3 to 20 pF) for light loading and better selectivity, and larger capacitance (25 pF to 47 pF) for heavier loading, higher sensitivity, but lesser selectivity.

Before connecting up the receiver project to the battery, check the wiring and then adjust the RF Gain control. C7, to maximum capacity (minimum RF Gain). Set the volume control R2 full counter-clockwise (for minimum audio gain). Check the lead polarity before connecting the 6-volt battery to the receiver, then plug in the headphones (2000-ohm type).

Tune the broadcast band with C3 while adjusting R2 for a comfortable audio volume. Adjust L1 for best band coverage for your particular location.

Tune the slug in for more inductance. Adjust C7 for increased RF sensitivity over the band, and if oscillation occurs, adjust for maximum capacity (just short of the oscillation point).

Check the RF amplifier action in the reflex circuit by tuning in a weak station and then connecting a 500 pF capacitor (approximate value) between the input and output jacks for increased RF sensitivity over the band.

(Continued on page 87)
The sun never sets on the British broadcasting empire.

By Brian Rogers

At the age of 12, while exploring the "shortwave" dial setting on our family radio, I picked up a transmission from the British Broadcasting Corporation in London. I'd never heard a foreign station before and I was thrilled that a fragile thread of energy called a radio wave could span a mighty ocean and link the far-off British Isles with the "Silvertone" console in our living room.

Since then, using receivers bearing names like Hammarlund, Hallicrafters, Drake and Realistic, I've heard the BBC countless times. But I haven't forgotten the evening, nearly thirty years ago, when I heard the station for the first time.

I still listen to the BBC today, and not just to recall a pleasant boyhood experience. Along with millions of other SWL's, I listen because, in its long broadcasting day, the World Service of the BBC offers a tremendous variety of programs received at good strength just about anywhere on the globe where you and your receiver happen to be.

Empire Service. Calling its shortwave programs the "Empire Service," the BBC began broadcasting on high frequency December 19, 1932. Six days later, on Christmas, King George V used the infant medium to address his subjects throughout the world. He spoke of radio's power to do good and bring people closer together.

A service in Arabic was begun in 1938 to counter Mussolini's anti-British broadcasts to the Middle East. Other foreign-language broadcasts soon followed.

World War II gave the BBC an opportunity to earn a reputation for impeccable accuracy and thoroughness in news coverage. A reputation it still enjoys today. Citizens of occupied countries learned they could trust the station because it always told the truth, no matter who the truth might hurt. England's setbacks and defeats were reported as faithfully as her triumphs and victories.

By 1945, almost everyone in Europe believed unquestioningly in BBC newscasts. On D-day, when General Eisenhower used these programs to instruct French civilians, thousands of people obeyed without hesitation.

Today the BBC external Services employ 110 journalists working in shifts to process the more than one million words a day that pour into the newsroom in London's Bush House. This flood is whittled down to fill 250 separate news programs in the 39 languages the broadcaster currently uses.

The English language "around-the-world, around-the-clock," World Service includes seventeen nine-minute bulletins of world news daily. Also heard are five-minute summaries of British...
news called "News About Britain," and reports from BBC correspondents in fifteen-minute "Radio Newsreel," programs.

**World News Roundup.** In addition to major wire services such as the Associated Press, United Press International, and Reuters, the BBC uses as a news source its own radio monitoring service. Located at Caversham Park, about 50 miles from London, its professional SWL's listen to over 400 news bulletins from more than 30 countries every day.

But BBC programming isn't all news. Of special interest to DXers is the World Radio Club, now boasting in excess of 30,000 members. "Meetings" of the BBC-sponsored organization are held on the air weekly. The best time for North American listeners to hear these electronic conclaves is 23:15 GMT (6:15 p.m. EST) on Wednesdays. The sessions are repeated at 21:00 GMT (4:00 p.m. EST) on Fridays. Membership is granted free-of-charge to anyone who writes for it.

Long a favorite of shortwave buffs, retired BBC engineer Henry Hatch currently conducts monthly instructional talks called "Radio for Beginners," on the club programs. Also featured are reports of stations heard by noted DXers and what the "pros" at Caversham are hearing.

**Listener Envolvement.** Every month colorful pennants are awarded to 25 lucky listeners who correctly answer a question posed by Mr. Hatch. Subjects of recent queries have included such topics as elementary electrical math, the international 'Q' code, and schematic circuit diagram symbols. Names of club members receiving correct responses are put in a container and a drawing is held to select the pennant recipients.

The BBC issues verification (QSL) cards only on special occasions. One such opportunity occurred in 1972 when the parent BBC organization celebrated its fiftieth anniversary of going on the air.

Annually, in the summer, another chance for a BBC QSL is offered when the World Radio Club holds its members-only DX Award competition. Certificates are awarded to DXers who correctly report reception from various BBC transmission sites during the two-week contest period. Dates, times, frequencies and transmitter locations are typed on the attractive 8½- by 10½-inch award certificates.

Contemporary rock music found on the international charts is played by Brian Matthew during his "Matthew on Music" program heard Wednesdays following World Radio Club. The BBC World Service is one of only a handful of sources for radio drama today. Programs called "Radio Theater" and "Theater of the Air" are heard weekly.

**Relays.** From the 50-studio center in the Bush House headquarters, BBC shortwave programs reach listeners via seventy high-powered transmitters located on ten sites throughout the world. North American listeners are best served by stations on Antigua, in the Caribbean; and at Sackville, New Brunswick, and Greenville, North Carolina. These relays are shared with other broadcasters, such as Deutsche Welle and Radio Canada International.

Other BBC relays are located on Ascension Island, Cyprus and Singapore. Programs reach these transmitters by means of undersea cable, SSB radio link, and satellite.

Many frequencies are used by the BBC to reach its estimated audience of seventy million and it would be impossible to list all those dial settings here.

North American listeners might check 11,775 kHz in the morning however, and 6,175 kHz in the evening.

All World Service times and frequencies are listed in a monthly magazine known as "London Calling." It is available by mail for $10.00 per year. Pictures of station personalities and descriptions of upcoming programs are included.

"London Calling," as well as membership in the World Radio Club, can be obtained by writing to BBC World Service, P.O. Box 76, Bush House, London, WC2B 4PH, England.
In this day and age there is virtually no communications service that does not require precise measurement of the transmitter's carrier frequency.

Sure, if you plunk yourself down in the middle of one of the amateur bands, you can be reasonably certain that if other stations don't get on your back, you're somewhere in a legitimate segment of the band. But there's no way you're going to crowd the edges of the bands, where much DX hangs out, or accurately zero-beat a net, without a frequency counter built into the receiver or transmitter, or an external counter. And unless you're in the market for one of those new, digital readout transmitters priced close to $1000, the external counter is your best bet. It certainly beats asking the receiving station if you're on frequency, for his receiver is most likely no better calibrated than your transmitter.

Why a Counter? Most important, precise transmitter frequency is often required for proper reception. For example, many modern AM CB transceivers are so selective, that even with delta tuning, a transmitter near the frequency tolerance limits will be received with "spitty," garbled modulation. Even worse, SSB requires the transmitter carrier be well within tolerance, for the receiver clarifiers often cannot properly tune a signal near the tolerance limits, and what you hear in this instance is a high pitched "Donald Duck" sound. For best reception on the receiving end, a modern CB transmitter should be within about ±1000 Hz of the channel frequency. If it gets beyond these limits, you really should have a service shop align the frequency synthesizer so your transmitter's carrier is as close to the channel frequency as is possible.

While a frequency counter is probably the most reliable way for the ham or transmitter output to a UHF connector on the rear of the REDCO RFC-50, connect the transmission line to another UHF connector, and key the transmitter. The carrier frequency will be indicated by a six digit, 0.3-inch, LED readout. Since the RFC-50 works off a minute sample of the power in the transmission line it can be left permanently connected, ready to indicate the transmitter's output frequency at all times.

Specifications. The REDCO RFC-50 Communications Frequency Counter is housed in a 7¾-in., by 8-in., by 2¾-in. cabinet. It can be powered by 120-VAC or 13.8-VDC, depending on which of two supplied power cords is plugged into a rear apron connector. The switching from one power supply voltage to the other is done automatically by the plug on the power cord.

The rated frequency range is 500 Hz to 40 MHz through a direct connection via a front panel BNC connector. Unlike most hobby type counters with direct connection, however, the input is not the usual 1-megohm; it is 50 ohms with back-to-back diodes across the load resistor providing protection against excessive input voltage. Two UHF connectors on the rear apron provide an RF sample from a transmission line for the counter input.

Operation. A resolution switch on the front panel positions the decimal point and provides the proper gate time for direct indication of MHz and kHz. It also serves as the power on-off switch.

Resolution is 10 Hz, meaning that in any frequency reading, the last place is not indicated. For example, 195.599 kHz is indicated as 0195.59 with the resolution selector at the "10" setting meaning that you should multiply the reading by 10. 0195.59 times 10 becomes 195.59 kHz. In another example (Continued on page 88)
This tailgating gauge helps you to keep your distance.

Space Cushion Timer

by Thomas R. Fox

Most of us who drive the highways these days have become witness, at one time or another, to the gruesome sight of a high speed, rear-end collision. With today's cars becoming smaller and lighter, the only way the auto makers can provide a margin of collision safety for the occupants is to design the cars to crumple on impact, thus absorbing the shock and hopefully leaving the passengers uninjured.

The drawback to this method is that while you and your loved ones may manage to avoid serious injury, your car is likely to be suited for use as nothing more than junkyard scenery.

The Principle. To help you avoid these unpleasant consequences, we suggest you build the Space Cushion Timer. This device works on the "two-second rule." The rule simply says that if a two-second interval is kept between cars at all speeds, ample braking distance will be provided for safe stops. In practice, you would fix a landmark at the side of the road, such as a light pole. When the car in front of yours passes the pole, two seconds should elapse before your car reaches that same spot. With our timer, you merely trip the touch plate, and 2.1 seconds later, a pleasant tone sounds. If you're at the landmark, then you are a safe dis-

Separate the template for the touchplate and make an individual printed circuit board for it. Make both PC boards very carefully.

The components all mount on the side opposite the foil pattern. Be sure to double check the polarities of electrolytic capacitors.
Space Cushion Timer

While almost any case can be used for the space cushion timer, this Radio Shack clock case seems ideal. This unit can be mounted at almost any convenient spot on the dashboard of your car.

Rationale For Two Seconds Following Distance

<table>
<thead>
<tr>
<th>Car Speed</th>
<th>Feet Car Will Travel In 1 Second</th>
<th>At 1 Car Length For Each 10 M.P.H. You Will Be (based on 20 ft. vehicle)</th>
<th>Safety Rule You Will Be</th>
</tr>
</thead>
<tbody>
<tr>
<td>30</td>
<td>44.4</td>
<td>60 ft. back</td>
<td>117.2 ft. back</td>
</tr>
<tr>
<td>40</td>
<td>58.6</td>
<td>80 ft. back</td>
<td>146.6 ft. back</td>
</tr>
<tr>
<td>50</td>
<td>73.3</td>
<td>100 ft. back</td>
<td>176.0 ft. back</td>
</tr>
<tr>
<td>60</td>
<td>88.0</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Parts List For Space Cushion Timer

- C1: 2.2 μF tantalum capacitor, 25-volt or greater
- C2: 0.047 μF ceramic disc capacitor, 25-volts
- C3: 2.2 μF non-polarized electrolytic capacitor, 25-volts
- C4: 22 μF electrolytic capacitor, 25-volts
- C5, C6: 0.1 μF ceramic disc capacitor, 25-volts
- C7: 1,000 μF electrolytic capacitor, 25-volts
- C8: 1N4001 diode
- C9: 1N4744A zener diode, 15-volts
- F1: 0.25 amp quick-acting fuse
- IC1: 556 dual 555 timer
- Q1: 2N3398 NPN transistor or equivalent
- R1: 100,000 ohm, 1/4-watt resistor
- R2: 2.2 kΩ resistor
- R3: 3,300,000 ohm, 1/4-watt resistor
- R4: 4.7 kΩ resistor
- R5: 47,000 Ω resistor
- R6: 47000 Ω resistor
- Z1: -8 ohm miniature speaker
- S1: AC sub-miniature SPST slide switch

Got parts problems? Solve 'em with Hobby Mart, page 89.
MY LOVE AFFAIR with microcomputers began with Popular Electronics' COSMAC Elf and progressed through the Bugbooks to the Mark 80 by E&I Instruments Company. They were great instructors, but it was becoming obvious that what I needed was a full system with a mainframe microcomputer.

In choosing such a system, I wanted something that was compact and aesthetically pleasing. Front panels and separate keyboards may fit the image of the electronic experimenter's laboratory but they sure clutter one's desktop! I also wanted a complete system because although it puts the payments in one large lump sum, it is cheaper in the long run than shelling out a hundred dollars here for software and another couple of hundred dollars there for an interface or two. But probably the biggest factor in my choice of Processor Technology's SOL-20 was the praise my friends had for this company's VDM and CUTSboard as well as their software including the SOLOS monitor program. Several of them have files full of Processor Technology material!

I am fortunate here in Toronto as there are three computer stores that sell the SOL-20. All were very helpful and their prices were very close. Here again I relied upon the advice of a friend who had dealt with them and chose The Computer Place on Queen St. West here in Toronto. I found their after service advice invaluable and they checked my results twice when my troubleshooting ability failed.

The kit came packaged in the original air cargo container. The flight crew could have kicked this well packaged box safely out the cargo door without doing any damage! However, I was a bit discouraged to find a revision notice right on the outside of the shipping box. What lay ahead?

The individual components were all of excellent quality. Most were made in the U.S.A. The PC boards were double sided, had solder masks and plated-through holes. More than enough Texas Instruments' sockets were included for the I.C.'s. One puzzle was that all the components were grouped and placed in numbered "zip-lock" plastic bags but no code to the numbering was included.

For instructions, I was expecting a schematic and a bag of components but I was very pleasantly surprised.

The manual is huge and very well organized. It is not quite in the Heathkit category but still darned good. There is a section very clearly giving the theory of this computer and an excellent set of schematic and construction diagrams. All the software included in the SOLOS "personality module", which acts as a firmware monitor, is clearly documented. Unfortunately, the Basic-5 included is not.

The assembly instructions were well thought out and follow a logical plan, with tests carried out as each phase of construction progressed. One failing of the instructions is that it is stated that an oscilloscope is optional and that the function testing can be done with a VOM. I found that not only is a scope mandatory, but that I needed the 50-MHz Hewlett-Packard oscilloscope in the lab of the local community college since a 10-MHz bandwidth was insufficient.

Construction. At this point, I would like to give two construction hints that I have developed and which were very helpful in building this kit. There is a lot of detailed checking of very dense PC boards before and after soldering and for this I have always used a stamp collector's light with magnifying lens. These can be purchased quite cheaply.
at any philatelic supply store. Also I use a soft nylon toothbrush to clean off the board after soldering to remove stray splatters of lead that can cause solder bridges. It works quite well.

Assembly starts with the power supply. It is self contained and very compact. The fan is much quieter than on other computers and is unnoticeable when the chassis is closed. On the PC board, a small modification had to be made to desensitize the “crowbar” circuit protecting against a power surge. Interestingly, a similar circuit was demonstrated in “Kilobaud Klassroom #6.”

There is very little point to point wiring as snap-on connectors and two cable assemblies are included. Amphenol RF connectors are supplied and are of the highest quality. All voltage tests were passed with honors.

The keyboard came pre-assembled, and I was disappointed at missing the chance to build it. The store informed me that there had been too many construction problems with it. As you can see, it has a separate calculator type keyboard which duplicates the numbers on the QWERTY keyboard but is simpler when entering numbers. Again, all function tests were passed.

The 16K RAM board comes as a “semi-kit”. This means that it is assembled, but jumpers have to be added or removed to create the options that you need. The board is not burned-in, but two programs are included to do this. Unfortunately, neither is on cassette or paper tape and must be entered manually. More annoyingly, both these programs require additional RAM to operate, and must be located at address 0000. This doesn’t allow the use of the RAM on the main PC board, which is addressed in the high area of memory for the use of the monitor program and cannot be readressed. You will have to borrow a working memory board which is properly addressed from a friend or the store where you buy the kit. Some people may nitpick that this particular memory board has dynamic rather than static chips, but the day is long gone when the CPU had to halt to allow refreshing and the average hobbyist will not be held up by the refresh time.

The main PC board was the major task. All ICs were socketed except two where there wasn’t enough room. There are repeated cautions in the manual about the handling of MOS devices, but I found that using the bottom of the chassis as a work surface with the power supply plugged in provided a good grounded work surface and the fan kept the solder fumes away.

Here is where I encountered the necessity of a good oscilloscope. The clock and VDM circuits both passed their tests on my VOM, but the VDM refused to work. A shorted disc capacitor in the clock circuit proved to be the culprit, but this could only be traced by examining the waveforms. Also, the value of resistor number 80 had to be decreased to 270-ohms to increase the sync amplitude on the video output to enable it to be displayed.

Interfacing. I used a “Pixie-verter” to interface to an old T.V. I chose this method mainly because it was cheaper but it also allows me to attach the computer to another T.V. without difficulty. Furthermore, most old TVs (the ones favored by hobbyists) lack schematics and have “hot chassis”, which makes patching one’s computer directly to the video amplifier circuit rather hazardous both to man and machine. I also tried the “Waterloo Modulator” featured in the January 1978 issue of Byte. This uses a 7413 to create an oscillator but the display was not as sharp. Another possibility I considered was a UHF modulator, but most old TVs don’t have UHF tuners. Theoretically, a UHF modulator would not give RF interference, but my Pixie-verter doesn’t seem to cause problems. However, the computer itself does cause considerable interference, which I believe is from the power supply even though it is shielded and well grounded. For this reason it is best to keep both your monitor and cassette as far from the computer as practical.

The chassis is of very heavy grade metal and sturdy. As I mentioned before, I used this as a grounded work surface. However, I feel that the solid walnut ends should be optional. I don’t know the current price of walnut but I would have preferred to have seen the wood with visible grain and inner workmanship. This would add a little more realism to the project.

Unfortunately, their diagnostic socket is not the same quality as the other sockets. Mounting the backplane on the chassis was not an easy job and it is necessary to remove it if you want to remove the main PC board for servicing. Perhaps Processor Technology’s designers feel that their products need servicing!

Once the construction was finished, I had some difficulty loading BASIC from a cassette and my VDM had a “nervous breakdown” during the burning-in period. At this point, I found the service at the Computer Place, where I had bought the kit, to be excellent and the fault was detected and repaired in just over a week.

I learned a great deal about computers by constructing one and found the experience a lot of fun. As a “hardware man” I have many plans for the future of my SOL. I am planning a circuit to create a typewriting sound when information is entered on the keyboard, and a bell sound at the end of the line. Heathkit already uses such a circuit and it makes data entry easier for a person used to a standard typewriter. I also plan to build the modem described in the November 1977 issue of Kilobaud. Always remember that as long as you are still building, you can counter the inevitable question of: “But what’s it good for?” with the answer, “Well, just wait until I have everything finished”. You never will!
How would you like to tune to a "dead" part of the broadcast band, flip a switch, and suddenly find it's jam-packed with stations? That's exactly what happened to us when we tried the Palomar Engineers' BCB Loop Antenna System!

We connected everything together—the loop antenna system and a budget receiver—set the dial to the high end, between stations, so we could hear how the loop antenna first affected the reception of interstation noise. We expected the noise would give us some idea of whether the antenna system actually had "gain." Problem was, the instant we flipped the antenna system's power switch on, the radio was no longer tuned to a "dead spot"—rather, we got a signal booming in like the transmitter was out the back door.

Tuning the receiver told us we were not going to find any "dead spots," because the high end was filled with DX we'd never heard before. To make certain some unusual skip condition wasn’t playing tricks, we turned off the Palomar loop antenna system and the high end went almost dead as the proverbial doornail. Where we had heard S3 to S7 signals, we could no longer hear anything but noise—there wasn’t a trace of a signal even with the receiver’s BFO turned on.

Talk about digging out signals from under the noise. The Palomar loop ant- enna was digging out signals we didn’t even know existed!

Maybe if we had a longwire antenna we would receive those magical signals we received with the Palomar. But in this age of apartment houses with sealed windows, condominiums where you can't hang anything out the window, townhouses where any form of wire or antenna brings petitions of pro-

test from the other side of town, and private homes with backyards no larger than a postage stamp, the longwire antenna is fast becoming a legend from the golden days of radio. Most BCB DXers are relegated to a piece of wire lying on the floor, or concealed under the carpet, for a skyhook.

The Palomar Engineers BCB Loop Antenna System has come to the rescue. The system consists of two separate devices. The first is a loop amplifier: a metal cabinet 7 1/4 x 6 x 2 1/4 inches that houses a broadband pre-amplifier, tuning capacitor, and power switch. The 9-volt battery power supply mounts on the back adjacent to a standard coaxial connector used for the output. The top of the cabinet has a phone-type jack mounted in the center of a 360° compass (which is also centered on the cabinet's top.)

The second part of the system is a somewhat oversize loop antenna assembly that plugs into the loop amplifier. The loop can be continuously rotated through 360°, or tilted ±90° from horizontal. A tilt scale is part of the loop assembly. The rotational scale is the 360° compass on top of the loop amplifier. The loop itself is but a small part of the total loop assembly; but the oversize hardware permits the loop to be positioned by the user without "hand effects" on the loop antenna itself.
When the antenna is plugged into the loop amplifier, the tuning capacitor (which is built into the amplifier) tunes the coil to the desired frequency or narrow range of frequencies, thereby providing the “amplification” associated with high-Q tuned circuits. Though the amplifier itself is rated by Palomar for a nominal gain of 20 dB, we attained signal improvements of 3 to 4 S-units, which represents a gain range of 18 to 36 dB—assuming the accepted value of 6 dB per S-unit.

The “extra” 16 dB of gain (63 dB—20 dB) is actually the result of tuning the loop, and the gain is realized in comparison with reception from a receiver having a built-in BCB antenna.

**Peak or Null.** For some unaccountable reason Palomar stresses using the device for nulling a strong signal in order to reduce interference to a weak signal, and both their instructions and descriptive literature concentrate on “nulling.” This might reflect, the fact that they make loops for the 160/80 meter amateur radio bands, 150-550 kHz VLF, 40-150 kHz Loran, and 10-40 kHz OMEGA bands, where nulling of a strong local groundwave signal might be required in order to receive a skywave signal. (A loop antenna produces sharp nulls on groundwaves, but the nulls are broad or non-existent on skywave signals. This permits local interference to be attenuated, or eliminated, while DX stations can be heard from all directions.)

But when it comes to BCB DXing it’s the gain of the system that really pays off. It is possible, however, that some DXers might experience interference by a local station while monitoring DX, so we'll cover our results in both peaking and rejecting signals.

**Hook up.** The Palomar Loop Antenna system is connected to the receiver with a short length of coaxial cable: anything in the thin category such as RG-58 or RG-59 will suffice. Use the shortest possible length. If the receiver you’re using for BCB DXing has a coaxial antenna jack simply use a matching plug on the end of the cable.

It is more than likely, however, that the shortwave radio, or hi-fi AM/FM receiver you’re using has screw terminals for the BCB or AM antenna connection, so simply solder a set of solder-lugs to the free end of the coaxial cable.

If your radioreceiver has screw terminals it’s possible that because of the extra-high sensitivity of the Palomar antenna a certain position(s) of the loop will cause “feedback” if the antenna system is mounted directly on the receiver, or immediately adjacent to the antenna terminals. The “feedback” is evidenced either by receiver blocking, or a loss of sensitivity in the receiver coincident with a whistle caused by self-oscillation of the system. Simply moving the Palomar unit a foot or so away from the receiver will eliminate the “feedback.”

Set the loop antenna so there is no tilt, as indicated by the 0° index of the loop assembly pointing straight down. Set your receiver’s tuning to a desired station, or to a “dead” frequency where you believe a station to exist. Switch on the loop amplifier and then adjust the loop amplifier’s tuning knob for maximum received signal strength or noise. If you tune for maximum noise readjust the tuning knob after you have a station tuned in. Then, holding the loop’s metal bracket and not the loop itself, rotate the loop assembly for maximum received signal strength.

If your receiver has an S-meter you will see an increase in the meter reading. If your receiver does not have an S-meter you will hear the signal increase in volume only if it was very weak—or not received—without the Palomar. If the signal was strong to start with, you probably will hear no effect from the speaker or headphones, because the receiver’s AGC (automatic gain control) will absorb the extra gain by reducing the receiver’s gain an amount equal to the gain provided by the Palomar system.

Now assume the DX station you want to receive is adjacent to the frequency of a strong local broadcaster.

This is where you use the null feature. Remember, nulling only applies to a groundwave signal; you cannot null a skywave in order to receive another skywave.

One of the easiest ways to null is to first peak the Palomar to the undesired local signal; then rotate the loop for minimum reception, followed by adjusting the loop’s tilt for additional null. With a little practice you can simultaneously adjust position and tilt to almost instantly null a station. The null is very deep; we have virtually eliminated all traces of a local broadcaster using a completely shielded Palomar-to-receiver input connection.

When the receiver has screw terminals, some signal will be picked up by the screw itself and the short length of unshielded coaxial wire connected to the screw, but the pickup will be insignificant. The null is exceptionally deep, and we have actually extracted a skywave signal out from under the sideband interference of a local station by simply nulling out the local. (It really works!)

The nulling can also be used to reduce or eliminate local electrical interference. Say the motor or ignition system on your neighbor’s oil burner, or a faulty fluorescent light, is giving you broad-spectrum noise—hash all across the band. Under certain conditions (it doesn’t work every time) you will be able to null out the electrical interference. We even got rid of the hash generated by a sewing machine motor in the next apartment.

**Summing Up.** If you already have a longwire outdoors there will be little, if any, advantage—unless you can utilize... (Continued on page 86)
HEATHKIT AD-1304 AUDIO PROCESSOR

Hi-Fi add-on stretches your system's dynamic range and filters out some unwanted noises

There are certain conditions when the dynamic range of recordings or live broadcasts is limited to prevent overmodulation of the receiver or transmitter. There are also instances when a relatively high background noise could be obtrusive. For the audiophiles for whom the occurrence of dynamic range limiting or background noise might prove annoying, the marketplace offers several types of audio processors which expand the dynamic range and/or reduce high frequency background noise. One of the devices that provides both dynamic range expansion and high frequency noise reduction in a single modular component is the Heathkit Model AD-1304 Active Audio Processor.

The AD-1304 is a line-level device that connects between an amplifier's or receiver's preamplifier output and main amplifier input. This is generally accomplished by using the amplifier's tape connections and the associated tape monitor switch (same way you'd switch any other line-level accessory). The tape monitor connections are simply moved to the audio processor.

Three Functions. This in-line connection permits the AD-1304 to provide any combination of three functions: dynamic range expansion; noise reduction; high frequency filter. A separate on-off switch is provided for each of the functions.

The dynamic range expansion is applied to both the signal peaks and the lowest volumes in such a way that the normal dynamic range of the signal source is increased by approximately 7 dB at midband frequencies. Figure 1 shows how this is done.

The AD-1304 continuously monitors the program for high frequency content in the range of each filter. When there is no program content the filter is normally in-circuit, and the higher frequencies are attenuated, starting at about 2 kHz. Since continuous noise (hiss) are high frequencies it is attenuated by the bandpass filters.

If there is high frequency program information within the range of a filter it is sensed and the filter is shorted, al-

Figure 4 is a picture directly off a spectrum analyzer oscilloscope. The horizontal sweep is calibrated from 20 to 20,000 Hz. Each major vertical division represents 5 dB; each minor vertical division is 1 dB. An unprocessed normal signal dynamic range of 20 dB is indicated by the two essentially straight lines two major divisions from the top and bottom. To this "normal" 20 dB range we apply the Heathkit dynamic expansion. The maximum signal is expanded approximately 1 dB at midband. But note the bass and high end are below the reference maximum level. The average between the low-high extremes and the midband is about 3 dB. Added to the 1 dB actual midband expansion, the effective value is about 4 dB.

The low level signal is attenuated 3 dB below the "normal" level at the midband by the expander. In total, the expander increases the dynamic range about 7 dB over most of the midband.

Noise Reduction. The AD-1304 is designed to suppress continuous high frequency noise. It does not suppress clicks and pops, such as you might hear from a dusty or mishandled record, or even radio static.

Noise suppression is accomplished by passing the signal through three triggered bandpass filters with center frequencies of 5 kHz, 9 kHz, and 13 kHz. The AD-1304 continuously monitors the program for high frequency content in the range of each filter. When there is no program content the filter is normally in-circuit, and the higher frequencies are attenuated, starting at about 2 kHz. Since continuous noise (hiss) are high frequencies it is attenuated by the bandpass filters.

If there is high frequency program information within the range of a filter it is sensed and the filter is shorted, all-


Once connected to the associated amplifier, each function can be individually switched in and out, or the tape monitor can be switched in as the signal source for the processor. With all processing switched out the overall frequency response is +0.2 dB 20-20kHz at a distortion no higher than 0.1% THD.

**Build it Yourself.** The AD-1304 is available in kit form for $199.95 (mail order price). Most of the circuit is on printed circuit boards: There is a large “mother” board with sockets for plug in expander and control/bandpass filter modules which are also printed circuit assemblies. A separate meter assembly is provided for tests and adjustments. The meter “panel” is internal and not normally seen when the cabinet is secured.

There is extensive user alignment and adjustment. Not difficult, but time consuming and requiring considerable care; just don’t rush through the adjustments if you want optimum operation.

**Performance.** The expander performs just what it’s supposed to do: namely, expand the dynamic range. However, limiting during mastering is performed on signal peaks, not the average program level, yet expanders expand average program level. This produces minor volume surges which do not exist in the tape-to-record-master process.

As for the noise filter, it also works as claimed. If you have a very old tape recording with a relatively high hiss level, or are listening to a very weak FM station, the noise filter noticeably reduces the high frequency noise.

As with most expanders and noise reduction systems the Heathkit AD-1304 is somewhat limited in application if you are interested in high fidelity sound. But if you want larger than life dynamic-range, and have signal sources that require “hiss” reduction, the AD-1304 might fill your needs.

For additional information on the Heathkit AD-1304 circle No. 1 on the reader’s service coupon.

---

The expander and three filter modules plug into the main board assembly. The test meter is built into the cabinet and is used for circuit alignment during construction and for circuit testing.

Since the processor will utilize a receiver’s tape connections, the tape connections are moved to the processor along with the tape/source monitor switch. It can be built for 120 or 240 use.

---

**Figure 1**

This oscilloscope photograph shows the AD-1304’s dynamic range expansion, which is explained in the text on preceeding page.

**Figure 2**

Here you can see the nulls of the 5, 9- and 13-kHz dynamic noise filters. The top line shows when they are not activated.

**Figure 3**

This ‘scope shot shows how the high frequency filter affects the top end of the spectrum. The signal is 10dB down at 15 kHz.
The Complete Idiot's Guide
to Becoming a Lid
(or how to be a lousy operator)

by Thomas R. Sundstrom W2XQ

The astounding growth in the number of amateur radio licenses issued in the past few years has resulted in a virtual logjam on the bands. As a byproduct of this overcrowding, good operating practices are vanishing as rapidly as bottles of '64 Lafitte Rothschild.

A poor operator is known as a "lid," and a lid is to be pitied, and hopefully educated, but not tolerated. If the educatory process is approached with tact, the errant operator's practices can be amended without alienating him or her. In this light, we bring you The Complete Idiot's Guide to Becoming a Lid.

On Tuning Up. Don't bother using one of those ridiculous oil-filled dummy loads for tuning up your transmitter. The only people who advocate their use are the people who manufacture them. The $20 to $30 which you might waste on them could buy a lot of beer. Instead, find the busiest frequency on the band, be it CW or phone. Since most of the activity is taking place here, it makes sense to load up your rig in the neighborhood in which you'll be operating, right? To allow for temperature variations, take at least ten minutes to accomplish tuneup, throwing a test tone about every 20 seconds or so, to allow for drift, and to let the other ops know that you're there.

On Calling CQ. Any frequency within your license segment is fair and legal territory for you to call CQ in. You don't necessarily have to be concerned with other stations transmitting on the same frequency, since you won't bother them while they are transmitting because they can't hear you.

Never answer another operator's CQ. Where's the challenge in that? You already know he wants to start a QSO. Instead, try calling a CQ right on the same frequency, and see who gets the first response. After all, why shouldn't every day be a contest day?

On CW. Now that you've finally gotten rid of that old manual key in favor of one of the new keyers, you can really burn up the ether with your speed. Always send just a bit faster than you can copy, because chances are the other op can't copy that fast either, and he'll have to ask you to QRS (slow down).
It's a lot better, and less embarrassing, than if he asks you to QRO (send faster). After all, you did spend a lot of money on that keyer.

Since you did spend all that money with the idea of becoming a better CW operator, it's a good idea to stay away from all of those abbreviations and "Q" signals. Nobody understands them, and you get more practice if you spell every word out.

On Phone. Stay away from those international phonetics when sending your call. Tres passé. Something catchy and current is much better. If those foreign ops can't get it, that's tough. They should watch more television.

Remember, there are many more CB'ers than hams, and the CB lingo is now part of everyday English. There's absolutely nothing wrong with using everyday vocabulary on the ham bands. That textbook grammar is strictly kid stuff.

One of the most efficacious methods of "punching through" on the HF phone bands (below 30 MHz) is to turn up your speech compressor to maximum. The splatter will clear out anything within 10 kHz in either direction. Let's face it: if your phone signal is good within its limited 2 kHz bandwidth, it ought to sound five times as good with the additional space. Don't give in to those guys who inevitably will ask you to detune. If their rigs don't have enough receiver filtering, that's their problem, not yours.

On Working DX. Don't wait until that DX station finishes calling CQ before you start answering. Start calling him as soon as you have his call down. He may have a local frequency manager listening on the side, who is taking down the calls of the stations answering the CQ, in order to have a list for the DX station to reply to. You can be first on the list, so why wait?

Regardless of how many other stations might be waiting to work him, always get the QSL routing information from your DX contact. Not only do you get the information you need, but you perform a service to the other operators waiting on frequency by allowing them to copy it also. Making the DX station repeat it a few times is always a good practice. Sometimes their English ain't too cool.

On VHF FM Repeaters. Always initiate a conversation by calling CQ. It's foolish to announce that you are listening on the frequency, because if you're not talking, it's obvious that you are indeed listening. Calling CQ will identify you as an A-1 HF operator.

Once you have the repeater, keep the pauses between transmissions to an absolute minimum, because there's always the possibility of losing the channel to someone else. First come, first served. Also, don't be misled by those people who yell "emergency!" That's just a ruse to get you off, and get themselves on. If there's a real emergency, they can use the landline. That's what it's there for.

Conclusion. Obviously, this has been a guide towards what not to do, and you can probably add to it based upon your own experiences. It is truly unfortunate that many operators substitute dollars and cents for common sense, and kilowatts for milliwatts when the latter, in each case, is sufficient to accomplish the task at hand. Remember, the whole world is listening to you. Think about it the next time you fire up the rig.
THE MOST ANNOYING PROBLEM faced by DXers and SWLs is the image. Unlike harmonics and other spurious signals produced by the transmitter, an image is not real—it is produced within the receiver itself. It causes novice SWLs to report stations on erroneous frequencies, and creates additional interference for DXers. You can't always cure them but every listener should be able to tell these phony images from the real thing.

Superheterodyne. All images are the result of superheterodyning, i.e. the mixing of two frequencies in a circuit to produce two other frequencies—the sum and difference of the two original frequencies. If you mixed WWV's 2500 kHz signal with Voice of America's 6190 kHz Greenville transmission, WWV and VOA would appear on 8690 kHz (6190 plus 2500) and 3690 kHz (6190 minus 2500). All modern radio receivers take advantage of the superheterodyne principle to provide more efficient and less expensive amplification circuits.

Every receiver contains its own built in mini-transmitter known as a "local oscillator." In the simplest radio, whatever frequency you are tuned to the local oscillator will operate exactly 455 kHz higher. Thus, if you are tuned to Radio Surcolombia on 5010 kHz, your local oscillator would be on 5465 kHz. The two are combined in your receiver's "mixer" circuit producing, of course, that desired 455 kHz "intermediate frequency" (usually referred to as the "IF"). From there on, all amplification circuits in the receiver (except those in the audio section) can be pre-set to this fixed IF. Equally important, selectivity (the ability to separate the desired signal from those on adjoining frequencies) is considerably better at 455 kHz than on higher frequencies.

Suppose, while you are listening to Radio Surcolombia on 5010 kHz (and your local oscillator is at 5465), Radio Moscow has a strong signal on 5920 kHz. 5920 just happens to be 455 kHz above 5465 so if it mixes with your local oscillator it will also produce an intermediate frequency of 455 kHz. In other words, Radio Moscow's 5920 kHz signal will show up as an image on 5010 kHz. Note that resultant frequency relationship—this type of image always shows up 910 kHz (two times the 455 kHz IF) below the real frequency. Therefore, your local oscillator and VOA's 6190 signal can produce a 5280 kHz image while WWV's 2500 kHz transmission might even show up at 1590 kHz on the standard AM band.

Another Kind Of Heterodyne. So far the kind of heterodyning process we've talked about has involved only radio frequencies. But there are also audio heterodynes. If you are tuned to BBC Ascension Island on 6005 kHz there may be interference from Radio Reloj de Costa Rica on 6006 kHz. No one need a pocket calculator to tell them that the difference between these two frequencies is 1 kHz (1000 Hz) well within the audio range. When this (not-so-super) heterodyne reaches the receiver's audio circuit it will be amplified and emerge from your speaker or headphones as a very annoying whistle. To distinguish it from other forms of the heterodyning process, the audio heterodyne is usually referred to simply as a "het."

Just as real interference can cause a

Like mirages in the desert radio stations are not always where they appear to be

by C. M. Stanbury
het, so can image interference—but there is one important difference. When the local oscillator produces interference on the frequency to which you’re tuned by mixing with a strong station on another frequency, the resultant het will vary in pitch as you tune across it—unless the image is caused by a pulse modulated station such as Loran or shortwave radar.

If, while listening to Radio Surco-
lombia on 5010 kHz, there is a het, turn the dial slightly. If the het varies in pitch, it is being caused by the Radio Moscow image (or some other strong station on 5920). If the het remains constant then there really is a second station within a few kHz of 5010.

**Some Strategy.** Short of actually modifying your receiver, or buying a new one, your most important defense against images caused in your local oscillator is the antenna tuner knob. Determine which antenna setting is best for each “band,” or more precisely the best setting for each MegaHertz. If you find two stations and know that one is an image but don’t know which, the real signal will be strongest at the proper antenna tuner setting while the image will be strongest at a slightly different setting.

The next step is to eliminate the het, by tuning out the image—and, yes, you can. Turn the dial very carefully until the pitch of the het drops to zero. Unfortunately, the most inexpensive receivers are a bit unstable so you may have to repeat this process every few minutes. However, if the image is caused by a broadcast station or even some utility stations with voice modulation, the worst of the interference will be eliminated so it is worth the effort. If the image is from radioteletype, facsimile, etc., the victory will be less clear cut.

Even if an image doesn’t cause interference it can, as noted at the beginning of this article, lead you to report a station on a false frequency. Any time you hear a broadcast station about 910 kHz below a regular shortwave broadcast band (see our chart) check that band to make sure you can’t find this same station with an even stronger signal. A station will always be stronger on its real frequency.

**Overload.** Sometimes signals will come in so strongly that a sensitive receiver cannot handle them. Under these circumstances, mixing will take place independent of the local oscillator—that hypothetical case of WWV (2500) and VOA Greenville (6190) producing images of 8690 and 3690 kHz. That sort of extreme frequency spread usually occurs only with standard AM stations—if you live in New York City you will often find WQXR (1560) mixing with WMCA (570) at 990 (1560 minus 570) and 2130 (1560 plus 570)—as long as the pitch can be recognized.

If you are receiving very strong signals from VOA Greenville on 6190 and Radio Canada International 6140, they might produce an image at 6240 kHz (2 x 6190 minus 6140). Note the difference between the image frequency and the real frequency is relatively slight so your antenna tuner control won’t help.

To make things still more complicated, such mixing may not be occurring in your receiver or antenna at all. If two transmitters are at the same location, a technical malfunction can cause mixing right at the transmitter site (in which case it is usually referred to as “cross-modulation.” We once found VOA Greenville transmissions on 15140 and 15280 interfering with WWV (1000 kHz (2 x 15140 minus 3200)). Neither 15140 nor 15280 were anywhere near strong enough to overload our receiver so the Greenville signal on 15000 was obviously real. On medium and long wave, cross-modulation occasionally occurs in the ionosphere (the “Luxembourg effect”). This has been extremely rare in North America due to the absence of super-powered transmitters which can quite literally overload the ionosphere. We have not seen the Luxembourg effect reported on short wave in any part of the world.

**Still More Complex.** Certain other minor receiver defects can create some outrageously exotic mathematical combinations. Minute radiation from the 455 kHz intermediate frequency amplifier can mix with incoming signals, and the local oscillator may be at its second harmonic. Suppose a listener in the Buffalo, N.Y. area is tuned to 1495 kHz. His local oscillator will be at 1950 kHz (1495 plus 455) and its second harmonic will be at 3900 kHz (2 x 1950). Meanwhile, there is a powerful local (WKBW) on 1520 kHz and another (CHOW) on 1470 kHz. If WKBW overloads the receiver, we have the equation; 3900 – (1520 + 1470 + 455) = 455 kHz. Therefore WKBW and CHOW will appear on 1495 kHz. Fortunately such signals, which can be detected via the variable het test previously described, are usually weak and generally limited to the standard AM band.

Then there are the new crop of synthesized frequency receivers. These use multiple local oscillators some of which deliberately radiate harmonics. Each model has its own particular arrangement of intermediate frequencies thus we cannot deal with them comprehensively here. However, note that overloading can be a major problem with the less expensive models. On the other hand, simple superheterodyne, local-oscillator-caused images are virtually eliminated by dual conversion.

**Buying A New Receiver.** When it (Continued on page 87)
Getting burned by the high cost of electricity? Go Sun Power!

**SOLAR SWINGER**

Homer L. Davidson

*Have you ever seen a model ship inside a bottle? The next logical step is to build a small radio inside of a radio or TV vacuum tube! We call it the Solar Swinger and it has no on/off switch, batteries or power supply. If you want to turn the Solar Swinger off, just place a cap or hood over the tube. You may want to let it play all the time—it doesn't hurt a thing. No need to worry about batteries running down, for the little radio is solar powered. It will operate in the sun, shaded daylight or under a desk lamp in the evening. Of course, the radio won't blast your ear drums with music, but you can listen to local AM broadcast stations with ease.*

**Tube Preparation.** Select a defective radio or TV tube with a bakelite base. The larger the glass tube, the greater building area for the small radio components. An antique radio tube is ideal, but not necessary. If you can't find one in the junk box, check with your local Radio-TV shop—they may throw out several hundred of these old tubes every year.

There are many old power output tubes available, such as 6L6G, 6C6G and 5U4G. Don't select a 6BK4 type as you cannot remove the top metal anode from inside the glass envelope. You may use a large tube (6LQ6) with a glass base and then mount it on top of a black tube base. Pick up or six old tubes to practice on.

Before attempting to remove the bakelite base from the tube, let air into the bottom of it. All radio and TV tubes operate with an internal vacuum—the air having been pumped out. A small glass seal is located at the bottom of the tube. Always wear a pair of gloves when working around glass or warm components.

Now you want to let air back inside the tube. Break off the black bakelite center key locator between the tube side the tube. Break off the black bakelite center key located between the tube prongs. You should see the pointed glass seal. Take a pair of long nose pliers and break off the glass tip. You may hear a rush of air, or see a couple of white areas form near the bottom of the tube envelope.

To prevent glass pieces or excess solder from falling on the floor or work bench, do all of the glass preparation inside of a large pasteboard box.

Next remove the soldering iron tip from a 150 or 250 watt soldering gun. Take a six-inch piece of number 14 copper wire, you can remove the insulation from a piece of number 14 romex or a single conductor electrical wire for this purpose) and form a loop shaped soldering element. Wrap the bare wire around the base of the tube next to the bakelite base area and insert about one inch into the gun tip and bend over. Tighten down the soldering iron nuts—real tight. After cutting a couple of glass bases you may want to snug up the soldering iron nuts for a greater transfer of heat. Keep the copper loop close to the gun tips so
Break off the black tube-locator pin and the glass tip with some long nose pliers.

Note the clean easy cuts this technique produces. Make sure you have a back-up tube.

Form a loop of copper wire that fits snug around the tube and into a soldering gun.

The four copper support wires are soldered into the pin bases. The components are soldered and glued to these supports.

Put the loop over the part of the tube you wish to cut and hold the tube firmly. Wear gloves to keep from burning yourself on the hot glass. Next apply heat to the loop and rotate the tube until the glass cracks.

The loop will heat up faster. Pinch it close together, and snug, clear around the tube with a pair of long nose pliers. You have now constructed a copper wire loop to replace the soldering iron tip.

Slip the wire loop over the end of the tube base and press the loop together at the ends—but not so close as to touch. Now hold the tube in the left hand and soldering gun in the right. Very slowly turn the vacuum tube inside the heated loop. Within a few minutes you will hear the glass crack and break in a perfect cut at the base of the tube. Some glass tubes take longer to break than others. In the meantime you may smell a hot bakelite odor from the wire loop, which is normal. Often the glass will crack clear around and just a tap on the end of the bakelite base separates the two pieces.

If you have selected a tube with a metal cap on top, turn the inside components until the connecting wire breaks off. Be careful not to break the remaining glass envelope, which is very brittle. It’s best to cut off the wires connecting the tube elements to the base with a small pair of side cutters. In case the tube elements and mica insulators will not pull through the small opening, use a pocket knife to cut out sections of the insulators. You may have to crush or remove the tube elements in sections. Again, proceed slowly to prevent breaking the glass envelope. If you break or crack the tube envelope, start on another one—one out of three is not a bad average.

If you choose a TV tube with a glass base (6LQ6), press the copper loop around the prongs and against the glass bottom of the tube. Break off the small glass seal between the prongs and let air into the tube. Heat up the soldering gun and rotate the tube until the glass cracks in a round circle. Now break and crush the glass base with the wire tube prongs into little pieces. Be very careful in removing the tube elements, they must be reduced in size until all parts fit through the small opening. You may want to cut and remove each element piece individually until all parts are removed from the tube envelope. Later on, you can glue this glass envelope over a separate bakelite tube base.

It's best to cut out three or four tube envelopes. After removing the tube elements, choose the best one. If the glass edge is a little irregular, don't worry; when placed upon the black base the area will be covered with rubber silicone cement and will look like it belonged there all along. Now wash out the white and dark areas inside the glass envelope.

**Tube Base Preparation.** To remove the remaining glass and connecting wires from the tube base, each tube prong must be unsoldered. Hold the tube base upright and over a pasteboard box. Apply heat from the soldering iron against each prong. Let the excess solder begin to boil and then fling the tube base downward and the excess solder will fall into the bottom of the pasteboard box. Use this method on each tube prong a couple of times to remove all of the solder. After the excess solder has been removed, pull the connecting wires out of the tube base area. You may have to break the glass in several pieces to remove some stubborn connections. Clean out the excess glass cement with a pocket knife and place the tube base with the glass envelope for safe keeping.

**Tube Base Construction.** Cut four pieces three inches long, of number 14 or smaller copper wire. These four support wires will become tie-in circuit and mounting supports for the small components. You may use any stiff wire for these supports as long as the wire itself can be soldered. Number 14 copper wire will just fit inside the tube pins and solder should be fed up from the bottom terminal. Also, you may solder the wire supports from the top side, down inside the tube base. Place support wires in terminals 1, 2, 6 and 8. Look at the bottom of the bakelite socket and start with Pin #1, to the
left of the center pin. (Although the tube locator pin is broken off you still can see where it was located.)

After all support wires are soldered into position, clean excess solder from each wire with a pocket knife. Scrape off rosin and excess solder down inside the base, next to the support wires.

Place a 6-32 3/4 inch machine screw and washer in the center hole of the tube socket. Slip a nut on the outside of the screw to hold it in position until the socket can be bolted to the wooden base. Temporarily, slip the glass envelope over the support wires to see if they will clear the top area. You may use longer support wires if the glass envelope is a lot longer in length. This may help string out the parts and keep them from shorting against each other. A cut glass envelope from a 5U4GT tube runs about three inches long.

A tube’s pin terminal connections (bottom view) are shown. Remember the tie-wire supports are reversed when the tube socket is upright. Scratch a line straight up from the tube locator pin, along the side of the socket, with a pocket knife. Now place a piece of masking tape around it and mark the support wires. You can now solder to your heart’s desire. The four supports will be used for component tie points and they are marked upon the sche-

![Diagram of a tube socket with pin terminals and wiring connections.]

The photo cells are mounted on two sides of the frame. The loop stick fits next in the middle of all the components. The transistors are in the base of the tube. Wire support number 8 is used only as a wiring tie-point for the small components. All other support terminals will be tied into the circuit after the tube socket is bolted to the wooden base.

The only wood work needed is to make two large holes in the base. One for the tube and one for the tuning capacitor. A bolt through the base hole holds the tube in place.

**Wiring in the Parts.** Mount the antenna coil (L1) in the center of the support wires since it is the largest component. Solder the top wire to pin 2 and the bottom terminal to pin 1. Leave it loose until all parts are soldered and then you can dab of silicone cement to hold it in place. Solder the collector terminal of Q1 and negative terminal of C2 to support wire number 2. Keep the leads fairly short and place a pair of long nose pliers next to the transistor body as a heat sink. The emitter terminals from each transistor will tie to terminal support number 1. Now solder in all small components to their correct support wire terminals. Place a piece of spaghetti over the collector wire of Q2 and solder into pin terminal 4, if it is long enough. If not, lengthen the terminal wire with a piece of hookup wire. Connect the small diode between the coil tap (L1) and the base terminal of Q1. Slip a piece of spaghetti over the wiring to prevent touching of other components.

Mount the solar cells last—inside the tube area. Be careful to observe correct wire polarity. The positive terminal will solder to terminal 1 and the negative wire to 6. After all wiring has been completed inside the tube socket, double check each component and tie wire before bolting to the wooden base. Now tack the antenna coil (L1) and solar cell into position with a dab of silicone cement.

**Base Layout.** You may pick up a wooden base mounting plate at any novelty or hobby store. Ours was 6¼ by 4½ and cost 99 cents. They may come in many sizes and shapes with a higher or lower price tag. Mark the parts layout on the bottom side of the wooden base. The tube socket may be mounted 1½” from the rear and in the center of the base plate. Place a

(Continued on page 94)
in search of New Edisons

Thomas Alva Edison was one of a kind, and the hero of every kid of the 1930s who made rotten-egg smells, and burned holes in his bedroom curtains with a chemistry set. All over the country, knee-pants test tube shakers dreamed of one day making great scientific discoveries for the betterment of mankind. And indeed some of them did just that, as witness the development of laser technology, plastics, television, and computer science, to mention but a few of the more obvious examples. Scientific progress continues to be made, of course, but something is clearly missing. It's the unique kind of inspired motivation that characterized Edison and other scientific greats of the past.

A year-long "Centennial of Light," an international celebration to commemorate the 100th anniversary of Thomas Edison's invention of the incandescent electric light bulb on October 21, 1879, has a second and equally important purpose: To inspire the youth of today and of the future in the belief that there are solutions to many of today's global problems. The solutions need only to be sought and found, through scientific developments as well as through social, political, and economic advances.

Thomas Edison, a highly principled inventor-businessman, is the ideal inspirational symbol. As Robert I. Smith, chairman of Public Service Electric and Gas Company, and head of the International Committee for the Centennial of Light paraphrases an Edison biography, "Although Edison led no armies, conquered no countries, enslaved no people, his life and his inventions have influenced the course of history more than any other person in recorded civilization."

The light bulb was but one of more than 1,000 inventions patented by Edison. Other outstanding inventions included: An entire system of electric generation and distribution, the phonograph, the motion picture camera, and equipment that made telephone and telegraph systems commercially practicable. Edison's scientific genius had direct bearing, long after his death, on the development of the modern electronics world as we know it, including invention of radio, television, and modern cinematography.

The Centennial of Light, kicked off in September 1978, will go on throughout 1979. Major elements of the planning are designed to attract students and educators. For example, symposiums will bring selected high school students and teachers to Florida's Disneyworld in February, and university students and professors will go to San Francisco in April.

Science Fairs will be encouraged in elementary and high schools throughout the country. Educational materials and scholarship programs will emphasize the need to encourage young people to pursue scientific knowledge. Other plans in the works include: The showing of special films, television, and radio programs, traveling exhibits, displays and lectures, and even parades.

Among those already planning special programs, events and activities for the Centennial are: The American Association for the Advancement of Science, the Smithsonian Institution of History and Technology, the United States Park Service, the Edison National Historic Site in West Orange, N.J. (the site of Edison's research laboratory), Menlo Park, New Jersey, the city in which Edison conducted his successful experiments with the incandescent lamp, the New Jersey Histori-
The celebration of the centennial of electric illumination will recall Edison's light and hopefully shed some on the process of invention for the youth of today

by Jorma Hyypia

U.S. Department of the Interior, Edison National Historic Site.

Edison's 1889 Strip Kinetograph, the first motion picture camera using strip film. Note that the film moved horizontally 20-40 fps.

An engraving made by J. J. Cade after the photograph taken of Edison and his phonograph by the famous Matthew Brady. This model used foil as recording medium.

nities watching the second invention of the light bulb included: Herbert Hoover, Madame Curie, George Eastman, Harvey Firestone and Cyrus Eaton.

Another center of activity will be West Orange, New Jersey, where Edison lived and worked for many years. The National Park Service now maintains and conducts tours through the laboratory buildings and through Glenmont, Edison's home. Plans call for a series of special celebrations, complete with invited dignitaries.

Many U.S. and overseas electronics corporations will celebrate the Centennial of Light and Thomas Edison. This is rightly so, because these companies represent the breadth of activities with which the inventor was involved. Each organization grew, one way or another, from the work of this man, his patents, his improvements, his methods of scientific inquiry, and his formulation of modern day research. The list of corporations reads like an electronics industry Who's Who and includes such household names as: American Telephone and Telegraph, Allis-Chalmers, General Electric, GTE Sylvania, RCA, Westinghouse Electric, many well-known electric power companies, and even the Japan Atomic Energy Commission.

Is it possible for a man or woman having Edison-like inventive genius to make his or her mark these days as an independent thinker and doer? Or does the pace and sophistication (equate that with high cost) of modern research demand that scientific brains congregate in corporate laboratories, or find refuge in university laboratories, there to plead for research grants year in and year out? Is it possible to be a truly "free" inventor, and still survive? In short, would a latter-day Edison be an anachronism in modern society?

The issues could be debated endlessly, and this is not the place to start. I might make this one personal observation. Many years ago, when I left a plush chemical research laboratory (rife with intra-company politics) to work in a far more primitive laboratory in a smaller company, I received this sage counsel from a more experienced researcher: "A good scientist can do good work anywhere, even in a garage." And perhaps even the reverse is true today: "A mediocre scientist, not approaching being a genius, can succeed in a glamorous corporate research environment."
IT'S SIMPLY BASIC

Use this low-memory inventory to keep track of your music
by Larry Friedman, WB2AHI

In last issue's program Inventory we showed how a disk system is used for massive data storage and fast retrieval. The program is typical of its kind for single-drive disk systems in that all the data from the disk is taken into the computer's memory, manipulated, and processed, and then the new "data file" is transmitted back to the disk. While this arrangement allows for data updating and selective error correction it requires relatively enormous computer memory (RAM), even when using a disk system which requires no additional memory for its own operating system (such as the PerCom LFD-400).

Less RAM. Now many of us computer hobbyists can't afford the amount of memory normally required by a disk inventory program. But, if we eliminate both selective error correction and deletion of unwanted data we can sharply reduce the amount of RAM required for data handling.

In fact, this month's program, Music Library, requires only enough RAM to process six data variables and the error correction loop. The whole bit (pun intended), including the program itself can be shoehorned into 4K of RAM.

Music Library will keep track of your records and tapes, and allow you to easily locate a long-lost treasure. Designed for SWTPCo version 2.0 BASIC in conjunction with the basic PerCom LFD-400 disk system, Music Library will run in about 4K of memory, and one single diskette will accommodate about 7000 individual entries, or in excess of 2300 complete entries consisting of artist, album (or tape) and song. The exact number will be determined by the length of each individual entry.

Updating. Once you have selected the starting disk sector (line 0115), the program will automatically and continuously write your data entries onto the disk. This is accomplished at line 1080. The Update command automatically locates the end of your previous data and simply adds on the new data without requiring any additional memory in the computer. This is because the program does not use an array table (large list of variables, which takes large quantities of RAM).

To keep the program reasonably short it does not provide for removal of an entry (this requires a considerable amount of RAM). But, it does have Error-Correction which should you make a mistake while entering data. The Error Correction system is intermingled with the start mode (lines 1000-1090). It is somewhat unusual in that it employs the "negative reaction" technique, meaning it won't write to the disk until you confirm there is no error by typing the word "error." (Yes, it is difficult to follow on the first five read-throughs.)

On a program run the computer will only output the information that it has, it won't fill with blank spaces by attempting to print information it doesn't have stored on the disk. (See lines 2050, 2055.)

If you utilize this program on a different computer system make certain the fundamental BASIC "conditional GoTo command" (IF-THEN) is tailored for your system. For example, in line 4030 the statement reads IF C$= NS Z=1. Your computer might require the statement to read IF C$=N$ THEN Z=1. (This byte-saving type of statement has been used throughout the program. Multiple statement lines have also been used to save RAM.)

The program can be easily modified to personalize the system for your particular needs.

MUSIC LIBRARY

000 REM "MUSIC LIBRARY" by Larry Friedman
010 REM FOR ELEMENTARY ELECTRONICS MAGAZINE
020 REM
030 REM WRITTEN FOR SWTP 8K BASIC VERSION 2.0
040 REM AND PERCOM LFD-400 DISK SYSTEM
050 REM
060 REM ----------------------------------------------
070 REM INPUT "NEED INSTRUCTIONS? (Y/N) " IS IF IS='Y' THEN 210
080 REM INPUT "SECTOR START" C
090 REM #10 DENOTES THE FILE NAME USED FOR THE PERCOM DISK SYSTEM
100 OPEN #10,C
110 DATA START,ARTIST,ALBUM,SONG,LIST,UPDATE

4057 PRINT "ALBUM":105
4058 ITO 4020
4070 IF Z=1 THEN 150
4080 PRINT "NO SONG UNDER NAME":NS:GOTO 150
5000 RESTORE #10
5020 PRINT "ARTIST":TAB(0);"ALBUM";TAB(36);"SONG"
5030 READ #10:AS:BS:CS
5040 PRINT AS:TAB(16):BS:TAB(36):CS
5050 GOTO 5030
6000 READ #10:AS:BS:CS
6010 CTO 4020
9999 END

READY
SAMPLE RUN OF "MUSIC LIBRARY" SHOWING TYPICAL DATA ENTRIES

READY
#RUN
NEED INSTRUCTIONS? (Y/N) Y

COMMAND FUNCTION
--- ---
START TO ENTER INITIAL DATA ENTRIES
ARTIST TO LOCATE ALBUM AND SONG BY ARTIST
ALBUM TO LOCATE ARTIST BY ALBUM
SONG TO LOCATE ARTIST AND ALBUM BY SONG
LIST FOR COMPLETE LISTING OF ALL FILES
UPDATE TO ADD TO LIST (SEE 'START')
EXIT TO LEAVE PROGRAM

COMMAND START

ENTER ARTIST, ALBUM, AND SONG:
TYPE 'LEAVE' TO EXIT 'START' MODE

ARTIST? TOMMY DORSEY
ALBUM? BIG BAND
SONG? TREES

ARTIST? TOMMY DORSEY
ALBUM? BIG BAND
SONG? MARIE

ARTIST? LED ZEPPELIN
ALBUM?
SONG?

ARTIST? STEVE MILLER
ALBUM?
SONG?

ARTIST? ERROR

ARTIST? STEVE MILLER
ALBUM: BOOK OF DREAMS
SONG?

ARTIST? STEVE MILLER
ALBUM?
SONG: JET AIRLINER

ARTIST? LEAVE

COMMAND LIST

ARTIST ALBUM SONG
TOMMY DORSEY BIG BAND TREES

(Continued on page 86)

Programs are written in SWTP type 2.0 8K BASIC, and might require some modification for use with other BASIC interpreters. Programs for this column are checked and debugged using a SWTP 6800 computer with 12K memory, a Micro-Term ACT-1 CRT terminal, an ASR 33 TTY, and a National Multiplex CC8 recorder. Printout will fit single line TTY or two lines on most CRT terminals.
ever had the annoying experience of having the car in front of yours on the highway begin to kick up dirty water on your windshield, and when you went for the washer button, nothing happened? Well, chin up, bunkie, the Washer Watcher is just for you. It not only warns you when the tank is empty, it warns you when you’re nearing refill time, before it’s too late. This handy device can also be an engine saver for those of you who have water-injected turbocharger setups on your car.

The heart of the unit is National Semiconductor’s LM1830 fluid detector, which responds to the conductivity of fluids across its probe leads.

**How It Works.** The LM1830 generates an AC oscillator signal (in order to prevent electrolytic coating of the probes, thereby reducing their efficiency) which is coupled to the probes by a 0.05-µF capacitor. When the conductive fluid in the tank reaches a low enough level, the resistance between the probes rises past the 13,000-ohm reference level (set internally within the IC), and the oscillator signal is coupled to the amplifier segment of the IC. The amplified 6,000 Hz signal is then fed to an LED which indicates the low fluid condition.

**Construction.** The circuit can be assembled quickly and easily on solderless breadboard stock. We used Continental Specialties Corp.’s Experimenter 350. Component layout is not critical, but you can use the layout shown in the photograph if you’re not feeling terribly creative.

The probe assembly in our model was made by drilling three holes in a triangular pattern in a large rubber stopper. After doing this, insert the metal probes (we used knitting needles). Measure the diameter of the narrow end of the stopper, and then cut a hole in the top of the fluid reservoir just slightly larger than the stopper’s narrowest diameter, thus allowing a snug fit. Solder a wire to each probe, and connect them to the appropriate pins on the IC. Do not cement the probes into position on the stopper yet, because you still have to calibrate.

**Calibration and Operation.** The longest probe, which connects to a ground anywhere in the engine compartment that’s handy, should be pushed down through the stopper so that it’s just touching the bottom of the reservoir.

The “refill” probe may be inserted to any length, depending upon how much margin you wish to have between the first and last warnings.

Remember, water varies from area to area, and the type of solvent you use in your washer reservoir, and the resulting mixture, can affect the calibration. Before you cement the probes and stopper in place, check the operation of the unit by referencing the warning lights with visual observations. Try to keep the solvent/water mixture the same each time you refill, in order to keep the unit calibrated.

When you’re satisfied with the unit’s calibration, cement the probes into the stopper, both on the top and bottom, and then cement the stopper into the hole in the reservoir. Silicon bath tub sealer should do the job very nicely. The next time you take a trip, let the Washer Watcher take some of the grief out of driving for you.
Some timely topics for the old time radio fan

by James A. Fred

Within the past few weeks I have received letters from two collectors who have found cathedral radio cabinets in near mint condition, but the radio chassis were missing. Now this seems strange to me because all the cathedral radios I've found that needed restoration had decorative cabinets. The speaker grill and grill cloth are the most likely items to be damaged. There is usually veneer coming off in several places. I even have a radio whose front has come loose from the sides. To get back to the letters it seems like a good idea to set up a system to find chassis for these cabinets. The Philco cabinet had no model number, but from the drawing he sent I believe it to be a model 33B or an 84B. The only information I have on the Sears cabinet is that it is Beehive or Cathedral shaped. If any reader has a chassis or speaker to fit either cabinet and he writes to me in care of ELEMENTARY ELECTRONICS magazine I will pass the information on to the cabinet owners.

I just received word that Antique Radio Press will no longer publish Antique Radio Topics. After January 1, 1979 it will be published by Puett Electronics, P.O. Box 28572, Dallas TX 75228. If you are interested in subscribing or want a sample copy write to Puett Electronics.

Parts for Sale. Antique Radio Parts, P.O. Box 42, Rossville, IN 46065 will publish two antique radio parts catalogs in 1979. The catalog will list tubes, parts, and services available to collectors of old radios and wireless equipment. To receive both catalogs send 25¢ in coin plus two long; self-addressed envelopes to the above address. If you live outside the United States send International reply coupons or 40¢ U.S. coins. The Postal Service will not accept envelopes for mailing back to them with foreign stamps. I know because I have received stamped, self-addressed envelopes from both Canada and Mexico and have been unable to use them. Another problem I have is receiving letters with requests for help that do not contain return postage. This is especially true with requests from foreign countries. Airmail in most cases costs 31¢ per 1/2 ounce. International reply coupons can be purchased in First Class Post Offices, also International Money Orders. These two items can be used to send funds to any country that is a member of the International Postal Union.

African Antique. Some time ago I received an interesting story and a photo for a round, metal table model radio from Ken Greenberg of Skokie, IL. The radio shown in one of the photos was purchased in the early 1950's. It was made by the Berec Battery Export Company in London, England for use in Africa. It was primarily used in Rhodesia and was sold to the natives for a small sum of money in an attempt to educate them via radio.

Mr. Greenberg's radio covers the medium and shortwave bands and operates on a power pack consisting of 1.5- and 90-volt batteries. It is a very rugged, moisture proofed radio that played surprisingly well when its attached wire antenna was extended. The radio uses a 1R5, 1S5, 1T4, and a 354 tube. It has a two-speed vernier dial drive. The cabinet is deep drawn from aluminum.

Radio/ Phonographs. There seems to be a group of collectors who are looking for the radio/ phonographs that were made between 1926 and 1931. Most collectors don't have room for these large console radios so the price hasn't shot up as has the older, smaller battery operated radios. I received a letter recently from a collector who is looking for several of these old radio/ phonographs. I was surprised to learn that one model of RCA had a Radiola model 17 radio along with a wind-up, 78 RPM, single play turntable in a highboy console cabinet. Likewise Wells-Gardner built a radio/phonograph for Lyon & Healy (a large, Chicago music store) that had an AC operated radio in a lowboy phonograph cabinet with a hand-wound record turntable. The above named radio phonos all had electric pickups to recover the sound from the records. I recall a Majestic highboy that had both an electric/turntable and an electric pick-up. This set was the model that used a five gang tuning capacitor and used type 26s, 27s, 45s and a "B" supply setting in the bottom of the cabinet. For a future column I'll try to find some photographs and more information on these early radio/ phonograph combinations.

An Old Acquaintance. One of the oldest names in radio may disappear from the scene this year. In the latter part of 1978 Dart Industries purchased the stock of the P. R. Mallory and Co., Inc., Dart Industries was especially interested in the battery division. The Duracell has found wide acceptance among the consumers of America. P. R. Mallory started the company in 1916, the year in which I was born. In 1929 it moved to Indianapolis, IN and a major thrust was made into the radio parts replacement market. Major lines were capacitors, resistors, volume controls, vibrators, battery chargers, telephone plugs and jacks, auto radio.

This is the heavy duty, battery powered round radio (referred to in the text) that was made for use in Rhodesia in the '50s.
power supplies, and some years later became a major battery manufacturer. I started my first radio repair shop in 1935 and for many years used Mallory parts exclusively. I remember when the Delco Radio Division of General Motors Corp. was buying 10,000 Mallory vibrators per day to keep Delco auto radio lines operating.

In recent years Mallory Distributor Products Company has been selling semi-conductors, security alarm systems, recording tape, and other modern products as well as their more traditional lines of replacement parts. Only time will tell if the Mallory name survives in the future of electronics.

New English Magazine. A new magazine titled Sounds Vintage is being published in Great Britain. Sounds Vintage is published bi-monthly and is written expressly for those persons interested in wireless and vintage sound. Among the areas covered are vintage wireless equipment, gramophones and cylinder players, disc record players, vintage amplifiers, and pre-war literature. In the future there will be stories of wireless pioneers, and of companies involved in the manufacture of radio and wireless equipment.

The price will be £6.80 U.K. (English Pounds—send an International Money Order), postage paid by air mail, for a one year subscription of 6 copies. Write to: Sounds Vintage, 28 Chestwood Close, Billericay, Essex, England.

More On Test Equipment. Many antique radio collectors neglect one of the most interesting facets of the hobby. These items are electrical meters and test equipment. I first became interested in radio in 1931 and have earned a living since 1935 in the radio-electronic field. I have always been interested in electrical meters and have built most kinds of simple test instruments. I built my first VOM (Volt-Ohm Meter) in 1934 and my first tube tester in 1935. Since then I've built capacitor testers, signal generators, VTVM's (Vacuum Tube Voltmeters) oscilloscopes, etc. I have built from scratch and from kits of parts, i.e., Heathkits and EICO kits.

Most collectors aren't interested in test equipment either, because it is too expensive, or they aren't interested in electronic repairing of their own equipment. At the ARCA conference in King of Prussia, PA several collectors had test equipment for sale at very reasonable prices. I saw several tube testers made in the early 30's. These testers would check 201A's, 199's, etc., which all collectors use. There were also individual test meters priced as low as 50¢ each which still worked well and only needed cosmetic repairs. In my stock I probably have more than 350 meters ranging in age from the 1920's to the 1960's. If you are interested the old brands to look for are Hoyt Jewell, Weston, Sterling, Beede, and Readrite. These meters were the more popular ones made for radio use. Other meters made for electrical and automotive use were Roller-Smith, Westinghouse, General Electric, and Splitdorf. The above named meters are the ones to look for in flea markets and garage sales.

Another group of meters were called pocket meters, or "Watch Case" meters and were intended for home use. This type meter was usually 2½ inches in diameter by a half-inch thick. The case was brass, nickel plated, and if the meter had only one range it would have one short lead wire and a pointed contact on the case. Most Watch Case meters were made to test filament and "B" batteries used with the 1920's battery radios. I know of several collectors who collect the brass, nickel plated meters. You can usually find these too at flea markets and garage sales.

A reprint of the Radiola III instruction booklet is now available along with the Radiola IIIA booklet that has been on sale for some time. You can get either booklet for $2.00 postpaid from Antique Radio Press, P.O. Box 42, Rossville, IN 46065.

Safeguarding Your Collection. I want to emphasize one more time the importance of having a complete list of all your antique radio equipment put into a safe place (not in your home). I recommend a safety deposit box in a bank or similar institution. I have written on this subject before, but apparently most collectors don't want to do this. Periodically I hear or read about a collector who was "ripped off" by a thief.

The latest happening I have heard about took place on the west coast. There is a collector out there who had 13,000 vacuum tubes. There were many tubes made between 1920 and 1930, some were made before 1920, and thousands were made after 1930. Fortunately he had the foresight to call in a prominent west coast antique radio appraiser who had seen the tubes and other collectibles the man had and had filed the proper paper work to prove these tubes existed. The collector was insured and his monthly premium was quite a lot of money. The insurance investigator was unhappy, as were the local police because the collector had promised to install a burglar alarm, but hadn't done so. After the insurance company investigator interviewed the appraiser by telephone the claim was approved to be paid.

(Continued on page 92)
For something like two years computerized CB transceivers have been the big talk at equipment shows. The trouble is, that's just what its all been—talk. Why, the last time I looked and listened it was one of the heavies in the computer and calculator marketplace that was going to turn CB on its ear with a computerized CB. With the notable exception of SBE's excellent Key/Com 1000 (you can read about it in this issue's CB XCVR Checkout), which was developed from their model 55 marine VHF transceiver, the traditional CB manufacturers have ignored computer control for CB sets. With all the developments in VHF/UHF scanners you'd think some of the technology would rub off on some of the other CB biggies, but up to now it hasn't. Now, however, SBE has some heavy competition in the field—the Pace 8117 by Pathcom. A real honest-to-goodness computerized CB transceiver.

The Pace 8117 is basically a base station with provision for operation off a 13.8-VDC power source (the DC cable is not supplied). The rig features the usual 40-channel coverage, PA and remote speaker jacks, an LED digital channel display, S/RF-output meter, RF gain control, Delta tuning, and the computer.

The Computer. The computer is programmed by a 4 by 3 (12 position) touch pad such as you would find on a touch-tone telephone. Ten of the buttons are dual function—numerals and commands—so there are effectively twenty-two operating keys which program the computer.

The instant power is applied the computer tunes the rig to channel 19. If you want to change channels there are fast and slow up/down selectors that step through each channel. If you want to go directly to a particular channel you can do that too. Now, none of these features really requires an on-board microprocessor; they simply come with the computer, which provides a user-selected 10-channel scan mode, a continuous scan of all 40-channels without stop, a 40-channel scan and latch onto either a busy (BZ) or clear (CLR) channel, and a programmable monitor that allows you to receive on one channel and monitor another on a sampling for one-half second every 10-seconds.

Two front panel switches determine what happens when the computerized scan or monitor finds what you're looking for. One switch, labeled BZ and CLR, determines whether a scan stops on a busy or clear channel. A switch labeled CSS provides a continuous 40-channel scan without a stop. If the scan stops (latches) to a channel in the BZ or CLR mode it remains on that channel until the user resumes scanning by pressing the appropriate pad button.

Programmed Scan. Here's how you might utilize the computer. Assume you have four active "assistance" channels in your area: 9, 10, 11, and 19. You could program only these channels into the 10-channel memory and the computer would scan only these four channels, stopping on the first one to become active. If you had to shift immediately to channel 9, let's assume you have just received an emergency call on 19, you could do it by simply pressing the 9 EMR (9 emergency) pad button. You can start, stop, or resume the scan (Continued on page 88)
Elementary Electronics has been able to obtain some of the latest 40-channel CB transceivers for review, and presents the test reports here. These units are not prototypes, but are “stock standard,” the same as the transceivers that you can buy over the counter. If you don’t find the particular unit you are interested in reported on here, check for the 1979 edition of CB Buyers Guide, soon to be on the newstands.

DAK MARK V
$119.95 (M. H. Scott)
General Description: A 40-channel AM transceiver for mobile and P.A. operation. Delta fine tuning ±2.5 kHz is provided. Power supply is 12 to 13.8 VDC with negative or positive ground. Overall dimensions are 23/4-in. H x 7⅛-in. W x 9-in. D.

Receiver Section Test:
- Input sensitivity: 0.4 μV
- Adjacent channel rejection: 56 dB
- AGC action: 7 dB
- Input level for 59 meter indication: 40 μV

Transmitter Section Test:
- AM RF output: 3.8 watts
- Modulation to 85%: yes
- Relative sensitivity for 85% mod.: -43 dB
- Modulation limited to 100%: yes

Editorial Remarks: The Mark V has a 6 dB per unit S-meter, double conversion, jacks for P.A. and remote speakers, L.E.D. digital channel indicator S/RF-output meter.

GENERAL ELECTRIC 3-5875
$469.95 (General Electric)
General Description: A 40-channel AM/SSB transceiver for mobile, P.A., base operation. Fine tuning ±2.2 kHz is provided. Power supply is 12 to 13.8 VDC with negative or positive ground. Overall dimensions are 2⅛-in. H x 7⅛-in. W x 9-in. D.

Receiver Section Test:
- Input sensitivity: 0.4 μV
- Adjacent channel rejection: 57 dB
- AGC action: 9 dB
- Input level for 59 meter indication: 50 μV
- Input level for 59 meter indication: 50 μV

Transmitter Section Test:
- AM RF output: 3.5 watts
- SSB RF output: 11.5 watts P.E.P.
- Modulation to 85%: yes
- Relative sensitivity for 85% mod.: -30 to -45 dB
- Modulation limited to 100%: yes


MOTOROLA CB-555
$409.95 (Motorola, Inc.)
General Description: A 40-channel AM/SSB transceiver for mobile, P.A. base operation. Fine tuning ±1.1 kHz is provided. Power supply is 12 to 13.8 VDC with negative or positive ground and 120 VAC. Features L.E.D. digital clock that works on AC only. Overall dimensions are 4-7/16-in. H x 1⅛-in. W x 11-in. D. There are front panel controls for: channel selection, volume, squelch, RF gain, and Delta tune. Switches for: PA/CB, Noise blanker, ANL, channel indicator dimmer; and tone. Standard accessories include a microphone, mobile mount, DC power cord.

Receiver Section Test:
- Input sensitivity: 0.4 μV
- Adjacent channel rejection: 57 dB
- AGC action: 9 dB
- SSB opposite sideband rejection: 50+ dB
- Input level for 59 meter indication: 50 μV

(Continued from page 94)
**Tell a computer how to tell itself what to do**

Figure 1

The important internal components of the 8080 central processing unit (CPU) are shown in this block diagram. The data is transferred along the wide lines according to the instruction in the instruction register. The clock keeps it all in perfect timing.

Going to the third address in line, the CPU may find a similar instruction which tells it to take the contents of the fourth location and store them in another CPU register. At this point, the CPU has two different numbers stored in two of its internal registers. The next instruction the central processor sees may be a command to add these two numbers together, that is, to add the contents of one register to the contents of another. The final instruction might then tell the CPU to take this result and store it in another specified location in computer memory, or to output it to an output port where it could be read by a terminal device.

Our simple example has shown that a computer program consists of two things: instructions to the CPU to perform certain operations, and data, or information that the CPU needs to carry out these instructions. The latter may come in various forms and we will discuss only a few of them here.

**Architecture.** Looking into the CPU, that microscopic silicon wonder, we find that it contains a number of distinct internal components. The ones we will discuss here are the registers, the program counter and the controller. The number, size and arrangement of these internal components is known as the CPU's architecture. For the purposes of this article, we will refer to the architecture of the popular 8080 8-bit microprocessor.

Since the length of a data word for the 8080 is 8 bits, or one byte, each internal register will be able to store one byte. Two exceptions to this are a couple of specialized registers called the stack pointer and the program counter. These registers must store memory address information, and since addresses in the 8080 can be up to 16 bits in length, these two registers must be able to store two bytes.

We will not discuss the stack pointer at this time, but the program counter will be of central importance. You will notice I listed the program counter as a CPU component in its own right because of its importance, but it is really a specialized register.

Let us imagine our simplified 8080 as illustrated in figure 1. We see the different registers with connections between some of them so that data can be easily transferred among them. Also illustrated is the controller with the clock input. Other CPU components include the arithmetic logic unit, the address buffer, and the instruction decoder.

What makes the whole thing go? That is the function of the system clock, which is usually connected externally to the CPU. It is a crystal oscillator.
When writing programs such as these in machine language, the individual CPU's architecture is a major consideration. The nature of the machine's instruction set is based upon its architecture, and in order to program for a different CPU, a different instruction set must be learned. High level languages like BASIC and PASCAL allow us to communicate in English-like statements of the problem. The interpreter or compiler translates the program into machine instructions the CPU can understand.

For our purposes, let us assume that our addition program has either been entered in machine language by a programmer or been translated by a compiler. At any rate, it now resides in memory as absolute machine code—the stuff our CPU can digest. Also, for our purposes, we will not use a terminal (input/output can really get complicated) and assume that the two numbers to be added are contained in the program.

**Instruction.** While there are perhaps more elegant and efficient ways to write this program, it will serve to illustrate some of the things the computer does. To the CPU, our program would look like this:

<table>
<thead>
<tr>
<th>Opcode</th>
<th>Operand</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>LXI H</td>
<td>200 040</td>
<td>Put address in H &amp; L</td>
</tr>
<tr>
<td>MVI B</td>
<td>005</td>
<td>Put &amp; in register B</td>
</tr>
<tr>
<td>MVI A</td>
<td>002</td>
<td>Put 2 in register A</td>
</tr>
<tr>
<td>ADD B</td>
<td></td>
<td>Add B to A</td>
</tr>
<tr>
<td>MOVMA</td>
<td></td>
<td>Put A into memory location</td>
</tr>
<tr>
<td>HLT</td>
<td></td>
<td>Halt</td>
</tr>
</tbody>
</table>

This is an assembler source code listing for our addition program. The assembler reads the letters and numbers and then translates them into binary numbers.

**Operation.** Let us now perform an actual addition of two numbers while examining what is taking place inside the CPU. To do this, it will be necessary to have an addition program contained in the computer's memory. As mentioned above, such a program will consist of instructions and data. The instructions are binary codes that cause the CPU to perform certain operations on the data. There is a limited number of instructions any given CPU can perform, and the list of these instructions is known as the instruction set for that CPU.

A computer program is a list of appropriate instructions, also known as opcodes, and their operands, or data the CPU needs to carry out the instructions, stored in an orderly manner in memory.

To execute the program, the program counter goes to the address of each instruction in turn, loads that instruction into the instruction register, and then goes to the address of the next instruction. The instruction in the instruction register is decoded by the instruction decoder and executed and the process is repeated until a programmer's error is encountered and the machine gets confused.

Figure 2

![Diagram of computer components](image)

**Assembler Source Listing**

<table>
<thead>
<tr>
<th>Opcode</th>
<th>Operand</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>LXI H</td>
<td>200 040</td>
<td>Put address in H &amp; L</td>
</tr>
<tr>
<td>MVI B</td>
<td>005</td>
<td>Put &amp; in register B</td>
</tr>
<tr>
<td>MVI A</td>
<td>002</td>
<td>Put 2 in register A</td>
</tr>
<tr>
<td>ADD B</td>
<td></td>
<td>Add B to A</td>
</tr>
<tr>
<td>MOVMA</td>
<td></td>
<td>Put A into memory location</td>
</tr>
<tr>
<td>HLT</td>
<td></td>
<td>Halt</td>
</tr>
</tbody>
</table>

This is, of course, incomprehensible to a human reader, especially since practical programs are many hundreds of times longer than this. For this reason, those bytes which are instructions and not data can be described by humans with short abbreviations called mnemonics. Mnemonics apply only to instructions in the instruction set and numeric data must be represented for humans by another form of notation than binary, usually octal (base 8) or hexadecimal (base 16). We won't discuss these here, however, and I will use decimal notation to indicate numbers the computer must deal with.

Remember that each 8-bit byte of code above resides in a separate location in memory and that each such location is specified by a unique address. For the 8080, addresses can be numbered from 0 to 65,535 decimal.

If we were to translate this program into readable form, we could see that it is telling the CPU to first load the H and L registers with the numbers in the next two memory locations. The first goes into the L register and the second into the H register (this reverse order is an 8080 convention and not true for all CPUs). This number will later be used by the computer to refer to an address elsewhere in memory.

The next instruction (not the next byte) is at address number 4 in our program. It tells the computer to put the following number (here, the number 5) into the B register. The next instruction similarly tells it to put the contents of the next memory location into the A register. At this point in the program, the computer registers look like figure 2. Note that the program counter contains the address of the next instruction to be put into the instruction register.

That instruction is the ADD B instruction that tells the CPU to add the contents of register B to the contents of register A. The result will be the new contents of register A, but the data in register B will not be destroyed.

**Answers.** The question now is what to do with the answer. In our case, we have chosen to store it in a location in

(Continued on page 87)
INTRODUCTION TO THE TRANSISTOR

Using transistors in your projects is easy once you understand how they work. This article will give you the basics of modern transistor theory enabling you to use these tiny dynamos in your construction projects.

THE TRANSISTOR AS A SWITCH

The transistor is undoubtedly the most important modern electronic component. It has made great and profound changes in electronics and in our daily lives since its discovery in 1948.

In this chapter the transistor will be introduced as an electronic component which acts similarly to a simple mechanical switch, since it is actually used as a switch in modern electronic equipment. The transistor can be made to conduct or not conduct, and electric current—which is exactly what a mechanical switch does.

An experiment in this chapter will help you to build a simple one-transistor switching circuit. This circuit can be easily set up on a home workbench, and it will enhance your learning if you obtain the few components required and actually perform the experiment of building and operating the circuit.

From this basic idea we will progress to simple circuits which use several transistors to accomplish the same end. This affords an easy introduction to why the transistor is used, and to how it is used in computers and other modern circuits.

When you complete this chapter you will be able to:
- describe the basic construction of a transistor;
- specify what transistor switching action is;
- differentiate between the two most common types of transistors;
- tell which currents flow through a transistor;
- specify the relationship between base and collector current in a transistor;
- calculate the current gain for a transistor;
- explain how a transistor can be ON or OFF;
- compare the transistor to a simple mechanical switch;
- do simple transistor current calculation.

THE BASIC TRANSISTOR

The diagrams below show several common transistors in use today. For each transistor, the lower diagram shows how the leads are designated and how to identify them in most cases.

QUESTIONS
1. How many leads are there on most transistors?
2. Where are there only two leads, what takes the place of the third lead?
3. What are the three leads or connections called?

ANSWERS
1. Three
2. The case can be used instead, as the diagram on the right. (This is limited to power transistors.)
3. Emitter, base, and collector.

In its simplest form a transistor can be considered as two diodes, connected back to back, as in this drawing.

Which has the thicker P region, the transistor shown above or two diodes connected back to back? Two diodes. The transistor has a very thin P region.

Two separate diodes wired back to back will not behave like a transistor. Why this difference in construction should make the transistor act like a transistor and not like two diodes will not be covered, as this is semiconductor physics and not electronics.
What is the main construction difference between two diodes connected back to back and a transistor?

The very thin P region used in the transistor.

The three terminals of a transistor—the base, the emitter, and the collector—are connected as shown below.

The two diodes are usually called the base-emitter diode, and the base-collector diode.

The symbol used in circuit diagrams for the transistor is shown on the following diagram, with the two diodes and the junctions shown for comparison.

Because of the way the semiconductor materials are arranged, this is known as an NPN transistor. Which transistor terminal has the arrowhead? the emitter.

It is also possible to make transistors with a PNP configuration, as shown below.

Both types, NPN and PNP, are made from either silicon or germanium.

QUESTIONS

4. Draw a circuit symbol for both an NPN and a PNP transistor. (Use a separate sheet of paper for your diagrams.)

5. Which of these might be silicon?

6. Are silicon and germanium ever combined in a transistor? (Hint: What was said about diodes?)

ANSWERS

4. Either or both could be silicon. (Either or both could also be germanium.)

5. Silicon and germanium are never mixed in any semiconductor.

HOW THE CURRENT FLOWS

If a battery is connected as shown below to an NPN transistor, then a current will flow as shown.

This current, flowing through the base-emitter diode, is called base current and is given the symbol \( I_b \).

Would base current flow if the battery were reversed? Base current would not flow as the diode would be back biased.

In the circuit below, the base current can be calculated using ohm's law, where

\[
I = \frac{E}{R}, \quad E = IR, \quad \text{and} \quad R = \frac{E}{I}
\]

Find the base current in this circuit. (Hint: Do not ignore the 0.7 V drop across the base-emitter diode.)

Your calculations should look something like this.

\[
I_b = \frac{(V_s - 0.7) \, V}{R} = \frac{(3 - 0.7) \, V}{1 \, \text{k}\Omega} = 2.3 \, \text{mA}
\]

In the circuit below, as the 10 V battery is much higher than the 0.7 V diode drop, we can consider the base-emitter diode to be a perfect diode, and thus assume the voltage drop is 0 V.

Calculate the base current.

\[
I_b = \frac{(10 - 0) \, V}{1 \, \text{k}\Omega} = 10 \, \text{mA}
\]

Look at the circuit below.

Will current flow in this circuit? Why or why not? It will not flow as the base-collector diode is reverse biased.
Now, we will put both of the circuits together. Note that we have two batteries, one in each of the base and collector circuits.

When both the base and the collector circuits, as in the diagram above, are connected, it demonstrates the outstanding characteristic of the transistor, which is sometimes called transistor action: If base current flows in a transistor, collector current will also flow.

Examine the current paths in the diagram below.

Base current (ib) flows through the base-emitter diode and causes the collector current (ic) to flow through the base-collector diode.

No current flows from the collector to the base, as shown by the dotted line below.

The reason why the collector current takes the path shown in the first of these two diagrams, rather than the dotted line path, is beyond the scope of this book. This is the domain of semiconductor physics and is not needed in electronic circuit design and analysis at this time.

Up to now we have been using the NPN transistor, solely for the purposes of illustration. A PNP transistor could have been used. There is no difference in how the two types work or behave. What is said about one is equally true for the other.

There is, however, one important circuit difference which is illustrated below. This is caused by the fact that the PNP is made with the diodes in the reverse direction from the NPN.

Note how the battery polarity is reversed and the current flows in the opposite directions through the diodes.

The two figures below show the battery connections to produce currents for both circuits. In both diagrams the current flow is counterclockwise.

As stated earlier, there is absolutely no difference between NPN and PNP transistors. Both are used equally in electronic circuits; one is not favored over the other. Base current causes collector current to flow in both. To avoid confusion, the rest of this discussion will be conducted using NPNs only as examples. And from now on, we will use the circuit symbols only.

Consider the action of the circuit below. It uses only one battery to provide the base and the collector current. The path of the base current only is shown in the diagram.

QUESTIONS
7. Name the components through which the base current flows. 
8. Into which terminal of the transistor does the base current flow? 
9. Out of which transistor terminal does the base current flow?  
10. Through which terminals of the transistor does no base current flow? 

ANSWERS
7. the battery, the resistor Rb, and the transistor 
8. base 
9. emitter 
10. collector 

Can you remember the outstanding physical characteristic of the transistor? When base current flows in the preceding circuit, what other current will flow, and which components will it flow through?

Collector current will flow. It will flow through the resistor Rc and the transistor.

The path of the collector current is shown in the diagram below.

QUESTIONS
11. List the components through which the collector current flows. 
12. What causes the collector current to flow? 

ANSWERS
11. the resistor Rc, the transistor, and the battery 
12. base current (Collector current cannot ever flow if
base current is not flowing first.)

It is a peculiar property of the transistor that the ratio of collector current to base current is constant. The collector current is always much larger than the base current. The constant ratio of the two currents is called the current gain of the transistor and it is a number much larger than 1.

Current gain is given the symbol $\beta$, called beta. Typical values of $\beta$ range from 10 to 300. 100 is a good typical value from many transistors, and we will use this number for convenience in our calculations.

**QUESTIONS**

13. What is the ratio of collector current to base current called?

14. What is the symbol used for this?

15. Which is larger — base or collector current?

16. Look back at the circuit before question 7. Will current be greater in $R_B$ or in $R_C$?

**ANSWERS**

13. current gain

14. $\beta$

15. Collector current is larger.

16. The current is greater in $R_C$, since it is the collector current.

The mathematical formula for current gain is as follows.

$$\beta = \frac{I_C}{I_B}$$

where:

$I_B =$ base current    $I_C =$ collector current

From this you can see that if no base current flows, no collector current will flow. And if more base current flows, more collector current will flow. This is what is meant when we say the "base current controls the collector current."

Suppose the base current is 1 mA and the collector current is 150 mA. What is the current gain of the transistor?

$150 = \frac{I_C}{I_B}$

Current gain is a physical property of the transistor. Its value can be taken from the manufacturer's published data sheets or it can be determined experimentally by the user.

In general, $\beta$ is a different number from one transistor type to the next, but it remains constant for a given transistor. Transistors of the same type have $\beta$ values within a narrow range of each other.

One of the most often performed calculations in transistor work is determining the values of either collector or base current, when $\beta$ and the other current are known. For example, suppose a transistor has 500 mA of collector current flowing and it is known to have a $\beta$ value of 100. Find the base current. To do this, use the formula as shown below.

$$\beta = \frac{I_C}{I_B}$$

$$I_B = \frac{I_C}{\beta} = \frac{500}{100} = 5 \text{ mA}$$

Now you do these simple examples.

**QUESTIONS**

17. $I_C = 2 \text{ A}, \beta = 20$. Find $I_B$.

18. $I_B = 1 \text{ mA}, \beta = 100$. Find $I_C$.

19. $I_B = 10 \mu\text{A}, \beta = 250$. Find $I_C$.

20. $I_B = 0.1 \text{ mA}, I_C = 7.5 \text{ mA}$. Find $\beta$.

**ANSWERS**

17. 0.1 A, or 100 mA

18. 100 mA

19. 2500 $\mu$A, or 2.5 mA

20. 75

This set of questions will serve as a summary of the first part of this chapter. You should be able to answer all the questions. Use a separate sheet of paper for your diagram and calculations.

**QUESTIONS**

21. Draw the circuit in frame 13, and show the paths of $I_B$ and $I_C$.

22. Which current controls the other?

23. Which is the larger current, $I_B$ or $I_C$?

24. $I_B = 6 \text{ mA}, \beta = 250$. Find $I_C$.

25. $I_C = 300 \text{ mA}, \beta = 50$. Find $I_B$.

**ANSWERS**

21. Refer to frame 13 to see if the figure is correct.

22. $I_B$ (base current) controls $I_C$ (collector current).

23. $I_C$

24. 1.5 mA

25. 6 mA

**THE TRANSISTOR EXPERIMENT**

The object of the following experiment is to find $\beta$ of a particular transistor by measuring several values of base current with their corresponding values of collector current. These values of collector current will be divided by the values of the base current to obtain $\beta$. The value of $\beta$ will be almost the same for all the measured values of current. This will show that $\beta$ is a constant for a transistor.

As long as the circuit is set up, measure the collector voltage for each current value. This will demonstrate experimentally some points to be made in future frames. Observe how the collector voltage $V_C$ drops toward 0 V as the currents are increased.

If you do not have the facilities for setting up the circuit and measuring the values, just read through the experiment to find out how it would be done. If you do have the facilities, you will need the following equipment and supplies.

1. 9-V transistor radio battery (or a lab power supply)
2. Current meter, maximum reading 100 $\mu$A
3. Voltmeter, maximum reading 10 V
4. Potentiometer box, or a 1 M$\Omega$ potentiometer, or assorted resistors with values in the table
5. $1-k\Omega$ resistor
6. A transistor, preferably NPN.

Almost any small commercially available transistor will do for this experiment. The measurements given in this book were obtained using a 2N3643. If only a PNP is available, then simply reverse the battery voltage and proceed as described.

Finally you will need several clip leads to join the components together. If you have adequate facilities, soldered joints can be used.

Set the up the circuit shown in the figure below.

Follow this procedure.
Did you get a consistent \( \beta \)? Was it close to the manufacturer's specifications for your transistor?

Apply these steps to the circuit above.

26. Determine \( I_c \).
27. Determine the voltage drop across the collector resistor \( R_c \). Call this \( V_r \).
28. Subtract \( V_r \) from the supply voltage to get the collector voltage.

Let us go through the first step together.

26. To find \( I_c \), we must first find \( I_b \).

\[
I_b = \frac{10 \text{ V}}{100 \text{ k}\Omega} = 0.1 \text{ mA}
\]

\[
I_c = \beta \times I_b = 50 \times 0.1 \text{ mA} = 5 \text{ mA}
\]

Now do the next two steps. Use a separate sheet of paper for your calculations.

27. To find \( V_r \):

\[
V_r = R_c \times I_c = 1 \text{ k}\Omega \times 5 \text{ mA} = 5 \text{ V}
\]

28. To find \( V_c \):

\[
V_c = V_s - V_r = 10 \text{ V} - 5 \text{ V} = 5 \text{ V}
\]

Use the same circuit, but use a value \( \beta = 75 \). Again find:

QUESTIONS
29. \( I_c \)
30. \( V_r \)
31. \( V_c \)

ANSWERS
29. \( I_b = \frac{10 \text{ V}}{100 \text{ k}\Omega} = 0.1 \text{ mA}; I_c = 75 \times 0.1 \text{ mA} = 7.5 \text{ mA} \)
30. \( V_r = 1 \text{ k}\Omega \times 7.5 \text{ mA} = 7.5 \text{ V} \)
31. \( V_c = 10 \text{ V} - 7.5 \text{ V} = 2.5 \text{ V} \)

Use the same circuit again, but with these values: \( R_b = 250 \text{ k}\Omega \) and \( \beta = 75 \). Again find:

QUESTIONS
32. \( I_c \)
33. \( V_r \)
34. \( V_c \)

ANSWERS
32. \( I_b = \frac{10 \text{ V}}{250 \text{ k}\Omega} = \frac{1}{25} \text{ mA}; I_c = \frac{75}{25} \times 0.1 \text{ mA} = 3 \text{ mA} \)
33. \( V_r = 1 \text{ k}\Omega \times 3 \text{ mA} = 3 \text{ V} \)
34. \( V_c = 10 \text{ V} - 3 \text{ V} = 7 \text{ V} \)

Write down your values for:
35. \( I_b = \) \[
36. \( I_c = \)
37. \( V_r = \)
38. \( V_c = \)

In the experiment which produced this table, \( \beta = 100 \). You can see this by forming the ratio \( I_c/I_b \) for almost every pair of current values.

For each value of \( I_b \) and its corresponding value of \( I_c \) in the experiment, calculate the value of \( \beta \). The values will vary slightly but will be close to an average. (Excessively low and high values of \( I_b \) may produce values of \( \beta \) which will be quite different. Ignore these for now.)
You should have these values.

35. $I_b = \frac{10\text{V}}{100\text{k}\Omega} = 0.1\text{mA}$

36. $V_r = 1\text{k}\Omega \times 10\text{mA} = 10\text{mA}$

37. $V_c = 10\text{V} - 10\text{V} = 0\text{V}$

Here the base current is just sufficient to produce a collector voltage of 0 V. This is a very important condition with many practical applications. Look at the two drawings below and compare their voltages at the point labeled $V_c$.

Consider a transistor which has sufficient base current and collector current to set its collector voltage to 0 V. Obviously it can be compared to a closed mechanical switch. As the switch is said to be ON, then the transistor is also said to be “turned on” or just ON.

**QUESTIONS**

38. From the above, what can a turned on transistor be compared to?

39. What is the collector voltage of an ON transistor?

**ANSWERS**

38. a closed mechanical switch

39. 0 V

Now compare these two circuit drawings.

Since the base circuit is broken—that is, it is not complete—there is no base current flowing. From the preceding problem you can see that $V_c$ can be set to any desired value by choosing a transistor with an appropriate value of $\beta$, or by choosing the correct value of $R_b$.

Consider now this special example. The object is to find $V_c$. Go through the steps of the previous few examples.

35. $I_b = \frac{10\text{V}}{100\text{k}\Omega} = 0.1\text{mA}$

36. $V_r = 1\text{k}\Omega \times 10\text{mA} = 10\text{mA}$

37. $V_c = 10\text{V} - 10\text{V} = 0\text{V}$

Now work through this example and compare the results to the examples above. Again the object here is to find $V_c$.

43. $I_b = $ 

44. $V_r = $ 

45. $V_c = $

**ANSWERS**

43. $I_b = \frac{10\text{V}}{100\text{k}\Omega} = 0.1\text{mA}$

44. $V_r = 1\text{k}\Omega \times 5\text{mA} = 5\text{mA}$

45. $V_c = 10\text{V} - 5\text{V} = 5\text{V}$

Note the output voltage this time is exactly half the supply voltage. This condition is very important in AC electronics and will be returned to in the AC section.

**SUMMARY**

At this point it is useful to compare the properties of a mechanical switch and a transistor.

<table>
<thead>
<tr>
<th>State</th>
<th>Transistor</th>
<th>Mechanical switch</th>
</tr>
</thead>
<tbody>
<tr>
<td>Open or OFF</td>
<td>No current flow. Full supply flow across collector and emitter.</td>
<td>No current flow. Full supply flow across terminals.</td>
</tr>
<tr>
<td>Closed or ON</td>
<td>Full circuit current flows as collector current. No voltage drop between collector and emitter.</td>
<td>Full circuit or load current flows through the switch. No voltage drop across the switch terminals.</td>
</tr>
</tbody>
</table>

The terms ON and OFF are used in digital electronics to describe the two transistor conditions just encountered. (Continued on page 86)
Lab Test Elementary Electronics For Yourself

In case you’re not at all familiar with us—we’re not a publication for electrical engineers and other wizards. No way.

ELEMENTARY ELECTRONICS is expressly for people who like to build their own projects and gadgets—and maybe get a little knee-deep in tape, solder and wire clippings in the process.

In fact, we have a sneaking suspicion that our readers like us because they think we’re just as bug-eyed and down-right crazy over great new project ideas as they are. And I guess they’re right!

E/E thinks of you who dig electronics as the last of a special breed. It’s more than just the “do-it-yourself” angle—it’s also the spirit of adventure. In this pre-packaged, deodorized world, building your own stereo system, shortwave receiver, darkroom timer or CB outfit is like constructing a fine-tuned little universe all your own. And when it all works perfectly—it really takes you to another world.

ELEMENTARY ELECTRONICS knows the kinds of projects you like—and we bring ’em to you by the truckload!

Ever hanker to build a sharp-looking digital clock radio? Or to hook up an electronic game to your TV? Or an easy-to-build photometer that makes perfect picture enlargements? Or a space-age Lite-Com so you and the family can talk to each other on a light beam? We’ve got it all to get you started.

WHEN IT COMES TO REPAIRS

E/E can save you time, trouble and a pile of money!

Has your sound system gone blooey just when the party’s going great? Do you shudder when your friendly neighborhood electrician hands you the bill? E/E can help.

Of course, we can’t make you a master electrician overnight. But we can show you the fundamentals of repair plus maintenance tips.

IF YOU’RE NEW TO ELECTRONICS YOU GET A “BASIC COURSE”!

That’s right! It’s a regular feature. And it gives you the complete, ground-floor lowdown on a variety of important electronics subjects. For example—


ENJOY GREAT ARTICLES LIKE THESE

• How to Build Your Own Transformer
• How to Select the Right Shortwave Receiver
• The Burgeoning World of Micro-computers
• Quickdraw Rickshaw—The Electric Car that Really Gets Around
• What’s Really Wrong with FM Radio?
• How to Power-Up Your Antique Radio
• The Vanishing Vacuum Tube
• How to Customize Your CB Antenna
• Those Incredible TV Sets of the Future
• Listening in on the Forgotten Continent
• DXing Endangered Species
• Sandbagging—CB Fun Without a License
• The World’s Worst Hi-Fi Components

TRY A FEW ISSUES AND EVALUATE OUR...

► HOW-TO-DO-IT HELP. Tips and pointers that add up to money saved. For example—tuning up your tape player . . . all about radios . . . whys and hows of turntables . . . care and feeding of speakers.

► NO-NONSENSE TESTS. The scoop on Pioneer’s TP-300 FM stereo car radio . . . how well does GE’s NiCad charger pep up your pooped batteries? . . . What’s your best bet in video games? Plus help in making buying decisions.

► EXCITING DISCOVERIES. Whatever your particular interest in electronics, you’ll be entering a world of discovery in the pages of ELEMENTARY ELECTRONICS.

ELEMENTARY ELECTRONICS is regularly $6.95 for 6 issues (one year). But with this special introductory offer you can enjoy a full year for only $3.98.

ORDER TODAY!

...for the excitement and satisfaction of:

“PLUG IN”

Yes, Enter my subscription. Bill me. (Outside U.S.A. and possessions $5.00)

P.O. Box 2630, Greenwich, Conn. 06830

Name: Address: City: State: Zip: Phone:

Please allow 6 to 8 weeks for delivery of your first copy.
Palomar Loop
(Continued from page 56)
ize the Palomar’s nulling. But if you are limited for BCB DXing to a receiver’s built-in loopstick antenna, or a piece of wire lying on the floor or stapled to the moulding, then the Palomar will pay off in almost unbelievable performance: you will actually dig out signals you never knew existed.

The Palomar loop antenna system works best in a frame house; brick and stucco will reduce maximum performance, and it might be necessary to position the antenna near a window facing the direction from which you want to receive signals. Aluminum siding generally acts as an almost total shield if the siding is grounded according to the electrical code, and the loop antenna might not offer any improvement in reception unless located in a window. Our tests in an aluminum-sided home indicated poor reception when the siding totally, surrounded the loop. When there was a discontinuity in the siding, such as a fiberglass or shingle front, good to excellent reception was attained, though nulling in some directions was not sufficiently deep. Further, reception in a basement which was partially below ground, with the siding starting above the basement ceiling—actually 3 feet above ground—was very good.

The equipment at the time this article was prepared—was available directly from Palomar Engineers, Box 455, Escondido, CA 92025. The loop amplifier is priced at $67.50 (less 2% type 9-volt battery). Plug-in loops are priced at $47.50 each. Make certain you specify the BCB antenna for 550-1600 kHz coverage. (Add $2 shipping and handling for U.S. and Canada to total order.) For additional information circle No. 52 on the reader’s service coupon.

Basic Course
(Continued from page 84)
terred, and their similarity to a mechanical switch is made use of in many digital situations. We will not get into the details of digital electronics in this book, beyond examining the simple transistor switch in the next chapter.

SELF-TEST
The questions below will test your understanding of this chapter. Use a separate sheet of paper for your diagrams or calculations. Compare your answers with the answers provided following the test.
1. Draw the symbols for an NPN and PNP transistor. Label the terminals of each.
2. Draw the paths taken by the base and collector currents.
3. What causes the collector current to flow?

Simply Basic
(Continued from page 71)

Tommy Dorsey Big Band Marie Black Dog
Led Zeppelin Book of Dreams
Steve Miller BCB of Dreams Jet Airliner

Command? Artist
Name of Artist? Steve Miller
Album: BCB of Dreams
Sing: Jet Airliner

Command? Album
Album Name? BCB of Dreams
Artist: Tommy Dorsey

Command? Song
Song? Marie
Artist: Tommy Dorsey
Album: Big Band

Command? Exit
Ready

4. What is meant by the term current gain? What symbol is used for this?
5. In the figure in question 2, $R_b = 27 \, \text{k} \Omega$ and $V_S = 3 \, \text{V}$. Find $I_b$.
6. Repeat question 5 with $R_b = 220 \, \text{k} \Omega$ and $V_S = 10 \, \text{V}$. Find $I_b$.
7. Using the same figure, find $V_o$ when $R_b = 100 \, \text{k} \Omega$, $V_S = 10 \, \text{V}$, $R_c = 1 \, \text{k} \Omega$, and $\beta = 50$.
8. Repeat question 7 with these values: $R_b = 200 \, \text{k} \Omega$, $V_S = 10 \, \text{V}$, $R_c = 1 \, \text{k} \Omega$, and $\beta = 50$.
9. Now use these values: $R_b = 47 \, \text{k} \Omega$, $V_S = 10 \, \text{V}$, $R_c = 500 \, \text{ohms}$, and $\beta = 65$.
10. Now use these values: $R_b = 68 \, \text{k} \Omega$, $V_S = 10 \, \text{V}$, $R_c = 820 \, \text{ohms}$, and $\beta = 75$.

Answers to Self-Test
If your answers do not agree with those given below, go back and review the appropriate sections.
1. 
2. 

4. Current gain is the ratio of collector current to base current. It is given the symbol $\beta = I_C/I_B$.
5. $I_b = \frac{(V_S - 0.7)}{R_b} = \frac{(3 \, \text{V} - 0.7 \, \text{V})}{27 \, \text{k} \Omega} = 27 \, \text{k} \Omega \approx 85 \, \mu\text{A}$
6. $I_b = \frac{10 \, \text{V}}{220 \, \text{k} \Omega} = 45.45 \, \mu\text{A}$
7. 5 V
8. 7.73 V
9. 3.1 V
10. 1 V

SHOOTING AHEAD IN ELECTRONICS
If you want to go further in your exploration of transistors, you can order the book from which this article was excerpted, ELECTRONICS, by Harry Kybett. Write to Self-Teaching Guides Department, John Wiley & Sons, Inc., Publishers, 605 Third Avenue, New York, NY 10016. The price is $7.25 postpaid. If you want more information about the popular Self-Teaching Guide series, just ask, and they’ll send you some. Be sure to mention you saw it in ELEMENTARY ELECTRONICS.
memory for future reference by the computer. The MOVMA instruction, at position 9 in our program, causes the contents of the A register to be moved to that location in memory where address is stored in the H and L registers!

The final instruction is the halt instruction (HLT) which stops program execution. If it were not there, the program counter would merely continue to step through all available memory—sometimes with intriguing results.

This program could be located anywhere in available memory that did not interfere with other machine operations. Our address designations merely reflect the sequential order of the program. To load it, we must first load the program counter with the starting address, then press RUN. The machine then takes over, driven and timed by the system clock.

It should be noted that our example was an addition routine. This was because practically all the computer does is add, with binary subtraction being merely a modified form of addition.

For example, multiplication can be thought of as the successive addition of one number a certain number of times. One illustrative but inefficient way to do this in machine code for $5 \times 8$ would be to clear the B register, and put 5 into the A register. We then add 8 to the B register 5 times each time we add 8 to the B register, we subtract 1 from register A. There is an instruction that looks for a zero condition in the A register. When this is the case, we have added 8 five times, or multiplied $5 \times 5$.

For programmers wishing to use machine instructions, it is not necessary to memorize all the binary numbers associated with the machine instructions.

Hi-Fi Reports
(Continued from page 32)

perior to the bulk of the units available. While the KD-5070 is described as an automatic turntable it will not play a stack of L.P.s, but it will deal with individual albums at the touch of a button. The controls provide automatic indexing for 7-, 10-, and 12-inch records. At the end of each play the tone arm returns to the rest and power turns off, unless the repeat play button is used. The tonearm can be operated manually if desired.

The vertical tracking force is adjustable in 0.1-gm increments from 0 to 3 grams and there is a calibrated anti-skate adjustment. The turntable speed is unaffected by line-voltage variations between 90 and 140 volts. The 33-RPM pitch control could be varied +5.5 percent and -7 percent, and the 45-RPM pitch control could be adjusted +3 percent and -5 percent. Wow and flutter measured 0.05 percent with peaks to 0.12 percent. Output cable capacitance is a nominal 90-pF. The listening panel felt that the sound quality of first rate cartridges was noticeably improved with this turntable.

Everyone who has tried the KD-5070 has been impressed with its ease-of-operation. With the automatic features all you do is put a record on the spindle and push the start button. You never have to touch the tonearm. It's great if you need a turntable that can be used by children. The KD-5070 carries a suggested retail price of $285.00.

Sony is giving everyone a chance (for $4.400) to be the first on their block to have a pulse code modulation, digital audio processor. It is said to virtually eliminate tape hiss, distortion and wow and flutter, and to provide 85 dB of dynamic range with the peaks clearly recorded. For more information circle 61 on the reader service coupon.

Heath is offering a new 125-watt-per-channel rack-mounting power amplifier kit with a mail order price of $359.95 (Model AA-1600). An optional oak-finished case is available for $27.95. Circle number 1.

Sansui claims to have the fastest responding preamplifier (model CA-F1) in the west (and east), with a 50-V aSec slew rate and 0.06-aSec rise time. The aux, tuner and tape inputs are claimed to have a 5- to 600,000-Hz frequency response and a 100-db signal-to-noise ratio, $495. Circle number 57 for more information about the CA-F1.

There are programs called assemblers which allow one to write a program using the written mnemonics and numbers. The assembler then reads this written program called a source listing, and translates the letters and numbers into the binary information for direct use by the computer. An assembler code source listing of our addition program would look like that in figure 3.

When this is read by the assembler, the comments and everything else is translated into the binary code as shown above at a starting address specified by the programmer.

The kind of machine programming we have discussed in this article is important to programmers wishing to write especially efficient or special-purpose programs. For the rest of us, it is perhaps interesting to realize that every time a BASIC program says A=7+2, something like that described above takes place in the machine . . . at 2 million cycles per second.

Signal Snares
(Continued from page 47)

tween the drain of Q1 and ground. The station signal should diminish. This indicates that the RF reflex portion of the circuit is operating correctly. The capacitor shunts the RF to ground, but does not affect the audio amplification as it has a high impedance to the audio frequencies.

Check the audio amplifier portion of the reflex circuit by tuning in a station and then removing the headphones from J2. Temporarily connect a 100-ohm, 1/2-watt resistor in place of the headphones to J2. Connect the headphones with a pair of clip leads across the output of D1 (across C6), and compare the signal level with the previous level at J2. The level at D1 should be lower than that of J2 to verify that the audio is being amplified by Q1.

Images
(Continued from page 64)

comes time to upgrade your present equipment, the first thing to consider is dual conversion. With this system two different IFs are used. A shortwave signal might, for example, be first converted to 3100 kHz. Thus a station's image would be a full 6200 kHz below its real frequency.

If you can't afford a dual-conversion receiver, at least one that doesn't overload, try for some amplification before the IF. Even one stage of amplification at the original frequency will reduce image problems. Two stages are even better, but more expensive than a quality synthesized frequency receiver.
Kathi's CB Carousel
(Continued from page 75)

at any time. On the other hand, if
you're just looking for action you could
simply have the computer continuously
scan all 40-channels searching for a
busy or unused channel.

Since the computer also tunes the
transmitter to the received channel, 
though it will not scan in the transmit
mode, protection is provided against an
invalid entry. Should you try to enter a
channel number greater than 40, or a
three digit number, the computer auto-

matically reverts to channel 19.

Channel programming for both the
memory and monitor modes is volatile,
meaning it vanishes when the power is
turned off. If you want to retain the
programming simply turn the volume
control down but not off. Once the
memory is "lost" it has to be reprog-
grammed.

Performance. As far as the computer
is concerned you get everything that's
claimed. It works well, and certainly
provides a convenient way to keep up
with all 40-channel action. There are

a few operating or programming hang-
ups that takes some practice to unravel, 
but they are just about what you'll find
on an ordinary VHF scanner. Basically,
there are no hang-ups once you get used
to the programming procedure.

As for the receiver and transmitter,
performance is what I've come to ex-
pect from the better quality transceiv-
ers. The receiver sensitivity measured
0.4 µV for a 10-dB S+N/N (signal
plus noise to noise ratio). Adjacent,
channel rejection measured 65 dB (con-
siderably better than the factory claimed
50+ dB), while the AGC action was
a superb 3 dB between the test limits of
2 nV and 10,000 µV.

The transmitter delivered exactly 4
watts output to a 50-ohm load. A -30-
dB microfone sensitivity- produced
100%. modulation, which was limited to
100%. The S-meter was calibrated for an
S9 indication with a 100 µV input.

All in all, an impressive package,
which is probably representative of the
way future computerized CB rigs are
likely to go. The Pace 8117 sells for
$249.95. For additional information
circle No. 64 on the reader service
coupon.

Redco RFC-50
(Continued from page 50)

ample, the display indicates 27,9651
with the resolution selector at the "100"
setting, meaning that you must multiply
the reading by 100. 27.9651 times 100
becomes 27.965100, or 27.9651 MHz.

Now suppose that you require great-
er resolution. Using our last example,
you would set the resolution to "10"
(meaning kHz) and the reading might
indicate 7.96515. You know the figure
that vanished when displaced to the left
was a 2, hence the frequency is
27.965150, or 27.96515 MHz. The er-
er is again in the digits column; 9 Hz
maximum plus the instrument's normal
error, which is specified as 9 parts in
10-6.

Our tests indicated reliable readings
to about 46 MHz; we would say the
upper limit should be the specified 40
MHz. The minimum input signal for a
reliable reading in the RF range of 50
kHz to 40 MHz feeding the direct front
panel input was nominally 30 mV,
somewhat more sensitive than the spe-
cified 100 mV. Because of normal com-
ponent tolerances, we would assume
the manufacturer's claim of 100 mV

to be typical.

The input power rating of the sam-
pling circuit is 100-watts P.E.P. Our tests
were limited to the maximum rating of
our test transmitter which is 250-watts
P.E.P., and all worked well up to 250
watts. We must assume the REDCO
1000-P.E.P. rating is correct. At the
end, we found flea power as low as
2-watts through the in-line connection
gave reliable performance.

While the in-line connection has no
effect at the lower frequencies, in the
range of 27 to 30 MHz it produces an
SWR of nominally 1.3:1. This has no real
effect on the average antenna sys-
tem or the associated transmitter's per-
formance, but you should be aware of
the fact your SWR indicator (meter)
will read slightly higher than usual.

Is it Accurate? Accuracy is always a
relative term, for it depends on what is
used as the standard of reference. In
this instance, we used a Hewlett-Pack-
ad frequency counter, which is gener-
ally employed for our transmitter
tests. The REDCO RFC-50 indicated
within 20 Hz of the HP's reading. Con-

sidering that the HP counter can indicate
0.001 Hz, the RFC-50's frequency read-
ing was essentially accurate; certainly
as accurate as the average hobbyist will
ever need or be able to afford. As to
long-term accuracy, that depends, as
do all other counters without a TXO
(temperature controlled oscillator), on
the ambient environment, and the qual-
ity of the counter's crystal and com-
ponents.

Summing Up. Overall, the REDCO
RFC-50 performs well as an in-line
Amateur or CB) frequency indicator.
The REDCO RFC-50 Communications
Frequency Counter is priced at
$179.95 complete with AC and DC
power cords. For additional informa-
tion, circle number 68 on reader ser-
tvice coupon.
YOU'RE UNDER SURVEILLANCE!!
A HOST OF PEOPLE, AGENCIES, AND COMPUTERS ARE BUSY SPYING ON YOU AND YOUR BUSINESS EVERY DAY, OFTEN ILLEGALLY...

HOW TO STOP IT OR DO IT BACK!

THE BIG BROTHER GAME

A Large Format (9 1/4" x 11") Quality Paperback, 240 Pages

$11.95

BUGGING, WIRETAPPING, TAILING, OPTICAL AND ELECTRONIC SURVEILLANCE, SURREPTITIOUS ENTRY, DETECTIVE TECHNIQUES, WEAPONS, COUNTERMEASURES

"A VIRTUAL ENCYCLOPEDIA ON SURVEILLANCE...
EVERYTHING YOU'VE ALWAYS WANTED TO KNOW ABOUT SPYING."

PLAYBOY MAGAZINE

With Each Order You Receive Free Other Material And Literature For Investigative Procedure

QUIMTRONIX
Postpaid—P.O. Box 548-EE
Seattle, Washington 98111

CIRCLE 17 ON READER SERVICE COUPON

AMAZING DEVICES

PPF-1 PHASER PAIN FIELD — This device recently developed and patented in our labs is being evaluated by law enforcement agencies for use. It is now available but will soon be under the jurisdiction of weapons and internal machine control. The device is handheld and looks like a BUCK ROGERS ray gun. It is harmless if not used with discretion.

IPG-1 INVISIBLE PAIN FIELD GENERATOR — This amazing, simple handheld device is about the size of a pack of cigarettes and generates a directional field of moderate intensity. It can be used to protect areas of your home, or in the corner of the room to keep an eye on it.

LASERS

RUBY LASER RAY PISTOL — Produces highly intense red beam. Safer to burn, as it is a far safer alternative. $59.95

HIGH POWERED CARBON DIOXIDE BURNING AND CUTTING, Complete plans and all parts sources. $39.95

SOLAR STATE OR 12 WATT, with built-in power supply plans. $8.00

POCKET LASER pistol, visible red plans. $6.00

SWIFT SECURITY

SNIP-2, SNOOPER PHONE — Dial home or office phone while an unauthorized person is monitoring your line with a phone tapping device. Excellent property protection and intrusion device.

SWIFT PLANS $7.00

SWIFT ALUMINUM PLANS $49.50

SWIFT ASSEMBLED AND TESTED $99.50

LONG RANGE XMT PLANS $6.00

SEE-IT IN THE DARK PLANS $6.00

DIRCETIONAL SHOTGUN MIKE PLANS $7.00

SUPER SENSITIVE PARABOLIC MIKE PLANS $7.00

SOUND & TELEPHONE OPERATED TAPE RECORDER $5.00

CATALOG ON PLANS, KITS & FINISHED UNITS $1.00

Send check in money order to SCIENTIFIC SYSTEMS, Dept. A10, Box 716, Amherst, N.Y. 14228

CIRCLE 12 ON READER SERVICE COUPON

DIGI-KEY CORPORATION

1-800-346-5144 TOLL FREE

DIgI-KEy CORPoraTion


DON'T FORGET OUR DISCOUNTS WHEN COMPARING PRICES

INTEGRATED CIRCUITS I.C. SOCKET PRICES SLASHED

I.C. SOCKETS

DIGI-KEY CORPORATION

1-800-346-5144 TOLL FREE

DIgI-KEy CORPoraTion


DON'T FORGET OUR DISCOUNTS WHEN COMPARING PRICES

INTEGRATED CIRCUITS I.C. SOCKET PRICES SLASHED

I.C. SOCKETS

DIGI-KEY CORPORATION

1-800-346-5144 TOLL FREE

DIgI-KEy CORPoraTion


DON'T FORGET OUR DISCOUNTS WHEN COMPARING PRICES

INTEGRATED CIRCUITS I.C. SOCKET PRICES SLASHED

I.C. SOCKETS

DIGI-KEY CORPORATION

1-800-346-5144 TOLL FREE

DIgI-KEy CORPoraTion


DON'T FORGET OUR DISCOUNTS WHEN COMPARING PRICES

INTEGRATED CIRCUITS I.C. SOCKET PRICES SLASHED

I.C. SOCKETS

DIGI-KEY CORPORATION

1-800-346-5144 TOLL FREE

DIgI-KEy CORPoraTion


DON'T FORGET OUR DISCOUNTS WHEN COMPARING PRICES

INTEGRATED CIRCUITS I.C. SOCKET PRICES SLASHED

I.C. SOCKETS

DIGI-KEY CORPORATION

1-800-346-5144 TOLL FREE

DIgI-KEy CORPoraTion

BIG ENOUGH TO UTILIZE FULL SIZE SPEAKERS
10" woofer, 5" midranger & 4" super tweeter
BIG ENOUGH TO HANDLE 50 WATTS/CHANNEL, SMALL ENOUGH TO FIT YOUR
BUDGET. Free, Resp. 30 to 22,000 Hz.
Ferro Fluid Damping. Cabinet size
20x12x9/16". Good things come in
small packages. A nice extra set for
the other room.

KIT ORDER No. 80 G-42 $88.88

CIRCLE 5 ON READER SERVICE COUPON

This Honeywell no. 7410093.001 ASC11 enclosed microswitch data entry
format keyboard. Comes with fully populated
IC’s, board. Some 100 IC’s, 7100
& 74HC series, or some of the matrix
IC’s, LSI chips MCM 4007, 4 - 30 MHz
crystal, a Mosfet MK2002, plugs into a wire
wrap board of 120 sockets. Also
2 large heatsinks. 4-2N3056, 2N2366,
4-jumper cables with dip plug
attached, 33 lamps No. 382 & other stuff.
Power for keyboard +5VDC, to
12VDC regulated. Pin out supplied
for keyboard only. Keyboard in console
is a complete assembly ASC11 encoded &
is easily removed to fit or use as is. The
additional circuitry was designed to
drive status indicators, Format, program level,
check & display etc. Console size: 19"
wx16"dx6". 80g. rear, front slopes to
2/3".hp. Removed from equipment.
Good for excellent condition:
Sh. Wt. 16 Lb. 80.82.5 lb. $68.88

BURGAL ALARM BOARD

NEW packaged system. A shelf
in the艮t. Protects your valuable: gun’s
CB’s, stereo equipment, test equipment,
Lots Price 22.88
Sh. Wt. 1 Lb. $5.78
3 for $22.88 BM-810474 $22.88

TOUCH SWITCH

ALARM

NEAT ASSEMBLED BOARD CONTAINS ALL SOLID STATE COMPONENTS.
Contains a DARI-VIN Drive, push-pull output, all
with complimentary power transistors &
mounted to heat sinks. Accepts input from tape
mics, magetic or ceramic phono cartridges,
mics, etc. Requiers a 48V xformer &1
meh volume control, (not supplied)
Output 8 into 8 ohms. (supplied with data)

Sh. Wt. 1 Lb. 80513 $5.78
'Stereo Xformer BGO-101 $2.88
'Stereo Xformer 20-Watt Xformer &
Cond. Sh. Wt. 1 Lb. 806544 $13.88

CIRCLE 5 ON READER SERVICE COUPON

WIRE WRAP TOOL KIT

NEAT NEW CLOSED-CIRCUIT ALARM BOARD

WILL ATCH A RELAY IF THE ALARM CIRCUIT IS
OPENED. THIS UNIT OPERATES ON 120V
AT SUCH A LOW PRICE, IT MAKES A PERFECT
COMPACT ALARM SYSTEN. With Data:

Sh. Wt. 1/2 oz. BK-32067 $2.88
5 for $13.88 BK-32067 $13.88/5

FREE JUMBO CATALOG! JAM-PACKED WITH PLUS ELECTRONIC PARTS, GADGETS, KITS AND MORE! CIRCLE 5 ON READER SERVICE COUPON

SUBSCRIBE TODAY TO ISAAC ASIMOV'S SCIENCE FICTION MAGAZINE

Now monthly!
To: ISAAC ASIMOV’S SF MAGAZINE
Box 1855 GPO, NYC, NY 10001
Enclosed is $5.95 for 6 issues (outside U.S.A. & poss. $6.97). I enclose $11.90 for 12 issues (1 yr.)
I prefer to use my MASTER Charge or VISA credit card
however, only these longer terms are available:
1 yr. (12 iss.) $11.90
2 yrs. (24 iss.) $22.90

Credit Card No.

CIRCLES 6 ON READER SERVICE COUPON
Hot Tubes. This happening brings up several questions to be discussed. Number one, what would a thief do with more than 13,000 radio-TV tubes? One knowledgeable collector felt that they were smuggled into Mexico. Why would they do this? Since there are only a few known radio collectors in Mexico they would no doubt be sent to other countries where radio collecting is becoming popular.

Number two, why haven't more radio collectors installed burglar alarms? Anyone handy with tools can buy equipment from radio catalogs to protect his home, museum, or work shop. Very often insurance companies give lower rates to persons with approved alarm systems.

Number three, why haven't radio collectors made a list of every radio, tube, etc., in their collection and put it into a safe (away from home) location? Using file cards list the name, manufacturer, year built, number of tubes, condition, amount paid, approximate present value, and any other fact that would help establish its value. Most insurance companies will cooperate by sending a representative to your location and will verify each item.

Fourth and last (for this discussion), why haven't radio collectors had the larger, more valuable items in their collections appraised? There are a large number of antique appraisers, but most know very little about old radio equipment. Radios are a special branch of the antiques field. What the antique radio collector needs is a "Blue Book" of antique radio values similar to the one used by used car dealers. A book of radio values would stabilize the radio collecting hobby. Everyone having such a book would know what his radios were worth as well as what other collectors radios, (that he might consider buying) are worth. The Antique Wireless Association has made a small beginning by listing prices for radios that have been sold or auctioned at their meetings.

To my knowledge there is only one appraiser for old radios now active. There are discussions going on at this time with the thought of establishing a nation wide "Antique Radio Appraisers Association." Well qualified collectors living in various parts of the United States would become members of the staff. This way any collector desiring an appraisal could find an appraiser within a few hundred miles.

Any reader who would like to comment on the insurance and appraisal discussion is welcome to write to me in care of ELEMENTARY ELECTRONICS magazine.

New from ASIMOV'S
3rd ISSUE!!!

IT HAS ALL THE EXCITEMENT OF SF ADVENTURE AND ALL THE DRAMA OF STUNNING VISUAL EFFECTS.

It's here! The 3rd issue of ASIMOV'S SF ADVENTURE Magazine. 112 pages long. New! Exciting!

In this Summer '78 edition, more great stories—such as Roger Zelazny's "The Last Defender of Camelot," Samuel R. Delany's "The Tale of Gogrik," more of Joe and Jack Haldeman II's "Starschool," an editorial from Isaac Asimov himself; a column by Craig Miller on SF in Hollywood (TV and movies); stories by talented newcomers AND a full-color pull-out poster. Lots of SF adventure and fun.

TO: ASIMOV'S SF ADVENTURE MAGAZINE

380 Lexington Avenue, New York, NY 10017

Enclosed is $1.75 plus 45¢ handling/shipping (total of $2.20) for the Summer '79 issue (Vol 3) of ASIMOV'S SF ADVENTURE Magazine.

Name ____________________________
Address ___________________________
City ____________________________ State ______ Zip ______

Please print name as it is to appear on mailing label.

ATTACHED POSTCARD:

(Continued from page 74)
### Active Electronic Sales Corp.

**Features**

**BRAND NEW!**

**JUST RELEASED 1979 IC MASTER 2500 pages**

Complete integrated circuit data selector. Master guide to the latest I.C's including microprocessors and consumer circuits.

Free Quarterly Updates $39.95

---

**Texas Instruments Low Profile Sockets**


Over one million pieces in stock.

<table>
<thead>
<tr>
<th>Contacts</th>
<th>Price</th>
<th>Contacts</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>8 PIN</td>
<td>08</td>
<td>14 PIN</td>
<td>12</td>
</tr>
<tr>
<td>14 PIN</td>
<td>14</td>
<td>16 PIN</td>
<td>18</td>
</tr>
<tr>
<td>18 PIN</td>
<td>18</td>
<td>20 PIN</td>
<td>20</td>
</tr>
</tbody>
</table>

---

**CMOS's**

<table>
<thead>
<tr>
<th>Part No.</th>
<th>140CBE</th>
<th>140ABE</th>
<th>140EBE</th>
<th>140FBE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Price</td>
<td>.25</td>
<td>.25</td>
<td>.25</td>
<td>.25</td>
</tr>
</tbody>
</table>

---

**Microprocessor Chips**

<table>
<thead>
<tr>
<th>CPU's</th>
<th>Stock level</th>
<th>Part No.</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>8080A</td>
<td>4600</td>
<td>$8.50</td>
</tr>
<tr>
<td></td>
<td>6800</td>
<td>16000</td>
<td>$8.50</td>
</tr>
</tbody>
</table>

---

**Interface Support Circuits**

<table>
<thead>
<tr>
<th>Part No.</th>
<th>Stock level</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>80212</td>
<td>4000</td>
<td>1.98</td>
</tr>
<tr>
<td>80216</td>
<td>2800</td>
<td>1.98</td>
</tr>
<tr>
<td>80224</td>
<td>1500</td>
<td>1.98</td>
</tr>
<tr>
<td>80228</td>
<td>4000</td>
<td>1.98</td>
</tr>
<tr>
<td>80233</td>
<td>7000</td>
<td>1.98</td>
</tr>
<tr>
<td>80237</td>
<td>5800</td>
<td>1.98</td>
</tr>
<tr>
<td>80242</td>
<td>5500</td>
<td>1.98</td>
</tr>
<tr>
<td>80248</td>
<td>11000</td>
<td>1.98</td>
</tr>
</tbody>
</table>

---

**Zilog**

<table>
<thead>
<tr>
<th>Part No.</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>280-CTC</td>
<td>$10.90</td>
</tr>
<tr>
<td>280A-CTC</td>
<td>$13.10</td>
</tr>
<tr>
<td>280A</td>
<td>$13.10</td>
</tr>
</tbody>
</table>

---

**LINEAR I.C.'s**

<table>
<thead>
<tr>
<th>Part No.</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>11400</td>
<td>2114</td>
</tr>
</tbody>
</table>

---

**MOS Static RAM's**

<table>
<thead>
<tr>
<th>Stock level</th>
<th>Part No.</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>11400</td>
<td>2114</td>
<td>$7.50</td>
</tr>
<tr>
<td>74000</td>
<td>2102LFP</td>
<td>$1.19</td>
</tr>
</tbody>
</table>

---

**MOS Dynamic RAM's**

<table>
<thead>
<tr>
<th>Stock level</th>
<th>Part No.</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>11400</td>
<td>2114</td>
<td>$6.95</td>
</tr>
</tbody>
</table>

---

**UART's**

<table>
<thead>
<tr>
<th>Stock level</th>
<th>Part No.</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>44000</td>
<td>415-5</td>
<td>$9.95</td>
</tr>
</tbody>
</table>

---

**Z80**

<table>
<thead>
<tr>
<th>Stock level</th>
<th>Part No.</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>21400</td>
<td>5101</td>
<td>$4.95</td>
</tr>
</tbody>
</table>

---

All new major manufacturer production material offered. Largest variety of device types available anywhere.
Solar Swinger
(Continued from page 67)

work cloth under the wooden base to
protect the soft wood from scratches
dents.

Cut a 1/4" hole about 1/4" deep for
the tube base. The 1/4" indentation will
take a large pasteboard washer to bolt
the tube socket into position. Finish
drilling out the 1-inch hole for the tube
prongs to fit comfortably inside. De-
dpending upon the size of the tuning
capacitor, lay it upon the bottom area
and drill a large hole to enclose the
whole body. Do not drill clear through
the board but leave about 1/4" at the
top side for the mounting area of the
tuning capacitor.

The tuning capacitor and the head-
phones are the only components mount-
ed outside of the tube envelope. A
small 1/4" hole is drilled in the center
and at the rear of the base towards the
tube socket. The headphone and an-
tenna wires will feed through this area
to the tube socket pins. Cut a groove
into the wood area between the cap-
citor and tube socket hole. The capac-
tor's two small connecting wires will
lay flat in this groove.

If needed, sand down the top of
the wooden base area with fine sand-
paper. Stain, varnish or spray paint the
top side. Choose a light color spray
paint, such as white or yellow, to give
the base and component parts a con-
trasting appearance. Spray on at least
two coats of paint and let it dry be-
tween each coat to produce a slick,
enamel appearance. Let the wood base
dry overnight before mounting any
parts.

Final Touchup. After the base ap-
ppears dry mount the variable capacitor
and connect two pieces of hookup wire
from it to tie into the tube socket.
Next, mount the small tube socket.
Temporarily, place a piece of masking
tape over the socket and wooden base
plate. Lay the base upside down (over
a shoebox) to wire up the remaining
components. Feed the earphone cable
to the head hole and connect to ter-
minals 4 and 6 of the tube socket.
Feed a short piece of hookup wire
through the same hole to serve as an
external antenna connection. Solder
this wire to terminal 2. Now solder the
capacitor's two wires to terminals 2
and 1. Once again, check over the en-
tire wiring procedure. Solar Swinger
should be ready to roll (and rock).

Connect the antenna wire to the out-
side antenna—or you can try to pick up
local stations at each end of the broadcast
band. If a ferrite, adjustable antenna
coil is used, adjust the core until the
stations are loudest at each end of the
band. Turn Solar Swinger's solar cell
toward the sunlight or operate under a
table lamp.

After all adjustments are made,
spread silicone cement over the tuning
capacitor wires. Cut out a large paste-
board or plastic washer and place it
over the tube pins. Use the 3/4-inch ma-
chine screw and bolt the tube socket
into position. To keep the earphone
wires from pulling out, apply silicone
cement in the small hole. Place four
rubber grommets or metal spacers on
each corner for feet, and cement in
place. Let the radio lay upside down
until the silicone cement sets up.

The glass envelope should be
mounted last and glued to the tube
base with black silicone cement. Place

CB Xcvr Checkout
(Continued from page 76)

clock alert operation. Standard ac-
cessories include a microphone, and
an AC power cord.

Receiver Section Test:
Input sensitivity ……………. 0.5 μV
Adjacent channel rejection ……… 64 dB
AGC action …………………… 1.5 dB
SSB opposite sideband rejection ……… 50+ dB
Input level for 56 meter indication ………. 350 μV
(Reading compresses above 56)

Transmitter Section Test:
AM RF output …………………. 3.8 watts
SSB RF output ………………… 11 watts P.E.P.
Modulation to 85% ………………… yes
Relative sensitivity for 85% mod. …………. -25 dB
Modulation limited to 100% ………… yes

Editorial Remarks: The CB555 has a relative reading S-meter, jacks for
P.A. and remote speakers, L.E.D.
digital channel indicator, S/RF/SWR
meter, CLOCK “alert” which will
automatically turn the unit on at a
designated time, and shut it off
one hour later.

- SBE Key/Com 1000
$259.95 (SBE, Inc.)

General Description: A 40-channel
AM transceiver for mobile, P.A., ma-
rine operation. Delta tuning ±1.5
kHz is provided. Power supply is 12
to 13.8 VDC with negative or posi-
tive ground. Overall dimensions are
2.1-in. H x 5.9-in. W x 8.8-in. D.

There are front panel controls for:
volume, squelch, RF gain, variable
circle 69
(CIRCULARS)
noise limiter, and Delta tune. Switch-
es for: CB/PA, noise blanker, panel
damp dimmer. Eleven keyboard
switches for channel selection and
control. Standard accessories include
a microphone, mobile mount, DC
power cable.

Receive Section Test:
Input sensitivity ……………. 0.3 μV
Adjacent channel rejection ……… 56 dB
AGC action …………………… 13 dB
Input level for 59 meter indication ………. 80 μV

Transmitter Section Test:
AM RF output …………………. 3.6 watts
Modulation to 85% ………………… yes
Relative sensitivity for 85% mod. …………. -31 dB
Modulation limited to 100% ………… yes

Editorial Remarks: The Key/Com 1000 has a 5 dB per unit S-meter, double conversion, jacks for P.A.
and remote speakers, L.E.D. digital
channel indicator, on-board micro-
processor providing 40 channel
SCAN, 10 channel memory SCAN,
alternate channel operation and
SCAN, 10-second check of priority
channel, S/RF-output meter, and
separate power connection for mi-
croprocessor memory.
ADDITIONAL INCOME

MECHANICALLY INCLUDED INDIviduals WANTED—ASMALL ELECTRONIC DEVICE FOR YOUR HOME. Get started in spare time. Experience, Knowledge or Investment Box Necessary. Design big profits: $300-$400/Wk. Possible. Write for free information. Telling Development Lab, Box 1506R, Pinellas Park, FL 33785.

$200 WEEKLY: BECOME COMMUNICATIONS SPECIALIST. FREE REPORT. GRAHAM, DBP5791, TAMOYA, WA 98499.

MAKE ONE MILLION DOLLARS the lazy way. mailing: Consumer Electronics Device Box, Permanent Homework. Send stamp. Laurenceau, Box 1225A. Long Island, NY 11710.

AUTHOR’S SERVICE

PUBLISH YOUR BOOK! Join our successful au-thors. Publicity, advertising, beautiful books. All subs-iated invited. Send for free booklets and free manuscript report. Carlton Press, Dept. SMM, 84 Fifth Avenue, NY 10011.

BIG MAIL!

RECEIVE MONEYMAKING OPPORTUNITIES. Your name placed with 2,500+ importers, wholesalers, manufacturers, etc. Earn from $100-$250 (SAVINGS POSTAGE!) Advertising Agency, Box 123-YNA, Wickersham, NJ 08080.

BLUEPRINTS, PATTERNS & PLANS

LINEAR AMPLIFIERS, 100 or 200 watt, 2-30 MHz. Omopolarized ANTENNA 200 MHz Couriers, Mod-u-lation BoostAXX-VOX. Plans $3.00 each. $10.00/ all. Catalogue: NEW ARMS/PORTAXIS. Box 130-A150, Paradise, CA 90269.

ELECTRONIC Gas Detector Plans with IC ampli-fiers included. For JH Industries, 524L Lanecreek, OH 44014.

NEW CRAFT PRINT CATALOG—Choose from over 100 different easy-to-build plans. Send $1.50 (completely refunded with your first order). BOAT BUILDERS (CP Div.)—380 Lexington Ave., NY, N.Y. 10017.

BOOKS & PERIODICALS

FREE! CATALOG SELF-IMPROVEMENT BOOKS. The Mall Book, Dept. 127A. 600 Welsh Stv., Print, ME 04351.

BORROW ANY AMOUNT. Enter A-1 credit. money in bank, get 80% more, send stamp. Vernon, Box Tabor-Hill, Oklahoma City 37147.

MILLIONS in Mail! Free Secrets. Transworld-X, Box 6226, Toledo, OH 43614.

NEW Luxury Car Without Cost! Free details, CODEX-A, Box 6673, Toledo, OH 43614.

100% PROFIT Bronzing Baby Shoes. Free Lit-erature. NBC Box 1004-D, Sebring, FL 33870.

BUSINESS OPPORTUNITIES—Cont’d

STAY HOME! EARN BIG MONEY, addressing en-velope. Special offer IQ. LINDEN, 2656-DA. Peterson, Chicago 60659.

WHOLESALE Rubber Stamp Outfits, Supplies, Cat-al. $1.00 Martin, 14252 Main, Jefferson City, MO 65101.


BORROW $25,000 interest free! Indefinitely! Any-where! Immediate 30 days! Free! Details. Executive SNS, Box 365, Buford, GA 30518.

RUMPER STICKER PRINTING DEVICE. Cheap, Simple-To-Use. Bumper, Box 237811, (JF), Tamps, Fl 33622.

$200 HUNDRED stuffing our circles into standard addressed envelopes. No limit. Minimum Kit $2.00. Coonet, Box 318-DC, Brooklyn, NY 11294.

MAKE More Money In Mailorder. HAGO, Box 846, Nash, NH 03259.

ASSEMBLE products at home. Many opportunities paying high weekly profits presently available! Wholesale. Enterprises, G2-12 Brighton 11th, Brooklyn, NY 11235.


HUGE PROFITS selling gifts, novelties, Newbery, 193A FM46, Seaside, TX 77585.

$300.00 WEEKLY Mailming Circulators. Write: McGuire, Box 91544, Tacoma, WA 98401.

$45.00 FREEBIES WAITING! GOVERNMENT DIRECTORY $3.50. PALMER, B11445DSO, Phoenix City, AZ 85017.

CABLE FM BROADCAST STATION. Investment/ experience unnecessary. Home operation possible. Excellent income reported! Free details. CAFM, Box 150 GIB, Paradise, CA 95969.

BUSINESS AND FINANCING. CONSULTANTS NEEDED! Complete training, Large commissions. Crystal Finance, 560 West Central—Suite 200, Mt. Prospect, Ill 60056.

$400 First Week with Ad Clocks or money back. Your own Advertising Business. Action Ad Clocks, Room AC-107-1E, 1512 Jarvis, Chicago, Il 60610.

WHOLESALE! Hundreds of Items. 2$00 break, $5.00 bgi. Send SASE for free “In stock” list. McCord’s, 2923 Cassell Dr., Anderson, IN 46012.


Big Printing Selling Books by Mail. Turbinfl-D, B207, Bochu. CA 91310.

$400.00 ANNUALLY. Free Gift and Details. Taylor, Box 2006RD, Columbus, OH 43220.

BUY IT WHOLESALE

400,000 BARGAINS Below Wholesale! Many Free Previews, Job Lots. Send SASE for Free Single Samples. Free Details Worldwide Bargain-Hunters, Box 120-IO, Highland, CA 92526.

PLANE, EX-LAND. Box 18327, Ex Lander, Box 18174. OKL, Box 566. Ponca City, OK 74604.

BARBEE By Mail offers fantastic SAVINGS. Send SASE. Guaranteed. Salem, 2736E-164, Brookyln 12229.

DO IT YOURSELF


DO IT YOURSELF—Cont’d

FREE Encyclopedia Winemaking, Beermaking Supples. Quality Winemaking, P.O. Box 141, Vinyo Industries, Box R/E-7468, Rochester, NY 14615.

BUILD Stereo Speaker Cabinets, microphone mixer, turntable. Specify plans. Box, where to buy materials. One dollar each self-addressed, stamped envelope. SC Enterprises, Box 1909, Hamilton, OH 45012.

BUILD your own car stereo power booster! $1.00 for plans, or price for details. Perkins Company, Box 680, Rainier, Oregon 97048.

EDUCATION & INSTRUCTION

USED: Course! Booklet! Lists 50 Smith’s, 124 Marthaesper, Salem, MA 01210.

COLLEGE degree by mail, via resumé. Education, 254D South Robertson, Beverly Hills, CA 90211.


COMPUTER Programming (BASIC or FORTRAN). Eletronics, FCC License, Mathematics. Correspond-ence study. Free Information: Intermountain Tech-nical Institute (Room 13), Box 258, Jerome, ID 83338.

HOW TO RETIRE AFTER WORKING 15 YEARS. New letter. Sample $1.00. Stonehenge, Box 348, Bolton, Canada M5V 2L2.

DO YOU KNOW “How to Write A Classified Ad That Pulls” includes a certificate worth $2.00 toward a classified ad in any of our publications? For your coupon send $1.50 (includes postage) to R. S. Warner, Books, Inc, Dept. CT, 380 Lexington Ave., New York, N.Y. 10017.

FUND RISING—SELF USE CATALOGS

GIANT! Gilt-Glazed product catalog, Self Use Fund Raising, etc. Satisfaction Guaranteed. $1.95. NorPre Mail Order Dept. 82579, Castleton, New York 12033.

FOR THE HOME

PRACTICAL tips for home, garden and workshop can be found in “1001 How-To Ideas.” Send $1.50 for your copy (includes postage) to 1001 How-To Ideas, 380 Lexington Ave., New York, N.Y. 10017.

GOVERNMENT SURPLUS

JEPS—$50.00—CARS—$33.50! 200,000 ITEMS—GOVERNMENT SURPLUS—MOST COMPREHENSIVE DIRECTORY AVAILABLE TODAY! Sent-free of charge to areas of your choice. 1001 How-To Ideas, 380 Lexington Ave., New York, N.Y. 10017.


HOBBIES & COLLECTIONS

"NEW" Electronics Kits for the Hobbyist. $1.00 for catalog and monthly kit news; Hobbi Shack, P.O. Box 329, Jersey City, N.J. 07302.

HYPNOTISM

FREE Fascinating Hypnosis Information! Starting! DLMH, Box 447, Anchorage, California 99506.

For Greater Classified Savings...Results...and Profits...

Place your ad in one of our SPECIAL COMBINATIONS: Combo #1, Combo #2, or Combo #3. Each combination is designed to give you the largest audience available. For further information write to R. S. Weyner, Classified Ad Manager, Davis Publications, Inc., 330 Lexington Ave., N.Y., N.Y. 10017.

ELEMENTARY ELECTRONICS—is published Bi-monthly. The rate per word for CLASSIFIED ADVERTISEMENTS is $1.30 payable in advance—minimum ad $15.00. Capitalized words 40¢ per word additional.
MONEYMAKING OPPORTUNITIES—Cont’d

BARN money addressing envelopes. K-O PUBLICATIONS, Box 1301, Wilmington, N.C. 21000

HOW TO WRITE A BESTSELLER—Amazing new method! Free booklet. King Dept. M-131, 226 Spencer St., New Haven, Conn. 06520

MILLIONS in Mail! Free Secrets. Transworld-3, Box 5528, Toledo, OH 43614

MAKE YOUR CLASSIFIED AD PAY
Get: "How to Write A Classified Ad That Pulls." Includes Certificate worth $2.00 towards a classified ad in this publication. Send $1.50 plus 25¢ (for postage) to R. Wayne, Davy Publications, Inc., Dept. CL, 380 Newsstand, New York, N.Y., 10017

PLEASE be sure to include your zip code when ordering merchandise from classified advertisements. You’ll receive faster delivery.

GUARANTEED big money making program Abrams Ent., P.O. Box 6972, Evansville, IN 47712


HOMEPLOYED! Needed! 1000 weekly addressing, mailing. Ideal for students. Box 13974, HLC, Ill. 60114

$2500 Monthly Mailing Circulars. Dealers Wanted. Details? (refundable). Enterprises, Box 408-10, Erie, PA 16512

"THREE Steps to Success." Send snack: Mailing Systems, G.P.O. Box 2450, N.Y., NY 10001

REAL Estate Appraising. Fantastic profit! AAR, Box 512-B, Hayward, Calif. 94544

$500 CASH ADVANCE: stuff 1000 envelopes, information: self-addressed stamped envelope. Freedom 01-11, Box 1098, Orange Park, Fl. 32073

PEN PALS
JOIN North America’s leading penpal club. Details from Friends Worldwide CP-95/F Anjou, Montreal, H1R 4G9

PERSONAL—Cont’d

DATE GALLERY Meet singles-anywhere. Call DATIONLINE, toll-free (600) 421-3245.

RECORD Telephone conversations privately—automatically have recorder Unlimited, Robert’s, 2515 Elmwood Blvd., Wauau, WI 53140.

JAPANESE Girls Make Wonderful Wives. We have large number of listings. Many interested in marriage. Only $1.00 brings application, photos, names, descriptions, questionnaire, Etc. Japan International, Box 345 AA, Caretini, Bay, CA 95311.

BEAUTIFUL Mexican- Oriental girls Needing American, Box-PHOTOS. Free details "actual" photos. World, Box 3760-D, San Diego, CA 92103.

FREE: 1,000 LADIES PHOTOS. World’s largest Matrimonial Catalog Page/Hanging A.D. Inter- contact, Box 12, Toronto, Canada M4A 2M4

JAPANESE Introductions! Girls’, photographs, descriptions, brochure, details, $1.00 INTER-PACIFIC, Box 306-DC, Birmingham, MI 48212.

BEAUTIFUL MEXICAN GIRLS! Correspondence. Photos, details free! "Latinas," Box 1716-D, Chula Vista, CA 92012

BECOME ORDAINED Minister locally. Free Lifetime credentials. Use title "Revered." Write: Church of the God Within, Box 6513A, Miami, FL 33161.


TRADITIONAL, home-loving ladies seeking marriage. Rainham, Box 6125, Jacksonville, Fl. 32207

RADIO & TELEVISION

TV TUBES w each. Send for Free 46 page color catalog Cornell, 1-W University, San Diego, California 92109.

TUBES Oiled, latest. Supplies, components, schem- ates, 200 tubes free. Flipside Apparatus, the book, 151E-W Maplewood, Hammond, IN 46434

SAVE 50% build your own speaker system. Write Music Radio Electronics, 1951 Grove Street, Kansas City, MO 64106

LINEAR Amplifiers 3-30 MHz. Schematic, De- tailed instructions For Basic BL-200, Mobile BL-100 and BL-200. All, $4.00. Home’s, Box 541, Pendleton, OR 97360

BUILD Distance Crystal Sets. 10 plans-25¢; Hand- book "15 Different"-50¢; 20 different-50c, Kit Complete, 20¢, Laboratories, 147-G, Garden Glen, CA 90245

POLICE Beacons, Crystal, Antennas, Radar De- tectors, CB’s, HFP, Box 1024, Denver, CO 80212

YOUR crystal radio plans and crystal diode; $1.00, Henky, 502 Armstrong, Pleasant Hill, MO 64070

SCIENCE & CHEMISTRY

FIREFORKS! Spectacular novelties. Simplified manufacturers textbook. $5.00. Topco, Box 5920, Clovis, CA 93611

TREASURE FINDERS—PROSPECTING EQUIPMENT

GOLD-Silver. Where to find it. How to refine it. $5. J. Trachtenberg, P.O. Box 671, Ferth, Amherst, NY 14224

WATCHES, WATCHMAKING & REPAIRING

WATCH and clock repairing books, tools, materials. Furniture Radio, North American, Box 77, Eilitt, Fox River Grove, IL 60021

WORK CLOTHES

WORK PANTS $2, Coveralls $4. Postpaid. Catalog $1. (refundable with order). Merchandise Garment Co. 15050-DF WY-700, Detroit, MI 48208

To be included in the next issue, please send order and remittance to R. S. Wayner, ELEMENTARY ELECTRONICS, 380 Lexington Ave, New York, N.Y. 10017

INVENTIONS WANTED
INVENTIONS, patents, wanted cash, royalty. Auto, electro-mechanical, mechanical devices, Housewares, etc. We develop, finance, manufacture and market from an idea to perfected product. Free evaluation and brochure. Request Kit DP, Fronticore Publications, 250 West 57th Street, New York, New York 10019

MAIL-DRAWING OPPORTUNITIES
GREATEST proven moneymaker INVENTIONS, MAKE YOUR MILLION. $8.00. Burke Publishers, 2822 East 17th St., Indianapolis, IN 46208

MAGNETS
MAGNETS. All types. Specials-20 dic, or 15 bar, or 30 or 50 as advertised. $1.00. Magnets, Box 192- E, Randallstown, Md. 21133

FREE PROOF. Moneycraft, Guaranteed. Free report. Finish Wayner, Davis -ADVS Dept., Box 11773, NC 28220

FREE SAMPLES, Workmen’s Textile, 405 North Adams, Mount Hope, WV 25055

FREE HOUSE-ORDER OPPORTUNITIES

Lapaz, Pacific Palisades, GRAPHIC memory. Stop BER. No collateral.

Free Proof. Moneycraft, Guaranteed. Free report. Finish Wayner, Davis -ADVS Dept., Box 11773, NC 28220

FREE SAMPLES, Workmen’s Textile, 405 North Adams, Mount Hope, WV 25055

MEMORY IMPROVEMENT
INSTANT MEMORY ... NEW WAY TO REMEM- BER information. Release your PHOTOGRAPHIC memory Stop forgetting! FREE information. Institute of Advanced Teaching, 6450 Via- Lapaz, Pacific Palisades, CA 90212.

MISCELLANEOUS
ENTER THE UNITED STATES’ FABULOUS LOTTERY. Details: Joe Davis, 15-2763 Oak, Vancouver, Canada V8M 2V7.

HOME BREW now is legal. Complete instructions $2.50. Lewis Recipes, Box 6156, Elara, NY 10034

"AMAZING!" Secret Compassions, Low Cost, Full Information, Hide Your Valuables, Many Types. Catalog $1.00 (refundable). Marsett Company, Dept. EE. Box 460, Norwalk, Ohio 44607

MONEYMAKING OPPORTUNITIES
$250.00 profit/ thousand possible-stuffing-mailing envelopes. Offer: Rush stamped addressed envelope Universal-ADVIVE X1619 Fort Lauderdale, Fl. 33315.

$150.00 WEEKLY Mailing Circulars. Start Im- mediately. Everready, 422A Commercial Ave., Brooklyn, NY 11218

MAKE YOUR CLASSIFIED AD PAY. Get: "How to Write A Classified Ad That Pul". Includes certifi- cate worth $2.00 towards a classified ad in this publication. Send $1.50 plus 25¢ (for postage) to R. Wayne, Davy Publications, Inc., Dept. CL, 380 Newsstand, New York, N.Y., 10017


$250 WEEKLY Home Mailing Program. Details: Thomas, Dept-D1, Box 11773, Charlotte, NC 28220

$250 WEEKLY! PANTASTIC HOME MAILORDER PROFITS! DEALERS, WANTED. GRAHAMABO DFPX, 9851 TACOMA, WASH 98409


HOW to get paid in advance stuffing envelopes, make small fortune doing it. Details: $1.00. Martin, 3610 Top, Wisconsin Rapids, Wi. 54494

$250 WEEKLY Mailing Letters Free Details. Karmichol, 5030-D Cherry, Baton Rouge, LA 70801
Never Stopped Publishing

Where is White's Radio Log?

-P. D., Powell River, B.C.

Keep looking! White's Radio Log is a part of Communications World which is now published once a year. The 1979 edition hit the newsstands in late January. If you can't find a copy, send $1.75 plus 25 cents for postage and handling to:

Communications World
Single Copy Sales Dept.
380 Lexington Avenue
New York, NY 10017

Don't hesitate, they sell out pretty quick.

Charter Reader

Your November-December 1978 issue announced the 15th anniversary of Elementary Electronics. I still have your first 1963 issue and continue to find it very interesting. This premier edition gave me my first knowledge of electronics magazines. I would just like to mention that although I haven't written for information, I still find the answered questions very informative. Thanks for having this column in the magazine.

---

Announcing a new service for hobbyists: Circuit Design Service.

An alphabetical directory of 1500+ hobbyshops.

Circuit Design Service

A hobbyist's dream come true. A hobbyist's nightmare avoided.


elementary electronics index to advertisers

---

Epilepsy
It's not what you think.
The 90-minute miracle

Solderless saves time like you wouldn't believe. Our Proto-Board® solderless breadboards put everything you need to get your circuit up and running on an aluminum backplane that lets you work at frequencies from DC to half a Gigahertz. Three Proto-Board® models feature built-in regulated power supplies—and one of them's a build-it-yourself kit.

CSC solderless breadboards save energy, too. Especially yours. Because circuit building becomes a simple plug-and-chug process, straight from an idea to a working circuit.

That's why we've become the easiest-to-find solderless breadboards in the world—available at more stores than anybody else in the business. Because people who know solderless best insist on CSC.

Save time and energy. Get a head start with CSC.

There are 9 Proto-Boards® in all, manufacturer's suggested U.S. resale prices from $15.95 to $124.95.

CONTINENTAL SPECIALTIES CORPORATION

70 Fulton Terrace, New Haven, CT 06509 (203) 624-3103, TWX 710-455-1227
OTHER OFFICES: San Francisco: (415) 429-8872, TWX 910-372-7982
Europe: CSC UK LTD Phone Saffron-Walden 779-2168, TLX B7747
Canada: Len Finkler Ltd., Ontario

1-800-243-6077
Call toll-free for details

CIRCLE 7 ON READER SERVICE COUPON
Realistic's System Seven... a new size and shape for stereo

Miniaturization breakthrough! Realistic's fabulous new System Seven combines beauty, elegant small size and a level of acoustical quality you've never heard, until now, in low-priced bookshelf stereo.

System Seven includes our new STA-7 AM/FM receiver (10 watts per channel, minimum RMS into 8 ohms, 20-20,000 Hz, with no more than 0.5% total harmonic distortion) and a pair of our amazing Minimus™-7 speaker systems — featuring large-exursion woofers and soft-dome tweeters in diecast enclosures only 3 1/2" high.

Bass without bulk. Despite its small size, System Seven delivers rich, satisfying bass to 50 Hz and sound levels up to 90 dB for accurate reproduction of anything from classical to rock music.

What's the secret? The receiver has a unique equalization network engineered especially for the speakers. And it's switchable so you can use full-size speakers, if you wish.

Compact, but no compromises. You get "full-size" high-fidelity features with System Seven — magnetic and aux inputs, tape monitor, A/B speaker switching, even 75 and 300-ohm FM inputs. U.L. listed, of course, and housed in a stunning jet-black metal cabinet with blackout dial.

At last — true hi-fi perfectly sized for a bookcase. The 4-1/2-lb. speakers can even be used for bookends!

The price for all this may be the surprise of your audio life — only $299.95, a savings of $39.90 off the "each" price!

Audition System Seven. Small has never been so beautiful!

*Price may vary at individual stores and dealers.

Radio Shack
The nationwide supermarket of sound

Sold only at Radio Shack

A Division of Tandy Corporation
Fort Worth, Texas 76102