YOU CAN COUNT LIKE A MICROPROCESSOR, see page 81

02342

Elementary Electronics

elementary Electronics

MAY-JUNE 1978 $1.25

FOR BEGINNERS

SIMPLY BASIC

Programming bowling scores will be right up your alley

COMMUNICATIONS COUNTDOWN

Cover a galaxy of action with the *new* radio

SHORTWAVE-BAND AIDS

Beat the SWL champs with e/e's DX tips!

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Radio Shack PRO-2001 takes your town in stride!

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- Apple II Computer
- Heath SB-104A Amateur Transceiver
- RCA Cosmac VIP TV Graphics Game

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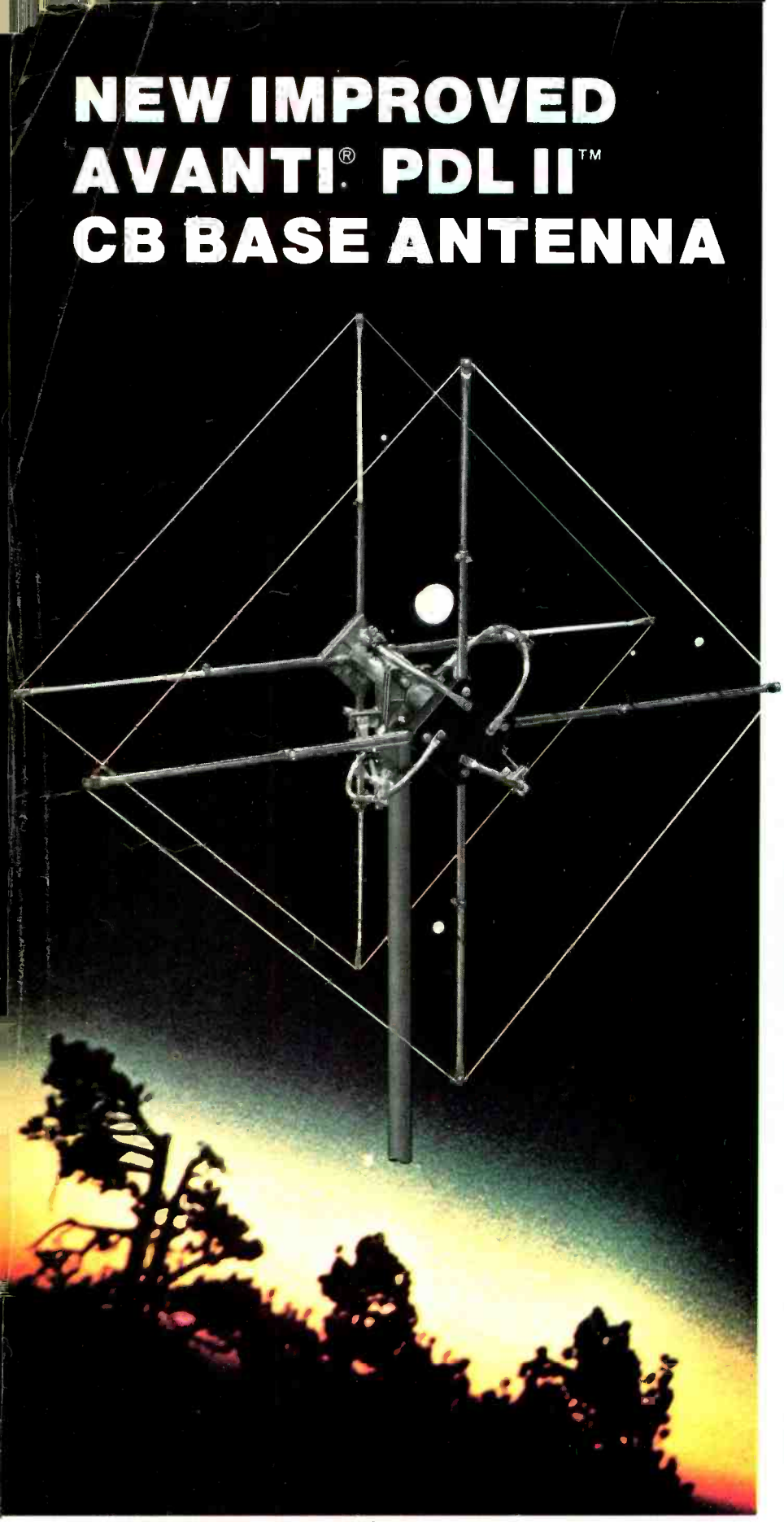
Build this new oldie and lure them in like Grandpa did!

0 71486 02342 05

A DAVIS PUBLICATION

NEW IMPROVED AVANTI® PDL II™ CB BASE ANTENNA



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16x more power to you with a CO-INDUCTIVE design and an orbital gamma match

More Gain because this system of creating an impedance match is higher in "Q" and lower loss than previous matching devices and acts to increase radiation.

Better reception with increased efficiency through use of orbital gamma match.

Better rejection front-to-back separation is 32 db.

Burn-out proof. The PDL has no coils or transformers to burn-out or detune. D.C. ground construction offers better lightning protection than any commercially available lightning protectors.

Compact construction. *New* cast aluminum rear hub. *New* fiberglass filled high impact ABS front hub. *New* swaged joints on orbital gamma match plus cadmium plated parts and bolts, stainless steel clamps, aircraft quality heavy duty tubing for strong, low weight, long lasting construction.

SPECIFICATIONS — PDL II Model AV-122	
Forward Gain	12 db over standard reference isotropic
Band Width	Full 40 Channels
Front-to-back ratio	32 db
Polarity Isolation	23 db Vertical to Horizontal
VSWR	1.2:1
Switch Box Included	Low VSWR co-axial changeover to effect switching horizontal to vertical.
Impedance	50-52 ohms
Directional Beam	Light or Medium duty rotor
Lightning Protection	D.C. Ground
Power Multiplication	16x
Wind Load Area	2.0 sq. ft.
Stacking kit available	

high performance CO-INDUCTIVE™ *antennas*

Avanti makes a complete line of high performance mobile CB antennas and accessories. For free catalog, write:

avanti

Avanti Research and Development, Inc., 340 Stewart Avenue, Addison, IL 60101

creators of the famous MOONRAKER®

CIRCLE 35 ON READER SERVICE COUPON

B&K-PRECISION's new 3½ digit DMM

For over two years, our competition has been trying to figure out how B&K-PRECISION could sell a full-feature 3-digit DMM for only $99.95. They've dissected it, analyzed it, and some even asked us how we did it. Well, they can start all over because we did it again!

B&K-PRECISION's new Model 2800 portable DMM features 3-1/2 digit display, auto-zeroing and 100% overrange reading for only $99.95. Basic DC accuracy is 1%. Twenty-two ranges read up to 1000 volts DC or AC, 1000mA and 10 megohms.

All ranges are well protected against overloads. Even if you should accidentally apply +1000VDC to the 2800 while switched to an ohms range, no instrument damage will result. All DC and AC voltage ranges are protected up to ±1000 volts DC or AC. The current ranges receive the double protection of diodes and a series fuse.

For accurate in-circuit resistance measurements, the 2800 measures with high– or low-power ohms ranges. At low-power ohms, less than 0.2 volt is developed across the measured resistance. To forward bias semiconductor junctions, the high-power ohms ranges develop about 2 volts.

B&K-PRECISION also has a full complement of optional accessories for the 2800. Accessories include a carrying case, wire tilt stand, AC adapter/charger, high-voltage probe, direct/isolation probe NiCad Batteries and 10-amp current shunt.

The B&K-PRECISION 2800 may be a mystery to our competitors, but for you—it takes all the mystery out of which DMM to buy.

See your local distributor for immediate delivery.

B&K PRECISION DYNASCAN CORPORATION

6460 West Cortland Avenue, Chicago, Illinois 60635 · 312/889-9087

In Canada: Atlas Electronics, Ontario · International Sales: Empire Exporters, Inc., 270 Newtown Road, Plainview, LI, NY 11803

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elementary electronics

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Cover photo by Neal Slavin

The Cobra 50XLR CB has it all. AM/FM Stereo. Cassette. And CB. All in one compact unit. All engineered to bring you the same loud and clear sound Cobra is famous for.

The remote mike houses the channel selector, squelch control, and channel indicator. So all you need for talking CB is right there in your hand. The cassette player features through the dial loading and four-way fader control.

Because they're only five inches deep, there's a Cobra in-dash radio to fit almost any car with little or no modification to the dash. This feature, plus the step-by-step Installation Manual and Universal Installation Kit makes them the easiest in-dash radios to install. An our Nationwide network of Author ized Service Centers makes them the easiest to service.

There are four Cobra in-dash models to choose from including AM/FM/Stereo/8-track/CB. But no matter which you choose you can be sure of getting the best sounding radio going. The ultimate car radio.

The Cobra.

Cobra®

Punches through loud and clear.

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DYNASCAN CORPORATION
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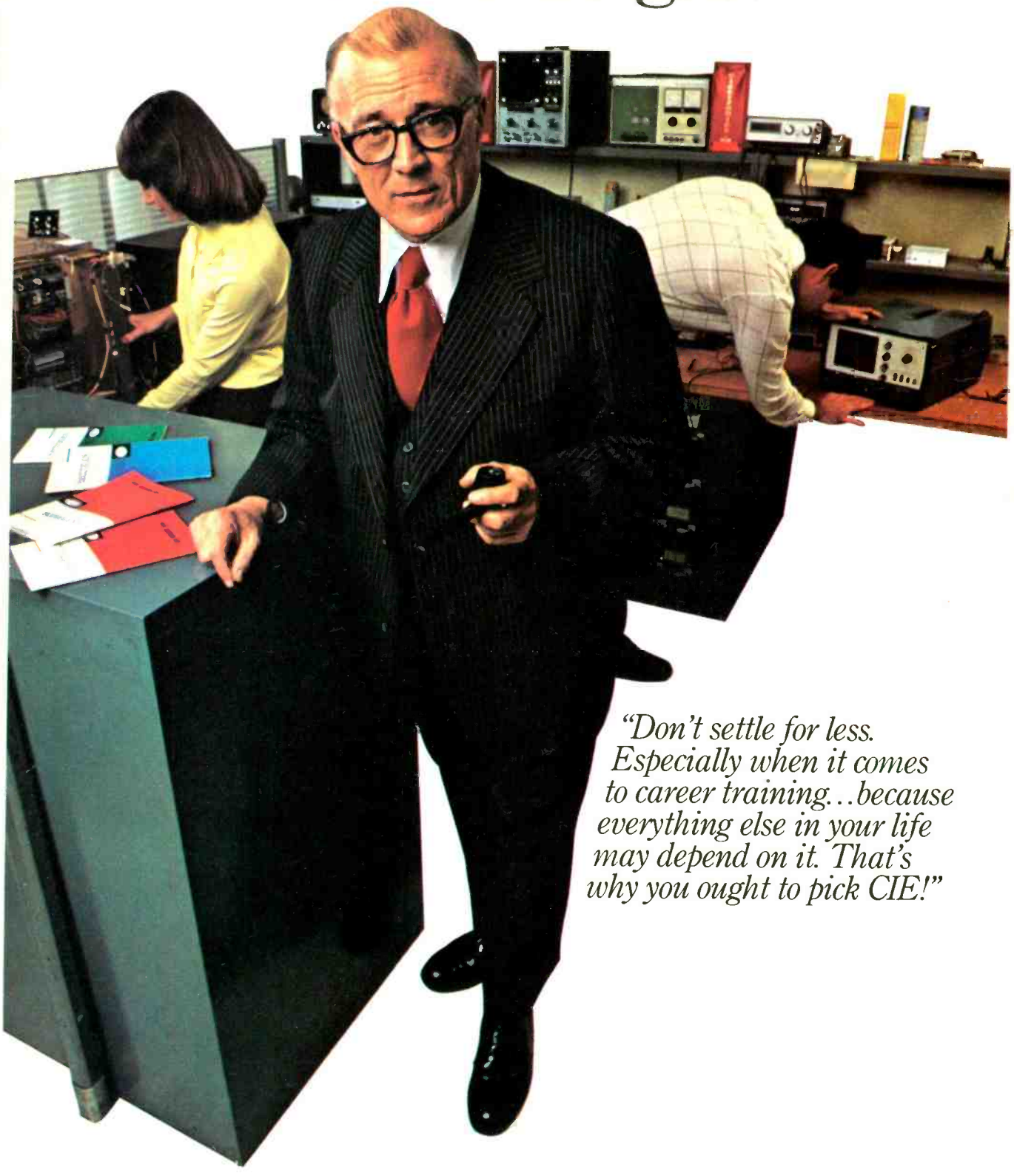
CIRCLE 9 ON READER SERVICE COUPON

THE ULTIMATE CAR RADIO.

"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 whole 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 cycle.

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!

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CIE training is not 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.

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Patterns shown on TV and oscilloscope screens are simulated.

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MAIL TODAY!

Hey, look me over

Showcase of New Products

Electronic Organ Kit

Here's a new kit for the aspiring musician in the family. The Heath TO-1860 is a kit-form version of the Thomas Troubadour 186. Features of the new organ kit include unique Color-Glo keys, preset chords, chord memory, automatic rhythms and more. A "Speakeasy Section" includes automatic arpeggio, automatic strum and "fancy fingers" which automatically plays a counter melody along with the music. The Troubadour also will allow you to play one or any combination of 17 different instrumental voices. Nine fully assembled, tested and tuned circuit boards greatly simplify assembly. The cabinet comes completely assembled of furniture-grade hardwoods, and a matching bench is included. For more information on the TO-1860 organ kit, mail order priced at $1,750.00, write for a free catalog to Heath Company, Dept. 350-510, Benton Harbor, MI 49022.

CIRCLE 31 ON READER SERVICE COUPON

Tone Arm Shell

Audio-Technica's new tonearm shell is what you need when you have more than one phono cartridge. The AT-N Universal tonearm shell, with a suggested retail price of $5.95, mates easily with the turntable tonearm for smooth installation and removal. Increasingly, audiophiles are buying two or more phono cartridges for special uses. An adult who

(Continued on page 11)

CIRCLE 61 ON READER SERVICE COUPON

You meet the nicest people on the upper 17.

The most serious CB'ers were the first to move from 23 to 40 channels. And the upper 17 are still their uncrowded province.

President Electronics never made a CB with fewer than 40 channels. We set out fresh to meet the FCC's tough new standards with new electronics and new ideas.

That's why every President has one of the most sophisticated compression circuits in CB—to assure consistent 100% modulation.

And why every President has power output circuits that are vastly improved over many old 23-channel designs.

So when you move up, move up to President.

And if you want to move all the way up, move up to the Madison—the most base station your money can buy.

Madison not only gives you 40 AM channels... it also gives you 40 upper and 40 lower sideband channels. And it gives you the extra range and performance you get only from superb SSB, with 12 watts of peak envelope power.

And it gives you all the controls you need for complete command of everything that comes out of or goes into the radio... And a digital clock with alarm to remind you of scheduled QSO's...

And a separate speaker for improved sound and improved convenience... And more.

We did, however, leave off the automatic ice maker.

Today, owning a 23-channel CB is like owning a mono record player—great nostalgia, but out of touch.

So get in touch with the upper 17.

There's room.

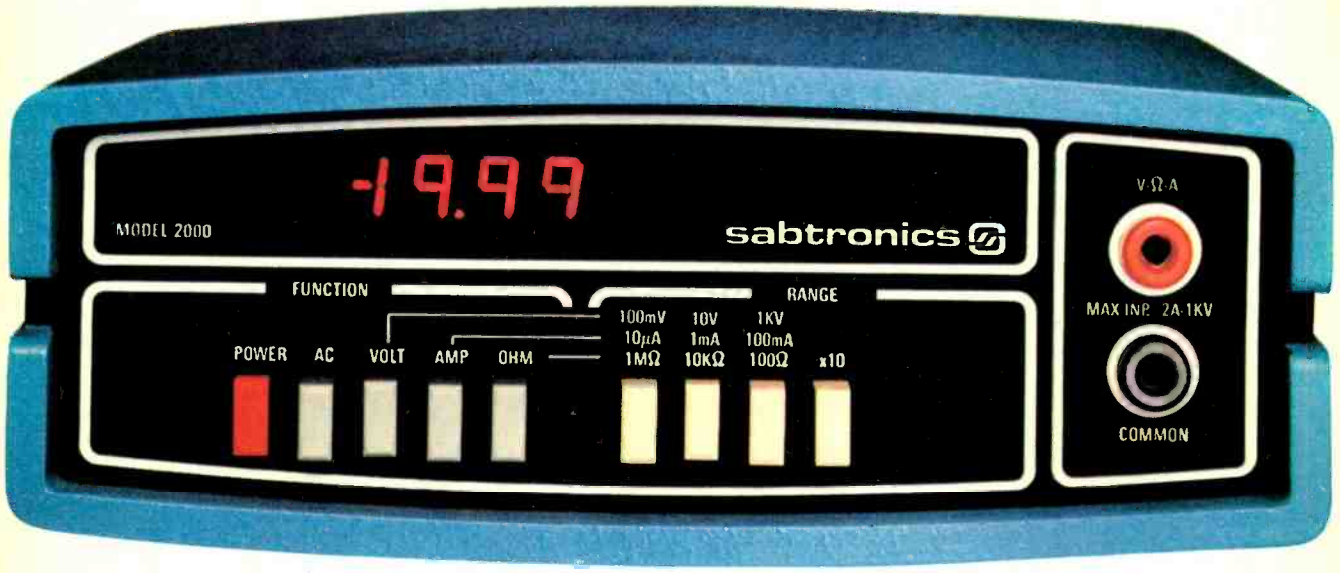
PRESIDENT

Engineered to be the very best.

President Electronics, Inc.
16691 Hale Avenue · Irvine, CA 92714 · (714) 556-7355
In Canada: Lectron Radio Sales Ltd., Ontario

CIRCLE 24 ON READER SERVICE COUPON

Uncompromising performance.
Incredible price.
A professional 3½ digit DMM Kit for less than $70.



Incredible? True! Professionals and hobbyists alike are believers in this Sabtronics 2000, the only portable/bench DMM which offers such uncompromising performance at the astonishingly low price of $69.95.

Uncompromising performance you'd expect only from a specialist in digital technology such as Sabtronics: Basic DCV accuracy of 0.1% ± 1 digit; 5 functions giving 28 ranges; readings to ±1999 with 100% overrange; overrange indication; input overload protection; automatic polarity; and automatic zeroing.

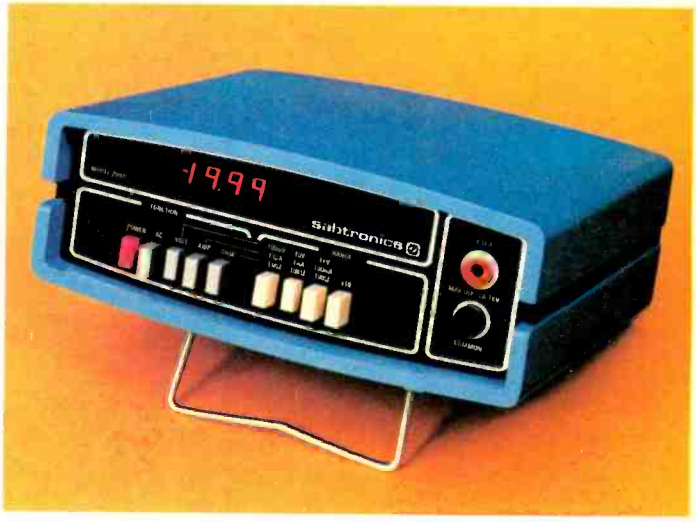
The low price of $69.95? Simple: The Model 2000 is all solid-state, incorporating a single LSI circuit and high-quality components. You assemble it yourself, using our clear, easy-to-follow, step-by-step assembly manual. Kit is complete, including a high-impact case.

Now you too can have it! A professional-quality, 3½ digit Sabtronics Model 2000 DMM kit for only $69.95. If you don't have one in your lab, use the coupon below to order NOW.

BRIEF SPECIFICATIONS:
DC volts in 5 ranges: 100 μV to 1 kV · AC volts in 5 ranges: 100 μV to 1 kV · DC current in 6 ranges: 100 nA to 2 A · AC current in 6 ranges: 100 nA to 2 A · Resistance: 0.1 Ω to 20 MΩ in 6 ranges · AC frequency response: 40 Hz to 50 kHz · Display: 0.36" (9,1 mm) 7-segment LED · Input impedance: 10 MΩ · Size: 8" W x 6.5" D x 3" H (203 x 165 x 76 mm) · Power requirement: 4 "C" cells (not included).

GUARANTEE:
Examine the 2000 DMM kit for 10 days. If not completely satisfied, return unassembled for full refund of purchase price. (Less shipping and handling)

Use your Master Charge or Visa.
To order by phone call: (214) 783-0994



Made in U.S.A.

To: Sabtronics International, Inc. EE 6
13426 Floyd Circle, Dallas, TX 75243

Please send me_____ Sabtronics Model 2000 DMM kit(s)
at $69.95 each..... $_____
Shipping and handling, $5.00 per unit* $_____
Texas Residents Add Sales Tax $_____
TOTAL enclosed $_____

Name_____

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*USA only. Canada $6.50. All other countries, $10.00 (surface mail)

sabtronics INTERNATIONAL INC.
13426 Floyd Circle • Dallas, Texas 75243

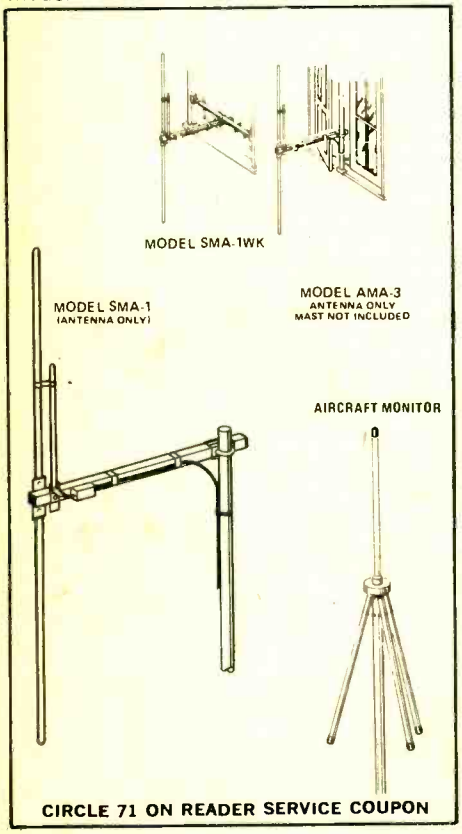
HEY, LOOK ME OVER

(Continued from page 8)

shares his audio equipment with younger family members might keep a lower cost, rugged cartridge on hand for their use and for parties, where the turntable may be jostled. The AT-N tonearm shell fits virtually all Japanese- and most European-made tonearms. For more information, write to Audio-Technica U.S., Inc., 33 Shiawassee Avenue, Fairlawn, OH 44313.

Scanner-Monitor Antenna

FINCO offers a new and different line of Sanner-Monitor antennas called the SMA line and an Aircraft Monitor AMA line. Reading up the SMA series of omni-directional Scanner-Monitor antennas, is the model SMA-1 for operation in the Lo-VHF 30- to 50-MHz, Hi-VHF 148- to 174-MHz, and UHF 450- to 512-MHz frequencies. The unit operates as a ½-wave dipole in the Lo-VHF Band, as a 3/2 wave dipole in the Hi-VHF Band, and as a "J" stub in the UHF Band. ($8.95). The model SMA-1K is identical to the SMA-1,



CIRCLE 71 ON READER SERVICE COUPON

but includes a kit with 65-ft. of coaxial cable with a connector and weather boot on one end. ($17.95). The model SMA-1WK is identical to the SMA-1, but includes 18-ft. of coaxial cable with connector and weather boot on one end and a complete window mounting kit. ($21.95). The aircraft monitor model AMA-3 is an omni-directional antenna tuned for the 108- to 138-MHz aircraft frequencies. The unit operates as a ½-wave omni-directional ground plane. ($20.95). For further information, write The Finney Company, 34 W. Interstate Street, Bedford, OH 44146.

Small but Good

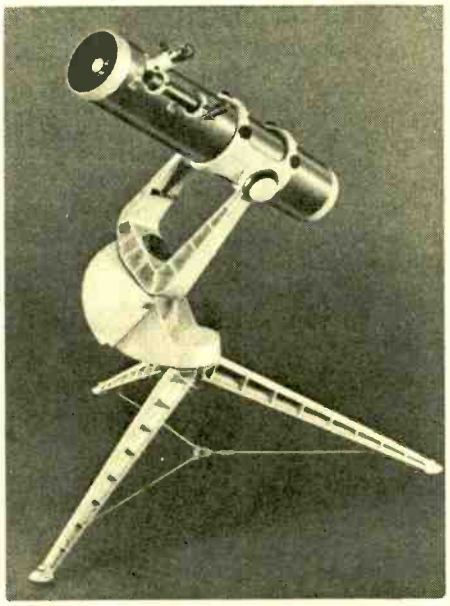
NLS has added a low cost, miniature, cathode ray oscilloscope to their line of test equipment. The MS-15 Miniscope weighs only three pounds, is physically small at 2.7-in. high by 6.4-in. wide by 7.5-in. deep and sells for $289.00. The vertical bandwidth is 15 megahertz. Internal and external triggering are provided

CIRCLE 77 ON READER SERVICE COUPON

along with automatic- and line-synchronization modes as well as a horizontal input. There are 12 vertical-gain settings from 0.01 volts to 50 volts per division. Twenty-one time-base settings from 0.1 microseconds- to 0.5 seconds-per-division are included. An optional 10 to 1 probe and a carrying case are also available. For more info on the MS-15, write to Non Linear Systems Inc., P.O. Box N, Del Mar, CA 92014.

Telescope Designed for Amateurs

A compact, easy-to-use 6-in. f/6 Newtonian telescope, designed by astronomers for amateur and professional observers alike, is now available from Edmund Scientific. The Telescope features compact portability, superior optics and sophisticated adaptability to many astronomical applications, especially astrophotography. Its lightweight, cast-aluminum alloy equatorial yoke mount and



CIRCLE 59 ON READER SERVICE COUPON

stable tension-tripod base fold compactly for easy storage and transporting. Its 5- to 85-degree latitude adjustment make it suitable for use throughout the world. Capable of revealing stars as faint as 13th magnitude and splitting double stars separated by as little as ¾ second of arc, its superior ⅛ wave optics feature a precision-annealed, aluminized and over-coated 6-in., f/6 parabolic primary

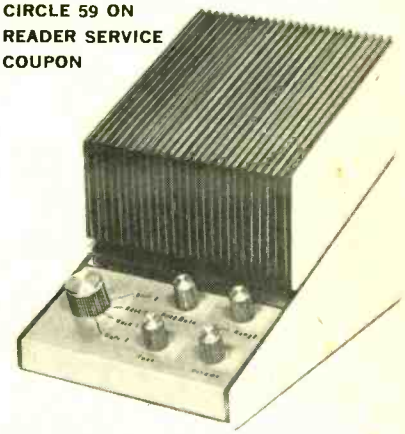
HEY, LOOK ME OVER

mirror and large, fully adjustable, ⅛ wave elliptical diagonal mirror. Its standard equipment includes: synchronous clock drive; self-lubricating, low-friction bearings on both R. A. and Declination axes; fine adjustment declination control; engraved, easy-to-read drum setting circles; standard 1¼-in. I.D. rack and pinion focusing mount; newly designed and ray-traced Edmund 28mm, 33X RKE Eyepiece; quick-release tube and polar angle adjustment knobs; and a unique cradle-design that accepts accessory mounts. The complete Edmund 6-inch f/6 Telescope System (stock no. 3001) sells for $399.00 T.C.C., and is available by mail from Edmund Scientific Co., 7782 Edscorp Bldg., Barrington, NJ 08007. Parts are available for those who would rather do it themselves.

Sound Conditioner

Sound conditioning helps increase the personal comfort level by modifying the severity and annoyance of noises beyond our normal control. Edmund's new Sound Conditioner helps mask unwanted noise while adding restful, interesting background sounds. Used by light sleepers, daytime sleepers and travelers, it electronically simulates the soothing sounds of ocean surf, falling rain and a rushing

CIRCLE 59 ON READER SERVICE COUPON



waterfall. The Sound Conditioner contains a five-in. diameter speaker, three modulating controls, on/off volume switch, and a four-sound channel selector that adjusts for most situations and for personal taste. The waterfall sound produces a deep Niagara Falls roar and is intended for blocking out loud noises. Operates on 115/230V AC, 50-60 Hz current. The Sound Conditioner can be ordered by mail (stock no. 72,293) $129.95 postpaid, plus $1.00 for handling, from Edmund Scientific, 7782 Edscorp Bldg., Barrington, NJ 08007.

Pinball Machine Kit

Heath is offering the Bally Fireball home pinball machine in kit form. Building the machine from a kit results in substantial cost savings over the assembled models. The Fireball machine features all solid-state electronics and a built-in computer which controls the game. Scores are displayed on a bright red LED readout and a special computer synthesizer plays dif-

(Continued on page 14)

BUILD 20 RADIO and Electronics Circuits

PROGRESSIVE HOME RADIO-T.V. COURSE

Reg. U.S. Pat. Off.

Training Electronics Technicians Since 1946

Now Includes

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

- ★ No Knowledge of Radio Necessary
- ★ No Additional Parts or Tools Needed
- ★ Solid State Circuits
- ★ Vacuum Tube Circuits

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

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

You will learn how to build radios, using regular schematics; how to wire and solder in a professional manner; how to service radios. You will work with the standard type of punched metal chassis as well as the latest development of Printed Circuit chassis.

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

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

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

THE KIT FOR EVERYONE

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

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

PROGRESSIVE TEACHING METHOD

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

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

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

THE "EDU-KIT" IS COMPLETE

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

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

FREE EXTRAS

• SET OF TOOLS

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

SERVICING LESSONS

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

FROM OUR MAIL BAG

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

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

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Today an electronics technician or hobbyist requires a knowledge of solid state, as well as vacuum tube circuitry. The "Edu-Kit" course teaches both. You will build vacuum tube, 100% solid state and combination ("hybrid") circuits.

PRINTED CIRCUITRY

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

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

Progressive "Edu-Kits" Inc., 1189 Broadway, Dept. 590 DJ Hewlett, N.Y. 11557

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

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PROGRESSIVE "EDU-KITS" INC.

1189 Broadway, Dept. 590 DJ Hewlett, N.Y. 11557

CIRCLE 19 ON READER SERVICE COUPON

HEY, LOOK ME OVER

(Continued from page 12)

ferent tunes when bonuses or extra scores are made. Scores of each individual player, up to four at a time, are stored in the computer's memory and

displayed automatically. Bonus balls are also awarded automatically. A *skill* control allows programming the computer for beginner or advanced play. The full-color playfield is the same size as commercial machines, and has *thumper bumpers, sling shots* and player-controlled flippers for plenty of ball action. The mail order price of the pinball machine, designated by Heath as model GD-1110, is $699.95. For further information, write for a free catalog to Heath Company, Dept. 350-480, Benton Harbor, MI 49022.

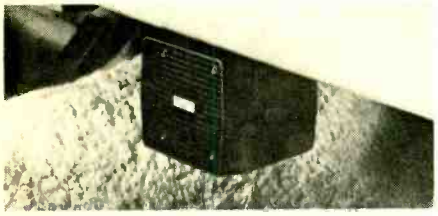
Pocket Digital Clock Radio

Travelers can count on "guaranteed wake-up" service with this new AM/FM clock radio from Sanyo. This trim unit, model RPM6800, is just one inch thick and less than six inches wide. It features a liquid crystal clock readout, LED tuning eye for AM and FM, seconds display and a PM indicator to help cure jet-

lag confusion. The alarm wakes the sleeper with short continuous bursts of a persistent beeping sound. To let you know that the alarm is set the word "Auto" appears on the clock face. The digits are always "on" but there is a small switchable lamp for viewing the face at night. The unit has a built-in AM antenna and telescoping FM antenna. Also included is an earphone jack and a foldaway tilt-up stand. The unit is powered by three penlight batteries and an included "long-life" lithium battery for the clock section. Suggested retail price is $69.95.

Economy CB Speaker

A new CB external speaker called the Krikette voice communications speaker, Model 3025, is said to provide voice clarity and intelligibility across the entire audio range. Its bracket permits mounting anywhere in a car, diesel tractor cab, pickup truck, van or recrea-



CIRCLE 65 ON READER SERVICE COUPON

tional vehicle. The Krikett speaker's sturdy, high-quality black plastic construction assures solid performance in extremely hot, cold, wet or dry weather conditions. It's designed for use in any mobile application including boats and airplanes, and may be associated with CB, single sideband, marine FM, ham radio or any other voice communcations system. It handles a full 5-watts RMS. Sells for $9.95. For further information, write to Acoustic Fiber Sound Systems, Inc., P.O. Box 50829, Indianapolis, IN 46250.

Anti-Static Record Mat

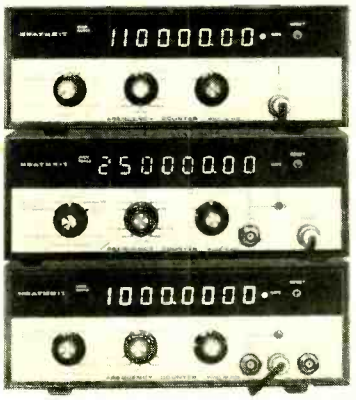
The anti-static mat, Audiotex Laboratories' newest record accessory, reduces static charge from records for static-free listening. Carbon fibers impregnated into the anti-static mat (30-8570) attracts

CIRCLE 63 ON READER SERVICE COUPON

static away from an album the moment it's placed on the mat. This action is reported to free the reproduction from static induced noises. The 12-inch diameter rubber mat may be used either as a turntable replacement mat or on top of the original mat. Sells for $3.29. Audiotex Laboratories manufactures a complete line of essential record care products and accessories. Get all the info direct from Audiotex Laboratories, Division of GC Electronics, 400 South Wyman, Rockford, IL 61101.

Trio Counters

Heath Company has introduced three new frequency counter kits; the IM-4110, the IM-4120 and the IM-4130. Input frequencies of the three counters are 5 Hz to 110 MHz, 5 Hz to 250 MHz (in two ranges) and 5 Hz to 1 GHz (in three ranges) respectively. The new counters offer excellent accuracy and resolution for a wide variety of counting jobs including: CB, AM and FM, hi-fi equipment, marine and aircraft radio, military applications, land mobile and more. Additionally, the counters can be used for events, period and period averaging. Eight digit LED readout indicates the frequency counted. A switchable attenuator on the 110 MHz input divides the input signal by one, ten or one hundred to facilitate measurement of large amplitude signals.



CIRCLE 31 ON READOR SERVICE COUPON

The time base switch selects the gate time and the resolution of the display. The 4120 and 4130 time bases are controlled by a TCXO (temperature compensated crystal oscillator) with a temperature stability of ± 1ppm and an aging rate of <5ppm/yr. (The 4110's crystal oscillator has temperature stability of ± 10ppm and an aging rate of <10ppm /yr.). The IM-4110 is priced at $189.95, the IM-4120 at $329.95 and the IM-4130 at $529.95. The counters are also available fully assembled and tested at slightly higher prices. For complete details on these frequency counters and other Heath instruments, write Heath Company, Dept. 350-24, Benton Harbor, MI 49022, for a free catalog.

Getting Cheaper Instruments

The VIZ WD-751A is a general-purpose 3½-digit semi-autoranging liquid-crystal-display VOM operating on internal batteries or on AC line current with an adaptor. Its CMOS LSI circuitry is exceptionally stable, can't be damaged by

CIRCLE 75 ON READER SERVICE COUPON

momentary overloads, and, because of its very low power consumption, prolongs battery life. What's new about this product is that the price has been reduced from $179 to $150. Further information and data sheets are available from VIZ Test Instruments Group, VIZ Mfg. Co., 355 E. Price Street, Philadelphia, PA 19144. ■

BOOKMARK
BY BOOKWORM

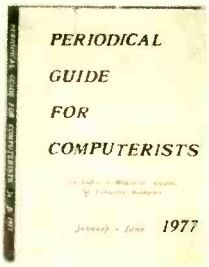
Super Satisfying Book. The last word on amateur single sideband has been reprinted by Ham Radio in cooperation with the Collins Radio Group. *SSB* offers Radio Amateurs fundamental information on single sideband circuits and techniques. Following a basic introduction to SSB, this colorful paperback edition further delves

Everything you ever wanted to know about SSB.

Soft Cover
131 pages
$4.95

into sideband explaining the nature of signals, exciters, RF-linear amplifiers, receivers, tests and measurements, and the elements of an Amateur SSB station. The book is a welcome source of practical knowledge that belongs on every Amateur's bookshelf. Available from many better radio stores or mail order from the Ham Radio Publishing Group, Greenville, NH 03048, for 35¢ additional for postage.

Where It's All At. *The January-June 1977 Periodical Guide for Computerists* indexes 1,080 articles from 23 hobby and professional computer publications. Articles, editorials, book reviews, and letters from readers which have relevance to the personal computing field are indexed by subject under 90 categories. The *32 page book* is



Indexes 23 publications for all levels of computer hobbyists.

Soft Cover
32 pages
$3.00

available postpaid for only *$3.00* from *E. Berg Publications, 1360 SW 199th Ct., Oloha, OR 97005* or from local computer stores. A January-December 1976 Guide is also available for $3.00 postpaid. By the time you read this, the ol' Bookworm is sure that the July-December 1977 index will be available.

Better than Eever. The American Radio Relay League has totally revised *Understanding Amateur Radio* into a new format. It was written by Jay Rusgrove, W1VD, Doug DeMaw, W1FB, and George Grammer, W1DF. The book is practically a complete beginner's course in the fundamentals of electronics. It will serve as a firm foundation for those who are preparing for amateur and commercial license exams. It can be used as a classroom textbook by those who are teaching basic electronics theory. The narrative is

A must for the amateur radio enthusiast's library.

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223 pages
$5.00

in simple language. Minimum emphasis has been placed on mathematics. The theory and application of vacuum tubes and transistors is covered, with maximum exposure of the latter. Included are theoretical and practical data on receivers, transmitters, power supplies, modulation methods, antennas, transmission lines, workshop techniques, assembling a station, and much more. *Understanding Amateur Radio* contains 15 informative and engrossing chapters. It is a book that no electronics technician or radio amateur should exclude from his library. The size is 8¼ by 10½ inches. Published by the American Radio Relay League, Inc., Newington, CT 06111.

8080 Debugging Program. *DBUG: An 8080 Interpretive Debugger,* a program for entering, debugging and storing assembly language programs by Christopher A. and Jonathan A. Titus is the first of the Bugbook Application Series on assembly language programming. DBUG permits the user to enter a program into an 8080 microcomputer memory and single-step it through, instruction by instruction. The DBUG program with supporting documen-

Step by step debugging of 8080 microcomputer software.

Soft Cover
100 pages
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tation is an aid for those who develop 8080 microcomputer software. With DBUG the user can enter and change data and program steps stored in random-access memory. After a program is entered, it can be single-stepped by using the break point to observe the effect of a particular instruction on each of the 8080's internal registers. DBUG steps through one complete instruction regardless of the number. User guidance information and examples of DBUG applications are included in the book. For your copy, write to E & L Instruments, Inc., 61 First St., Derby, CT 06418. ■

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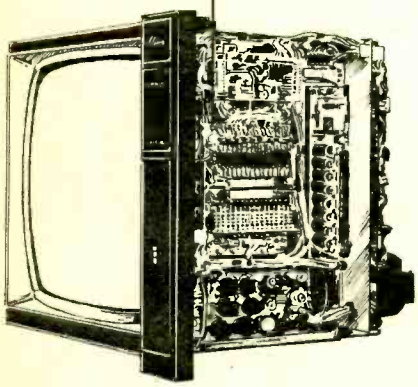
CIRCLE 20 ON READER SERVICE COUPON

Four different schools give you this 25" DIAGONAL hobby-kit Color TV...



No other home training school gives you both an exclusive solid state color TV and an SQ® Quadraphonic Receiver complete with four speakers . . . all in one course. You get both for less than the tuition cost of TV or Audio alone from the next leading school. And only NRI's Master Course in Color TV/Audio servicing lets you train on equipment designed specifically for training with exclusive "power-on" features.

NRI doesn't give you hobby kits or commercial sub-assemblies. We invested the time and money to design equipment with learning in mind.

Only NRI gives you this 25" DIAGONAL designed-for-learning Color TV...

It's the only way you can (1) get the feel of typical commercial circuitry, (2) learn bench techniques while building complete units from the "ground" up, (3) perform over 35 "in-set" experiments during construction, and (4) end up with a 25" diagonal solid-state color TV with console cabinet *and* a 4-channel quadraphonic Audio Center.

NRI passes the savings on to you

NRI can save you money because our engineering eliminates the cost of buying from an outside source. We pay no salesman's commission. Students are enrolled by mail only. The savings are passed on to you in the form of low tuition fees, extras like the TV's console cabinet and the four speaker Quad System; a 5" triggered sweep oscilloscope, CMOS digital frequency counter, and an integrated circuit color TV pattern generator. Where NRI supplies a professional color

pattern generator, most other schools use a TV set with a built in alignment generator of no use for servicing other sets. Only NRI designs, engineers, and supplies training kits specifically for learning and professional use. You can pay hundreds of dollars more for a similar course and not get a nickel's worth more in training and equipment.

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...plus complete Quadraphonic Audio Center!

More know-how per dollar

That's what it all boils down to, the quality of training you get for the money you spend. In our 62-year history, more than a million students have come to NRI and we're fully approved for career study under the G.I. Bill. We must be teaching something right.

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Widest Choice of Courses with CB, Digital Computer, and other career opportunities

NRI offers not one, but five excellent TV/Audio servicing courses so you can tailor your training to your budget.

Or you can study other opportunity fields like Digital Computer Electronics, Citizens Band Radio, Communications, Aircraft or Marine Electronics, Mobile Radio, and more. Send for our free catalog and see for yourself that no one gives you more training and equipment for your dollar. There's no obligation, and no salesman will call.

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DX central reporting

A world of SWL info!

BY DON JENSEN

☐ Shortwave listening DXers often like to measure their progress in terms of how many stations, or how many countries they have managed to hear. In one's first year as an SWL, the log book totals might show 25, 50, 100 stations or countries heard. The next year there will be another benchmark of progress.

One North American DXer has tallied around a thousand different shortwave broadcasting stations in the past 25 years. Several have QSLs from more than 200 different countries after many years of trying to collect them from the stations they log.

H.A.C. Back when Dxing started, say a half century ago or so, there was another measure commonly used by radio listeners. This was HAC . . . Heard All Continents. In those days there were fewer shortwave stations around the globe and many of them were very low powered. It was a real challenge to tune shortwave stations on each of the continents—Africa, Asia, Europe, North and South America and Australia/Oceania.

Times have changed; no longer is HAC a challenge. Now it is possible to hear stations from the six continents in a single day thanks to high powered shortwave transmitters. There are a number of different combinations of stations that will give you HAC, but here is one rather easy-to-hear set:

Africa: South Africa's Radio RSA is a regular catch in all of North America. You can find this station signing on in English at 2230 GMT on 11,800 kHz.

Asia: Radio Peking is another sure bet to check off another continent. The Chinese station can be heard on 15,060 kHz in an English service to North America beginning at 0000 GMT.

Europe: There are many possibilities here. Why not SBC, the Swiss Broadcasting Corporation at Berne, Switzerland. You should find good signals on 9,590 kHz with English programming at 2100 GMT.

North America: Our choice on our home continent is Radio Canada International, the foreign service of our northern neighbor. Try 9,640 kHz at 0100 GMT for English broadcasts.

South America: The best known, and probably the easiest to hear of the South American stations is HCJB, the Voice of the Andes in Quito, Ecuador. During most of the evening, say 0100-0400 GMT, listen in on 9,560 kHz.

Australia/Oceania: The "Down Under" continent and the many islands of the Pacific, I lump them together as the sixth continent for HAC purposes. The target here is Radio Australia. There are many possible times to tune and many frequencies. A good one for early risers is 5,995 kHz anytime between about 0800 and 1300 GMT.

Easy? For many of you that is true. In a period of just under 12 hours, you see, you can log HAC. Okay then, try to make HAC with a harder, lower powered set of stations!

Africa: Radio Garoua is one of the regional domestic shortwave stations in the West African country of Cameroon. Listen for this one at sign-on time, shortly after 0500 GMT on 5,010 kHz. Programming is in French and English.

Asia: The nation of Malaysia is made up of three separate geographical entities. There is the Malayan peninsula, plus the areas of Sabah and Sarawak on the island of Borneo. Radio Malaysia-Sarawak at Kuching runs 10 kilowatts of power. Check for this one on 5,005 kHz, with transmitter at Sibu, during the early morning time slot, between 1000 and 1500 GMT. This can be quite tough!

Europe: The lower powered shortwave voices are the home service outlets, such as Sudwestfunk, at Rohrdorf, West Germany, which runs 20 kilowatts of power. The frequency is 7,265 kHz and you can try for this one about 0200 GMT, with programming in German.

North America: In this, lower powered version of HAC, we again turn to a Canadian station for our own continent. The target is CFCX in Montreal, which relays the programs of its CFCF medium wave outlet on shortwave. The frequency is sometimes blocked by other stations, including the BBC relay on Ascension Island, but when it is free of interference you should find CFCX on 6,005 kHz.

South America: There are literally hundreds of potential targets south of the Tropic of Cancer in our hemisphere. What shall it be? Well, how about Radio Colosal in Colombia, which broadcasts on 4,945 kHz and should be audible every night in Spanish programming.

Australia/Oceania: We can wrap up this HAC with Radio New Zealand, broadcasting throughout the night on 6,105 kHz. Listen between about 0500 and 1000 GMT for some good results.

You say you're still not satisfied? All right, then, here is a Very tough way to make your HAC!

Africa: Radio Hargeisa, a regional Somali station located in the city of Hargeisa. It has been heard occasionally on about 11,645 kHz at around 1500 GMT.

Asia: Kung Chun Broadcasting Station, also referred to as the Voice of the Chinese Air Force, which broadcasts from Taipei, Taiwan. It has been reported on the air on about 6,105-6,108 kHz during the early mornings in North America.

Europe: One of the rarest of the European stations is the Polish Pathfinders Station, 7,205 kHz, scheduled for broadcasting from 1100-1700 GMT, with broadcasts starting two hours earlier on Sundays. This station is operated by a Polish Boy Scout-like organization.

North America: Radio Huayacocotla has a tongue-twister of a name. This Mexican station also is quite difficult to hear, because of its "way-down" 120 meter band frequency of 2,390 kHz, and because of low transmitter power. Evenings would be the best time for U.S. and Canadian listeners to try this one.

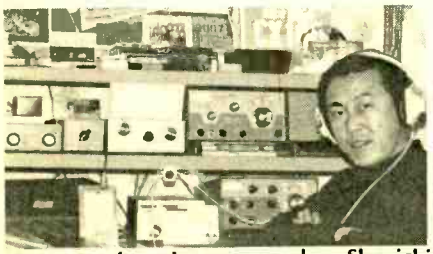
South America: A very, very difficult number is the Falkland Islands Broadcasting Service station at Stanley in the remote Falkland Islands of the far South Atlantic. It broadcasts on 2,370 kHz and when it is audible in North America it is in the 0000-0100 GMT time slot. But it has been reliably reported here only two or three times since 1958!

Australia/Oceania: Radio Cook Islands is one of the glamour stations of the past year. It was last reported on 5,045 kHz around the 0700 to 0800 GMT period and it has been heard by quite a number of DXers in recent months.

Now that makes a tough six-continent HAC. But as long as we're on the hard-to-hear items, let's add the seventh continent . . . Antarctica!

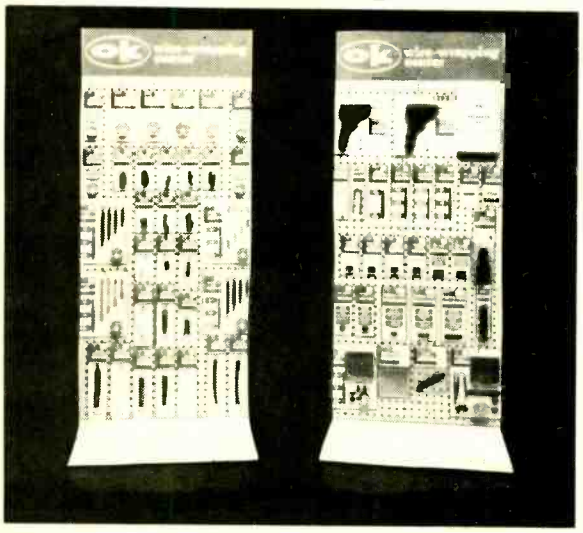
Yes, there is a shortwave outlet on the frozen continent. It is AFAN, the American Forces Antarctic Network outlet on 6,012 kHz, which programs for military personnel and civilian scientists stationed at McMurdo base and other Antarctic outposts. It can be heard, usually in the Fall, around 1000 to 1200 GMT.

Our "challenge" HAC is ultra tough, no mistake about that. But each of those seven stations has been heard in the U.S. or Canada. ■

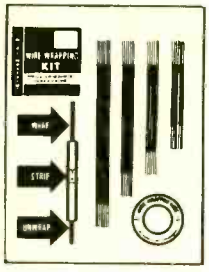


Meet one of our Japanese readers, Shunichi Sekiya, who lives in Tokyo. Sharp-eyed readers will note the American-made Drake receivers in Shunichi's impressive set-up.

ok® wire wrapping center



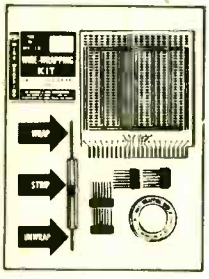
for quality electronic parts and tools.



WIRE-WRAPPING KITS

Contains: Hobby Wrap Tool WSU-30, (50 ft.) Roll of wire Prestripped wire 1" to 4" lengths (50 wires per package) stripped 1" both ends.

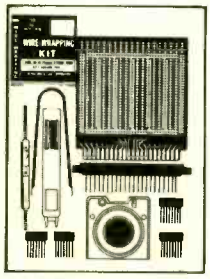
Wire Wrapping Kit, (Blue)	WK-2-B	$12.95
Wire Wrapping Kit, (Yellow)	WK-2-Y	$12.95
Wire Wrapping Kit, (White)	WK-2-W	$12.95
Wire Wrapping Kit (Red)	WK-2-R	$12.95



WIRE-WRAPPING KIT

Contains: Hobby Wrap Tool WSU-30, Roll of wire R-30B-0050, (2) 14 DIP's, (2) 16 DIP's and Hobby Board H-PCB-1.

Wire-Wrapping Kit	WK-3B (Blue)	$16.95



WIRE-WRAPPING KIT

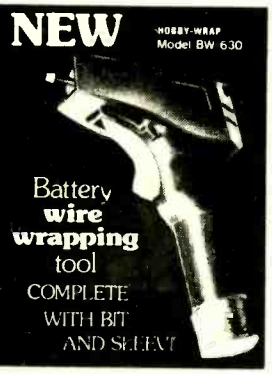
Contains: Hobby Wrap Tool WSU-30 M, Wire Dispenser WD-30-B, (2) 14 DIP's, (2) 16 DIP's, Hobby Board H-PCB-1, DIP/IC Insertion Tool INS-1416 and DIP/IC Extractor Tool EX-1

Wire-Wrapping Kit	WK-4B (Blue)	$25.99

HOBBY WRAP TOOL

Wire-wrapping, stripping, unwrapping tool for AWG 30 on .025 (0,63mm) Square Post.

Regular Wrap	WSU-30	$6.95
Modified Wrap	WSU-30M	$7.95



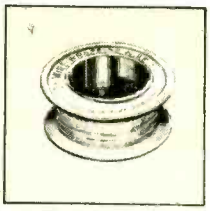
WIRE-WRAPPING TOOL

For .025" (0,63mm) sq. post "MODIFIED" wrap, positive indexing, anti-overwrapping device.

For AWG 30	BW-630	$34.95*
For AWG 26-28	BW-2628	$39.95*

Bit for AWG 30	BT-30	$3.95
Bit for AWG 26-28	BT-2628	$7.95

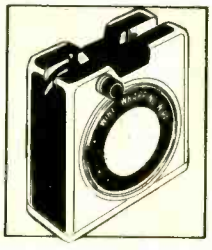
*USE "C" SIZE NI-CAD BATTERIES (NOT INCLUDED)



ROLLS OF WIRE

Wire for wire-wrapping AWG-30 (0.25mm) KYNAR® wire, 50 ft. roll, silver plated, solid conductor, easy stripping.

30 AWG Blue Wire, 50ft. Roll	R-30B-0050	$1.98
30 AWG Yellow Wire, 50ft. Roll	R-30Y-0050	$1.98
30 AWG White Wire, 50ft. Roll	R-30W-0050	$1.98
30 AWG Red Wire, 50ft. Roll	R-30R-0050	$1.98



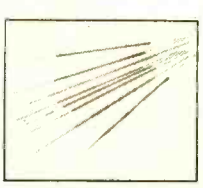
WIRE DISPENSER

- With 50 ft. Roll of AWG 30 KYNAR® wire-wrapping wire.
- Cuts the wire to length.
- Strips 1" of insulation.
- Refillable (For refills, see above)

Blue Wire	WD-30-B	$3.95
Yellow Wire	WD-30-Y	$3.95
White Wire	WD-30-W	$3.95
Red Wire	WD-30-R	$3.95

PRE CUT PRE STRIPPED WIRE

Wire for wire wrapping, AWG-30 (0.25mm) KYNAR® wire, 50 wires per package stripped 1" both ends.



30 AWG Blue Wire, 1" Long	30-B-50-010	$.99
30 AWG Yellow Wire, 1" Long	30-Y-50-010	$.99
30 AWG White Wire, 1" Long	30-W-50-010	$.99
30 AWG Red Wire, 1" Long	30-R-50-010	$.99
30 AWG Blue Wire, 2" Long	30-B-50-020	$1.07
30 AWG Yellow Wire, 2" Long	30-Y-50-020	$1.07
30 AWG White Wire, 2" Long	30-W-50-020	$1.07
30 AWG Red Wire, 2" Long	30-R-50-020	$1.07
30 AWG Blue Wire, 3" Long	30-B-50-030	$1.16
30 AWG Yellow Wire, 3" Long	30-Y-50-030	$1.16
30 AWG White Wire, 3" Long	30-W-50-030	$1.16
30 AWG Red Wire, 3" Long	30-R-50-030	$1.16
30 AWG Blue Wire, 4" Long	30-B-50-040	$1.23
30 AWG Yellow Wire, 4" Long	30-Y-50-040	$1.23
30 AWG White Wire, 4" Long	30-W-50-040	$1.23
30 AWG Red Wire, 4" Long	30-R-50-040	$1.23
30 AWG Blue Wire, 5" Long	30-B-50-050	$1.30
30 AWG Yellow Wire, 5" Long	30-Y-50-050	$1.30
30 AWG White Wire, 5" Long	30-W-50-050	$1.30
30 AWG Red Wire, 5" Long	30-R-50-050	$1.30
30 AWG Blue Wire, 6" Long	30-B-50-060	$1.38
30 AWG Yellow Wire, 6" Long	30-Y-50-060	$1.38
30 AWG White Wire, 6" Long	30-W-50-060	$1.38
30 AWG Red Wire, 6" Long	30-R-50-060	$1.38

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CIRCLE 22 ON READER SERVICE COUPON

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Electronics in the News!

Putting Air in the Ground

By putting air where plastic used to go in wire insulation, Western Electric is saving over 50-million pounds of precious plastic and other petroleum derived products a year. A new high-speed process for manufacturing foam insulated wire that promises to lead to a whole new generation of telephone cables.

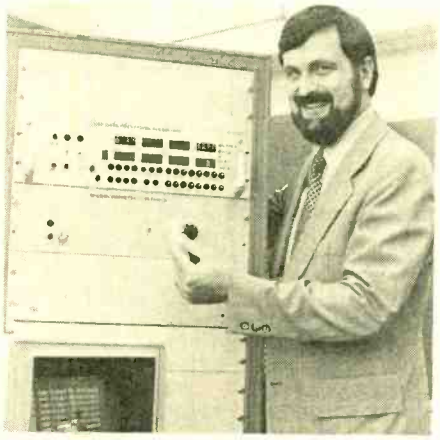
Jointly developed by Western Electric and Bell Laboratories, DEPIC (for *D*ual *E*xpanded *P*lastic *I*nsulated *C*onductor), the new cable technique is already saving telephone companies millions of dollars a year in buried cable costs.

Single conductors of DEPIC cable have a dual plastic coating consisting of a foamed core within a relatively thin (2.0 mil) solid skin. About 40 to 50 percent of the core consists of air cells. Unpigmented, the foam is extruded from pellets of high-density polyethylene which contain chemical blowing agents. The thin outer skin—also made of high density polyethylene—contains pigments for all the standard colors telephone company installers need to identify wire pairs within cables. This skin is necessary because foam insulation alone would be too susceptible to mechanical damage, would have too low a breakdown voltage and because it would interact too easily with the filling compounds used to make waterproof cable.

Western Electric's Georgianne Gerald doesn't really need the scales to tell her that the section of DEPIC telephone cable closest to her is much lighter than the section of conventional cable to the left.

Data Encryption Chip

A small but vital microelectronic chip only 1-cm. square has been tested and validated at the Commerce Department's National Bureau of Standards (NBS)—marking the first NBS validation of a commercial implementation of the Federal Data Encryption Standard. With approximately 10,000 electronic components in its silicon chip, the device is capable of enciphering or deciphering 64 bits of computer data in 40 microseconds. The metal-oxide semiconductor device was developed by Rockwell International's Collins Group. Other companies, among them IBM and



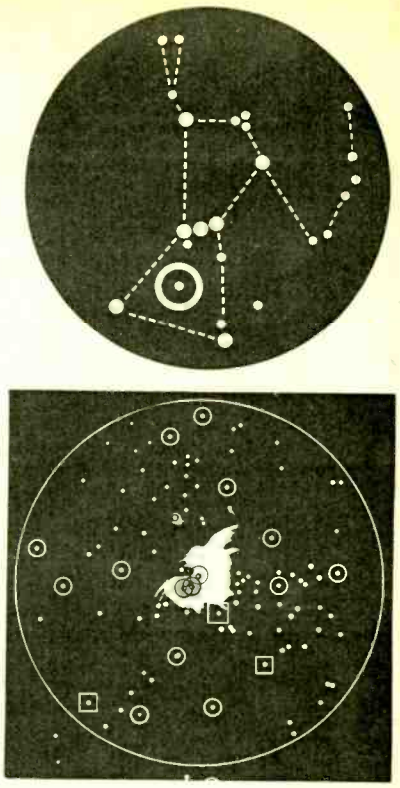
Security against theft or misuse of computer data is the object of new encryption systems that will use a chip such as that held in Dr. Dennis Branstad's hand. The chip, made up of 10,000 electronic components, can scramble or unscramble 64 bits of computer data in 40 microseconds.

Motorola, Inc., have announced their intention to build data encryption hardware for NBS validation under the Federal standard, designed for use by Federal departments and agencies in protecting valuable or sensitive computer data during transmission.

Additional standards are being developed for applying data encryption to communications and data storage systems. Besides these anticipated uses, according to Dr. Dennis K. Branstad, NBS project leader for the data encryption standard, are applications in personal identification systems and in visa validation procedures. "The devices will be commercially available for use outside the government in operations requiring computer security, as in electronic fund transfers, credit card verification, and proprietary data transfer," Branstad notes.

Computing Star Formation

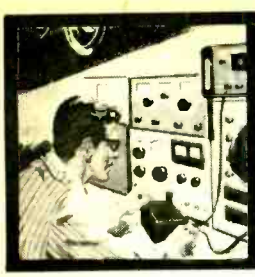
The constellation Orion contains not only stars but also an enormous interstellar cloud of carbon monoxide. Computer-aided studies, performed at the University of South Florida, of both the stars and their surrounding cloud have produced evidence supporting a controversial theory that stars are being formed at many different points throughout the cloud as it collapses.



Computer-aided studies of a nebula within the constellation Orion have produced evidence supporting a theory that stars are being formed at many different points throughout the cloud as the cloud collapses. The top figure is a diagram of the entire constellation, with the approximate location of the nebula and gas cloud outlined. Below is an enlargement of this area, in which the large circle indicates the approximate extent of the invisible gas cloud beyond the nebula. The small circles indicate where some of the stars found to have been formed from the cloud are located. The small squares indicate some of the reference stars used to determine the motions of the stars.

Conventional theory holds that stars can be born only in the dense center of the cloud, where matter is packed more tightly. The new evidence, at least in the case of Orion, indicates that the gas cloud is collapsing toward a common center, and that stars have formed in the dilute outer portions of the clouds as well as in the dense center.

The star motions were measured using a sophisticated plate overlap technique only recently made possible by the availability of powerful computers. Using an IBM computer, a System/360 Model 65 at the University of South Florida, the scientists analyzed 140 candidate stars in two groups of photographic plates taken 40 or more years apart. ■



Ask Hank, He Knows!

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

Hank Scott, Workshop Editor
ELEMENTARY ELECTRONICS
229 Park Avenue South
New York, NY 10003

What's Inside

What size resistor is in a standard spark plug?

—E. D., Boulder, NV

A resistor of about 5000 ohms is deeply inserted into the center electrode of a spark plug to minimize radio noise interference.

Wants a Lot for Nothing

My question is why can't diode radios that don't take any source of voltage be used with speakers?

—C. M., Orangeburg, SC

You could drive a 5-inch PM speaker, if your receiver and antenna were near a radio station tower, but at a distance, the power received is measured in microwatts. There's enough to give low volume from a headset, but that's it.

He Hears Voices

Got a question for you, Hank. Is there a receiver miniaturized enough to be put in right next to your middle ear by putting up through the eustachian tube? Reason is I started hearing voices and started thinking I was going nuts. Then a guy with a CB linear near blew my head off. Instant relief. But I would like to know where the jackass that did it bought 'em. So, if you could find out for me, I would appreciate it.

—N. N., Durango, CO

Sounds like you have galena crystals in your head! Did you have any dental work done lately?

Your case is not unusual. It has happened before. However, some doctors may not believe you, so take a portable CB with you and have the doctor's nurse call off names of flowers into the CB where you can't hear it. Once he believes you, then they can look for the remedy.

As for a receiver stuck in your head—no such thing.

One Size Fits All

Is it wrong to use overrated components in a project? For example, I used an 1-A rectifier in a circuit where 50 mA current is required. I used a few one-watt resistors (only because I had them) in place of ¼-watt resistors, etc.

—L. M., Ithaca, NY

No, it's not wrong most of the time! However, you'll find the project being a bit bulkier than it should be. This may be a problem in RF projects. As a rule, I buy only 1-ampere rectifying diodes because they do about 99 percent of the jobs required of a diode. You can save lots of money by making bulk purchases and using what you have and not buying odd-valued parts.

I Like to Solder

Hank, I heard that those new crimp-on antenna connectors aren't much good. Do you agree?

—J. O., Reno, NV

I don't know who you are listening to, but tune him out. The new crimp-on jobs are quite good. I found that some cable assemblies have their center tips soldered and some do not. So, I solder every unsoldered tip I come across. Actually, I never had any problems, but I'm fussy that way.

Antique Restorer

Hank, I am active in restoring antique radios not only for myself, but for my friends, also. I need a source of schematic diagrams and technical data that I can call on. I don't mind paying a small fee. Can you help me?

—D. F., Tulsa, OK

Schematic diagrams and service information on specific radio and TV sets are available at a nominal charge from Supreme Publications. Supreme is able to supply such information from its own service manuals, from its extensive files of factory data going back to the 1920's, and from manuals of other publishers. The charge is $1.50 and up, and the usual charge is $2.50. James Lynch told me over the phone, "Each request for material is a challenge to us, and while most items can be easily and quickly filled, at times our Mr. Beitman (who has been connected with diagrams and servicing for 40 years) spends an hour to find a hard one. 'It's fun,' so he says." It is good to know that there is a large organization ready to supply service material on a radio or a TV set you may find hard to repair and for which you do not have a diagram and other helpful service data. Write Supreme Publications, 1760 Balsam Road, Highland Park, IL 60035.

Lend a Hand

The list is short this issue—not too many pals to help out. If you can help, please be sure to write.

Δ Sprague Tel-Ohmike Resistor & Condensor Analyzer, Model TO-3 manual specs and/or any printed information: send to Jim Dodson, 1305 So. 107th Ave., Apt. D, Tulsa, OK 74128.

Δ General Electric, Model L-640 Radio schematic diagram and manual: Howard E. Colbert of 810 So. 21 St., St. Joseph, MO 64601 would like to restore the unit he has and needs help.

Δ General Electric Tube Checker Model TC-3: operating instructions needed by Jim Rodwell, 1942 Mitten Ct., East Troy, WI 53120. ■

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Get into personal computing the right way with a powerful computer system from Heath. Start with the H8. It features 8-bit operation, fully expandable memory, a versatile 8080A CPU, and is the only machine in its price class that, due to its "intelligent" front panel and built in monitor program, can function without peripherals.

Next, add our 12" CRT video terminal. The H9 operates in three different modes, has a 67-key ASCII keyboard, and features a built in interfacing board to make hook-up a breeze.

Add "mass storage" with the ECP-3801 cassette recorder/player and cassette I/O and you've got a system that's ready to go wherever your programming skills take you.

Weigh yourself with electronic precision with our Digital Electronic "Weighing Machine"

Uses solid-state electronics and a strain-gauge transducer element like expensive laboratory scales. The GD-1186 features 300-lb. capacity, can be wired to give weight in pounds or kilograms, and has a bright, easy-to-read 4-digit LED display. It's battery operated so it's safe to use even after a shower. And for extra convenience, the GD-1186 comes with additional cable so you can mount the read-out most anywhere you desire.

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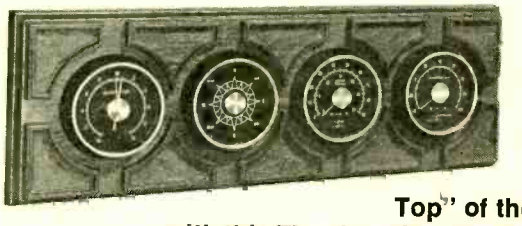

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Undoubtedly the finest AM/FM stereo receiver we've ever designed, the AR-1515 combines distinctive functional styling with excellent tuner performance, and a clean, powerful, amplifier section to give you a home entertainment center of unsurpassed quality. Power output is 70 watts, minimum RMS, per channel into 8 ohms with less than 0.08% total harmonic distortion from 20-20,000 Hz. FM sensitivity is an outstanding 1.8 μV for really clean and clear reception. And the AR-1515 is the only stereo receiver in its price range that provides digital frequency readout!

This SSB/CW Receiver is the one the Hams are enthused about!

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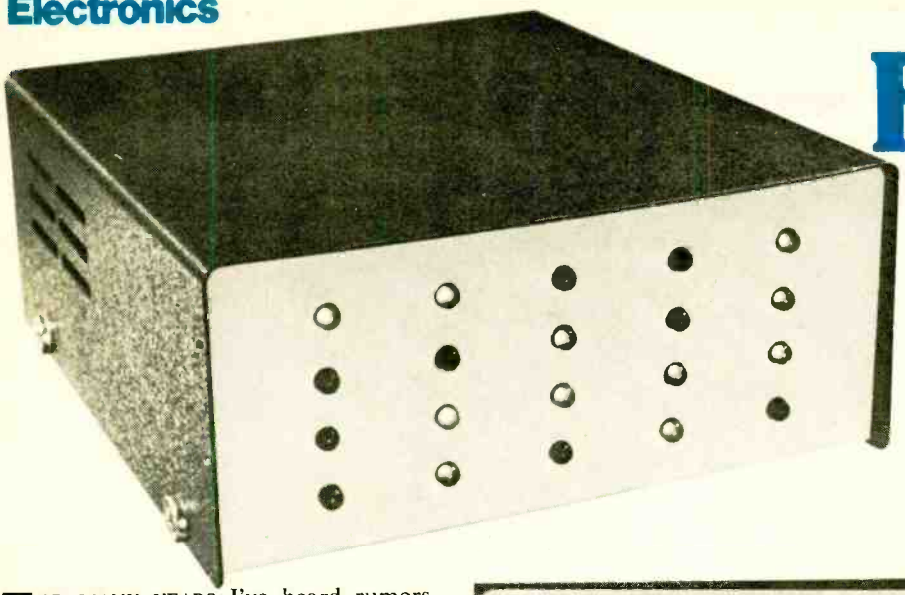


Friendly Flasher

Solid state circuits make your livingroom look like a computer center.

by David E. Stanfield

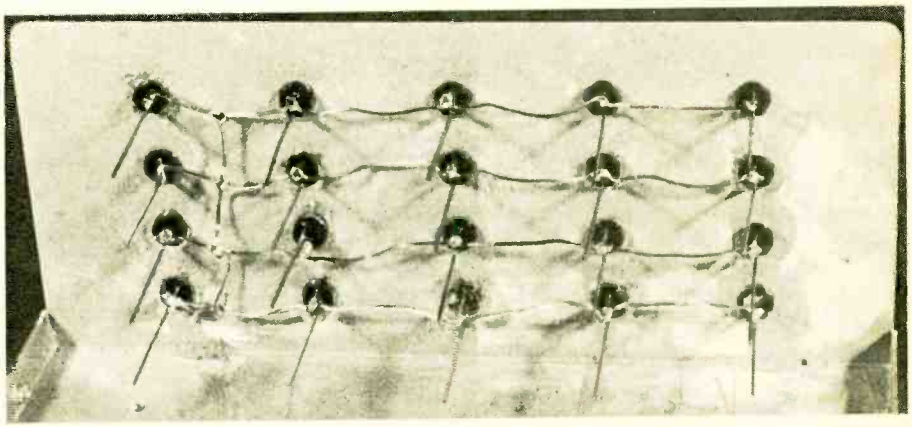
FOR MANY YEARS I've heard rumors that the banks of blinking lights seen on the front panels of many computers are just to impress the computer's owner. It must be admitted that the sight of several square feet of flashing lights acting under the control of unseen forces can exert a powerful pull on almost anyone. Certainly a display of this sort is much more fascinating than a painted metal panel even though they often convey the same amount of useful information.

The Old way. While it's fine for a businessman to have a large computer merrily blinking away, the average electronics enthusiast must find other, less expensive ways to have a decent set of flashing lights. One simple approach that has been used for many years is based on small neon-filled tubes.

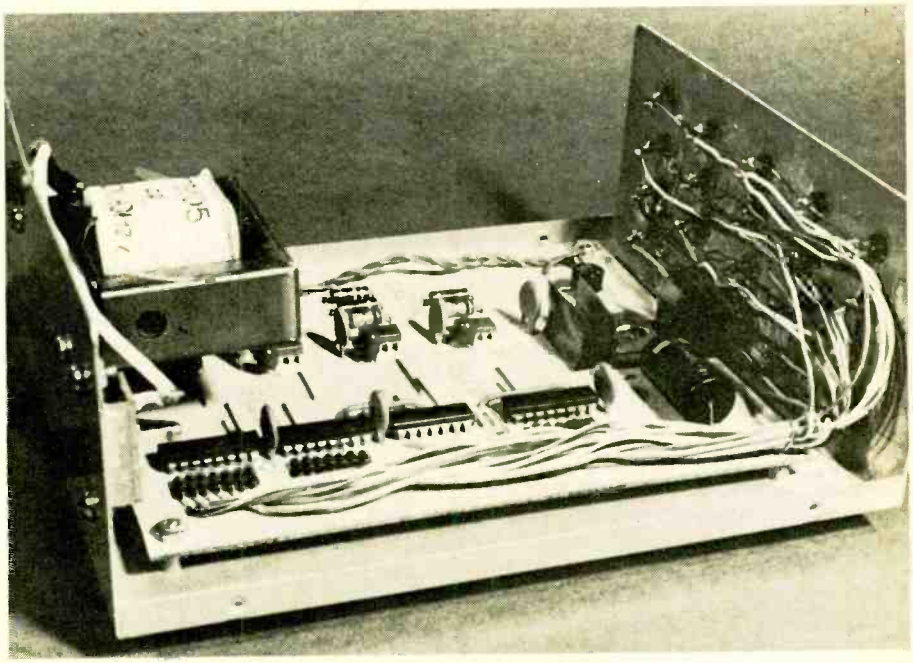
Experimenters take several of these circuits, hook them up in parallel and feed them off a ninety volt battery. Variations in values of the resistors and capacitors keep all the lights from coming on and going off at the same time and the total current drain is so low that battery life is measured in months of continuous use.

Over the years, I've built several versions of the neon tube Idiot Box. Recently, I decided to see if I couldn't design and build a modern, solid-state box of blinking lights. I had so much fun in the process that the things I learned from necessity were a real pleasure. The design I evolved is fairly simple but offers several instructive pointers, especially in the area of combining standard circuits in novel ways. And to keep things as simple as possible, I only used parts available from local electronics supply stores, which means anyone should be able to obtain them.

How it works. In order to get an over-



This view of the back of the flasher front panel shows how the LEDs are connected to the five-volt DC power source. On a more complex panel design it would be a good idea to use insulated wire. The design of your flasher is up to you.



An interior view of the completed flasher gives a good perspective of how the project is laid-out and how the wiring is routed to keep the chassis neat and professional looking. This project is a good one for those interested in learning more about digital integrated circuits, how they are interconnected and designed.

e/e FRIENDLY FLASHER

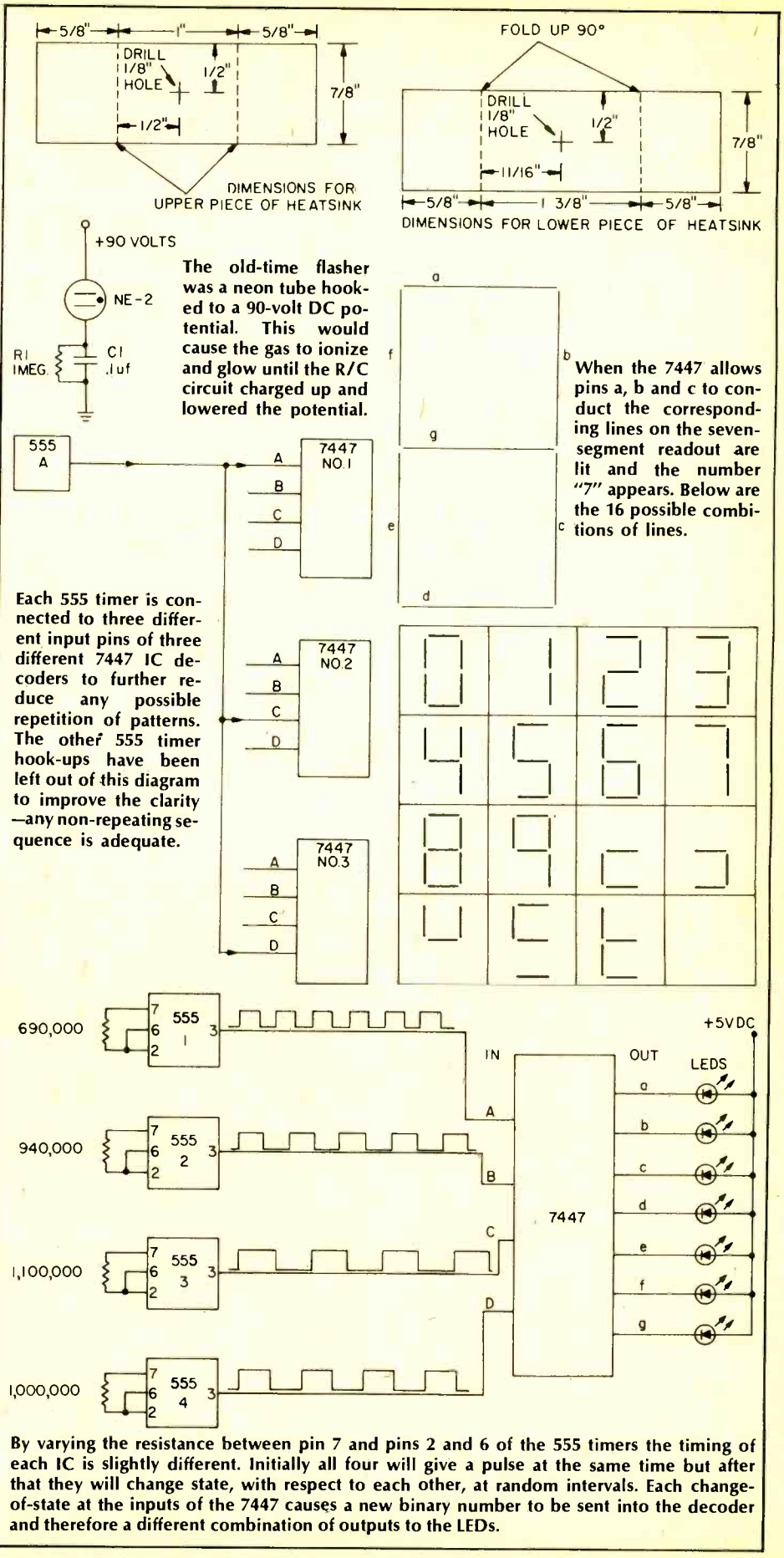
all idea of how the circuit works, we can begin by studying the inputs and outputs of a 7447 integrated circuit. This particular circuit is designed to decode Binary Coded Decimal inputs in order to turn on the correct outputs which are used to drive a seven segment readout. For now, it is enough to know that by applying one of the sixteen possible combinations of inputs to the chip, we get a unique combination of output lines turned on. We can replace the seven segment readout with seven individual light emitting diodes (LEDs). If we can devise a scheme to turn the inputs of a 7447 on and off at different times, we have a solid basis for a modern box of flashing lights.

This turns out to be relatively easy to accomplish. We can use a standard multivibrator circuit built around the 555 timer chip to provide repeating cycles of on and off signals. If we build four of these multivibrators and cause each one to have a different period of oscillation, we can then connect the output of each multivibrator to one of the input pins of the 7447 decoder/driver.

The output of each 555 multivibrator is connected to only one input of the 7447. Each time any of them changes from low to high or from high to low, the overall combination of inputs to the 7447 is changed and this in turn causes a new pattern of output lamps to turn on.

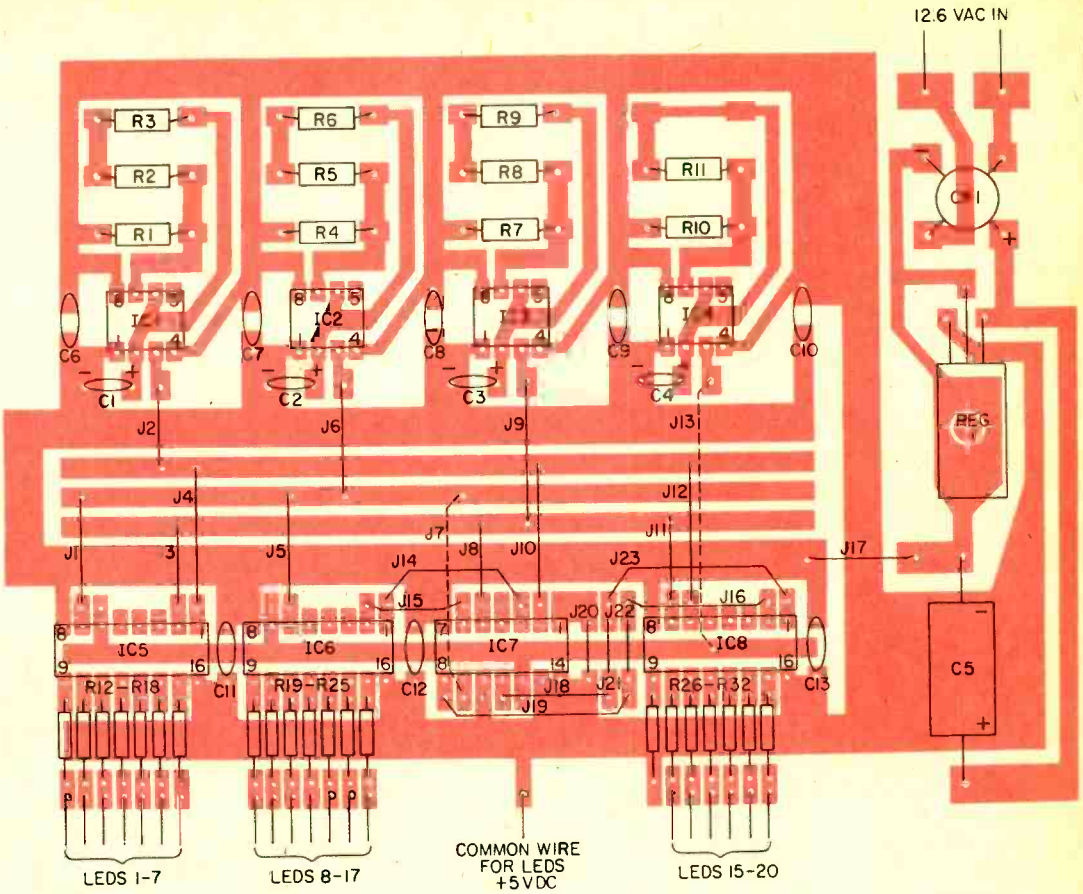
So far we have used a total of five integrated circuits to control seven lamps. This poor ratio of chips to lights can be greatly improved if we care to add more lights. It only takes one additional 7447 to handle each further group of seven lamps. We can share the outputs of the existing 555 multivibrators among the inputs of these additional 7447 decoder/drivers. By thoroughly scrambling the order in which we connect the multivibrators to the inputs of the new 7447s, we can keep the output pattern from each 7447 from being the same.

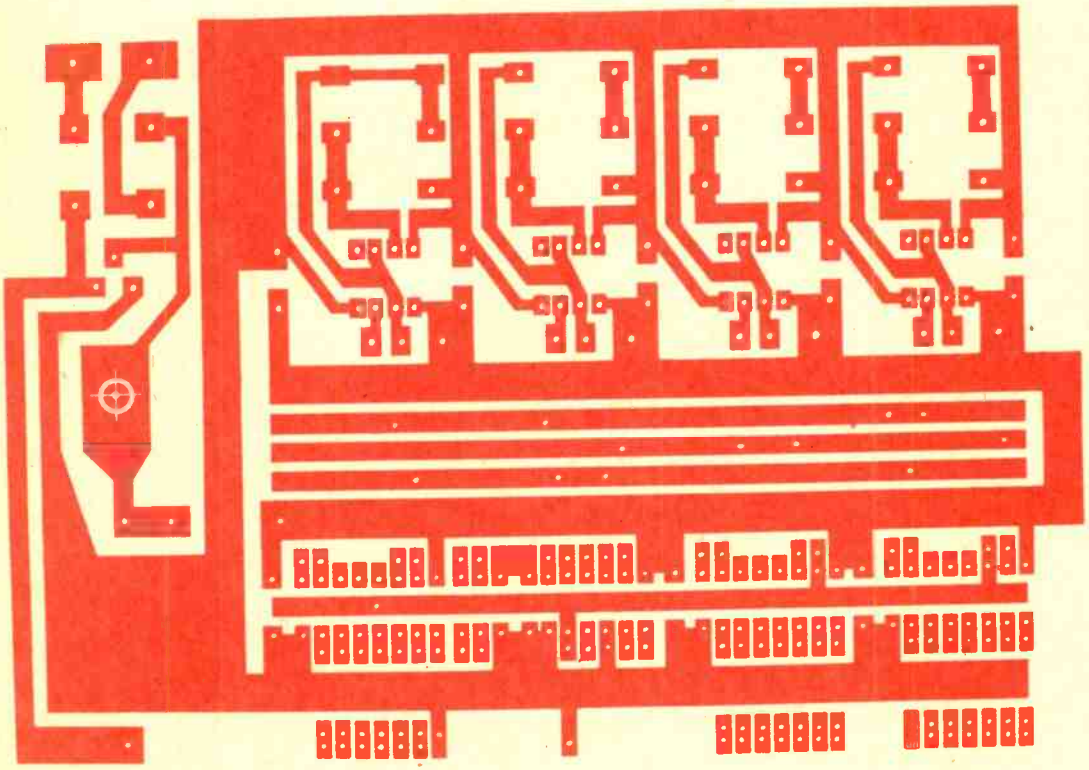
The next step in this progression is to simultaneously apply the output of one multivibrator to three different input lines of three separate 7447s. In this case, we are applying the same output to the A input of the first chip, the C input of the second and the D input of the third. Because of the way 7447s decode the various input lines, the same signal being applied to different inputs on each 7447 has a completely different effect on the output pattern from each of these chips. By similarly scrambling



By varying the resistance between pin 7 and pins 2 and 6 of the 555 timers the timing of each IC is slightly different. Initially all four will give a pulse at the same time but after that they will change state, with respect to each other, at random intervals. Each change-of-state at the inputs of the 7447 causes a new binary number to be sent into the decoder and therefore a different combination of outputs to the LEDs.

This is the parts location diagram for the friendly flasher. Note the author's liberal use of despiking capacitors (C6 through C13). If a 21st LED is desired, cut the foil pattern to separate the outside end of resistor R26 from the body of the circuit board. Then run a wire from the resistor connection to the LED then back the 5VDC common. Be careful to use insulated jumpers on the bottom side of the circuit board and where one jumper crosses another. Elsewhere in this article is a chart which explains what type of jumpers should go where. Use IC sockets for all the IC chips. This will simplify assembly, testing and, if needed, repair.





Here is a full-sized template of the circuit board pattern. A photo etching procedure would be ideal for such a complex circuit, or else one of the new kits that enable you to lift a pattern straight off a magazine page. What ever technique you use, be very careful that you don't get any bridges between sections of the board. Don't be put-off by the apparent complexity of this project—once you figure it out it is really quite simple and straightforward, especially after you have a completed printed circuit board. Making the printed circuit board is, after all, part of the fun of building any project.

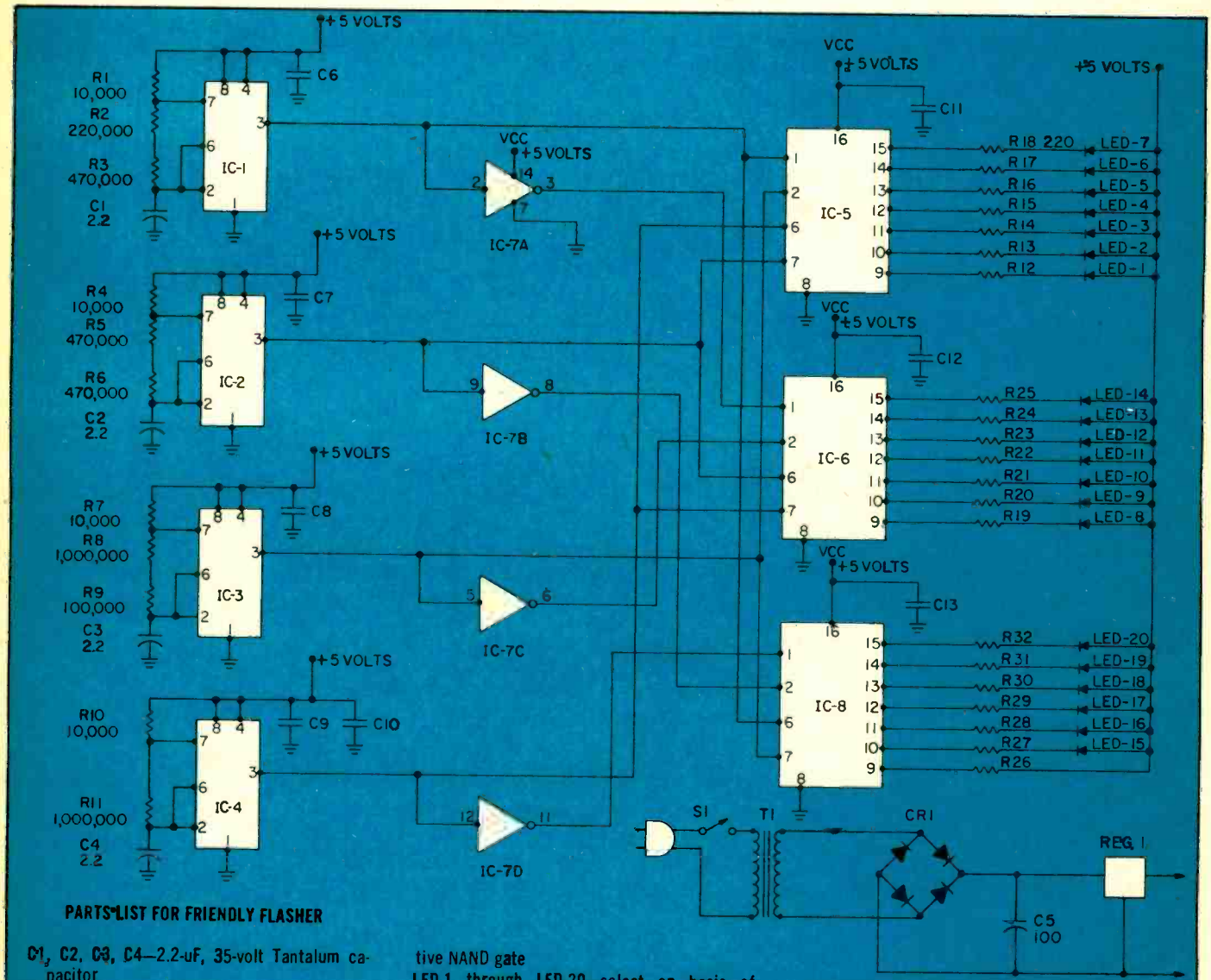
the outputs of the remaining multivibrators among the other inputs of the 7447s, we can obtain a well mixed final set of patterns.

The six-percent solution. As I mentioned earlier, the 7447 integrated circuit is normally used to decode Binary Coded Decimal inputs and then turn on the correct segments of a seven segment display. The individual segments of such a display combine to create sixteen possible output combinations. One of the combinations of inputs results in all seven outputs being turned off.

Any time all four of the 555 multivibrators happen to have their outputs high, all inputs of the 7447s will be high and this will cause all output lamps to be turned off. This occurs each time power is first applied to the circuit (the capacitors are charging) and roughly six percent of the time during normal operation.

I was so horrified when I first saw all the lamps turn off in my breadboard version of this circuit that I added an extra integrated circuit to correct this situation. In essence, I allowed the output of each 555 multivibrator to go directly to an input on two of the 7447s. Before I allowed this output to reach an input of the third 7447, I inverted it. This meant that anytime all the outputs of the 555s went high, some of the inputs of the 7447s would have lows (inverted highs). This would prevent all four inputs of any given 7447 from simultaneously going high.

While I could have used a 7404 Hex Inverter (six inverters on one chip), I chose the common 7400. By tying one of the two inputs of each gate to +5 volts, each gate acts as an inverter. The reason I selected this method of invert-



PARTS LIST FOR FRIENDLY FLASHER

C1, C2, C3, C4—2.2-uF, 35-volt Tantalum capacitor
C5—100-uF, 50-volt electrolytic capacitor
C6, C7, C8, C9, C10, C11, C12, C13—0.1-uF, 10-volt disc capacitor
CR-1—Full-wave bridge rectifier, 1.5-amp, 50-volts
IC-1, IC-2, IC-3, IC-4—555 Timer
IC-5, IC-6, IC-8—7447 BCD to seven segment decoder/driver
IC-7—7400 (A package) quadruple 2-input positive NAND gate
LED-1 through LED-20—select on basis of color, size and price
REG-1—Type 7800, 5-volt, 1-ampere regulator
R1, R4, R7, R10—10,000-ohm, ½-watt resistor
R2—220,000-ohm, ½-watt resistor
R3, R5, R6—470,000-ohm, ½-watt resistor
R8, R11—1-megohm, ½-watt resistor
R9—100,000-ohm, ½-watt resistor
R12 through R32—220-ohm, ½-watt resistor
S-1—SPST slide switch
T1—Small 12.6-VAC filament transformer
Misc—Cabinet 6¼ in. by 2¾ in. by 7¼ in. assorted machine nuts and screws; wire caps; power cord; scrap metal for heatsink; grommet; circuit board standoffs and paint.

ing the multivibrator outputs lies in the fact that there are exactly four gates available on a 7400 chip. This allowed me to use one gate for each multivibrator output and not have any left over.

Power supply. The power supply shown is quite straightforward. An ordinary filament transformer changes the line voltage to 12.6VAC which is then rectified and filtered to 12.6VDC. I then used an inexpensive 5-volt regulator to produce a stable smooth 5VDC output. Avoid 6.3 VAC filament transformers since the regulator becomes unstable with an input of less than seven volts.

One of the nice features of the 5 volt regulator is the fact that it will automatically shut itself off if its temperature approaches dangerous levels. The higher the voltage we apply to the regulater, the more power it must dissipate in order to maintain a constant output. This wasted power can heat up the regulator and cause it to shut off.

One final comment and we will have covered the entire circuit. Based on personal experience, I added a small despiking capacitor between the +5 volt inputs and ground on each integrated circuit. While those who like to design for a minimum number of components will feel that this is a wasteful practice, I believe the cost of these capacitors is so low in relation to the amount of trouble they can prevent that I always include a generous number of them in any digital project I'm building.

FRIENDLY FLASHER JUMPERS

Jumper number	Type of wire	Location
1	Bare	Top
2	Bare	Top
3	Bare	Top
4	Bare	Top
5	Bare	Top
6	Bare	Top
7	Insulated	Bottom
8	Bare	Top
9	Bare	Top
10	Bare	Top
11	Bare	Top
12	Bare	Top
13	Insulated	Bottom
14	Insulated	Top
15	Insulated	Top
16	Insulated	Top
17	Bare	Top
18	Bare	Top
19	Insulated	Top
20	Bare	Top
21	Bare	Top
22	Bare	Top
23	Insulated	Top

Construction. Due to the relatively slow speed at which this circuit operates, almost any of the usual construction techniques can be used. The best place to begin construction is with the circuit board. The pattern shown can be used or you can devise your own. Either way, you should start by etching and drilling your board. Then, if you are using my pattern, solder the various jumpers in place. The component layout shows their placement. Once all jumpers are in place, carefully inspect the board for solder bridges. Install the bridge rectifier and 100 mfd filter capacitor in place. Take care to observe the polarity markings on the capacitor and to orient the rectifier correctly. The package the rectifier comes in shows how to identify the leads.

Next, install the 5 volt regulator and its heatsink. The two pieces of the heatsink are placed next to the board and the regulator on top of them. A small screw is then run through the regulator, heatsink and circuit board. When everything is properly aligned (regulator leads in their holes, heatsink not shorting out any leads), fasten everything in place with an appropriate nut. The heatsink can be fashioned from almost any kind of scrap metal.

Now is a good time to install all the resistors and capacitors. This will take care of most of the parts to be installed and at this stage, problems are easy to diagnose. The component layout shows where these parts go. I suggest that you insert and solder one part at a time rather than trying to do them in batches. Be especially careful with the current-limiting resistors along the bottom edge of the board. Watch for solder bridges and solder flowing into the other hole on the pads.

Testing the ICs. Now, taking care to align the pins correctly, insert IC-1 into its holes and solder in place. You may plug the line cord in and use your voltmeter to take a reading on pin 3, the output pin. The voltage here should swing between roughly zero and five volts, remaining at each point about one-half second. If this is the case, the entire circuit of the first multivibrator is working. If it isn't, make sure the IC is really a 555, check for solder bridges, measure the +5 voltage on pins 8 and 4 and recheck the orientation of the pins to make sure the IC isn't installed backwards. As a last resort, remove the chip and substitute another.

Once the first multivibrator is functioning correctly, remove the line plug from the wall and solder in the remaining 555s (IC-2, IC-3 and IC-4) one-at-a-time. After each is soldered in, apply power and verify its operation the same way you did for the first 555. When all the 555s are in place and working, you will have a functioning power supply and four good multivibrators.

You should now solder IC-5 in place. In order to test its operation, an LED can be used to probe each of the outputs. To do this, take an LED and gently spread its leads apart. Then use an ohmmeter to take forward and reverse readings across these leads in order to make sure that you have a good LED. (One reading should be much higher than the other.)

Next, cut about a foot of stranded hookup wire and solder one end to the pad used as a common return for the LEDs. This pad is located along the bottom edge about midway between the first and second groups of current limiting resistors. Then attach either lead of the LED to the other end of this wire. At this point, apply power to the board and briefly touch the free end of the LED to ground.

Should the LED light up when you touch it to ground, kill power to the board and lightly solder the lead attached to the hookup wire. If it failed to light up, reverse the leads of the LED at the stranded wire and again touch the free lead of the LED to ground. This time it should light and after killing power, you should solder the lead attached to the hookup wire.

What you have done is fashion a simple test probe that will light up whenever the free lead of the LED is applied to a point at ground potential. (The power supply must be on.) Since this simple probe has no means of limiting the current flowing through the LED, you can destroy the LED if you touch ground more than a brief instant. However, you can safely probe the output sides of the current limiting resistors already on the board and that is how you will test the outputs of the 7447 lamp drivers.

To proceed, apply power to the board and touch the free end of the LED to each output lead of the current limiting resistors located just below the first 7447 (IC-5). The output lead of these resistors is the one nearest to the bottom edge of the board. As you probe each lead, the LED should flash on and off in an irregular fashion. If everything appears fine at all these outputs, remove power from the circuit and solder in the second 7447 (IC-6). If something isn't working right, follow the general hints I suggested for correcting problems with the multivibrators.

Use the above check-out procedures for the second 7447 (IC-6) and then the third (IC-8). After you have in-

(Continued on page 87)

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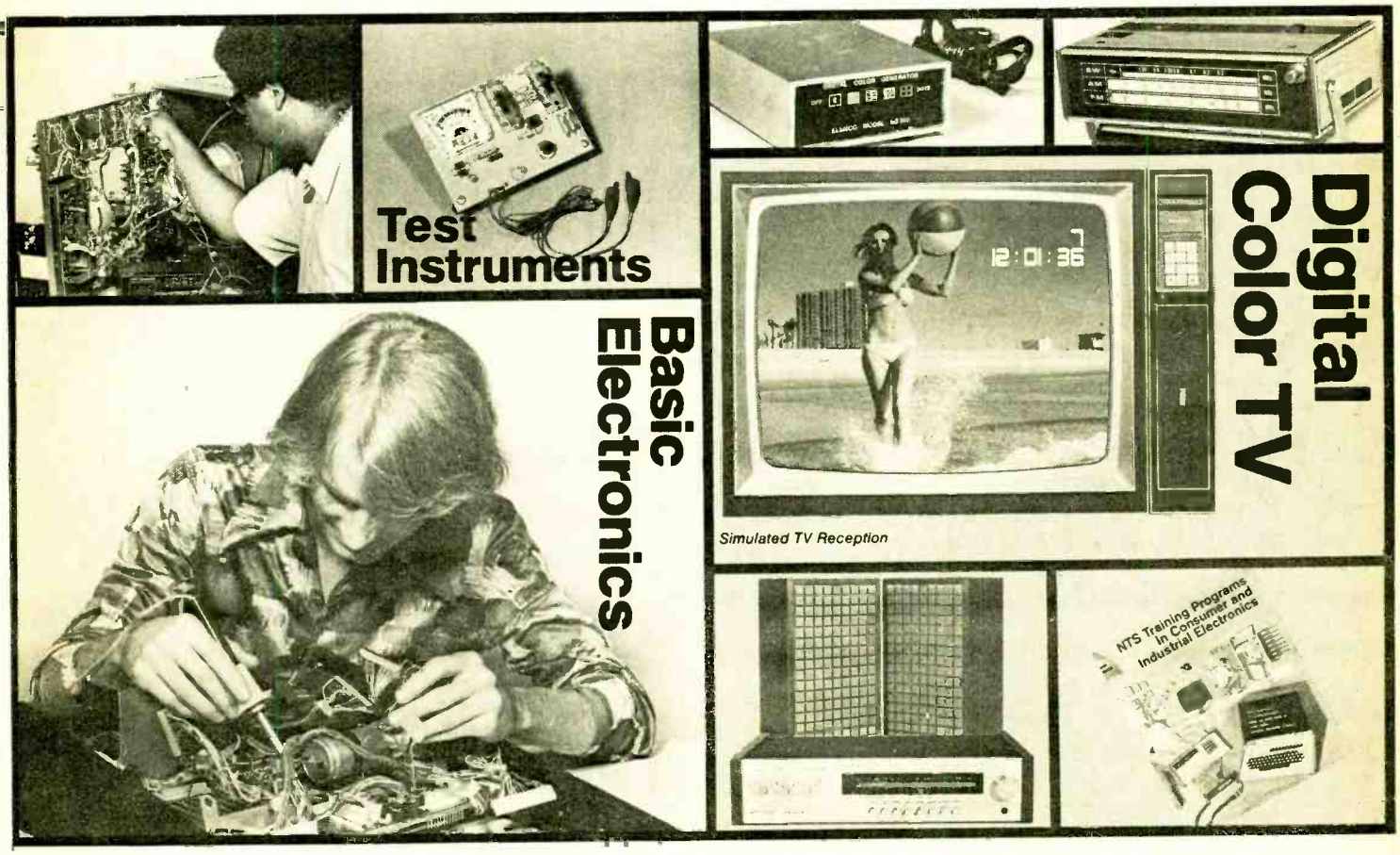

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DXing the North Country

by Brian Rogers

☐ On the Eastern coast of Canada, between the cities of Sackville, New Brunswick, and Amherst, Nova Scotia, there stands a square-shaped, two story, white stucco building. Surrounding the building and varying in height from 130 to 380 feet is a series of white and orange antenna masts. Strung between the masts is a network of radio transmission lines which, if taken down and measured out, would total several miles in length. The building, as veteran SWLs might know, houses the transmitters of the shortwave broadcasting station known as Radio Canada International.

The eight transmitters, five of which put out a whomping 250kW, make RCI "armchair copy" every evening throughout most of North America, even when the listening is done on simple transistor portable receivers using built-in whip antennas.

Other areas served by these "big rigs" are Eastern and Western Europe, the Caribbean, Latin America, Africa, the Soviet Union and the South Pacific.

On the air since 1971, the powerful broadcast station's inaugural was marked with the isuance of a commemorative stamp by the Canadian Post Office.

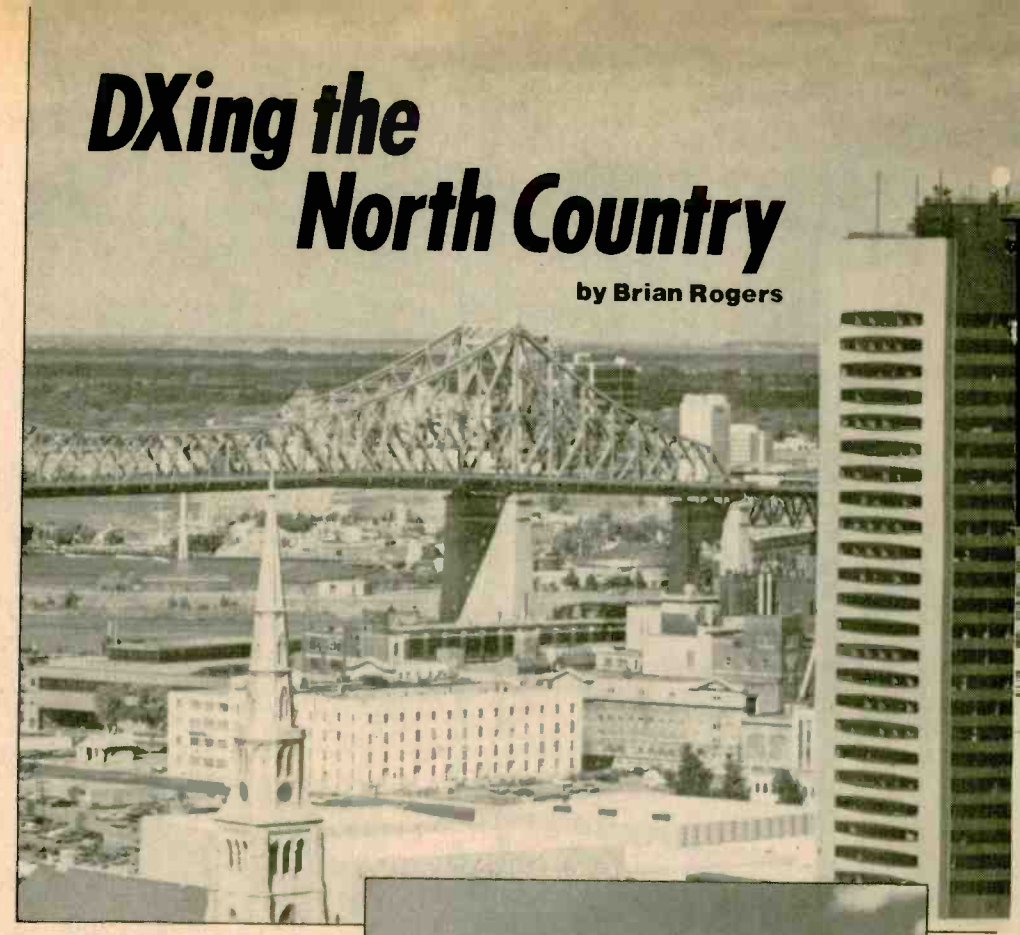
Long a favorite of SWLs because of its easily-copied signal and varied programming, Radio Canada began shortwave broadcasting in February, 1945, when transmissions in English and French were directed to Canadian troops in Europe. Soon Dutch, Slovak, Spanish and Portugese language programs were offered and Latin America and the Caribbean were added as "target" areas.

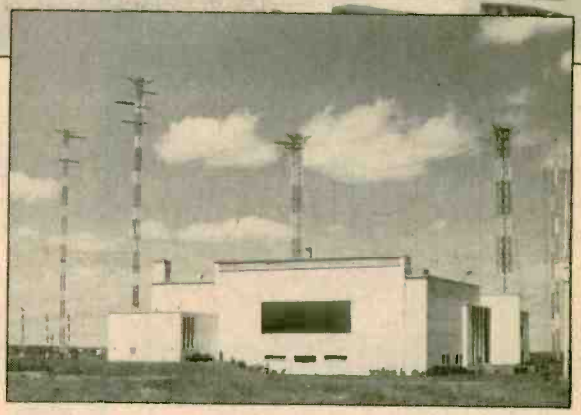
Presently, RCI offers programs in eleven languages, including Russian, Ukranian and Hungarian.

The transmitters, Collins 821A-2's, are controlled by a computer. The operator, using teletypewriters, can program up to one hundred transmitting conditions as long as twenty-four hours before they will be needed. Functions programmed in this way are such things as filaments on, plate-current on, RF key, AF key, and so on. The operating frequencies can be tuned to any setting between 3.95 and 26.5 MHz in twelve seconds or less.

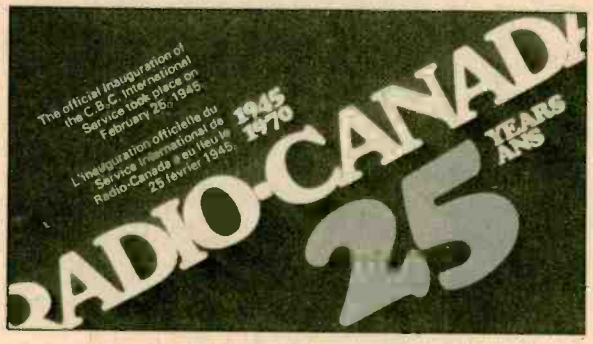
These transmitters can even tell the repairman where it hurts when they are sick! A printout locates the area in which a breakdown has occurred.

Studios for Radio Canada International are located in the 23 story Maison de Radio Canada building, located on a 25-acre site on Montreal's Dorchester Boulevard. Over 3,000 people are employed in the Maison de Radio Canada. Not all are employed by RCI however,





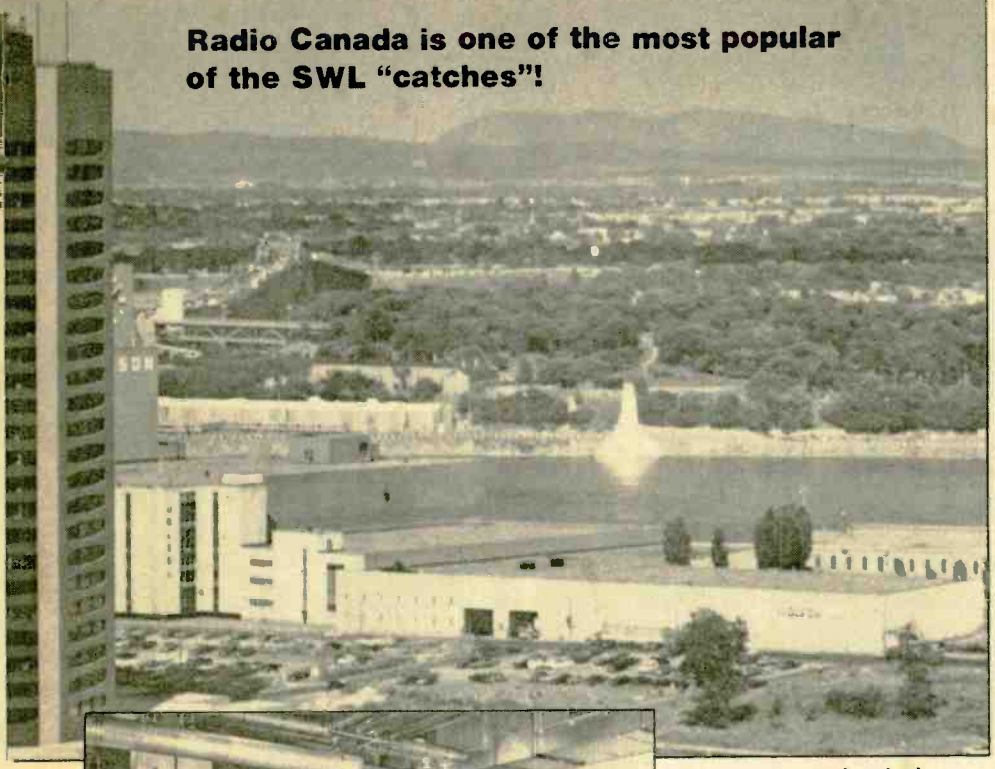
Sackville, New Brunswick is the site of the Radio Canada transmitting facilities. Here we see the antennas that beam Radio Canada's message to the European continent. The transmitter plant consists of two 50KW transmitters, three 250 KW transmitters all aimed antenna-wise at locations outside Canada; and two more 250KW signal pushers.

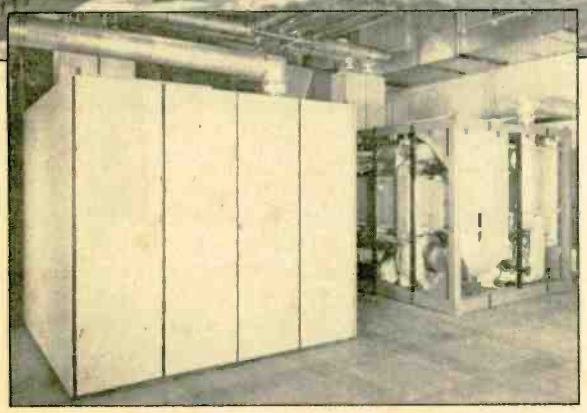


Canada Radio Canada International celebrated its silver anniversary in 1970. Radio Canada has been estimated by Gallup to reach over a million listeners within the borders of the United States—not a bad-sized audience for a CBC owned broadcaster!

Radio Canada has had many attractive QSL cards during its years of operations. This one, a resource map of Canada, points up the vast size of that country. Signals from the main studios travel a microwave relay system 600 miles to the transmitters.

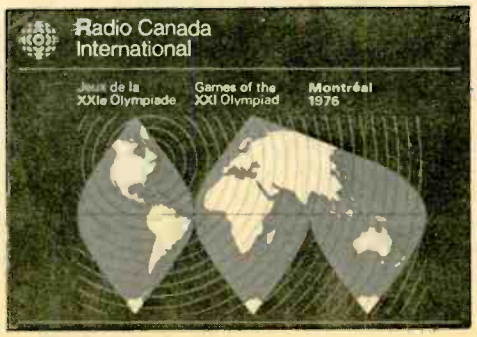
Radio Canada is one of the most popular of the SWL "catches"!





If you ever wondered what a 250KW transmitter looks like, here you can look at two of them, one of them with its side panel removed. These transmitters, state-of-the-art, can be computer controlled and set for up to a hundred different operations an hour in advance. They can operate in any of the major SW bands, and change frequency in less than a minute!

When the first Canadian, domestic satellite was launched in 1972, Radio Canada commemorated the event with a special QSL. Radio Canada tries to keep its international audience well informed of Canadian achievements in the Sciences and Technology.



Montreal—Olympic City, 1976! This was Radio Canada's olympic QSL. A listener returns a previously filled out QSL card to Radio Canada. If the information as to frequency, time heard and content is correct, Radio Canada returns the QSL as "verified."

since the facility is shared with domestic radio and television services.

News and "magazine" type feature programs are enjoyed regularly by Radio Canada's listening audience, estimated by the Gallup Institute to total nearly one million weekly in just the United States alone.

News programs are put together by a staff of twenty-five people. They have at their disposal the services of such agencies as Canadian Press, Reuters, the Associated Press and Agence France-Presse.

Programs leaving studios in the Maison de Radio Canada building take a unique route on their journey to the transmitter towers. Between Montreal and Sackville, a distance of 676 miles, is a series of microwave towers. Spaced about 30 miles apart, there are 27 of these structures. The last one, located about two miles from Sackville's control console, is connected to the transmitters by landline. From the console the signals go into the antennas and from there, hopefully, off the ionosphere, back to earth and into your receiver.

North American listeners can hear Radio Canada in the evening beginning at 2300 GMT (6:00 P.M. EST,) when the "World at Six" news program is broadcast. This offering, aired on 5,960 kHz, is followed thirty minutes later by a telephone interview program known as "As it Happens." In addition to these, programs half an hour in length are aired at 0100, 0200, 0300 and 0400 GMT, which is 8:00, 9:00, 10:00 and 11:00 P.M. EST.

The first two of these transmissions are on 9,535 and 9,605 kHz, respectively; while the final two can be tuned on 9,655 kHz. Listeners can identify Radio Canada by hearing its tuning signal, the first two bars of "Oh, Canada," played repeatedly a few minutes prior to the start of each transmission.

High postage and secretarial costs caused Radio Canada to cancel its traditional QSL verification policy in 1975. They now use a "do-it-yourself" QSL card which is mailed to listeners annually with the Spring program schedule. The SWL can either keep the card as a souvenir or fill out the back with the usual time, date and frequency information, and return it to Montreal. If the information provided by the listener is found to be correct, the card will be stamped "Verified," and returned to him; not just a souvenir then, but a true verification.

Radio Canada's current program schedule can be obtained by writing to the station at P.O. Box 6000, Montreal, Quebec, H3C 3A8, Canada. ■

Spider Web Receiver

Lure hard-to-get DX into your SWL lair with this hot little receiver

by Charles Green

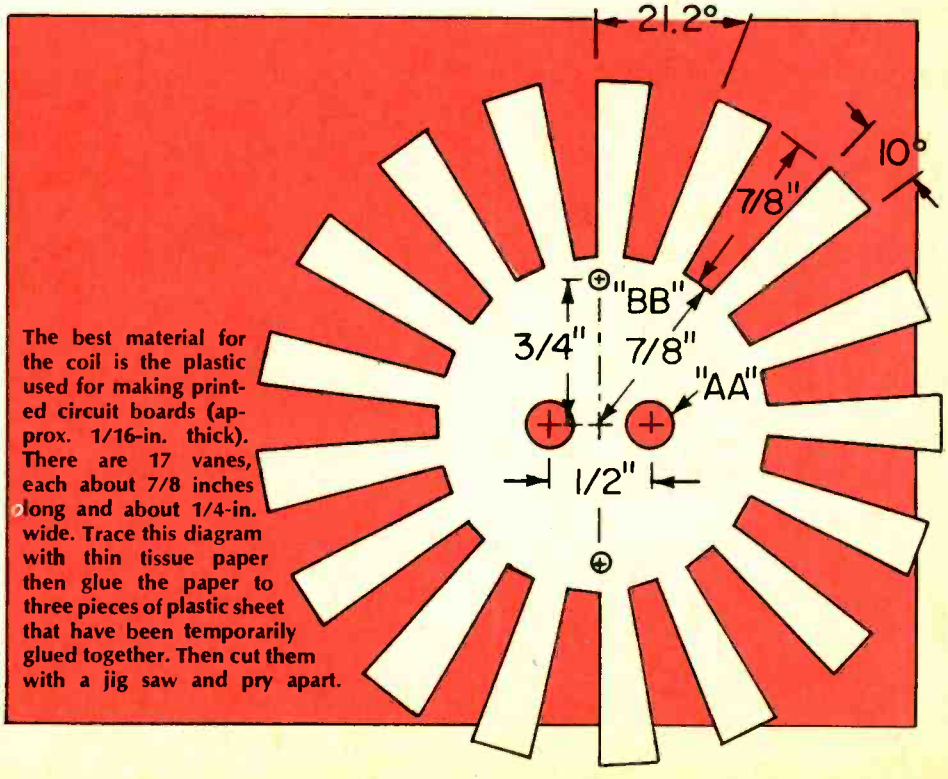
IN THE OLD DAYS OF RADIO, back when grandpa was building his first one tube radio, the spiderweb coil was the "cat's pajamas." This type of tuning coil was very popular with the home-constructors, and with good reason; the spiderweb coil is a high Q type, wound with interleaved turns for minimum residual capacity. Many of the old timers made long distance reception commonplace with this type of tuning coil in their radios.

The spiderweb coil is a type of coil in which the wire is wound on a flat form so that the radius of successive turns increases from the center outward. You can experiment with this type of coil by building our receiver model which combines the old spiderweb coil with present day solid state circuitry. The receiver covers from 550 kHz to 14 MHz, with three plug-in spiderweb coils in a FET regenerative-detector circuit. A stage of audio is included with a pnp transistor directly coupled for good headphone volume.

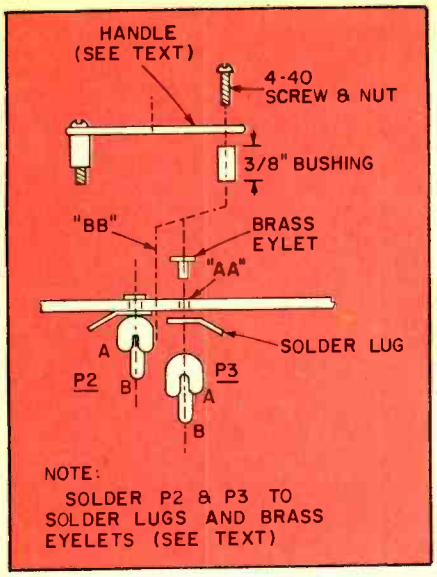
The Spiderweb Coil Receiver Circuit. Signals from the antenna are coupled through J1 and C1 to L1 and the tuning capacitor C3. The bandspread capacitor C2 is used to fine-tune crowded SW bands and the resultant signals are fed via C4 to the gate-leak R2 and the gate of FET Q1. The RF signals are detected and amplified by Q1 and a portion of the RF is fed back into L1 from the source circuit of Q1. This feedback RF is detected and further amplified by Q1. The regen control R1 varies the amount of RF feed-back to L1.

The detected audio signals in the drain circuit of Q1 are coupled through T1 to the AF Gain control R5 and to the audio amplifier circuit of Q1. The amplified signals are direct-coupled via the collector circuit of the pnp transistor Q1 through J4 to external high impedance phones. DC power for the circuits is supplied by an external 6 volt battery. Bias current for the Q1 base circuit is supplied by the R6-R7 divider circuit, and R8-C7 acts as the interstage decoupling network to minimize audio feedback between the stages via the DC power bus.

Three plug in coils are used for L1, each one covering a different band of



The best material for the coil is the plastic used for making printed circuit boards (approx. 1/16-in. thick). There are 17 vanes, each about 7/8 inches long and about 1/4-in. wide. Trace this diagram with thin tissue paper then glue the paper to three pieces of plastic sheet that have been temporarily glued together. Then cut them with a jig saw and pry apart.



Solder the phono plugs to each spiderweb by using small brass eyelets as rivets. A handle will simplify plugging-in.

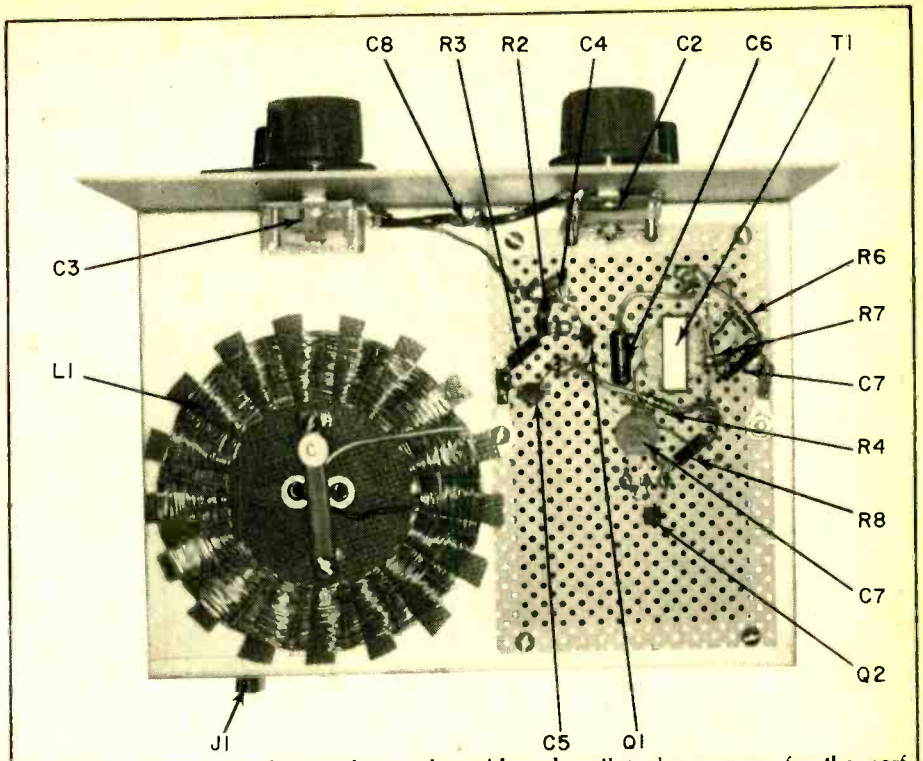
frequencies. L1 A tunes from 7 MHz to 14 MHz, L1 B tunes from 1.7 MHz to 5 MHz, and L1 C tunes from .55 MHz to 1.6 MHz.

Spiderweb Coil Construction. Look at the drawing of the spiderweb coil form. There are seventeen "vanes," ⅞-inch long and approximately ¼-inch wide, positioned around the perimeter of a 1½-inch disc. A good quality plastic should be used for the coil form; the coil forms shown in the receiver model photo are made from the type of plastic sheet used for printed circuit boards (approx. 1/16-inch thick).

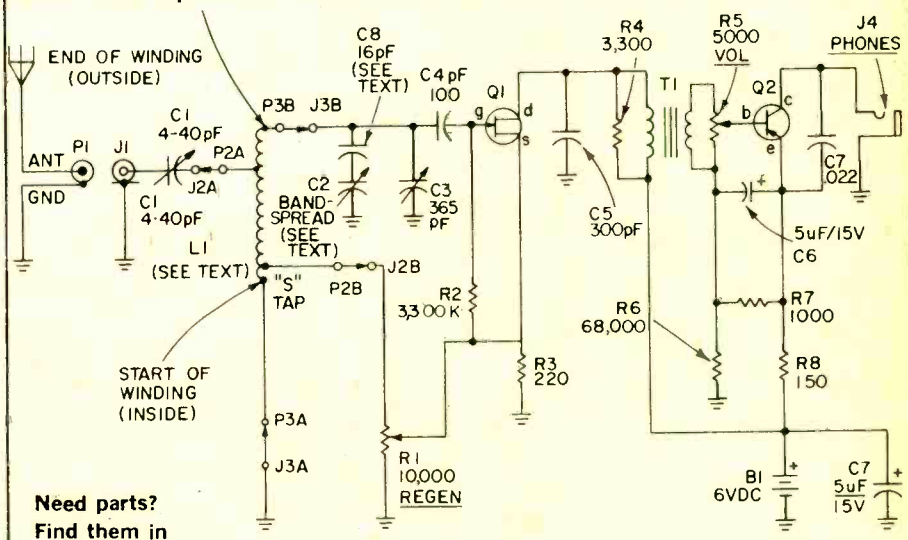
The easiest way to start construction of the coil forms, is to trace the outline of the spiderweb coil form drawing and temporarily cement the tracing onto a sheet of plastic. Then cut out the coil form with a hack saw. If desired, three sheets of plastic can be temporarily cemented together with rubber cement and the coil forms for all three bands can be cut out at the same time. After cutting out the forms, carefully pry apart the spiderweb coils.

Brass eyelets (available at notions counters in department stores) are soldered to lugs and P2-P3 as shown in the drawing. Carefully drill holes to fit the eyelets, positioned ½-inch apart, for each of the three spiderweb coil forms, and mount the phono plugs (P2-P3).

Refer to the Spiderweb Coil Winding Table and wind the coils with the turns indicated for each band. Start winding on the inside of each coil form and wind to the outside of the form. Allow enough wire at each end of the coil to solder to P3A-B as shown in the schematic. After winding the coil make the



This layout shows how best to locate the spiderweb coil to leave room for the perf-board. Note capacitor C8 which is used to help achieve the desired bandspread.



Need parts?
Find them in
HOBBY MART—page 88.

PARTS LIST FOR SPIDERWEB RECEIVER

C1—4 to 40 pF midget mica trimmer (ARCO 422 or equiv.)
C2—Bandspread capacitor (modified C3, see text)
C3—365 pF subminiature variable capacitor (Radio Shack 272-1341)
C4—100 pF capacitor
C5—300 pF capacitor
C6, C7—5uF/15 VDC Miniature electrolytic capacitor
C8—16 pF capacitor (see text)
J1, J2, J3—Phone jacks
J4—Phone jack
L1—See Coil Table and text
P1, P2, P3—Phono plugs (see text)
Q1—FET (NPN), Motorola HEP-F0015, or equiv.)
Q2—Transistor (PNP), Motorola HEP-57 or HEP-S0019 (or equiv.)
R1—10,000-ohms linear taper potentiometer
R2—3,300,000-ohm resistor, ¼-watt
R3—220-ohm resistor, ¼-watt
R4—3,300-ohm resistor, ¼-watt
R5—5,000-ohm audio tape potentiometer
R6—68,000-ohm resistor, ¼-watt
R7—10,000-ohm resistor, ¼-watt
R8—150-ohm resistor, ¼-watt
T1—Audio transformer; PRI: 10,000-ohms, SEC: 2,000-ohm (Calectro D1-722 or equiv.)
Misc: 5 by 7 by 2-in. aluminum chassis, 5 by 7-in. copper clad board (for front panel' sheet plastic for L1 form (see text), knobs 3 by 4½-in. perf board, two lug solde strip (to mount C1) 6 brass eyelets.

taps as indicated in the table; carefully scrape the enamel off the wire for a good soldered connection to the tap leads to P2A-B.

Receiver Construction. Most of the receiver components are mounted on a 3- by 4½-inch perf board section installed on a cut-out portion of a 5-by 7-by 2-inch aluminum chassis. As shown in the photos, the perf board is installed on one half of the top of the chassis to leave enough room for the plug-in spiderweb coils. The tuning capacitor C3 and the bandspread capacitor C2 are mounted on a 5- by 7-inch section of copper-clad printed circuit board used as the front panel. A similar section of sheet aluminum would also be suitable for the front panel. The panel is held by the mounting nuts of the regen control R1, audio gain (volume) control R5, and the phone jack J4 that are mounted in holes drilled through the front of the chassis and the lower half of the panel.

Begin construction of the receiver by cutting the perf board section to size and then temporarily positioning it upon the top of the chassis. Lightly draw the outline of the board on the top of the chassis, then remove the board and layout the chassis cut-out within the board outline. The cut-out section on the model shown is approximately 2½ by 4-inches. Drill holes near the inside corners of the cut-out section and use the holes to start a hack saw or jewelers saw. After the chassis section is cut-out, drill six mounting holes for the perf board edges. Install the perf board on the chassis with small machine screws and nuts.

Locate and install the board components with perf board clips. Do not install Q1 at this time to minimize any possible damage to the FET; solder Q1 into the circuit when all of the other components have been connected. Temporarily place an alligator clip across the source and gate leads (shorting them together) while soldering the FET in place. Cut the leads of all of the components to allow short, direct connections and to prevent any of the leads from accidently coming in contact. Make sure that you remove the alligator clip from the FET after soldering. For best results follow the component layout of the model shown in the photo. T1 is mounted by drilling holes in the perf board to fit the mounting tabs and then bending them over for a snug fit under the board. Position the three ground lugs on three of the board mounting screws, as shown in the photo.

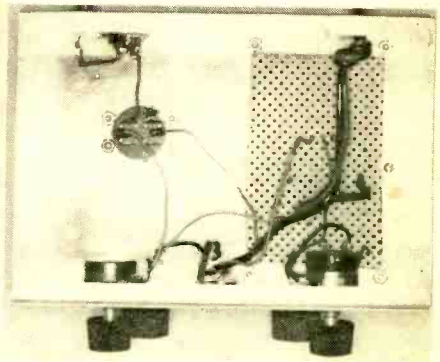
SPIDERWEB COIL WINDING TABLE

	WIRE SIZE	TOTAL TURNS	ANT TAP (P2A)	"S" TAP (P2B)
BAND A 7 MHz to 14 MHz	#18 Enam.	4	½-Turn from end	1-turn from start
BAND B 1.7 MHz to 5 MHz	#24 Enam.	17	1½-turns from end	2-turns from start
BAND C .55 MHz to 1.6 MHz.	#28 Enam.	52	10-turns from end	1-turn from start

Cut holes in the center of the remaining portion of the chassis top to fit J2 and J3. Space the two jacks to fit the plugs P2 and P3 mounted on the plug-in spiderweb coils. A dual jack was used on the model shown in the photo. But, it may be easier to use separate jacks for easier spacing in the front and rear of the chassis to fit the components to be installed; R1, R5 and J4 on the front and J1, C1 and the rubber grommet for the DC power leads on the rear chassis. C1 is mounted on a two lug terminal strip with a small access hole drilled in the chassis to allow adjustment.

Bandspread Capacitor Construction. The bandspread capacitor C2 is a modified tuning capacitor that originally had a 365-mmf capacity. The model in the photo utilizes a Radio Shack miniature type with plastic dielectric. In this particular make of capacitor, the stator blades are made from thin sheet metal and are fastened with only one screw and nut. Carefully remove the end nut (after removing the plastic outer cover) and pry out the stator blades one by one with small pliers until only one blade is left. Replace the nut and tighten it. Check with an ohmeter to see if the blade is shorted to the rotor blade assembly. If so, remove the nut and readjust the stator blade. The rotor blades should be able to rotate freely as the shaft is turned.

Front Panel. Mount the panel on to the front of the chassis by drilling the appropriate holes and securing it with the mounting nuts of the panel controls. After the panel is mounted with the copper clad surface facing outward, locate and drill the holes for C2 and C3. Install the two variable capacitors and then connect them to the circuit board with short leads. C8 is mounted between the stator of C2 and the stator of C3. The exact value of C8 is best determined by experiment after the receiver is operational for the desired bandspread. A good starting value is 16 mmf (as on the model shown in the photo).



This bottom view of the receiver shows the jacks for the spiderweb and how they are hooked up to the antenna. Note how the perfboard is secured to the chassis.

Completing Construction. Complete the construction of the receiver by wiring the underchassis components. Make sure that the leads to J2 and J3 are as short and direct as possible; position these leads up and away from the chassis bottom. Connect the DC power leads to the circuit and mark them with the proper polarity. Or, a red lead can be used for positive and a black lead for negative polarity. Make a knot in the power leads before putting them through the rubber grommet on the rear of the chassis.

Install knobs on the shafts of the front panel controls. If necessary, cut the shafts of the controls for a uniform appearance. Cement a 1-in. length of Number 18 wire on the rear of the C3 knob. Or, a shaped section of clear plastic with a black line drawn down the center can also be used for a pointer.

Dial Calibration. The front panel dials are marked with rub-on lettering positioned on three concentric India-ink lines for the C3 dial, and one inked line for C2. Begin dial calibration by plugging in the "C" Band (Broadcast Band) coil and connecting earphones and a six

(Continued on page 100)

Claudia's Computers

Twelve-year-old shows that age is no barrier to computer fever.

by Charlene Knadle, WB2HJD

☐ Who's using computers these days? Not just adults in business, science and math, if that's who you thought. To prove it meet 12-year-old Claudia Napfel. This Long Island, New York junior high school student is a whiz at operating both her own and her father's computers. But Claudia doesn't stop there—she programs both computers to do math and science problems, to play games and most important to her, to help her enjoy her music.

Claudia says that the computers help her with her two favorite school subjects, science and math. Not surprisingly, these are Claudia's best subjects in school. So that she could use her father's more powerful computer Claudia learned how to program it on his ASR-33 teletype input.

Claudia's computer can play math games and it will quiz her on many levels.

Music Machine. In addition to playing games for fun, Claudia gets a great deal of pleasure out of her music programs. She often writes music and programs the computer to play it back on a synthesizer to see if there are any unusual notes. Says Claudia, "when I write songs the computer helps me with notation and time," and she finds it improves her ability to read notes too.

What do her friends think?

"They call me brainy," said Claudia, "walking dictionary and things like that. But they're just kidding—when they're here they're fascinated." When asked if using a computer ever becomes "old hat," Claudia answered: "No, I'm never bored with it even though it's familiar. I'm fascinated every time I sit down at the terminal." ■

No easier, better way to learn electronics than with the HEATHKIT Self-Instruction Program!

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Famous
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For use with Heathkit Electronics Courses 1 through 4, this optional trainer helps you perform all the experiments that are supplied with the courses quickly and easily. Has solderless breadboarding sockets, dual variable power supply for positive and negative voltages, sine and square wave signal source, center-tapped line transformer. After you complete the course, the trainer is ideal for experimenting and breadboarding with your own circuit designs.

Kit ET-3100 ..... **$59.95**

Digital Trainer Kit and Course

What you should know about these courses

The courses and the optional trainers may qualify for a Federal Tax Deduction. Treasury Regulation 162-5 permits an income tax deduction for educational expenses undertaken to: (1) maintain or improve skills required in one's employment or other trade or business, or (2) meet express requirements of an employer or a law imposed as a condition to retention of employment, job status or rate of compensation. In many instances, your employer may re-imburse you in part or in total for taking these courses.

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COURSE 1: DC Electronics

The first step toward a complete understanding of a fascinating and rewarding field of endeavor. As you'd expect, Course 1 is simply and logically arranged and assumes no prior electronic knowledge. It begins at basic electron theory and goes on in detail with nothing omitted. Course 1 comes with everything you need for successful completion and, most importantly, a high degree of understanding. The only materials needed are a record player, a few basic hand tools and a VOM. Progressing at your own established pace, you learn in an unhurried environment free from pressure. Like all Heathkit courses, learning is easy with simple, step-by-step "programmed" instructions. Audio aids help emphasize the text material and an optional final exam lets you test your overall comprehension.

Essentially, Course 1 covers current, voltage, resistance, magnetism, Ohm's Law, electrical measurements, DC circuits, inductance and capacitance. In short, a complete foundation in basic electronics. Included are texts, records, and 56 electronic components for 20 different experiments. Also available is the ET-3100 Experimenter/Trainer that helps you perform projects and experiments quicker. The average completion time for Course 1 is 20 hours.

If you choose to take the optional final exam and score a grade of 70% or better, you will receive a Certificate of Completion and 2.0 Continuing Education Units (CEUs). CEUs are a nationally-recognized way of acknowledging participation in non-credit adult education.

Course EE-3101 ..... **39.95**

COURSE 2: AC Electronics

The second of the Heathkit basic electronics courses which coupled with Course 1, forms the foundation for all the courses that follow. The same straightforward, simple format is utilized to teach you the theory of alternating current. Course 2 includes all the necessary material for best understanding and successful course completion. The only other materials required are a record player, a few basic hand tools and a VOM. Like the other Heathkit Self-Instruction Courses, AC Electronics is designed to let you progress at your own pace moving up when you're ready. Step-by-step, "programmed" instructions make it a rapid, easy process. Records reinforce the text material. An optional final exam lets you evaluate your understanding of the material.

Course 2 basically covers alternating current, AC measurements, capacitive and inductive circuits, transformers and tuned circuits. For best understanding, Course 2 requires the completion of Course 1 (or equivalent knowledge). Included are texts, records and 16 electronic components for 8 different experiments. The optional ET-3100 Experimenter/Trainer kit enables you to perform projects and experiments quicker. The average completion time for Course 2 is 15 hours.

If you choose to take the optional final exam and score a grade of 70% or better, you will receive a Certificate of Completion and 1.5 Continuing Education Units (CEUs). CEUs are a nationally-recognized way of acknowledging participation in non-credit adult education.

Course EE-3102 ..... **39.95**

For advanced learning; DIGITAL TECHNIQUES

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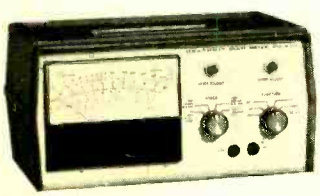
Course EE-3201 ..... **54.95**
EEA-3201, Optional Cassettes **6.95**
Kit ET-3200, Digital Trainer Kit **79.95**

Recommended Test Equipment



You need a quality multimeter like the Heathkit IM-5284 to complete these courses. Tests and experiments are quicker and more precise with this solid-state VOM that measures AC and DC volts, ohms and DC current. The IM-5284 is easy to build and operate even for the first time kit builder and will continue to be very useful long after you've completed your Heath courses.

Kit IM-5284 ..... **37.95**

NOTE: **Having completed the above courses, you will be ready to move up to our other advanced courses; Microprocessors and Computer Programming – the super technology of tomorrow.**

COURSE 3: Semiconductor Devices

One of the most important of the Heathkit Self-Instruction Courses and the one that reveals the technology you *must* know to stay ahead. What you'll learn in this course is absolutely necessary for understanding the solid-state devices prevalent in nearly everything electronic. Course 3 covers every aspect of a fascinating subject in simple, easily-understood terms. Everything is included except a few basic hand tools, a record player and a VOM. Progressing at a self-established pace, you move through the material as you are ready. Step-by-step "programmed" instructions make it a short, easy process. Records reinforce the text material. An optional final exam is available upon request if you wish to test your overall comprehension of the course material.

Course 3 covers semiconductor fundamentals, diodes, zeners, bipolar transistor operation and characteristics, FETs, thyristors, ICs and optoelectronics. Included are texts, records and 27 electronic components for 11 different experiments. Also available is the ET-3100 Experimenter/Trainer Kit that enables you to perform projects and experiments quicker. Prerequisites for the semiconductor course are Ccurses 1 and 2 or equivalent knowledge. The average completion time for Course 3 is 30 hours.

If you choose to take the optional final exam and score a grade of 70% or better, you will receive a Certificate of Completion and 3.0 Continuing Education Units (CEUs). CEUs are a nationally-recognized way of acknowledging participation in non-credit adult education.

Course EE-3103 ..... **39.95**

COURSE 4: Electronic Circuits

This course lets you utilize what you've learned in Courses 1 through 3 to understand the operation of complex electronic circuitry. It's just as easy to follow as the first three courses and also includes all the materials you need except the small hand tools, VOM and record player. Like the other courses, you work at your own pace aided by the records (or optional tapes) and may test yourself with the optional final exam.

Course 4 covers basic amplifiers, typical amplifiers, operational amplifiers, power supplies, oscillators, pulse circuits, modulation and demodulation with emphasis on integrated circuits. Included are texts, records and more than 110 electronic components for 18 different experiments. The ET-3100 Experimenter/Trainer Kit is also available as an option. Course 4 requires the completion of Courses 1 through 3 or equivalent knowledge. The average completion time for Course 4 is 40 hours.

If you choose to take the optional final exam and score a grade of 70% or better, you will receive a Certificate of Completion and 4.0 Continuing Education Units (CEUs). CEUs are a nationally-recognized way of acknowledging participation in non-credit adult education.

Course EE-3104 ..... **49.95**

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☐ Send me the *Electronic Circuits Course* (EE-3104) *with the Experimenter/Trainer* (ET-3100) at the special price of only $99.95 plus $3.00 shipping and handling.

☐ Send *all four of the courses above* (EE-3101, 3102, 3103, 3104) with the Experimenter/Trainer at the special price of just $199.95 plus $4.50 shipping and handling.

In addition, please send the following *courses (less trainer):*

☐ DC (EE-3101) ☐ AC (EE-3102) ☐ Semiconductors (EE-3103) for just $39.95 plus $1.50 shipping and handling each.

☐ Electronics Circuits (EE-3104) for just $49.95 plus $1.50 shipping and handling.

☐ Send me the *Digital Techniques Course (EE-3201) with its Experimenter/Trainer* (ET-3200) for only $124.95 plus $3.00 shipping and handling.

☐ Also send me the IM-5284 *VOM kit* for just $37.95 plus $1.50 shipping and handling.

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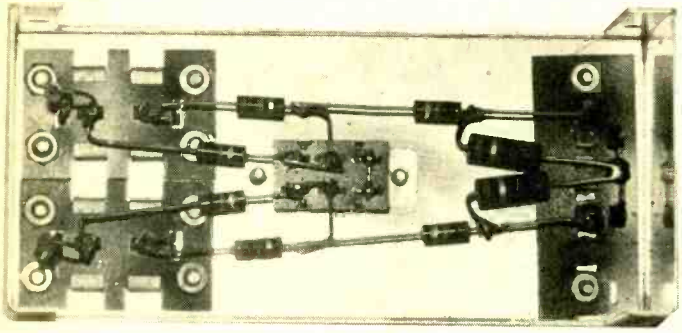
JACK-IN-THE-BOX

Get rid of that HI-FI wire jungle with this neat little box

by Fred Chapman

☐ It seems as though I am always being called upon to make tape copies of something. My daughter wants a favorite record album recorded onto cassette. Cast members from a local musical want open-reel, cassette, or eight-track dubs of the one night the audience outnumbered the cast. A good buddy cons me into doing a sound track for his movies.

It would be simple if only the source and recording equipment were always the same, or, if I had five-grand worth of mixdown gear. Lacking this, we have our problems.



Circuitry of Jack-in-the-Box shown with the cabinet cover removed. As you see, the circuit layout is very clean, with leads squared off, and plenty of room between components. It's a neat, useful project.

Daughter's cassette machine has only a low level mike input, a monaural at that. My music system is stereo with no mono provisions. Sometimes I need mono tapes of stereo sound, other times 'fake-stereo' (actually two-track mono), open-reel tapes from mono sources.

At first this called for weird and often not-so-wonderful lashups of wire and resistors which might or might not get all the way through a recording session without falling apart and creating some interesting sounds of their own. *Jack-in-the-Box* solved 99-44/100ths of my problems.

Building the Solution. As you can see by the schematic, each of the two separate stereo channels has an input with an effective loading of about 15K as well as a second input which offers a 10-ohm 2 Watt load. This second input is the one to use when you plug into the *SPKR* jack of the source. The resistor substitutes for the internal speaker which is cut off by the plug. This keeps the power amplifier from running unloaded which could cause effects ranging from mild distortion, or noise, to complete destruction of the output stage.

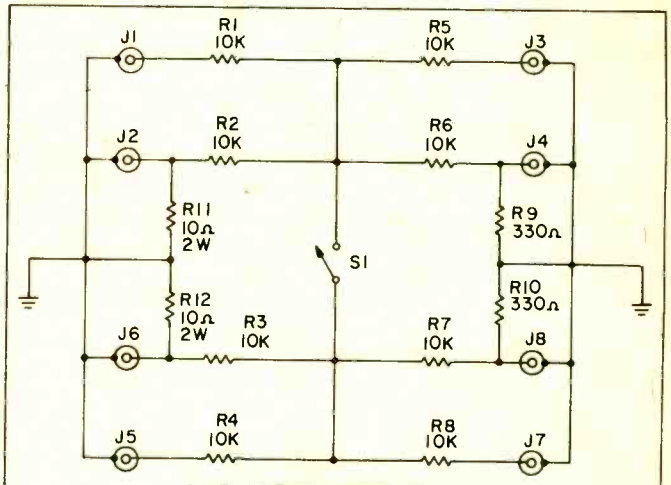
There is a choice of two outputs. One provides a 15-kilohm source impedance and an attenuation determined by the input impedance of the recorder. The other presents a 330-ohm source and provides an attenuation of between 40 and 46 dB depending on recorder input impedance.

S1 allows the two sides of the network to be paralleled to combine left and right inputs, or outputs, while still providing at least 20-kilohm isolation between any two jackets.

Lots of Uses. There are many more uses for Jack in the Box than even these mentioned. For example, you can run inputs into J1 and J3 and take your output from J4. You can add another speaker level input into J2 to make a three input static mix. Remember if you are bridging a PA to record something—you do not use the J2-J6 speaker load jacks but one of the Hi-Z inputs. A PA system (or any amplifier connected to a speaker load) should not have another low value resistor shunted across it's output.

This is probably the world's simplest electronic project to build. The only precaution to take is to build the gadget in an aluminum or steel box. Do not use one of those nice little boxes made of bakelite with an aluminum panel. You are dealing with microphone level signals at J4 and J8 and that means a potential for noise pickup.

If all new parts are used, *Jack-in-the-Box* can be built for less than $10. However, half of the parts will probably come out of your junk box. ■



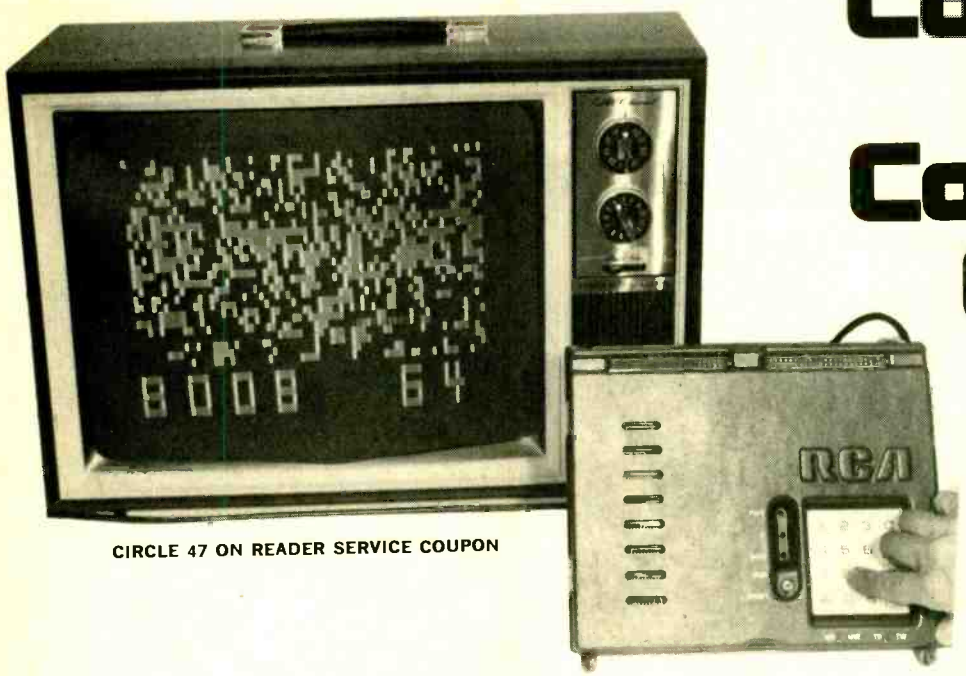
PARTS LIST FOR JACK-IN-THE-BOX

J1-8—Dual phono jacks
R1-8—10,000-ohm, ½-watt resistor
R9, 10—330-ohm, ½-watt resistor
R11, 12—10-ohm, 2-watt (or greater) resistor
S1—SPST slide switch
Misc.—Aluminum box, wire, solder, hardware, etc.

Looking for parts? You'll find them and more in our HOBBY MART section beginning on page 88.

e/e assembles the...

Cosmac VIP Computer Game



CIRCLE 47 ON READER SERVICE COUPON

Enjoy games and graphics too with this super RCA kit

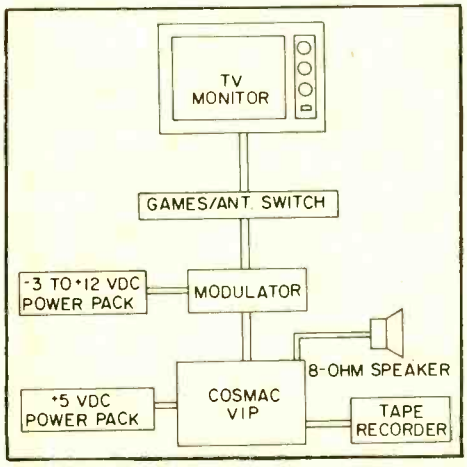
RCA's NEW "FUN MACHINE" is a home hobby computer that offers remarkable entertainment and educational potentials at modest cost. Assemble this one-card COSMAC VIP (Video Interface Processor) kit, feed the output to a conventional black-and-white TV set through a simple modulator, add a small cassette tape recorder for permanently storing programs, and settle down to virtually endless experimentation.

You can immediately program and play 20 different games *without* spending another cent on program software because the games are included in the $275 purchase price of the VIP kit. Right there is where you can save a bundle when you figure that many other game computers on the market require additional investments of twenty dollars and more for each game or two you want to play. Your only cost is for blank cassettes on which to write your own game programs. If you can't locate a COSMAC VIP in a local electronics or computer store, you can write to RCA Solid State Division, Box 3200, Somerville, NJ 08876 and circle No. 47 on the Reader's Service coupon.

More Than Games. In addition to playing the games and creating computer art and animation on your TV screen, you can go on to develop your own programs utilizing a special, "easy-to-learn" CHIP-8 hexadecimal language. And if you have a mind to go deeper, you can obtain hands-on experience using machine language.

The COSMAC VIP is *not* for you if you seek a machine that can process income tax returns and file cooking recipes. It quite possibly *is* for you if fun experimentation is the desired objective. You could experiment endlessly without adding another item to the system. However, hardware hackers will appreciate the complete external interface capabilities that permit systems expansion for such additional applications as model railroad control, music synthesis and even color graphics.

Memory can be increased to 4K bytes by just adding four ICs to the printed circuit card. This permits sophisticated programs for a system of this class. A comprehensive 44 line interface also provided can be used to add "almost anything" to the system including 32K bytes of programmable memory; this interface provides all the COSMAC microprocessor signals. Those wanting to add existing IO devices such as relays, music synthesizers, printers, or an ASCII keyboard, can use a parallel IO port option that is provided. Adding four readily available ICs to the printed circuit card provides an 8 bit output port, an 8 bit input port, and handshaking signals on 22 interface pads.



This block diagram shows the interconnect arrangement of the COSMAC VIP and its various inputs, outputs and power supplys.

Be advised that much of the documentation provided with the COSMAC VIP, especially material intended for *extended* experimentation, is not written for newcomers to the hobby computer field. In fact, making the basic system operational will be much easier for those who already have some knowledge about computing terms and procedures such as RAM, ROM, memory addressing, instructions, bytes and the like. If the VIP is to be your first venture into hobby computing, you can pick up the needed background knowledge through a little extra reading. Later on, I'll provide some tips and suggestions to get you over some of the rougher spots I had to labor through.

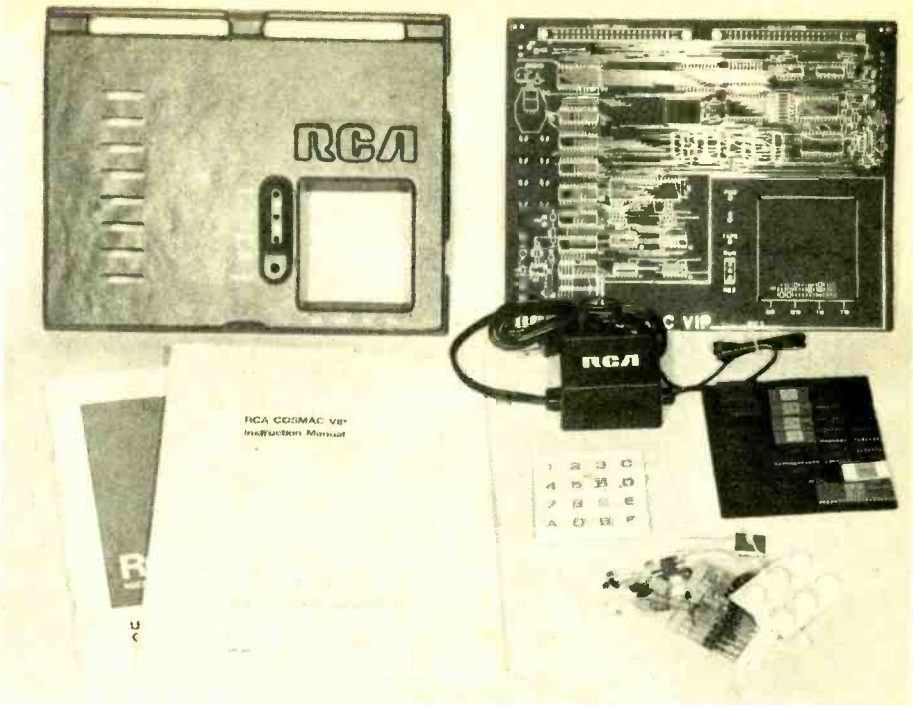
The COSMAC VIP utilizes RCA's 91-instruction CDP1802 microproces-

sor and a graphic video display interface. Other features include: a 2048-byte RAM (Random Access Memory); touch-pad type of hexadecimal keyboard; 100-byte-per-second audio cassette interface; wall-pack type power supply; sound circuits used for signal tones and games; 512-byte ROM (Read Only Memory); capability for on-card RAM expansion up to 4096 bytes; on-card parallel I/O port expansion capability.

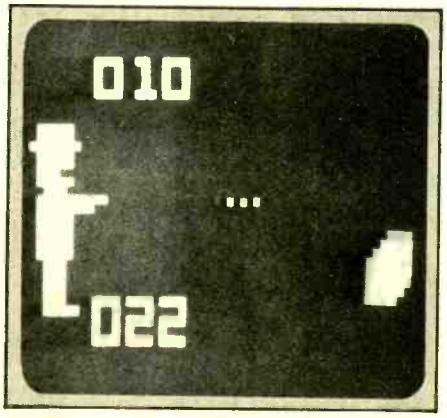
Assembly. You'll have no problems putting the kit together provided you have some experience in kit building. Just be sure to observe the cautions when handling static-sensitive IC's, and check the polarity of your power source before turning on the juice to eliminate the chance of damaging some ICs. Plug-in sockets are provided for only some of the ICs. I recommend that you pick up a few more from your local electronics retailer for the other ICs; unsoldering a defective or improperly oriented IC can be nerve-wracking. The VIP comes with a plastic cover that protects the components on the card, but for some reason no *bottom* protective panel is provided. I strongly urge that you add a protective bottom, perhaps of Masonite. Make sure to leave the rubber feet on the card to provide space for ventilating air flow.

You'll need a modulator if you want to use a conventional black-and-white TV set as a video readout; the VIP can be connected directly to a commercial computer video display. The modulator is *not* supplied by RCA, so you will have to shop around for a suitable unit to convert the VIP's video signal to an RF signal that can be fed to the antenna terminals of a TV set.

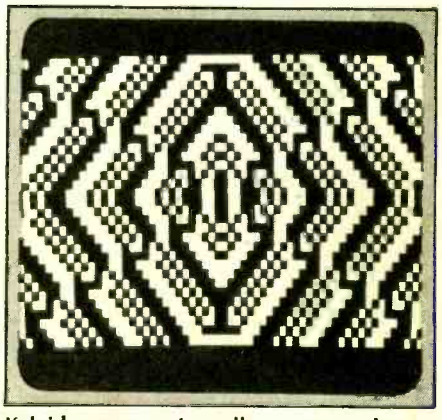
I tried a *Pixe-Verter* PXV-2A modulator (ATV Research, 12 & Broadway, Dakota City, Neb. 68731) and at $8.50 it seems to be a good value. The kit goes together quite easily if you are able to decipher the rather crude components placement drawings. Just be sure that you put the components on the plain side of the PC board. This converter has two controls: one is for tuning the output to an unused TV channel (channel 3 in most areas); the other very handy control (not found on other makes of modulator) is used to eliminate bleeding whites in the video display that might be caused by overmodulation. If tuning to channel 3 seems difficult, try moving the "channel select tap" jumper wire to another section of the coil on the PC board, then retuning again to channel 3.



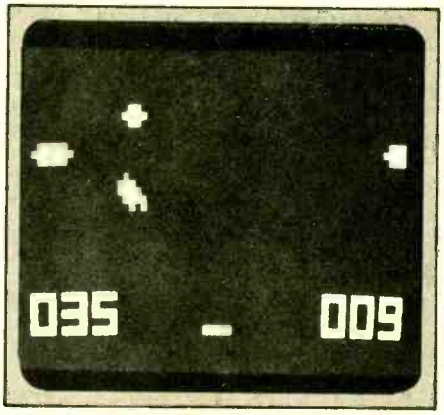
Assembly of the COSMAC VIP kit takes only from 3 to 4 hours because of the small number of components that need to be assembled. The kit includes a 5-VDC power pack, instruction manual, and a quite-technical manual for the CDP 1802 COSMAC Microprocessor which need not be read to build and use the VIP.



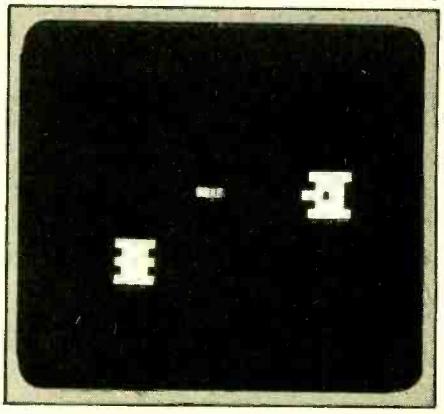
Shooting at a Moving Target—shoot straight, or angled up or down by hitting keys 3, 6 or 9 respectively. Target at right moves in a random manner in right sector.



Keleidoscope—not really a game but a program to generate an almost endless pattern of geometric shapes—the patterns evolve in stages rather than just appearing. Another program permits a Video Drawing



Space Intercept—Blast UFOs out of the sky by adjusting the angle-of-ascent of the rockets. Stop motion photography in this photo creates the triple image.

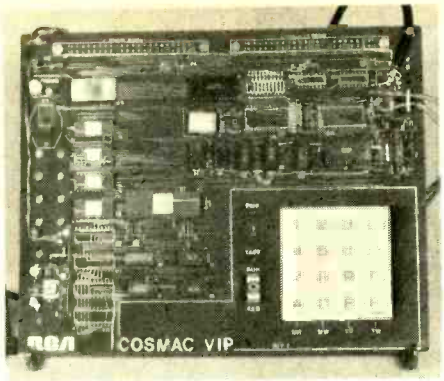


Armored Vehicle Clash—Try to blast the elusive tank that is under the computer's control. Key "F" fires the gun.

If you intend to use the same TV set for normal broadcast viewing, you need a games/antenna switch with at least a 60 dB rating and made especially for this purpose. This goes onto your regular antenna terminals on the TV set, and the TV roof antenna lead and the VIP modulator output go to indicated terminals on the switch. This switch is not part of the Pixe-Verter package, so shop for it locally.

Use coax cable (RG-59/U or equivalent) to connect the modulator to the TV set and to the VIP. A 72/300 ohm transformer at the TV set is not needed.

You can use a 6-volt lantern battery to power the Pixe-Verter; be sure that the *negative* side goes to the modulator input and positive goes to ground. Two other brands of modulators I tested use *positive* DC, so watch the connections if you switch from one type of modulator to another in the course of your experimentation. You can also power the modulator with a regulated DC voltage supply such as a Heathkit IP-2728, or even with an inexpensive AC adapter. For some reason, my system works better at a somewhat reduced voltage of about −3.5 VDC instead of the recommended −6 VDC. I suggest that you add a pot to a battery or adapter type power supply to vary the voltage. Also add an inexpensive 0-15 VDC voltmeter if your power pack lacks a meter. There's another advantage to adding a voltage adjusting pot; slight adjustments of the video display at times can be made much more easily with a voltage change than by digging into the modulator to retune.



Eighteen ICs and other components, including the hexadecimal keyboard, go on the card. Sockets are provided for some, but not all ICs. The author suggests that you obtain additional sockets.

The Pixe-Verter, or any other modulator you choose, will work only on a properly functioning TV set. Even a set that puts out a good TV picture may not perform as well with the weaker RF signal from the computer. It may be necessary to slightly readjust the vertical height and vertical linearity controls of the set, as well as fine tuning and horizontal hold.

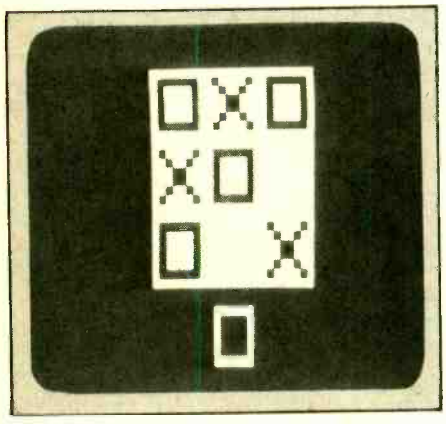
Sup-'R'-Mod-II, a black-and-white modulator sold by M & R Enterprises (PO box 61011, Sunnyvale, CA 94088), costs $25.95 because it comes fully assembled, with a connecting cable and a deluxe games/antenna switch. This unit utilizes a +12 VDC power supply (not provided), and has a single control for tuning to channel 3.

The first M & R unit I received was defective in several respects (the assembler must have had a bad morning), but the company promptly sent a second unit when I complained. The replacement unit also came with four pages of instructions, instead of the one page provided with the defective unit.

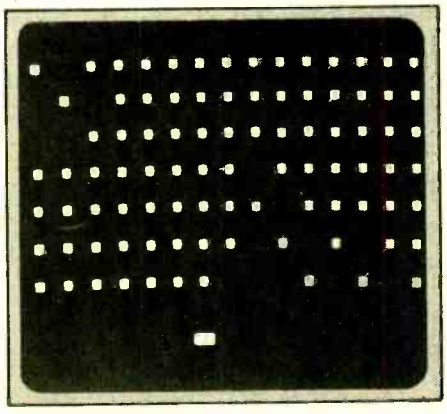
My main problem with the M & R modulator was getting adequate picture contrast, and in wholly eliminating the slightly annoying moiré type interference patterns in the whites of the display image. I snapped up the contrast to a wholly acceptable level by adding a 4700-ohm resistor in parallel with the 10K resistor next to the shielded box on the PC board. I never did get rid of all the moiré interference, and fine tuning was a bit more difficult, I thought, than with the Pixe-Verter. The main advantage of the M & R unit is that it comes fully assembled and provides a good antenna switch and connecting cord. Also, it might work much better with your more modern transistorized TV set than with my old vacuum tube job.

When everything is connected and working properly, and you turn on the VIP as instructed in the manual, you should see a random pattern made up of square white spots on a completely black background. When you key 8008 on the hex keyboard, this number should appear in the lower left corner and number 64 should appear in the lower right corner of the display. If you get all that, you are in business!

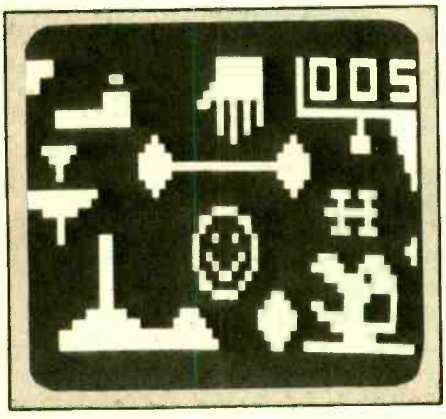
Hexadecimal System. The COSMAC VIP utilizes hexadecimal notation to indicate memory locations and to program instructions to the computer. Writers of the VIP manual assume that you already know how the hex system works, which may not be the case if you are new to computer work, so here are some works of explanation.



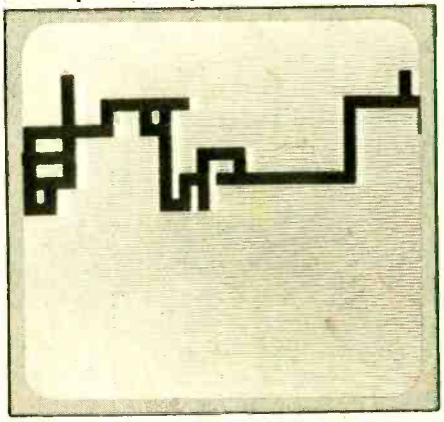
Tick-Tack-Toe—Computerized version of an old favorite—just like the real thing most games end in a draw but the computer will win if you get careless.



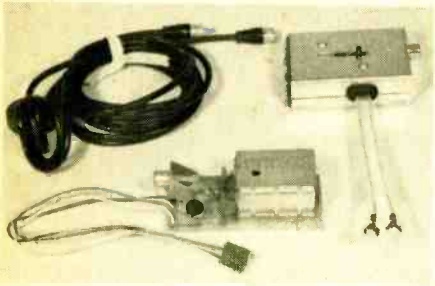
Wipe Off—Paddle (bottom center) bounces a projectile across the field and the object is to wipe off the spots in 20 shots.



Dot Dash—Keep a moving dot from colliding with the obstructions by adjusting its heading with the hex keys.



A-Mazing—Move a spot through a randomly drawn maze by working the hex keys. The maze can be created by the computer or drawn utilizing the VIP display Drawing Game.



The M&R modulator, at $25.95, is expensive but is factory assembled and includes a broadcast/computer switch and cables.

The hexademical system utilizes a counting base of 16 instead of the 10-base with which we are much more familiar. To expand the decimal counting system beyond 9, without getting into double digits, it is necessary to create additional "numerals" with letters of the alphabet: 0,1,2,3,4,5,6,7,8,9,-A,B,C,D,E,F. To understand how these extra numerals affect consecutive counting, consider memory locations that begin, for example, at 0700. Counting proceeds in familiar manner to 0701, 0702 and so on up to 0709. The next number is not 0710, but instead 070 A followed by 070B, 070C, 070D, 070E and 070F. Only after the full sixteen digits are used, does counting go to 0710 to proceed, again in familiar manner, to 0719 after which you get to 071A, 071B, etc.

Memory locations, as tabulated in various VIP games programs, increase in increments of two. For example:

Location	*Instruction Byte*
0200	6000
0202	6380
0204	611F
0206	620F

The skipped locations relate to the second pair of instruction digits in each byte. Thus, location 0202 refers to instruction 63 and location 0203 refers to instruction 80.

During normal programming you need only tell the computer the *first* byte location in a sequence to be fed into the memory. Programming a game is basically a simple procedure after the insertion of a CHIP-8 instruction program (more on this later) into memory. Flip the toggle switch to RUN while pressing key C. Punch the four-digit starting location (0200 for games), followed by 0 which tells the computer to start remembering what follows. Key in the whole series of four-digit codes provided in tabular form in the manual. That done, flip the toggle switch to RESET, then back to RUN. If you made no programming errors, the game is ready for play. Should it not work, you can quickly examine all memory locations by a simple procedure explained in the manual.

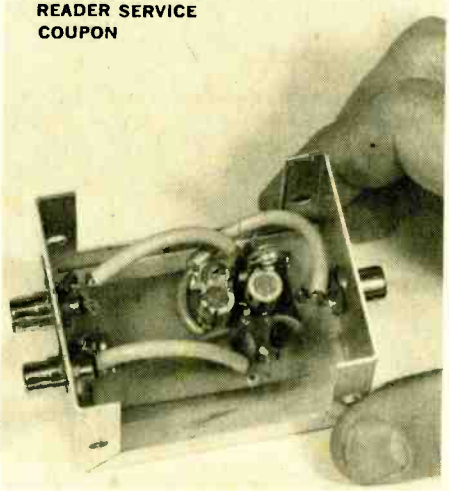
Cassette Recorder a Must. When you turn your VIP computer off, all the information programmed into memory is lost and would have to be reprogrammed. To avoid this tedium, store programmed material on tape from which it can be read back into memory in a few seconds any time it is needed. When recording a new program on tape, I suggest you do so several times in sequence leaving 10 to 20-second intervals between the recordings. If there should be a defect in the tape that spoils one recording, you will still have others that work properly.

Most games require, in addition to the specific games program, a basic CHIP-8 operating instruction program. When you first put this into memory, tape it about ten times on a cassette so that you can keep putting it into the computer memory repeatedly without bothering to rewind repeatedly. Each time the CHIP-8 program and a game program have been combined, and work properly, tape *both* programs in sequence on a tape so that you can at any time read back the *full* program into memory.

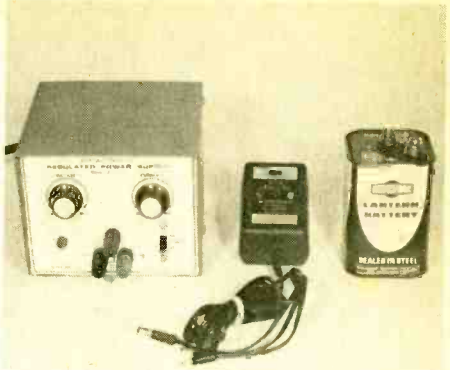
When taping a program, or reading it back, you initiate the actions by keying letters F and B respectively, followed by a number indicating the number of 256-byte "pages" to be recorded. It's important to always indicate the length of the program in pages. The last memory byte recorded on tape is shown on the display on completion of a memory insertion from tape; be sure that it agrees with the byte indicated in the manual. Allow two pages for the CHIP-8 program, and one page for every 256 bytes *or fraction thereof* in a game program. If the game has 258 bytes, for example, key four pages.

Figuring the proper number of pages can be tricky at times, as in the case of the *Dot-Dash* travel-the-maze game. You must provide enough pages to include memory locations 0300 to 03FF even though they are not used in the basic game (instructions are put into 0200-02FF and the maze pattern is in 0400-0501). So when you record or play back the Dot-Dash game, be sure to key in *six* pages rather than the more usual three to five pages. You can create your own additional mazes by programming into memory block 0300-03FF using another drawing game; but when this information is transferred to the Dot-Dash game, it must be inserted into the 0400-0501 memory bank. These are the kinds of things you must discover for yourself through experimentation because the manual writers do not lead you by the hand all the way.

When you eventually tire of these games, you can go on to a list of more than a score of additional program ideas including such teasers as Intoxication Tester, Shuffleboard, Invisible Maze, Lunar Landing, Blackjack, Turing Machine, Nim and others. The only catch: the VIP manual doesn't tell how to program these and you are strictly on your own. But if you solve even half of these problems, you are sure to become a VIP (Very Important Person) in your local hobby computer circles. ■



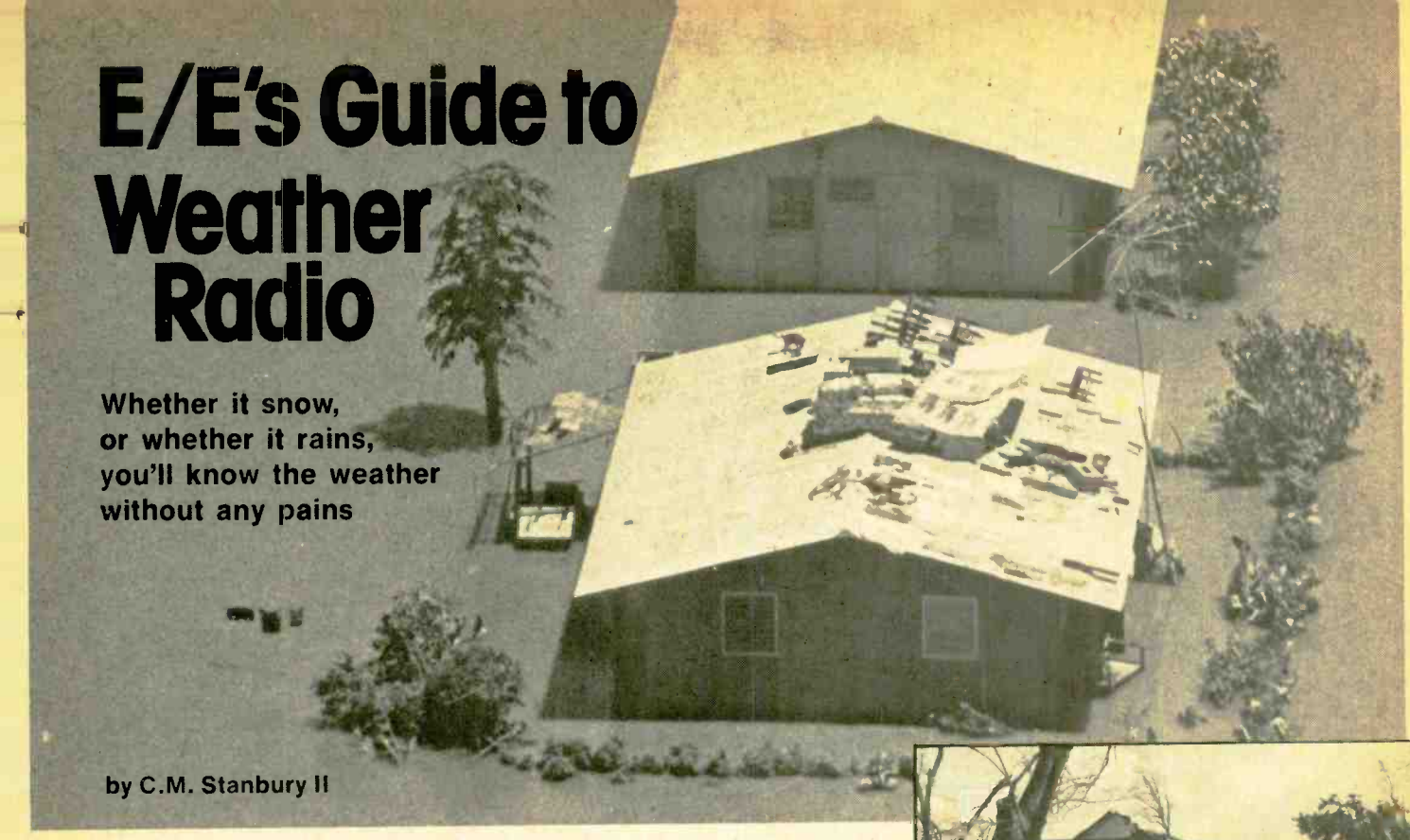
Of the modulators tested by the author, the Pixe-Verter was the least expensive and worked the best. The assembled modulator should be housed in an aluminum mini-box fitted with phone jacks for the video input and output, and for the –6-VDC power input. The mini-box and jacks are not included in the Pixe-Verter kit.



Low voltage power, of either –6 VDC or +12 VDC, is needed depending on the type of modulator used. Six volts can be provided by either a lantern battery, a Universal Adaptor or a regulated power supply. The voltage output should be variable; so add a suitable pot to the lantern battery or Universal Adapter if either is used.

E/E's Guide to Weather Radio

Whether it snow, or whether it rains, you'll know the weather without any pains



United Press International Photo

by C.M. Stanbury II

Floods that accompany hurricanes, typhoons (a hurricane in the Pacific or Indian Ocean), or heavy rain storms can cause heavy loss of life if warnings are not received promptly.

Tornadoes are a big hazard in this country. Before the advent of radio weather forecasts many hundreds of people were killed every year when the storms struck unexpectedly.

☐ With all the speculation these days about changing climates and shifting weather patterns, more and more people are becoming amateur meteorologists If you are one of them, there are a variety of continuous weather broadcast services which you can tune in on —everything from local marine conditions to major continental disturbances. These stations offer up-to-the-minute information almost any time you want it.

VHF. Probably the best known of the special weather broadcast stations are those operated for small boat owners by the National Oceanic & Atmospheric Administration. If you live anywhere near a major body of water (sea shore, Great Lakes etc.) one of these transmitters will be audible on either 162.55 or 162.4 MHz. There are also a few VHF marine broadcasts in Canada on 161.65 MHz.

Recepion is usually limited to about 50 miles but sometimes, during certain weather conditions, signals can be heard as far as 250 miles or more. This phenomenon is known in communications circles as "trop" which is short for tropospheric inversion. It occurs when there is an abnormal arrangement of atmospheric pressure, temperature and/or water vapor in the lower troposphere. "Trop" usually occurs when both the transmitter and receiver are within the same high pressure system during the late afternoon and early evening. This phenomenon should not be confused with ionospheric "skip."

Two MHz Marine. If your location is not suitable for VHF marine reception, marine weather broadcasts from both the U.S. and Canada can also be found between 2450 and 2670 kHz. Although nearly all 2 MHz marine traffic now uses single sideband modulation, many of the broadcasts continue to employ ordinary AM. As was noted in a 1976 e/e article on 2 MHz, reception is similar to that on the standard AM broadcast band.

The broadcasts below 2600 kHz are aired by various shore to ship telephone transmitters, and in Canada by general purpose coast stations operated by the Department of Transport. Meanwhile a number of U.S. Coast Guard stations have broadcasts on 2670 kHz. Further the USCG transmits emergency weather bulletins immediately upon receipt both on 2670 and 2182, the international calling and distress frequency.

WWV. Possibly the most widely heard weather broadcasts in the world are those aired by the National Bureau of Standards time station WWV (Fort Collins, Colorado) on 2500, 5000, 10000 and 15000 kHz. They are scheduled at 8, 9 and 10 minutes past each hour. The first 2 one-minute segments are devoted to the Atlantic and Gulf coasts while the broadcast at 10 minutes past the hour covers the Pacific. Although as much information as possible is crammed into WWV's relatively short transmissions, the emphasis is on major disturbances; hurricanes, gales and blizzards.

WWV broadcasts a very different kind of "weather" report at 18 minutes past each hour: "solar/terrestial" conditions which mainly effect the ionosphere and the troposphere but no one knows exactly how this influences what we normally consider "weather." Ionospheric conditions, with the exception of static, control all distant radio reception below 30 MHz. Because of this WWV will be heard best during daylight hours on 10 and 15 MHz with 2500 or 5000 kHz taking over at night. More detailed Pacific weather is provided in four segments between 48 and 52 minutes past each hour by National Bureau of Standards station WWVH at Kekaha on the Hawaiian island of

Kuaui. Although WWVH uses the same frequencies as WWV, the latter is silent (except for those ticks which mark each second) during all WWVH voice transmissions.

VOLMET. In the May/June, 1977 e/e ("DXing the Forgotten Continent") we told you about aeronautical weather broadcasts from stations at Gander, Newfoundland and New York (see Figure II for a repeat of frequencies and times). But the Federal Aviation Agen- also operates "VOLMET" broadcasts from Oakland, Anchorage and Honolulu. These contain specific and up to the hour weather conditions for a variety of locations around the eastern Pacific (while Gander and New York provide similar coverage of western Atlantic and Canadian airports). Frequencies for the eastern Pacific service are 13344, 8903, 5519 and 2980 kHz. Oakland transmits at 5 and 35 minutes past the hour, Honolulu at 20 and 50 past, and Anchorage at 25 and 55 minutes past each hour.

Meanwhile, on these same frequencies, listeners in western North America will sometimes be able to hear Tokyo at 10 and 40 past followed immediately by a 5 minute transmission from Hong Kong Aeradio. Both broadcast Asian weather reports in English. English language shortwave weather broadcasts can also be heard from Europe. By far the most easily monitored is Shannon Aeradio (EIRE), which airs an extensive 20 minute west European rundown on the hour and half hour. Shannon has four frequencies more or less to themselves; 13312, 8833, 5533 and 2889 kHz.

Before leaving shortwave, it should be noted that very few regular international broadcast stations have weather reports. Generally speaking fulltime weather outlets are more useful because the listener can be sure transmissions aren't being edited for the tourist trade. However, Radio Cairo's weather summary on 9805 kHz at 1802 EST is of special interest, as fulltime weather sources are not readily audible from that part of the world.

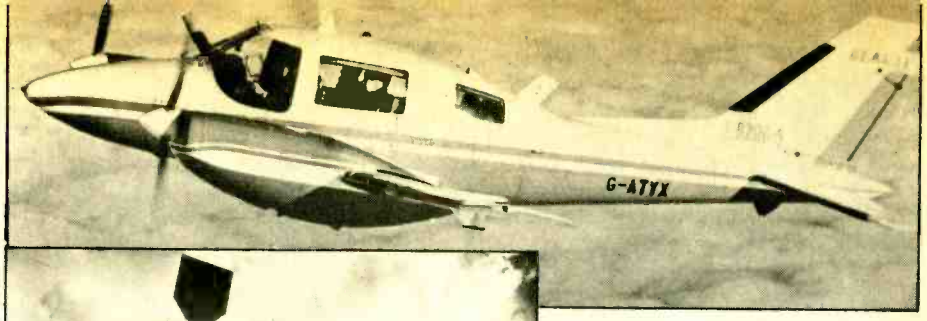
Long Wave. By now astute readers will have noted a major gap in our coverage; mid America. In order to fill in this hole, you'll have to try long wave. Between 200 and 400 kHz a number of FAA beacon stations have continuous weather broadcasts. Reception of these has improved considerably over the last decade because most of the other U.S. beacons which once crowded the band have now been phased out. In fact, for a veteran long wave monitor like the author, coming back and hearing how much the band has changed is sort of a spooky experience.

Reception between 200 and 300 kHz is very similar to what you encounter on the standard AM Broadcast Band, especially the low end of the latter. But long wave weather broadcasters have considerably less transmitter power than such well known clear-channel operations as WNBC, WSM, and KFI. Another notable difference is that long wave tends to be more affected by nearby thunderstorms. Even local reception, in some cases, can be wiped out.

Although these stations now serve primarily as weather broadcasters, they are still assigned beacon style IDs: eg. Detroit, Michigan is "DT" on 388 kHz, Cleveland, Ohio is "CLE" on 344 kHz and so on. Many Canadian LW beacons have similar broadcasts but few are continuous. Most are for only a few minutes duration at 17 and 47 past each hour. The beacon ID is transmitted during the remainder of the hour. Incidentally, for the past five years or so there has been a marked improvement in Canadian reception as compared to tropical beacons on the same frequencies. This appears to be the result of some unexplained change in ionospheric "weather." Neither the reduction in U.S. interference nor normal variations caused by the sunspot cycle seem to account for the phenomenon. So these days it seems that both the tropospheric and ionospheric weather is strange.

Equipment. We assume that every

(Continued on page 94)



High above the clouds this pilot will eventually have to descend back through them; to help the pilot know that his desination is clear of fog or dangerous winds the FAA provides weather broadcasts on its 200- to 400-kHz beacons. International aviation forecasts are available on a SW VOLMET network.

Radio broadcast stations that transmit purely weather information are scattered throughout the world, but are concentrated near shipping and airline routes. Network type SW weather broadcasts are rare since the listeners are often scattered over a very large area.

Shortwave Weather Broadcasts

kHz	Station	Time (minutes past each hour)
2500	WWV	08
	WWVH	48
2889	Shannon Aeradio	00 & 30
2980	Oakland Aeradio	05 & 35
	Tokyo Aeradio	10 & 40
	Honolulu Aeradio	20 & 40
	Anchorage Aeradio	25 & 55
3001	New York Aeradio	00 & 30
	Gander Aeradio	20 & 50
5000	WWV	08
	WWVH	48
5519	Oakland Aeradio	05 & 35
	Tokyo Aeradio	10 & 40
	Hong Kong Aeradio	15 & 45
	Honolulu Aeradio	20 & 50
	Anchorage Aeradio	25 & 55
5533	Shannon Aeradio	00 & 30
5652	New York Aeradio	00 & 30
	Gander Aeradio	20 & 50
8833	Shannon Aeradio	00 & 30
8868	New York Aeradio	00 & 30
	Gander Aeradio	20 & 50
8903	Oakland Aeradio	05 & 35
	Tokyo Aeradio	10 & 40
	Hong Kong Aeradio	15 & 45
	Honolulu Aeradio	20 & 50
	Anchorage Aeradio	25 & 55
9805	Radio Cairo	1802 EST only
10000	WWV	08
	WWVH	48
13272	New York Aeradio	00 & 30
	Gander Aeradio	20 & 50
13312	Shannon Aeradio	00 & 30
13344	Oakland Aeradio	05 & 35
	Tokyo Aeradio	10 & 40
	Hong Kong Aeradio	15 & 45
	Honolulu Aeradio	20 & 50
15000	WWV	08
	WWVH	48

SUPER BCB Booster

Make any broadcast receiver a DX star with this sharp-tuning preamp.

by Herb Friedman

IMAGINE YOUR BROADCAST BAND RECEIVER jammed from end to end with a solid wall of signals! Flea's-whisper stations, that normally can't be heard with headphones, booming into your shack at S9. This is the kind of reception you'll get with the *Super BCB Booster*, a preamplifier specifically designed for BC DX'ers.

Whether you live in a concrete and steel tower, or out in the boondocks with enough space for a long-wire antenna, the *Super BCB Booster* will dig out stations you've never heard before because its average gain is almost 42 dB—7 S-units of extra sensitivity.

The booster can function as an electronic antenna with signals received only by loopstick antenna coil L1, or as a preamplifier, with a "longwire" antenna connected to binding post BP1.

How It Works. The signal voltage appearing across tuned circuit L1/C1 is fed to FET Q1, which provides approximately 20 dB gain on top of the L1/C1 resonant "gain." Q1's output feeds transistor Q2, an emitter-follower that provides a 10- to 15-dB power gain, and also a low impedance output for connection to the relatively low impedance input of a communications receiver.

Though intended for direct connection to a receiver's antenna input terminals, the *Super BCB Booster* can also be used with "loop antenna radios" by connecting the booster's output to a loopstick antenna (duplicate of L1) positioned near the radio. We'll show how both connections are used.

Powered by a 2U6 type 9-volt transistor radio battery the current drain is less than 2 mA and a standard battery will last at least three-months, even under heavy service. An activator or heavy duty battery can last a year or more. With such low power consumption there's no reason to build an external AC power supply for the *Super BCB Booster*.

Construction. Although the circuit appears simple, extreme care must be taken with the circuit board preparation since the high overall gain can cause instability if a single component, or printed circuit foil, is out of position. We suggest no attempt be made to use point-to-point wiring. Use a PC board that is an exact copy of the supplied template (any PC board material can be used). If you cannot make your own PC boards you can obtain a *plated board* (for easy soldering) from the source indicated in the parts list.

Avoid component substitutions; Q1 and Q2 should be the specified types. Though the booster might work with some "general replacement" transistors, it might not work with others. Worse yet, it might work only on very weak signals while distorting strong signals.

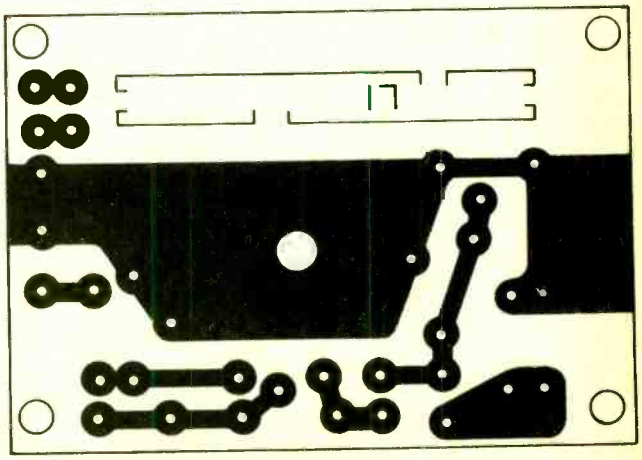
The specified components will provide distortion-free reception on signals as strong as 80,000 uV. It will deliver excellent performance with battery voltage falling as low as 6-volts.

The circuit board and a *very short* connection to output jack J1 are the only critical assemblies. You can make mechanical modifications as long as the general layout approximates the unit shown in the photographs.

We suggest that the unit be assembled in a plastic cabinet with an aluminum front panel, though a full plastic cabinet can be used because the PC board has a built-in hand-capacitance shield. Maximum stability, however, is attained through the use of a metal front panel because it reduces the possibility of feedback from booster's output to its input.

Drilling the PC Board. All of the component mounting holes except for tuning capacitor C1 can be made with a #58, #59, or #60 bit. Capacitor C1 requires a 5/16-inch hole. If you don't have a 5/16-inch bit use a 1/4-inch drill and enlarge the hole very carefully with a miniature round file. The corner holes, which are used for the mounting screws, should clear #4 or #6 screws—which ever you prefer to use.

The PC board is best assembled in the following manner: Install capacitor C1 first, then all the remaining components except Q1. Then push Q1's leads through the board and solder. Note that Q1 is supplied with a shorting-clip around all the leads. *This clip must be*



Make a PC board that is an exact duplicate of this Template. Do not try to use point-to-point wiring since the high gains could cause instability if any parts or strips of foil were out of position. If you have any problem making yours write to the address listed with the parts for a finished board.

BCB BOOSTER

left in position until assembly is completed and the booster is ready for operation. If the clip is removed a high static voltage from the tip of the soldering iron, or a voltage generated through normal handling, might destroy Q1. Place a paper or tape tag on or near Q1 to remind you to pull off the shorting clip before applying power.

Double-check that the tab sticking out from Q1's case faces the nearest edge of the PC board before soldering. The round side (opposite the flat) of Q2 should face the same edge of the PC board.

Note that L1's primary and secondary windings are independent though their *ground* connections are generally shorted together by a wire jumper on the PC board. If for some reason you prefer a separate antenna system ground, open the shorting wire and install a "ground binding post" on the panel.

After L1 is wired to the PC board it can be secured with a few dabs of silicon rubber adhesive such as Silastic or G.E.'s RTV.

Since stand-offs space the PC board away from the panel to prevent shorts between the foil(s) and the metal panel, it will be impossible to add wiring after the assembly is installed on the panel. Install the wires for the connections to BP1, J1, SW1 and the battery connector before mounting the PC board. Insulated #20 or #22 solid wire is suggested. Mount the PC board to the panel using a 1/4-inch spacer or stack of washers between the panel and PC board at each mounting screw.

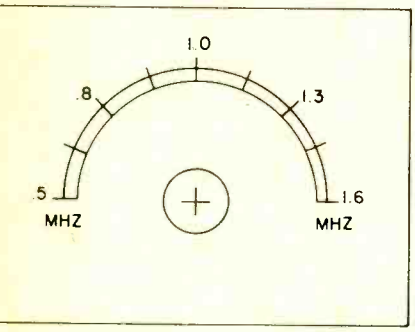
After all wiring to the panel components is completed adjust L1's slug so it protrudes between 1/4- to 1/2-inch from the top of the coil form—no further tuning is needed.

Make up a connecting lead from shielded or coaxial cable to go from output jack J1 to the receiver's antenna terminals. For least signal attenuation the lead length should not exceed 15-inches.

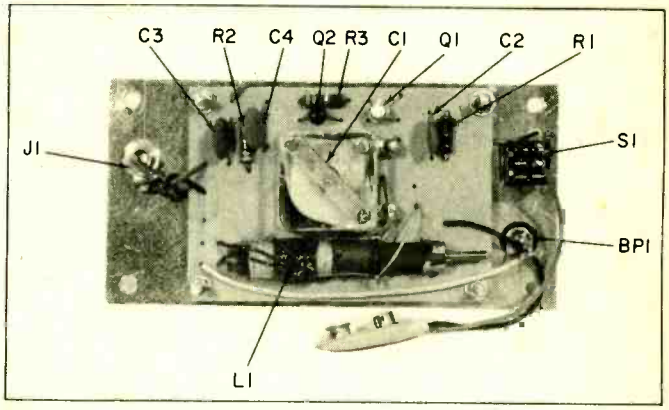
If the booster will be used with a transistor-type radio having a built-in loop antenna and no terminals, connect the free end of the output cable to a loopstick antenna coil the exact duplicate of L1. Remove the primary winding—the heavy outer winding of plastic insulated wire wrapped around the coil. Position this coil on the radio's case opposite the built-in loopstick antenna and tape the coil in place.

***Using The* Super BCB Booster.** Turn on both the receiver and booster and tune in the desired station or frequency. Then adjust tuning capacitor C1 for maximum signal strength or highest S-meter reading. As a general rule the

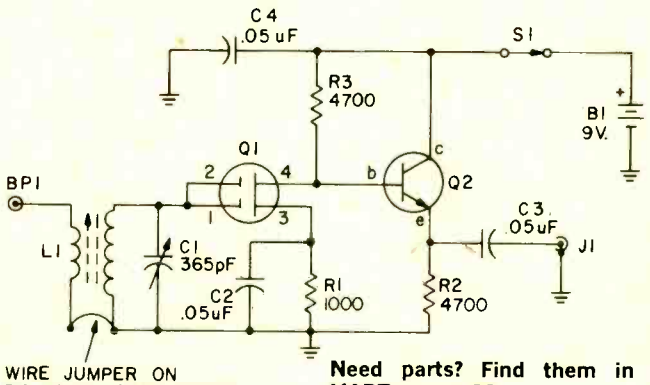
(Continued on page 94)



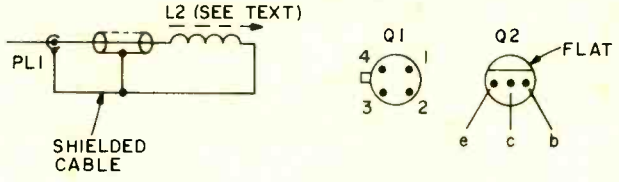
The tuning dial faceplate can be used as is; just cut it out and paste it down.



The complete assembly—showing the recommended locations for BP1, S1 and J1. Note that J1's ground lug is used; there are two connections to the PC board—one for the ground terminal and one for the jack's center conductor. Shielded cable isn't needed; just wrap the ground wire around the conductor a few times.



Need parts? Find them in HOBBY MART—page 88.



PARTS LIST FOR SUPER BCB BOOSTER

B1—9-volt battery (type 2U6 or equiv.)
BP1—Insulated 5-way binding post or equiv.
C1—365 pF miniature tuning capacitor (Polyvaricon type)
C2, C3, C4—0.05 uF disc capacitor rated 10 VDC or higher
J1—Phono jack
L1—Loopstick antenna (Radio Shack 270-1430 or equiv.)
L2—Same as L1 (Optional. See text.)
PL1—Phono plug (Optional for L2)
Q1—FET, RCA 40600
Q2—NPN transistor, 2N3394
R1—1000 ohms, ½-watt, 10% resistor
R2, R3—4700 ohms, ½-watt, 10% resistor
S1—SPST switch
Misc.—Cabinet, PC board, hardware, etc. A plated printed circuit board is available for $5 from the Electronic Hobby Shop, Box 192, Brooklyn, N.Y. 11235. U.S. orders add $1.50 for postage and handling: Canadian orders add $3. No foreign orders, please. New York State residents must add appropriate sales tax for your area. Postal money orders speed delivery; otherwise allow 6-8 weeks for delivery.

L1 is secured to the back of the PC board, after it has been wired, with a couple of drops of silicon rubber adhesive. The coil can serve as an "electronic antenna," and a "long wire antenna is needed only if you are after super-DX reception. To keep dust out of the tuning capacitor's plates—and thereby avoiding snaps, crackles and pops when tuning—we suggest a model that is supplied with a plastic cover.

e/e checks out the...

Realistic PRO-2001 Scanner

Thousands of channels, millions of minutes of fun, all at your command!

CIRCLE 32 ON READER SERVICE COUPON

IT WASN'T TOO LONG AGO that the action band hobbyists—those who monitor police, fire and emergency calls on the Public Service bands—could easily get by with a receiver covering a few crystal controlled frequencies. Because of the relatively low sensitivity of many scanners and the few frequencies in local use all that was needed was a handful of crystals to cover all, or most, of the action in your locality.

These days the Public Service Bands (PSB) are jumping with action—everything from police and fire to telephone calls, the F.B.I., marine, and even mass transit operations. Allow for the super sensitivity of the modern solid-state scanner and it would take *several* handfuls of crystals to keep track of just one band; you'd need a mountain of crystals to cover the 30-50 and 144-174 MHz VHF bands, and the 430-512 MHz UHF band. The cost of the crystals would come to more than the price of a modern computer-controlled scanner, such as the Realistic PRO-2001, that lets you select any PBS frequency at the touch of a few buttons. Better still, the PRO-2001's computer can search out signals on active frequencies you didn't even know were in use.

Yes, you read correctly, the PRO-2001 has a built in computer; and while the computer doesn't calculate math problems or keep track of checkbook balances, it will program any PSB frequencies into 16 channels, an additional monitor channel (#17), and automatically search a user selected range of frequencies until it uncovers who is using what frequency. It can then enter the "discovered" frequency into one of the channel memories.

Unlike some other attempts at user-programming of frequencies which often led to accidental erasing of a desired frequency, Realistic's computer control assures that nothing happens until everything has been checked out by the computer. Say you have a particular frequency programmed into channel #1 and you desire to reprogram another frequency. You would enter the new frequency into a *monitor* (holding) memory, check it out by listening, and only when you are satisfied you have entered the correct frequency would you signal the computer to make the change in channel #1. Make an error? Program a frequency outside the scanner's working range and the computer flashes an *error* message without affecting the frequencies already programmed into the 16 channels.

A seven digit L.E.D. display, calibrated in MHz and kHz, indicates the frequency entered (programmed) into one of the 16 channels, the frequency entered into the monitor (holding) memory, and the word *Error* when you make a mistake in frequency.

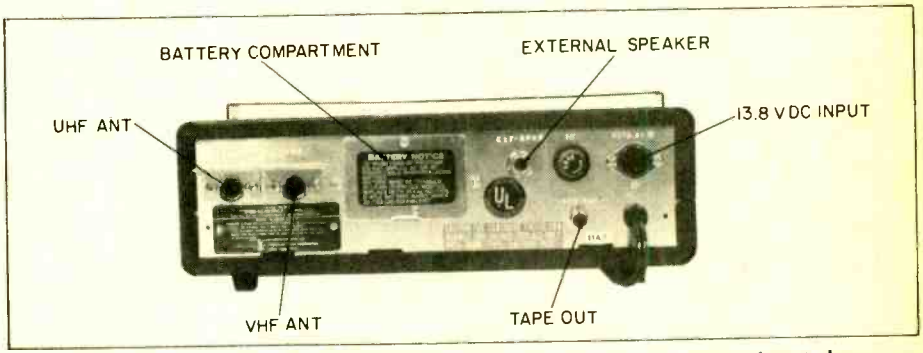
The PRO-2001 is designed for both base and mobile (or portable) operation. It has an attached 120 VAC linecord and a receptacle for the supplied 13.8 (12) VDC power cord. A gimbal bracket is also provided for mobile installations.

In addition to the DC power socket the rear apron has "auto" type jacks for the VHF and UHF antennas (separate connections), a phone type jack for an external speaker, and a phono jack for a tape recorder (possibly for logging received signals).

The front panel is divided into two sections. The larger section has sixteen pushbutton switches for selection of the desired channels with associated LEDs indicating the channel being monitored. There are volume and squelch controls, and a switch that selects automatic scanner operation, manual mode, and stepping from channel to channel in the manual mode. A second switch provides a delay of approximately ten seconds after the end of a transmission to insure the scanning doesn't resume before the seconds station gets a chance to transmit.

As mentioned earlier, the "tuned" frequency is indicated on a 7-digit L.E.D. readout.

The smaller front panel section contains only pushbuttons and an L.E.D. indicator lamp. Eleven buttons provide the numerals 0-9, and a decimal point,



Both the 30-50 MHz and 144-174 MHz bands use a common antenna input, however there are separate front ends for each band. The UHF band (430-512 MHz) requires its own antenna. The tape jack is bridged across the speaker output and permits the recording of all the received signals, an aid in logging. The unit is normally powered from 120 VAC using an attached linecord, or can also be powered by 13.8 VDC (nominally 12 VDC) through a DC power input. The PRO-2001 is a versatile, high-performance, state-of-the-art monitor which will get you in on the action bands.

e/e CHECKS PRO-2001

for programming a frequency into the monitor memory. A CL (clear) button allows you to correct mistakes, a MONITOR button permits you to monitor a preprogrammed frequency regardless of what channel has been normally selected. A ENT (enter) button will enter the programmed frequency into a channel, and a SCANNER button puts the receiver into either the scanner or manual mode.

Finally, we find four buttons labeled: UP, LO, FS, and SS. These are used for *automatic search* between two selected frequencies. Here's how it works. Press a PROGRAM button which will cause the L.E.D. to light, indicating the unit is ready to be programmed. Then, press the LO button and enter the lowest selected frequency you want to search. Assume we have entered 156.550 MHz. Then, press UP and enter the highest frequency you want to search; assume 159.350 MHz. When you press FS (fast search) the scanner will start at 156.550 MHz and step upwards 5 kHz per step until it finds a signal. The frequency is indicated on the readout. If you want to monitor the signal you simply press the MONITOR button. When you want to resume the search, press FS, or SS again, if you want a *slow scan*. Once you have locked onto a signal with the monitor button, you can enter the signal's frequency into a channel by simply pressing the ENT button. Once you have entered a frequency into a channel you must reprogram the search frequencies if you want to resume the search.

The search mode can even involve two bands. If you set up for 35.500 MHz LO and 152.650 UP the search

The smaller front panel section provides push button control of all the functions; frequency selection, frequency changes, monitoring before entering a frequency into a channel (programming), search, and scan. Make a mistake? Clear it with the CL key to save already programmed channels.

The 9-volt transistor radio battery is located on the rear apron. By maintaining power at all times on the CMOS ICs it assures that the programming is still there if AC/DC power fails.

CIRCLE 32 ON READER SERVICE COUPON

will take place within this range of frequencies on all frequencies within the PRO-2001's tuning range.

The tuning range is 30-50 MHz (LO VHF), 144-174 MHz (HI VHF), and 430-512 MHz (UHF). Each frequency step for all tuning modes is 5 KHz for VHF and 12.5 kHz for UHF—the standard frequency spacing. If you accidentally reprogram to the next lower correct channel; for example, if you erroneously program 155.556.000 the computer will correct to 155.555.000 (5000 Hz spacing) when you press the monitor or ENT buttons. A similar correction to 12.5 kHz is made for the UHF frequencies. If you attempt to program a frequency outside the monitor's tuning range the message *Error* is displayed on the digital readout.

Overall performance checked out strictly first rate. Measurements are really unimportant because most modern equipment delivers essentially similar measurements. The PRO-2001's sensitivity of 0.5 uV on VHF and 1.0 uV on UHF is typical of other high performance monitors, as is the 60 dB adjacent channel selectivity attained through use of a crystal filter in a 10.7 MHz first IF, and a ceramic filter in the 455 kHz second IF.

What *doesn't* show on measurements is what makes the PRO-2001 an outstanding performer. There's automatic center channel detection—if the transmitting station is slightly off-frequency, or you program a few kHz off-frequency, the detector automatically "pulls" for proper reception. This alone makes the PRO-2001 a winner. Then, there's an unusually crisp and clean sound from the built-in speaker even at unusually loud volume levels—there is little distortion even at piercing sound levels.

Finally, there is "permanent" memory even when the power is turned off. You can pull the plug in your home, move the PRO-2001 to your car, plug in to the auto battery, and when you turn the power switch *on* all the frequencies are still entered in the 16 channels. The reason for this is a CMOS RAM (random access memory) that is kept alive by a 9-volt transistor radio battery stored in the back of the rear apron. The battery is permanently connected to the memory integrated circuits—it is not turned off by the power switch—and because the CMOS devices consume a minute amount of current the battery will last about six months, the exact time depending on the type of battery used. Channel programming is not lost when the battery is replaced as long as the linecord is plugged in while you are changing the battery. If you attempt to change the battery with the linecord disconnected it is most likely the memory cells will lose their programming. We say "most likely" because we inadvertently changed the battery with the linecord disconnected and did not lose programming. Perhaps a capacitor in the CMOS power circuit held the charge long enough to maintain memory (we did make the change rather quickly), but don't depend on it to work for you. Simply follow instructions and be certain the linecord is plugged into an AC outlet before you disconnect the battery.

Summing Up. From almost every point of view the PRO-2001 comes up a *winner*. If there is any complaint it concerns the programming procedure,

(Continued on page 94)

A seven digit LED display, calibrated in MHz and KHz, indicates the frequency entered into a channel, the frequency located by the search mode, the frequeny entered into the monitor, or the frequency selected befor the user tells the computer what to do with it. Normally, the digital display is an indicator as to what channel is received.

SHORTWAVE-BAND AIDS

Become a "world-class" DXer by setting up your own super-equipped, shortwave listening post.

by Roger Peterson

A globe is a great aid for the SWL. It is not as compact as a wall map but with a flexible ruler you can measure distance without the distortion effects of a flat map. If you have trouble finding Ouagadougou the first time you catch Radio Voltaique you might need a pocket atlas with a good gazetteer to find it in Upper Volta in West Africa. Make sure it's up-to-date.

☐ YOUR NEW SHORTWAVE radio is all plugged in and hooked to the antenna outside your window and you're starting to listen to the world. You've read a little about the sport of DXing—tuning in for long distance stations—and you decide to give it a whirl. How can you pursue this hobby and get a flood of exotic QSL cards coming through the mail? You have the main ingredients—short wave set and antenna. But what else do you need?

Information Aids. You probably began your listening by simply tuning through the bands to see what stations you could stumble onto. In time, you can catch a lot of stations this way. The experienced DXer, however, has a better way. He has an up-to-date list of foreign station broadcasts—by country, time and frequency. Thus he is able to target his tuning so that every time he turns on his set, he knows exactly what to look for. He may not always be successful in getting the program he tunes for but he knows where it can be found on the dial and, just as important, what time it is on the air.

The author tunes in a rare catch on his Drake SSR-1 shortwave receiver. Note the convenient layout of this listening post. Everything is handy but the desktop remains uncluttered—a key to relaxed DXing.

Where does the DXer get such a list? Unfortunately, your local newspaper doesn't carry shortwave program listings. If you are a regular reader of *Elementary Electronics*, you have access to Don Jensen's DX articles and are probably familiar with *Elementary Electronics*' sister publication, *Communications World*. These are great sources of information for the DXer but there are many additional sources that will also prove helpful.

The first source is a copy of the *World Radio TV Handbook*. This 500-page annual publication lists all known shortwave broadcasters of the world. It lists them by country, by frequency and by time of broadcast. It also has a wealth of other essential information. For example, it gives the mailing addresses of all these stations—a necessity for your sending in your reception reports. It is available at many electronic stores or by mail from Gilfer Associates, Inc., P.O. Box 239, Park Ridge, N.J. 07656.

Up-dating foreign station broadcasting times and frequencies once a year is still not enough for the ardent DXer. The rapidity with which stations change their frequencies because of seasonal propagation conditions and interference by other stations broadcasting on the same or nearby frequencies, will amaze you. Therefore, the smart DXer joins a shortwave club and receives its periodic bulletins. These will feature reports sent in by members from all over the country, noting changes in frequencies and broadcasting times.

The same periodical will give you information about QSL card receptions. Members report on how long it took to receive these from various countries and whether or not return postage was needed. When you consider that it costs 31 cents each time you mail an overseas reception report, you may think twice before sending one into a country that seldom replies. But you can get this kind of information from your shortwave club bulletin.

There are a number of shortwave clubs in the U.S. Some specialize in various types of shortwave listening. Others cover a variety of shortwave broadcasting. The largest in the U.S. that caters exclusively to the foreign broadcast shortwave listener is the North American Short Wave Association, P.O. Box 13, Liberty, Indiana 47353.

Many DXers take the information they get from these various sources and make up a target list. One way to do this is to use graph paper and list the countries you plan to try for down the left hand side of the paper, alphabetically. Leave space between countries because many will have more than one frequency that they broadcast from. List the frequencies in the column to the right of the country. Now go to the top of the page and list the time in twenty-four numbers. Start at the left wih "00" and continue across the page with "01," "02", etc. Finally, fill in the squares below to correspond to each country's broadcasting time and frequency. Now you have a practical, cross-reference list to work from. You can approach it from either the top (by time of day) or

e/e AIDS TO DX

by country (using the left-hand column).

Time Conversion Aids. One of the mysteries for the beginner in shortwave listening is the Greenwich Mean Time (twenty-four hour) clock system. All program listings are given in such unfamiliar numerals as "2300 hours," "1300 hours," etc. It makes no sense at all to go looking into a reference book every time you see or hear this kind of time announcement. Instead, make up a time equivalent chart and tack it up on the wall behind your receiver. Since I want a morning-to-afternoon-to-night listing, I start at the top with 1100 and put down 6 A.M. next to it, etc.

As handy as the chart is, you will find that a 24-hour clock is also a virtual necessity. You can make one yourself by simply lettering in the "13" to "23" additional hour-numbers under the appropriate existing numbers on an old kitchen clock. I used this arrangement for a while but found that I always had to hesitate and think a second to determine whether the clock said 0200 or 1400 hours. I finally broke down and purchased a regular 24-hour digital clock at an electronics store. Now when I sit down at my listening post and glance up at the clock on the shelf, I'm completely converted to G.M.T.–the World broadcaster's and DXer's universal time.

Listening Aids. Your new shortwave radio probably has a built-in speaker and you might wonder how much better the sound would be with a larger, external unit. Unless your particular set has a very poor speaker, you won't see much difference with the addition of an outside speaker. Shortwave reception is a long way from hi-fi. There is, however, one listening aid that every shortwave listener should have and that is a set of headphones.

Unless you live alone in a tent in the middle of a forest, the squeaks and noises from your shortwave set's speaker will not make you very popular with the rest of the family. This will be a very definite problem in the wee hours of the morning or late at night when you're trying for some glamorous African or Polynesian "catch."

Headphones fulfill another need; they blot out external noises and let your ears concentrate on your listening and tuning. The last thing you need is the sound of a car's backfiring or the ringing of a doorbell when you're in the midst of tuning in that hard-to-get foreign station.

When you purchase headphones, make sure you get the communications type. The hi-fi headphones, used to listen to stereo music are not for shortwave listening. They will only emphasize the squeaks and buzzes that you don't want to hear. And since you will be using them for many hours, make sure they are comfortable. If you wear glasses, you may want to check into a special type of headphone that rests on your temples and has an adjustable tubular sound arm that goes into your ear.

Recording Aids. One of the handiest items to have near your radio receiver is a tape recorder. Some DXers use tapes to send in QSL reports. Others record specific programs or portions of them. A tape recorder is particularly useful in catching those "P.O. Box numbers" and addresses spoken over the air by the foreign broadcaster. Also it is a must if you are listening to a DX program where a whole list of frequency changes is being given out over the air. Unless you're a shorthand whiz, you simply can't write these numbers down fast enough. With a recorder, you can playback that portion of the broadcast and write down the information at your leisure. You will also find a recorder handy when you're busy taking down notes on a program's content for a QSL report and you are interrupted by the telephone or doorbell. In that case, you simply turn on your recorder and finish your report later.

A tape recorder is one of the most valuable DX aids—it will remember that long string of frequency changes that you couldn't copy fast enough or will keep listening while you answer the phone or doorbell. You can use a fancy reel-to-reel job or a small cassette recorder like this Panasonic RQ-332. Make sure the recorder has a jack so you can patch in your receiver. This unit has a counter so you can easily go back to a catch by winding to the number.

If you don't have a tape recorder and set out to purchase one, you might consider an expensive reel-to-reel type, but I find an inexpensive portable cassette recorder works fine for my needs.

Geographic Aids. Part of the fun of shortwave listening is to bring in those programs from the far corners of the World. Unless you have recently completed a modern geography course, you will need some reference material to look up the locations of such obscure countries as Brunei, Sierra Leone and Sri Lanka. A wall map will probably be your first purchase. This is useful and nice to have; when your set is bringing in a program, you can look up and marvel at the wonderful World of shortwave listening that brings you this broadcaster from several thousand miles away. However, it still won't be quick or easy to find some of these obscure nations on the map. A better way is to get a compact atlas that has a good gazetteer to give you the page or map reference for a particular location. I find a "pocket book" size atlas the handiest to use. When you buy one, be sure it is a recently-published edition. In places like Africa, new countries are being born every year.

(Continued on page 100)

TARGET LIST
Time G.M.T.

Country & Frequency	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Albania 7065 7300																								
Algeria 9685																								
Angola 3375 4820																								
Argentina 5985 6120																								
Australia 11705 15205																								

Every dedicated shortwave enthusiast should have a long target list — mark the frequency under the country and put an "X" under the time it signs on.

e/e checks out the...

Apple II Computer

Find programming gold at the end of this Apple's rainbow.

Many hobbyists just starting out in personal computing learn the hard way, and much to their pocketbook's chagrin, that a "basic computer kit" is just a black box that also needs a terminal, memory expansion, higher language program, and some device to feed the higher language into the computer. Generally, the "extras" cost more than the computer itself. Other hobbyists learn that some kit computers have little or poor technical backup for the builder who runs into assembly problems, or who receives defective components.

One way to avoid all these hassles and get right into the end use of personal computing is to purchase a complete system that's up and running as soon as it's unpacked, preferably with a built-in higher language such as BASIC. One of the few personal computers that meets these requirements is the Apple II from the Apple Computer Company.

Skin of the Apple. The Apple II contains so much in the way of resident programming and operating features it's difficult to know where to start, so let's begin with appearance.

The Apple II is built into a low profile desk-size cabinet slightly larger than a portable typewriter and it weighs only a bit more than a good quality portable. All circuits are self-contained right down to the keyboard, so the first logical question is: "What is used for the display?"

The Apple II has a video jack for a CRT (video monitor), but the company recommends that you purchase a RF modulator and use your own TV rather than an expensive CRT. Just about any of the popular RF modulators will work well with the system and you'll find that the quality of the picture will rival even the best CRT.

Since the Apple II has built in color graphics the best video monitor is a color TV, though you can use a B & W if you have no need for color graphics or are trying to cut costs. (Right off the bat you start saving because there's no need for a relatively expensive CRT monitor; your home or office TV, no matter how inexpensive, can serve as the monitor.)

The output of the RF Modulator feeds a coupling device such as the ones supplied with electronic games; the type that lets you switch the TV between the game (computer) and the regular antenna. Even with the modulator installed you can still use the video output to drive a standard 75-ohm input CRT monitor—if you have need for such a device.

Another extra supplied with the Apple II is a set of "game paddle controls" which can be plugged in by the user. Apple has some game programs available on cassette tape, or you can write your own. The computer works with or without the paddles, there's no need for modifications or "jumpers"; if you want the paddles you just plug them in.

Moving along to the most important part, the computer itself, we find it is initially supplied in the least expensive version (about $1298) with 8K of RAM and 8K of ROM (*R*ead *O*nly *M*emory). The ROM contains a 2K monitor system and a 6K BASIC that includes any length variable names, syntax and range errors indicated immediately when entered, multiple line statements, graphic commands (COLOR = expr, PLOT,HLIN,VLIN, etc.), paddle read commands, TEXT and graphic commands to set display from BASIC, memory boundary adjust, switchable I/O (input/output) assignments, cassette save and load commands, and a host of other usual and unusual features.

However, the resident BASIC is an integer BASIC (no decimal places). While it can be used for many advanced programs it is less than suitable for a student as far as math or statistic studies are concerned. Apple's solution?

If you do need a floating point BASIC, Apple has available a 16K BASIC on cassette tape (which requires 16K of memory) that is among the most complete we have seen or used in personal computers. Perhaps the only limitation—caused by the fact the Apple II is a microcomputer and there's a limit to what can be built in at reasonable cost—is that each time extended BASIC is loaded the user must decide between having graphic commands or LET and REM commands. The extended BASIC also provides for moving the cursor anywhere on the screen without affecting anything already displayed there; or, the cursor can be programmed to erase as it moves, or to enter displayed characters into memory.

We could use up several pages describing the programming features and still might not cover everything of specific interest to you. The best thing is to send for Apple's descriptive brochure which spells it all out in detail.

One important thing we would like to mention is a special appendix in the "APPLESOFT Reference Manual" (for extended BASIC) on converting BASIC programs not written in APPLESOFT.

e/e CHECKS APPLE II

One of the most frustrating things for the personal computing hobbyist is to spend an hour or more typing in a seemingly endless program only to find it doesn't work because there is little standardization between so-called *ANSI Standard BASICs*. Between ANSI BASIC and IBM BASIC, there are some far out discrepancies. Apple's conversion appendix can't handle every problem you might run into, but it does cover a goodly number of the most common discrepancies.

One thing we must mention is the sound effects generator, audible through a built in speaker. The generator can be user-programmed to *pong*, *ping* or *flutter* with a variety of tones. Really enlivens games!

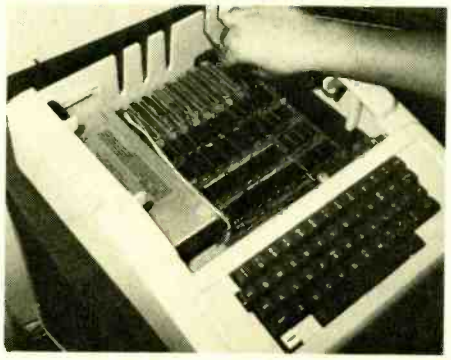
At the Apple's Core. The computer can address from 4K to 48K bytes of RAM on the main board, and sockets are provided so the user can increase memory by simply plugging in the appropriate chips. Either 4K or 16K chips can be used. The total RAM capacity is organized into three increments and you can intermix 4K and 16K chips. Memory might be configured as 4K/4K/4K, 16K/4K/4K, 16K/16K/4K, etc. It can be ordered with any initial configuration, factory installed and checked. Memory select sockets and "jumpers" program the computer for your particular memory organization, and the jumpers can be changed easily if you upgrade the memory capacity.

Just as the user can add RAM by simply plugging in the appropriate ICs, so too can he add ROM by plugging programmed ROMs into one or both of the spare ROM sockets factory installed on the main board. The address for the ROMs (or PROMs) is above the highest RAM location and can be under software control, as can be the built-in monitor and integer BASIC.

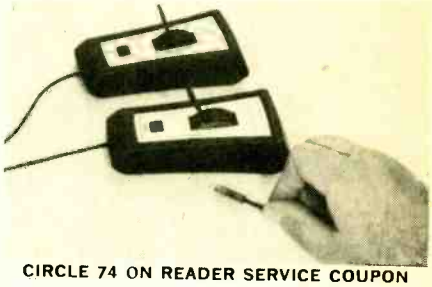
While there are eight connectors for peripheral equipment such as printers and disk recorders, no peripheral control boards were available at the time this article was prepared. Cassette recording of programs through the SAVE and LOAD functions are presently done utilizing an ordinary audio cassette recorder through phono jacks labeled cassette IN and OUT. The OUT feeds a recorder's AUX input. The recorder's monitor output (from across the speaker) feeds the IN jack. The recorder interface operates at 1500 baud, some five times faster than the 300 baud Kansas City standard used by many hobby computers. This permits unusually rapid loading of long programs such as the 16K Applesoft extended BASIC. Note that the recorder is not under computer control as far as start and stop is concerned; the user starts the recorder in the play or record mode before hitting RETURN (to load or save), and stops the recorder after the operation is completed.

We had no problems loading the sample game, graphic and checkbook programs using a moderately priced cassette recorder (about $50), and could load the 16K BASIC tapes (we

(Continued on page 87)

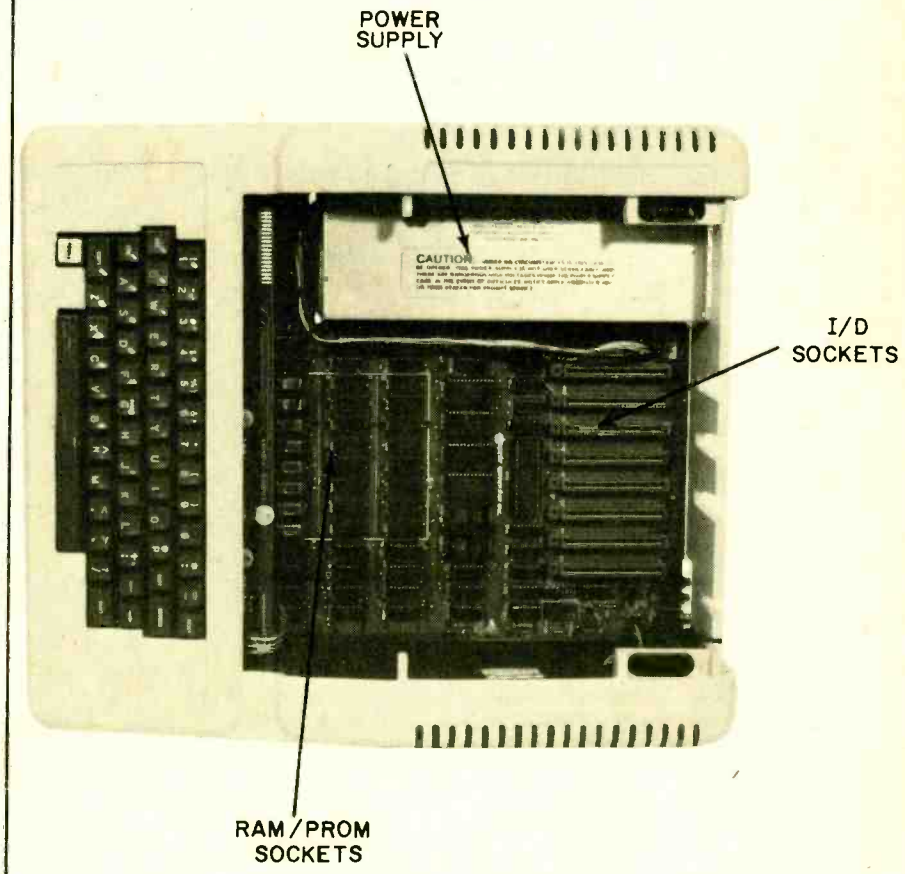


Apple will soon be releasing a number of peripheral devices. They will plug right into provided I/O ports in the back of the computer's board.

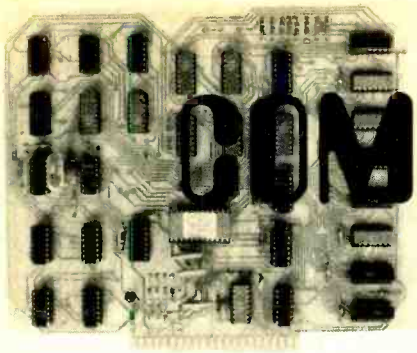


CIRCLE 74 ON READER SERVICE COUPON

Home computers often are used for games —they can really be a lot of family fun! With many home computers it can be technically difficult to add game paddles, which somewhat limits the games that can be played. Apple comes equipped with two paddles, which can be plugged right in and programmed to operate with special BASIC commands and functions.



The Apple II is a desk-size computer with a built-in keyboard, integer BASIC in ROM and 4-color display capability. It has a standard video output jack for connection to either a color or black-and-white monitor. However, you can save a good bit of money by using a simple RF modulator to connect the Apple to your home television set—and the display quality will still be excellent. You can add more memory, up to 48K, at any time. If you need more than an integer BASIC, Apple has a 16K BASIC available.



COMPUTER READOUT

by Norman Myers, Computers Editor

No-TV Computer Games challenge your intelligence more than your reflexes.

☐ Last issue we talked about the important and fascinating role microcomputers are having in industry and in home appliances. We talked about small computers for billing and keeping inventories, for controlling factory equipment, as well as the role of microcomputers in microwave ovens and sewing machines.

But there is much more. Microcomputers have become a part of our lives not only through home appliances but also through the variety of games and educational units that have come into our homes. We now think of games on television screens as common. Yet, only five years ago, we never heard of the idea. Now a new breed of educational and entertaining games are being developed at breakneck speed, games that have the potential for tremendous variety and growth. These games will be as common as checkers and all *hope* to be as popular and everlasting as Monopoly. This issue we will cover a variety of these "no-TV-needed" games, and we will spend some extra time playing one that is becoming very popular—computer backgammon.

Sports. Hand-held calculators have proven to be such a natural tool of just the right size that it is not surprising to find computer games being made in calculator-sized packages. Two sports-oriented games that have recently hit the market are Football and Auto Race, both by Mattel Electronics. In Football an array of light emitting diodes (LEDs) marks the position and movement of your running back as you maneuver him across the field. Your man must dodge five computer controlled tacklers to score a touchdown. An LED numeric display keeps track of how well you do in downs, time left, and yards to go. Auto Race is similar. You race your car around a lap of LEDs and try to miss the cars put in your path by the computer, and to beat the clock that continues to count down as you speed your car along. Both games have one feature found to be all-important in such games—sound. The Football game plays "Charge" if you make a touchdown, and the Auto Race has both motor sounds and beeps for collisions. But it is the LED display that is attractive and innovative on these Mattel games. The matrix has about 400 LEDS to give a kind of television screen appearance. Football sells for $30 and Auto Race is 25, both available at standard retail stores.

Battles. Battles are another arena that seems to appeal to our sense of challenge. Here again Mattel has a calculator-sized game of missile against anti-missiles that is (as you might guess) called Missile and uses the LED array found in the other two games. It sells for $25.

On the larger, tabletop scale, there is a game sweeping through neighborhoods called Code Name: Sector. This Parker Brothers game pits two players against each other as each controls a destroyer attempting to sink a submarine. The difficulty lies in the submarine being controlled by the computer through about 5000 sections of a nautical chart. You are given information on its speed, direction, and depth, but you are left to plot its course as a true destroyer captain would. The game is not only interesting and reasonably priced ($40); it also has behind it an old-fashioned success story.

Around 1975, Robert Doyle of Micro Cosmos in Boston, Mass., approached Parker Brothers and others with some ideas for microcomputer games. Parker Brothers was interested, gave Doyle a green light, and through trial and error Code Name: Sector was developed. It was Texas Instruments that managed to form a special mask to fabricate the read-only-memory (ROM) and microprocessor with computer instructions.

Milton Bradley also went to Texas Instruments to have special fabrication work. In this case it was for their Electronic Battleship, a game where the computer is not competing with the players but, instead, is providing sounds and light flashes when ships are sunk. In the standard battleship-type game players try to guess where an opponent's ships are on a grid and sink them by calling out grid locations. With Electronic Battleship the computer knows where all the ships are and lets out sounds of sonar, explosions, and the like, as hits or near-hits are made.

And More Wizardry. Microcomputers may be a natural for that old electromechanical clanker—the pinball machine. Electronic logic is already used in pinball machines, such as the Atariana by Altair and Lucky Seven by Williams. These units keep track of score and control a variety of light and

To operate Tryon's Gammonmaster you press the start key and the computer rolls some LED "dice" and play begins. This unit protects its pieces carefully and builds a very solid defense. The author only managed to win twice in 20 hard fought games.

CIRCLE 76 ON READER SERVICE COUPON

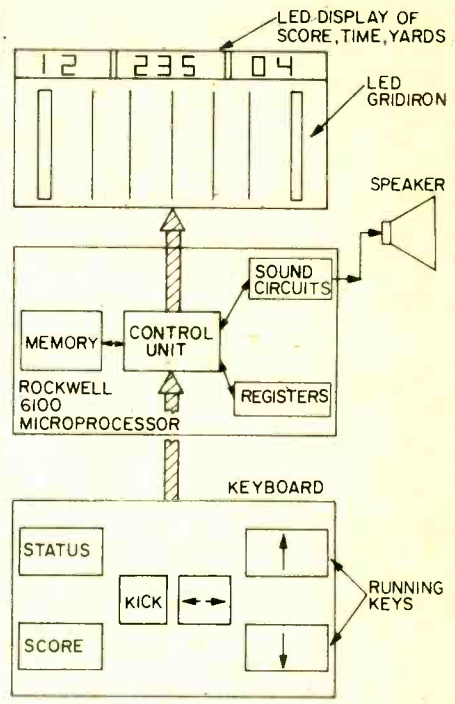
sound. But watch out for more.

I predict a small table-top pinball machine for your home that will compete against the player. If, for example, you press a flipper button, it may block the move unless you move to prevent that block. Or it may try to control the course of the ball away from your home goal.

Then there are the number guessing games where you try to determine the computer-selected secret number in as few guesses as possible. Comp IV by Milton Bradley sells for $30 and gives you indications of how close you are to the number. The idea is to use your noodle to home in on the number. National Semiconductor has taken a different tack. They seem interested in building learning machines for children. Their Quiz Kid is one example that kids I have met seem to love. You tell the calculatorsized computer what kind of mathematics problem you want (addition, subtraction, multiplication, division, or a combination) and you tell it the level of difficulty you want. Press a start button and poof—a problem appears on the calculator-type LED readout. You have three chances to put in the correct answer. If you cannot get the answer, the Quiz Kid gives the answer. Further, it keeps score of the number right and wrong. Quiz Kid Racer can be linked to another Racer so that two youngsters can compete against each other in these mathematics games while still competing against the computer. Needless to say, the kid who is turned on by Quiz Kid will get a lot of practice in math.

Parlor Games. There is probably no parlor game with more possible moves and more possibilities than the age-old game of chess. Giant high speed computers have been programmed with chess strategies and those computer programs are very difficult for a tournament chess player to beat. But those programs have taken up to 30 seconds to make a decision which means that around 30,000 possible outcomes or strategies were considered during that 30 seconds. These large programs have been designed to look ten to fifteen moves ahead, which a human cannot do.

So, it is a little surprising to find a computerized chess set on the market that is the size of a large bread board and which makes decisions in a matter of seconds. If you would guess that chess cannot be completely handled by such a small and fast microcomputer you are correct. But the Chess Challenger by Fidelity Electronics is said to win against an average player 30 to 75 per cent of the time. A rather attractive game, the Chess Challenger has a chess board on the left side and a keyboard accompanied by LEDs on the right. You key in your move and it will respond with its move. You move all pieces by hand. The unit sells for around $200 (Heath sells a version) and for an extra $75 a Chess Challenger can be purchased that allows you to select from three levels of play. Also, a hand-held unit that gives you the moves but you have to supply the chess board is made by Staid and is called Compuchess. The unit sells for around $160 and can be instructed to play at six different levels where level six is a tournament level of play.



This block diagram shows how the game is processed by the microcircuitry. You play against the computer and your running back tries to evade the computer-controlled tacklers to score a touchdown. To compete with others you have to score faster than your opponents in this game.

Backgammon. Then there is that hot game called backgammon. If you have heard of it but are afraid to try playing —don't be. It can be played and loved by anyone from five years of age on up. The fact that it is fun and not as difficult as chess makes it a natural for the microcomputer market. Sure enough, there are computerized backgammon games. One is marketed by Tryon Marketing in Miami, Florida, and the other by Texas Micro Games in Houston, Texas. Each retails for around $200 and each works on the same principle. As with the Chess Challenger, the playing board is to the left and the keyboard and readout are on the right. To get a feel for what the microcomputer is doing, let's briefly review the game of backgammon and then let's take a look at the kind of strategies and actions the computer has to consider before it can make a smart move.

(Continued on page 96)

No-TV Computer Games and their Manufacturers

Sports	"Football"	C	Mattel
	"Auto Race"	C	Mattel
Battles	"Code Name: Sector"	D	Parker Brothers
	"Electronic Battleship"	D	Milton Bradley
	"Missile"	C	Mattel
Pinball	"Atarian"	D	Altair
	"Lucky Seven"	D	Williams
Number Guessing	"Comp IV"	C	Milton Bradley
Learning	"Quiz Kid"	C	National Semiconductor
Parlor Games	"Chess Challenger"	D	Fidelity
	"Compuchess"	C	Staid
	"Gammonmaster"	D	Tryon
	"Computer Backgammon"	D	Texas Micro Games

Computer games that do not use television games are gaining in popularity both for entertainment and for educational value. The above list shows a sample of what has recently come on the market. **"C"** means the game is hand calculator-sized, and **"D"** means it is meant for a desk or table.

e/e assembles the...

Heath SB-104A SSB Transceiver

Super state-of-the-art makes long-distance hamming a cinch. CIRCLE 31 ON READER SERVICE COUPON

THERE ARE MANY GOOD REASONS for owning a Heathkit SB-104A SSB transceiver—reasons that would make any self-respecting Ham's mouth water, but there is one feature on this unit that makes it stand head-and-shoulders above a lot of the competition. A feature that makes operating an SSB transceiver easier than flipping channels on a CB set.

This feature is bandpass tuning coupled with digital frequency readout. Just think, no more frantic tuning of the final as you change frequency to chase DX, or peaking of the receiver pre-selector to hear a signal barely discernable over the noise level. On the SB-104A you simply tune until the digital readout indicates the desired operating frequency and that's it. Press the microphone's PTT or hit the key and you're on-the-air. No tuning, no loading, no peaking, no anything. All tuning is automatically optimized by bandpass filters.

Controls Out Front. Other less spectacular, but no less important reasons for going Heathkit is that the VOX gain and VOX delay controls are out on the front panel where they can easily be adjusted by the user to compensate for a particular change in voice characteristic, such as a low soft tone with relatively long pauses between phrases, instead of the user's normal rapid-fire pacing. (After all, sometimes a long day's work slows down speech as well as energy.) On the SB-104A you don't have to go searching behind concealed panels, or look for concealed controls in order to adjust the VOX for speech or CW keying. (For CW operation a sidetone is provided, its level adjustment in on the rear along with the anti-vox adjustment.)

We don't have room to cover the more commonplace SB-104A features—you can read about them in Heathkit's literature. We'll cover some of the unusual operating conveniences furnished along with the bandpass tuning and front panel VOX controls.

First, there's the digital frequency readout in MHz down to 100 Hz. The main VFO is a standard solid-state design utilizing an FET and three-stage buffer. The frequency display simply indicates the output frequency derived from the VFO and its mixers. The VFO is not a digital frequency generator. Overall stability is rated at 100 Hz/30-minutes after a 30-minute warm-up. The digital frequency readout accuracy is within ±200 Hz ±1 count.

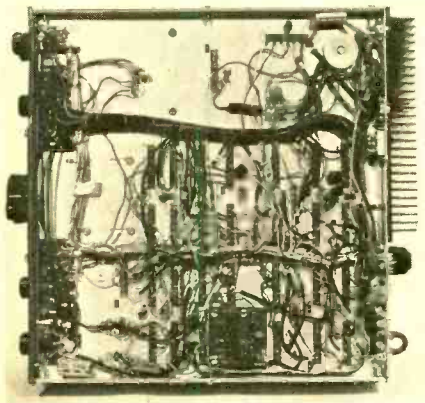
The front panel switching indicates the many operating features. A panel meter can be switch selected to indicate the input power supply voltage (13.8 volts), ALC (automatic level control), and relative power output. A VOX switch selects VOX or PTT operation. A 400 Hz switch selects an optional 400 Hz CW filter if the option is installed; otherwise, the SSB filter provides the CW selectivity. There is the usual noise blanker, and LSB/USB/CW selector (there is no AM operation). Since the output transistors can be zapped if the system tune-up exceeds about 30-seconds—as when you're adjusting an antenna matching system or tuner—a low power *Tune* switch is provided. In the *low tune* mode power output is reduced to nominally 1-watt (the exact value depending on the specific band in use).

In addition to the *Vox Gain* and *Vox Delay* there are front panel controls for *AF Gain, RF Gain, AGC Action* (fast, slow, off), *MIC/CW Level,* and *Band.* The bandswitch selects the operating frequencies and reception-only of 15 MHz WWV for frequency and time checks. (The transmitter does not operate on 15 MHz even though the frequency is indicated on the digital display.)

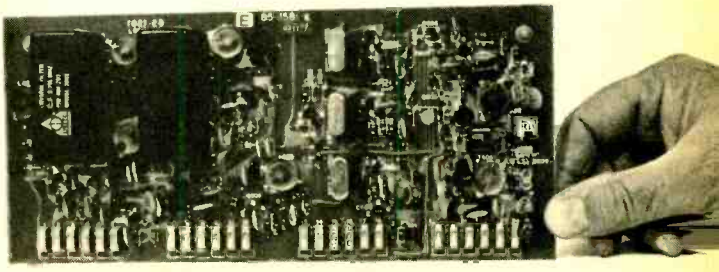
Inputs and Outputs. Extensive rear apron connections permit many customizing arrangements to suite the particular needs of the user.

Phono-type jacks are provided for phone patch connections, auxiliary AF input/output, driver out, IF out, two spares, a speaker, ALC output (for an associated linear amplifier), the VFO output, the VFO buffer amplifier input, telegraph key, and a common receive/transmit antenna or a separate receive antenna. (Yes, the antenna connections are the phono type. For some unknown reason Heath is still hung up on the phono jack while the rest of the world uses UHF or BNC connectors. It means you must cut off UHF connector prewired to your antenna's transmission line, or make an adaptor cable.

Two multi-contact keyway-type sockets provide for the power and accessory connections. Power can be obtained directly from a 12-volt auto/marine battery, or the optional HP-1144 AC Power Supply. An SB-604 optional Accessory Speaker has space inside the cabinet, and pre-drilled holes, for internal mounting AC power supply.



This view of the bottom of the chassis shows the factory provided wiring harness and the board connectors.



The SSB/CW filter module is typical of the other cards. Here both filters—the large black boxes—are shown installed. Note the lifting handles on each corner. You don't have to pry the boards out of this durable unit.

e/e HEATH SB-104A

The accessory connector provides 13.8 and 11 volt outputs, remote control of the transceiver's T/R relay, a set of isolated SPDT relay contacts, and high/low output selection.

Modular Construction. Most of the SB-104A circuits are on plug-in modules that mount in what is essentially a main-frame. The motherboard that provides connections for the modules is interconnected by a wiring harness that is supplied factory-sized and wrapped. The two most critical assemblies, the VFO and the receiver front-end module, are supplied factory assembled and aligned.

The basic kit includes only the SSB IF filter. The 400 Hz CW filter is optional, and we suggest you install it at the time of construction if you feel you will need the extra selectivity at some future time. The installation is made with the least fuss and possibility for error if done while the circuits and wiring are still fresh in your mind.

Bandpass Is Best. One thing for certain, it's almost impossible to describe the ease of operation using bandpass tuning. After years of tuning the final plate, the driver, the receiver preselector, and heaven knows what other circuits, it was strange to simply set the tuning dial to the desired frequency and do nothing other than squeeze the mike's PTT switch or hit the key. Fact is, we often found that when we tuned across the band searching for a station or a QRM-free hole we unconsciously reached for a tuning control that wasn't there.

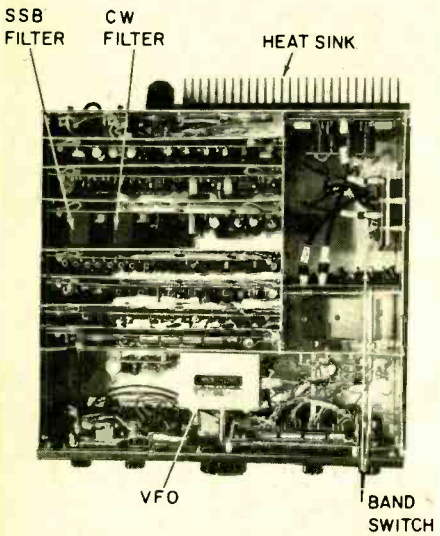
As for efficiency, bandpass tuning checked out great. Receiver sensitivity was essentially constant from one end of each band to the other. The transmitter output was similarly constant across each band, with a little more output at the higher frequencies. For example, on 80 meters the nominal CW output was 85-watts, increasing on each band to a maximum of 98 watts at the high end of 10 meters.

Our Glowing Conclusion. If you're looking for what pretty much amounts to a state-of-the-art amateur radio transceiver, this new rig really fills the bill. Its solid-state technology, its snappy styling, and its, ease and quickness of operation are dazzling. In weeks of operation our amateur radio staff (all experienced Advanced Class hams) were terrifically impressed by the unit, getting extraordinary reports on its signal strength and especially its audio quality on SSB while operating under the most adverse of conditions. Once you try the CW filter, for example, you'll never be afraid of QRM again. So for all of you Novice and Technician Class hams looking for the next step up in equipment, or you CBers ready to take the big plunge into ham radio, we can recommend the Heath SB-104A without any reservations whatever.

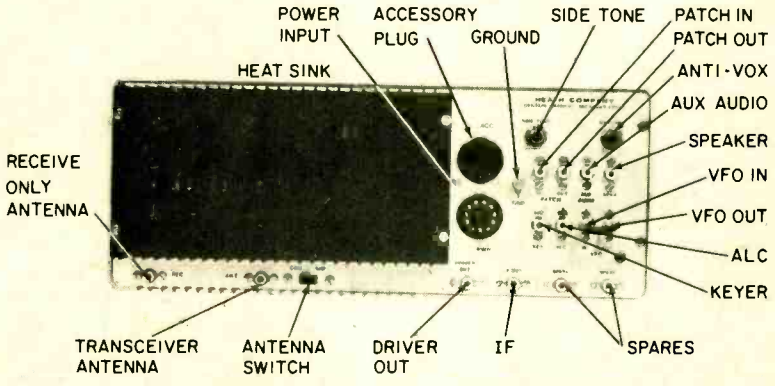
The basic SB-104A transceiver is priced (mail order) at $699.95. Optionals include the noise blanker kit at $26.95, the 400 Hz CW filter at $39.95, a mobile mount for $36.95, the station speaker with enclosure for $37.95, and the fixed station power supply at $89.95.

For complete information on the SB-104A line circle No. 31 on the reader's service coupon. ■

The digital readout displays the complete operating frequency and no interpolations are necessary. The frequency is not some switch-selected value plus the dial readout. All switches are clearly marked and efficiently located on the panel. This unit offers good value plus the satisfaction of buiding the unit. For more information circle No. 31 on the reader's service coupon.



This top view shows the layout of the chassis. Note the neat arrangement of the circuit boards on the left.



Except for the microphone and headphone jacks on the front panel, all inputs and outputs are on the rear apron. The two large keyway connectors are for power input and the accessory power and T/R-relay connections. Note that the antenna connectors are phono jacks rather than UHF connectors; positioned under the RF output transistor heat sinks they are hard to use and difficult to replace.

Radiation Roundup

This team is ready to go when the roentgen counts go up!

by Shane Piroli

☐The spectre of a nuclear accident is an all too familiar fear to we who must live in this Atomic Age. To date, nuclear facilities have had an enviable safety record and have shown themselves to be as safe or even safer than conventional plants. The fact remains that even a small accident at a nuclear plant could result, at worst, in tremendous loss of life and, at best, in a sudden and hard-to-meet threat.

By the order of the Federal German Education and Science Ministry, the town of Karlsruhe, Germany has commissioned the world's first "nuclear fire-brigade." The seventy-man station, christened the Karlsruhe Nuclear Research Center, is fully operational and ready to function in its unique way at any time—though all hope the Center will remain unneeded.

The Center is equipped with a good number of vehicles and many of them are radio-controlled at distances up to and surpassing a kilometer. Besides normal first-aid supplies, the Center also inventories more than six hundred protective radiation-suits to cover the event of a mass evacuation from a nuclear facility. The remote control devices, in particular, are masterpieces of electronic ingenuity. With them, help can arrive in places man alone might not dare to go.

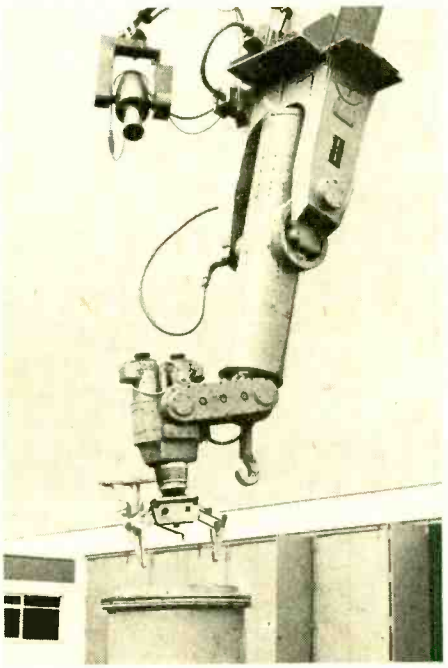
In the event of a rescue operation, the Center is geared to react in three separate waves of action. First, a group of high-speed (90-mph) vehicles are sent to the stricken area to report back on the radiation leakage, damage, extent of casualties, etc. This "scout" wave patrols the perimeter of the area, delves into the area itself, and generally functions as first-in. The second wave is not far behind.

This second wave is composed of larger vehicles able to render more sophisticated assistance. One of the unique vehicles in this second wave, pictured herein, is a gasoline-driven, remote-controlled cart with an operational range of about 600 meters. The cart's operator takes it into the suspect area and a front-mounted geiger counter clicks out a reading. If a radioactive spot is found, a marker is dropped by the cart for later machinery and men to find.

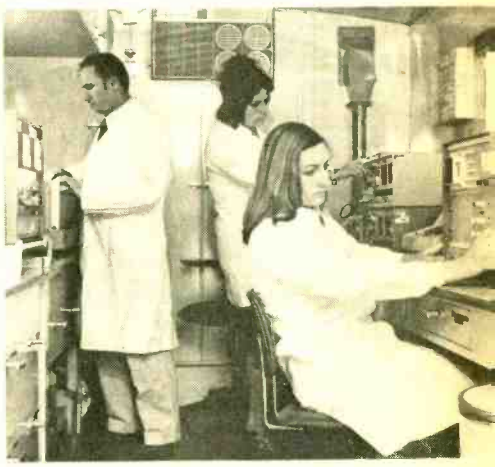
The third wave is a group of technicians who must cope with all the problems unearthed by the first two waves. It is these men and women who must find ways to remove contaminated materials, to prevent the radiation from spreading and who, more importantly, must check to see that there are as yet no undiscovered sources of unshielded radiation.

The Center is run like a normal fire-station, with a constant emergency watch on duty. The nature of their work ensures that they do not get much practice, but they have drills and practice all the time. There have been several false-alarms to keep them on their collective toes, but as yet no real emergencies.

They may, in fact, never be called out for the "real" thing—and they're the first to hope that they never are. Yet, if the need ever arises it seems the Center is ready to prove its worth, and to show nuclear countries throughout the world that such protection may be much better later than never. ■



A close-up of a manipulator arm shows that they are surprisingly dexterous for their size. This, one of the larger ones, is mounted atop an all-wheel drive truck. It is used to lift objects too heavy for a man, or to lift large and contaminated objects.



The interior of one of the largest class of vehicles is a vast array of sophisticated measuring devices. Here, all data is evaluated and life or death decisions must be made by the technicians inside the mobile labs. Each lab can function as an independent control area in event of a true emergency.

IT'S SIMPLY BASIC

Don't Spare the Computer Time, Keep Your Bowling Records on the Ball With this Striking Program!

by Larry Friedman, WB2AHN

Just fourteen years old, Larry Friedman, who set up this program, is an old hand with computers. He has built his own computer system using an SWTP 6800 as the base. The computer gets such diverse uses as processing complex electronic equipment test reports and keeping the statistics for Larry's baseball and bowling teams. Larry is also a consultant on programs for electronics experimenters, and a real whiz as an amateur radio operator and as a beginning pilot.

In previous programs we have utilized the computer as a time saver to repetitively process electronic and mathematical formulas. In this program we show how the computer can be used as a filing system to store data on magnetic or paper tape, or via any recording system. The program is designed to keep the running records of a bowling team, although it can be easily modified to store information about almost anything. You could modify it to keep the records of a complete baseball team by simply changing all DIGITS = 0 to DIGITS = 3. DIGITS is found on lines 110 and 260. Also take out the INT functions which are found on lines 380 and 510. The reason for the changes is that baseball averages and some other records are calculated to 3 decimals while bowling statistics are calculated as integers.

One of the features of this program is error correction. Should you make an error while entering data the program has an error correction subroutine that allows you to correct the errors. If you don't have enough RAM in your computer system to run the complete program, the error correction can be removed by taking out lines 190, 300, and 410-490.

Whenever there is a PRINT #3 or INPUT #3 it is an indication to the computer to PRINT or INPUT from the recording port. On your system the recording port number will probably be different from this so be sure to check the recording port number of your own computer. On many computers, it will be the same as the control port.

To allow for a variable number of players (you will decide how many) the program often uses subscripted variables. Without them, you would have to alter the program to specify how many bowlers are on your team. Through the use of subscripted variables, however, the program will simply ask you how many bowlers are on your team and the computer will give you the correct amount of inputs for the right amount of bowlers.

In lines 430-470 we utilize subscripted variables to tell the computer what values to use without wasting an unnecessary amount of memory, or your time.

By the way, in this program we use the *sequential* method of filing, the only method that can be used with audio cassettes or paper tape. This means that you must enter the same information-format each time you run the program. If you start with five members of your team, you must thereafter enter five inputs in the same order each time. (If a team member should drop out you could enter his data as zeroes, but it must be entered all the same).

If you enter the program correctly it should run like the sample runs shown. If it doesn't, the first lines you should check are 340-390. These are the statements where all the data is printed out. So now bowl over your friends. ■

BOWLING FILES PROGRAM

```
 LIST

0100 REM "RECORD" BY LARRY FRIEDMAN
0101 REM ON LINES WHERE THERE IS A PRINT#3 OR INPUT#3
0102 REM IT IS INDICATING TO PRINT OR INPUT FROM THE
0103 REM RECORDER PORT. CHANGE #3 TO THE PORT # OF YOUR
0104 REM RECORDER
0105 REM
0106 REM LINES 410-490 IS THE SUBROUTINE FOR LINE CORRECTION
0107 REM ************************************************
0110 DIGITS= 0
0120 PRINT "DO YOU WANT TO:"
0130 PRINT "(1) STORE NEW INFORMATION ON TAPE"
0140 PRINT "(2) ADD NEW INFORMATION TO OLD AND PRINT IT."
0150 INPUT C1:ON C1 GOTO 160,250
```

```
SAMPLE RUN SHOWING AUTOMATIC DATA CORRECTION

RUN
DO YOU WANT TO:
(1) STORE NEW INFORMATION ON TAPE
(2) ADD NEW INFORMATION TO OLD AND PRINT IT.
? 1
HOW MANY BOWLERS ARE ON YOUR TEAM?
? 5
ENTER NAMES, GAMES BOWLED, AND TOTAL PINS.
#1 ? JOE SANTINO, 30, 5391
#2 ? MARK BERK, 30, 4197
#3 ? BILL HASTINGS, 30, 5131
#4 ? EPTE REDMANN, 30, 5099
#5 ? ROBERT SANCHEZ, 30, 4991
ARE THERE ANY ERRORS?? YES
```

```
0160 PRINT "HOW MANY BOWLERS ARE ON YOUR TEAM?":INPUT B1
0170 PRINT "ENTER NAMES, GAMES BOWLED, AND TOTAL PINS."
0180 FOR K=1 TO B1:PRINT "#";K;:INPUT N$(K),G(K),T(K):NEXT K
0190 INPUT "ARE THERE ANY ERRORS?",Y$:IF Y$="YES" GOSUB 410
0200 PRINT "PUT THE TAPE INTO THE RECORD MODE"
0210 PRINT "AND HIT RETURN ":INPUT Q$
0215 REM THE INFORMATION WILL NOW BE STORED ON CASSETTE
0220 FOR K=1 TO B1:PRINT#3,N$(K);",";G(K);",";T(K):FOR L=1 TO 50
0230 NEXT L:NEXT K
0240 PRINT "THE DATA HAS BEEN ENTERED.":STOP
0250 PRINT "HOW MANY BOWLERS ARE ON YOUR TEAM?"
0260 INPUT B1:DIGITS=0:PRINT "START THE TAPE IN THE PLAY MODE."
0270 FOR K=1 TO B1:INPUT #3,N$(K),G(K),T(K):NEXT K
0280 PRINT "ENTER GAMES AND TOTAL PINS FOR THE BOWLERS."
0290 FOR K=1 TO B1:PRINT "#";K;" ";N$(K);:INPUT A(K),B(K):NEXT K
0300 INPUT "ANY ERRORS?",Y$:IF Y$="YES" GOSUB 410
0310 PRINT "PUT THE TAPE RECORDER IN THE RECORD MODE AND HIT RETURN."
0320 INPUT Q$:FOR K=1 TO B1:PRINT #3,N$(K);",";A(K)+G(K);",";B(K)+T(K)
0330 FOR P=1 TO 50:NEXT P:NEXT K
0340 PRINT "NAME";
0350 PRINT TAB(24);"AVG.";:PRINT TAB(31);"G";:PRINT TAB(40);"T.P."
0360 FOR K=1 TO 45:PRINT "*";:NEXT K:PRINT
0370 FOR K=1 TO B1:PRINT N$(K);:X(K)=(B(K)+T(K))/(A(K)+G(K))
0380 PRINT TAB(24);INT(X(K));:PRINT TAB(31);A(K)+G(K);
0390 PRINT TAB(40);B(K)+T(K):NEXT K:FOR K=1 TO 45:PRINT "*";:NEXT K
0400 PRINT :GOTO 500
0410 PRINT "HOW MANY LINES CONTAIN ERRORS?":INPUT E1
0420 PRINT "ENTER THE NUMBER OF THE LINES WHERE THE ERRORS WERE MADE."
0430 FOR X=1 TO E1:INPUT A:T(A)=1:NEXT X
0440 PRINT "ENTER NAMES,GAMES,TOTAL PINS."
0450 FOR X=1 TO B1
0460 IF T(X)=1 GOSUB 490
0470 PRINT :NEXT X
0480 RETURN
0490 PRINT "#";X;:INPUT N$(X),G(X),T(X):RETURN
0500 FOR K=1 TO 5:A1=A1+(A(K)+G(K)):A2=A2+(B(K)+T(K)):NEXT K
0510 PRINT "TEAM";:PRINT TAB(24);INT(A2/A1)
0999 END

READY
#
```

SAMPLE RUN SHOWING INITIAL INFORMATION ENTRIES

```
RUN
DO YOU WANT TO:
(1) STORE NEW INFORMATION ON TAPE
(2) ADD NEW INFORMATION TO OLD AND PRINT IT.
? 1
HOW MANY BOWLERS ARE ON YOUR TEAM?
? 5
ENTER NAMES, GAMES BOWLED, AND TOTAL PINS.
#1 ? JOE SANTINO, 30, 5391
#2 ? MARK BERK, 30, 5197
#3 ? BILL HASTINGS, 30, 5131
#4 ? PETE REDMANN, 30, 5099
#5 ? ROBERT SANCHEZ, 30, 4991
ARE THERE ANY ERRORS?? NO
PUT THE TAPE INTO THE RECORD MODE
AND HIT RETURN
?
THE DATA HAS BEEN ENTERED.
STOP 5354
```

```
HOW MANY LINES CONTAIN ERRORS?
? 2
ENTER THE NUMBER OF THE LINES WHERE THE ERRORS WERE
MADE.
? 2
? 4
ENTER NAMES,GAMES,TOTAL PINS.

#2 ? MARK BERK, 30, 5197


#4 ? PETE REDMANN, 30, 5099


PUT THE TAPE INTO THE RECORD MODE
AND HIT RETURN
?
THE DATA HAS BEEN ENTERED.
STOP 5354
READY
#
```

SAMPLE RUNS SHOWING INFORMATION ENTRIES FROM WEEK TO WEEK

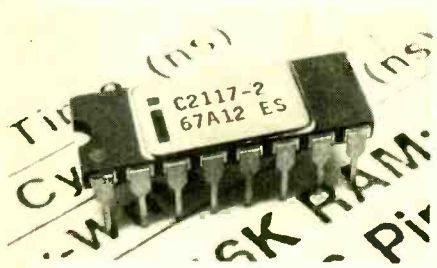
```
RUN
DO YOU WANT TO:
(1) STORE NEW INFORMATION ON TAPE
(2) ADD NEW INFORMATION TO OLD AND PRINT IT.
? 2
HOW MANY BOWLERS ARE ON YOUR TEAM?
? 5
START THE TAPE IN THE PLAY MODE.
ENTER GAMES AND TOTAL PINS FOR THE BOWLERS.
#1  JOE SANTINO? 3, 600
#2  MARK BERK? 3, 521
#3  BILL HASTINGS? 3, 511
#4  PETE REDMANN? 3, 509
#5  ROBERT SANCHEZ? 3, 498
ANY ERRORS?? NO
PUT THE TAPE RECORDER IN THE RECORD MODE AND HIT
RETURN.
?
NAME                    AVG.    G       T.P.
****************************************
JOE SANTINO             181     33      5991
MARK BERK               173     33      5718
BILL HASTINGS           170     33      5642
PETE REDMANN            169     33      5608
ROBERT SANCHEZ          166     33      5489
****************************************
TEAM                    172
```

(Continued on page 92)

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.

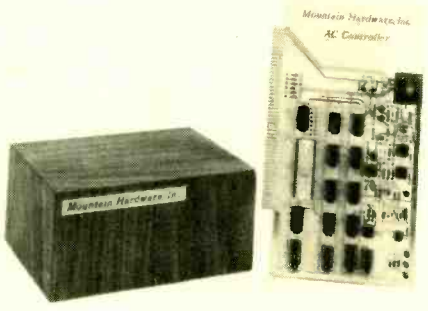
COMPUTER NEW PRODUCTS

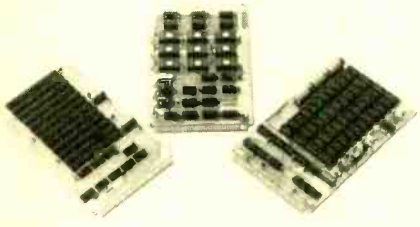
Here in one place each issue of e/e you will find product information on the newest hobby computers and accessories.



Second Generation 16K RAM Family—Intel's second family of 16-kilobit RAMs, designated the Intel R2117, offers a maximum access time of 150 nanoseconds, and a cycle time specified at 320-ns which is claimed to be at least 55 nanoseconds faster than earlier 16K RAMs having 150-ns access. Power dissipation and maximum supply current have also been reduced. "Current spiking," which generates system power line noise, has been cut in half. Also, the 2117 provides a full ±10% tolerance on all three power supplies (+5, +12 and −5 volts), and TTL compatibility with 300 MV of additional noise margin over competitive 16K RAMs, says Intel. One application of the new latched output mode is hidden refresh. It holds the data output valid following a read access. As a result, a read cycle can be extended to a read and refresh cycle without affecting data validity. The 2117 family is packaged in standard 16-pin dual-in-line packages and there are three speed selections: 2117-2, 150-ns maximum access, 320-ns read/write, 375-ns RMW cycle; 2117-3, 200-ns maximum access, 375-ns read/write, 375 RMW cycle; 2117-4, 250-ns maximum access, 410-ns read/write, 515 RMW cycle. Price for the 2117-2 is about $55.00. Circle 51 on Reader Service card for more information.

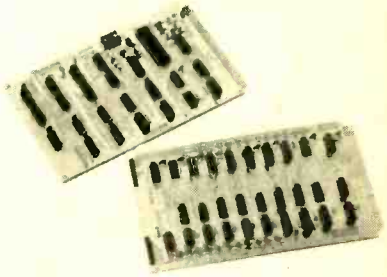
Intelligent Remote Controller—Mountain Hardware's Introl system is a sophisticated remote control system that communicates over standard 110 VAC power lines so that no other direct wiring between a computer and remote units is needed. The AC Controller board is an S-100 compatible board that is capable of controlling up to 64 remote units anywhere in a building. The AC Remote unit has two independently controllable AC sockets that can turn two 500-watt appliances on or off. The computer can also "poll" the remote to check its on/off status. Programs are easily written in Basic or assembly language to monitor and control remote devices. Applications for the Introl system include home security, solar heater control and even an easily implemented automated darkroom, according to the manufacturer. Software routines are provided to help create unique control programs. Future compatible remotes will include a dual temperature sensor and an 8-input status sensor. Introl systems are available in kit or assembled form. All AC Remotes are housed in walnut cabinets. Kit prices: AC Controller, $149; AC Remote, $99. Circle 70 on Reader Service Card for more information.





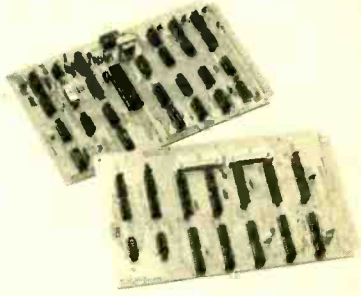
Static Memory Modules for PCM-12—Three static memory modules are available for use with the PCM-12, a 6100 microprocessor-based, 12-bit microcomputer system marketed by Pacific Cyber/Metrix. Model 1202A is a 4096-word by 12-bit memory element (left in photo) that constitutes one full field of memory for the PCM-12. There are 59 IC's, of which 48 are premium-quality, low-power, 1K static memory devices. Priced $289 assembled and tested, and $199 in kit form. Model 12160 is a combination EPROM/RAM that holds (in the highest pages of its field) 1:5K 12-bit words of UV-erasable ROM and (in its lowest pages 512 12-bit words of n-channel RAM; two such boards fill a 4K field of memory with 3K words of EPROM and 1K words of RAM. Prices: $455 assembled, $385 in kit form. Model 12210 (right) is a non-volatile memory organized as 4096 12-bit words. It's comprised of 48 1K MOS RAMs with automatic-recharge battery back-up; the module retains memory contents for us to 30 days with system power turned off. In combination with PCM's 12230 Power-Fail module, this unit makes a PCM-12 system totally transparent to AC-line power failures. Prices: $580 assembled and $490 in kit form. Circle 64 on Reader Service Card for more information about this product.

Parallel-I/O Interface Modules—Pacific Cyber/Metrix offers a 12060 TTY/CRT Interface Module and a 12310 Parallel I/O Interface Module as accessories for the company's PCM-12 microcomputer system. The 12060 interfaces the PCM-12 microcomputer system. The 12060 interfaces the PCM-12 to any Teletypewriter, to any TTY-substitute terminal, or to any CRT terminal. The module uses DEC's device codes 03 and 04, and provides inputs and outputs for both the 20-mA



and RS-232 signaling levels. Other features: user-selectable transmission rates from 110 to 9600 baud, and programmable one-stop-bit or two-stop-bits operation. Prices of the 12060: kit, $97; assembled, $167. The 12310 is a TTL-level interface module that executes, for the PCM-12, an instruction set identical to that which DEC's DR8-EA model executes for the PDP-8/E; it provides the 12-bit parallel input/output control capability necessary in data collection and control applications. Two 26-conductor ribbon cables (included) supply all connections to external equipment. Prices of the 12310: kit, $138; assembled, $215. Circle 64 for more information about this product.

Reader/Punch Interface Modules—Pacific Cyber/Metrix adds two more modules, a High Speed Reader/Punch Interface (12070) and a Mag-Tape Interface (12080) to support the company's PCM-12 micro-



computer system. Both are available in kit form or fully assembled. The Reader/Punch module interfaces the Addmaster model 601 paper-tape reader and Epson model 6110 paper-tape punch to the PCM-12. It's fully compatible with PDP-8

(Continued on page 94)

CB NEW PRODUCTS

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

Mobile CB SSB Rig

The new SBE Sidebander IV Model (SBE-27CB/A) is a compact, 40-channel SSB/AM mobile transceiver featuring digitally synthesized circuitry which is said to supply stable, accurate frequency generation on upper sideband, lower sideband, and AM frequencies on all 40 Citizen's Band channels. RF output of the unit is 4-watts AM and 12-watts SSB PEP. Features include receiving

CIRCLE 60 ON READER SERVICE COUPON

section with both a switchable noise blanker and switchable noise limiter. Other controls are squelch, volume, SSB clarifier, and RF gain control for adjusting receiving sensitivity to near or far stations. The Sidebander IV carries a suggested list price of $379.95 and is available at SBE dealers throughout the country. Further information is also available by writing SBE, Inc., 220 Airport Blvd., Watsonville, CA 95076.

Torture Tested

If your base antenna collapsed from the weight of ice and wind force this past winter, you might consider replacing it with the Avanti Astro Beam. An unusual test of an Astro-Beam CB base antenna was performed at the factory during the past winter. With the temperature at 15° and winds around 25 mph, an Astro-Beam and several other Avanti antennas were sprayed with water until an

CIRCLE 66 ON READER SERVICE COUPON

ice build up of several hundred pounds accumulated. Avanti reports that the Astro-Beam not only kept its shape, but its transmit and receive qualities were unchanged! Test programs like this make sure that the Avanti antenna will not only give you their performance, but stay up there as well. The Astro-Beam sells for $79.95. Write today for a free catalog. Avanti Research and Development, Inc., 340 Stewart Ave., Addison, IL 60106.

Finger-tip Control

Finger-tip convenience can now be added to the microphones made by Astatic. Urban Engineering is now manufacturing a Finger-tip Volume Control for use on all Astatic TUG8, TUG9, and TUP9 style D104 microphones, including the Golden Eagle and new Silver Eagle. The unit replaces the stock bottom plate and requires no drilling or modifications of any kind. Made of handsome

CIRCLE 67 ON READER SERVICE COUPON

black Cycolac, it is both attractive and durable, insuring years of trouble-free service. No-scratch feet protect fine furniture, while the large easy-to-read dial gives complete volume adjustment at the touch of a finger. No more fumbling with screwdrivers or nail files. Shipped complete with all hardware and instructions. Sells for $7.95. For more information, write to Urban Engineering, Inc., P.O. Box 5701052, Miami, FL 33157.

Ultra Base Station

The Ultra CP-2000B CB SSB base station transceiver from CPI has a unique modulation circuit which is reported to provide an unusually high-level of modulation without exceeding the FCC's stringent specifications for 40-channel radios. The new CPI circuitry actually outperforms the modulation of tube-type radios, thus providing the benefits of solid state reliability in a transmitter suited to the serious hobbyist. The Ultra CP-2000B also outperforms the FCC's requirement for spurious harmonic radiation by 10 dB with an outstanding −70 dB figure. In addition, the radio possesses infinite SWR mismatch tolerance, so the unit's output transistors cannot be damaged by high SWR. Suggested price of the Ultra CP-2000B is $600.00. For further information on the CP-2000B, and the complete line of CPI's high technology,

CIRCLE 72 ON READOR SERVICE COUPON

American-made communications gear, write to Communications Power, Inc., 2407 Charleston Road, Mountain View, CA 94043.

Kills TVI

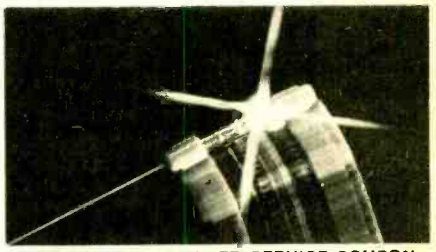
Telco has a new addition to its line of Low Pass TVI Filters. The XLP-150 handles more than 150 watts AM/300 watts PEP SSB. According to the manufacturer it suppresses all harmonics above 41 MHz by more than 75 dB. The unit eliminates transmitted harmonics causing TVI. With all the fuss the

CIRCLE 57 ON READER SERVICE COUPON

FCC is now making about TVI, the SLP-150 is a must for CB stations. Easily installed in coax transmission line with standard PL 259 connectors. Sells for $14.50. No input/output polarity necessary. For additional information, contact Telco Products Corporation, 44 Seacliff Avenue, Glen Cove, NY 11542.

Antenna Flasher

Shur-Lok's new CB antenna accessory, appropriately named "See Mee" Antenna Flasher, is designed to be used on loaded steel masted antennas or full-length steel whips. See Mee lights and flashes when the CB mike is keyed or a message is transmitted. The "See Mee" neon bulb is fired by the R. F. power generated by any CB Radio.



CIRCLE 55 ON READER SERVICE COUPON

The neon bulb is enclosed in a special unbreakable enclosure, decorative in the daytime, and a flashing beacon to friends at night. See Mee is easy to install, no wires to hook up, has a self locking feature, a lifetime 20,000-hour neon bulb and an unbreakable enclosure. Suggested retail price is $2.95. For more info, write to Shur-Lok Mfg. Co., Inc., 413 North Main, Hutchins, TX 75141. ■

Kathi's CB Carousel

by Kathi Martin, KGK 3916

You won't have to sweet talk the "candy company" if you use this gadget.

☐ AS MANY OF YOU have found out the hard way, next to selectivity when it's really needed, the most important characteristic of a CB rig is the modulation; to be more precise, how much distortion and how much talk power? Depending on someone else for a modulation check is often a waste of time because one CB'ers "tree top tall" is another's "you're muddy and distorted."

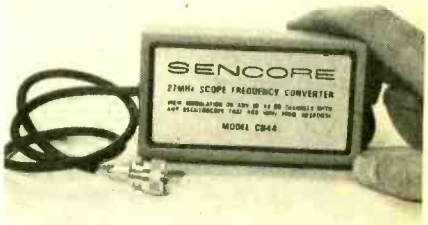
Modulation Checks. The best way to check exactly how much talk power your rig is putting out is to take a look at the actual modulated RF on an oscilloscope; but as I have discovered in my travels, many CB service shops that claim to have the latest in laboratory test equipment lack a 'scope capable of handling up to 30 MHz. In fact, many only have ordinary service 'scopes, and really make their modulation checks by simply listening to the signal on another receiver. Unfortunately, unless the modulation is a mess of hash and hum anything sounds "tree top tall" when received five or 10 feet away.

Now I realize that many service shops, CB clubs, REACT teams and individual CBers cannot afford a 30 MHz 'scope when the most it will be used for is to check modulation; but there is a way you can use an ordinary service grade or hobby 'scope to check CB signals for modulation with as much accuracy as a lab 'scope will give you.

The trick is to use a special frequency converter that "beats" the 27 MHz CB signal down to less than 1MHz, and 1 MHz can be handled by virtually any 'scope built since 1947. Fact is, a converter such as the Sencore Model CB44 beats the signal down to around 500 kHz, a frequency easily handled even by those second-rate 'scopes some educators stick on their students.

The photographs taken off my 'scope show how the frequency converter works. In top picture I have installed vertical amplifiers with a 1 MHz upper limit in my Tektronix 'scope. One amplifier, illustrated by the top trace, gets a channel 19 direct RF output feed from a Realistic Navaho transceiver. The other 1 MHz amplifier, illustrated by the bottom trace, gets a feed of approximately 519 kHz from the Sencore CB44 frequency converter. Note how the direct RF feed—the top trace—is distorted, totally unusable; and note that the input sensitivity has been set for 10 mV, yet the signal does not fill one major vertical division.

The bottom trace, through the frequency converter, is exactly the same signal at the exact same time as the top trace. Firstly, note the amplifier attenuator is set for 2-volts (some output from the converter) and the modulation pattern is easily observed. (That is what low distortion, full talk power modulation is supposed to look like.)

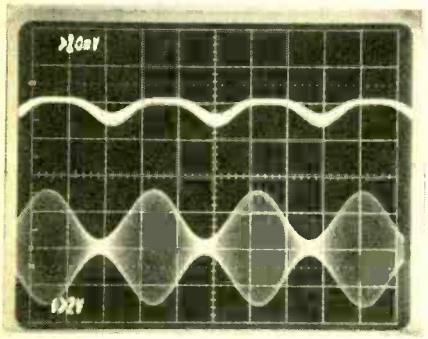


The CB44 isn't much larger than a pack of king-size cigarettes. It has one connection, to the transceiver, and provides a 12-watt dummy load and its own power (part of the RF output is rectified for operating DC). For more information circle number 54 on the reader's service coupon.

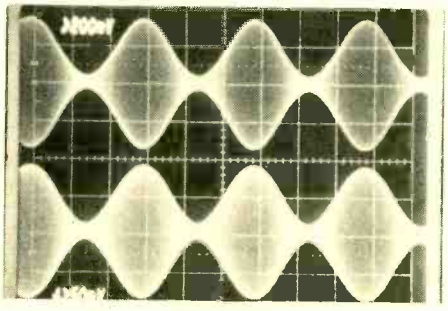
Just to show I'm not selling you a bill of goods, I've prepared the bottom scope display. The amplifier for the top trace has been changed to a 60 Mhz model (it can easily handle 27 MHz). The amp for the bottom trace is still the 1 MHz amplifier. I have used attenuation probes to change the input sensitivities so you can be certain I haven't simply retouched the top photo. Note the amplifier sensitivities now show 200 mV and 50 mV.

Other than the density of the traces, which only affect the photograph, there is no difference to the eye between the top trace made directly from 27 MHz, and the 519 kHz converted frequency made exactly at the same time from the top signal, shown by the bottom trace.

(Continued on page 90)

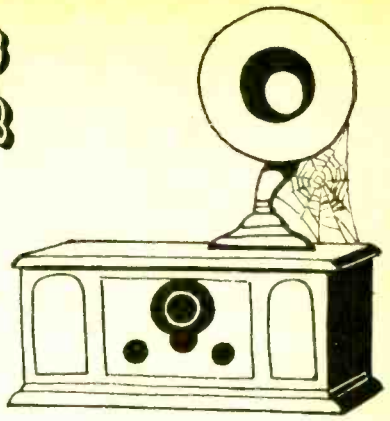


A 27 MHz CB signal fed into a 1 MHz vertical 'scope amplifier produced the unusable trace shown at the top. Feeding the same 27 MHz CB signal through the Sencore CB44 and then through a 1 MHz amplifier produced the perfect representation of the modulated signal shown by the highly-readable bottom trace.



Which is the real signal? The top trace is the direct 27 MHz signal fed through a 30-MHz vertical amp. The bottom trace is the same signal converted by the CB44 and fed to a 1 MHz amp. Other than brilliance, which is a function of the 'scope, the traces are identical; proving the CB44 delivers an accurate trace of a 27-MHz signal at a signal frequency below 1-MHz.

ANTIQUE RADIO CORNER



The ABC's of B battery eliminators.

By James A. Fred

☐ Hello! out there in Radioland. Here it is spring and almost into summer. We have been talking about collecting antique radios for a long time. Now let us consider an accessory necessity to the operation of an old battery radio. One of the more expensive items a radio owner had to buy were batteries.

There was an "A" battery used to light the filaments of the vacuum tubes. There was the "B" battery needed to supply the high plate voltage for the tubes, and a "C" battery that supplied the grid bias voltage. The A battery was usually a 6 volt storage battery just like the one used in an automobile. This battery was called a storage battery because it stored up electrical energy when it was charged and then gave up the energy to light the tube filaments. It was necessary to take this battery to a charging station as often as one time per week. Recharging the battery cost from 50¢ to $1.00 for each charge. It wasn't long before radio users purchased their own battery chargers.

B batteries were called primary batteries because the chemical design provides a certain amount of energy and then is exhausted. It could not be recharged. Most one, two, or three tube radios used one or two 45-volt B batteries while four or five tube sets with loudspeakers normally used three B batteries. In 1926 an Eveready, 45 volt, type 772 battery cost $3.75 and, when used two hours per day, lasted about four months. The heavy duty Eveready Layerbilt B battery cost $5.50 and lasted about eight months. So you can see that back then operating a radio many hours per day was very expensive.

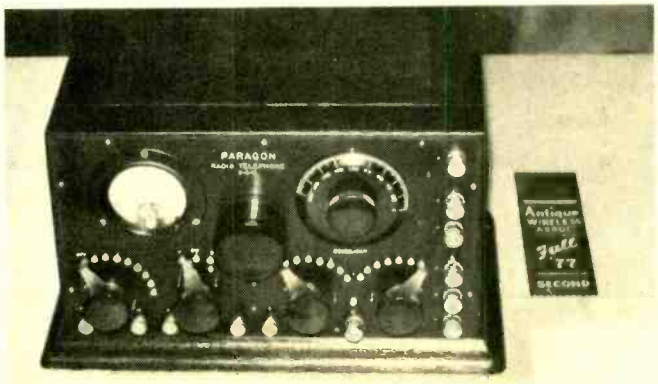
The C battery cost less than $1.00 and was used to supply a fixed bias voltage to the power output tube. This tube would then draw less current from the B battery and provide more undistorted power from the loudspeaker. The above estimated life of a B battery was based on a radio set using a C battery. A C battery would last several years.

It wasn't surprising that a B battery substitute was soon designed, These devices become known as B battery eliminators. There are three good reasons why a battery substitute is advantageous. They are: economy, convenience, and superior performance. Economy was important because the eliminator could pay for itself if used two years or more. The price of an eliminator ran from $30.00 to $50.00 while one built from a kit would be 20% less. Convenience merely meant that the set owner would never have to worry about his battery being dead just when his favorite program came on the air. As long as he paid his electric bill the eliminator would play his radio. On the part of superior performance a debate began among the experts. However, the consensus of opinion seemed to be that a well designed B eliminator would outperform a set of B batteries.

The B eliminator consisted of a power transformer, rectifier, filter choke(s), filter capacitor, and one or more adjustable resistors. These devices were housed in a steel container with a line cord, switches, etc. A circuit diagram of a typical B eliminator is shown. The transformer was used to step up the 115 volt AC line voltage to about 300 volts. This voltage was rectified (changed to pulsating DC) by a full wave rectifier tube. There were different kinds of rectifiers in use. There were electrolytic rectifiers that relied upon a chemical action to rectify the AC. There were high vacuum tubes and gaseous tubes. All the rectifiers did the same thing, but the gaseous tube was more efficient because it had no filament and so saved 10 watts of power. The best known gaseous rectifier was the Raytheon type BH tube. In the 1930's another gaseous rectifier tube, an OZ4, was used in millions of automobile radios.

After the AC was rectified into pul-

Here's an antique RCA radio transmitter, model ET-3619. It was one of the contest winners at the AWA Confernece that was recently held in Dearborn, Michigan.



A second place winner in the transmitter division at the AWA Conference was this Paragon Radio Telephone, type 2-5-U.

sating DC it had a 120 cycle ripple voltage superimposed on it. If this voltage were applied to a radio receiver all you would hear would be a loud hum. The filter chokes and filter capacitors were put into the circuit to smooth out the pulsating DC and provide smooth, hum free, DC. These are L1, L2, C1, C2, C3.

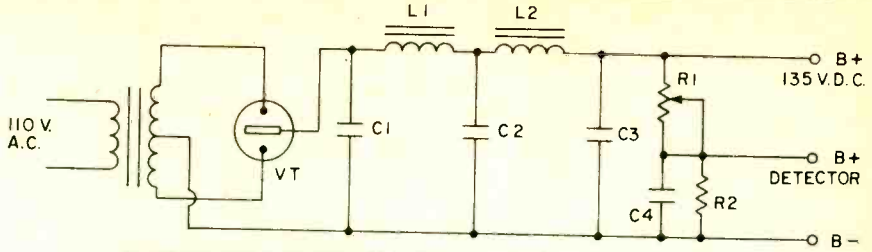
The average B eliminator provides 180 volts for all tubes except the detector. The detector is usually operated at a lower voltage, often 67½ volts DC. To obtain optimum performance the detector voltage should be variable so resistor R1 is used to adjust the detector voltage. C4 is a bypass capacitor used as an RF return to ground.

Some collectors try to find B eliminators to power their battery radios. Recently I found that I had 7 eliminators. I will restore them when I find time and will sell or trade some of them. I especially want to find a Kingston "B" Eliminator made by the Kokomo Electric Company, Kokomo, IN. The reason I want this one is because I worked for the Kingston Radio Company, the sucecssor to the Kokomo Electric Company, for 8½ years as a Junior Radio Engineer between 1945 and 1954. If any reader has a Kingston "B" Eliminator I would be happy to trade one of mine for it. The QST magazines of the 1925-1926 era advertise the Kingston Eliminator.

In my youth I wanted to be a radiotelegrapher, but I never did much about it. As I read POPULAR MECHANICS, RADIO CRAFT or a QST magazine I would see the advertisement for the Dodge Telegraph Institute, which later became the Dodge Radio and Telegraph Institute in Valparaiso, Indiana. Still later, as the demand for railroad telegraphers ended, the Institute began to train students in Radio and Electronics and changed their name to the Valparaiso Technical Institute.

In November 1977 members of the Indiana Historical Radio Society were guests of the Valparaiso Technical Institute. At one time in its history it was known as the Dodge Institute and it is estimated that over 50% of all trained Railroad Telegraphers had graduated from the Dodge Institute. During WW II thousands of GI's were trained in radio theory and operation at the Institute.

An AM radio station, WMWI operating on 1080 KC, is operated in conjunction with the Institute, and the Wilbur H. Cummings Museum of Electronics is located in the same building that houses the radio station. Mr. Cummings was the first President of the Institute's Alumni Association. He also held a teaching position in the school and served as Vice-President on Engineering for the National Broadcasting Company.



PARTS LIST FOR A TYPICAL "B" BATTERY ELIMINATOR—1926 VINTAGE

C1, C2, C3—2-uF electrolytic capacitor, 400-VDC
C4—.5-uF electrolytic capacitor, 200-VDC
L1, L2—5-Henry Filter Choke
R1—10,000-ohm potentiometer
R2—10,000-ohm resistor

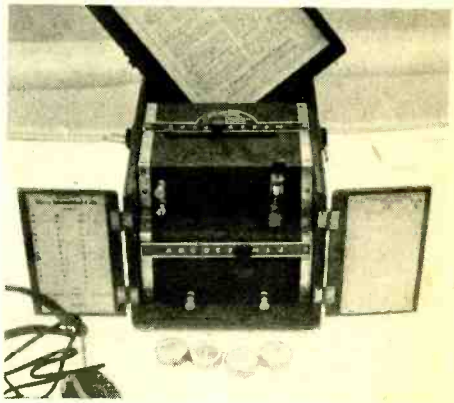
Need components? HOBBY MART has them—see page 88.

The Museum houses many old radio receivers, speakers, electrical measuring instruments, early telephone quipment, an Edison wax cylinder player, old Television sets, and a 78 RPM Seeburg Jukebox. One of the most interesting exhibits is a salesman's sample case with the different stages in the manufacture of a vacuum tube displayed. Each stage in the tube's assembly has its own example taken from an actual production line. There is the filament, plate, grid, base, pins, stem, and glass bulb preform. Finally there is the completely finished, ready to operate, tube.

I was amazed to find, listed among a sampling of their graduates, that two old friends I have known for 30 years had graduated from the Dodge radio and Telegraph Institute.

If you are in the vicinity of Valparaiso, Indiana it will be well worth your time to visit the Wilbur. H. Cummings Museum of Electronics. I am sure you will enjoy it.

In the September-October issue of ELEMENTARY ELECTRONICS magazine I told you how to modify an 864 vacuum tube so that it could be used in place of the WD-11 tube. I realized that the spacing of the pins in the 864 base was slightly different than those of the WD-11. Some of my readers wrote in telling me they were having trouble inserting the 864 tube into a WD-11 socket. Most collectors were able, with a little effort, to get the 864 into the WD-11 socket. I talked to my friends over at Antique Radio Parts about this problem and now they have come up with the perfect replacement tube base for the WD-11. They have purchased a



This crystal radio receiver is in mint condition! It's from the collection of Hardin McCauley of St. John, Indiana. It's a Commerce Radiophone made in Detroit, MI.

quantity of blank tube bases and will jig bore the pin holes in the exact configuration to fit the WD-11 sockets. They will stake in 3 small pins and the one large pin to make the base complete. They will offer the base to those collectors who want to rework their 864 tubes, or for those collectors who lack the tools or experience necessary to make the base change, they will have new 864 tubes with the new WD-11 bases already installed. The pin location dimensions will be taken from a 1923 WD-11 tube. Write to Antique Radio Parts, P.O. Box 42, Rossville, IN 46065 for their brochure Be sure and enclose a long SASE.

You may remember that I told you about a new book "Saga of the Vacuum Tube" by Gerald Tyne that would be available in 1977. After nearly a year's delay, and a change of publishers, the book is now available. This new book records the history of the vacuum tube. This fascinating study not only traces the history of the tube in the United States, but presents little-known information about the French, English, Dutch, and German pioneers. It has 494 information packed pages beginning

(Continued on page 92)

BASIC E/E COURSE

MICROPROCESSORS THEIR NUMBER SYSTEMS AND CODES

Microprocessors are changing your world, and if you want to keep pace you'll have to know how they work and how to use them. This two part series will have you understanding the basics of using number systems and codes—the essentials of microprocessor programming—and give you the foundation for experimenting on your own. Get ready for the great new microprocessor era with ELEMENTARY ELECTRONICS.

WHAT YOU WILL LEARN. To understand and work with microprocessors, it's necessary to understand the binary numbers and codes which make up the basic language of these microprocessors. If you approach the problem logically, you'll find that it's all even easier than you might suspect.

In this first installment, we begin to condense the *Heathkit* home-study course on microcomputers. We think you will agree that this course makes learning interesting and fun.

By the time you finish this installment, you'll understand quite a bit about numbering systems. Given any decimal number, you will be able to convert it into its binary or octal equivalent. You'll be able to convert back and forth from binary to octal. You'll know what a *radix* is, an integer, and a whole lot about numbering systems in general.

Follow along in these continuing installments and join us on the path to understanding microprocessors.

DECIMAL NUMBER SYSTEM

The number system we are all familiar with is the decimal number system. This system was originally devised by Hindu mathematicians in India about 400 A.D. The Arabs began to use the system about 800 A.D., where it became known as the Arabic Number System. After it was introduced to the European community about 1200 A.D., the system soon acquired the title "decimal number system."

A basic distinguishing feature of a number system is its **base** or **radix**. The base indicates the number of characters or digits used to represent quantities in that number system. The decimal number system has a base or radix of 10 because we use the ten digits 0 through 9 to represent quantities. When a number system is used where the base is not known, a subscript is used to show the base. For example, the number 4603_{10} is derived from a number system with a base of 10.

Positional Notation. The decimal number system is positional or weighted. This means each digit position in a number carries a particular weight which determines the magnitude of that number. Each position has a weight determined by some power of the number system base, in this case 10. The positional weights are 10^0 (units) (1 unit), 10^1 (tens), 10^2 (hundreds), etc. Refer to Figure 1 for a condensed listing of powers of 10.

$10^0 = 1$
$10^1 = 10$
$10^2 = 100$
$10^3 = 1{,}000$
$10^4 = 10{,}000$
$10^5 = 100{,}000$
$10^6 = 1{,}000{,}000$
$10^7 = 10{,}000{,}000$
$10^8 = 100{,}000{,}000$
$10^9 = 1{,}000{,}000{,}000$

Figure 1

We evaluate the total quantity of a number by considering the specific digits and the weights of their positions. For example, the decimal number 4603 is written in the shorthand notation with which we are all familiar. This number can also be expressed with positional notation.

$(4 \times 10^3) + (6 \times 10^2) + (0 \times 10^1) + (3 \times 10^0) =$
$(4 \times 1000) + (6 \times 100) + (0 \times 10) + (3 \times 1) =$
$4000 + 600 + 0 + 3 = 4603_{10}$

To determine the value of a number, multiply each digit by the weight of its position and add the results.

Fractional Numbers. So far, only *integer* or whole numbers have been discussed. An integer is any of the natural numbers, the negatives of these numbers, or zero (that is, 0, 1, 4, 7, etc.). Thus, an integer represents a whole or complete number. But, it is often necessary to express quantities in terms of fractional parts of a whole number.

Decimal fractions are numbers whose positions have weights that are negative powers of ten such as:

$10^{-10} = 1/10 = 0.1$, $10^{-2} = 1/100 = 0.01$, etc.

Figure 2 provides a condensed listing of negative powers of 10 (decimal fractions).

$10^{-1} = 1/10 = 0.1$
$10^{-2} = 1/100 = 0.01$
$10^{-3} = 1/1000 = 0.001$
$10^{-4} = 1/10{,}000 = 0.0001$
$10^{-5} = 1/100{,}000 = 0.00001$
$10^{-6} = 1/1{,}000{,}000 = 0.000001$

Figure 2

A radix point (decimal point for base 10 numbers) **separates** the **integer** and **fractional** parts of a number. The integer or whole portion is to the left of the decimal point and has positional weights of units, tens, hundreds, etc. The fractional part of the number is to the right of the decimal point and has positional weights of tenths, hundredths, thousandths, etc. To illustrate this, the decimal number 278.94 can be written with positional notation as shown below.

$(2 \times 10^2) + (7 \times 10^1) + (8 \times 10^0) \times (9 \times 10^{-1} + (4 \times 10^{-2}) = (2 \times 100) + (7 \times 10) + (8 \times 1) + (9 \times 1/10) + (4 \times 1/100) = 200 + 70 + 8 + 0.9 + 0.04 = 278.94_{10}$

In this exemple, the left-most digit (2×10^2) is the **most significant digit** or MSD because it carries the greatest weight in determining the value of the number. The right-most digit, called the **least significant digit** or LSD, has the lowest weight in determining the value of the number. Therefore, as the term implies, the MSD is the digit that will affect the greatest change when its value is altered. The LSD has the smallest effect on the complete number value.

BINARY NUMBER SYSTEM

The simplest number system that uses positional notation is the binary number system. As the name implies, a **binary** system contains only two elements or states. In a number system this is expressed as a base of 2, using the digits 0 and 1. These two digits have the same basic value as 0 and 1 in the decimal number system.

Because of its simplicity, microprocessors use the binary number system to manipulate data. Binary data is represented by binary digits called **bits.** The term bit is derived from the contraction of **b**inary digi**t**. Microprocessors operate on groups of bits which are referred to as words. The binary number 11101101 contains eight bits.

Positional Notation

As with the decimal number system, each bit (digit) position of a binary number carries a particular weight which determines the magnitude of that number. The weight of each position is determined by some power of the number system base (in this example 2). To evaluate the total quantity of a number, consider the specific bits and the weights of their positions. (Refer to Figure 3 for a condensed listing of powers of 2.) For example, the binary number 110101 can be written with positional notation as follows:

$(1 \times 2^5)+(1 \times 2^4)+(0 \times 2^3)+(1 \times 2^2)+(0 \times 2^1)+(1 \times 2^0)$

To determine the decimal value of the binary number 110101, multiply each bit by its positional weight and add the results.

$(1 \times 32)+(1 \times 16)+(0 \times 8)+(1 \times 4)+(0 \times 2)+(1 \times 1)= 32+16+0+4+0+1=53_{10}$

Fractional binary numbers are expresesd as negative powers of 2. Figure 4 provides a condensed listing of negative powers of 2. In positional notation, the binary number 0.1101 can be expressed as follows:

$(1 \times 2^{-1})+(1 \times 2^{-2})+(0 \times 2^{-3})+(1 \times 2^{-4})$

$2^0 = 1_{10}$	$2^6 = 64_{10}$
$2^1 = 2_{10}$	$2^7 = 128_{10}$
$2^2 = 4_{10}$	$2^8 = 256_{10}$
$2^3 = 8_{10}$	$2^9 = 512_{10}$
$2^4 = 16_{10}$	$2^{10} = 1024_{10}$
$2^5 = 32_{10}$	$2^{11} = 2048_{10}$

Figure 3

To determine the decimal value of the binary number 0.1101, multiply each bit by its positional weight and add the results.

$(1 \times 1/2) +(1 \times 1/4)+(0 \times 1/8)+(1 \times 1/16) = 0.5+0.25+0+0.0625 = 0.8125_{10}$

In binary number system, radix point is called binary point.

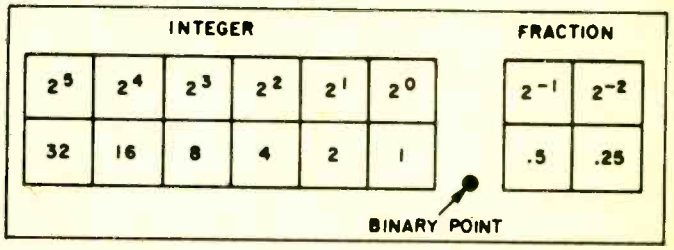
$2^{-1} = 1/2$	$= 0.5_{10}$
$2^{-2} = 1/4$	$= 0.25_{10}$
$2^{-3} = 1/8$	$= 0.125_{10}$
$2^{-4} = 1/16$	$= 0.625_{10}$
$2^{-5} = 1/32$	$= 0.03125_{10}$
$2^{-6} = 1/64$	$= 0.015625_{10}$
$2^{-7} = 1/128$	$= 0.0078125_{10}$
$2^{-8} = 1/256$	$= 0.00390625_{10}$

Figure 4

Converting Between the Binary and Decimal Number Systems

In working with microprocessors, you will often need to determine the decimal value of binary numbers. In addition, you will find it necessary to convert a specific decimal number into its binary equivalent. The following information shows how such conversions are accomplished.

Binary to Decimal. To convert a binary number into its decimal equivalent, add together the weights of the positions in the number where binary 1's occur. The weights of the integer and fractional positions are indicated below.



As an example, convert the binary number 1010 into its decimal equivalent. Since no binary point is shown, the number is assumed to be an integer number, where the binary point is to the right of the number. The right-most bit, called the **least significant bit** or LSB, has the lowest integer weight of $2^0=1$. The left-most bit is the **most significant bit** (MSB) because it carries the greatest weight in determining the value of the number. In this example, it has a weight of $2^3=8$. To evalaute the number, add together the weights of the positions where binary 1's appear.

In this example, 1's occur in the 2^3 and 2^1 positions. The decimal equivalent is ten.

Binary Number	1	0	1	0_2
Position Weights	2^3	2^2	2^1	2^0
Decimal Equivalent				

$$8 + 0 + 2 + 0 = 10_{10}$$

To further illustrate this process, convert the binary number 101101.11 into its decimal equivalent.

Binary Number	1	0	1	1	0	1	.1	1
Position Weights	2^5	2^4	2^3	2^2	2^1	2^0	2^{-1}	2^{-2}
Decimal Equivalent								

$$32 + 0 + 8 + 4 + 0 + 1 + .5 + .25 = 45.75_{10}$$

Decimal to Binary. A decimal integer number can be converted to a different base or radix through successive divisions by the desired base. To convert a decimal integer number to its binary equivalent, successively divide the number by 2 and note the remainders. When you divide by 2, the remainder will always be 1 or 0. The remainders form the equivalent binary number.

As an example, the decimal number 25 is converted into its binary equivalent.

$25 \div 2 = 12$ with remainder	1 ← LSB
$12 \div 2 = 6$	0
$6 \div 2 = 3$	0
$3 \div 2 = 1$	1
$1 \div 2 = 0$	1 ← MSB

Divide the decimal number by 2 and note the remainder. Then divide the quotient by 2 and again note the remainder. Then divide the quotient by 2 and once again note the remainder. Continue this division process until 0 results. Then collect remainders beginning with the last or most significant bit (MSB) and proceed to the first or least significant bit (LSB). The number $11001_2 = 25_{10}$. Notice that the remainders are collected in the reverse order. That is, the first remainder becomes the least significant bit, while the last remainder becomes the most significant bit.

Note: Do not attempt to use a calculator to perform this conversion. It would only supply you with confusing results.

To further illustrate this, the decimal number 175 is converted into its binary equivalent.

$175 \div 2 = 87$ with remainder	1 ← LSB
$87 \div 2 = 43$	1
$43 \div 2 = 21$	1
$21 \div 2 = 10$	1
$10 \div 2 = 5$	0
$5 \div 2 = 2$	1
$2 \div 2 = 1$	0
$1 \div 2 = 0$	1 ← MSB

The division process continues until 0 results. The remainders are collected to produce the number $10101111_2 = 175_{10}$.

To convert a decimal fraction to a different base or radix, multiply the fraction successively by the desired base and record any integers produced by the multiplication as an overflow. For example, to convert the decimal fraction 0.3125 into its binary equivalent, multiply repeatedly by 2.

$0.3125 \times 2 = 0.625 = 0.625$ with overflow	0 ← MSB
$0.6250 \times 2 = 1.250 = 0.250$	1
$0.2500 \times 2 = 0.500 = 0.500$	0
$0.5000 \times 2 = 1.000 = 0$	1 ← LSB

These multiplications will result in numbers with a 1 or 0 in the units position (the position to the left of the decimal point). By recording the value of the units position, you can construct the equivalent binary fraction. This units position value is called the "overflow." Therefore, when 0.3125 is multiplied by 2, the overflow is 0. This becomes the most significant bit (MSB) of the binary equivalent fraction. Then 0.625 is multiplied by 2. Since the product is 1.25, the overflow is 1. When there is an overflow of 1, it is effectively subtracted from the product when the value is recorded. Therefore, only 0.25 is multiplied by 2 in the next multiplication process. This method continues until an overflow with no fraction results. It is important to note that you can not always obtain 0 when you multiply by 2. Therefore, you should only continue the conversion process to the accuracy or precision you desire. Collect the conversion overflows beginning at the radix (binary) point with the MSB and proceed to the LSB. This is the same order in which the overflows were produced. The number $0.0101_2 = 0.3125_{10}$.

To further illustrate this process, the decimal fraction 0.84375 is converted into its binary equivalent.

$0.90625 \times 2 = 1.8125 = 0.8125$ with overflow	1 ← MSB
$0.81250 \times 2 = 1.6250 = 0.6250$	1
$0.62500 \times 2 = 1.2500 = 0.2500$	1
$0.25000 \times 2 = 0.5000 = 0.5000$	0
$0.50000 \times 2 = 1.0000 = 0$	1 ← LSB

The multiplication process continues until either 0 or the desired precision is obtained. The overflows are then collected beginning with the MSB at the binary (radix) point and proceeding to the LSB. The number $0.11101_2 = 0.90625_{10}$.

If the decimal number contains both an integer and fraction, you must separate the integer and fraction using the decimal point as the break point. Then perform the appropriate conversion process on each number portion. After you convert the binary integer and binary fraction, recombine them. For example, the decimal number 14.375 is converted into its binary equivalent.

$14.375_{10} = 14_{10} + 0.375_{10}$

$14 \div 2 = 7$ with remainder	0 ← LSB
$7 \div 2 = 3$	1
$3 \div 2 = 1$	1
$1 \div 2 = 0$	1 ← MSB

$14_{10} = 1110_2$

$0.375 \times 2 = 0.75 = 0.75$ with overflow	0 ← MSB
$0.750 \times 2 = 1.50 = 0.50$	1
$0.500 \times 2 = 1.00 = 0$	1 ← LSB

$0.375_{10} = 0.011_2$

$14.375_{10} = 14_{10} + 0.375_{10} = 1110_2 + 0.011_2 = 1110.011_2$.

OCTAL NUMBER SYSTEM

Octal is another number system that is often used with

microprocessors. It has a base (radix) of 8, and uses the digits 0 through 7. These eight digits have the same basic value as the digits 0–7 in the decimal number system.

As with the binary number system, each digit position of an octal number carries a positional weight which determines the magnitude of that number. The weight of each position is determined by some power of the number system base (in this example, 8). To evaluate the total quantity of a numbr, consider the specific digits and the weights of their positions. Refer to Figure 5 for a condensed listing of powers of 8. For example, the octal number 372.01 can be written with positional notation as follows:

$$(3 \times 8^2)+(7 \times 8^1)+(2 \times 8^0)+(0 \times 8^{-1})+(1 \times 8^{-2})$$

The decimal value of the octal number 372.01 is determined by multiplying each digit by its positional weight and adding the results. As with decimal and binary numbers, the radix (octal) point separates the integer from the fractional part of the number.

$(3 \times 64)+(7 \times 8)+(2 \times 1)+(0 \times 0.125)+(1 \times 0.015625)=$
$192+56+2+0+0.015625 = 250.015625_{10}$

$8^{-4} = 1/4096 = 0.000244140625_{10}$
$8^{-3} = 1/512 = 0.001953125_{10}$
$8^{-2} = 1/64 = 0.015625_{10}$
$8^{-1} = 1/8 = 0.125_{10}$
$1_{10} = 8^0$
$8_{10} = 2^1$
$64_{10} = 8^2$
$512_{10} = 8^3$
$4096_{10} = 8^4$
$32768_{10} = 8^5$
$262144_{10} = 8^6$

Figure 5

Conversion From Decimal to Octal

Decimal to octal conversion is accomplished in the same manner as decimal to binary, with one exception; the base number is now 8 rather than 2. As an example, the decimal number 194 is converted into its octal equivalent.

$194 \div 8 = 24$ with remainder	2 ← LSD
$24 \div 8 = 3$	0
$3 \div 8 = 0$	3 ← MSD

Divide the decimal by 8 and note the remainder. (The remainder can be any number from 0 to 7.)

Then divide the quotient by 8 and again note the remainder. Continue dividing until 0 results. Finally, collect the remainders beginning with the last or most significant digit (MSD) and proceed to the first or least significant digit (LSD). The number $302_8 = 194_{10}$. Figure 6 illustrates the relationship between the first several decimal, octal, and binary integers.

To further illustrate this process, the decimal number 175 is converted into its octal equivalent.

$175 \div 8 = 21$ with remainder	7 ← LSD
$21 \div 8 = 2$	5
$2 \div 8 = 0$	2 ← MSD

DECIMAL	OCTAL	BINARY
0	0	0
1	1	1
2	2	10
3	3	11
4	4	100
5	5	101
6	6	110
7	7	111
8	10	1000
9	11	1001
10	12	1010
11	13	1011
12	14	1100
13	15	1101
14	16	1110
15	17	1111
16	20	10000
17	21	10001
18	22	10010
19	23	10011
20	24	10100

Figure 6

The division process continues until a quotient of 0 results. The remainders are collected, producing the number $257_8 = 175_{10}$.

To convert a decimal fraction to an octal fraction, multiply the fraction successively by 8 (octal base). As an example, the decimal fraction 0.46875 is converted into its octal equivalent.

$0.46875 \times 8 = 3.75 = 0.75$ with overflow	3 ← MSD
$0.75000 \times 8 = 6.00 = 0$	6 ← LSD

Multiply the decimal number by 8. If the product exceeds one, subtract the integer (overflow) from the product. Then multiply the product fraction by 8 and again note any "overflow." Continue multiplying until an overflow, with 0 for a fraction, results. Remember, you can not always obtain 0 when you multiply by 8. Therefore, you should only continue this conversion process to the accuracy or precision you desire. Collect the conversion overflows beginning at the radix (octal point) with the MSD and proceed to the LSD. The number $0.36_8 = 0.46875_{10}$. Figure 7 illustrates the relationship between decimal, octal, and binary fractions.

Now, the decimal fraction 0.136 will be converted into its octal equivalent with four-place precision.

$0.136 \times 8 = 1.088 = 0.088$ with overflow	1 ← MSD
$0.088 \times 8 = 0.704 = 0.704$	0
$0.704 \times 8 = 5.632 = 0.632$	5
$0.632 \times 8 = 5.056 = 0.056$	5 ← LSD

$0.136_{10} = 0.1055_8$

The number 0.1055_8 approximately equals 0.136_{10}. If you convert 0.1055_8 back to decimal (using positioned notation) you will find $0.1055_8 = 0.135986328125_{10}$. This example shows that extending the precision of your conversion is of little value unless extreme accuracy is required.

DECIMAL	OCTAL	BINARY
0.015625	0.01	0.000001
0.03125	0.02	0.00001
0.046875	0.03	0.000011
0.0625	0.04	0.0001
0.078125	0.05	0.000101
0.09375	0.06	0.00011
0.109375	0.07	0.000111
0.125	0.1	0.001
0.140625	0.11	0.001001
0.15625	0.12	0.00101
0.171875	0.13	0.001011
0.1875	0.14	0.0011
0.203125	0.15	0.001101
0.21875	0.16	0.00111
0.234375	0.17	0.001111
0.25	0.2	0.01
0.265625	0.21	0.010001
0.28125	0.22	0.01001
0.296875	0.23	0.010011
0.3125	0.24	0.0101

Figure 7

As with decimal to binary conversion of a number that contains both an integer and fraction, decimal to octal conversion requires two operations. You must separate the integer from the fraction, then perform the appropriate conversion on each number. After you convert them, you must recombine the octal integer and octal fraction. For example, convert the decimal number 124.78125 into its octal equivalent.

$124.78125_{10} = 124_{10} + 0.78125_{10}$

$124 \div 8 = 15$	with remainder	$4 \leftarrow$ LSD
$15 \div 8 = 1$		7
$1 \div 8 = 0$		$1 \leftarrow$ MSD

$124_{10} = 174_8$

$0.78125 \times 8 = 6.25 = 0.25$ with overflow $\quad 6 \leftarrow$ MSD
$0.25000 \times 8 = 2.00 = 0 \quad 2 \leftarrow$ LSD

$0.78125_{10} = 0.62_8$

$124.78125_{10} = 124_{10} + 0.78125_{10} = 174_8 + 0.62_8 = 174.62_8$

Converting Between the Octal and Binary Number Systems

Microprocessors manipulate data using the binary number system. However, when larger quantities are involved, the binary number system can become cumbersome. Therefore, other number systems are frequently used as a form of binary shorthand to speed-up and simplify data entry and display. The octal number system is one of the systems that is used in this manner. It is similar to the decimal number system, which makes it easier to understand numerical values. In addition, conversion between binary and octal is readily accomplished because of the value structure of octal. Figures 6 and 7 illustrate the relationship between octal and binary integers and fractions.

As you know, three bits of binary number exactly equal eight value combinations. Therefore, you can represent a 3-bit binary number with a 1-digit octal number.

$101_2 = (1 \times 2^2) + (0 \times 2^1 + (1 \times 2^0) = 4 + 0 + 1 = 5_8$

Because of this relationship, converting binary to octal is simple and straight forward. For example, binary number 101001 is converted into its octal equivalent.

101001_2
REWRITE AS
MSB LSB
101 001
YIELDS
51_8

To convert a binary number to octal, first separate the number into groups containing three bits, beginning with the least significant bit. Then convert each 3-bit group into its octal equivalent. This gives you an octal number equal in value to the binary number.

Binary fractions can also be converted to their octal equivalents using the same process, with one exception. The binary bits must be separated into groups of three beginning with the most significant bit. For example, the binary fraction 0.011101 is converted into its octal equivalent.

0.011101_2
REWRITE AS
MSB LSB
0.011 101
YIELDS
0.35_8

Again, you must first separate the binary number into groups of three beginning at the radix (binary) point. Then covert each 3-bit group into its octal equivalent.

To separate binary number into 3-bit groups when the number does not contain the necessary bits, add zeros to the number until the number can be separated into 3-bit groups. For example, binary number 10010101.1011 is converted into its octal equivalent.

10010101.1011_2
REWRITE AS
MSB LSB
010 010 101.101 100
YIELDS
225.54_8

As before, the integer part of the number is separated into 3-bit groups, beginning at the radix (binary) point. Note that the third group contains only two bits. However, a zero can be added to the group without changing the value of the binary number. Next, the fractional part of the number is separated into 3-bit groups, beginning at the radix (binary) point. Note that the second group contains only one bit. By adding two zeros to the group, the group is

complete with no change in the value of the binary number.

Note: Whenever you add zeros to a **binary integer,** *always place them to the* **left** *of the most significant bit. When you add zeros to a* **binary fraction,** *always place them to the* **right** *of the least significant bit.*

After you have formed the 3-bit groups, convert each group into its octal equavalent. This gives you an octal number equal in value to the binary number. Now convert binary number 1101110.01 into its octal equivalent.

1101110.01_2
REWRITE AS
MSB LSB
001 101 110.010
YIELDS
156.2_8

Separate the integer and fraction into 3-bit groups, adding zeros as necessary. Then convert each 3-bit group to octal. **Never** shift the radix (binary) point in order to form 3-bit groups.

Converting octal to binary is just the opposite of the previous process. You simply convert each octal number into its 3-bit binary equivalent. For example, convert the octal number 75.3 into its binary equivalent.

75.3_8
YIELDS
MSB LSB
111 101.011
REWRITE AS
111101.011_2

The above example is a simple conversion. Now a more complex octal number (1752.714) will be converted to a binary number.

1752.714_8
YIELDS
MSB LSB
001 111 101 010.111 001 100
REWRITES AS
1111101010.1110011_2

Again, each octal digit is converted into its 3-bit binary equivalent. However, in this example, there are two insignificant zeros in front of the MSB and after the LSB. Since these zeros have no value, they should be removed from the final result.

WHAT YOU HAVE LEARNED

1. A basic distinguishing feature of a number system is its *base* or *radix*. The base indicates the number of characters of digits used to represent quantities in that number system. A *subscript* may be used to show the base a number has been written in.
2. An *integer* is any of the natural, whole numbers and their negatives, or zero. *Decimal fractions* are numbers whose positions have weights that are negative powers of ten.
3. The *radix* separates the *integer* and fractional parts of a number. In our *decimal* system we refer to the radix as a "decimal point." In the *octal* system, for example, it might be called an "octal point."
4. A *binary* system contains two elements or states. In a number system it is expressed as a base of 2, using the digits 0 and 1. Binary digits are called *bits* and microprocessors operate on groups of *bits* which are referred to as words.
5. To *convert* a *binary* number *into* its *decimal* equivalent, add together the weights of the positions in the number where binary 1's occur.
6. To *convert* a *decimal* number *into* its *binary* equivalent, successively divide the number by the desired base. Note the *remainders*. The remainders will form the equivalent binary number.
7. The *octal* numbering system has a base (radix) of 8 and uses the digits 0 through 7. As with the binary system, each digit position of an octal number carries a positional weight which determines the magnitude of that number.
8. *Conversions from decimal to octal* are accomplished in the same manner as decimal to binary with one exception: The base number is now 8 rather than 2.
9. You may represent a 3-bit binary number with a 1-digit octal number. To *convert from binary to octal* first separate the number into groups containing three bits, beginning with the least significant bit. Then convert each 3-bit group into its octal equivalent. This will give you an octal number equal in value to the binary number.
10. In converting as above, to separate the binary number into 3-bit groups when the number does not contain the necessary bits, *add zeros* to the number until the number can be separated into 3-bit groups. ■

Friendly Flasher

(Continued from page 37)

stalled all three 7447s and verified correct operation at all twenty outputs, you are ready to install and test the 7400 (IC-7) which will be used as four inverters.

Make sure that power has been removed from the board and solder the 7400 (IC-7) in place. To test the 7400 for correct operation, apply power and use a DC voltmeter on pins 1, 4, 10, 13 and 14. Each of these pins should read a steady five volts. Next, check pins 2, 5, 9 and 12 for inputs swinging back and forth between high and low. Finally, check the output pins 3, 6, 8 and 11 to make sure that they also swing between high and low.

When you have met all these conditions, you may remove power. At this point, you have a working circuit board that you have thoroughly checked out. All that remains is to wire in the LEDs and assemble everything in a suitable enclosure.

The selection of an enclosure for this project is pretty much a matter of individual taste. You may wish to build your own or purchase one ready-made. Rather than give detailed instructions which may not apply to your particular choice, I want to pass along some general hints.

The area requiring the greatest attention to detail is the mounting of the LEDs. Make sure that all the holes are exactly lined-up; the slightest misalignment will make the project look sloppy. Paint the front panel before installing the LEDs and, when you do install them, use one of those super strong, super fast instant glues. Be sure to test the LEDs before installation. Finally, in a random fashion, solder the twenty output wires to the LEDs. Be sure to use a heat-sink each time you solder a wire to an LED.

Before applying power, recheck all LEDs with an ohmmeter and secure any loose wiring. Make a final visual check and then plug in the power cord. Now hit the switch and you should be rewarded with twenty flashing LEDs. Let everything cook for a couple of hours and then put the rest of the cabinet together.

Now you are ready to make your favorite black box look like it is really doing something important. ■

e/e Checks Apple II

(Continued from page 66)

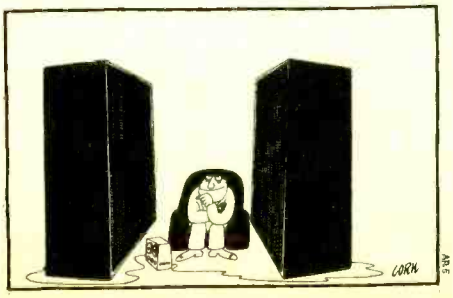
had two samples) using either a real cheap recorder ($30), or a better quality (about $90) model. Unusually, we could not load BASIC using the *moderately* priced machine. Apple specifically recommends a particular model, moderately priced machine which we could not obtain locally; so our advice when looking for a recorder to go with the Apple II is to try before you buy.

Tasting The Apple. Most likely because of the color graphics, games are an important part of Apple II's orientation. The computer is supplied with two paddles, wired together, which connect to the computer by simply plugging each into what would otherwise be a standard IC socket. Provision is made for future expansion through prewiring of the game I/O port for four paddles, 3 TTL inputs, and 4 TTL outputs.

Depending on your technical knowledge and sophistication our description of the Apple II might appear too simple or too complex. This is so because the Apple II can be used on two different levels. Loaded with the 16K Applesoft BASIC it is an unusually easy to use, extremely powerful personal computer suitable for the student from elementary grades clear through college and advanced studies. Alternately, the Apple II has sufficient complexity and adaptability for the computer technology student and experimenter who wants to do a lot of homebrew expansion and adaptation. It's sort of like the movies made back in the thirties; a cute plot for the kiddies, and slice-of-life for the adults, with each patron seeing only the theme aimed at his or her age/maturity level.

The Apple II prices start at $1295 and head upward depending on the amount of memory needed or purchased. There are so many options your best bet is to get the rather thorough brochure from Apple before going down to your local computer store for hands-on experience. From our own observations, it's quite likely many of you will know more about the Apple II from the brochure than the staff at the store. This is because there are so many levels of features and potential usage you and the store's staff might not be talking on the same level, or about the same features.

For additional information on the Apple II circle No. 74 on the reader's service coupon. ■



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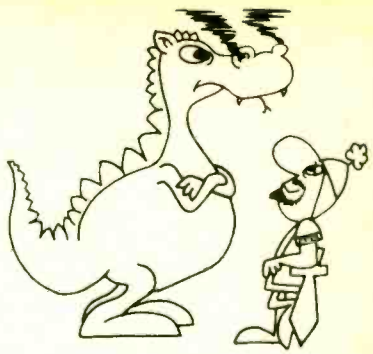

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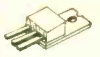

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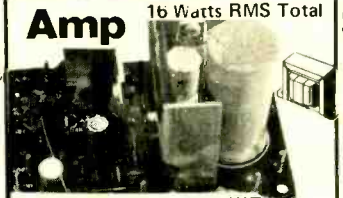

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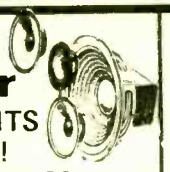

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SAVE WITH SURPLUS! **B&F**

CIRCLE 6 ON READER SERVICE COUPON

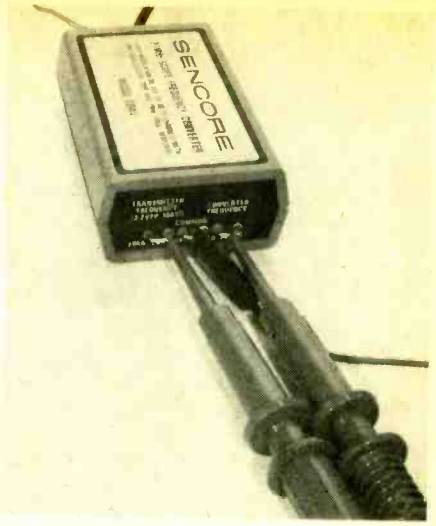
Kathi's CB Carousel

(Continued from page 78)

In short, all we need to observe high frequency RF on even an "audio 'scope" is a Sencore CB44 Frequency Converter, which at $75.00 is well within the budget of all CB shops, many clubs, and some technical CB hobbyists.

How It Works. The CB44 derives the low frequency representation of a CB signal by "beating" (heterodyning) the 27 MHz CB signal against a fixed oscillator of approximately 26.66 MHz. (Yes, the same thing is done in your transceiver to beat the CB signal down to the IF frequencies.) When two signals are beat the output of the mixer stage contains the original signals, the sum of the signals, and the difference between the signals. By passing the output through a frequency selective filter only the difference frequency is allowed to pass through to the output of the converter. In the case of th CB44, the difference frequency (approximately 27 MHz minus 26.66 mHz) is nominally 340 KHz, and this is the signal fed to the general purpose 'scope

Somewhat surprisingly, the CB44 does not require either a battery or external power source because operating power is derived from the CB signal itself. The CB44—which works with an input power in the range of 1 to 12 watts—has a built in 12 watt 50 ohm dummy load. Part of the signal appearing across the load is rectified and filtered to the DC needed to power the coverter's circuits. You just connect the CB44 to transceiver's output jack and it's up and running (to borrow a phrase from the computer hobbyists).

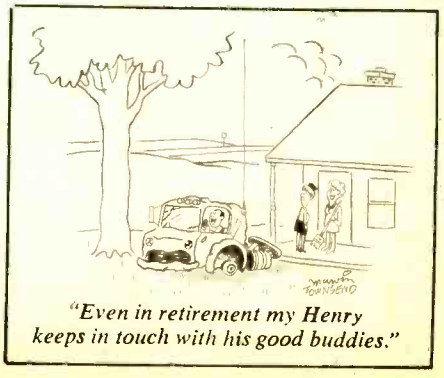


Wire loops on one end allow the 'scope and frequency counter probes to be easily connected to the frequency converter.

The output of the converter and a sample of the RF input are fed to wire loops to which instrument test leads are easily secured (just clip them on). The sample of the RF input is provided just in case you want to check the transceiver's output frequency on a counter. Because the RF sample also contains rectified DC it cannot be used for direct modulation tests—it serves only for use with a frequency counter.

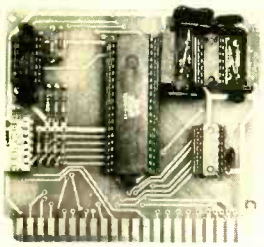
Measuring just 4⅝-in. by ⅞-in. by 2¾-in. the CB44 can be easily stored in a toolbox, or carried to meetings and jambories for on-the-spot talk power tests. (Remember, you need some form of signal to feed into the mike.) It's often a good way to raise a few dollars for your club or REACT team—$1 for each talk power and frequency check.

For additional information on the Sencore CB44 Frequency Converter circle No. 54 on the reader's service coupon. ■



"Even in retirement my Henry keeps in touch with his good buddies."

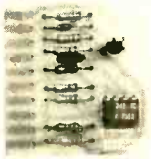
ELECTRONIC SYSTEMS
p.o. box 212 Burlingame CA 94010
(408) 374-5984



UART & BAUD RATE GENERATOR

Part no. 101
- Converts serial to parallel and parallel to serial
- Low cost on board baud rate generator
- Baud rates: 110, 150, 300, 600, 1200, and 2400
- Low power drain +5 volts and -12 volts required
- TTL compatible
- All characters contain a start bit, 5 to 8 data bits, 1 or 2 stop bits, and either odd or even parity.
- All connections go to a 44 pin gold plated edge connector
- Board only $12.00; with parts $35.00

RS-232/TTL INTERFACE



Part no. 232
- Converts TTL to RS-232, and converts RS-232 to TTL
- Two separate circuits
- Requires -12 and +12 volts
- All connections go to a 10 pin gold plated edge connector
- Board only $4.50; with parts $7.00

DC POWER SUPPLY

Part no. 6085
- Board supplies a regulated +5 volts at 3 amps., +12,-12, and -5 volts at 1 amp.
- Board has filters, rectifiers, and regulators
- Power required is 8 volts AC at 3 amps., and 24 volts AC C.T. at 1.5 amps.
- Board only $12.50

TAPE INTERFACE

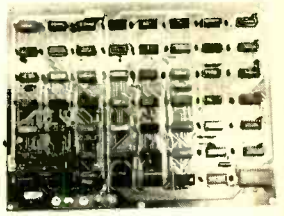
Part no. 111
- Play and record Kansas City Standard tapes
- Converts a low cost tape recorder to a digital recorder
- Works up to 1200 baud
- Digital in and out are TTL-serial
- Output of board connects to mic. in of recorder
- Earphone of recorder connects to input on board
- Requires +5 volts, low power drain
- Board $7.60; with parts $27.50
- No coils

Part no. 107

RF MODULATOR

- Converts video to AM modulated RF, Channels 2 or 3
- Power required is 12 volts AC C.T., or +5 volts DC
- Board $4.50; with parts $13.50

TELEVISION TYPEWRITER



Part no. 106
- Stand alone TVT
- 32 char/line, 16 lines, modifications for 64 char/line included
- Parallel ASCII (TTL) input
- Video output
- 1K on board memory
- Output for computer controlled curser
- Auto scroll
- Non-distructive curser
- Curser inputs: up, down, left, right, home, EOL, EOS
- Scroll up, down
- Requires +5 volts at 1.5 amps, and -12 volts at 30 mA
- Board only $39.00; with parts $145.00

8K STATIC RAM

Part no. 300
- 8K Altair bus memory
- Uses 2102 Static memory chips
- Memory protect
- Gold contacts
- Wait states
- On board regulator
- S-100 bus compatible
- Vector input option
- TRI state buffered
- Board only $22.50; with parts $160.00

TIDMA

Part no. 112
- Tape Interface Direct Memory Access
- Record and play programs without bootstrap loader (no prom) has FSK encoder/decoder for direct connections to low cost recorder at 625 baud rate, and direct connections for inputs and outputs to a digital recorder at any baud rate.
- S-100 bus compatible
- Comes assembled and tested for $160.00

APPLE I MOTHER BOARD

Part no. 102
- 10 slots – 44 pin (.156) connectors spaced ¾" apart
- Connects to edge connector of computer
- Pin 20 and 22 connects to X & Z for power and ground
- Board has provisions for bypass capacitors
- Board cost $15.00

MODEM

Part no. 109
- Type 103
- Full or half duplex
- Works up to 300 baud
- Originate or Answer
- No coils, only low cost components
- TTL input and output-serial
- Connect 8 ohm speaker and crystal mic. directly to board
- Uses XR FSK demodulator
- Requires +5 volts
- Board $7.60; with parts $27.50

To Order:

Mention part number and description. For parts kits add "A" to part number. Shipping paid for orders accompanied by check, money order, or Master Charge, BankAmericard, or VISA number, expiration date and signature. Shipping charges added to C.O.D. orders. California residents add 6.5% for tax. Parts kits include sockets for all ICs, components, and circuit board. Documentation is included with all products. Dealer inquiries invited. 24 Hour Order Line: (408) 374-5984. E21

CIRCLE 29 ON READER SERVICE COUPON

Basic—Keep Out of the Gutter With Bowling Score Program

(Continued from page 73)

```
ADY

 RUN
DO YOU WANT TO:
(1) STORE NEW INFORMATION ON TAPE
(2) ADD NEW INFORMATION TO OLD AND PRINT IT.
? 2
HOW MANY BOWLERS ARE ON YOUR TEAM?
? 5
START THE TAPE IN THE PLAY MODE.
ENTER GAMES AND TOTAL PINS FOR THE BOWLERS.
#1  JOE SANTINO? 3, 541
#2  MARK BERK? 3, 568
#3  BILL HASTINGS? 3, 567
#4  PETE REDMANN? 3, 500
#5  ROBERT SANCHEZ? 3, 512
ANY ERRORS?? NO
PUT THE TAPE RECORDER IN THE RECORD MODE AND HIT
RETURN.
?
NAME                    AVG.    G       T.P.
**********************************************
JOE SANTINO             181     36      6532
MARK BERK               174     36      6286
BILL HASTINGS           172     36      6209
PETE REDMANN            169     36      6108
ROBERT SANCHEZ          166     36      6001
**********************************************
TEAM                    172

READY
```

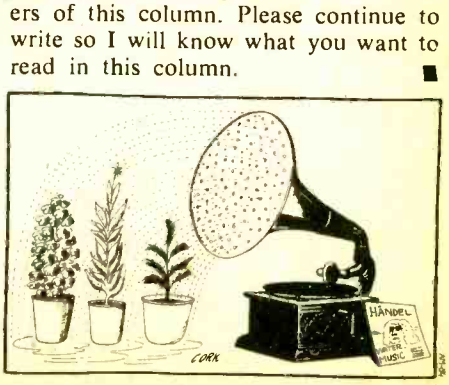

Antique Radio Corner

(Continued from page 80)

with electrical developments piror to 1880 and concluding with the early days of broadcasting. Many historical photographs and diagrams are included. There is also a ten page index of tube types. The softbound version is priced at $9.95, while a hard back edition is available for $19.95. The book is available at all Howard Sams & Co, Inc. book dealers or by mail from: Vintage Radio, P.O. Box 2045, Dept. ARP, Palos Verdes Peninsula, CA 90274. I am sure you will find it fascinating reading as well as being a valuable reference book.

I have just received the latest copy of the Old Timer's Bulletin, the quarterly publication of the Antique Wireless Association. There are many interesting items there. Jack Gray's museum has been moved to the new Crosley Community Center located at 1223 Central Parkway in downtown Cincinnati, Ohio. The Center is also the home of stations WCET-TV and WQLA-FM. Jack Gray had one of the finest radio museums in the country when he died in 1970. Members visiting the Foothill College Museum at Los Gatos, CA will have an opportunity to see Philo Farnsworth's original TV equipment made in 1927. An almost forgotten pioneer, he died in 1971 after developing a cathode ray system of Television. He held 150 US and 100 foreign patents.

So long for now. I have been receiving some interesting letters from readers of this column. Please continue to write so I will know what you want to read in this column.



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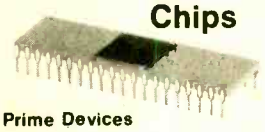
386CN	276-1731	99¢
555CN	276-1723	79¢
556CN	276-1728	1.39
566CN	276-1724	1.69
567CN	276-1721	1.99
723CN	276-1740	69¢
741CN	276-007	49¢
741H	276-010	49¢
3900N	276-1713	99¢
3909N	276-1705	99¢
3911N	276-1706	1.99
4558CN	276-038	79¢
75491	276-1701	99¢
75492	276-1702	99¢
7805	276-1770	1.29
7812	276-1771	1.29
7815	276-1772	1.29

Computer Chips



Prime Devices

8080A Microprocessor. 8-bit, NMOS.
276-2510 Reg. 17.95 ..... Sale 12.95

2102 1K Static RAM. Under 450 ns.
276-2501 ..... 2.49 Ea. or 8/14.95

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REGULARLY $1.95. Archer® Semiconductor Reference and Application Handbook. Complete specs and application data on every Archer semiconductor — display devices, too! 46,000 cross-reference/substitution listings plus glossary of words, symbols, abbreviations.
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Offer good at participating Radio Shack stores and dealers

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IC Socket Wrapping Tool. Strips and wraps 30-gauge wire. 276-1570 ..... 6.95
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50' Red 30-ga. Kynar® Wire. 278-501 ..... 1.99
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Trim Multi-Purpose Cabinets

SALE

[A] Compact. Makes even your small projects look professional. 5⅞x9x4⅞". **270-281** 10.95
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Full-Spec Devices Direct from Motorola and National Semiconductor

Type	Cat. No.	ONLY
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7413	276-1815	79¢
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7427	276-1823	49¢
7432	276-1824	49¢
7441	276-1804	99¢
7447	276-1805	99¢
7448	276-1816	99¢
7451	276-1825	39¢
7473	276-1803	49¢
7474	276-1818	49¢
7475	276-1806	79¢
7476	276-1813	59¢
7485	276-1826	1.19
7486	276-1827	49¢
7490	276-1808	79¢
7492	276-1819	69¢
74123	276-1817	99¢
74145	276-1828	1.19
74150	276-1829	1.39
74154	276-1834	1.29
74192	276-1831	1.19
74193	276-1820	1.19
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74196	276-1833	1.29
74C00	276-2301	SALE 29¢
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4001	276-2401	49¢
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4013	276-2413	89¢
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4511	276-2447	1.69
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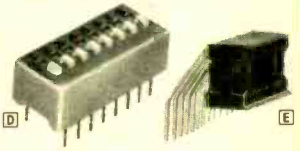
SALE LED Digital Displays

Digits	Size	Drive	Cat. No.	Reg.	SALE
[A] 1	0.6"	Anod.	276-056	2.99	2.29
[A] 1	0.6"	Cath.	276-066	2.99	2.29
[B] 1	0.3"	Anod.	276-053	1.99	1.49
[B] 1	0.3"	Cath.	276-062	1.99	1.49

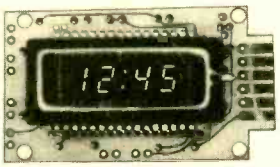
Digits	Size	Drive	Cat. No.	Reg.	SALE
[B] 1	0.3"	Anod.	276-1210	4/6.99	4/5.49
[B] 1	0.3"	Cath.	276-1211	4/6.99	4/5.49
[C] 4	0.5"	Anod.	276-1201	6.95	5.99
[C] 4	0.5"	Cath.	276-1202	6.95	5.99

IC Accessories



[D] DIP Switch. For changing preset logic states. **275-1301** 1.99
[E] Right-Angle 16-Pin Socket.
276-1985 ..... 1.49

SALE MA1003 Automotive Clock Module



Just add switches and install 12-hour readout, 0.3" digits, ±0.5 sec./day accuracy. 12VDC.
277-1003. Reg. 24.95 ..... Sale 19.95

Archer® Project-Boards — Predrilled PCB's

SALE
Time Base Generator. Built-in 10 MHz xtal or ext. input. Decade selector, switch. TTL output. Requires 5VDC. Reg. $5.99.
277-115 (PCB less parts) ..... Sale 4.99

NEW
5V, 3-Amp Power Supply. Metered output current, foldback limiting. Remote sensing. For all 5V TTL projects.
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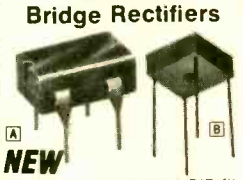
Shown Built with Recommended Parts and Cases

Full-Wave Bridge Rectifiers



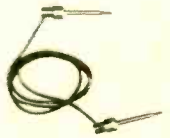
NEW

[A] 1-Amp, 50 PIV. Mini DIP fits PCB or 8 and 14-pin sockets.
276-1161 ..... 69¢
[B] 6-Amp, 50 PIV. Heavy-duty leads, heat sink mtg. hole.
276-1180 ..... 1.99

Mike Elements

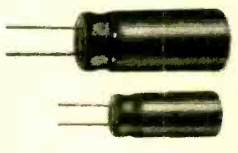
Dynamic. Tiny yet delivers 80-10,000 Hz response. −65 dB. 200 ohms. ¾x⅞".
270-093 ..... 1.69
Hi-Z Crystal. 50-8000 Hz response. −55 dB. 1½x1¼".
270-095 ..... 1.39

SALE 2-Foot Mini Test Clips



Red. Reg. 1.99
278-1158 ..... Sale 1.49
Black. Reg. 1.99.
278-1159 ..... Sale 1.49

35VDC Electrolytic Pak



Package of 10 with two of each value: 4.7, 10, 25, 50 and 100 μF. PC mounting. **272-1035** 2.99

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Weather Radio

(Continued from page 58)

e/e reader owns at least some sort of shortwave receiver. But long wave is somthing else again. The selection of long wave receivers is not what it was in the 1960s and even in the 60s most serious LW monitors preferred military surplus equipment. But now, in the 70s, Realistic's DX-160 shortwave receiver has a long-wave band and will prove quite adequate for the beginner. Other shortwave receivers which cover LW include the Kenwood R300 and in the more expensive "communications" class price range, the Drake SPR4 and Dymek DR22. In addition, many European made general listening receivers include an LW band because in Europe some of these frequencies are used for standard broadcasting.

Antennas. Whatever receiver you choose, you should have an outdoor antenna. Even a random length of wire, strung as high as possible, will produce satisfactory results.

On VHF almost all scanners cover the marine weather frequencies but if you are interested in reception beyond 50 miles you will need an outdoor antenna. Many antennas designed for VHF marine reception are readily available, but if your TV antenna works especially well on channel 7 it might just do for the most distant weather broadcasts. ■

e/e Checks PRO-2001

(Continued from page 62)

certainly not performance. It would be nice to be able to resume a search after a frequency is entered in a channel. As it now stands, the LO and UP frequencies must be reprogrammed after a searched frequency is entered; but this inconvenience is a small price to pay for otherwise outstanding performance. It's hard to see how one could find a better scanner at any price.

The PRO-2001 is priced at $399.95 including the DC power cable and the mobile mounting bracket, but not the 9-volt battery. Make certain you invest in a battery when you get the scanner if you want the "permanent" memory to work when you initially apply power. The PRO-2001 Programmable FM Scanning Receiver is available only at Radio Shack stores.

For additional information circle No. 32 on the reader's service coupon so you too can get in on the action band action. If you haven't been tuning in on these frequencies, this is a good time to find out about the action. ■

BCB Booster

(Continued from page 60)

direct signal pickup by L1 will be sufficient. If greater sensitvity is needed connect 6 to 15 feet of wire to BP1. If you connect a longwire antenna take note; the signal level out of the booster can be so high as to overload the receiver.

If there is a strong local station in your area it's possible that the signal strength will be boosted to a level that swamps the receiver when listening to a weak signal on the other end of the dial. If this happens simply detune the booster away from the strong signal's frequency until the interference is reduced or eliminated. While this might sacrifice some gain on the desired station, the loss will probably be slight.

It is possible for the booster's output to radiate back to its input (particularly when using a loopstick coupling coil). You'll know when this happens—the booster breaking into self-oscillation—if the receiver gets "blocked," or off-frequency signals get tuned in and *lost* as C1 is adjusted. If this problem occurs, position the booster as far as possible from the receiver and keep any external antenna, if used, away from the receiver and booster's output cable.

Under certain conditions the *Super BCB Booster* will provide an additional benefit which should not be construed as improper operation. Some inexpensive receivers are highly prone to "marine band" image interference when signals at the high end of the broadcast band are received. The booster, by providing tuned preselection, suppresses or eliminates these interference-causing image signals while providing amplification to broadcast signals. Don't assume the loss of image signal reception means reduced sensitivity. Actually, the desired signal will be getting full boost while the image interference is squashed. ■

Computer New Products

(Continued from page 74)

software, and uses DEC's device codes 01 and 02, and operates the reader at rates to 150 charactres per second and the punch at 50 characters per second. Prices of the 12070: kit, $97; assembled, $167. The Mag-Tape Interface allows an ordinary audio cassette recorder to be substituted for the paper-tape reader and punch. The byte-standard self-clocking FM circuitry allows operation at a rate three times faster than that of the reader/punch on a TTY terminal. Also, it's possible to take advantage of the inexpensive mass-storage capability of the audio cassette which can store 30,000 characters on a single slide. Prices of the 12080: kit, $117; assembled, $187. Circle 64 on Readers Service Card. ■

Computer Readout

(Continued from page 68)

Make That Point! Backgammon is catching on like wildfire and to many of us it is a new game, but the history of backgammon is older than history itself. Boards dating from over 3500 years ago were found by Howard Carter as he searched and cataloged the treasures of King Tutankhamun. One of those boards is on tour with the King Tut treasures right now. Perhaps you have seen it. Like chess, it is styled after a game of war. Unlike chess, pieces are not lost. Instead the white pieces race clockwise around the board while the black pieces race counter-clockwise. The object is for a player to get all his pieces on his home section (the right lower section for white and right upper for black) and then to get them off the board before his opponent. The first to get all men off wins. The game uses dice to determine how far you can move pieces when it is your turn. There are clearly times when a certain roll of the dice is highly advantageous because, among other things, if you are able to land on an opponent's unprotected man you can send him to the "bar" (off the board) where he must stay until a certain roll of the dice gets him onto the board again. It is a big gambling game in Las Vegas and taken as seriously as chess in many clubs. The skill part is important and comes into play in knowing exactly what to do with any roll of the dice that might come up. This is truly the skillful part of the game because the pieces can appear on the board in millions of different ways, yet for a given roll of the dice a skillful player will know the best move. Sound difficult? Well, remember that there are various levels of play. A five-year-old can play and enjoy the game, and because of the dice-rolling chance element, that youngster may even beat a tournament master—but not very often.

Now let us take a look at the computerized backgammon. I have used the Tryon version and I suspect that the Texas Micro Games unit is comparable. Let me say right off that, before I played with the Gammonmaster, I never played backgammon before in my life. Let me also add that this computer game can be taken lightly or seriously. If you want to have a clever toy, this will do nicely. If you want to be challenged at a serious game of backgammon, this computer version should satisfy that urge. In simple terms, the computer is hard to beat and makes a great instructor.

The external operation is simple enough. You press a start (ST) key on the keyboard. The computer "rolls" a pair of dice which are actually composed of LEDs in a dice pattern in the upper right hand corner of the game. Suppose it is your move. You choose what pieces you want to move following the dice roll, then you enter the "from" position and the "to" position on the keyboard for each piece you choose to move—usually two pieces, one for each die. Entering the *from* and *to* locations allows the computer to change the board layout in its memory, but first the computer checks to see if your moves are legal. It knows the dice values because it has rolled them, so it can determine if your moves are allowed. If not it lights up two big zeros on the LED display. If the moves are legal, however, it rolls the dice for its own move. Now comes the interesting part. The computer has to decide where to move what pieces given the board layout and the roll of the dice. Whoever programmed the unit is a fine backgammon player. The computer protects its pieces well and builds very nicely toward a solid defense on its home section of the board. I have played the unit over twenty times and have won only twice. Once was by only one piece and once I got lucky and really skunked the computer. While I have won only twice, however, I have become a much stronger player over those twenty or so games and maybe the next twenty games I will win four or five times.

The sophistication of the computer is amazing to watch and I only hope I can learn to be as clever as it is. For example, I have noticed that if it is way ahead, it will arrange the pieces on its home section in such a way as to almost assure itself that when future dice rolls are done the home pieces will be able to get off the board quickly and easily. If it is behind, however, it does not seem to build this luxury onto its home section and instead makes a mad rush to get any pieces off that it can. In a nutshell, computerized backgammon seems to work very well and serves as an excellent instructor for young and old alike.

There we have it. A rundown of several types of non-television games that are fun and often educational. In future articles we will continue to explore the world of microcomputer applications. Computerized chess can be covered in more detail if you like, and the world of microcomputers interacting more and more with radio systems (CB, ham radio, navigation, etc.) will be explored. Further, some makers of microcomputer games are finding education to be a very important arena to develop. New ideas are being generated which many feel sure will find their way into the classrooms slowly but surely. Stay tuned for more micromania and keep the letters coming. ■

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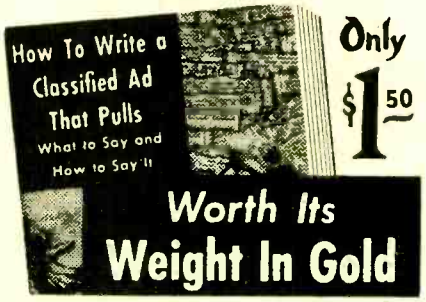

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Aids to DX

(Continued from page 64)

Record-Keeping Aids. Sooner or later you will realize the necessity of keeping track of at least some of the stations you have heard and at what time of day and frequencies you received them on. Thus the need of a log. Like station or chures. Others are handy little folders and some are simply mimeographed lists. Your problem is to find some way of keeping them in order and available for ready-reference. After trying a number of things, I finally settled on a large 8½ by 11-inch looseleaf binder. I have it indexed by continents and place the literature inside in various ways. Some I punch and, others I paste on a blank page and a few I put into a page with a pocket stapled to it. All are alphabetically placed, by continent.

Listening Post Aids. When you start your shortwave listening, you won't need much space—a corner of the kitchen table or a shelf in the den. But as you get more involved with DXing, the more additional objects and devices target lists, every experienced DXer has his own idea about the form a log should take. In fact, many DXers combine their station or target list with a log. Others, like myself, have a separate log to use as a permanent record.

Why a record of what you have heard? First, if you are sending in QSL reports and hoping to get verifications in return, the log tells you the date you sent the report in and gives you an idea of whether the verification is overdue. You may, as I have, used an old address and the log tips you off as to when it is time to check up on your report.

Another valuable thing about a log is in looking up the stations you have previously heard. Your log will tell you the time you heard them and which frequency came through for you at that particular time of the year. Finally, if you are a member of a SWL club, you may be trying to qualify for a DX award and a record of your receptions and verifications will be a virtual necessity for this.

In addition to a log, I find two other record-keeping devices helpful. One is a small looseleaf notebook, indexed by the day of the week, to record specific programs that I wish to tune in to regularly. I simply jot down the name of the program, time and frequency and thus have a quick-reference source to my favorite listening.

The other record-keeping device you will need is a place to keep station programs. As you begin to receive verifications from your QSL reports, you will begin to collect all kinds of literature about the stations, their full range of frequencies and their broadcasts. Some of these are elaborate, full-color bro- you find yourself having to cope with. You may add some other electronic gear, such as an antenna tuner or a calibrator. Now you not only need more physical space but you have the additional wires to plug in. And then there's the tape recorder and headphones, and all the reference material mentioned above needs some place to be kept and yet handy to get at. Unless you organize your listening post, you will suddenly find yourself in the midst of terrific clutter.

My set-up is a simple 5½-foot long table, built in against the wall of my den. On top of the table is a 10" wide shelf, raised 10" above the table-top. I place my receiver on this shelf which puts it at eye-level. A desk lamp also sits up on the shelf and I have plenty of room to add any other electronic equipment there also.

Underneath the shelf, I have all the room I need for my reference books, tape recorder, etc. I have lots of desk space in front of the shelf and also a place to rest my elbows while tuning my receiver. Finally I have a multiple outlet panel to take the various electrical plugs. I recommend the type that has a three-way plug and its own fuse. One final suggestion. Put an executive desk-type chair on your Christmas list and then you're set for many relaxed hours of fun and DXing. ■

Spiderweb Receiver

(Continued from page 46)

volt battery to the receiver. Set the Bandspread capacitor C2 to minimize capacity and the Tuning Capacitor C3 to maximum capacity. Connect a signal generator to J1 and then calibrate the dial with the generator. Adjust the AF Gain R5 and R1 as necessary for a good received signal. Make sure that the signal generator output is kept low enough to prevent overloading of the receiver. Begin with a modulated signal generator frequency of 550 kHz and mark the receiver dial accordingly. Proceed up the dial to 1600 kHz and mark the scale at convenient points. Then replace the "C" with the "B" plug-in coil and calibrate the scale from 1.7 to 5 MHz with the signal generator. Also, calibrate the "A" plug-in coil with a generator from 7 to 14 MHz. If a signal generator is not available, you can calibrate the bands with markings noted from received radio stations of known frequency. The Bandspread dial is not calibrated, but, a set of points can be marked over the range of C2 to aid in tuning the dial, or for logging purposes in the crowded SW bands.

Operation. For best results a good antenna and ground are required. Also high impedance earphones (2000 ohms or more) are needed. If a DC power supply is used in place of the 6 volt battery, make sure that the supply does not have any hum in the output as this will affect the receiver sensitivity. Tune C3 for a received station, while at the same time adjusting the Regen control R1 for a whistle. If the station is AM, back off R1 until the station is received clearly. If the received station is CW, adjust R1 for a convenient "beat note." Many strong side-band stations can also be received by experimentally tuning R1 and C2 for best reception. Adjust the AF Gain control for good earphone volume. Adjust C1 for best reception for each coil. The position of the "S" tap can be experimented with (moving up or down on L1) for best regeneration over the band. Also, try several FET's as Q1 for maximum sensitivity over the higher SW frequencies. ■

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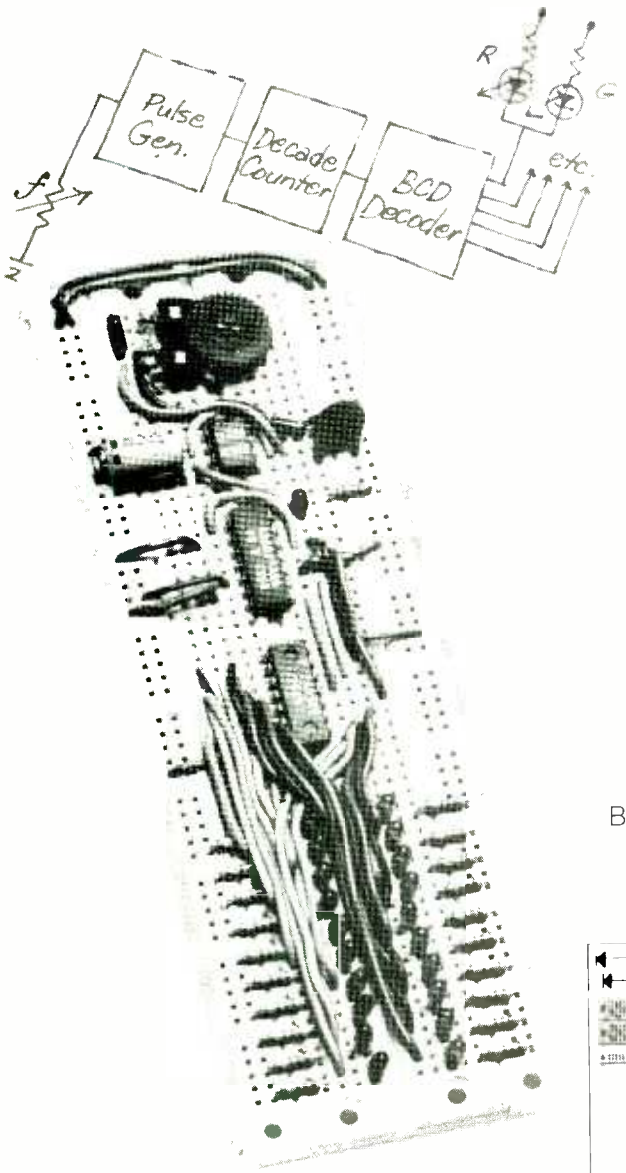

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	QT-35B	4.1	3.8	12	2.00
.7"	QT-18S	2.4	2.1	36	4.75
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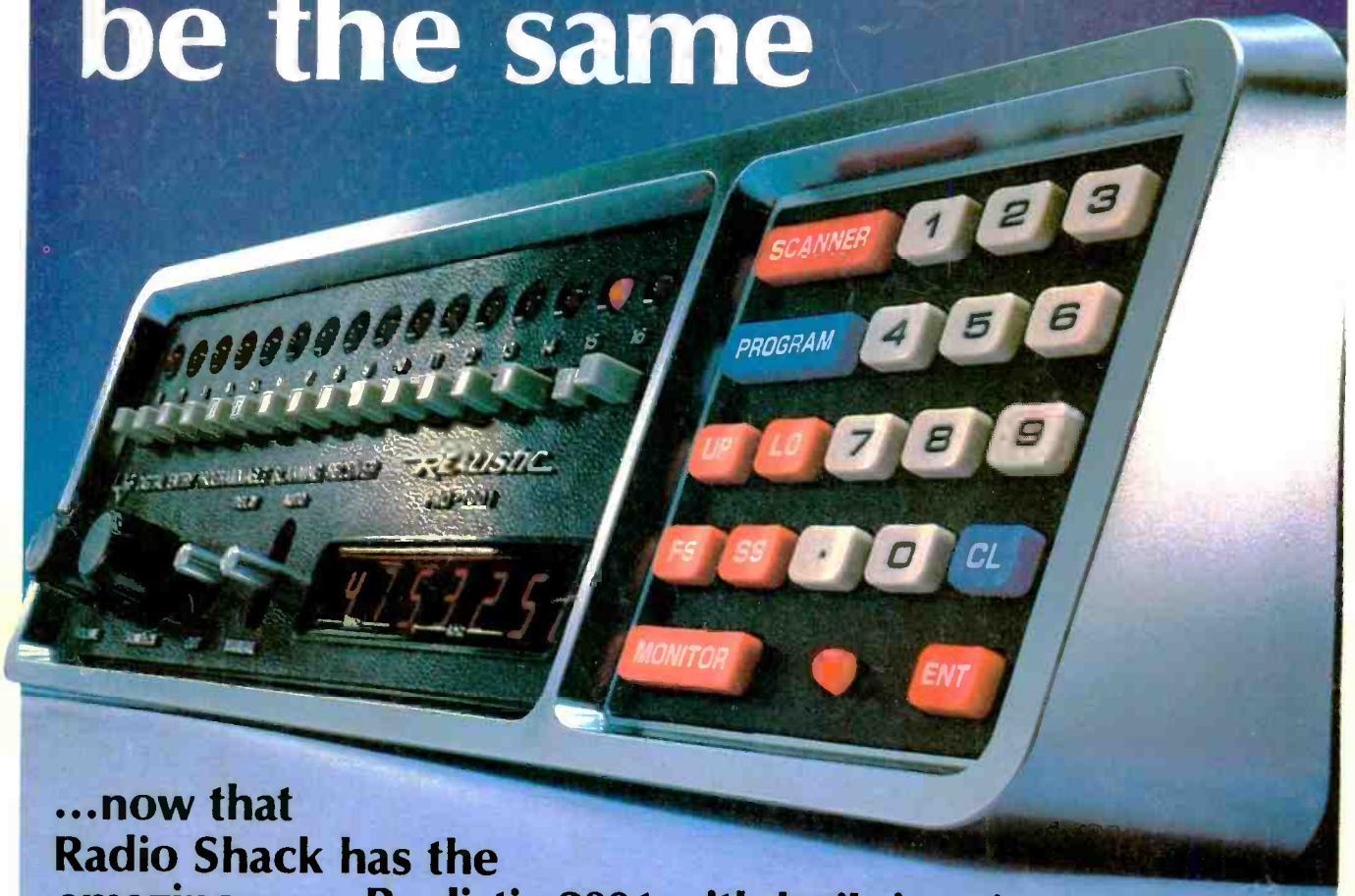

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