elementary Electronics

SEPTEMBER-OCTOBER 1980
UK 95p
$1.35
IN CANADA $1.50

Including-
Science & Electronics

INFLATION-BUSTING TECHNOLOGY

- Metal Detector makes your fortune
- Energy Sentry checks power savings
- Darkroom Contrast Meter cuts paper losses

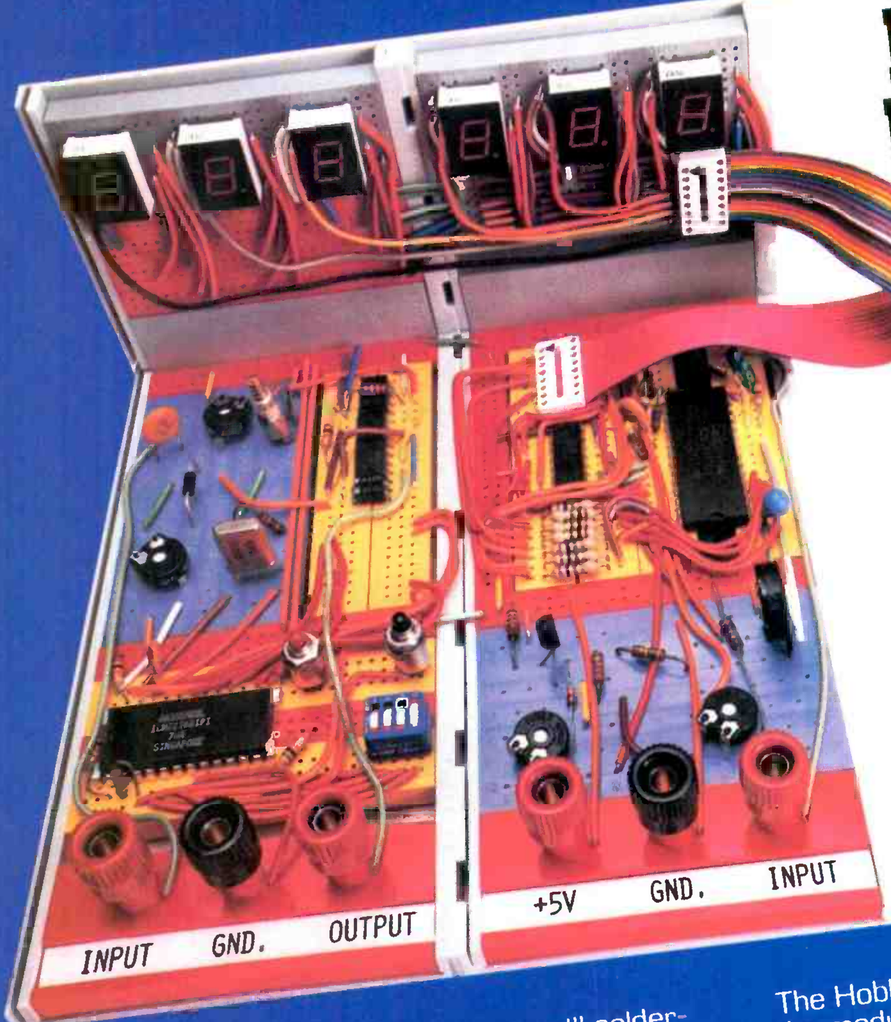
...CEPTS IN ...ECTRONICS

✓ R... omputer Thermostat
— ... microprocessor
e...

✓ A... be Digitizer
— ...rcuitry aids
c... ing

A DAVIS PUBLICATION

INTRODUCING HOBBY-BLOX™



The new modular circuit building system designed especially for electronic hobbyists.

Until now, you had to buy "professional" solderless breadboards for your projects and pay "professional" prices. Now there's Hobby-Blox,™ a totally new circuit-building system that's not only economically priced but offers many more advantages to the hobbyist.

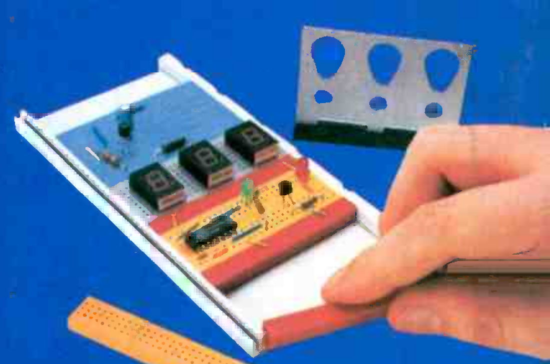
At the core of the system are two expandable starter packs (priced under $7.00), one for discrete component projects, the other for integrated circuit projects. Each comes with a number of Hobby-Blox modules that fit into a tray and an illustrated project booklet. In addition, the system includes 14 separate component packs you can purchase individually — terminal, distribution and bus strips, speaker panels, binding posts, etc. — priced from $1.29 to $3.59.

The Hobby-Blox system is easy to use because the modules are color-keyed and letter/number indexed. It's time-saving, because they're solderless. It's compatible with DIP's of all sizes and a wide variety of discrete components. And you save money, because the parts can be reused again and again.

How far can you go with the Hobby-Blox system? Take a look at the example above. Then you'll know why we say, "your only limit is your own imagination!"

For a free catalog and the name of your nearest Hobby-Blox dealer call toll-free (800) 321-9668.

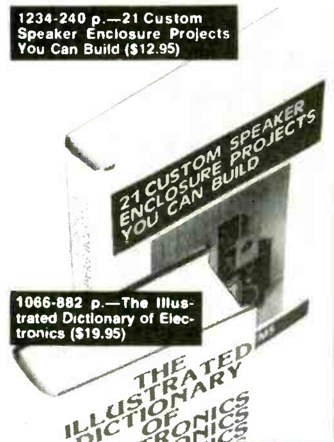
Patents Pending
© A P PRODUCTS INCORPORATED 1980
Prices shown are current suggested U.S. resale.



A P PRODUCTS INCORPORATED
1359 West Jackson Street
Painesville, Ohio 44077
(216) 354-2101

In Europe, contact A P PRODUCTS GmbH
Baeumlesweg 21 • D-7031 Weil 1 • W. Germany

CIRCLE 16 ON READER SERVICE COUPON



An Extraordinary Offer to introduce you to the benefits of Membership in

ELECTRONICS BOOK CLUB

take any **6** of these 24 unique electronics books (values to $105.70) for only **$2.95** for ALL SIX

with a Trial Membership in the Book Club that guarantees to save you 25% to 75% on a wide selection of electronics books

Facts About Club Membership

- The 6 introductory books of your choice carry publisher's retail prices of up to $105.70. They are yours for only $2.95 for all 6 (plus postage/handling) with your Trial Membership.
- You will receive the **Club News**, describing the current Selections, Alternates, and other books, every 4 weeks (13x a year).
- If you want the Selection, do nothing; it will be sent to you automatically. If you do not wish to receive the Selection, or if you want to order one of the many Alternates offered, you simply give instructions on the reply form (and in the envelope) provided, and return it to us by the date specified. This date allows you at least 10 days in which to return the form. If, because of late mail delivery, you do not have 10 days to make a decision and so receive an unwanted Selection, you may return it at Club expense.
- To complete your Trial Membership, you need buy only four additional monthly Selections or Alternates during the next 12 months. You may cancel your Membership any time after you purchase these four books.
- All books — including the Introductory Offer — are fully returnable after 10 days if you're not completely satisfied.
- All books are offered at low Member prices, plus a small postage and handling charge.
- **Continuing Bonus**: If you continue after this Trial Membership, you will earn a Dividend Certificate for every book you purchase. Three Certificates plus payment of the nominal sum of $1.99 will entitle you to a valuable Book Dividend of your choice which you may choose from a list provided Members.

May we send you your choice of 6 of these practical time-and-money-saving books as part of an unusual offer of a Trial Membership in Electronics Book Club?

Here are quality hardbound volumes, each especially designed to help you increase your know-how, earning power, and enjoyment of electronics. Whatever your interest in electronics, you'll find Electronics Book Club offers practical, quality books that you can put to immediate use and benefit.

This extraordinary offer is intended to prove to you through your own experience, that these very real advantages can be yours... that it *is* possible to keep up with the literature published in your areas of interest, and to save substantially while so doing. As part of your Trial Membership, you need purchase as few as four books during the coming 12 months. You would probably buy at least this many anyway, without the substantial savings offered through Club Membership.

To start your Membership on these attractive terms, simply fill out and mail the coupon today. You will receive the 6 books of your choice for 10-day inspection. YOU NEED SEND NO MONEY. If you're not delighted, return the books within 10 days and your Trial Membership will be cancelled without cost or obligation.

ELECTRONICS BOOK CLUB, Blue Ridge Summit, Pa. 17214

CIRCLE 4 ON READER SERVICE COUPON

ELECTRONICS BOOK CLUB

Blue Ridge Summit, Pa. 17214

Please open my Trial Membership in ELECTRONICS BOOK CLUB and send me the 6 books circled below. I understand the cost of the books I have selected is only $2.95 for all 6, plus a small shipping charge. If not delighted, I may return the books within 10 days and owe nothing, and have my Trial Membership cancelled. I agree to purchase at least four additional books during the next 12 months after which I may cancel my membership at any time.

800 806 861 887 971 1006 1059 1066
1097 1113 1119 1136 1146 1167 1168 1169
1196 1199 1212 1222 1225 1234 1255 8224

Name ________________ Phone ________

Address ________________

City ________________

State ________________ Zip ________

(Valid for new Members only. Foreign and Canada add 15%.) EE-980

elementary Electronics

September/October 1980
Volume 20, No. 5

Science & Electronics

SOLVING THE ENERGY DILEMMA

28 Solar Ponds—*tapping the power locked up in the sea*
☆ 37 Energy Sentry—*simple, accurate circuit measures appliance power consumption*
☆ 51 Installing the RapidCircuit RC-6000 Electronic Thermostat—*microprocessor answer to saving energy in home heating and cooling*

BUILD UP YOUR TEST EQUIPMENT KNOW-HOW

32 Hobbyist's Test Bench—*take this short-cut to setting-up an electronics hobbyist test bench*
59 Oscar, the Audio Generator—*easy way to a high-quality audio generator using a unique optical coupler*
73 Binary/BCD Tester—*converts raw binary data into seven digit display*

KEEPING TRACK OF COMMUNICATIONS

36 Swiss Radio International—*listen in to the land of the cuckoo clock*
43 Radio Direction Finding—*the A to Z of this esoteric radio skill*
56 Keeping a Shortwave News Log—*some of the most objective, as well as the most slanted news comes from SW broadcasters—and here's how to keep a record of it*
77 Electronics Notebook—*learning how radio transmitters work*

CASH-SAVING CONSTRUCTION PROJECTS

☆ 25 Houndog—*with this easy-to-build metal detector, you'll find the fortune that lays just beneath the surface*
47 Low-Cost Aircraft Receiver Conversion—*any old FM portable will do*
☆ 53 Darkroom Contrast Meter—*let this project make all your darkroom paper grade decisions for you*

PROFILES ON NEW COMPUTER GEAR

☆ 62 Checking out the . . . Alphanetics Tape Digitizer—*converting cassette stored programs into digitized data makes TRS-80 loading much surer*
70 Simply Basic—*appointments calender program will put your life in order*
75 Checking out the . . . Heath H17 Floppy Disk Drive—*solidly-built unit works perfectly with the H8 microcomputer*

ANTIQUE RADIO ASPECTS

67 Restoring Antique Radio Phonographs—*this popular combination from the past can still provide a lot of fun if you treat the equipment right*
71 Antique Radio Corner—*how to avoid old-time shocks*

LOOKING AT THE CB FUTURE

58 CB Spectrum—*working over President's extra-tough entry into the CB field*
63 CB at 900 MHz—*there's a lot of space up there for CBers, so get ready*
☆ 76 Using General Electric's New HELP!—*everything you need for emergency operation in one neat, self-contained package*

REGULAR DEPARTMENTS

8 New Products Parade—*look over the newest in the field of electronics equipment*
12 Science News—*we'll be watching for the latest in research and development in this fast-moving column*
16 DX Central—*Don Jensen, our DX King, takes us on a tour of the exotic world of shortwave listening*
23 Cover to Cover—*here's some electronic reading that'll keep your eyes glued to the page*
42 Mini-Feature—*a Personal Electronic Alarm System*
90 Input/Output—*Hank Scott answers your letters with his usual know-how*

☆ Cover Stories

Audited Paid Circulation ABC   MPA

AUTHORS IN THIS ISSUE

Anthony Caristi, James Fred, Herb Friedman, Larry Friedman, Robert Grove, Leslie Huggard, Don Jensen, David Leithauser, Les Lewyn, Paul Margolis, Kathi Martin, Roger Peterson, Brian Rogers, Leo Sands, Hank Scott.

Cover Photo by Ray Solowinski

THE STAFF

Associate Publisher & Editor-in-Chief
Julian S. Martin, KA2GUN

Editor
Alan H. Rose, K2RHK

Associate Editors
Paul Margolis
Joe Dubovy, W2TCC

Citizens Band Editor
Kathi Martin, KGK3916

Workbench Editor
Hank Scott

Art Director
Ralph Rubino

Associate Art Director
David Pindar

Assistant Art Director
Celeste Barbera

Cover Art Director
Irving Bernstein

Art Editor
Delia Nobbs

Art Assistant
Ron Kuliner

Production Director
Carl Bartee

Production Manager
Carole Dixon

Production Assistant
Annette Simon

Newsstand Circulation Director
Don Gabree

Classified Advertising Director
Rose Wayner

Subscription Circulation Director
Robert V. Enlow

Subscription Circulation Manager
Eugene S. Slawson

Marketing Director
James C. Weakley

President and Publisher
Joel Davis

Vice President and General Manager
Leonard F. Pinto

Vice President and Treasurer
Victor C. Stabile, KBP0681

Vice President; Marketing—Editorial
Carole Dolph Gross

ISSN: 0013-595X

ELEMENTARY ELECTRONICS / SCIENCE AND ELECTRONICS is published bi-monthly by Davis Publications, Inc. Editorial and Executive offices: 380 Lexington Ave., New York, NY 10017; all subscription orders and mail regarding subscriptions should be sent to P.O. Box 2630, Greenwich, CT 06835. In U.S.A. and possessions, one-year subscription (six issues) $6.95; two-year subscription (12 issues) $12.95; three years (18 issues) $18.95; and four years $23.95. Elsewhere, add $1.00 postage for each year. For change of address, please advise 6 to 8 weeks before moving. Send us your current mailing label with new address. Advertising offices: East Coast; 380 Lexington Ave., New York, N.Y. 10017, 212-557-9100; Midwest; 360 N. Michigan, Suite 1022, Chicago, IL 60601, 312-527-0330; West Coast; J. E. Publishers' Rep. Co., 8732 Sunset Blvd., Los Angeles, CA 90069, 213-659-3810. Controlled Circulation. Postage paid at New York, New York, and Sparta, Illinois.

LETTER FROM THE EDITOR

To Our Readers:

Everything changes. And those of you who enjoy electronics as a hobby, or make your living in it, know that nothing is changing as fast as electronic technology. Since ELEMENTARY ELECTRONICS began in 1963, we have seen the transistor multiply in applications, and plummet in price. Integrated circuits have become plentiful and cheap, and microprocessor devices -- not to mention computers -- are now available for all kinds of service.

You, the reader have been changing too. Whereas in 1963 you were challenged by relatively simple transistor projects -- radio receivers, burglar alarms, etc. -- now many of you are at home in the esoteric world of microcomputers, use the most sophisticated communications equipment, and build projects that make high-powered engineers sit up and take notice.

Of course, as conditions changed we changed. As it became feasible to include more complicated circuits in our construction projects, we published them. We were tentative at first, because we weren't positive that you wanted the new projects. But when we saw that you liked and built the ones we published, and wanted more, we really went to town. Now we do some of the most sophisticated construction projects around, and we're constantly looking for even more advanced ones.

The same thing is true in our computer, energy and communications coverage. You are involved with microcomputers extensively, so we are now, too. You can program, hook up the many accessories that are available -- and get them working -- so we can cover them and much more. In other words, now we can do the far-reaching computer coverage that you want. Energy conservation devices, communications equipment -- it works out the same. The more advanced the equipment became, and the more our readership developed in capabilities, the more possible it has been for us to provide the complex coverage we've always wanted to offer you.

Now it's time to make the final change. The industry is ready for it. You, our readers, are ready for it. None of us are "elementary" about our electronics any more. So why not stop calling ourselves "elementary"? Well, we have stopped. From now on, we'll be SCIENCE & ELECTRONICS. As SCIENCE & ELECTRONICS, we'll be doing even more interesting and innovative construction projects, more about the exciting advances in home computers and communications, more practical ways to save energy. And you'll be seeing more about how things work, and the ways in which science is making what once seemed a far-off future rapidly become the very real present. All in all, SCIENCE & ELECTRONICS will give you the best of both worlds. So get set for the electronics action of the 80s, because you're going to see it all in SCIENCE & ELECTRONICS

Sincerely, Alan Rose

Alan Rose, Editor

At CIE, you get electronics career training from specialists.

If you're interested in learning how to fix air conditioners, service cars or install heating systems — talk to some other school. But if you're serious about electronics, come to CIE — The Electronics Specialists.

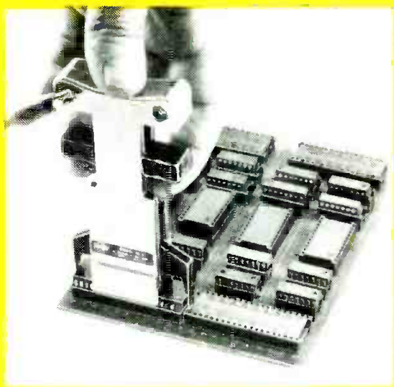
Special Projects Director
Cleveland Institute of Electronics

NEW PRODUCTS PARADE

SHOWCASE OF NEW PRODUCTS

Safe 28-40 Pin DIP Puller

A new 28-40 pin IC extractor, Model EX-2, from O.K. Machine and Tool extracts ICs having standard .600-in. body widths, including MOS and CMOS devices. Unique mechanism is self-adjusting, and gently lifts the IC from its socket or board using uniform pressure applied simultaneously at both ends of the IC. Designed for easy one-hand operation, the EX-2 features heavy chrome plating for reliable static dissipation, as well as a terminal lug for attaching a ground strip. The EX-2 is priced at only $7.95, and is available

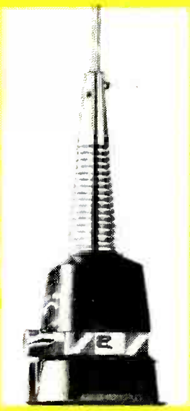


CIRCLE 33 ON READER SERVICE COUPON

through local electronics retailers or directly from O.K. Machine and Tool Corporation, 3455 Conner Street, Bronx, New York 10475.

New Scorpion Antenna

Antenna Specialists' new Super Scorpion base-loaded CB mobile antenna is said to increase radiator efficiency by more than 33% over conventional antennas. The performance gain is due in part to its full 60-in. tapered whip. Made of high-resiliency stainless steel, the whip bends full circle and snaps back perfectly, creates less surface to air resistance, and resists pitting and corrosion. It is factory tuned across all 40 channels. The high impact Lexan base mounts on a trunk lip or roof using Antenna Specialists' Leverlok—an electrical/mechanical connection that instantly disconnects by twist-



CIRCLE 34 ON READER SERVICE COUPON

ing a lever. The Super Scorpion's coil is precision wound of 12-gauge enamel-coated copper wire for maximum efficiency. Damage hazards like branches, garage doors, etc., are greatly reduced by a stainless steel shock absorbing spring. For temporary installations, a companion to the Super Scorpion, the MR678 Scorpion antenna, is also available. This unit features a heavy duty magnet mount that holds firm at highway speeds. The suggested retail price of the Super Scorpion model is $39.95; and the MR678 Scorpion, $34.50. Complete details are available from A/S antenna dealers or by writing to The Antenna Specialists Co., 12435 Euclid Ave., Cleveland, OH 44106.

Darkroom Timer

A new microprocessor-controlled darkroom timer kit, the Heathkit PT-1500, incorporates several new features. The PT-1500's programmable memory can hold times for up to nine processing steps and an enlarger step. Autostep sequencing loads the timer, so the user can be ready to proceed to the next step. The enlarger and safelight outlets are designed so one goes on when the other goes off. And if the optional PTA-1500-3 Auxiliary Outlet accessory is used to connect the timer to an external device (such as a color drum), the PT-1500 turns on the Auxiliary Outlet during countdowns in the processing mode. A four-digit LED display times to 99 minutes, 59 seconds or 999.9 seconds. A display switch turns off the LEDs and backlighting, without affecting countdowns or memory, when you need complete darkness. Four alarm settings mark time in 1, 30 or 60-second intervals, selectable in any combination, or once at the end. The Litetouch front panel is impervious to darkroom chemicals, and provides touch control of the PT-1500's functions. For more information on the PT-1500 Darkroom Timer Kit, mail order priced at $119.95, FOB Benton Harbor,

CIRCLE 1 ON READER SERVICE COUPON

MI, send for a free catalog to Heath Company, Department 350-120, Benton Harbor, MI 49022, or pick up a copy at the nearest Heathkit Electronics Center.

Scanner Multiband Antenna

A new tri-band monitor antenna, called the Avanti Astro Scan (AV-801), combines three antennas in one, with each antenna operating at peak potential. The Astro Scan monitors the entire range of HF, VHF and UHF signals, including the new "T" Band. State-of-the-art design on this new base antenna improves both gain and bandwidth over previous monitor antenna designs. Gives you fewer dead spots, longer ranges and clearer reception. With Astro Scan, you will also be able to pick up more on-the-scene mobile reports. The antenna is compatible with all old or new base scanners. The Astro Scan uses DC ground construction to cut static and noise. Unique co-

(Continued on page 10)

NEW PRODUCTS PARADE

(Continued from page 8)

inductive design eliminates troublesome coils, making it durable in extreme weather conditions, or in case of nearby lightning strikes. The Astro Scan also features compact aerodynamic construction—

CIRCLE 36 ON READER SERVICE COUPON

well balanced to reduce strain on the mast and rigging. Cryogenic aluminum used in the Astro Scan actually gains strength in colder weather, helping it to resist ice storms. Sells for $37.95. For more information, contact Avanti Research & Development, Inc., 340 Stewart Avenue, Addison, IL 60101.

Ultrasonic Cleaner

Heath Company of Benton Harbor, Michigan, the largest manufacturer of electronic kits in the world, announces the addition of an Ultrasonic Cleaner to its prod-

CIRCLE 1 ON READER SERVICE COUPON

uct line. The Heath GD-1151 Ultrasonic Cleaner deep-cleans watch parts, most jewelry, dentures and other delicate items that might otherwise be damaged by hard scrubbing, abrasives or harsh cleaning agents. It accepts any detergent or cleaning solution that is normally safe for the item to be cleaned. The GD-1151 will not interfere with radio or television reception. For more information on the GD-1151 Ultrasonic Cleaner, mail order priced at $89.95, write for a free catalog, with over 400 useful electronic kits, to Heath Company, Dept. 570-480, Benton Harbor, MI 49022, or pick up a copy at the nearest Heathkit Electronic Center.

Sound Package

The Omni-Sound Home and Auto Mini Speaker System from the Audiotex division of GC Electronics is compact in design—just 7½-in. high. Rated conservatively at 25 watts RMS, the Omni-Sound (Cat. No. 30-5121) has a 2-in. diameter, wide-dispersion tweeter, and 4-in. woofer. High-temperature voice coils in the tweeter and woofer dissipate heat, allowing the drivers to handle higher levels of power with less distortion. Frequency response is 55-20,000 Hz. The Omni-Sound includes a

CIRCLE 35 ON READER SERVICE COUPON

"multi-use" mounting bracket for positioning the speaker in any direction. The speaker is housed in a black die cast aluminum cabinet and features convenient push-button connection terminals. Suggested retail price of the Omni-Sound Speaker is $99.95 per pair. Available at Audiotex/GC Electronics dealers nationwide. For more information, write to GC Electronics, 400 So. Wyman St., Rockford, IL 61101.

Solid Sound

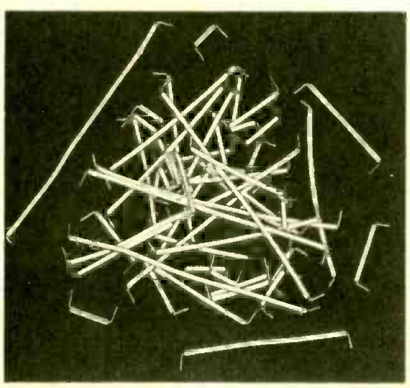
The new Realistic Optimus T-70 Speaker System from Radio Shack features an acoustically tuned labyrinth enclosure which reinforces bass response and provides higher efficiency. Rated at 75 watts continuous power, the speaker includes an 8-in. long-throw woofer and a high-efficiency soft dome tweeter. Frequency response is 55 to 20,000 Hz. Mitre-folded walnut veneer machined from a single panel is used to construct the T-70's cabinet, assuring continuity of grain pattern and color. The cabinets are hand-sanded and given a hand-rubbed oil finish. Size: 29¼-in. x 10¼-in.

CIRCLE 32 ON READER SERVICE COUPON

x 10⅞-in. The Realistic Optimus T-70 Speaker System, designed and manufactured by Radio Shack in Fort Worth, Texas, is available exclusively from participating Radio Shack stores and dealers in all 50 states and Canada. Priced at $129.95 each.

Jumper Wires

Here's a new kit which contains 20 AWG jumper wires that are precut and turned 90 degrees at both ends to allow easy insertion in breadboarding modules. Jumpers are Kynar insulated and pre-



CIRCLE 33 ON READER SERVICE COUPON

stripped .25-in. on each end. These jumper wires replace the tedious job of cutting, stripping and bending wires for interconnecting components in both solderless and soldered prototype or laboratory applications. These jumpers are offered 50 per package, in assorted lengths from ½-in. to 4-in. Jumper wire kit part no. RW-50 is priced at $2.95. In stock at local electronics dealers or directly from O.K. Machine and Tool Corporation, 3455 Conner Street, Bronx, New York 10475.

Computer Color Display System

Percom sells the Electric Crayon, a low-cost, computer-operated color graphics generator/controller. Designed to generate color displays on either a TV set or monitor, the Electric Crayon includes its own ROM operating system—EGOS—which accepts single-character commands directly from a parallel ASCII keyboard or program-generated commands from a computer. As shipped, the Electric Crayon interfaces with a TRS-80 computer, but it may be easily adapted to interface with any com-

CIRCLE 37 ON READER SERVICE COUPON

puter. The Electric Crayon has 10 display modes, including an alphanumeric-semigraphics mode, a second higher density semigraphics mode and eight graphics modes. Up to eight colors may be generated, depending on the mode selected. In the highest density mode, requiring a full complement of refresh memory, the display resolution is 256 picture elements by 192 picture elements. An internal character generator generates a full 64-character ASCII subset. The Electric Crayon with the EGOS operating system, 1K-byte of refresh memory (character store memory) and a comprehensive users manual which includes description and operating instructions, an assembly language listing of EGOS and listings of BASIC language demo programs sells for $249.95. Orders may be placed by calling Percom's toll-free order number: 1-800-527-1592. More information can be had by writing to Percom Data Company, 211 N. Kirby, Garland, TX 75042. ■

SCIENCE NEWS

ELECTRONICS IN THE NEWS

Audio Help for Blind Typists

An audio typing unit that can "speak" typed information was announced by the Office Products Division of IBM. The unit produces synsynthetic speech with an unlimited vocabulary, helping blind typists to independently produce error-free copy. Designed for use by blind typists, the Audio Typing Unit can be attached to any of four IBM magnetic media typewriters. It allows a blind typist to review and proofread material by hearing what has been typed or stored on the magnetic media. A blind operator will now be better able to edit and revise documents, producing error-free copy without the assistance of a sighted person.

Through the technology of voice synthesis, the IBM Audio Typing Unit produces sounds that correspond to the typewriter keys that the operator has touched. These audio responses are created by combining a stored set of basic speech sounds, called phonemes, in accordance with preprogrammed pronunciation rules stored in electronic memory circuits.

A blind typist uses the audio keypad (above), placed next to the typewriter, to operate the IBM Audio Typing Unit and to activate audio responses that include the pronounciation and spelling of individual characters, words or lines of text.

A voice synthesizer unit produces and blends the phoneme sounds to form continuous speech.

The IBM Audio Typing Unit consists of an audio key pad, an audio console and an optional headset, and can be attached to the IBM Mag Card II, IBM Mag Card/A, IBM Memory or IBM Memory 100 Typewriter.

A blind typist uses the audio keypad placed next to the typewriter to operate the IBM Audio Typing Unit and to activate audio responses that include the pronunciation and spelling of individual characters, words or lines of text. In addition, the IBM Audio Typing Unit verablizes punctuation and capitalization, provides audio prompts to guide the operator in the use of the host typewriter and gives audible indications of typing position on the page.

The blind will reap the immediate reward of this latest IBM innovation, but eventually sighted persons may prefer this system of audio feedback as an aid in reducing errors in typewritten copy.

All Steamed Up

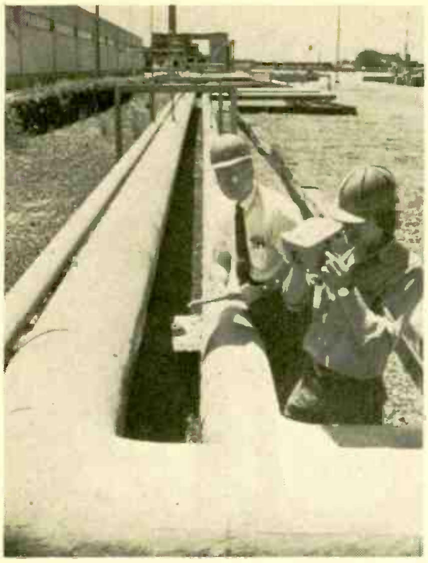
Western Electric's Kearny Works in New Jersey is one place that won't run out of steam, thanks to a new development in its energy-saving program. Engineers at the WE plant were getting pretty "steamed up" over energy losses that they suspected were coming from rooftops and buried steam lines throughout the facility. Since heat losses in these areas aren't readily detectable by maintenance people, the Kearny engineers knew they would have to take a different tack. So they took to the air.

More precisely, they commissioned an outside firm to conduct an aerial survey of the plant using an infrared scanner to determine the location of high temperature discharges.

During the aerial survey, the infrared data was recorded on magnetic tape and later compared with aerial photographs of the plant to show the location of the energy losses.

The result? The first thing learned was that excessive heat was being lost through the roof of one of the buildings. Based on this information and other economic factors, the roof was replaced and insulation added. It was estimated that this action will save over 50,000 gallons of fuel oil over the course of a year.

The survey pinpointed where energy losses were occurring throughout the facility. Kearny engineers



Notice any steam escaping? If there is any, Western Electric's Stanley Kielb (right) will detect it with the infra-red scanner he's using. Senior plant engineer Art Gardner (left) records suspected losses for investigation and repair.

were so pleased with the results of their aerial infra-red survey that they followed up by using a small infra-red scanner to further pinpoint sources of heat loss.

Called "Probeye," the highly sensitive, hand-held infra-red viewer is used by maintenance people to detect steam leaks inside the facility. It is based on the principle that all objects, living or otherwise, radiate infra-red energy according to their temperature. As the viewer scans a scene, it detects and converts the levels of such radiation to corresponding levels of visible light, thereby producing on the screen a display containing readily discernible temperature patterns of all of the objects in range.

Since the Kearny steam heating system usually remains fully operational at least seven months a year, several small steam leaks could represent a costly annual loss in fuel and money.

For example, it is estimated that 1,000 pounds of steam costs between three and four dollars. Using this figure, a small steam leak ½-inch in diameter under 90 pounds of pressure would cost almost $14,000 a year. Using the infra-red viewer on a regular basis greatly reduces the chances that one of these leaks would go undetected. By employing the most modern techniques in their energy conservation program, Western Electric's Kearny Works is assured of being one place that won't run out of steam.

Laser Freezes Fire

A new laser technique that gives detailed "snapshots" of what is happening in a chemical reaction on a time scale of a few *billionths* of a second has been developed by scientists at IBM. The technique may have far-reaching effects on the understanding of fast-acting chemical events such as combustion in automobile engines, key processes in petroleum refining and other high-temperature reactions.

The molecules and fragments of molecules in various energy states taking part in a chemical reaction can be identified by the frequencies of infrared light they absorb. This is a standard technique known as infrared spectroscopy. But in the past it has not been possible to record a complete infrared spectrum with a single short laser flash. This is exactly what the new IBM technique does. It involves two key innovations: the first is a method generating a flash of infrared light having a broad, uniform range of frequencies which serves as a probe. When this light is passed through the sample, the infrared absorption spectrum of the sample is imprinted on it.

What happens next is the second key step in the technique. The output infrared beam, with the imprinted spectrum, is focused into a chamber filled with potassium vapor. A precisely tuned beam of blue light from an organic dye laser is sent into the

Scientists study a series of spectra showing the progress of a chemical reaction in which the compound methyl isocyanide undergoes an explosive rearrangement of its molecular structure. A new laser technique permits these spectral "snapshots" to be made in a few nanoseconds, which is a lot faster than a Brownie!

chamber at the same time. The two beams of light interact with the potassium atoms in such a way that a large fraction of the energy of the blue light is added to that of the infrared, shifting its color into the visible spectrum range.

In this interaction, the spectrum of the infrared beam, which contains the information about the composition of the sample, is virtually unchanged in shape, even though its energy has been shifted into the visible region where it can be recorded on a photographic plate in a conventional spectrometer.

Thus a broad infrared spectrum can be recorded in one laser pulse of about five nanoseconds (billionths of a second) duration.

The new technique overcomes a major limitation of infrared spectroscopy, the fact that photographic emulsions are insensitive to light with a wavelength greater than one micrometer (1/25,000 inch). The infrared spectral region of greatest interest for identifying molecular species is 2 to 20 micrometers.

The IBM experiments so far have covered the region from about 2.5 to 3.7 micrometers, but the technique is believed to be extendable to most of the 2-20 micrometer range with the use of other metal vapors, such as cesium or rubidium.

Scientists soon plan to look inside a gasoline engine's cylinder to determine how gasoline really burns. Armed with this knowledge, engine designers and fuel chemists can work together to redesign the gasoline engine—thanks to electronics.

Musical Watch Chip

Music from a wristwatch is the latest concept in personal electronics. Implemented by OKI Semiconductor in the form of an integrated circuit, it will be available to digital watch makers during 1980. The new IC performs all the functions of a sophisticated chrono-alarm watch, while functioning as a music box on the wrist. The concept of generating a melody rather than simply emitting a series of beeps for the alarm function is unique.

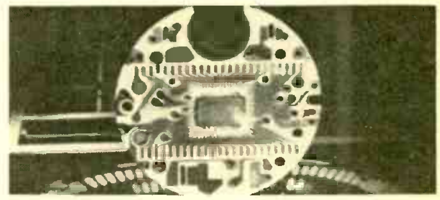
"This particular product heralds a new generation of communication," said Jerry Crowley, President of OKI. "It's the precursor of a speech product—a talking watch—which is essentially a data communicator on the wrist."

SCIENCE NEWS

"The design of this chip, the MSM-5016, is based on microprocessor architecture," he said. "It effectively compresses data in a small portion of memory, then brings that data out in an audio format."

Frequency generators activated by a relatively large read-only memory (ROM) on the chip produce musical pitches and durations. Depending upon the tempo selected, approximately one minute of melody can be programmed into the ROM. Tones can range in duration from sixty-fourth notes to dotted whole notes.

The MSM5016 is a low-threshold voltage, ion implanted metal-gate CMOS integrated circuit that provides all signals needed to drive an LCD watch with six digits, ten flags



The MSM5016, a melody alarm watch IC from OKI Semiconductor, generates a preprogrammed melody instead of a series of beeps operating in the alarm mode.

and two information segments. The circuit time base is a 32.768 kHz crystal-controlled oscillator. Oscillator RC network components are included on the circuit.

The time base frequency is counted down to provide *hours, minutes, seconds, date* and *day-of-the-week* information for two different time zones in the normal watch mode. For the stopwatch mode, a separate indication of hours, minutes and seconds is provided for six digits, and tenths of a second are made available for display on ten flags.

In the melody alarm mode, hours and minutes are displayed on four digits along with the characters AL on two digits.

The time display can be bonded to produce either a 12-hour or 24-hour format. For direct drive of the display, 51 phase controlled outputs are provided. The 32-kHz output serves as the backplane drive for the LCD display.

Power for the MSM5016 is derived from a single 1.35V to 1.65V battery. An on-chip voltage doubler is used to generate the display drive voltage. Fourteen special inputs are provided to facilitate testing of the watch functions and melody alarm. ■

DX CENTRAL REPORTING

A WORLD OF SWL INFO

BY DON JENSEN

The South Seas—maybe it was a travel poster, perhaps a TV travelogue, or possibly it was only in your mind's eye. But you have your image of the South Seas.

The vision: A palm-fringed, cloud-hung tropic isle, white sand, surf rolling whitely over a coral reef, a night with the twinkling points of light dotting the sky, a fragrant warm breeze, the throbbing of drums, the strum of ukeleles. . . .

It doesn't really matter if the fantasy picture is completely accurate. I'm willing to wager that most people have exotic mental pictures of the Pacific region similar to mine, even if we haven't really traveled west of Hoboken, Hamtramck or Hoquiam.

Exotic Oceania. And that's probably why, for shortwave listeners, there is a very special attraction in tuning the stations of Oceania.

Time may seem to stand still in paradise, but you do have to be aware of the time factor when you tune for the shortwave stations of the Pacific. The phrase, "half a day away" is literally true when we consider this region. That day may be today, but it could equally be tomorrow, for the International Date Line runs right through the middle of the Pacific Ocean.

DX listeners normally log stations received in terms of Greenwich Mean Time (GMT), also known as Universal Time. GMT is, of course, five hours ahead of Eastern Standard time, six hours ahead of CST, seven hours ahead of MST and eight hours in advance of PST.

New Zealand, for example, is exactly a half a day away from GMT. Time there is GMT+12 hours. If you live in Boston, and you're DXing at 5 a.m. EST on a Sunday morning, it is, of course, 1000 GMT, the standard time reference. That makes it 10 p.m. Sunday night in New Zealand.

On the French Pacific island of New Caledonia (GMT+11 hours) it is 9 p.m. Sunday. But in the Cook Islands, just east of the International Date Line, (GMT—11 hours), it is 11 p.m. *Saturday* night.

If you are tuning for Pacific area stations on the lower SW frequency bands, be prepared to lose some sleep. Lower frequency shortwave signals require a "path of darkness" along the route from station to receiver. In practice this means that, for shortwave stations operating below approximately 9,000 kHz, the best times for reception will be roughly between 0800 and 1500 GMT. Depending on where you live in North America, that's post-midnight to dawn your local time.

So let's look at some of the Pacific region stations that you can tune without a great deal of difficulty.

Radio New Zealand. New Zealand is a good place to begin the Pacific quest. Although this island country "down under" has a relatively modest shortwave operation—only a couple of 7.5-kilowatt shortwave transmitters—it is widely heard in North America.

A few years ago, Radio New Zealand nearly disappeared from shortwave because of a financial crunch. That seems to be resolved now; however, some cost-cutting steps have been taken. If you want a QSL card from them, for example, you must include with your reception report three International Reply Coupons available at your post office, to prepay the reply postage.

Most programs of Radio New Zealand are in English, but you may find the newscast in the Maori language at 0455 GMT an interesting listening experience.

During the evening hours, say 0400 to 0600 GMT, you can tune 15,345 or 17,860 kHz. During the wee hours, 0700 to 1030 GMT, try 6,105 kHz. Reports may be sent to Radio New Zealand, P.O. Box 2092, Wellington, New Zealand.

Papua New Guinea Calling. New Guinea, or at least the eastern half of

Devoted Ham and SWLer Lewis E. Parsell, Sr. tunes the world with his Panasonic RF-4900 receiver. He is shown in his ham shack.

that island, is the nation of Papua New Guinea. This emerging country has established a widespread network of radio stations to cover its sizable area and out-islands.

The SW DXer can tune in Papua New Guinea stations of the country's National Broadcasting Commission from such exotically-named places as Kimbe, Kundiawa, Goroka, Kavieng, Popondetta, Vanimo and others.

For starters, though, try the easier to hear National service station, a 10-kilowatt transmitter, on 4,890 kHz. Try this at about whatever time dawn comes to your locale. Most of their programming is in English.

Reception reports may be sent to the National Broadcasting Commission of Papua New Guinea, P.O. Box 1359, Boroko, Papua New Guinea.

Indonesia. The other half of New Guinea Island, and the chain of islands to the west of it, make up Indonesia. This country is one of the most active shortwave countries in the world. The government network has shortwave stations in nearly 50 Indonesian cities and towns. Then there are hundreds of other SW outlets, mostly operated by municipal and kabupaten (districts equivalent to U.S. counties) authorities. Most of the latter are very low powered, and are real challenges for the DXer.

For now, though, try the English language service of the Voice of Indonesia on 11,790 kHz at 1400 GMT. The station's address for confirming reception reports is P.O. Box 157, Jakarta, Indonesia.

Ici Tahiti . . . If you're willing to tune for stations that broadcast in French, rather than in English, consider two not so hard to hear stations on Tahiti and New Caledonia.

Tahiti—officially the station is known as France Region 3 (FR3)—is probably the favorite station of many SWLs because it epitomizes the exotic fantasy I mentioned earlier.

In French, the station at Papeete announces as, "Ici Tahiti . . ." (This is Tahiti). And, with the throbbing, seductive local music so often heard on this station, what more could you want to set the mood?

Best bet is probably 15,170 kHz between about 0300 and 0530 GMT. Reports go to Boite Postale 125, Papeete, Tahiti.

On New Caledonia, the station is Radio Noumea, and a nice signal often will be found on 7,170 kHz at around 0900 to 1000 or so GMT. Its address is Radio Noumea, Boite Postale G3, Noumea, New Caledonia.

Two to Shoot For. To wrap up this capsule view of some of the shortwave voices of the Pacific area, two of the more difficult targets are the Solomon Islands Broadcasting Service and Radio Cook Islands.

The former, while not the easiest log, is probably just tough enough—if you have a reasonably sensitive shortwave receiver with frequency readout accurate enough to permit you to know to a rather high degree of certainty the frequency to which you're listening—to make you feel you've accomplished something when you hear it.

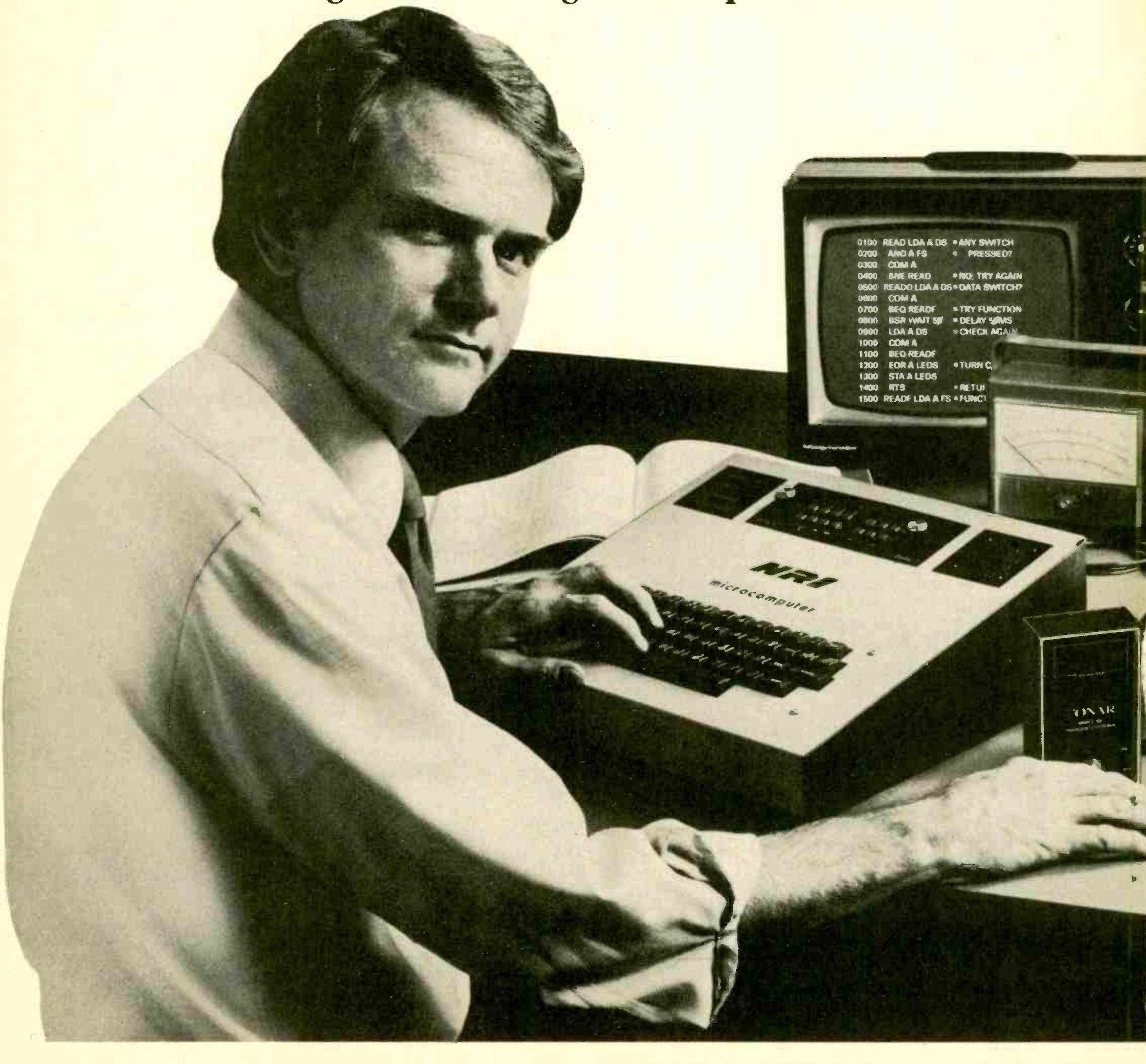
Look for this one between midnight and dawn your local time. For instance, try for SIBS on 9,545 kHz around 0700 or 0800 GMT. Another frequency to try is 5,020 kHz.

Radio Cook Islands, at Rarotonga is not an easy station to hear. But there are quite a few North American DX listeners who have both heard this one and obtained its attractive QSL card.

So, if you want to give it a try—and many tries probably will be needed before you hear it—tune during the same period on 5,045 kHz. ■

Microcomputers are here! Get in on the ground floor with NRI's new "at home" training in computer technology.

Only NRI Gives You "Hands-on" Experience as You Build Your Own Designed-for-learning Microcomputer



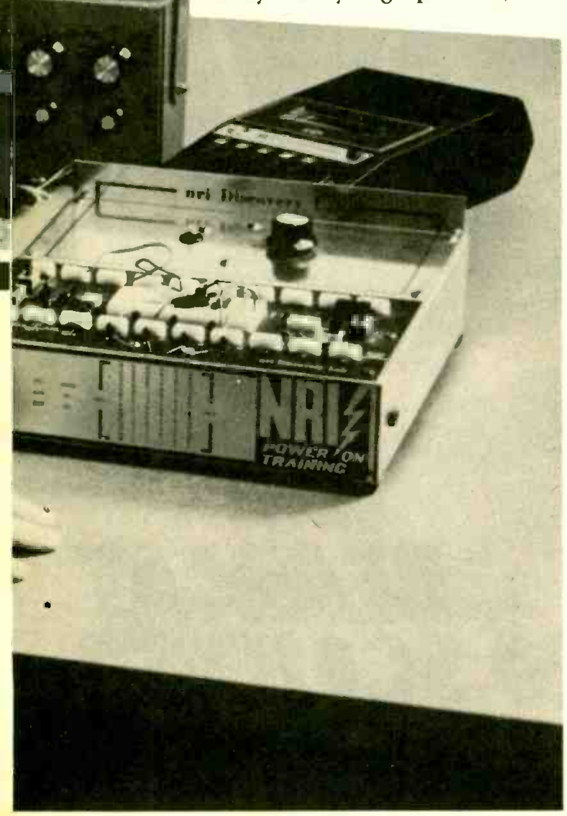
The microprocessor, that amazing little chip which shrinks electronic circuitry to microscopic size, has changed the world of the computer with dramatic speed. Now, big-performance computers are here in compact sizes...priced to make them practical for thousands of medium and small businesses, even homeowners and hobbyists.

Microcomputers are already being put to work on jobs like inventory control, payrolls, cost analysis, billing, and more. In homes, they're able to handle budgets and tax records, control environmental systems, index recipes, even play sophisticated games. And hobbyists across the country are expanding the state of the art while developing their own programs.

Become a Part of This Incredible World ... Learn at Home in Your Spare Time

NRI can give you the background you need to get into this booming new field. Microcomputers require a new discipline, a broader viewpoint... the ability to think in both hardware and software terms. And NRI's new course in computer technology is geared to bridge the gap.

You get a firm foundation of digital theory while you get practical,



"hands-on" experience working with the NRI Discovery Lab®, assembling test instruments you keep, and even building your own fully functional microcomputer.

Best of all, you do it at your own convenience. You learn at home with clearly written, "bite-size" lessons that carry you through the course in logical progression. There's no need to go to night school or quit your job...you progress at the pace that's most comfortable to you, backed by your personal NRI instructor and individual counseling whenever you want it.

Assemble an Advanced Microcomputer with Exclusive Designed-for-Learning Features

Only NRI trains you with a microcomputer that's specifically designed to teach you important principles as you build it. This state-of-the-art unit performs every function of comparable commercial units, has capabilities well beyond many. But each step of construction provides specific training, reinforces theory to make it come alive. And once you've finished, your microcomputer is ready to go to work for you. Or you can even sell it commercially.

You also assemble professional test instruments for use in your training. You get your own CMOS digital frequency counter and transistorized volt-ohm meter to keep and use in diagnosing problems and servicing computers. Together with up-to-the-minute lessons and NRI's 60-plus years of home study experience, you get the most in training and value.

Other Courses in Today's Electronics

Even the servicing of home entertainment equipment has taken quantum jumps forward. NRI keeps you right up with the latest, with training in stereo, video tape and disc players, and the latest TVs. You even build your own 25" diagonal color TV, the only one complete with built-in digital clock, varactor tuning, and computer control that lets you program an entire evening's entertainment. In our complete communications course, you learn to service two-way radio, microwave transmitters, radar, AM and FM transmitters, CB radio, paging equipment, and more. And you build your own 2-meter transceiver or 40-channel CB while you learn.

Free 100-Page Catalog No Salesman Will Call

Send the postage-paid card today for your personal copy of the NRI electronics course catalog. It shows all the equipment, training kits, and complete lesson plans for these and many other courses. There's no obligation of any kind and no salesman will ever bother you. Find out how you can learn new skills, keep up with technology, advance your future with training for new opportunities. Get in on the ground floor now! If card has been removed, write to:

NRI McGraw-Hill

NRI Schools
McGraw-Hill Continuing Education Center
3939 Wisconsin Ave.
Washington, D.C. 20016

COVER TO COVER

YOUR ELECTRONIC BOOKSHELF

Antique Radio. For either collectors of old radios, or those who simply want to get an old-time radio back into working condition, *How To Repair Old-Time Radios* by Clayton Hallmark shows how to do it. With little technical knowledge of radio or electronics, but with the troubleshooting tips, testing methods and parts substitution data included, almost any-

Soft cover
252 pages
$7.95

Keep those old-timers going strong.

one can locate the cause of trouble, repair defective parts or find replacements for even obsolete tubes and other components. This is a factual, step-by-step, well-illustrated guide for either experienced or novice electronics buffs, and it explains all the ins and outs of a bygone technology. Throughout, the emphasis is practical, not theoretical, and geared to but a single purpose—getting an old radio set to work. There's also a handy guide to pinning down the cause of problems like weak and distorted reception, hum, whine, squeals, intermittent crackling and all the other troubles that seem to plague old-fashioned radio equipment. Published by Tab Books, Blue Ridge Summit, PA 17214. Circle No. 63 on the Reader Service Coupon.

Programmer's Manual. Here's an understandable guide to the BASIC subroutine, *The Most Popular Subroutines in BASIC* by Ken Tracton. It can be used on any floating point BASIC integrator or computer to avoid tedium, economize on computer time and make programs run faster. It's a practical handbook—not a theoretical manual—for both the professional and the hobbyist, and is designed to help a computerist integrate the subroutine into his programs in a variety of practical, time-saving ways. It includes the most

Soft cover
182 pages
$5.95

Streamline BASIC Computing.

useful and most often requested programs—all organized into one handy collection! Published by Tab Books, Blue Ridge Summit, PA 17214. Circle No. 63 on the Reader Service Coupon.

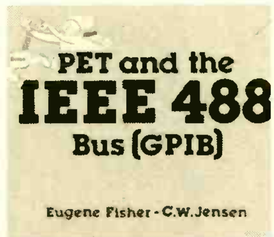
First in a Series. *Weekend Projects for the Radio Amateur, Volume 1* is written for the electronics hobbyist interested in constructing low-cost Amateur Radio equipment while investing a minimum of time. Volume 1 in a series, the book supplies the

Soft cover
60 pages
$3.50

Construction Projects for Hams.

builder with schematic diagrams and helpful suggestions for the construction of a preamplifier, noise blanker, transmatch, 160-meter converter, small transmitter, amplifier, external VFO, plus various test equipment and Amateur Radio accessories. All projects included can be completely assembled within hours, or a few days at the most. *Weekend Projects for the Radio Amateur* is available directly from the ARRL, 225 Main Street, Newington, CT 06111, or from local electronics dealers. Circle No. 61 on the Reader Service Couoon.

What's GPIB? The inexpensive PET microcomputer can be used in electronics laboratories with the standard IEEE 488 Bus to control test equipment. *PET and the IEEE 488 Bus (GPIB)* by Fisher and Jensen tells everything one needs to know about PET-GPIB interactions. The



Soft cover
233 pages
$15.00

Interface PET with GPIB.

book begins with a thorough description of the GPIB (General Purpose Interface Bus) and details GPIB lines and signals—a useful reference. A "recipe" book for PET-GPIB implementation in the lab. *PET and the IEEE Bus (GPIB)* is published by Osborne/McGraw Hill, 630 Bancroft Way, Berkeley, CA 94710. Circle No. 62 on the Reader Service Coupon. ■

ITEM NO.
WK-7

CMOS SAFE

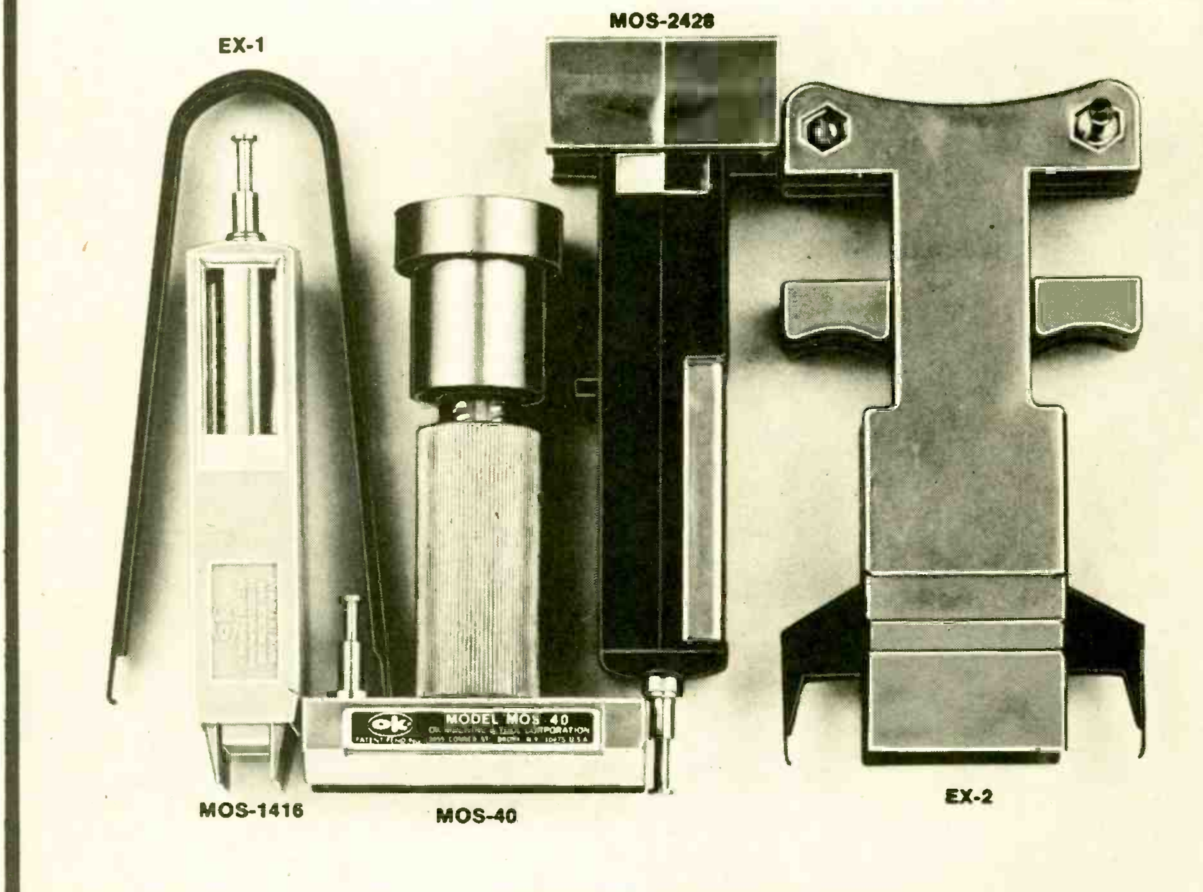
IC INSERTION/EXTRACTION KIT

KIT INCLUDES

- **MOS-1416** 14-16 CMOS SAFE INSERTER
- **MOS-2428** 24-28 CMOS SAFE INSERTER
- **MOS-40** 36-40 CMOS SAFE INSERTER
- **EX-1** 14-16 EXTRACTOR
- **EX-2** 24-40 CMOS SAFE EXTRACTOR

OK MACHINE & TOOL CORPORATION
3455 CONNER ST., BRONX, N.Y. 10475 U.S.A.
PHONE (212) 994-6600 TELEX NO 125091

PRINTED IN U.S.A. PATENT PENDING



WK-7	COMPLETE IC INSERTER/EXTRACTOR KIT	$29.95

INDIVIDUAL COMPONENTS

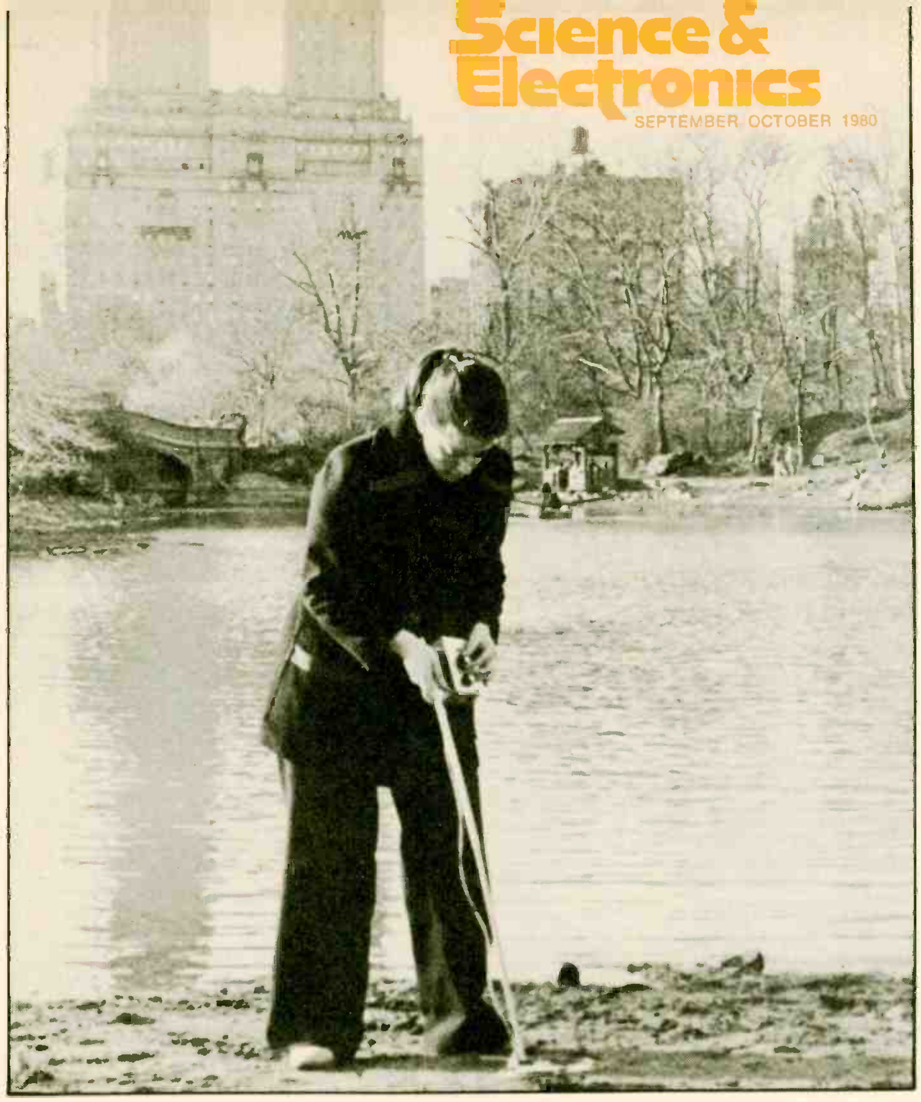
MOS-1416	14-16 PIN MOS CMOS SAFE INSERTER	$ 7.95
MOS-2428	24-28 PIN MOS CMOS SAFE INSERTER	$ 7.95
MOS-40	36-40 PIN MOS CMOS SAFE INSERTER	$ 7.95
EX-1	14-16 PIN EXTRACTOR TOOL	$ 1.49
EX-2	24-40 PIN CMOS SAFE EXTRACTOR TOOL	$ 7.95

MINIMUM BILLING $25.00. ADD SHIPPING CHARGE $2.00. NEW YORK RESIDENTS ADD APPLICABLE TAX.

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

CIRCLE 26 ON READER SERVICE COUPON

Science & Electronics
SEPTEMBER OCTOBER 1980



HOUNDOG

BY
LESLIE
HUGGARD

This electronic metal detector is a thoroughbred

ONE OF THE PROBLEMS with the hobby of treasure-hunting is that much more money has been spent on looking for it than the value of what might and has been found gives. One of the best ways to balance the books is to start out as inexpensively as possible, and that opportunity is provided by *Houndog*, a relatively simple and inexpensive metal detection device. *Houndog* can sniff out metal objects as small as a penny buried as deep as 3 to 5-inches, and will operate reliably for up to a year on one 9-volt transistor battery.

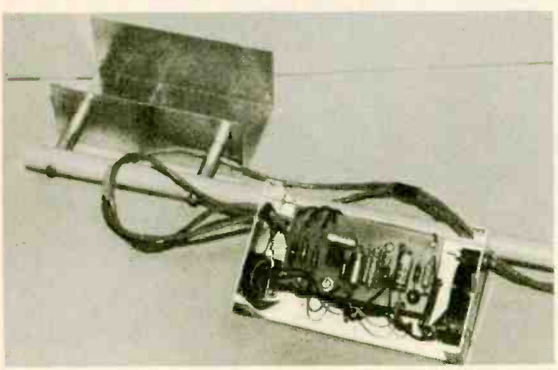
Operational Principle. *Houndog's* "nose" consists of three large inductance coils which, when placed in proximity with a conductive metal will exhibit a change in their total inductance value, the change being read by the circuitry and translated into an audible signal. In short, when *Houndog* "barks," it's time to start digging.

The Circuit. The heart of the circuit is U1, an audio amplifier, whose differential inputs are fed by a bridge circuit consisting of L1, L2, and R7, fed through R6A and R6B. U1's output is coupled to L3 by either C1 or C1 and C2, depending upon the setting of sensitivity switch S1. The placement of L1, L2 and L3 is such that the total field set up in L1 and L2 by current flowing in L3 is effectively zero. Therefore, the inputs to the amplifier are equal and opposite (zero), and it's output will be zero.

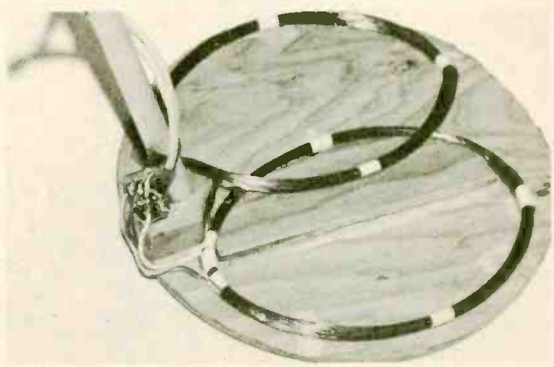
When a conductive metal enters the field, it changes the distribution to the effect that the field across L1 and L2 is no longer zero, and a voltage appears across the amplifier's inputs. The coil connections are such that when this condition exists, the positive input voltage is in phase with that of the output, and the circuit oscillates. The signal is fed to Q1, causing it to turn on, allowing current to flow to buzzer BZ1, creating *Houndog's* "bark."

Because the coils used in *Houndog* are designed to be hand-wound, and also due to the effects of stray capacitance and noise generated internally in the circuit itself, a feedback loop has been included (through R7) which will allow the user to keep *Houndog* from sounding off due to false signals caused by variations from the theoretically perfect zero field.

Construction. There are actually two steps involved in the assembly of the *Houndog;* wiring the PC board for the control circuitry, and the construction of the coils for the search head (which we'll discuss later). With the exception of C7, the potentiometers, the switches and BZ1, all components mount directly on the PC board, as indicated in the PC component layout guide. C7 is soldered directly to the terminals of S1, and the potentiometers and switches and the buzzer are mounted to the



This photo shows the circuit board mounted in the cabinet, and the method used for attaching the cabinet cover to the handle.



Closeup of the search head shows the position of coils L1/L2 and L3, and their respective overlaps as described in the text.

aluminum or plastic chassis. As always, pay careful attention to the polarities of the electrolytic capacitors during installation. Although not completely necessary, use of an IC socket for U1 is recommended.

The circled numbers appearing on the schematic and parts layout guide are for keying up the connections to the off-board components. It is not necessary for you to etch the numbers onto the PC board, so long as you refer to them during the final wiring stages.

To assist you in construction of the coils (L1, L2 and L3), we have provided a diagram of a coil form which may be cut from plywood. This, at the very least, will allow you to wind L1/L2 and L3 to the same basic dimension, which is about the only critical factor (outside of getting the number of turns of wire correct) in the construction of the search head.

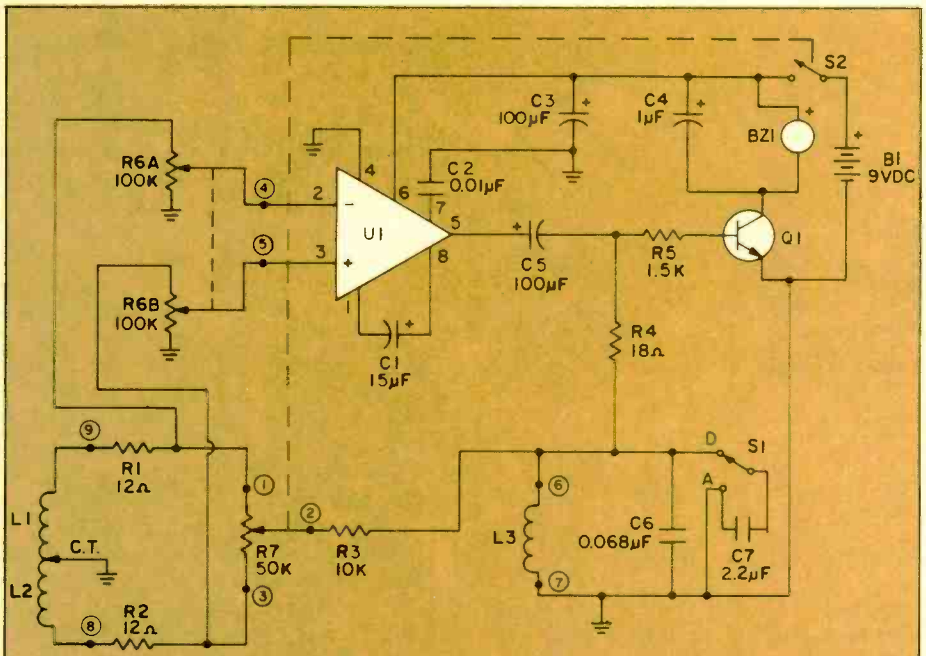
When winding L1/L2, rather than winding two sets of 30 turns each, we suggest that at turn 30 of L1, you scrape away a bit of the insulation and solder the ground tap in, wrap the solder junction with a small bit of tape, and then begin the next 30 turns for L2. This provides a stronger final assembly, and less of an alignment problem (you now need deal only with aligning two coils instead of three).

When the coils are completely wound, bind them with tape before removing them from the form. This will help to hold their shape until they are installed on the search head.

Final Assembly/Calibration. Before permanently attaching the coils to the plywood head, it is best to tack them down temporarily with either tape or rubber cement (for obvious reasons, no metal fasteners can be used now or during the final attachment).

Connect L1/L2 to the PC board with 2-conductor shielded wire, attaching the inner conductors to the outside ends of L1 and L2 (points 8 and 9), and using the braided shield for the center tap ground connection. The shield should be grounded to circuit ground on the PC board. Single conductor shielded wire is used for the connection of L3 to the circuit, with the braided shield used for the grounded side of the coil. Solder the braid to circuit ground on the PC board as you did for L1/L2.

Set R6A/R6B to a two-thirds clockwise position, and set R7 to its midpoint. When you throw power switch S2 on, the buzzer should *not* sound. If it does, reverse the L3 connections at the coil end and try again. Slowly reduce the amount of overlap between the two coils until the buzzer sounds. At this point, backing off counter-clockwise on R6A/R6B should cause the buzzer to silence. If this is the case, carefully mark the position of the two coils, and prepare to attach them permanently to the search head.

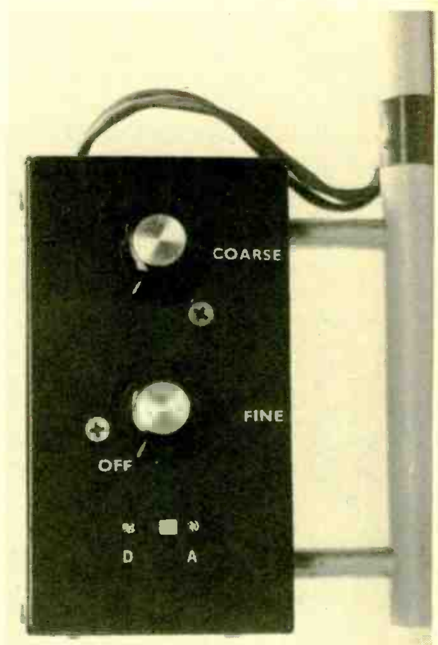


PARTS LIST FOR HOUNDOG

B1—9-VDC transistor battery
BZ1—piezoelectric buzzer (Radio Shack #273-060)
C1—15-uF, 15-VDC electrolytic capacitor
C2—0.01-uF, 50-VDC ceramic capacitor
C3, C5—100-uF, 35-VDC electrolytic capacitor
C4—1-uF, 35-VDC electrolytic capacitor
C6—0.068-uF, 25-VDC mylar capacitor
C7—2.2-uF, 35-VDC non-polarized electrolytic capacitor
L1, L2—30 turns of #20 enameled copper wire see text
L3—60 turns of #20 enameled copper wire
Q1—2N5210 NPN low-level transistor
R1, R2—12-ohm, ½-watt resistor, 10%
R3—10,000-ohm, ½-watt resistor, 10%
R4—18-ohm, ½-watt resistor, 10%
R5—1,500-ohm, ½-watt resistor, 10%
R6A/R6B—dual-section 100,000-ohm linear-taper potentiometer
R7—50,000-ohm linear- taper potentiometer with SPST switch (S2)
S1—SPDT slide switch
S2—SPST rotary switch (part of R7)
U1—LM386 audio amp integrated circuit

Misc.—battery clip, aluminum chassis, hookup wire, solder, spacers, knobs, 100-foot roll of #20 enameled copper wire, weatherproofing finisher (varnish, shellac, polyurethane, etc.), non-metallic support rod, 10-feet of 2-conductor shielded wire, 10-feet of 1-conductor shielded wire, ¼-inch plywood stock, etc.

A complete parts kit for Houndog including pre-etched PC board and all components (but less case) is available from Niccum Electronics, Rte. 3, Box 271B, Stroud, OK 74079. Price for the complete kit is $24.50; a pre-etched and labeled PC board only is $5.50. No CODs, Please.



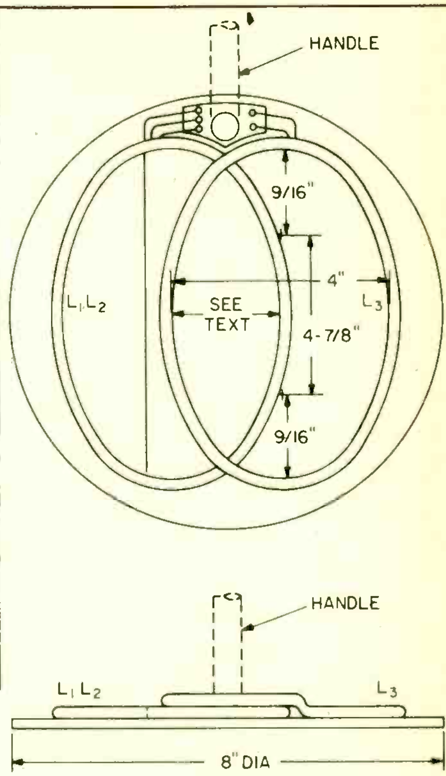
Houndog's control head is laid out simply; there's an SPDT switch and two adjustments.

As a final test, return R6A/R6B to the two-thirds position, set R7 just below the point where the buzzer sounds, and S1 to the "discriminate" position. Bring a penny directly above the coils' overlap, and lower it to a height of about 3-inches above the coils. If the buzzer does not sound, try re-peaking R6A/R6B and R7 for a lower threshold (increase R6A/R6B more clockwise, while backing off more on R7 to stop oscillation) and repeat the procedure. Three inches should be the minimum distance at which *Houndog* detects the presence of the penny.

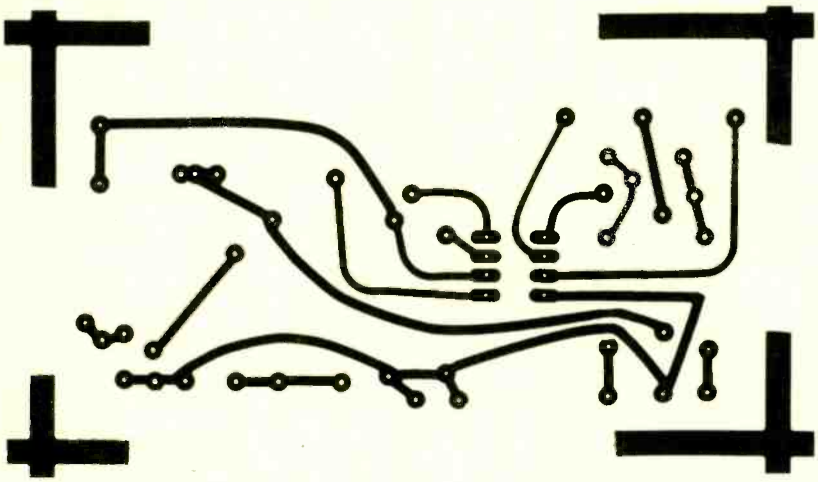
Remember that when conducting these tests, you should be in an area free from the presence of large metallic objects, such as radiators, pipes and ducts, etc. Their presence may cause you to set the sensitivity of R6A/R6B too low, making actual measurements against coins ineffective to the point of believing that the unit is not working.

You may now attach the coils to the head in a permanent manner with epoxy or several coats of polyurethane or shellac, in order to affix the coils firmly and make the assembly weatherproof.

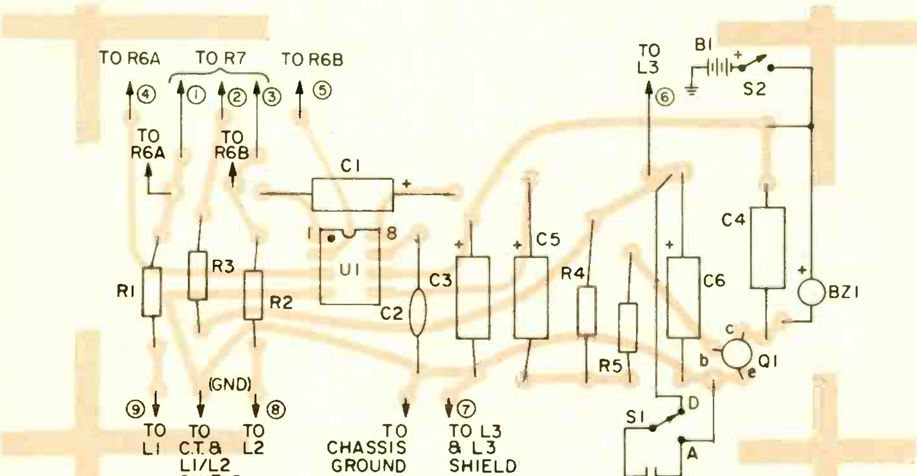
Conclusion. Once you get out of doors with *Houndog*, it might be wise to bury some treasure of your own, and adjust the controls for maximum sensitivity depending upon the type of soil found in your locality. These adjustments will vary from area to area, depending upon soil composition, which is why we haven't used a calibrated dial for the potentiometers. Don't be discouraged if your first few hours of searching with S1 set to the "discriminate" (coins) position don't unearth Captain Kidd's treasure chest. With S1 set in the "all" position, you'll get a lot more "barks," but you might find a lot of tin cans and beer can pull-tops for your efforts. Patience is a virtue in this hobby. ■



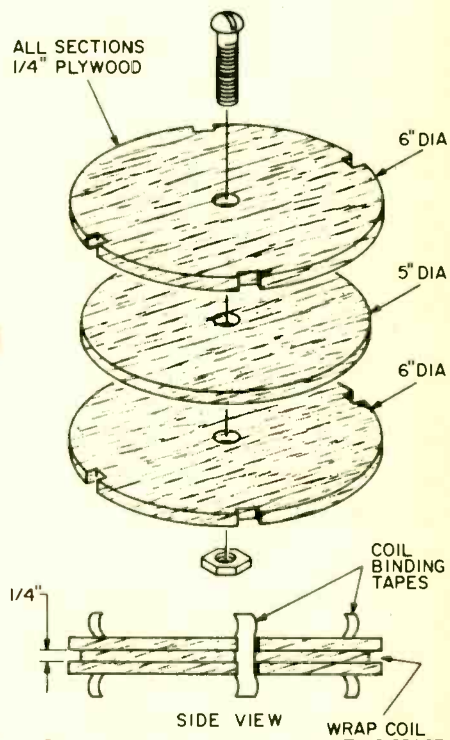
The dimensioning guide for the search head shows you how to bend round coils into the elliptical shape necessary for installation on the search head plywood base.



Here is the full scale etching guide for Houndog's PC board. If you purchase a Niccum PC board, the layout may differ slightly. Follow their assembly instructions for it.



The component layout guide gives you the connections for the off-board components. If you use another method of assembly, rest assured that parts layout isn't critical.

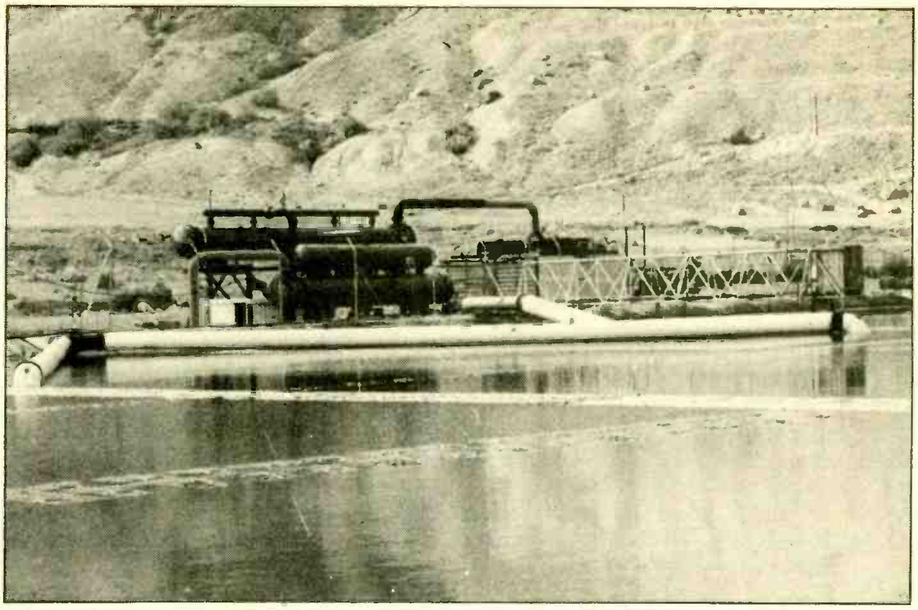


Use this template for winding the coils. The finished coils will be circular, and you will have to bend them into an oval, as seen in the diagram above, to fit them.

The Solar Power Station

Israel's innovative solar pond system generates electricity from sunlight

BY PAUL MARGOLIS



Courtesy Israel Development Authority and Ormat Turbines Ltd.

BY THE EARLY 1990's, Israel expects to meet much of its electricity needs with solar generated power. An all solar powered 150 kilowatt generating plant was put into service in late 1979, and more ambitious projects are slated for the future.

The Ein Bokek project, located on the shores of the Dead Sea, makes use of the concept of the solar pond—a body of water whose salt content is such that the water in its depths rises to high temperatures—and a turbogenerator powered by this heat energy. The combination of these two relatively simple and low cost technologies has made possible an innovative approach to electricity production. This large scale application of solar technology is the first of its type.

Solar Priorities. The Israeli government was understandably interested in giving a high priority to the development of solar energy. Continuing hostility from the oil-producing Arab countries dictated energy conservation long before it became necessary for the rest of the world. Israel was one of the first countries to take advantage of the abundant and free energy from the sun; nearly every rooftop sports a solar water heater, with its distinctive panels and collecting tank.

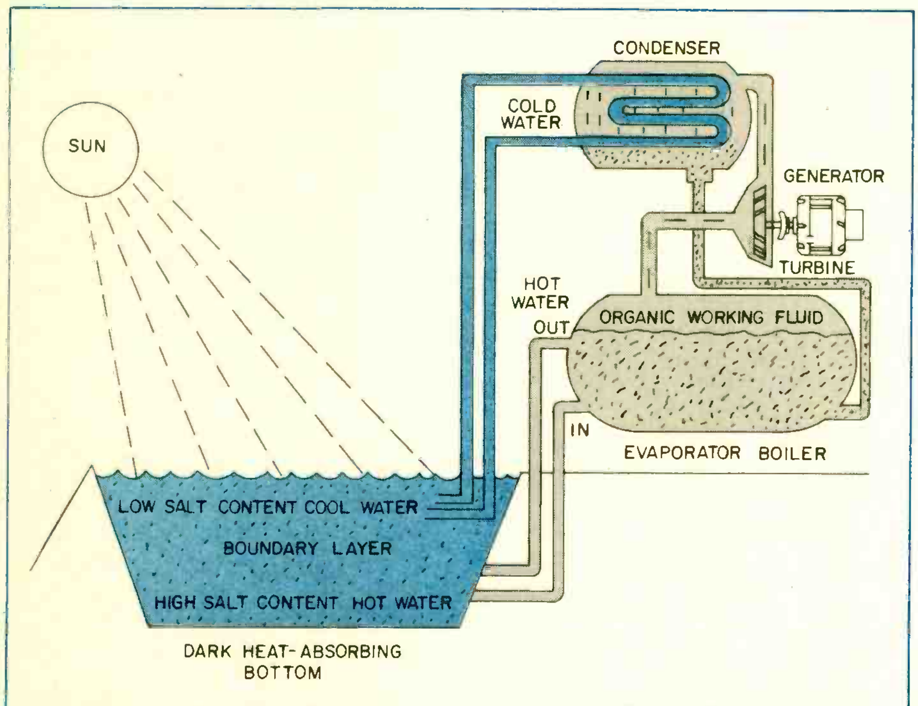
A 15,000 square foot solar pond was constructed at Ein Bokek by excavating an area of the Dead Sea shore, damming the seaward side, and lining the excavation with a black, heat-absorbing rubber substance. Water was let in, and its salinity level was constantly monitored to ensure that the proper gradient level would be reached. The high salt and mineral content prevents normal convective cooling, and the salinity increases with depth. The water at the bottom of the pond rose nearly to boiling temperature after a few hours under the desert sun.

The hot water was then circulated through a heat exchanger, where it heated an inorganic working fluid to the gaseous state. This gas powers a turbine attached to an electric generator.

The turbogenerator system that converts the heat of the solar pond into electricity is a unit known as the Ormat Energy Converter (OEC). This is a low-temperature, low-pressure generating system that was originally designed to produce electricity from waste heat. It uses a closed system wherein the working fluid is heated up, used to run a turbine, then condensed and used over again. The OEC is ideal for use in applications where a constant 175-200°F heat flow is available.

Encouraged by the success of the pilot plant at Ein Bokek, the Israeli government has the project's two contractors, Ormat Turbines and Solmat Systems, at work on a 5,000 kilowatt power station. This generating station should be operational by 1981, and will be the first module of a system with an eventual capacity of 2,000 *megawatts*. Meanwhile, the Ein Bokek plant has been constantly producing 150 kilowatts, day and night, winter and summer. The Dead Sea is a body of

(Continued on page 85)



This diagram explains the solar pond generating system and shows the transformation of sunlight into electrical energy by taking the heat generated and powering a turbine.

Innovations

The sharpest picture ever achieved in big-screen projection TV
The new Heathkit Screen Star sets a new standard in picture quality for big-screen projection TV. The finest F1.0 lenses you can buy produce one of the clearest, brightest pictures ever.

Imagine watching all your favorite TV movies and sports events on a big 6-foot diagonal screen. Heathkit's three-tube projection gives you brighter, more vivid color. And it's a lot easier to build than conventional TV's.

A complete computer system in one compact unit
The Heathkit All-In-One Computer takes the guesswork out of selecting a balanced computer system. It includes built-in floppy storage, smart terminal, heavy-duty keyboard, 12-key numeric pad, Z80 CPU, and 16K RAM expandable to 48K—all in one compact unit.

Two Z80 microprocessors mean terminal and computer never share power. So both can operate faster on more complex programs. And there's no better way to learn about computers than to build one yourself.

The only computerized home weather station for instant, up-to-the-minute weather reports
Just push a button for reliable weather information anytime you need it with the unique Heathkit Weather Station. It gives you digital readouts of F or C temperatures, wind speed in miles or kilometers per hour or in knots, wind direction, barometric pressure, date and time of day, even the wind chill factor.

This microprocessor-based weather computer has memory to store data and precision infra-red sensing devices built into the outdoor transmitter. And it's very easy to build.

The finest stereo receiver ever introduced by one of the leaders in audio technology
It's loaded with luxury features that let you adjust your music to your preference.

Special features include a Precision Tuning System (PTS) that automatically corrects mistuning. 5-section FM tuning capacitor gives you maximum rejection of unwanted signals for lower noise, cleaner sound. Digital frequency readout, center tune meter, and flywheel loaded tuning are just a few of the luxury touches. Complete specifications are in the latest Heathkit Catalog.

Get together with your
FREE HEATHKIT CATALOG

You'll both get a lot out of these easy-and-fun-to-build electronic kits . . . and become a little closer at the same time! Get started now!

FREE . . . WORLD'S LARGEST CATALOG OF QUALITY ELECTRONIC KITS!

☐ **YES,** please send me a FREE copy of your latest Heathkit catalog. I am not now on your mailing list.

Name ______________________
Please Print

Address ______________________

City ______________ State ________ Zip ______

ELEMENTARY ELECTRONICS R 139-699

ALOG
n build-it-
athkit Catalog.
ts for your home,

y, Dept. 139-692
, MI 49022
kit Catalog.
your catalogs.

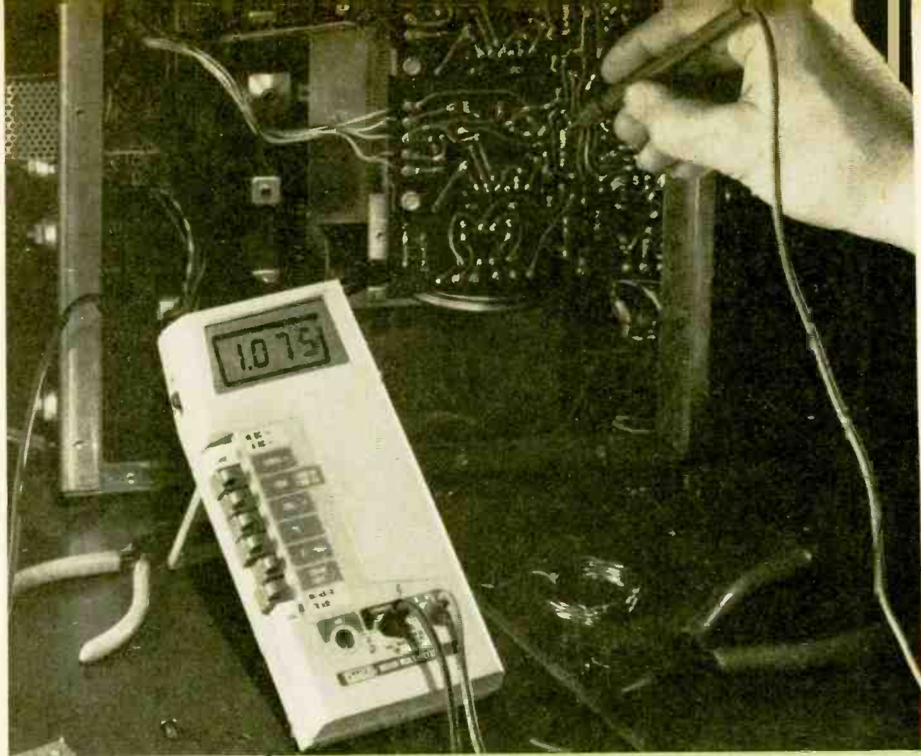
State ______

Zip ______

The Hobbyist's Test Bench

This guide to selecting the right gear for troubleshooting and experimenting will give you an idea of what's available in the field of equipment for the hobbyist

BY HERB FRIEDMAN



Circle Number 67 on the Reader Service Card.

☐ The day of the "screwdriver mechanic" is long past in electronics. Troubleshooting the complicated and delicate circuits of today requires much more sophisticated equipment than the screwdriver and ohmmeter that were once enough. The trick, for the electronics hobbyist, is selecting reliable and accurate test equipment at a reasonable cost.

The key to success in equipping a hobbyist test bench at a rock bottom price is to always keep in mind two important facts: A) Only a few basic instruments will handle most hobbyists needs; B) You don't need laboratory-standard equipment, because you're not building space labs for NASA. For example, most hobbyists will rarely have need for a voltmeter with 0.01% accuracy, so why spend several hundred dollars for an instrument you might only need once? Unless you intend to contract out for laboratory services, you don't need a scope with vertical delay line, sweep delay, dual sweep or plug-in amplifiers.

What You Really Need. Let's take a look at the test bench instruments that will satisfy most hobbyists's needs.

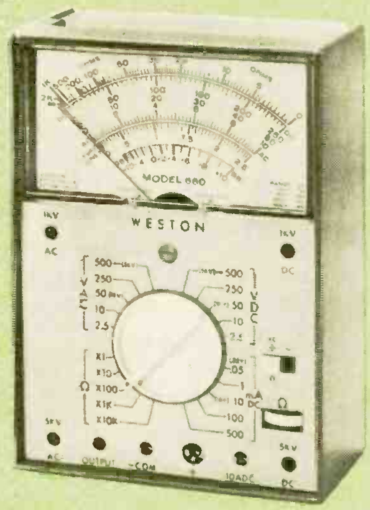
Leading the list is an ordinary 20,000-ohm, 50,000-ohm, or 100,000-ohm volt-ohm-milliammeter. Its common worse-case tolerance of 3% for DC measurements and 5% for AC measurements is more than adequate for typical use. If you need better than this, you should make measurements with a scope rather than a digital meter.

The VOM, as the meter is more often called, measures AC and DC voltages, resistance from "0" to several megohms, DC current from microamperes to about 10 amperes, and sometimes OUTPUT, which is nothing more than the AC function in series with a DC blocking capacitor that permits the user to measure AC in the presence of DC without the DC affecting the meter's reading.

Just about any type of VOM can be used by the hobbyist, although models with meter scales measuring approximately 5 inches, and with at least three resistance ranges (Rx1, Rx10, or Rx100 and Rx1000), are the most convenient.

About the only measurements the VOM cannot handle are instantaneous and pulse waveforms; these require an oscilloscope.

As a basic measuring instrument for hobbyists the VOM is recommended over a digital meter because the VOM can "track" a slowly varying voltage, current, or resistance. A digital meter "jumps" from one value to the next. The ability to literally *see* an incremental change in value is



A good VOM like this Weston 660 is basic to the well-equipped test bench. Meters with a needle movement can actually be used to "track" any incremental changes in voltage as they occur. This is good for troubleshooting. Circle No. 66 on the Reader Service card.

B&K-Precision's Model 2845 DMM (Digital Multimeter) is autoranging and microprocessor controlled. In this meter, the microprocessor analyzes the applied signal, selects the range that will provide the greatest resolution. Circle Reader Service Number 68.

often more important to the hobbyist than the precision of a digital meter.

When you require absolute accuracy, say to resolve the difference between 4.85 and 5.25 VDC, there is no low cost substitute for the digital multimeter, or DMM. Depending on how much you spend, DMM accuracy will typically range between 0.05% and 1%; this contrasts with VOM accuracy, which is usually in the 1% to 5% range for hobbyist-grade equipment.

The DMMs have virtually the same measurement functions as the VOM, the primary difference being that the measurements are indicated by a digital readout rather than a meter movement.

DMMs use either an LED or LCD display. As a general rule of thumb, the LCD display is used in the lower cost meters because, with its low current requirement, it serves nicely for a battery power supply that lasts almost the shelf life of the battery. DMMs with LED displays generally require a 120 VAC power source. When battery powered, they usually use NiCads, which require frequent recharging.

Whether LCD, LED, portable or bench model, DMMs usually have the same functions. Within a given type, higher price generally reflects greater accuracy and a larger, more readable, display.

As your interests become increasingly sophisticated, you will probably find frequent use for an oscilloscope such as this unit from B & K Precision. For more information, circle R. S. No. 68.

Probes like this one from Global Specialties are a must for digital experimenters. Circle No. 69.

The Oscilloscope. Once you get beyond the stage of puttering with simple experimenter type projects, the most valuable test instrument is the oscilloscope. Most of today's equipment has some form of pulse circuitry, and the only way you can test or measure most pulse-type circuits is to actually *look* at the waveform. The way you look at a waveform is with an oscilloscope, or "scope" as it's usually called in the trade.

While those laboratory type scopes with plug-in amplifiers that go well into the RF region, and digital CRT display, are both attractive and impressive, their price is similarly just as impressive. Yet few hobbyists need a laboratory grade scope. At most, you scope will need just a few of the less expensive "laboratory" features. Primarily, a *calibrated time-base* is an absolute requirement, even for the beginning hobbyist. Particularly when dealing with digital circuits, you must know the timing of an event, and how often it occurs.

The time base, or *horizontal sweep* as it's often called, is calibrated in CRT graticule divisions. For example, if there are 10 horizontal divisons, one of the sweep speeds, or time base, might be *1 sec./div.;* which means that it takes the sweep 1 second to traverse 1 division, or 10 seconds for the whole 10 divisions. When each division is precisely 1 cm., you might see the time base calibrated in centimeters; for example, 1 sec./cm.

Calibrated time bases are always switch selected, with a potentiometer adjustment for selecting sweep speeds in between switched values. Note, however, that the time base calibrations are valid only when the potentiometer is set to a "calibrated" position.

While not as important to the hobbyist as a calibrated time base, a *calibrated vertical input attenuator* is a decided convenience. Similar to the calibrated time base, the vertical attenuator is calibrated in volts per division or centimeter, and there is a variable attenuation adjustment. Scopes with vertical inputs calibrated in *gain*—X1, X10, X100—are better than those having just a continuously variable input attenuator. However, you'll need some form of calibration reference voltage—which is often built into the scope—if you want precise voltage measurements.

As for the scope's frequency range, anything that will handle home TV will generally be more than adequate for the hobbyist. A vertical frequency response 3 dB down at about 4 MHz or higher will be sufficient. Often, scopes intended primarily for TV servicing will have switch-selected sweeps specifically calibrated for the vertical and horizontal TV receiver sweep in addition to the standard time base.

If you plan on using the scope to examine modulated RF waveforms into the HF-VHF range (above 5 MHz), say for an amateur transmitter, you'll need a *direct plate* scope input. This is a set of input terminals that connect directly to the CRT plates without passing through an amplifier en route.

Variable Power Supply. The next item to consider for your test bench is either a variable voltage power supply or a signal generator. On the assumption most hobbyists will be experimenting with solid-state circuits of all types, we'll opt for the power supply first.

Solid state circuits and equipment appear to use an almost infinite selection of operating voltages. Unless you have an endless assortment of battery types, the best way to power an experimental circuit, or any battery powered equipment, is by using a *protected* variable voltage power supply. First off, a range of about 0-30 volts will handle almost all of the experimenter's voltage needs. Secondly, since current-carrying capacity is what really costs money, figure a maximum output current of 1-2 amperes. Even a 500 mA output will handle most experimenter needs.

Protection means the way whereby the power supply protects itself or the circuit it is powering. One characteristic of solid-state circuits is that they usually short circuit. If there is no protection in the power supply, the supply would attempt to deliver full current *into* the short. A supply with basic protection will automatically start to reduce the output voltage when the current starts to exceed the rated maximum output voltage or the voltage programmed by the user. If the supply senses an excessively low impedance approaching a *dead short* the output voltage might be reduced to zero.

An even more convenient protection is *user programmed* maximum current. In this instance, the power supply has both voltage and current adjustments. After the user programs the desired output voltage, he short circuits the supply's output terminal and then sets the current adjustment for the *maximum* desired value. If the circuit or equipment that's powered attempts to draw more than the programmed current, the supply automatically shuts down the output voltage. Of all the power supplies available, the type with programmable maximum output current is usually the most valuable for the hobbyist.

If you intend to work only wtih digital circuits then a *digital power supply,* meaning one with a fixed, regulated 5 volt output, will probably handle almost all your needs at a relatively modest cost.

The Logic Probe. Speaking of digital equipment, many consider the *logic probe* the most important tool for the digital experimenter. Basically, the logic probe simply tells the user whether a test point in a digital circuit is HIGH (1) or LOW (0). Usually the indicator is an LED built into a hand holdable probe; when the LED lights up, the test point is HIGH; when the LED is out, the point is LOW.

The input impedance to a logic probe is often on the order of several megohms (it is always "high impedance") so there's no "loading" of the circuit being tested. Most probes also have several sensitivity ranges, to accommodate the various reference voltage levels in RTL, TTL, DTL, CMOS, MOS and microprocessor circuits.

While the basic probe indicates either HIGH or LOW, the more sophisticated models can "catch a pulse"; meaning they have memory. For example, if the circuit is LOW but a transient pulse has occurred, the logic probe will "catch the pulse" and indicate the pulse even though the circuit has returned to LOW. Some probes require the memory to be manually disabled for the next pulse, others automatically clear when the probe is lifted off the circuit.

The Signal Tracer. One of the least esoteric but most convenient pieces of test gear is the *signal tracer.* This device can track a signal almost from the antenna, through RF and IF amplifiers, through the AF amplifier, and up to the speaker. With a tracer, an advanced hobbyist, or a technician who is familiar with what AF and RF circuits should be doing, can knock hours off a difficult servicing or troubleshooting job. The signal tracer is basically a very high gain audio amplifier with a switch-selected RF probe—actually an RF detector probe.

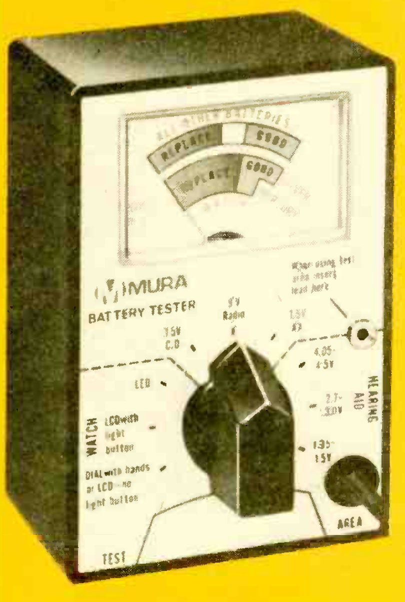
The straight AF amplifier can trace a minute signal from a magnetic phono pickup, a microphone, or a receiver's detector. Where the signal stops is where the trouble is.

The Mura Clamprober is a handy variant of the VOM. It is pocketable and gives results. Circle R. S. No. 71.

Something like this Logic Monitor from Global Specialties is a must when precise measurements of faulty microprocessor chips are called for. For more information, circle R. S. Number 69.

A status symbol among hobbyists and a primary tool for the professional, there is no substitute for an accurate frequency counter. For more information circle Reader Service No. 68.

Smaller frequency counters like this one fom Optoelectronics, Inc. are all the counter that most hobbyists will ever be in a position to need. Circle Number 72 on Reader Service card.



This Mura Battery Tester is a handy device, especially if you spend a lot of time around portable solid state equipment. Its color-coded scale is set up to give a quick reading of the most popular battery voltages. For more information, circle Readers Service Number 71.

In experiments or projects involving complicated circuitry, it is often important to know the exact capacitance of components; this capacitance meter is the ticket. Circle No. 69

Similarly, with the RF probe switched in ahead of the AF amplifier, a signal can be tracked through a receiver from the first RF amplifier. (If the received signal isn't strong enough for detection, feed in a stronger "local" signal from a signal generator.)

Even SSB and FM signals can be tracked with what is otherwise an AM RF detector probe. SSB and FM will be highly distorted; but again, where the signal fails to pass is where the trouble is.

As a general rule, signal tracers provide access to their own speaker terminals so the tracer's speaker can be used as a substitute for the speaker of the receiver or amplifier being tested. Also, many signal tracers have a built in AC wattmeter; if you suspect some equipment is defective you can measure how much power it draws and compare the figure against the equipment's specifications.

If you're into any kind of experimentation or service of radio communications gear it's almost certain that you will need a signal generator. Generally, the low cost "service grade" signal generator is more than adequate, unless your work is almost entirely restricted to FM or TV equipment.

The typical service grade generator provides a variable RF output level in the range of about 100k Hz to 50 MHz on fundamental frequencies, with harmonics providing usable test signals to above 150 MHz. The RF signal can be unmodulated (CW, for *continuous wave*), or modulated, either by a 400-1000 Hz internal oscillator, or by an external AF signal through terminal connections. The internal oscillator's signal, whose level is adjustable, is available at the same set of terminals, so it can be used as a separate AF test signal (say, for troubleshooting amplifiers).

The type of modulated test signal depends on whether the generator is tube or transistor (one is not necessarily better than the other). Tube generators can generally be AM modulated to 30%-50% by the internal oscillator—30% is the standard test value for AM receivers.

Transistor generators can generally be modulated to 80% to 100%. Only if you have specific reason to test the adjacent channel rejection of CB (Citizens Band) receivers will you need modulation capability greater than 30%. (More than 30% modulation usually adds big bucks to the cost of a signal generator.)

The Frequency Counter. Everyone wants a frequency counter. It is probably the most common status symbol in electronics. However, unless you're a Radio Amateur or an RF experimenter, money spent for a counter is probably better invested in some piece of general purpose test equipment. Glamor aside, you'll have very little use for a counter in digital, audio or general electronic experimentation.

But, as we said, if you're into RF you need one; and it will probably turn out to be one of the most important instruments on your bench. The counter has no low cost equal when it comes to troubleshooting oscillators, multipliers and frequency synthesizers. There are even experimenters who signal trace RF amplifiers with a small homebrew sensing coil attached to a counter.

Counters come in many shapes, sizes and styles. As a general rule, however, there are two basic types: those with the reference crystal in a heated, temperature-compensated oven, and those with an unheated crystal as the time base reference. The accuracy of any counter is that of the reference crystal oscillator, plus or minus 1 count. Those which have heated crystals simply provide a higher, more stable accuracy, as required for precise transmitter frequency measurements. Unless you are a service technician who must certify the output frequency of VHF or UHF radios or AM, FM and TV transmitters, there is no good reason why you need spend the extra several hundred dollars for a counter with a crystal oven.

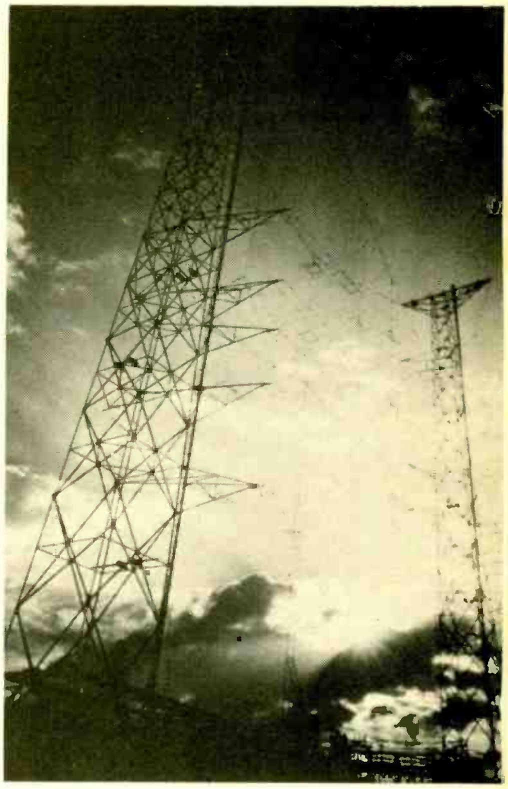
A low-priced general purpose frequency counter will generally cover from about 50 to 100 MHz. If you need coverage above this maximum it is usually less expensive to connect an accessory *prescaler* ahead of the counter. The prescaler is a device that multiplies the frequency counter

(Continued on page 86)

Tuning in Swiss Radio International

This David among SW Goliaths has much to offer

BY ROGER N. PETERSON



TUCKED AWAY IN TINY SWITZERLAND is one of the best shortwave broadcasters in the business—Swiss Radio International (SRI), the external service of the Swiss Broadcasting Corporation. Compared to the giants in the world of shortwave broadcasting, SRI is not large in either the number of programs aired or in the size of its staff. While they broadcast 24-hours a day, their program schedule would easily fit in the outside margin of a single page of the BBC's printed schedule.

On the other hand, most shortwave listeners who are familiar with SRI tune to them regularly because of the quality of the programs. People find SRI broadcasts good listening because they are informative and entertaining. SRI has a staff of 130 people, most of whom are headquartered in Berne, where the broadcasts originate. Broadcasts are made every day in nine different languages – English, German, French, Italian, Portuguese, Spanish, Arabic, Esperanto and Romansch (Switzerland's national language). Each program lasts 30 minutes and a single program is offered every day.

Image Making. The mission of SRI, according to its charter, granted by the government, is ". . . to strengthen the ties between Swiss living abroad and their native country, as well as to promote Switzerland's image around the world." This is the foundation for SRI programming. As a result, information is the key to their broadcasts. From Monday to Friday, *Dateline* is the regular half-hour program. Here reporters, editors and independent Swiss newsmen contribute news reports, commentaries and interviews on developments of major significance, giving the listener the Swiss viewpoint on world affairs. The central newsroom at SRI compiles some 30 news bulletins a day and the Swiss pride themselves on their accuracy. They never broadcast an item before it is confirmed by a second reliable source.

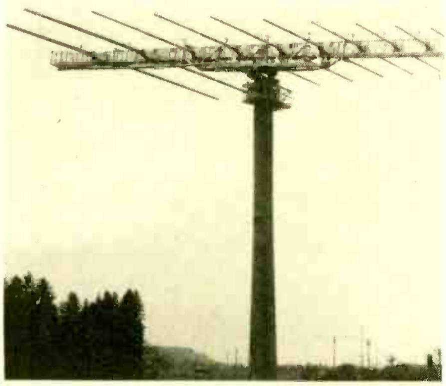
Weekend Programming. When the weekend comes around, however, there is an abrupt change of pace in the programming. The emphasis switches from news to entertainment, cultural and documentary programs. Sometimes these features are used for in-depth examination of especially interesting and important subjects which were initially offered on one of the earlier weekday *Dateline* broadcasts.

On the first and third Saturdays of each month, a program called *Talkback* is heard. This answers listeners' questions, comments and criticisms of SRI programs with reports, interviews and discussions. Between items, Swiss country music is offered. On the second and fourth Saturdays of each month, the popular *Swiss Shortwave Merry-Go-Round* is aired. This features "The Two Bobs"—Bob Thomann and Bob Zanotti—and is one of the most popular DX programs on the air today. Most of the program is spent on answering technical questions on subjects like antennas, tuners and receivers. It's a "must" program for beginning shortwave listeners, but is also popular with the "pros" who want to stay up to date with important new developments. "The Two Bobs" certainly prove that there is much more to international shortwave radio than QSL cards.

On Sundays there is a different show each week. *Inter/Action I* is heard on the first Sunday and it is concerned with Swiss organizations and Swiss-based international agencies. It shows who they are and how they operate. The next Sunday brings *Inter/Action II*, which is about the same organizations but about their operations in the field. SRI reporters interview specialists and

(Continued on page 82)

"The Two Bobs" of SRI, Bob Zanotti (left), and Bob Thomas, are internationally known.



Here's the log-periodic antenna used for the 250 kw transmitter at Schwarzenburg.

Kurt Bischoff (left) and Paul Sufrin are shown preparing the "Dateline" program.

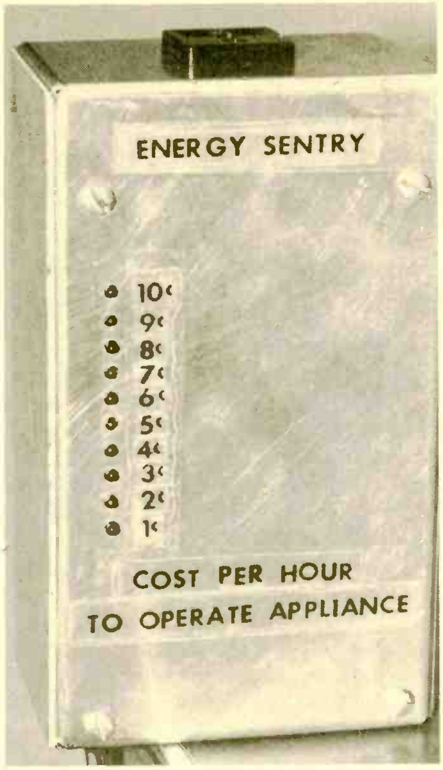
ENERGY SENTRY

Monitor your power consumption to save energy and reduce your electric bill

BY ANTHONY CARISTI

IF YOU PAY the electric bill, you know only too well what has happened to that bill over the past few years. In addition, you have been bombarded through radio, television, newspapers, and magazines on how important it is to conserve energy, wherever possible. Part of energy conservation includes the electricity used in your home. With the help of Energy Sentry you can determine just how much it is costing you to operate that appliance or T.V. set. This will help you to minimize your electric bill, while saving precious fuel.

Energy Sentry is an easy to construct circuit; built in a small enclosure, with a built-in receptacle into which the appliance is plugged. Ten separate LED's provides an indication of the power consumption of the appliance. Energy Sentry is calibrated in "cents per hour" over a range of 1 to 10 cents. Depending upon your electric rate, this will provide a useable power range of up to 1500 watts. This is near the maximum power which can be delivered by an ordinary 115 volt power receptacle.



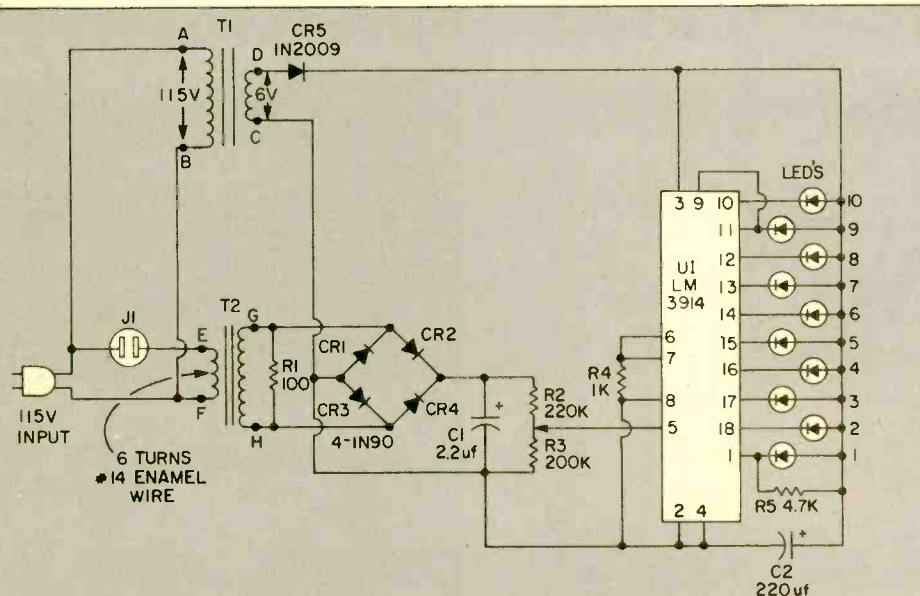
A simple calibration procedure is provided at the end of this article allowing you to compute the average cost of a kilowatt hour of electrical power in your home or office.

About The Circuit. The heart of Energy Sentry is current transformer, T2, which produces an output voltage across its secondary winding corresponding to the magnitude of current flowing in the AC line. A current transformer follows the same turns ratio relationship as does the more common voltage transformer, except that secondary current, not voltage is determined by the number of turns of both primary and secondary. In the case of Energy Sentry, the primary of the current transformer consists of just 6 turns of wire wound by yourself around the core. The secondary is the existing 115 volt winding of the transformer, resulting in a turns ratio of perhaps 100. The existing 12 volt winding of the transformer is not used.

The primary of the transformer is connected in series with the power line and the appliance under test. The current drawn by the appliance induces a proportional current in the secondary. Since a current transformer must operate into a load to provide a path for secondary current, a voltage across R1 is produced which is proportional to the magnitude of the current (and power) drawn by the appliance. This voltage varies linearly with primary current and therefore linearly with power. This is true since the voltage fed to the appliance under test is a fixed power line voltage that is well regulated by the power company.

A bridge rectifier circuit converts the secondary voltage of T2 to pulsating DC which is filtered by C1. The resulting DC voltage is fed to input terminal 5 of U1 through calibrating potentiometer R3. It can be seen that the drive voltage to U1 will be determined by the current drawn by the appliance you are checking out.

U1 is a LED driver chip which has been designed to drive a series of 10 LED's in response to the voltage applied to its input terminal, pin 5. When the voltage applied to the input is zero,



A complete parts kit including PC board, all components and cabinet is available from Niccum Electronics, Rte. 3, Box 271B, Stroud, OK 74079. Price is $24.50; a pre-etched and labeled PC board only is $6.50.

PARTS LIST FOR ENERGY SENTRY

- C1—2.2 ufd 10 volt electrolytic capacitor
- C2—220 ufd 10 volt electrolytic capacitor
- CR1, CR2, CR3, CR4—Germainium diode 1N90 or similar
- CR5—Silicon diode 1N2069 or similar
- J1—Power receptacle Radio Shack 270-642 or similar
- LED 1 through LED 10—Radio Shack 276-026 or similar
- R1—100-ohm, ¼-watt composition resistor 10%
- R2—220,000 ohm, ¼-watt composition resistor 10%
- R3—200,000 ohm miniature potentiometer, PC mount
- R4—1,000 ohm, ¼-watt composition resistor 10%
- R5—4,700 ohm, ¼-watt composition resistor 10%
- T1—6-volt transformer (Radio Shack 273-1384)
- T2—6 or 12-volt transformer (Radio Shack 273-1505 or similar)
- U1—National LM3914N Radio Shack 276-1707
- Misc.—Cabinet, line cord, plug, wire, solder, etc.

no LED will be illuminated. As the voltage is raised each succeeding LED will light, one at a time, until the 10th LED is illuminated. Thus, it can be seen that the circuit will provide a visual indication of the current drawn by the appliance under test.

A fascinating display can be seen when a light bulb load is being observed. As soon as the light bulb is flicked off, LEDs representing full current to no current, will light in rapid succession in an interesting display.

Power to operate the circuit is provided by T1, which feeds a half wave rectifier and capacitive filter composed of CR 5 and C2. The resulting DC voltage, about 8 volts, is sufficient to operate U1. Since U1 has a built-in regulator, the circuit will hold calibration regardless of changes or fluctuations in power line voltage.

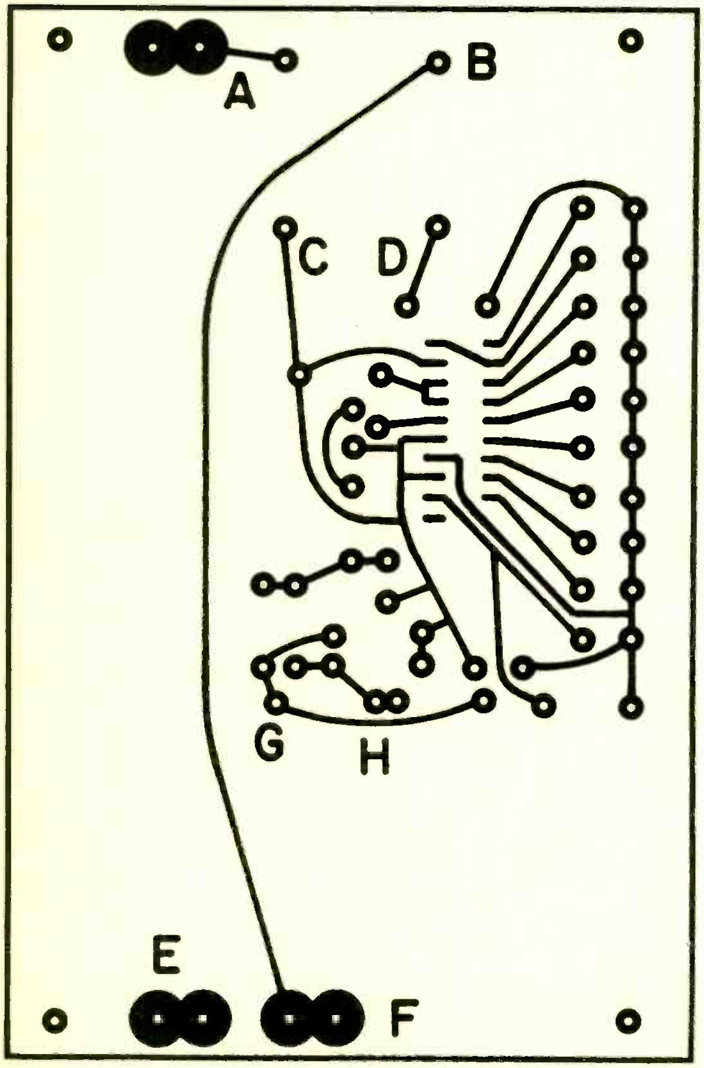
Construction. Most of the circuitry of Energy Sentry is contained on a printed circuit board. At lower left is a full scale layout of the foil layout as seen from the copper side of the board. At right is the parts layout as seen from the component side.

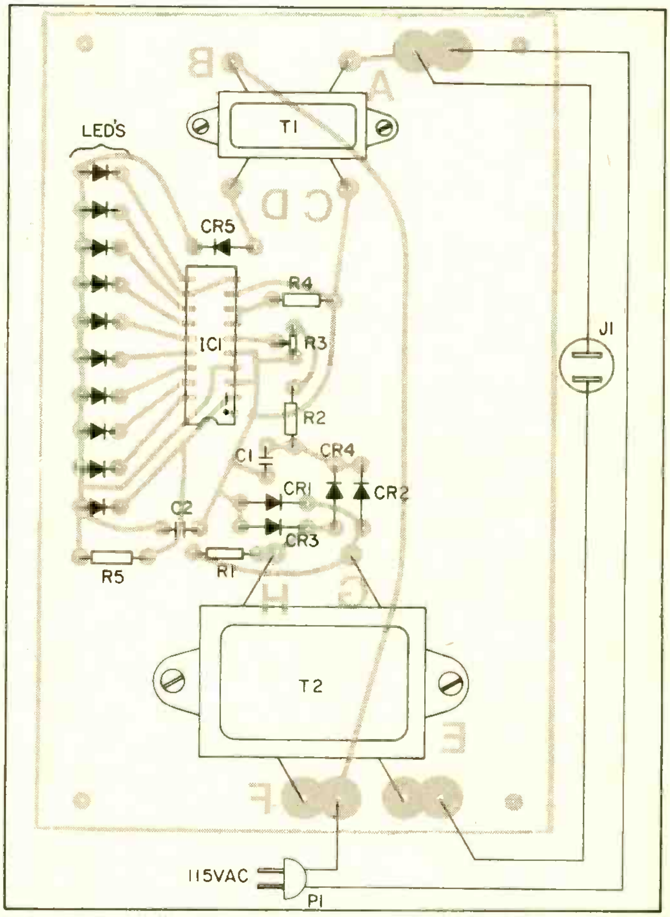
Note that the set of 10 LED's is placed on the copper side of the board. This will permit the printed circuit board to be assembled into a cabinet with the LED's protruding through a set of 10 holes drilled in the cabinet. A drilling template for the cabinet front can easily be obtained by making a photocopy of the printed circuit layout and placing it on the front of the cabinet. The printed circuit board can be mounted in the cabinet with a set of four ⅜" long spaces used for clearance and #6 machine screws.

Transformer T2 has been selected for ease of adding the additional winding. This transformer has ample room between the laminations and winding to easily fit 6 turns of #14 enamel wire. Do not use wire of smaller gauge. *Place sufficient insulating tape around the laminations to prevent a short circuit between the enamel wire and core.* If you substitute another transformer for T2 it may be necessary to remove the existing low voltage winding to provide sufficient room for the new primary. The additional winding placed on the transformer is connected to pads E and F of the printed circuit board. In a similar manner, use pads marked A, E, F, G and H for the 115 volt and transformer connections as shown in the schematic diagram. Except for pads G and H, use #14 gauge wire.

It is recommended to use a socket for U1. This will prevent damage to the IC or printed circuit board in the event U1 has to be removed for service. Double check the polarity of the LED's, diodes, and electrolytic capacitors before soldering them in place. These

(Continued on page 42)





Seen above is the component side of the Energy Sentry PC board. T2 provides power coupling, and T1 provides power for circuit.

To the left is the PC board, with the etched side up. The row of LED connection terminals can be seen on the right.

EQUIPMENT AND TRAINING NO OTHER SCHOOL CAN MATCH!

Explore micro-computers, digital systems and more, with state-of-the-art equipment you build and keep!

EXCLUSIVE! TRAIN WITH THE NEW H89 NTS/ HEATH ALL-IN-ONE MICROCOMPUTER! NTS's Master Course in Microcomputers now includes this remarkable new desk-top computer. Features floppy disk storage, "smart" video terminal (terminal has its own microprocessor, doesn't share one with computer as do most desk models), two Z80 microprocessors, 16K RAM expandable to 48K, professional keyboard.

The new H89 (pictured above) is here and NTS home training has it! An exciting way to explore the very latest in microprocessor technology.

Of course if your interests lie in other areas of electronics, NTS has many programs to choose from. And they include the widest array of solid-state and digital equipment ever offered by any home-study school.

Simulated TV Reception

FM Transceiver

Besides the latest in microcomputers, students may work with the NTS/HEATH digital color TV (25" diagonal with optional programming capabilities), digital test equipment, an NTS/Heath 2-Meter FM transceiver, plus much more field-type equipment to make your training exciting and relevant.

Each NTS program uses step-by-step lessons and manuals to guide you through experiments, testing, and kit building as you develop skills. The NTS Project Method of training is one of the many reasons students quickly acquire practical know-how.

Digital Multimeter

Our new full color catalog shows you what each course covers, and identifies every unit of equipment included. Send for it today and discover for yourself the *many advantages* of NTS electronics training, and how you can benefit.

NTS NATIONAL TECHNICAL SCHOOLS
Technical-Trade Training Since 1905
Resident and Home-Study Schools
4000 S. FIGUEROA, LOS ANGELES, CA 90037

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

NTS also offers courses in Auto Mechanics, Air Conditioning and Home Appliances. Check card for more information.

NATIONAL TECHNICAL SCHOOLS
4000 South Figueroa Street, Dept. 222-090
Los Angeles, California 90037

Please rush FREE color catalog on course checked below

- ☐ **MicroComputers/MicroProcessors**
- ☐ **Communications Electronics**
- ☐ **Digital Electronics**
- ☐ **Industrial Technology**
- ☐ **Auto Mechanics**
- ☐ **Air Conditioning**
- ☐ **Home Appliances**
- ☐ **Color TV Servicing**

Name ______________________ Age ______

Address ______________________

Apt. __________ City ______________________

State ______________________ Zip ______

☐ Check if interested in G.I. information.
☐ Check if interested ONLY in classroom training in Los Angeles.

 (Continued from page 38)

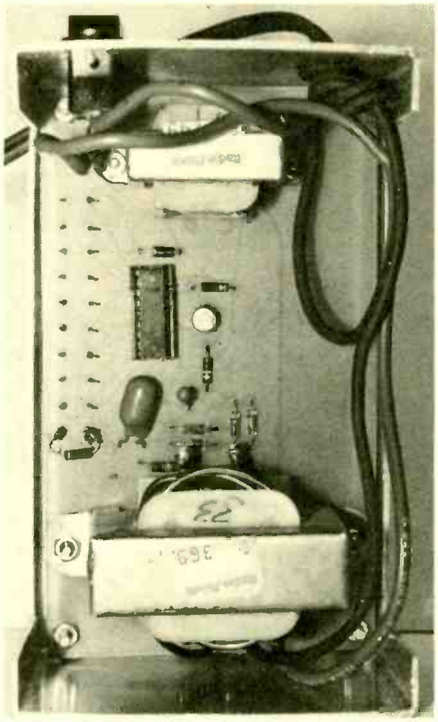
components are polarized and the circuit will not work if any of these are placed incorrectely on the board.

Before inserting U1 into its socket, apply power to the circuit and measure the DC voltage across C2 to ensure that the circuit is operating properly. Once this is done, disconnect line power before inserting U1. Be sure the IC is plugged in facing the correct direction. Pin 1 of the IC is indicated by a small dot on the foil layout.

Test And Calibration. For best accuracy, the circuit should be calibrated somewhere near the middle of its range. A set of six 100 watt incandescent lamps, connected in parallel, will provide an excellent 600 watt load to calibrate the unit.

Before the calibration can be performed, determine the actual cost of electricity in your area. The easiest and best way to do this is to obtain a recent electric bill which shows the number of kilowatt hours of electricity used, and the total cost during one billing period. Divide the electrical cost by the number of kilowatt hours. The resulting quotient will be the average cost of one kilowatt hour of electricity.

Once you have determined the cost per KWH, multiply this by the wattage of your test load. In this case it would be 8¢ times .6 KW (600 watts) for six 100 watt lamps connected in parallel. Thus, in our example:



The inside of the Energy Sentry cabinet has the two transformers and the circuit board.

8¢ per KWH × 0.6 KW = 4.8¢ per hour. 4.8¢ can be rounded off to 5¢ strictly for calibration purposes.

Connect the test load to the receptacle on Energy Sentry. Plug the line cord into a 115 volt receptacle and adjust R3 so that LED #5 (5¢) is illuminated. This completes calibration of your cost saving Energy Sentry.

Use of the Instrument. You may use Energy Sentry on any 115 volt appliance in your home. Although this unit will generally be accurate to within 1¢ per hour, it does not take into account the power factor of the load. In the case of appliances which generate heat, such as toasters, irons, and coffee makers, the power factor of these units is 1 and no correction factor is necessary. Other appliances which use inductive components, such as motors, have power factors of possibly 0.8 or 0.9. In this case Energy Sentry will indicate a cost per hour greater than true cost. A correction can be obtained by multiplying the indicated cost per hour by the power factor of the appliance or load being tested.

Note. Be sure to insulate the transformer case of T2 from the metal case. If not, an AC leakage current to the case will make the case hot, creating a shock hazard. ■

A Personal Electronic Alarm System

Computer-coded signals notify the police BY LES LEWYN

WITH CRIMES OF VIOLENCE and other kinds of crimes constantly on the increase, firms in the fields of electronics have come up with a host of devices for the protection of the public.

One such firm is a company called American Sentry Systems of 49 Larkspur Street, San Rafael, California. Its newest development is a small portable alarm that works by radio and which is carried by a user. All one has to do is to merely press a small button on the device, which is the size of a packet of king size cigarettes, which then transmits a signal to a radio frequency receiver and alarm transmitter.

A coded message is then automatically sent by radio to American Sentry Systems' head office. This coded message tells them exactly where the signal is coming from. Then police nearest the place where the signal came from are instantly notified, also by radio. Basically, in under two minutes, police know about the emergency and can be on their way to give aid.

The portable device is very simple. It can be carried in one's hand, slipped into a pocket, put under the pillow in bed or into the drawer of the bedside table. It's much faster than using the telephone, as all one has to do is to press the button and this action sends a radio signal to a transmitter that is to be installed by the firm in your home, place of business or wherever wanted.

Each owner of such a device has its own coded signal. Therefore, when a signal is sent to American Sentry Systems, they know there at once who sent it and where that person is located.

The company installs its system for approximately $200.00, and there is an additional $10.00 monthly charge for the service, which operates 24-hours a day, every day.

The Company's communications center is well "fortified" and protected against bombs, fires and even against earthquakes. It has its own emergency power supply, and the entire building is bugged. ■

Radio Direction Finding

How the pros track down signals

BY ROBERT GROVE

THE VAST MAJORITY of shortwave listeners and scanner buffs are content with listening in, unconcerned with the compass bearing (azimuth) of the station. But there are many instances where exact coordinates are important.

Ships at sea and aircraft in flight depend upon knowing accurately the positions of transmitters as an aid to navigation. The Federal Communications Commission and many military facilities employ elaborate radio direction finding (RDF) antennas to determine the sources of radio transmissions. Illegal "pirate" stations, sources of interference and even incidental sources of radiation like test instruments and industrial equipment may be tracked down by highly sensitive directional antennas and receivers.

Another important use for radio direction finders is in the location of downed aircraft. Emergency locator transmitters (ELT) are automatically activated by the impact of a crash. They send out siren-like wails on 121.5 MHz, signalling monitoring receivers that an accident has taken place. Specially-equipped search aircraft are then dispatched, which home in on the emergency beacon.

Signal Propagation. The term physicists use to describe the path taken by electromagnetic energy such as a radio wave is "propagation." In radio parlance, propagation is divided into two broad categories: ground wave and skywave. By ground wave, we refer to the portion of the signal which remains close to the ground as it travels from the transmitting antenna to the receiving antenna. Ground wave is the dominant propagation at frequencies below 1 MHz or so.

When you listen to the AM broadcast band, you are usually listening to ground wave signals. Even at night, ground wave signals can travel great distances, allowing reception over thousands of miles.

The constancy of ground wave propagation is one reason why low frequency direction finding is so reliable.

As radio frequencies become increasingly higher, their skywave components become more and more easily reflected by the upper ionosphere, returning them back to the earth. And when they arrive, they are often severely distorted, making measurements of them unreliable for direction finding. This phenomenon is sometimes called "night effect" because it becomes more severe after the sun goes down.

Direction finding techniques at the higher frequencies make use of technologies which are capable of ignoring or canceling out the skywave portions of the arriving waves.

It would be convenient if the same sort of direction finding antennas could be used on all frequencies; unfortunately, they can't. At the lowest frequencies, wavelengths are very long. Signals travel across the ground unaffected by obstructions. Skywave reflections are not a consideration here.

At the higher frequencies (VHF and above), signals scatter easily. Nearby buildings, trees, and even rain can have an effect. Multipath, the result of several multiple reflections arriving at the receiving antenna simultaneously, can totally confuse an RDF set.

Even variations in temperature and humidity make subtle changes in the apparent paths taken by radio waves and when a radio signal passes the coastline, it takes a sharp bend. This coastal refraction must be taken into consideration for accurate bearing measurements. But, before we give up entirely, let's have a closer look at some of the successful methods used for radio direction finding.

Homing In. Probably the crudest method of signal locating is by field strength readings. This process involves constantly monitoring of the strength of a radio signal while the finger is moving in a particular direction. Only a simple whip antenna is needed for this technique. If the signal becomes stronger, the listener is moving in the right direction; if it becomes weaker he is moving away; if it stays fairly steady, the RDF-Conveying vehicle is probably moving in a path at right angles to the location of the transmitter.

Field strength detection may be improved with the stair-step method of signal detection (see Fig. 1). As the name implies, stair-stepping involves a repeated zig-zag motion of the vehicle, with constant attention to resulting changes in field strength. By resolving the changes in meter readings into bearing on a map, a good idea of the location of the transmitter can be determined after just a few readings.

Since both of the previous methods involve moving toward the target, they are collectively known as "homing."

Triangulation. It isn't really necessary for the RDF operator to work so laboriously to zero in on his quarry; triangulation is much quicker. By using a directional antenna, one mobile station can take two bearings on the target from two different receiving sites. Superimposing the resultant compass readings on a map, the bearing lines will cross at or near the target, assuming no reflections alter the radio waves. Two receiving stations can do the job much more quickly by exchanging readings.

It isn't possible for one station to determine the actual *location* of a transmitter, only its bearing. This is because a transmitter may be powerful and distant, or weak and close. The receiver has no way of knowing.

There have been crude attempts at comparing the vertical angle (elevation) of skywave signals from distant shortwave stations with the angles of other known transmission sites, but conclusions arrived at in this way are often unreliable. Two receiving stations tend to improve accuracy.

The Omega System. The lowest frequencies are used for the longest distance measurements. The Omega system operates at the basement of the radio spectrum between 10 and 14-kHz. Because the wavelengths of these low frequency signals are so long, it is a simple matter to measure their phase angle relationships with good accuracy.

For example, suppose two identical transmitters were sending signals on the same frequency simultaneously. If the listener were midway between them, he would hear their arrival at the same instant. Since the signals are on continuously, it is possible for a trained listener to compare the arrival times of different portions of their waves.

By comparing the phase angles between the signals monitored from two (or more) signals of known position, it is possible for the listener to determine his position with respect to them.

Another venerable system for navigation is LORAN (LOng Range Aid to Navigation, shown in Fig. 2). Its powerful and raucous pulses are easily heard any evening (and most of the day) near 1900-kHz.

The principle of LORAN is similar to that of Omega, but instead of measuring the difference in arriving wave angles, timed pulses are compared. Since the pulses are transmitted by several coastal stations simultaneously, their arrival times should be the same to a receiver exactly in the middle of their cluster. Lanes, or marked pulses, are periodically transmited so that the receiver operator knows which set of pulses he is hearing and measuring. By comparing LORAN signals from several transmitters, a vessel at sea can get a

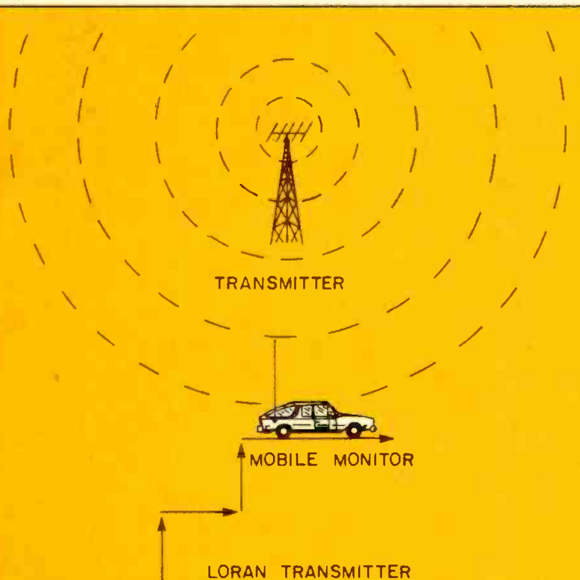


Fig. 1. The "stair-stepping" technique is one of the means by which a mobile RDF operator can get a fix on his quarry. By changing location in 90° "steps" it's possible to narrow down location of transmitter.

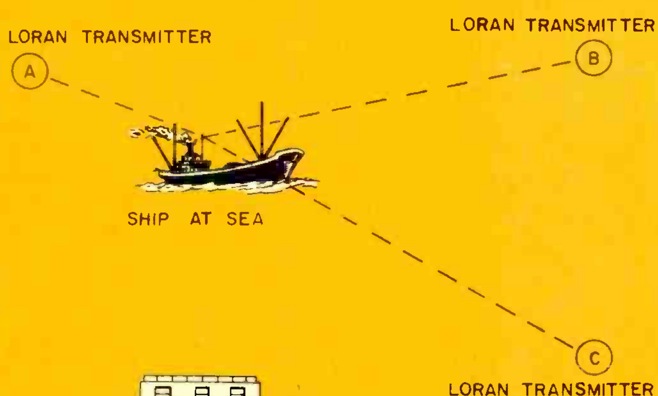


Fig. 2. Ships running up to 1500 miles offshore can find their positions by triangulating the signals received from LORAN transmitters. The intersection of the electronic lines of position and matching them up gives positions on LORAN charts.

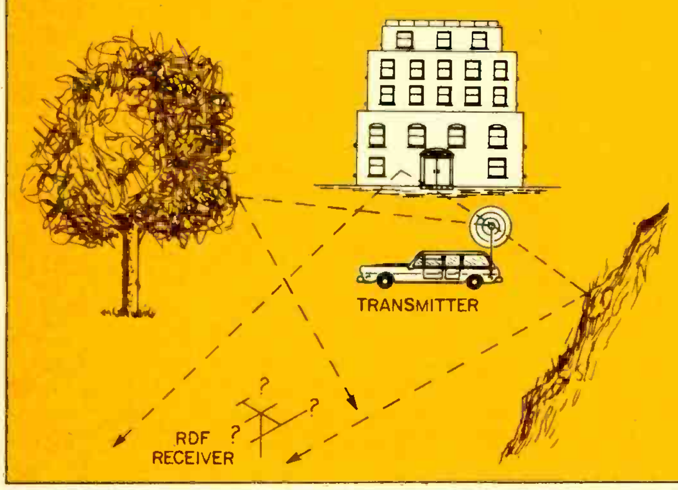


Fig. 3. Signal reflection from terrain, buildings or even trees can wreak havoc with RDF detection attempts, particularly at higher frequencies. The operator must always allow a large margin of error in readings.

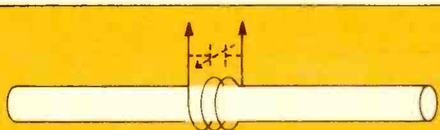


Fig. 4. A ferrite rod antenna with a single layer of wire coiled about it forms a highly effective "loopstick" RDF antenna. This antenna can be tuned to a precise frequency, boosting the signals.

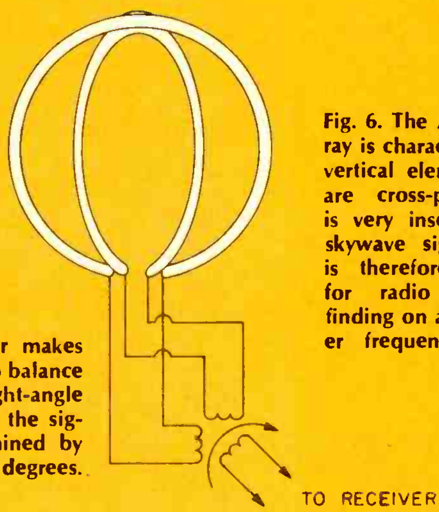


Fig. 5. The goniometer makes use of a rotating loop to balance the outputs from two right-angle loops. The direction of the signal received is determined by a dial calibrated in degrees.

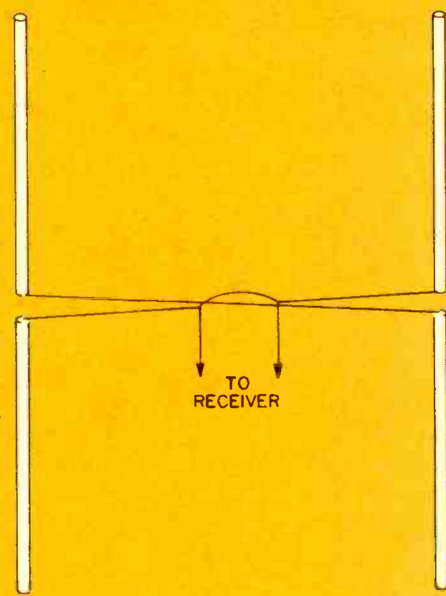


Fig. 6. The Adcock array is characterized by vertical elements that are cross-phased. It is very insensitive to skywave signals, and is therefore popular for radio direction finding on all the lower frequency bands.

pretty good idea of its exact position. Fishing fleets often make use of LORAN to return to locations where schools of fish can be found.

High Frequency Problems. At the higher frequencies, from shortwave through VHF and UHF, it becomes increasingly difficult to make anything meaningful out of phase relationships. Not only are the periods of the waves extremely short at those wavelengths, but the radio signals themselves are severely buffeted about by terrain and man-made obstacles (see Fig. 3), making measurement meaningless.

Loop Antennas. The simplest, and certainly one of the oldest methods of RDF involves the use of a simple loop of wire or metal tubing. It behaves like a single-turn winding of a transformer, coupled to the incoming signal by a core of air. If the front on the arriving wave strikes against the loop broadside, current flows simultaneously in opposite directions, resulting in signal cancellation, or a null signal.

If the signal strikes the edge of the loop, current flows primarily in one direction, and a signal will be heard.

In order for the loop to work properly, it must be physically small compared to the wavelength of the signal to be received. Loops are typically only a foot or two in diameter, making their capture area very limited. For this reason, they make poor receiving antennas unless used with amplification.

More recently, there has been a trend toward the use of ferrite material to reduce the physical sizes of the loop without reducing the amount of signal pickup. A rod of ferrite is wound with a single layer coil, which may be tuned to enhance a particular frequency, as illustrated in Fig. 4. The axis of the rod will indicate the directions of the received signal by a deep null. Maximum signal is received broadside off the "loopstick" antenna.

A major disadvantage to the loop is that it has "bidirectional ambiguity," that is, it doesn't know its front from its back. It has two maximum and two minimum signal levels, each pair separated by 180°.

Improving The Loop. But there's a way around the two-faced loop; it can be coupled with a sense antenna to give a cardioid (heart-shaped) directivity pattern. In this case, a short whip captures some signal, feeding it into the system in a manner which will cancel (at least partially) some of the signal coming from one direction because of its phase relationship.

The ADF (automatic direction finder or "radio compass") is one of the more familiar applications of the common loop antenna system.

The Goniometer. A more sophisticated version of the loop has a name which would be a great item on a trivia quiz: The Bellini-Tossi goniometer!

In the goniometer, illustrated in Fig. 5, two loops are mounted at right angles to one another. Balanced transmission lines feed the signals to a pair of coils also mounted physically at right angles to one another. A third coil is rotatable and is used as a coupling link to the receiver.

If a radio signal were to arrive at an angle positioned midway between the two loops, it would cause identical signal voltages to flow down the feedline. The pickup coil is adjusted midway between them for a balanced signal. If the signal favored one loop more than the other, the pickup coil would have to be rotated proportionately to balance the two signals.

In actual application, the pickup coil is connected to a shaft which turns a needle on a compass card, indicating the bearing of the incoming signal.

Unfortunately, as neat as the system sounds, it is limited to the lower frequencies. The capriciousness of sky waves bouncing back from the ionosphere at oblique angles confuses the loop at shortwave frequencies.

Adcock Array. Widely used in the HF portion of the spectrum for many years, the Adcock array (Fig. 6) is still a classic approach to direction finding.

In this scheme, two vertically-polarized dipoles are cross-phased and fed commonly to a receiver. The Adcock is insensitive to vertical waves, making it more reliable than the loop for RDFing. It is essentially a null indicating antenna array.

Two Adcocks may be mounted at right angels to one another, resolving bearings in a manner similar to that used in the goniometer.

Steerable Arrays. It is possible to switch among a number of fixed antennas, each pointing in a different direction, to determine the bearing of an unknown transmitter. Obviously, the more antennas, the better accuracy (resolution) the system will have. A total of 360 antenna elements facing outwards in a circle should theoretically provide resolution of one degree.

While such a switching process could be accomplished by a motor, it is done electronically by diode switching in modern RDF installations.

The most common configuration of the switched circular cluster of elements is known as the Wullenweber array. It is popularly used by the FCC and military intelligence installations. The Wullenweber has an extremely wide frequency range and excellent bearing accuracy. Readout may be on a calibrated meter or cathode ray tube display (CRT).

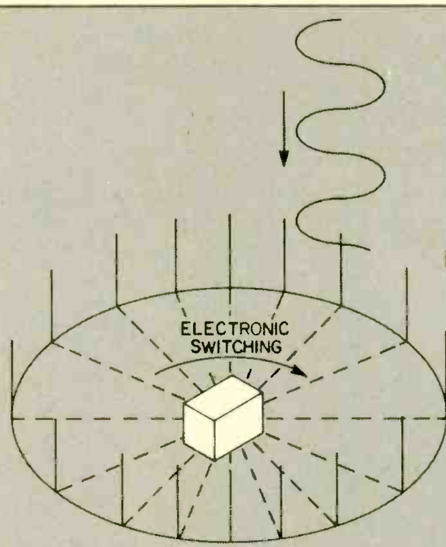


Fig. 7. A Doppler sensing antenna makes use of rapid rotational signal switching.

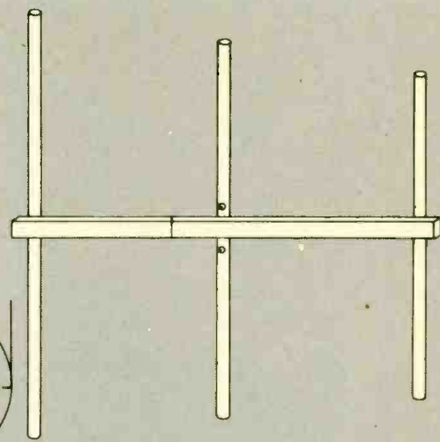


Fig. 8. The Yagi is a classic of antenna design known for its simplicity and performance over a narrow frequency range.

Doppler Sensing. Some inventive radio amateurs have developed miniature electronically-switched arrays. One of these, the "DoppleScAnt" was developed by Terrence Rogers, WA4BVY. It makes use of the fact that if the antennas are switched fast enough, there will be a slight frequency shift in some of the elements due to the relative motion of the antenna with reference to the arriving radio wave (see Fig. 7).

The principle involved is analogous to the change in pitch heard from a train or car horn as the source passes the listener, and is known as the Doppler Effect. In the case of the Doppler antenna, the source is fixed but the antenna moves electrically.

Since only certain elements of the antenna will be affected strongly by the Doppler Effect (those elements moving in the same direction as the radio wave), the antenna can resolve bearings with precision.

VOR Direction Finding. Used by private and commercial aircraft, VHF Omnidirectional Ranging works much like a lighthouse beacon, with a known period of rotation measured against a compass bearing. For example, if you know that the beacon can be seen once every 5 seconds, and you know that you saw it one second after it began its sweep past north, you may assume that you are positioned at a point 20% around a circle (72°) with the lighthouse at the center. Knowing the location of the lighthouse, it is a simple matter to determine your bearing relative to it.

The airport VOR works the same way, except a sweeping radio beacon is intercepted instead of a light. When the beam sweeps by your aircraft, you can determine your position relative to the airport because the signal also lets you know when it swept a fixed reference direction.

Voltage Averaging Verticals. If two identical vertical elements, each connected to a receiver by an identical length of cable, were to receive a signal arriving at right angles to a line between them, their signals would cancel each other and nothing would be heard. But if the arriving radio wave were skewed slightly off to the side, there would be a voltage difference induced in the two antennas, and output would occur at the receiver.

By carefully calibrating such a system, it should be possible to provide a good system of bearings on an arriving signal. And, while the system has bidirectional ambiguity, it is possible to determine which way the signal increases with respect to the two elements.

When two such antennas are mounted on a vehicle roof, left and right are easily determined. And center-zero provides a good bearing. This system has been developed to a high level of dependability by a volunteer group of pilots and radio amateurs. It is widely used for locating the automatic emergency beacons aboard downed aircraft. In the most commonly used version, two ¼-wave verticals are separated by ¼-wave distance. They are electronically switched back and forth several hundred times each second, comparing their cardioid patterns.

In actual use, resolution has been as sharp as one foot on ground targets while flying at 5000 feet!

VHF and UHF. Due to the short wavelengths of higher frequency radio signals, highly directional antennas may be built having short dimensions.

For fixed locations, several popular antenna designs mounted on rotators

(Continued on page 83)

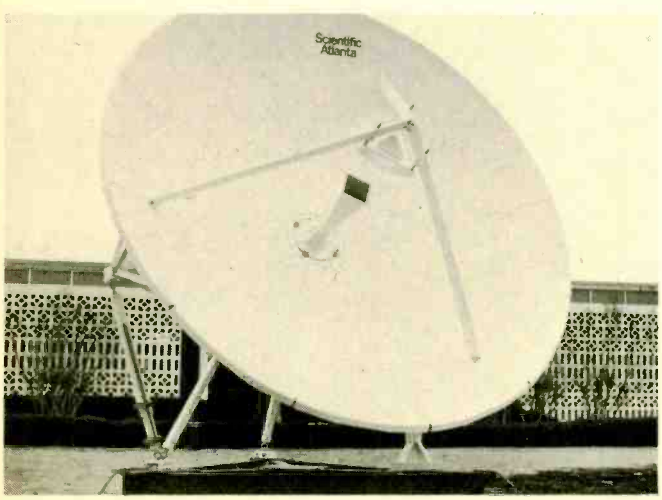


Fig. 9. The parabolic dish reflector gives the highest gain and directivity of any antenna system now in use. It traps nearly all the radio energy which strikes it, and concentrates it to give maximum results. A small dipole or cavity is at the dish's center.

Convert your AM/FM pocket radio into an aircraft scanner

Monitor the skies with this simple receiver conversion

BY ROBERT GROVE

"DELTA FLIGHT 759 TO KNOXVILLE TOWER . . . what is your local weather? We're experiencing a lot of turbulence."

"Cessna 616 to Miami Center . . . we've spotted what looks like a boat in trouble. Would you notify the Coast Guard?"

The VHF band is filled with intriguing listening. Private aircraft, commercial airliners, military and government flights fill the skies 24 hours a day, seven days a week. Many scanner listeners are discovering the fun and excitement of tuning in on aircraft in flight.

But aircraft scanners are expensive; even pocket aircraft radios command premium prices. There is another way.

Any inexpensive pocket AM/FM portable radio may be converted into an effective aircraft band monitor. The receiver's AM band will remain untouched, so that you will still be able to listen to your favorite local broadcast stations. While the changes to the FM band will allow aircraft band reception, the procedure may be easily reversed to restore the set to FM band reception if desired.

Absolutely any AM/FM portable, even the larger multiband radios, may be converted. Our illustrations happen to use the Radio Shack 12-609. You may wish to check local discount houses for advertised specials on similar radios; flea markets and garage sales are also excellent sources of pocketable AM/FM radios. These are frequently found for $5 to $10.

The Conversion. Before beginning the changeover process, it is a good idea to check the radio completely to determine that it is in good working order. Use a fresh battery and tune it through its FM range to be sure that it is functional, sensitive, and that its audio is loud and clear.

Next, remove the back carefully and locate the IF transformers, as shown in Fig. 1. Some of the IF transformers are used for AM and some for FM. It is virtually impossible to predict accurately which are which without a diagram. Fortunately, only one of them is of interest to us for this conversion project: the FM discriminator transformer; and it is easily located.

If you examine the parts layout of your radio carefully, you will note that one of the IF transformers, probably the one farthest removed from the tuning capacitor, will have two or three glass diodes alongside it (see Fig. 2). That is the discriminator transformer; the diodes are the detectors which extract audio from the IF circuitry. Switch the radio on and adjust it to receive the background hiss between FM stations.

Using an appropriate non-metallic fiber, wood or plastic tool, adjust the slug slightly until the background hiss peaks to a maximum. You have now converted the radio to receive AM! This step was necessary because *all* VHF aircraft transmissions are AM.

The next step is to increase the tuning range to receive the 108-136 MHz aircraft band. Since the receiver already tunes 88-108 MHz, we are nearly there!

Changing Frequency. Inspect the circuit board and locate two open-wound coils each consisting of four or so turns and positioned next to the tuning capacitor shown in Fig 3. Tune in an FM broadcast station (it will probably sound distorted now) and touch each coil lightly with your finger. When you touch one of them, the station will be detuned off-frequency; this is the oscillator coil. The remaining coil is in the RF amplifier circuit. Both coils will be altered to change the receiver's tuning range. To raise the frequency of the circuit we need to decrease the inductance of the associated coils.

There are several ways to decrease the inductance of a coil: spread the turns father apart; pinch each turn to flatten it slightly; twist the turns at right angles to each other; insert a brass slug inside the windings; remove one or more of the turns; short-circuit two adjacent turns with solder.

The first step in changing the tuning range of your radio will be to spread the turns of the oscillator coil widely apart with a small screwdriver. Be sure to spread them evenly and do not allow the coil to touch any adjacent metal part or wiring. Spread the turns of the RF coil similarly.

Now attempt to tune through the range of the dial, noting the locations of the FM broadcast signals. Chances are you'll find them cutting off below

(Continued on page 84)

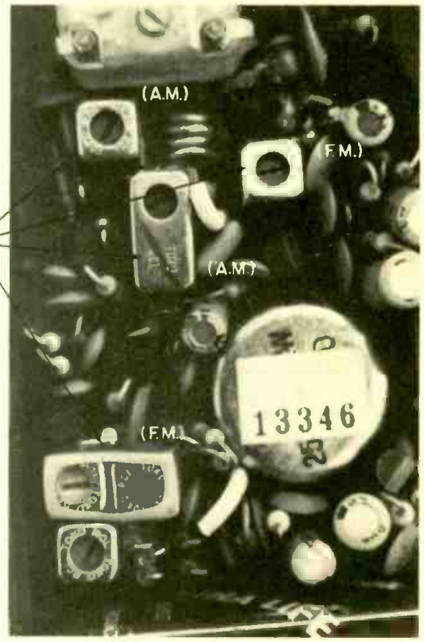
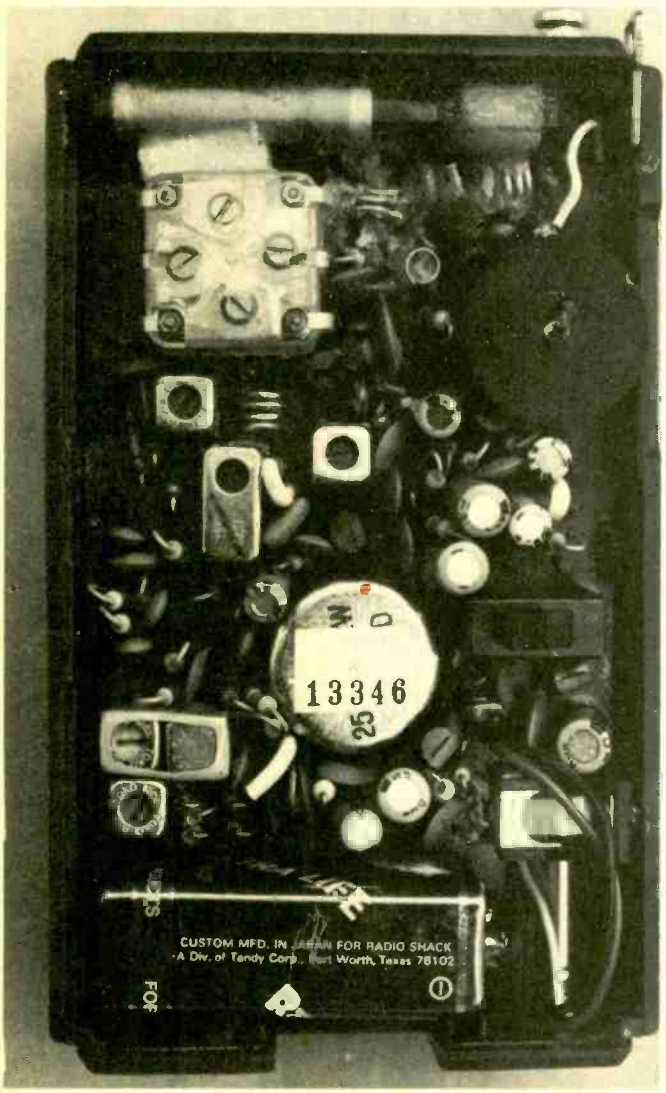


Fig. 1. The IF transformers are shown in this photo. Since it is virtually impossible to tell which are for AM and which are for FM, a process of trial and error will be employed in retuning the frequency.



The open radio gives an idea of the overall parts placement. It is important to work methodically, going from one area of the conversion to the next in the right order. You will find most layouts similar.

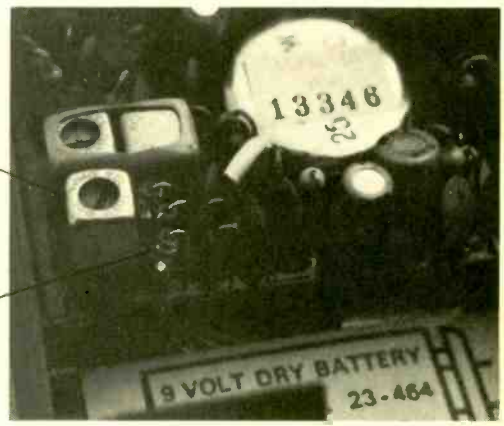


Fig. 2. The discriminator transformer, shown here, has several glass diodes beside it. These take audio from the IF stage.

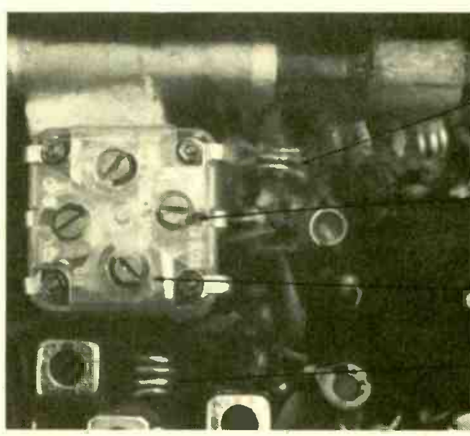
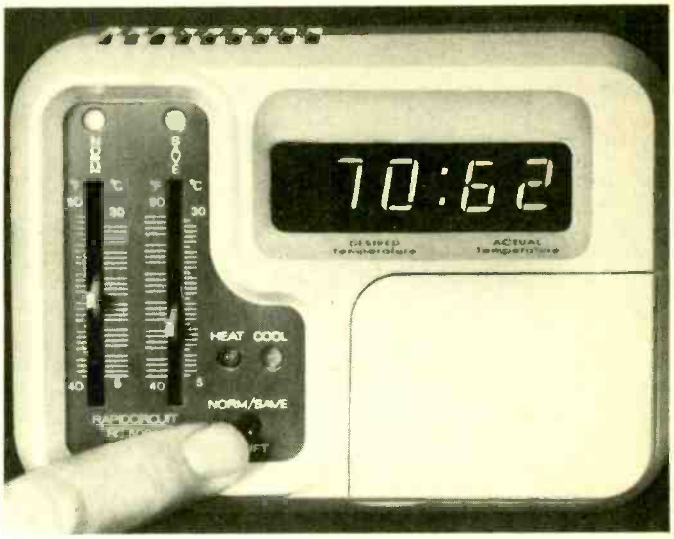


Fig. 3. The two open wound coils located next to the tuning capacitor must have their inductance raised to raise the frequency.

E/E INSTALLS THE...

RAPID CIRCUIT RC-6000 ELECTRONIC CLOCK THERMOSTAT



CIRCLE 99 ON READER SERVICE COUPON

Micrologic circuitry watches your energy costs

THIS PAST WINTER, the new national pastime was "riding the thermostat." Homeowners everywhere jockeyed the thermostat setting for various household situations in a losing effort to keep their paychecks in *their* pockets and not in Abdul's pantaloons. Their efforts were honorable, but intentions are not always fulfilled by occasional usage. In the rush to get out of the house and to work in the mornings, the temperature setting was usually left too high—keeping the family cat cosy warm all day. "Enough!" was the cry heard from California to Maine. Electronic temperature control is the answer for which Americans were asking.

And the solution is an electronic clock thermostat which can reduce the energy usage from 9% to 29% depending upon the region of the country in which your home is located, and other conditions. For example, if you keep your home's temperature down at 60°F half the time and 70°F the remainder, you stand to save approximately 15% of your fuel bill during the heating season, or $150 for the 12 hour setback. And that amount is based on last season's oil and gas prices. Wait and see what Abdul has in store for you next winter.

To see what an electronic clock thermostat could do for a home in the New York City area, one unit was installed for consumer home testing. The editors selected the new Rapid-Circuit RC6000 dual setback thermostat for heat/air-conditioning control that presently retails for $149.95. This model also controls the home's air cooling system in the summer, providing additional savings. After the RC6000 was installed (details shortly), here's what we pleasantly discovered.

How It Works. The secret to the clock thermostat system working on one pair of wires between the remote control relay downstairs and the clock thermostat upstairs is that the leads carry both AC and DC voltages. Refer to the Theory Block Diagram drawing.

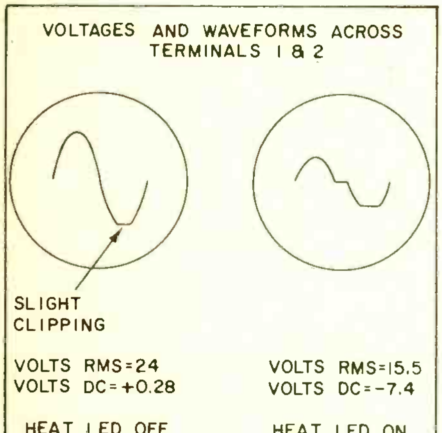
AC power is stepped down from the line to 24-VAC and sent through the control box to the thermostat. We connected an oscilloscope and voltmeter across terminals 1 and 2 at the thermostat. There was a little flattening of the 24-volt sine wave indicating low-power rectification that provides DC power to drive the circuits in the thermostat. The clock circuit used this DC power and pulses from the 24-VAC feed to operate the clock circuit. Also, the DC power drives the thermostat circuit, setback circuits, temperature sensing circuit, display circuit, and logic circuits all in the thermostat unit upstairs.

Now the problem remains for the thermostat to tell the remote control box that it should turn the furnace *on* or *off*. Well, in the absence of any heat *on* signal, as the power condition is described above, the relay circuit is not energized. When the thermostat wants the furnace to go *on*, it rectifies the 24 volt AC in the line. Our scope and voltmeter indicated that the sine wave was distorted dropping the rms voltage to 15.5 volts and the DC voltage superimposed on it reversed to −7.5 volts. This causes a DC politity sensitive relay circuit in the remote control box to energize closing a set of contacts connected to the furnace "heat on" circuit. It's that simple. A temperature sensitive transistor detects room temperature, another circuit compares it to the temperature setting being used (normal or setback), and the specially programmed logic circuit does all the rest. What made this thermostat possible was the development of micrologic chips at low cost, otherwise the thermostat would be so large the room itself would be heated by the heat generated by its circuits.

Temperature. The clock face readout on the thermostat indicated both the thermostat's preset temperature and the actual room temperature. Desired temperature is set by a slide control located on the left side of the thermostat's face. In the RC6000, there are two slide controls; one for NORM (normal) setting, and one for SAVE (setback) temperature. By pressing the NORM/SAVE button once, the temperature indication is switched from NORM (normal) to SAVE, and back again by depressing the button one more time. A yellow LED on top of each temperature slide control illuminates indicating the NORM or SAVE mode of operation.

Time. Yes, you can have the correct time also, by sliding the TIME/ALT/TEMP switch all the way to the left. The HRS button and MINS button set the clock to the correct time with AM or PM indication on the clock face. The time feature is not an idle add-on feature, since the RC6000 must keep track of the time for programmed setbacks in temperature. With the switch in the ALT position, the clock face will alternate between temperature and time indications. The clock also controls the dual temperature setback feature. For example, the clock can be programmed to set back the temperature at 8 A.M. when you leave for work, and 11 P.M. when you retire for the night. The temperature can be returned to the normal mode at 6:40 A.M., just prior to your getting out of bed, and at 4:30 P.M. just before you return home for the evening. Of course, you can use both setbacks or just one. A SETBACK button assists in programming set times for temperature changes.

Bonuses. Built into the RC6000 are a few additional features. Two LEDs indicate heating and cooling system status. When the red HEAT LED is on, the furnace is operating; and when the green COOL LED is on, the air conditioner compressor is on. The NORM/SAVE button allows the owner to override the clock programming. For example, should you leave the home vacant after the evening meal to go to the movies, the heating temperature can be shifted down to the SAVE setting to conserve precious fuel. The HEAT/COOL switch selects either heating or cooling system control for winter/summer energy savings. The AUTO/MAN switch permits the thermostat to automatically or manually



This diagram shows the difference in wave forms when the heat is on and when it's not.

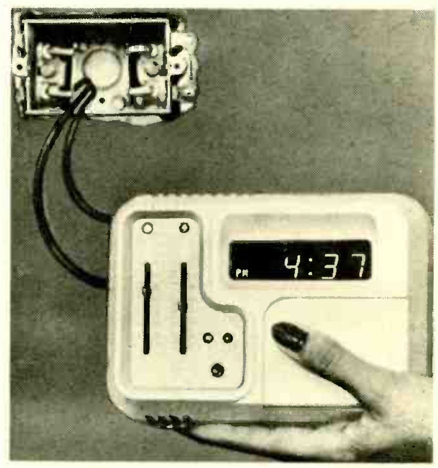
control the air conditioner fan. Inside the unit is a mini four-hyphen switch device that allows setting temperature differentials from 1 to 15 degrees. This feature allows a time lag during which the desired temperature reaches remote areas in the home away from the thermostat. The unit comes preset for four degrees—suitable for most homes. Not seen, but built into the circuit is a two-minute, safety-lag setting during cool operation to prevent possible damage to the compressor from too rapid recycling. And, if you want to think metric, you can switch from Farenheit readings to Centigrade readings at the flick of a switch.

Murphy's Law. If something can possibly go wrong, it will! The RC6000 comes complete with illustrated installation instructions. Just follow these instructions and simple diagrams, and that is it! In our actual installation, the transformer supplied with the RC6000 did not fit into the knockout of the junction box supplying power to the furnace. The box flush-mounted to a fireproof surface leaving no room on the sides of the box to mount the transformer. To solve the problem, a new cover plate for the junction box with knockout hole was purchased from the local houseware store. Be sure to close up any open knockout hole.

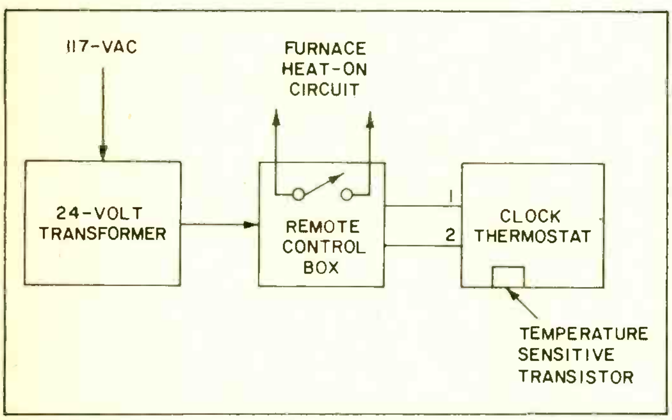
The next problem was identifying the two wire leads from the basement to the upstairs thermostat location. The color trace fiber in the leads could not be found or never existed. Since lead identification is important to the RC-6000 installation, we began to solve the problem by connecting a drycell to the two leads in the basement. The positive lead was labled "1" and the negative lead labled "2". Upstairs, a VOM picked out the positive lead quickly and it was labled "1", the other being "2". Thus identified, the hookup continued.

Should You Get One? There is no doubt about it! Your home will be more comfortable during normal living hours due to the RC6000's temperature regulation of the living areas with a total reduced cost of bulk fuels used. That's right! You use less oil or cubic feet of gas to keep your home comfortably warm, which means cash savings in an inflationary period.

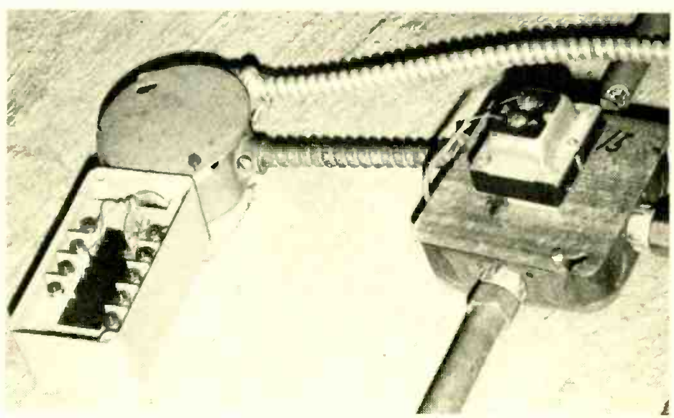
The RapidCircuit Electronic Clock Thermostat comes in four models: with single or dual temperature setback, and with or without air conditioning control, with prices ranging from $119.95 to $149.95 for the top-of-the-line RC-6000 model described in this article. Get more details by writing direct to RapidCircuit Corp., 5721 18th Avenue, Brooklyn, New York 11204 and do it before next winter does you in. For more information circle number 99 on the readers service coupon. ■



The RC-6000 control unit is easily held in the hand, and fits in with almost any decor.



At the heart of the clock thermostat is a temperature sensitive transistor, which determines the setting for the microprocessor.

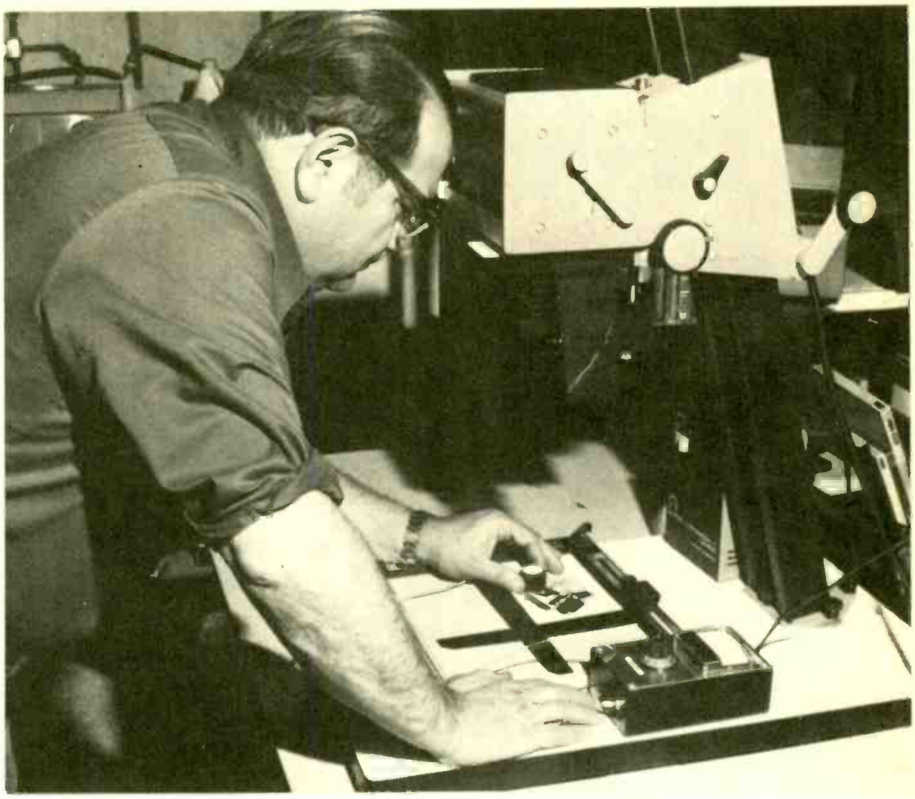


A junction box such as this one makes the installation neater and more convenient. They are available at hardware stores everywhere.

Darkroom Contrast Meter

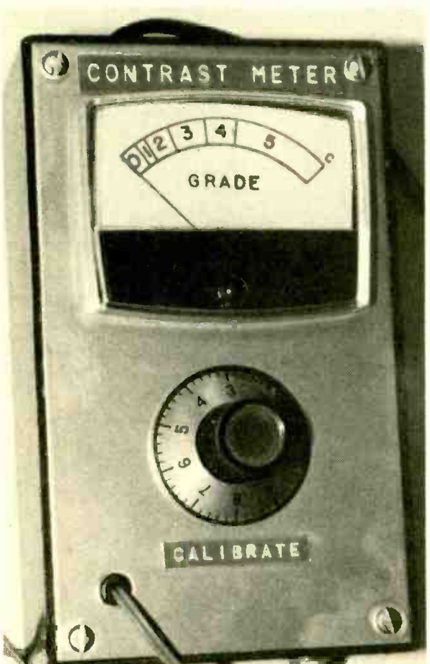
Make perfect prints every time

BY HERB FRIEDMAN



WITH THE COST OF SILVER rising faster than the price of oil, every test strip or "washed out" print you throw in the wastebasket represents a considerable amount of money. Money you can spend on film, chemicals, and other photographic gear.

A printing exposure meter saves time and material by almost insuring a perfect exposure at the first try. However, there remains the problem of proper contrast. To be more specific, matching the paper grade or variable contrast filter to a particular negative's contrast range. Expert printers sometimes "eyeball" the correct paper grade by simply looking at the negative. Nevertheless, hobbyists, like you and I often must run through a stack of printing paper to make test prints. This can be an evening's work or more.



Photograph of Contrast Meter shows its meter calibrated for various paper grades.

Using a photographic contrast meter you can eliminate virtually all guesswork and test prints. A contrast meter automatically tells you the *standard* contrast paper grade for an "average" negative. This means a negative containing both highlight and shadow detail.

Every photographer has his or her idea of what constitutes the proper contrast range for a particular black and white print. In actual fact, there are "standard" contrast ranges for each paper grade. However, the grade of a particular paper might not precisely match the accepted standard. As a general rule, if you match the paper grade to the negative's "standard" contrast range you will wind up with a *good* to *excellent* print. Bringing the print up to exhibition quality might take some tweaking of the basic print, but at least you will be starting out with something that's *good.*

The contrast meter shown is self-calibrated to the "standard" contrast grades. It will be accurate if you use the specified components. To start with, focus the enlarger on the easel. Then, position a photoresistor light pickup under the maximum light area (which will be *d-max* or maximum shadow density). Adjust the contrast meter for maximum meter reading. Then, you move the pickup under *d-min,* the minimum light transmission (which is maximum highlight in the print). Now, read the paper grade off the meter scale.

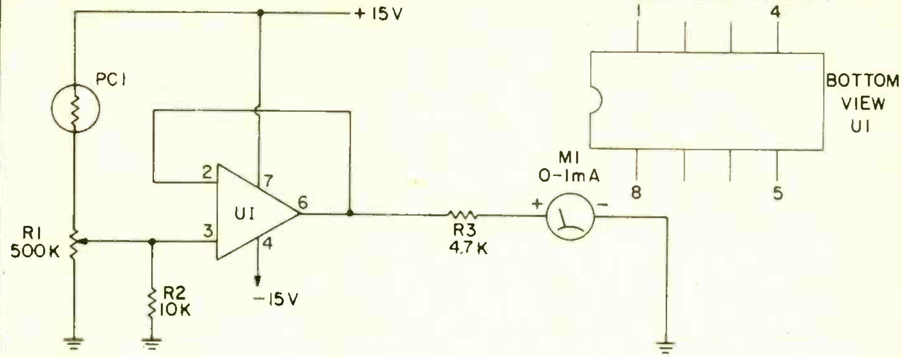
For the sake of discussion, let's assume your meter reading is dead center in the #2 grade. Let's assume you like your prints with a little extra "snap" (contrast). If you use #2 paper or filter you'll end up with a "standard" contrast range. Slightly extending development, process or using #2½ filter or #3 paper, will give the extra snap your looking for. If the meter reads right on the border between grades #2 and #3, you should move to the nearest higher grade paper (#3) for "average" photographic scenes. For portraits, use #2½ or #2 for a "softer" effect.

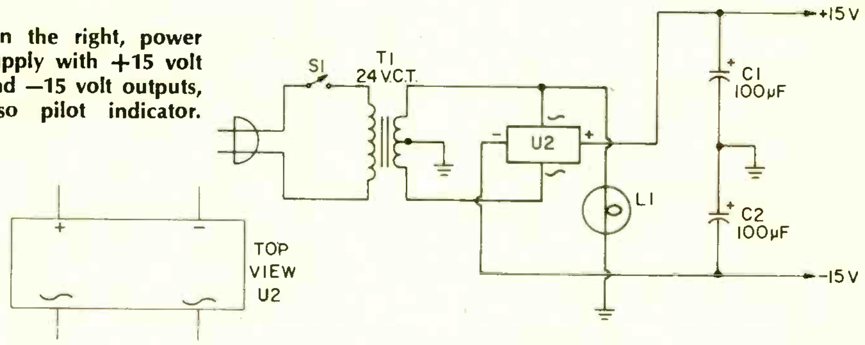
Construction. The project is self-calibrated; you can use it as soon as the last wire is soldered. However, the calibration is accurate only for the specified photoresistor and meter. The meter scale is cemented on the existing meter scale. The new scale is automatically calibrated to the resistance range, rate of change, and spectrum sensitivity of photoresistor PC1 in the schematic. *The scale is inaccurate for any other photoresistor or meter.* Use a Calectro D1-912, 0-1mA meter. The printed circuit board shown later is designed to fit directly over the meter's terminals. Radio Shack has an 0-1mA meter which appears to be similar to the Calectro. This meter has similar electrical characteristics and can be substituted; its terminals, however, are not the same as the Calectro and the PC board will not fit, nor are the terminals strong enough to support the PC board because they are simply small solder lugs. If you mount the PC board off the meter, you may substitute the Radio Shack meter.

The parts layout is not critical, so you can use the PC template shown left or make your own. The advantage to our layout is that it fits the Calectro meter. Use only the IC2 bridge rectifier specified. It has the new lead arrangement with both the positive and negative terminals on the same side. If you substitute the older "diamond" lead bridge rectifier with positive and negative outputs on opposite sides, change the PC foil layout for IC2 accordingly.

IC1 is any type 741 operational amplifier. We recommend the 8-pin mini-DIP because it matches the PC layout. you may substitute a TO-5 or 14-pin mini-Dip type 741 IC. (It doesn't matter what or how many letters or numerals are added after the "741," as long as the device is a 741, it can be used as the amplifier in this project.

There isn't sufficient clearance between the component side of the PC board and the meter case for capacitors C1 and C2 so they are installed as shown, on the foil side of the board. They are the last PC board components installed; even the two wire jumpers are installed first. Simply pass the leads through the PC board from the foil side, press the capacitors against the board, and then solder the leads to the foil using as little solder as is possible. Snip the excess lead length flush with



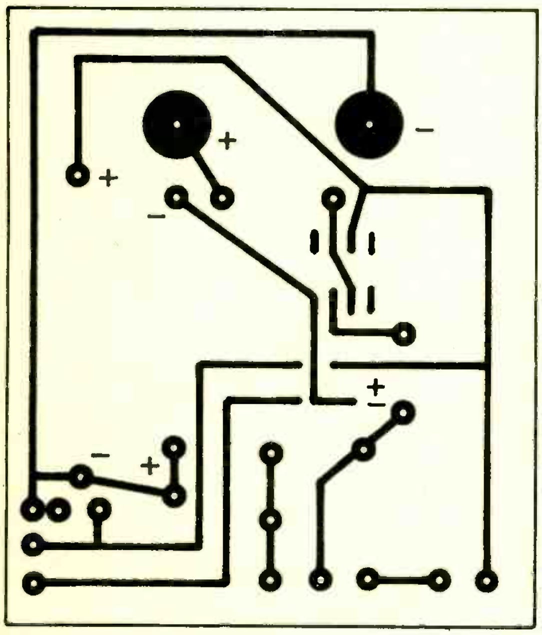


On the right, power supply with +15 volt and −15 volt outputs, also pilot indicator.

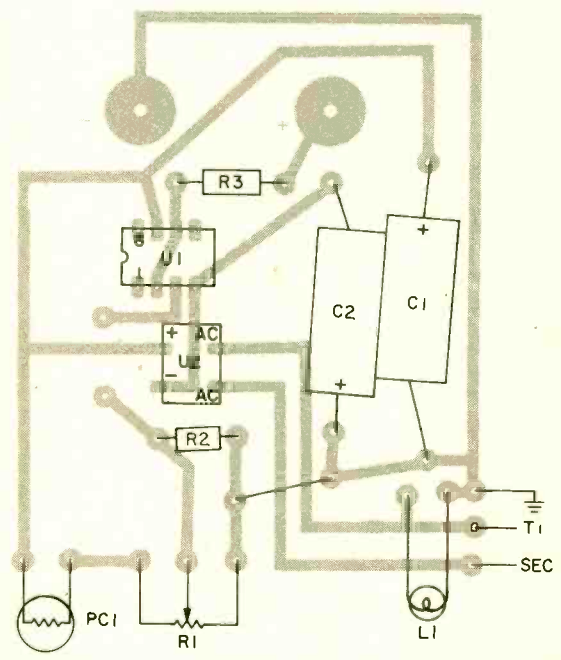
PARTS LIST FOR DARKROOM CONTRAST METER

C1, C2—100-mF, 25-VDC capacitor
I1—14-volt replacement lamp, see text (or Radio Shack 272-1141)
M1—0-1 DCmA meter, Calectro D1-912 (see text)
PC1—Photoresistor, National type 4921 (do not substitute)
R1—500,000-ohm linear potentiometer
R2—10,000-ohms ½-watt resistor
R3—4700-ohms, ½-watt resistor
S1—SPST switch
T1—Transformer 120v. 24v. C.T. at 0.1A or higher current
U1—Integrated circuit type 741 (8-pin mini DIP version, see text)
U2—50 PIV Bridge Rectifier, Radio Shack 276-1161 or see text
Misc.—Cabinet, printed circuit materials, etc.

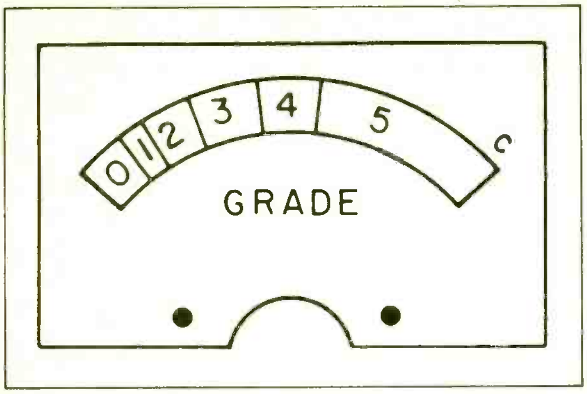
Photoresistor PC1 is available for $4.00 from Custom Components, Box 153, Malverne, NY 11565. Add $2 per order for postage, handling and insurance. Residents of New York State must add sales tax. Canadian orders must include an additional $2.00 for shipping. No foreign orders, please.



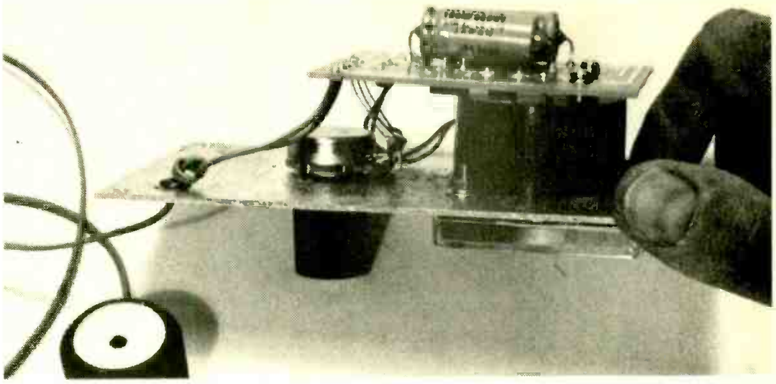
This is the Contrast Meter PC board with the etched side up. Make sure to observe meter polarity markings over the meter.



On the right, can be seen the Contrast Meter looking at the component side of printed circuit board.



Above can be seen the meter with its highly non-linear markings which correspond to various grades of paper.



Notice how the large capacitors are mounted on the etched side of the PC board. The meter connections are used to support the entire PC board.

the board on the component side.

The meter has no pilot lamp and you obviously must have some form of illumination if you don't want to juggle a flashlight each time you take a reading. Illumination is provided by a pilot lamp you must install within the meter.

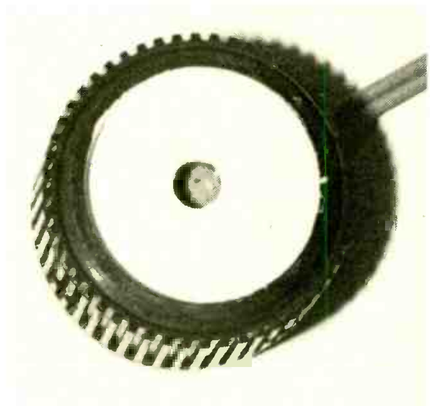
Modifying The Meter. Very carefully remove the plastic meter face; it simply snaps off. If you have difficulty, use a small screwdriver at the notch molded into each side of the back of the face. Now look at the back of the meter. It has two mounting screws and two raised circular "boss' " where two additional mounting screws would go if there were four mounting screws. Locate the "boss" at the bottom of the meter and very carefully, using a slow drill speed, drill a ¼-inch hole through the center of the boss. Take extreme care not to damage the meter pointer.

One way to sharply reduce the possibility of pointer damage when you drill the hole, is to make the hole in three passes. Start with a small bit of approximately 1/16" move up to approximately 3/16", and finally ¼".

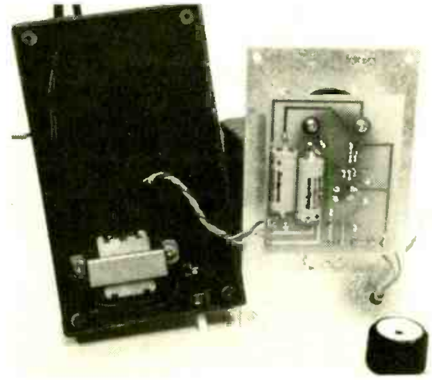
Next, remove the two screws that secure the meter scale and slip the scale *upwards* from under the pointer. Using scizzors, cut out the new meter scale we've provided, staying to the inside of the black outline. Using a paper punch, or any other punch approximately 3/16" to ¼", punch the holes for the mounting screws using the "dots" as the target centers.

Coat the original meter scale with a thin layer of rubber cement and apply the new scale, taking extra care that it's aligned with the top and side edges of the original scale. Slip it under the pointer—and replace it in the front of the meter again.

The pilot lamp is installed next. I1 is a 14 volt replacement pilot for CB transceivers; it comes with attached wire leads. If you cannot obtain the 14 volt replacement type use the 12 volt type specified in the parts list. (The 14 volter, *in this project,* will have slightly reduced brilliance, which is what's needed in a dark room.) Place a thin ring of contact adhesive (such as Touch-n-Glue) around I1 where the metal base just touches the glass. Insert the lamp into the meter until it touches the front of the case, then push the glue down *very lightly* with a toothpick (don't force the glue into the case).



See text for size of precise hole drilled bottle cap which is now our light sensor and probe in the photograph shown above.



Everything has been assembled and cover has been removed. Cable connecting PC board to power supply should not be tight.

After 24 hours the glue will have shrunk and secured the lamp to the case quite securely.

Next, proceed to assemble the photoresistor pickup component.

Photoresistor PC1 is mounted in a small enclosure; anything from a large knob to a plastic or metal box will work. The only requirement is that the box be reasonably light tight. A clear plastic box cannot be used unless it is painted opaque. The pickup shown in the photographs is an ordinary replacement knob that has been drilled out to fit PC1, which is secured inside with plastic cement. The only critical aspect of the pickup is the hole under which PC1 is mounted: it must be 3/16", or the next immediate larger size, if you use numbered drill bits. *The project will not work accurately if the hole is larger or smaller because the meter scale is calibrated for PC1's characteristics under a 3/16" hole.* (Try to center PC1 under the hole.) The wire from the pickup to the meter can be anything that's convenient; usually, 3' is more than adequate. (Thin, rubber covered "speaker wire" is suggested because it's highly flexible and will not break.)

Final Assembly. Transformer T1 can be any 24 volt *center tapped* model as long as it's rated 0.1 ampere or higher. (Note that lamp I1 is connected from one side of T1 to the center tap—which is 12 volts.) Use any plastic utility cabinet large enough to hold T1 without interfering with the meter and the PC board which is installed on the cabinet's panel as shown.

Do as much of T1's wiring as is possible, leaving only the three connections from the secondary to the PC board, for the last connection.

Install the meter and calibration control R1 on the panel and then install the PC board on the meter (if you have used the type of assembly shown in the photos). Connect the wires from I1 to

(Continued on page 84)

Keeping a Shortwave News Log

Record the flow of current history

BY BRIAN ROGERS

AT MIDNIGHT GMT ON TUESDAY, January 23, 1973, the World Service of the British Broadcasting Corporation announced that Lyndon Baines Johnson, 36th President of the United States, had passed away at his home near Johnson City, Texas. On Friday, August 9, 1974, at 1500 hours GMT, station CFRX in Toronto, Ontario, Canada, stated that within one hour Gerald R. Ford would become President of the United States.

On Wednesday, March 26, 1975, at 0100 GMT, HCJB in Quito, Ecuador, reported that King Faisal of Saudi Arabia, while holding court in Riyadh, had been assassinated by his nephew, Prince Musad. Where did I get this information? Did I write to broadcasters and ask when and how they had reported various historical events? Did I travel to England and take notes while peering over the shoulders of the professional SWL's at the BBC's Caversham Park monitoring station?

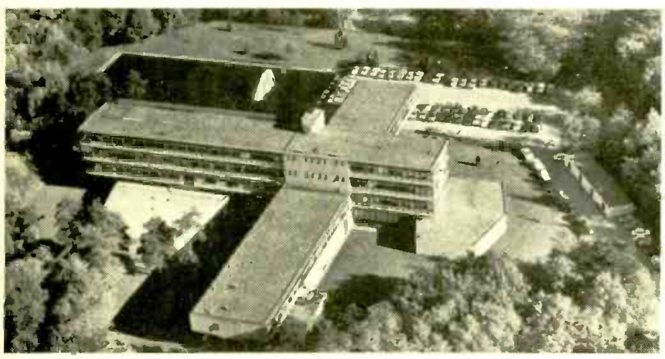
The answer to both these questions is "no." To obtain the facts that open this article, I merely looked in my log books, located in my den, in my house. Keeping track of the opening stories of shortwave news programs has become a "hobby-within-a-hobby" for me.

Log Sheets. Compiling a "news-log" is an easy task. Using commercially prepared logging pages, such as those provided by Gilfer Shortwave, in Park Ridge, NJ, the listener has a few inches of space in every line to make notes on. This is in addition to the usual time, date, and frequency columns. The Gilfer forms are pre-punched to fit in a three-hole, loose-leaf notebook. Other companies also market logging materials, or they can easily be made at home using ruler and pen or pencil.

Simple receiving equipment is frequently enough to pursue this "spinoff" hobby. Radio Canada International, Radio Nederland, Deutsche Welle, HCJB, and other stations that send strong signals into North America, begin their transmissions with newscasts. These broadcasts can usually be heard on inexpensive portable receivers.

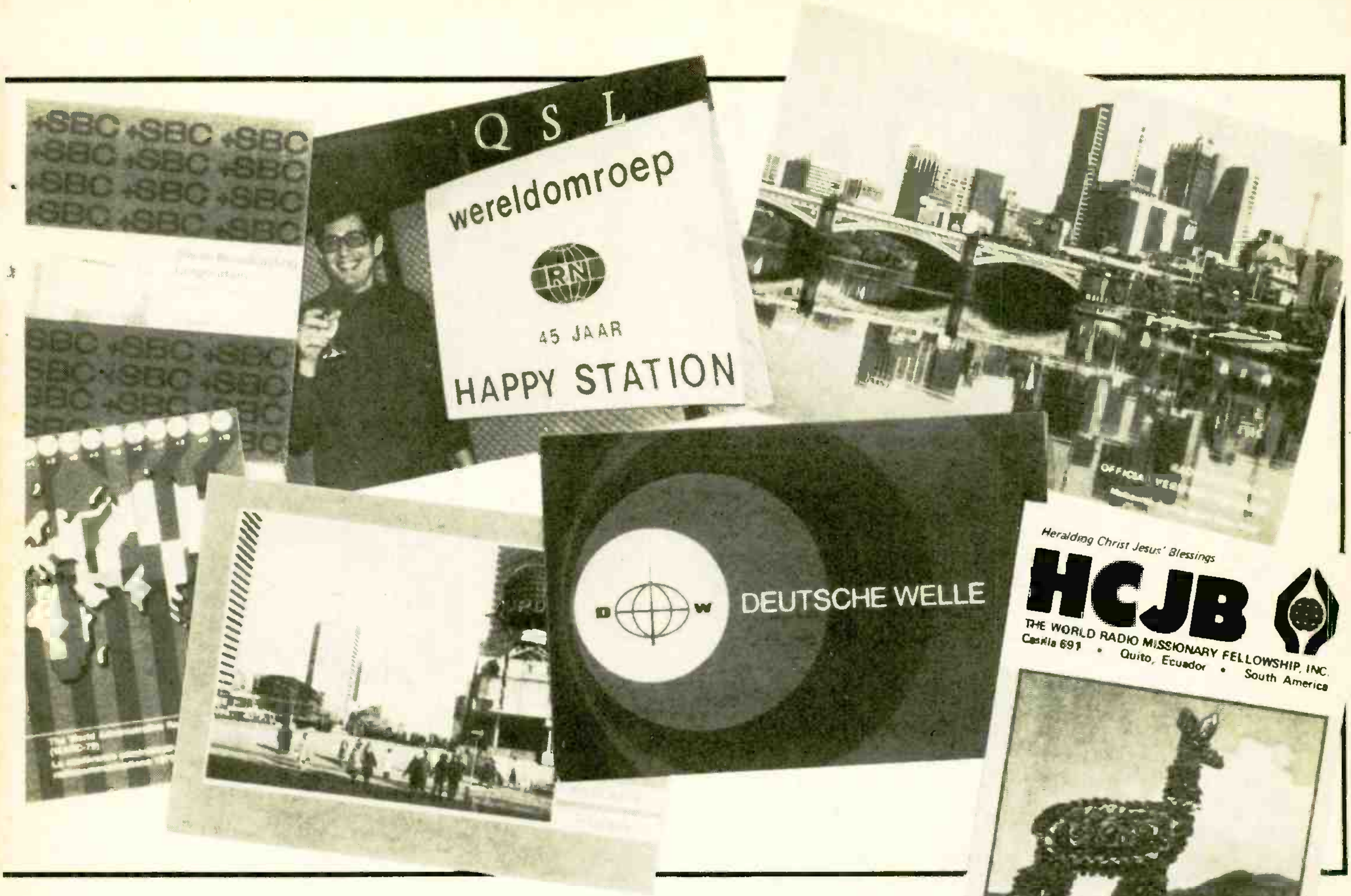
If you don't make your letters too large, you'll have space to jot a few brief notes about every newscast you hear. Recent notations in my log include such things as: "200 dead in Yugoslav earthquake;" "Whereabouts of Amin still a mystery;" and "U.S. ends economic aid to Pakistan over nuclear development." Each notation fits nicely into the four-and-three-quarter-inch "Program/Contact" space on a Gilfer LS-1 logging sheet.

The listener will soon nave his or her own personal chronicle of war, disaster, pestilence, revolution—all the occurrences that comprise the news of the day. It's often fascinating to examine the stories various stations use to open their newscasts and compare them with items carried by other broadcasters. Also, hearing one story as reported by



This modern building near Hilversum, Holland houses newsroom and production studios of Radio Nederland, a popular broadcaster.

From this flurry of activity in the BBC newsroom comes the best in international news coverage. The BBC has no peer in the field.



several sources can often contribute to the listener's understanding of it.

The record will include more than world events. Hearing what a foreign shortwave broadcaster says about happenings in your own country is frequently a good way to get information about your nation's domestic affairs.

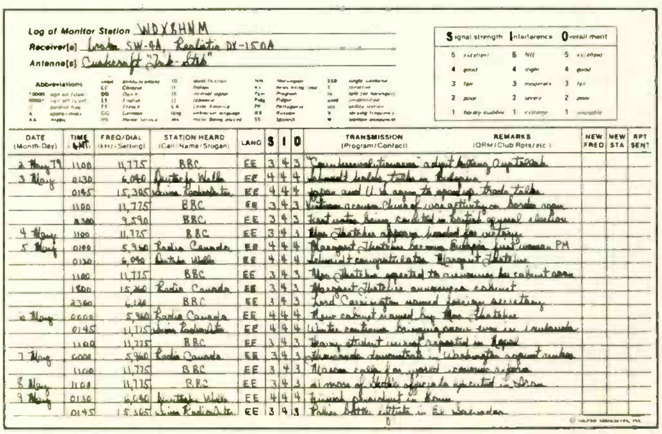
Following another country's "local" stories from day to day can be intriguing, too. Election campaigns are examples of this type of story, as are reports of natural disasters. How Darwin, Australia, recovered from the cyclone that devastated it on Christmas Day, 1974 was captivating news.

Student SWLs preparing papers can have knowledge of precisely when recent events occurred. All they need do is consult their own listening post logs.

Stories that develop over a long period of time, such as the events leading to the resignation of Richard Nixon, can be examined later to find out what happened in a daily parade of historical occurrences.

By writing just a few words during each news program he or she hears, the SWL will soon have a readily available volume of recent world history. And, the longer the listener keeps such records, the greater the time period covered by this individualized history book.

Gilfer Shortwave will send its catalog to anyone who writes. The address is Box 239, Park Ridge NJ 07656. ■

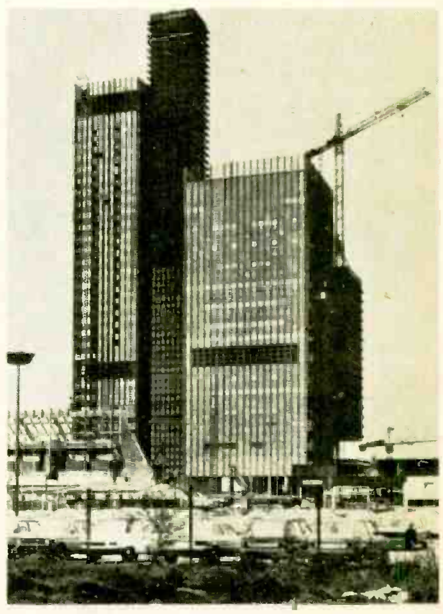


Log of Monitor Station WDX8HNM
Receiver(s) Drake SW-4A, Realistic DX-150A
Antenna(s) Cushcraft "Tele-Stik"

Signal strength	Interference	Overall merit
5 excellent	5 Nil	5 excellent
4 good	4 slight	4 good
3 fair	3 moderate	3 fair
2 poor	2 severe	2 poor
1 barely audible	1 extreme	1 unusable

DATE (Month-Day)	TIME (GMT)	FREQ/DIAL (kHz/Setting)	STATION HEARD (Call/Name/Slogan)	LANG	S	I	O	TRANSMISSION (Program/Contact) REMARKS (QRM/Club Rpts/etc.)	NEW FREQ	NEW STA	RPT SENT
2 May 79	1100	11,775	BBC	EE	3	4	3	[illegible]			
3 May	0130	6,040	Deutsche Welle	EE	4	4	4	Schmidt holds talks in Bulgaria			
	0145	15,385	Swiss Radio Intl	EE	4	4	4	Japan and U.S. agree to speed up trade talks			
	1100	11,775	BBC	EE	3	4	3	[illegible]			
	2300	9,590	BBC	EE	3	4	3	[illegible]			
4 May	1100	11,775	BBC	EE	3	4	3	Mrs Thatcher appears headed for victory			
5 May	0100	5,960	Radio Canada	EE	4	4	4	Margaret Thatcher becomes Britain's first woman PM			
	0130	6,040	Deutsche Welle	EE	4	4	4	Schmidt congratulates Margaret Thatcher			
	1100	11,775	BBC	EE	3	4	3	Mrs Thatcher expected to announce her cabinet soon			
	1800	15,260	Radio Canada	EE	3	4	3	Margaret Thatcher announces cabinet			
	2300	6,120	BBC	EE	3	4	3	Lord Carrington named foreign secretary			
6 May	0000	5,960	Radio Canada	EE	4	4	4	New cabinet named by Mrs Thatcher			
	0145	11,715	Swiss Radio Intl	EE	4	4	4	[illegible]			
	1100	11,775	BBC	EE	3	4	3	[illegible]			
7 May	0000	5,960	Radio Canada	EE	3	4	3	Thousands demonstrate in Washington [illegible]			
	1100	11,775	BBC	EE	3	4	3	[illegible]			
8 May	1100	11,775	BBC	EE	3	4	3	[illegible]			
9 May	0130	6,040	Deutsche Welle	EE	4	4	4	[illegible]			
	0145	15,365	Swiss Radio Intl	EE	3	4	3	Police battle leftists in El Salvador			

News log forms like this one are available from Gilfer Shortwave, or you can make them up on your own. Keeping them in some sort of binder gives you an ongoing collection of world events that can be reviewed and updated as events develop & take shape.



The new home of Deutsche Welle, German shortwave service, will be built in Cologne.

CB SPECTRUM

President's new AR 711: Professional CB

BY KATHI MARTIN KGK3916

Of all the ills that befell CB when the FCC arbitrarily ended the sales of 23-channel transceivers, perhaps the worst was technical stagnation.

Before "Black Monday," when 23-channel CBs could no longer be sold, CB had become the leader in applying new technologies to consumer electronic equipment. Because of its vast market—almost 11 million transceivers sold in the final 23/40-channel year—CB resulted in astounding price reductions in applying new technology. The miniature low cost mechanical filter and the inexpensive frequency synthesizer are just two of the advanced circuits made economically feasible by CB.

Similarly, operating features once found only in "gold-plated" communitions equipment became commonplace because of CB. The built in SWR meter and even the P.A. speaker jack are two operating aids that come to mind.

But after "Black Monday," when 23-channel CB sales became illegal, new circuits and features were almost nowhere to be found in CB. The reason was not that manufacturers weren't developing new ideas; it was simply that there was very little incentive for new production or design.

The CB Deluge. Almost weekly someone would discover a long-forgotten warehouse stacked with thousands of 40-channel transceivers which went unsold when the CB market died. These newly discovered "surplus" transceivers were often sold for as little as 25% of their original price. Also, there was the stock from brands which went out of business. In short, with low-priced transceivers swamping the marketplace, there was little demand for new transceivers with new ideas which had to be priced considerably higher than the surplus, job lot and close-out transceivers.

Today there are no longer any forgotten warehouses stacked with CBs. The great buys are almost all gone, so now there's room for new models.

Professional CB. One of the first manufacturers to come out with a new concept in CB is President, a familiar name in quality CB transceivers. Their latest model, the AR-711, is touted as a "Professional CB Radio." What "professional" means in this instance is rugged construction, extra monitoring convenience for the motorist and trucker and top quality *talk power.*

Unfortunately, these are not characteristics which are immediately apparent. At first glance, the AR 711 looks like any other quality 40-channel AM transceiver from "the good old days." You notice the better signal reports only *after* using the rig.

The transceiver is housed in an unusually heavy-duty metal cabinet measuring approximately 2.25-in. H. x 16.25-in. W. x 9.6-in. D. The familiar mobile mounting bracket is provided. On the rear are jacks for the 12-13.8-VDC power cable (which can be negative or positive ground), the antenna, an external speaker and a P.A. speaker.

Kathi Martin, our CB editor, appearing in a Science & Electronics T-shirt, mike in hand.

On the left side—the driver's side—is the microphone jack. The microphone is equipped with a 3-foot coil cord that stretches to 12 feet.

The Control Panel. Now for the business end. On the extreme right of the front panel is a large channel selector knob. On the extreme left are the volume, squelch and RF gain controls and a microphone gain control. The squelch and mike gain controls each have a switch that is activated when the control knob is pulled straight out. A switch on the squelch control turns on the P.A. feature. The switch on the mike gain control cuts in a receive HI CUT that attenuates the high frequencies heard in the speaker. (It's an aid in cutting through background noise.)

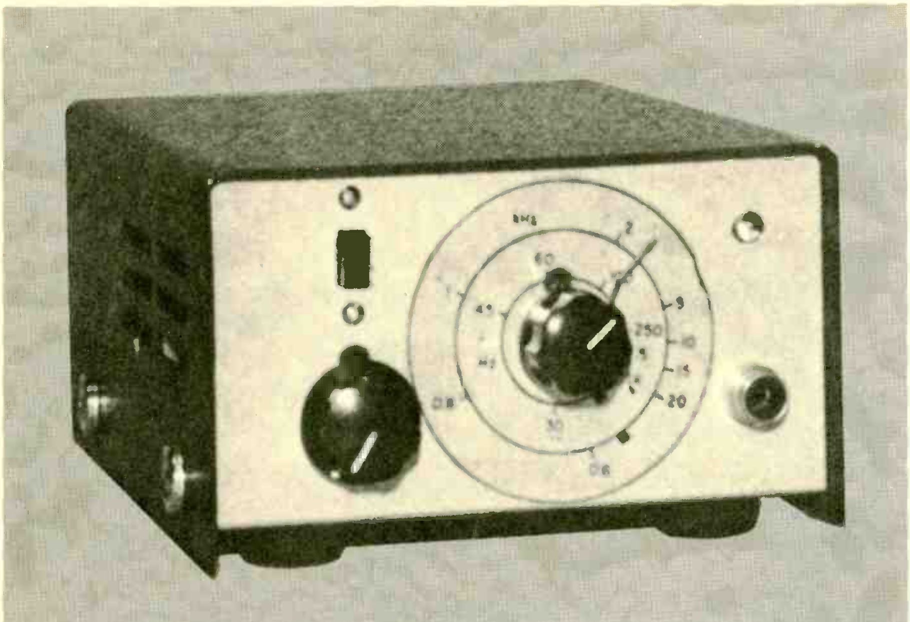
In the center of the front panel are grouped a combination S/RF-output meter, an LED digital channel indicator, a noise blanker/ANL, On-Off switch and three tuning switches labeled CH9, CH19 and NORM. When the NORM switch is depressed, the operating channel is selected by the channel selector knob.

When either the CH9 or CH19 switch is depressed, the receiver and transmitter both shift instantly to the indicated

(Continued on page 85)

CIRCLE 70 ON READER SERVICE COUPON

This front view, above, shows the handsome, rugged AR 711 with its heavy duty external speaker. The rear of the AR 711's chassis, at right, has provision for attaching a PA speaker, the external speaker, and a power cord quick-detach plug connection.



OSCAR, The Audio Freak

A handy audio oscillator for the electronics hobbyist

BY LESLIE HUGGARD

There's nothing quite as useful as an audio oscillator for testing defective audio or amplifier circuits. An audible signal, or the lack thereof, is proof positive as to whether or not a circuit is behaving as it should. Unfortunately, a good, stable variable oscillator can run into hundreds of dollars—far more than all but the wealthiest hobbyist can afford to spend.

Oscar is an inexpensive, easy-to-build oscillator with a frequency range from 30-Hz all the way up to 25-kHz and an almost flat response over the whole range. It uses a unique circuit: a Wien network with a photocell and 1.5-volt bulb coupled to maintain frequency stability. A compact unit (ours fits easily into a 5¾-inch by 4-inch by 2-inch box) Oscar will drive into a low impedance load, and is powered by a 9-volt transistor radio battery. Those parts that you don't have in your junk box can be found at the local Radio Shack or other well-stocked electronics supply house convenient to you.

Easy Assembly. Assembling Oscar is quite simple. All of the components—except for the variable potentiometers R2a, R2b and R3, the switch, LED and 9-volt battery—are mounted on an etched PC board. Our Oscar is rather fancy, mounted in a two-toned enameled aluminum box with vents and rubber feet, but any Bud or other box of approximately 6-inch by 4-inch by 2-inch dimensions will serve as a housing.

Oscar's heart is a Radio Shack LM386 low-voltage audio amplifier, an IC "bug" giving 20dB of gain without external components. Amplifier output feeds directly into a Wien network which determines the output frequency. From there the signal is fed back into the positive input of the amplifier.

The 150-kohm resistor (R6) is series with the input serves two purposes: it reduces the signal from the Wien network to the amplifier input to a satisfactory level. And, together with the input impedance to the amplifier, it provides an impedance which doesn't affect the audio frequency determined by the Wien network components. The oscillator's frequency is varied by changing the setting of the ganged potentiometers R2a, R2b.

The 5,000-ohm switched variable potentiometer serves as an ON-OFF switch in the circuit and volume adjustment control.

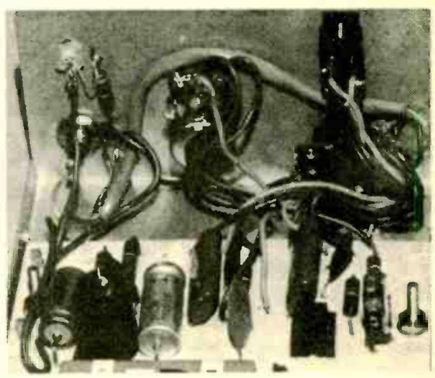
Thus far we have listed the components for a pretty straightforward amplifier circuit. The following components—a photocell (R4), 1.5-volt bulb (L1) and a 100,000-ohm preset linear potentiometer are what make for Oscar's uniqueness.

Circuit Theory. The photocell (R4) is a Radio Shack RS 276-116 or equivalent, with a 5-megohm to 100-ohm resistance range. It will be coupled to a Radio Shack 1.5-volt at 15ma. miniature bulb. The theory behind this circuit is that the light output of a bulb filament varies proportionately to applied voltage. The light output from this bulb is closely coupled to the photocell, the resistance of which varies in proportion to the light shining on it. This circuit ensures that, with proper setting of R1, the output of the oscillator is held constant over its entire frequency range, despite frequency gain variations in either the amplifier or Wien network.

The capacitor C5 blocks DC from getting to the photocell, and C6 blocks DC from the output. The LED lets you know that the oscillator is running.

The thermal time constant of the bulb filament is sufficient to prevent the light output from "following" the waveform output, except at the lowest frequencies. And, if R1 is carefully set, the circuit will be stable even at the lowest frequencies.

Make it Light-Tight. The only tricky spot in assembing Oscar is making the bulb/photocell unit. While the sketch should make this procedure clear, there are several points worth stressing. One—the most important—is that the unit must be absolutely light-tight when assembled. The fit between the bulb base and sealing grommet, and of the heat-shrinkable tubing over the entire assembly, is critical. Also, the tip of the bulb should just clear the surface of the photocell. The whole assembly then mounts on the PC board, supported on the photocell leads.



This photo shows the soldering connections at the rear of OSCAR's front cabinet panel.

While there are very few components on the PC board, it is necessary to pay close attention to the mounting and placement of these. Make sure that the polarities of the electrolytic capacitors are correct and that the amplifier IC "bug" is the right way around.

The PC board itself should be raised ½-inch or so above the bottom of the housing to prevent the soldered joints from shorting. This can be done by drilling two pieces of squared-off plastic to pass the shafts of the bolts attaching the PC board to the housing.

The frequency adjusting potentiometers R2a, R2b should be wired so that rotating the shafts clockwise REDUCES the resistance in the circuit. Reducing the resistance causes the oscillator frequency to rise in accordance with the formula:

$$f = \frac{1}{2\pi RC}$$

where R = R2+R3 and C = C1 or C2, as selected by the range switch S1.

Turning it on. At this point Oscar is just about ready to be buttoned up and turned on. The final step is turning the center rotor of R1 all the way to ground. Now connect the battery, put the top cover on, attach a pair of 1000-ohm or greater headphones and turn Oscar on.

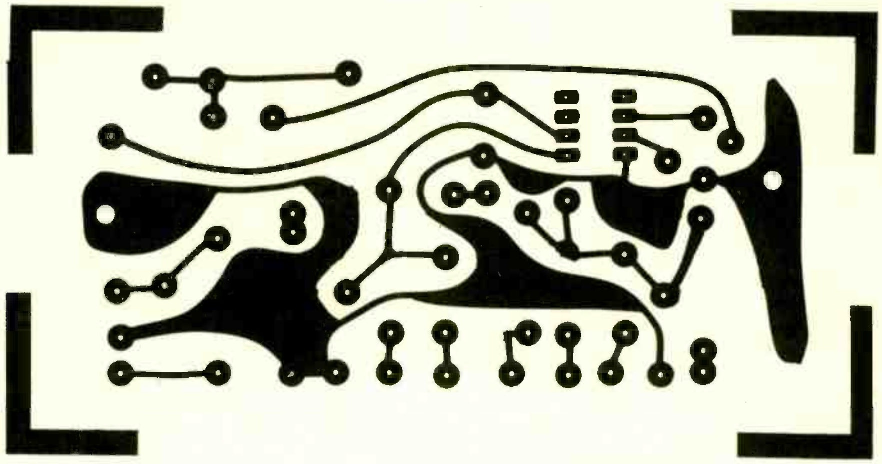
With S1 on the upper frequency range, turn the ganged pots R2a, R2b all the way counterclockwise for maximum resistance in the circuit. A sound—a distorted 600-Hz—should be heard in the headphones.

Let Oscar run for a minute or so to condition the photocell to the light. Now adjust R1 until the distortion just disappears. An oscilloscope makes this easier: adjust R1 for an output waveform that is just short of clipping.

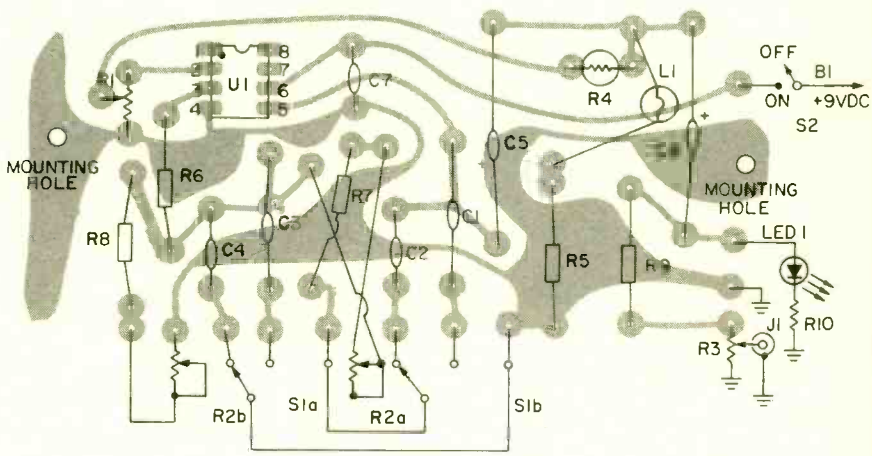
To make life easier for yourself, remember to drill a ¼-inch hole in the oscillator housing opposite the center rotor of R1 to allow a screwdriver blade access for adjustments.

Vary the output frequency by turning the ganged potentiometers R2a, R2b. Turn to the upper end of the frequency range—25-kHz, well beyond your hearing range—and allow a few seconds for the oscillator to stabilize there. Turn back to the audible signal range to make sure that the circuit is still oscillating. If it's not, turn R1 carefully towards ground until the oscillation starts up again.

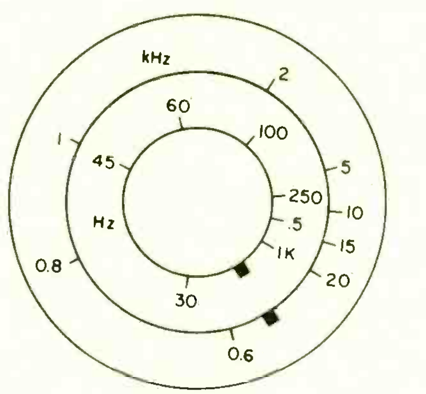
Now that the upper frequency range is adjusted, switch to the lower range.



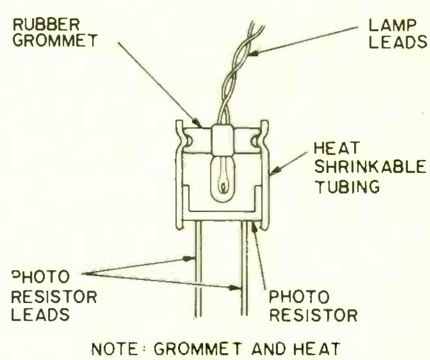
This is the circuit board template, appearing here in its exact size. For those who feel that their skills are not up to board etching, there is a complete kit listed below.



The parts placement is such that nearly any available cabinet which can easily hold the PC board is suitable for OSCAR. This cabinet leaves plenty of room for all components.

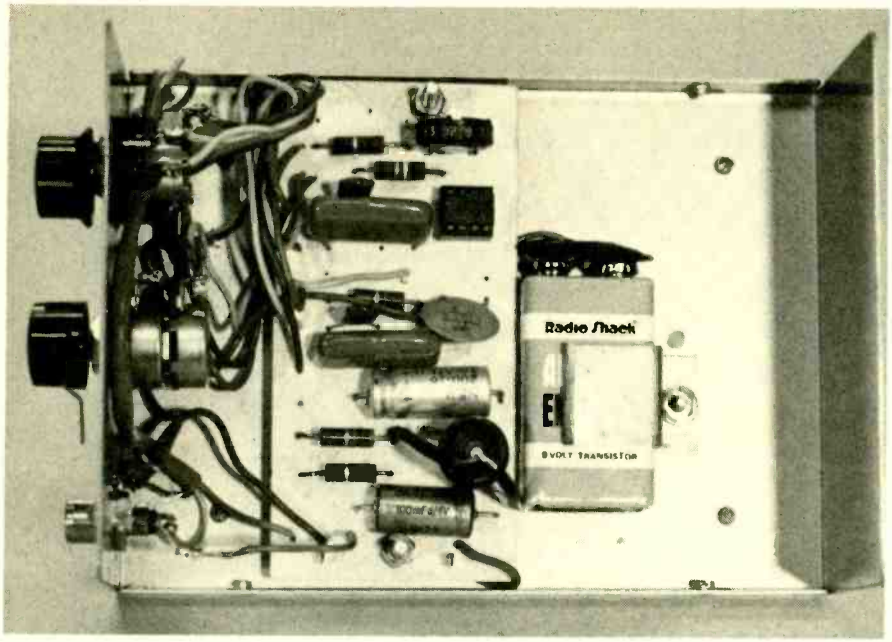


Trace this exact size oscillator range diagram or cut it out and use on the face of the oscillator. It is calibrated exactly for the dual frequency ranges available.

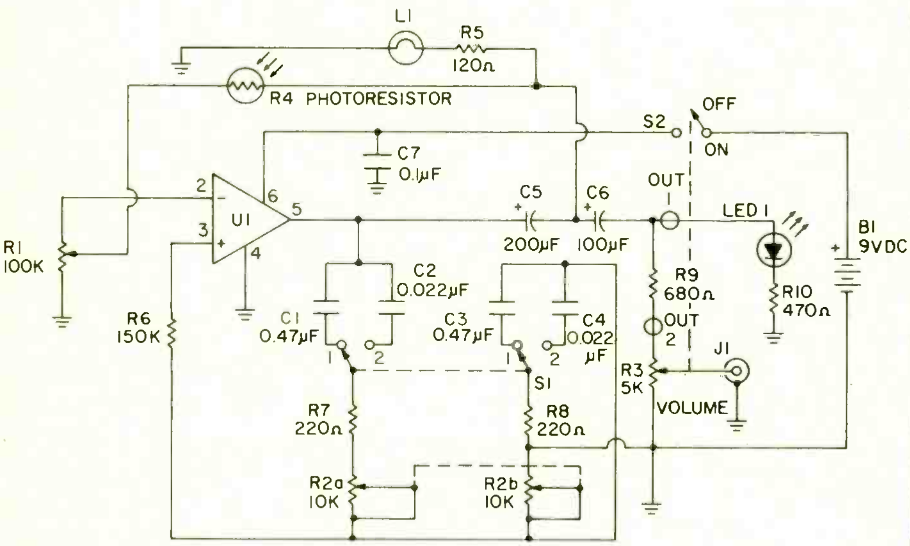


NOTE: GROMMET AND HEAT SHRINKABLE TUBING MUST BE BLACK

It is very important that the photocell and bulb tandem arrangement be light free.



This foil side down parts overlay shows the exact placement of all the components on the circuit board. Care is required in soldering and placing components with precision.



PARTS LIST FOR OSCAR

B1—9-volt transistor radio battery
C1, C3—0.47-uF, 50-VDC capacitor
C2, C4—0.022-uF, 50-VDC capacitor
C5—200-uF, 16-VDC electrolytic capacitor
C6—100-uF, 4-VDC electrolytic capacitor
C7—0.1-uF ceramic capacitor
J1—Shielded phono jack (Radio Shack 274-346 or equivalent)
L1—Miniature bulb, 1.5-volt 15-mA
LED1—Small red Light Emitting Diode
R1—100,000-ohm linear preset potentiometer for PC board mounting
R2a, R2b—10,000-ohm linear ganged potentiometers
R3/S2—5,000-ohm linear potentiometer with ON-OFF switch
R4—Photoresistor, 5-megohm to 100-ohm range (Radio Shack 276-116 or equiv.)
R5—120-ohm, ¼-watt resistor
R6—150,000-ohm ¼-watt resistor
R7, R8—220-ohm, ¼-watt resistor
R9—680-ohm, ¼-watt resistor
R10—470-ohm, ¼-watt resistor
S1—DPDT slide switch
U1—LM 386 Op amp Integrated Circuit (Radio Shack 276-1731 or equiv.)

MISC.—Box, PC board, 2 1-inch roundhead machine screws with nuts and washers, IC socket (8-pin), 9-volt battery clips, wire, knobs, sheet metal screws and assorted hardware as needed.

Note: A complete parts kit (less battery, cabinet and hardware) is available from Niccum Electronics, Rt. #3, box 271B, Stroud, OK, 74079, for $17.50 plus $1.00 postage and handling. For the etched, drilled and labeled PC board alone, send $5.50 plus $1.00 postage and handling.

At the bottom end, about 30-Hz, the frequency amplitude may vary at a very slow rate. If that is the case, give the circuit a little more negative amplitude by turning R1 up slightly from ground. Some experimentation with R1 settings should yield a compromise position giving the best overall performance for both frequency ranges. When this is attained, the oscillator output should be constant within ±1dB over the whole frequency range.

Troubleshooting Oscar. If this output stability cannot be achieved, the ganged potentiometer R2a, R2b is probably at fault. The cheaper varieties track poorly; some may have worse than a 50% difference between the tracks in places. Before throwing out the old one and replacing it, try swapping the R2a and R2b leads around to see if this improves performance.

If the output frequency response is still unsatisfactory, change the 120,000-ohm resistor (R5) in series with the bulb one value up or down. Readjust R1 as before.

While you were making all those adjustments in the lower frequency range the LED should have been winking away at you. This indicates that the oscillator is running and that it has stabilized after a frequency change. You will notice that, in the upper range, the LED stays on steadily. This is because the human eye can't assimilate light oscillations above a certain frequency, so the high-speed flashings appear as a steady light.

Oscar is somewhat sensitive to variations in voltage, especially to low voltage. Serious clipping will result if the voltage drops below eight volts, but the oscillator will operate at up to 14 volts with only an adjustment of R1. If left with the power off for long periods of time, the R1 setting will probably have to be adjusted.

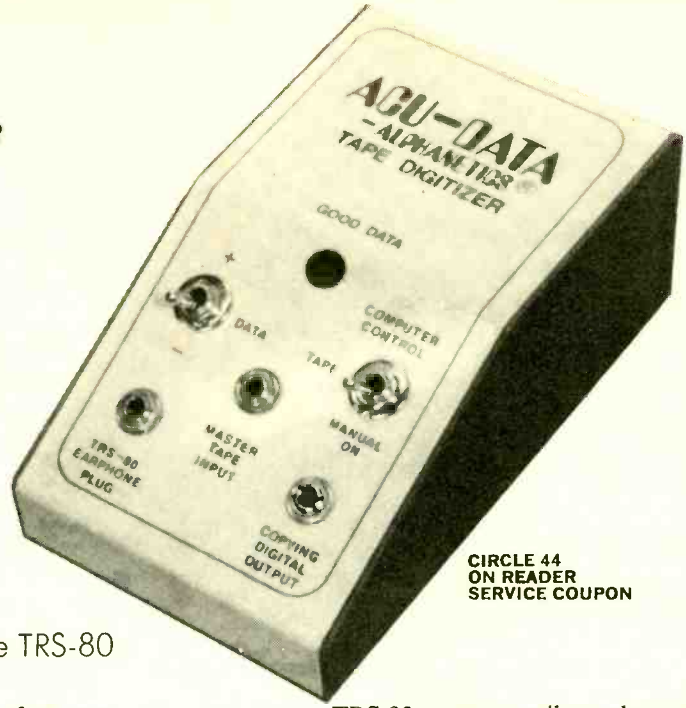
Oscar is a handy piece of test equipment well within the budget and building capabilities of any electronics hobbyist. It's a natural for shooting a signal into misbehaving audio or amplifier circuits: just attach a probe or even two leads to the output jack and you're ready to delve into the innards of recalcitrant circuits.

Other possible—and somewhat more farfetched—uses for Oscar are: as an audiometer, offering the bored hobbyist a hearing test at the bench; or, hooked to a high-powered amplifier and speaker, as a device to scare crows off the backyard garden patch.

Usefulness, low cost and ease of assembly makes Oscar both an interesting project and a welcome addition to any hobbyist's workbench. ■

E/E CHECKS OUT THE...

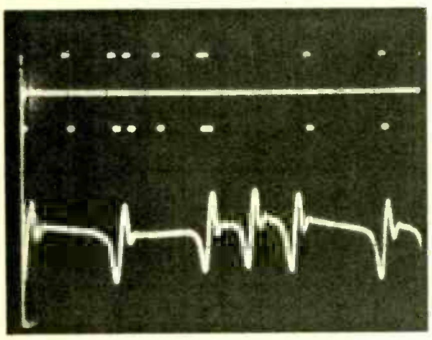
Alphanetics TRS-80 Tape Digitizer



CIRCLE 44 ON READER SERVICE COUPON

Make perfect tape copies every time with this sophisticated companion to the TRS-80

A PERFECT CLOAD EVERY TIME—that's the best way to describe what happens when an Alphanetics Tape Digitizer is used between a cassette recorder and a TRS-80 computer. No longer need you juggle the recorder's volume control endlessly, trying for a perfect load of a prerecorded program. No longer will ground loop hum or extraneous noise produce the dreaded BAD LOAD. Simply pop the tape into the cassette recorder, process the signal through the digitizer and you're ready to RUN a perfect tape.



Before processing (bottom), the audio signal is uneven; afterwards, the pulses are equal.

As an extra plus, the digitizer allows you to make perfect copies of any tape—even SYSTEM tapes—without going through the computer. Fact is, digitized tape copies are *better* than the original. For example, we had a "store bought" Radio Shack program tape that was defective. Somewhere on the tape was a defective bit(s) that prevented a good standard CLOAD; but when the tape was processed by the digitizer the CLOAD was perfect. So a "perfect" copy of the tape was prepared by dubbing to a second cassette recorder, which was connected to a special copying digital output jack on the digitizer. It provided a perfect CLOAD even when fed directly to the computer without going through the digitizer.

How It Works. The cassette recorder signal from the computer consists of two audio tones whose "warble" represents digital information. When the tape is played into the computer, it is converted back into digital information that the computer uses.

While the system is simple enough, the user faces three problems. First, the TRS-80 cannot easily make copies of a SYSTEM tape—it takes special software to do this. So if you save SYSTEM software, there's no way you can make a reliable back-up copy; CSAVE works only for a BASIC program or data retrieval.

Secondly, the computer is extremely finicky about the signal level from the cassette recorder; it won't load properly if the level is too low or too high; it must be just right. Unless your TRS-80 has a special Radio Shack modification (arranged through your local store) the "just right" level range is extremely narrow. In fact, even after you finally get the volume control setting correct for a tape, the next tape you use might require a completely new adjustment. It can get very irritating to go through seemingly endless attempts to get a good CLOAD.

Finally, tape noise, hum, and a too low recording level (burying the signal in the noise) can prevent a good CLOAD. This is often the problem with tapes from mail-order software houses and friends with whom you swap programs.

All these problems are resolved by the digitizer, as shown in the photo of the digitizer's input and output displayed on an oscilloscope.

The bottom trace is the signal from the tape itself (this from a good tape), essentially an audio waveform that the computer is supposed to interpret as digital information. Obviously, any hum, noise or sudden low recording level can interfere with the computer's interpretation of the audio waveform. Also, this waveform is difficult to copy

To hook the Tape Digitizer to the TRS-80, the plug that normally goes to the recorder's earphone jack is plugged into the computer's jack. A patch cord (not included) is then plugged into the MASTER TAPE INPUT jack and then into the earphone jack.

(Continued on page 82)

900 MHz CB

The CB of the future offers satellite communication

BY LEO SANDS

Do not despair, CBers. The new 900-MHz UHF-FM personal communications band was not selected by people who hate CB. If the band is established, it will usher in a new era in personal radio communication.

Once, many years ago, the FCC allocated the entire 10 MHz-wide 460-470 MHz band to the Citizens Radio Service. But, there were so few takers that most of the band was reallocated for other purposes. Now there are only 16 frequencies (8 paired channels) within that band that are still available to the General Mobile Radio Service (formerly Class A CB).

When the band was first opened up to the public, equipment costs were excessive. But, in the intervening years, much technical progress has taken place. The 450-512 MHz band is now the most sought after band by industrial and public safety radio users. The new 806-821 MHz and 851-866 MHz bands have become so popular that in the largest metropolitan areas all available channels have been assigned to users.

It is true that there is a big difference between 27 MHz and 900 MHz, but 900 has more to offer. When using FM on 900, the capture effect will make it possible for users to operate in close proximity with no interference.

The FCC chose the 900 MHz region for a new personal communications band because the space is available, and because it offers great potential for unique capabilities. Since frequency space is in great demand, we should be happy if the FCC does give us space at 900–in addition to space at 27 MHz.

It is expected that the FCC will issue a Notice of Proposed Rulemaking which will spell out the frequencies that will be available and the technical standards that will apply.

CB of the Future . . . Let's pretend that it's 1984. The FCC has established the new 900 MHz personal communications band, and the equipment is available. Let's also pretend that you have a 900 MHz mobile unit in your car and a base station at home. In addition, let's assume that you can use your present CB license to operate at 900.

The new band is divided into two segments, spaced 45 MHz apart. This will make it easier to operate repeater stations and will make it possible to use the full-duplex mode when making phone calls from your car.

You will not find the channels cluttered by business users, since (we're still pretending) the FCC has outlawed use of these channels for business use.

The mobile rig of the future will be an astounding machine. It will be capable of two-way voice communication on "paired" mobile telephone channels. Mobile units and base stations will be accessible through a repeater station on other paired channels, and direct hookups with base stations will be possible on still other paired channels. In addition, you will be able to communicate directly with base stations and mobile units on single-frequency simplex channels. Direct communication with the police in cars or at police stations will be possible on special channels, and you will also be able to listen to public information broadcasts about weather, traffic and other conditions on receive-only channels.

Your rig will be equipped with an adapter to enable you to transmit coded non-voice signals for "canned" messages and to enable you to gain access to a toll plaza, open your garage door, etc. In addition, you will have another accessory that enables you to transmit and receive digital data. For example, you could interrogate your home computer or a public computer to obtain data which would be displayed on an LED readout. You could also feed data into your home computer by touching the keys on a keyboard connected through the microphone input.

Your base station would have similar capabilities. It will enable you to communicate with other base stations and mobile units on a two-frequency simplex basis on some channels and on a single-frequency simplex basis on other channels. It also would enable you to communicate with mobile units and other base stations through repeaters on "paired" channels.

An accessory adapter will enable you to transmit and receive data on some channels. This device interfaces with your home computer. Another accessory provides control of access to your home and also allows you to arm and disarm your security system from your car. You also have an autopatch accessory that lets you connect your base to the phone system so you can make phone calls from your car through your home telephone instead of through a common carrier.

Still another accessory would let you use your base station as a radio paging transmitter. You, your kids and your wife would carry a tiny radio paging receiver whenever any of you leaves the house. Anyone at home could page them by pushing a button on the paging encoder. You could page your wife, for example; her pager will beep and she will call you on the phone or via radio to find out why you beeped her.

R/C at 900. Since your hobby is model railroading, you have a radio control system for your trains. The control transmitter operates on one of the radio control frequencies within the band. These frequencies are free from the kind of interference that plagues 27 MHz band radio controls.

Your base station at home could be connected to your home computer through a data terminal accessory. This hookup will allow you to retrieve information from the computer memory and to enter data with your handset keyboard while in your car. An LED readout in the car displays the data you request. No one who does not know your computer access code can gain entry to your computer, which is wired to control the home heating, air conditioning, lights and security system.

Both your mobile and your base deliver 10 watts of power and use narrowband FM. Although more channels could be derived by using SSB, the cost of providing the required frequency stability at 900 MHz would be prohibitive, given the state-of-the-art at present. Furthermore, FM has the advantage that you don't hear heterodyne whistles because of the "capture effect." You hear only one signal at a time, the strongest one your receiver "captures."

On your way to work, you would press one of the keys on the keyboard to set your rig to receiver police broadcasts so you can find out about traffic, road and weather conditions. As you approach a toll tunnel, you take a coded ID card from the glove box and press it into a slot. This causes your rig to switch to a special channel and to transmit your vehicle ID to a receiver at the toll gate. If you have been paying your toll bills on time, the toll gate will open to let you through and start the process of billing you for the toll.

While driving through the tunnel, you will be able to use your rig because there is a slotted coaxial cable along the roof of the tunnel which feeds signals to your set and picks up your transmitter's signals. At each end of the tunnel, the slotted coax is connected to a base antenna. When you transmit inside the tunnel, your signal is picked up by the slotted coax and fed to both outdoor antennas which radiate the signal into space. When receiving, one antenna picks up a signal and feeds into the tunnel where it is radiated.

After emerging from the tunnel, you set the rig on a repeater access channel, plug an ID card into a slot and key the mike. The coded card causes a special code to be transmitted, which unlocks the repeater. You now touch the keys to transmit the code number of Joe's base station, which is 50 miles away. Joe answers and you rachet jaw for a while. But you don't talk for long because you are being billed by the minute for repeater use.

You forgot to watch the fuel gauge and you run out of gas. So you press a special key that turns your transmitter on and causes your vehicle ID and location to be transmitted automatically on the highway emergency channel. Your vehicle ID and location data are displayed on a CRT at a police station. A voice comes out of your speaker asking for information about your problem. You tell the lawman and he arranges to have gas delivered to you.

The location of your vehicle is determined by a tiny Omega navigation receiver, which digitizes the output information and applies it to your transmitter's location.

Suddenly you recall that you have an appointment with the dentist which you can't keep because of another problem you must handle. No need to look for a pay phone; you can call the dentist's office from your car. You push the MTS (mobile telephone service) button, and your rig immediately scans the five mobile telephone channels. Four are in use, so the rig stops at the vacant channel and locks onto it. When you hear the dial tone, you insert your telephone service credit card into a slot and then dial the number by pressing the buttons on the handset keyboard. When the dentist's assistant answers the phone, you cancel today's appointment and make one for next week. The mobile telephone service company will eventually bill you for the call.

You also remember that you should phone your cousin in Seattle. This time you press the button which gives you access to your base station. Then you

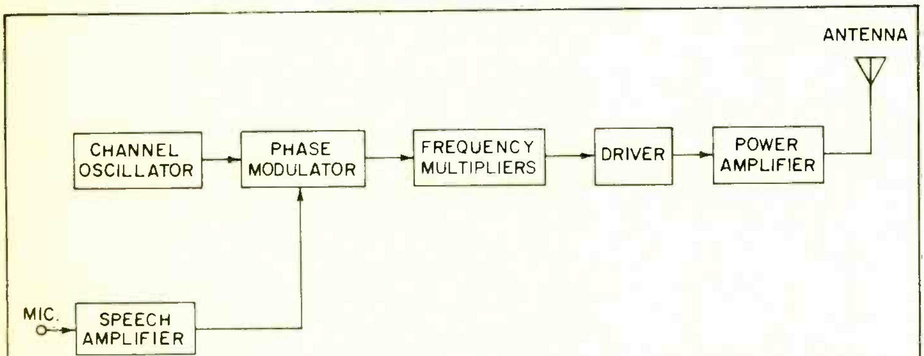


Fig. 1. Conventional transmitter circuitry requires using a number of frequency stages to multiply frequency level up to the 900 MHz range. This circuitry is limited in use.

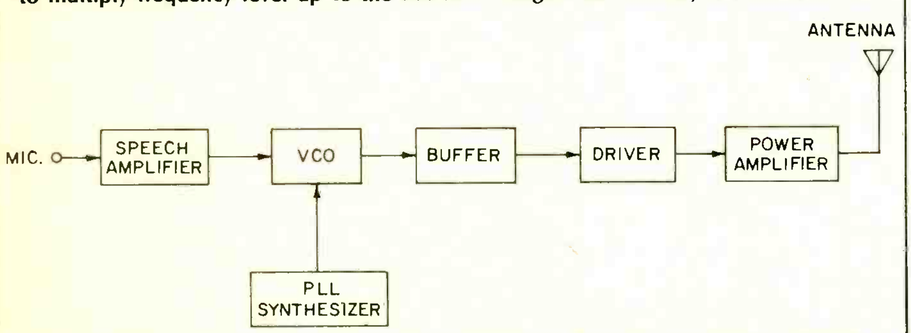


Fig. 2. This diagram shows the circuitry that will most likely be used in the CB of the future. A voltage controlled oscillator will cover any number of frequencies with PLL.

press buttons on the handset keyboard that cause the autopatch at your base to connect it to the telephone line. When you hear a dial tone, you press the buttons on the handset keyboard to dial your cousin's number. You made this call through your own base station instead of through the mobile telephone service company. The long distance toll will be billed by the phone company to your home telephone.

After concluding your phone call, you remember that you forgot to tell your wife to engage the security system while she is alone in the house. You don't have to bother her because you can switch on the security system from your car. You simply press a special key that automatically causes your rig to transmit your home base access code. When your base intercepts the signal, it automatically transmits verification back to you which lights a lamp. Now, you push keys on the keyboard to transmit the security system arming code.

When you approach the place where you work, you push your coded employee ID card into a slot. This causes the rig to transmit a code that unlocks the parking lot gate, which then opens to allow you to enter.

When you return home, you won't have to use a garage door opening transmitter to get into the garage. Instead, you push the special key on your rig that accesses your base and then touch the handset keys to transmit the garage door opener code. You can transmit other codes to turn on the driveway lights, turn the furnace or air conditioner on or off, and to disarm the security system.

These are just some of the many examples of how it *could* be, two, five or ten years in the future on 900 MHz.

Transceiver Circuitry. Using conventional techniques, a 900 MHz transmitter requires a chain of frequency multipliers to increase the oscillator frequency from around 20 MHz to the 900 region. The oscillator signal is fed to a phase modulator, as shown in Fig. 1, whose output is fed to the frequency multipliers which also multiply the FM deviation to ±5 KHz.

Using this technique, a separate crystal is required for each transmit channel. This will satisfy the requirements of those who need only a few channels.

A multichannel transmitter can employ a voltage controlled oscillator (VCO) which can operate directly at any number of channel frequencies. The carrier frequency is determined and stabilized by a phase locked loop (PLL) synthesizer that requires only one crystal. Fig. 2 is a simplified block diagram of such a transmitter.

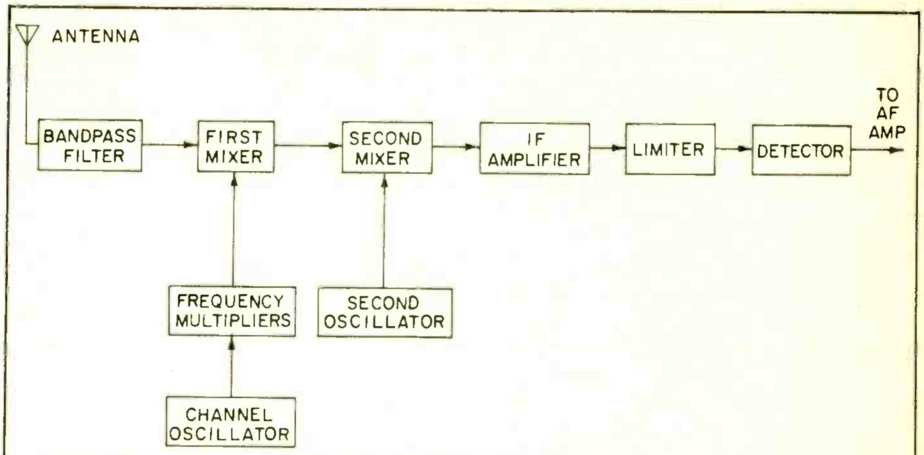


Fig. 3. The same conventional receiver configurations as are used in sets available today are easily adaptable for 900. Both can employ a PLL synthesizer for many channels.

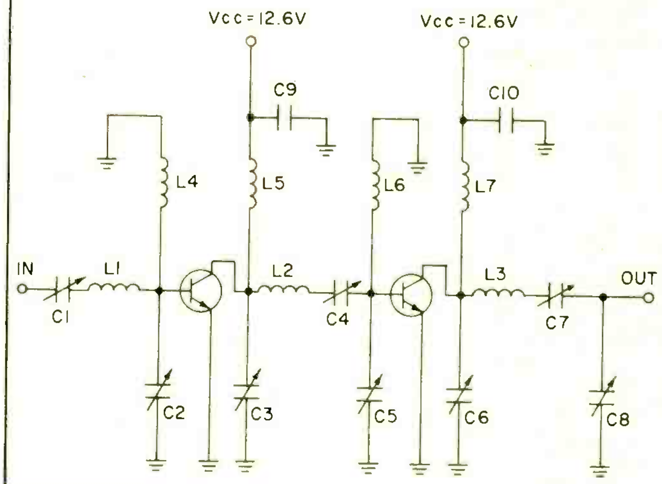


Fig. 4. The power amplifiers of 900 MHz sets require a transistor that is still quite expensive to manufacture. In time, with the popularity of 900 MHz CB, the price will come down the same as with 27.

A conventional receiver can also use frequency multipliers to supply a mixer injection frequency at the correct frequency, as illustrated in Fig. 3. A multichannel receiver can use a PLL synthesizer to generate any number of injection frequencies to enable receiving on all channels.

The output power of the transmitter must be at least 10 watts, to partially compensate for the great propagation losses at 900.

It is anticipated that there will be a variety of transceivers for use at 900, ranging from single-channel to all-channel types. Some will undoubtedly incorporate many of the devices that will be required to provide the unique services that will be available at 900.

The introduction of walkie-talkies will undoubtedly be delayed until it is established whether there is or is not a radiation hazard. Some say that 900 MHz signals can be dangerous, while there are others who claim that this is not true. The 900 MHz band is not new. It has been used for many years for point-to-point communication, and has been very satisfactory. No reports of anyone being harmed by radiation have ever been documented.

The cost of a 900 MHz rig can be kept down by using the PLL-VCO technique to simplify the circuitry. Among the most costly components are the RF power amplifier transistors, which currently cost around $12 each to manufacture. (The circuit of a 900 MHz power amplifier is shown in Fig. 4.)

In time, the cost will come down. The cost of equipment can be kept low by having the goodie attachments as outboard accessories that can be added when needed. But how far will you be able to talk?

Wave Propagation. It is true that signals at 900 are more readily absorbed by vegetation and blocked by large land masses, but they are easily reflected and can reach into areas where communication is impossible at 27.

We can compare 27 and 900 by looking at the numbers. The free space propagation loss at 900 is 32 dB greater than at 27. But the plane earth propagation loss is the same at 27 and 900. And that's what we usually encounter. Free space attenuation applies when the antennas can "see" each other. Between base stations this can be a mile, or at most five miles. If it is one mile, the free space attenuation at 27 will be 60 dB, and at 900 it will be 92 dB. That is the loss between two half-wave dipoles. Now if you use antennas that have a 6 dBd of gain (with respect to dipole), the loss at 900 MHz will drop to 80 dB. Since omni antennas at 27 usually have unity gain, the loss at 27 will be 58-60 dB.

After the free space loss no longer applies and plane earth propagation applies, the loss increases 12 dB each time distance is doubled. Shadow and diffraction losses may add 20 dB or more to the loss. It is important to remember that free space loss increases 6 dB each time distance is doubled and 12 dB for plane earth loss. If the free space loss applies only to one-half mile, the loss will be 6 dB less than at one mile under free space conditions.

Antenna Systems. At 900 MHz, gain antennas will be used to increase the effective radiated power (ERP) and to offset coaxial cable losses. Coaxial cables at the repeater stations will be the low-loss types such as Heliax, which has very low attenuation even at 900 MHz. RG-58 cable will be used with mobile antennas, cut as short as possible to minimize losses.

A quarter-wave mobile whip at 900 is only 3 inches tall. It should be mounted in the center of the vehicle roof to obtain the best radiation pattern. Gain-type mobile antennas less than 2-3 feet in length will provide from 3 dB to 5+ dB gain over a quarter-wave whip. For full duplex base station operation, an antenna duplexer will enable the same antenna to be used for simultaneous transmission and reception.

Base stations and repeaters will use omnidirectional gain antennas with up to 10 dB of gain. Some will employ antennas that have an offset, bidirectional or unidirectional radiation patterns, depending upon the direction of transmission and reception required. Some directional arrays can provide up to 15 dB of gain, which will increase ERP 31 times. Of course, the coax loss must be deducted from antenna gain to accurately estimate ERP.

Since a quarter-wave is only 3 inches at 900 MHz, a dipole will be 6 inches long. Four dipoles placed one over the other form an array having 6 dB.

Higher base antennas will be required at 900 than at 27. But, the antenna itself is much smaller and lighter and can be supported by a TV antenna mast or tower.

Assume that the reference height is 10 feet and that your antenna is 30 feet above the terrain. The height gain will add 10 dB to your effective radiated power (ERP). If your base transmitter puts out 10 watts and coax loss is 2 dB, your antenna will receive a 38 dBm signal. Now, if your base antenna has 7.5 dB of gain, your ERP will be 55.5 dB when you include 10 dB of height gain. This is equal to 35.28 watts ERP.

Now assume that the free space propagation applies to the first mile. At one mile, your signal will have a power level of −36.5 dBm (dB/mile). Then assume that at two miles, plane earth propagation reduces the level 12 dB to −48.5 dBm and at 4 miles to −60.5 dBm and at 8 miles to −72.5 dBm. Then also assume that after 8 miles, diffraction and shadow losses increase attenuation to 30 dB as distance is doubled. At 16 miles, your signal power level will have dropped to 102.5 dBm.

If at 16 miles, your signal is picked up by a mobile with a unity gain antenna and a coax loss of 0.5 dB, its receiver will get a −102 dBm signal (1.8 microvolts). On the other hand if a mobile has a 5 dB gain antenna, its receiver will get a −97 dBm signal (3.2 mV).

At a base station 16 miles away that has a 30-foot high 7.5 dB gain antenna, the loss will be reduced 10 dB by height gain and 7.5 dB of antenna gain minus 2 dB of coax loss for a net gain of 15.5 dB. The receiver will get a signal whose level is almost 6 microvolts.

If you increase your base antenna height to 60 feet, your height gain will be 6 dB more than at 30 feet. And if you use a 15 dB gain beam antenna your signal will be 7.5 dB stronger. With 13.5 dB of additional gain, your range will improve. Because of the shadow losses at 900, a repeater station with an antenna well above the terrain will dramatically increase your range. A repeater receives signals from mobiles and control stations at fixed locations on one frequency and returns the information on another frequency, as shown in Fig. 5.

If the repeater can be heard 20 miles away, it can enable mobiles and bases to intercommunication over a maximum distance of 46 miles when both stations

(*Continued on page 83*)

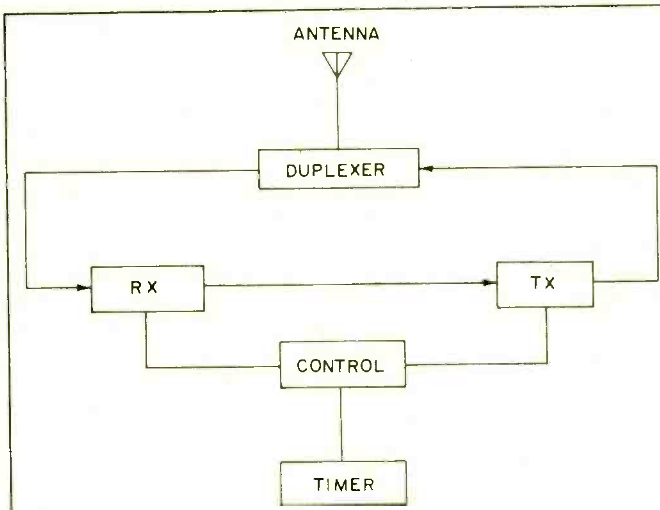


Fig. 5. A repeater system is the answer to the shorter range of 900 MHz CB. This diagram shows the configuration of a repeater station. A timer is necessary in the system to prevent one unit locking it up.

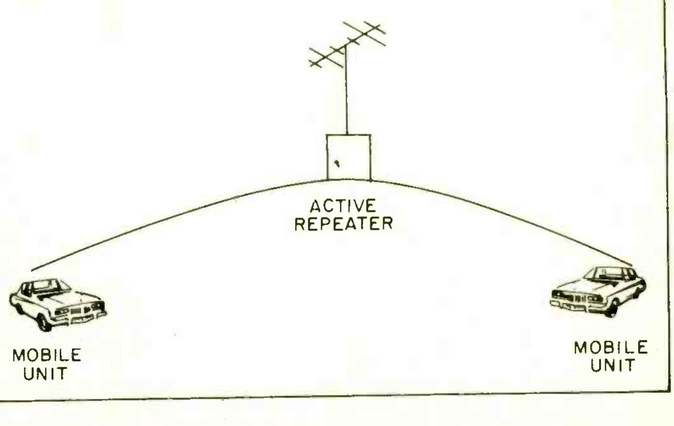


Fig. 6. A repeater located on a tall building or mountain can give remarkable range to signals sent through it. One system on top of a California mountain sends signals a distance of more than 200 miles.

Restoring Antique Radio-Phonos

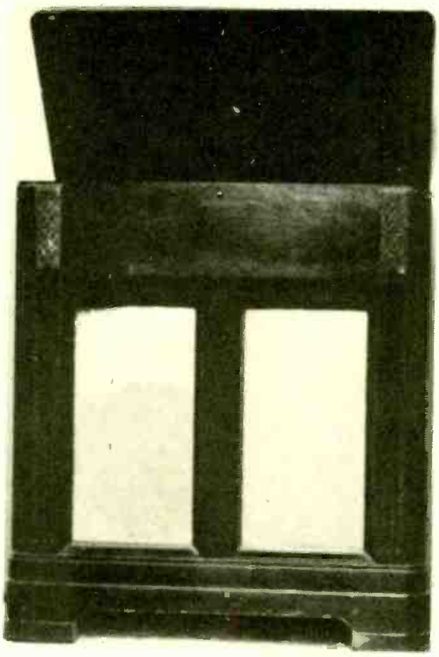
Listen to Big Band sound on original equipment BY JAMES A. FRED

ONE PHASE OF ANTIQUE RADIO collecting that has received very little attention in the periodicals is radio-phono combinations. My earliest encounter with them was in 1931, when I saw a 1929 Majestic highboy and a Brunswick lowboy. The phonograph was under the highboy's lid and a short person would have had trouble playing the records. The pickup arm and head are heavy by today's standards and wear on the records was terrible. The 78 RPM records of those days were made of pulverized limestone and shellac. If you played the records 50 times or more there would be gray color in the bottom of the grooves. I assumed that it was the limestone showing through.

Auto Changers. Going back to the late 1920's, I found that there were only a few models made with automatic record changers. Because 1927-1932 era radio-phonos with automatic record changers are hard to find, we will concentrate on combinations made in the middle 1930s to the early 1940s.

In this article we will consider only the console models with 78 RPM automatic record changers. This is not to say that you won't find single record players in console and table model cabinets, or changers in table model cabinets. There were at least five basic cabinet styles; one style had a full length lift lid with the changer usually on the left side and the radio on the right side. A second type had a half-lift lid over the changer on the left with the radio on the right front. A third type had a solid top with either two full-height drawers or two upper-half doors. The left drawer pulled out with the changer mounted on a base, while the radio was behind the left hand door. Sometimes the radio panel tilted forward to reveal the dial and knobs. The lower half of the cabinet usually consisted of two grilles covered with brown and gold design cloth. An 8-, 10-, or 12-inch speaker (depending on the selling price of the set) was mounted behind one grille, while the other grille was a door that opened to reveal the record storage compartment.

Cabinets. A notable exception to this style was the Philco radio-phono combination. Philco made a conventional appearing console cabinet, but the speaker grille was hinged at the bottom and could be tilted out at the top. Mounted at the bottom of the grille was a speaker while near the top of the tilt out grille, on a hinged shelf, was a record changer. The hinged shelf was designed to keep the changer level so it plays either pulled out or pushed in.



Most radio companies did not own the factories where the cabinets were made. They had a styling department that designed and drafted the blue prints of the cabinets. The blueprints were then submitted to several cabinet factories for bids. Indiana had many radio cabinet factories which were often furniture factories with a cabinet operation as a sideline. Michigan and Wisconsin also had many cabinet factories. I suppose the plentiful supplies of hardwoods and nearby veneer mills were the reasons Indiana had so many.

There were three standard finishes on these cabinets. One was walnut, another mahogany and the third a bleached or blond color. The cabinets were all wood with no hardboard, steel or vinyl. Backs were usually heavy cardboard. You can find many beautiful console cabinets styled for different periods.

Radio chassis came in many different sizes. For the cheapie combo, there was usually a five- or six-tube chassis (not much better in quality than a table model radio) with the addition of a tone control and a 6- or 8-inch speaker. Needless to say, these sets had low quality audio and marginal radio chassis. I wouldn't advise buying one of these types unless it was low in price or had an exceptional cabinet.

High Quality. The better quality combination had a chassis with eight or more tubes with push-pull audio output and a 10- or 12-inch speaker. Many times the set would have two or three short wave bands, elaborate dials, variable selectivity, magic eye tuning, etc. These are the sets to look for when you start to collect radio-phono combinations. Usually the better set will have a more attractive cabinet made of heavier wood and have a better finish.

The record changers used were three basic types. The changer either pulled the record off the center spindle and let it drop, or pushed the edge of the record so it would drop off the spindle, or used slicers on the edges of the records that would rotate to drop one record and hold the remainder of the record stack. Pick-up cartridges were usually crystal (Rochelle salts), ceramis (Barium Titenate), magnetic type (GE)

The oldest phonos had all mechanical turntable controls, like these shown on this Edison model that appeared just after the turn of the century. As time passed, technology heightened; innovations such as record changers came into widespread use.

or a light beam galvanometer as used by Philco. Most changers would play 8-, 10- or 12-inch records intermixed. Probably any Philco "Beam of Light" pick-up has been replaced long ago by a crystal cartridge.

Many claims to higher fidelity and less record wear were made for each type of changer. Some changers chipped the edges of the records (slicer types), while other changers chipped out the center hole in the records. Regardless of these faults, every home owner wanted a radio-phonograph in his living room or parlor.

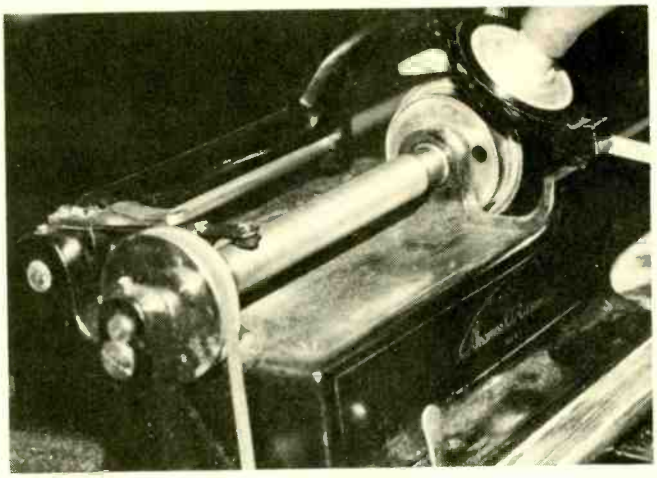
Record Flippers. There were two notably different record changers other than those previously described. RCA and Capehart-Farnsworth had changers that turned the records over and played the sides in sequence. These changers appeared in only the most expensive models, some costing as much as $1600.00 to $2000.00. Needless to say, if you find one of these grab it, if its cost is within your budget. There were other very expensive phono combinations too, such as Scott Radio Laboratories and Silver Marshall. These too are real collectors' items.

Record changers weren't normally made by the radio set manufacturer, but by companies that specialized in record players and changers. Home recorders were also quite popular in the late 1930's and early 1940's. A home recorder was usually a record changer with a sound recorder head in addition to the regular sound pickup head. Records used for home recording were made of aluminum with a coating of lacquer on each side. Recordings could be made from the radio or from a microphone supplied. Like many gadgets, the home recorder was used a few times and then forgotten. The records were not breakable, but were easily bent, and wouldn't hold up if played many times.

The more elaborate consoles had directional antennas built into the cabinet. These were bulky devices in the bottom of the cabinet and usually mounted in back of the speaker. By rotating the antenna, better reception could be obtained, and sometimes the operator could null out electrical noise by doing this. The shortwave bands weren't used by most people. It was like the recorder, in that interest in shortwave soon lagged and it was forgotten. Many of the sets were surprisingly good at picking up Europe, Asia, South America and Australia. For the avid shortwave fan, there were terminals for an outside antenna.

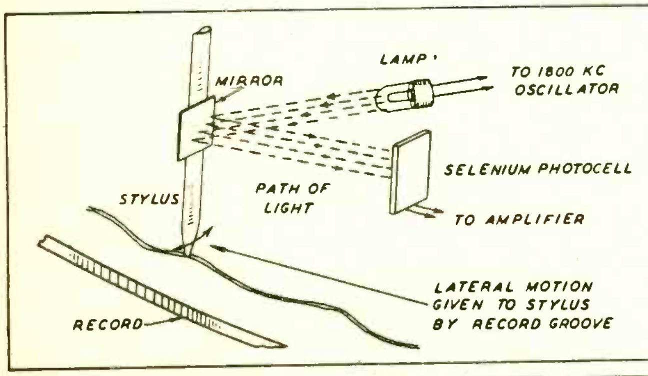
Pushbuttons. Pushbuttons, too, were a popular selling feature. Pushbutton tuners came in two general types. One was mechanical, and when you pushed a button, through a series of cams and gears, you actually moved the tuning capacitor. The other type of pushbutton tuner was a slide switch connected to a separate set of oscillator and mixer tuned circuits. Each button would select a separate station. To set up this type tuner, it was necessary to push in a button, tune the oscillator coil until the desired station came in, then fine tune the mixer coil or capacitor for the loudest sound. Any time after that, if you pushed that button, you would get the station it was tuned to. It did not disturb the dial or turn the tuning capacitor. Philco was the main company to use this system in their radios.

The best places to find radio-phono combinations are at auction sales, where I have seen beautiful sets go for $5.00, and in some cases no bids were received at all. Garage sales, tag sales, newspaper ads, auction houses and second-hand stores also sell them. I don't see many at flea markets, because they are bulky and hard to carry around. When looking for radio-phonos take a strong friend and a pickup truck. You will need both to get one home.



This closeup view of a turn of the century Edison with a drum instead of a disc shows the first system of sound reproduction that was used. The disc with a piece of tubing at right angles to it is the speaker connection.

The phonos with drum type records have a place in nostalgic Americana. They were replaced by the disc record players more than 60 years ago. A photo like this one of the record drum on the spindle is almost never seen nowadays.



Philco's "Beam of Light" pick up was a unique approach to getting sound from the grooves of record to amplifier. The light reflected from a mirror on the stylus varied with the vibration of the needle.

Restoration. After you get the set home, you will want to restore it so it looks and plays like it did when new. First check over the cabinet and see if it needs extensive work or refinishing. Before starting to work on the cabinet, remove the radio chassis, speaker, antenna, and changer. Usually there will be scratches, torn grille cloth, and missing knobs and handles. It always helps to vacuum all the dust and dirt from the cabinet. Wash the outside of the cabinet with a mild detergent and warm water. Quickly dry the cabinet so the veneer doesn't get water soaked. If there are only a few scratches, try colored paste shoe polish, colored paste wax, or even stain of a matching color. After the minor blemishes are hidden, give the cabinet a coating of paste wax and buff it carefully. Your cabinet will either look like new or it will have to be stripped and refinished. The scope of this article doesn't cover stripping and refinishing. If the grille cloth needs replacement, try fabric stores for suitable material or radio parts stores for replacement grille cloth.

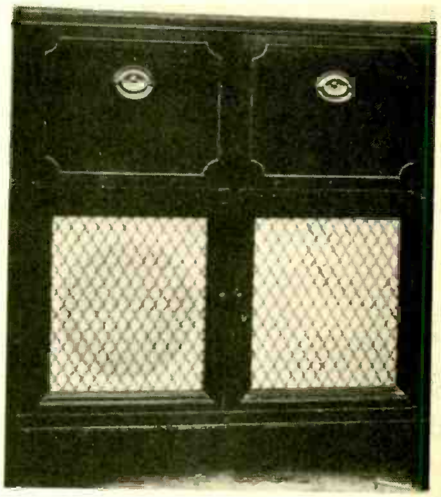
Next, clean all the dirt and dust from the radio chassis. I use an old paint brush and small wire brushes, plus the vacuum sweeper. Be especially careful not to bend the tuning capacitor plates (they are soft aluminum). Remove the tubes for testing, noting carefully which socket they came out of. Dust the speaker and inspect the cone for holes. If there are minor tears or small holes in the cone, buy a bottle of speaker cement. Spread the cement over and around the hole and cover with pieces of paper towels. Do the same with small tears.

Try the pushbuttons and see if they work mechanically. If not inspect them while pushing the buttons. Many times there is rust, dirt, or gummed lubricants that must be washed out or cleaned away. Relubricate all metal sliding parts and be sure all buttons return to their out position when other buttons are pushed in.

Test It Out. If everything is in order, reconnect all the various parts on your bench and replace good tubes in their sockets. Connect a 100-watt lamp bulb in series with the line cord and plug the series arrangement into the wall outlet. If the lamp lights brightly when you turn the switch on, you may have a short in your radio. Sometimes there is no switch as such, but one of the pushbuttons activates the switch. Find the rectifier tube and pull it from its socket; it will probably be a 5Y3G or an 80. If the bulb now lights dimly, you probably have a shorted filter capacitor. If you are not adept at radio repairs, you will now need to find professional help. If the lamp lights dimly the first time you turn it on, it is okay to remove the series lamp bulb and plug the set directly into the wall outlet. Look at the tubes to be sure the filaments are all lit. If so, you should hear a hum in the speaker or even hear a radio program if you turn up the volume. You may have to look at the printing on the front of the cabinet around the knobs to see which shaft is for volume, tuning, tone and shortwave selector. Try all positions of the knobs, so you are sure the radio is set to receive stations on the broadcast band. If the set plays well, you are now ready to tackle the record changer and put it right.

The oldest of the pick ups used were little more than needles in the record grooves, which mechanically conducted the vibrations of recorded sound to a wooden speaker cone. Speaker worked much like unamplified megaphone.

Changer Repair. Working on a record changer requires a little mechanical ability and a lot of common sense. The changer is a mechanical device that will need to be cleaned and lubricated. If you can repair an automobiie, you should have no trouble with the changer. The motor is mounted on rubber grommets, which no doubt will be hard. New soft grommets must be installed. There is a rubber-tired drive wheel that turns against the inside of the turntable. The rubber tire must be replaced in most cases or the turtable won't go around. Before you plug it in, you can turn the turntable by hand and see if it goes through the motions of dropping a record and setting the needle down where it should be. Remember, most of the changers you will find only play 78 RPM records, so you must have this type of record on hand to try the changer. If the changer works mechanically, then inspect the needle. It must be good and not have a worn point. If everything looks OK, set the radio-phono switch to the phonograph position, place a record on the changer and turn everything on. If the needle lands in the groove, but no sound is forthcoming, the pickup cartridge is probably dead. New replacement cartridges are available from most radio parts stores and mail order parts houses.



This Zenith radio-phono combo had record changer located in a drawer on the left.

If you want to play 45 and 33⅓ RPM records on your old set, you had better consider adding a modern changer. You will find changers on sale in many places. You may have to make a new mounting board or recut the board already there.

After you have restored your radio-phono combination, you will have a new appreciation of the "Golden Age of Radio." I doubt very much if you will go back to the artificial sound of a transistorized record player again. Listening to the "Big Band" records will bring back memories to the Senior Citizens, and may start a new listening trend if you are under 50 years of age. Good luck and happy hunting. ■

IT'S SIMPLY BASIC

The Computerized Appointment Book

BY LARRY FRIEDMAN WB2AHN

THIS MONTH'S PROGRAM, *Calendar*, is a handy program. It is designed to serve as a random entry diary or appointment book. Using a disk for storage, you can enter future events whenever you hear of them, and then get a printout, in sequential order, for any month of any year. The program has been specifically designed for the beginner. Various features, such as the sort, which arranges dates in order after they're read from the disk, have been kept as concise and simple as possible. The sort can be found in lines 1370-1450.

Calendar features 5 commands: START, UPDATE, DATE, MONTH and STOP. The START command allows you to enter data onto the disk. Because this program does not use subscripted variables in the START mode, the number of entries in the START mode is unlimited. To exit the START mode and return to the COMMAND mode, type 0,0,0. The UPDATE command is similar to the START command, but will append a previous file rather than start a new one. Unless you wish to erase your previously entered records, UPDATE is used for entering data; START is used only the first time you enter data to the disk.

The DATE command is used to retrieve data for a particular date. By entering DATE and then the date you want information for, the computer

(Continued on page 84)

```
LISTING OF "CALENDAP" BY LAPRY FRIEDMAN

100 PEM *
110 PEM *                 "CALENDAP"
120 REM *             BY LARRY FPIEDMAN
130 PEM *         FOP ELEMENTAPY ELECTRONICS
140 REM *

150 PEM * PROGRAM USES PADIO SHACK LEVEL II WITH TRS-DOS
160 PEM *


170 PEM * THIS PPOGRAM KEEPS A CALENDAP FOP AN UNLIMITED
180 PEM * AMOUNT OF YEAPS, IN A FILE 'DLIST:0'.
190 PEM *
200 PEM *

210 CLEAR 1500
220 DIM Q1(31),Q$(31),Z$(31)
230 DATA START,UPDATE,DATE,MONTH,STOP
240 FOP I=1 TO 5
250 READ X$(I)
260 NEXT I
270 INPUT "COMMAND  >";C$
280 CLOSE
290 FOP I=1 TO 5
300 IF X$(I)=C$ THEN 360

310 NEXT I
320 PRINT
330 PRINT "SORRY, COMMAND DOES NOT EXIST. PLEASE PE-ENTEP"
340 PRINT
350 GOTO 270
360 CLS
370 ON I GOTO 380  ,580  ,890  ,1090 ,1580
380 OPEN "0",1,"DLIST:0"
390 PRINT
400 PRINT "ENTEP DATA AS FOLLOWS:"
410 PRINT "(LINE 1)  DATE    (ENTER AS MM,DD,YYYY)"
420 PRINT "(LINE 2) GENEPAL INFORMATION"
430 PRINT "(LINE 3) GENERAL INFORMATION OP PERIOD '.'"
440 PRINT
450 PPINT "TYPE 0,0,0 TO EXIT 'STAPT' MODE."
460 PRINT
470 INPUT "<LINE 1>";A1,B1,C1
480 IF A1=0 THEN 530
490 INPUT "<LINE 2>";G$
500 INPUT "<LINE 3>";H$

510 PPINT#1,A1;",";B1;",";C1;",";G$;",";H$
520 GOTO 460
530 CLOSE#1
540 IF Q=1 THEN 680
550 PRINT "<EXIT 'STAPT' MODE>"
560 PPINT
570 GOTO 270
580 PRINT"<'UPDATE' MODE>"
590 OPEN "I",1,"DLIST:0"
600 OPEN "0",2,"TLIST:0"
610 IF EOF(1) THEN 650
620 INPUT#1,A1,B1,C1,G$,H$
630 PPINT#2,A1;",";B1;",";C1;",";G$;",";H$;",";
640 GOTO 610
650 Q=1
660 CLOSE
670 GOTO 380
680 Q=0
690 OPEN"0",3,"FLIST:0"
700 OPEN "I",2,"TLIST:0"
710 OPEN "I",1,"DLIST:0"
720 IF EOF(1) THEN 760
730 INPUT#1,A1,B1,C1,G$,H$
740 PRINT#3,A1;",";B1;",";C1;",";G$;",";H$;",";

750 GOTO 720
760 IF EOF(2) THEN 800

770 INPUT#2,A1,B1,C1,G$,H$
780 PRINT#3,A1;",";B1;",";C1;",";G$;",";H$;",";
790 GOTO 760
800 CLOSE#1:CLOSE#2:CLOSE#3
810 OPEN "I",2,"FLIST:0"
820 OPEN "0",1,"DLIST:0"

830 IF EOF(2) THEN 870
840 INPUT#2,A1,B1,C1,G$,H$
850 PPINT#1,A1;",";B1;",";C1;",";G$;",";H$;",";
860 GOTO 830
870 CLOSE#2:CLOSE#1
880 GOTO 270
890 PPINT "<'DATE' MODE>"
900 PPINT
910 INPUT "ENTER DATE (AS MM,DD,YYYY) >";D,M,Y
920 OPEN "I",1,"DLIST:0"
930 IF EOF(1) THEN 1040
940 INPUT#1,A1,B1,C1,G$,H$
950 IF A1=D THEN IF B1=M THEN IF C1=Y THEN 970
960 GOTO 930
970 CLS:FOP I=1 TO 5:PRINT:NEXT I
980 PPINT "DATE  ";A1;"/";B1;"/";C1
990 PRINT G$
1000 PRINT H$
1010 PPINT

1020 Z=1
1030 GOTO 930
1040 IF Z=1 THEN 1080
1050 PPINT "NO LISTING IN FILE FOP THAT DATE."
1060 PRINT
1070 GOTO 270

1080 Z=0:GOTO 270
1090 PPINT
1100 I=1
1110 PPINT "<'MONTH' MODE>"
1120 PRINT
1130 INPUT "ENTEP MONTH AND YEAP (AS MM,YYYY)";M,Y
1140 PPINT
1150 OPEN "I",1,"DLIST:0"
1160 IF EOF(1) THEN 1260
1170 INPUT#1,A1,B1,C1,G$,H$
1180 IF A1=M THEN IF C1=Y THEN 1200
1190 GOTO 1160
1200 Q1(I)=B1
1210 Q$(1)=G$
```

Antique Radio Corner

A mystery radio and old fashioned shock prevention

BY JAMES A. FRED

☐ Where are all the old vacuum tubes coming from? There doesn't seem to be any shortage of tubes made after 1928. Octal tubes are especially plentiful, although many of the loctal types are becoming hard to find. There are several tube suppliers in the U.S. who have stocks approaching 100,000 tubes. Some sell their tubes at reasonable prices, while others are extremely high in price. When it comes to buying WD-11s, 199s, WX-12s, 200As, 201As etc., it takes a lot of looking and much correspondence to find them. The 864 and 30 make reasonable substitutes if you use the proper filament voltages. In some cases, adapters are available, or you can find the 1920s adapters available at antique radio flea markets.

Tube Repairs. I have written several columns about tube substitutions, so this time I am going to discuss how you can sometimes repair old tubes. Some collectors object to tubes that have loose bases. Actually, a loose base doesn't affect the electrical operation of a tube unless the base has been twisted so far that the lead wires are broken or shorted inside the base.

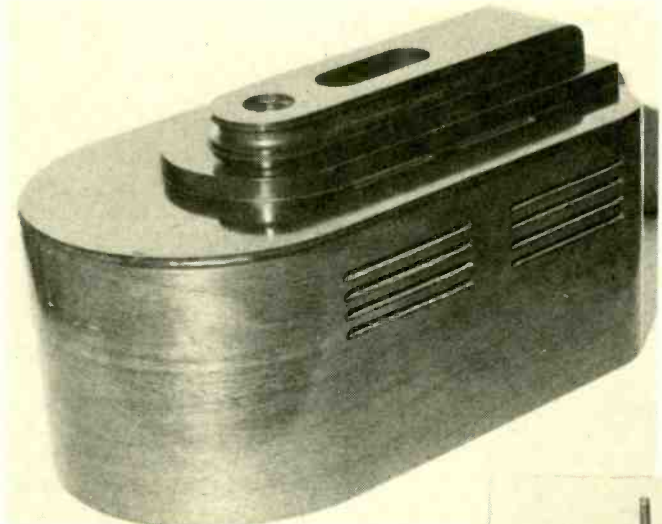
There are several ways to treat tubes that have loose bases. The easiest way is to arrange the base so the tube works OK, then wrap some tape around the base overlapping the glass bulb. Another approach is to drill a hole in the base and inject some household cement or epoxy into the hole. Set the tube aside with the base up and the cement or epoxy will run down to the glass bulb junction with the base. When the adhesive sets, the base will be as tight as it was when new.

The method I prefer, which is also the most difficult, is to unsolder the lead wires from the base pins and remove the base. Be very careful to keep the leads in the right relation to each other, and mark the filament location by placing a piece of tape on the glass bulb. Unsoldering is most easily done by immersing the ends of the pins into a solder pot and pulling the base from the bulb. Remove the old cement from inside the base and clean the solder from inside the tube pins with a soldering iron, a drill bit, or a small round file. Carefully clean the oxide from the lead wires with sandpaper and tin the leads. The lead wires are made from wire that is difficult to solder.

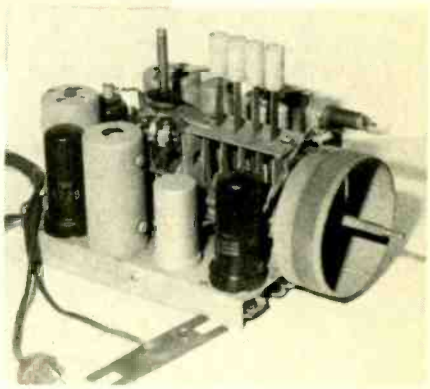
Since the wires are welded to the tube elements and are sealed in glass, they have to be made from an alloy that has the same coefficient of expansion as the glass. When reassembling the tube, apply a bead of cement or epoxy to the glass bulb in the area that will be just below the edge of the base when it is reassembled. Thread the lead wires back into the pins and use four pieces of masking tape at 90 degree intervals vertically, overlapping the base and bulb.

Immediately dip the tube pins into rosin solder flux and then into a solder pot. If you have no solder pot then use a soldering iron or gun. The lead wires should now be securely soldered to the tube base pins. A little cleanup of excess solder from the pins may be necessary so that the tube will easily go into its socket.

A Word of Caution. Do not wait for the cement or epoxy to harden before soldering the terminals. When you dip the pins into the solder pot the heat will expand the air in the base and if it can't escape it will blow the solder out of one or more of the tube pins. This will make it very difficult to get a neat solder job. If the cement or epoxy is still soft, the expanding air will leak through instead of trying to get out through the solder holes.



This art deco wooden cabinet holds the rebroadcasting radio, a mystery for all of the antique radio experts who have seen it. It is possible that it's one of the rarest kind.



With the cabinet removed, the circular antenna and pushbuttons of the mystery radio can be plainly seen. It was quite well made, possibly intended for display.

After you remove the bases from several tubes you will see that some lead wires weren't really soldered, but merely pressed against the solder in the end of the pin. This is the reason you can sometimes repair a tube by applying heat and solder with an iron or gun to the end of the pin. As the pre-1930 tubes become harder to find, it will pay you to take the time to try resoldering the pins of every defective tube you have before throwing them away. Over the past 10 years, I have restored a number of tubes this way.

Mystery Radio. International Radio in Ann Arbor, Michigan has always interested me. I know they may have been the first to introduce a pocket size AC-DC radio. They also had a bad habit of putting more tubes into a radio than were needed to improve the performance of the radio. They would have several filament ballast tubes in series, or they might use 4 tubes in push-pull parallel to drive the speaker. In their advertising, they would list a radio as having 12 tubes, when only 6 or 7 were actually doing the amplifying or detecting of the radio signal. In fact, I seem to remember the Federal government requesting them to stop this practice. They were told to quote *only* the number of tubes that actively amplified or detected the signal.

Irwin Miller of Staten Island, NY has an International Radio Corp. Kadette Tunemaster, Model KRC-2. The photos supplied by Mr. Miller show the cabinet and chassis. As you can see, there is no transformer, output tube or speaker. The tuner has a dial, 4 push buttons and a volume control.

My idea of the function of this tuner is as follows. As the name indicates, it is a broadcast band tuner that converts the incoming signal frequency to 1570 kHz, then amplifies and radiates it into space. Any radio in the vicinity also tuned to 1570 kHz. would pick up the incoming signal. In other words, this may have been the first community radio receiving system. It could have been used in any location where there were many radio sets such as in a hospital, nursing home, school, hotel, a prison, or as a monitor in a radio broadcasting station. A centrally located Tunemaster could be used to tune in a station and it would rebroadcast the station to any other radio in the building that was tuned to 1570 kHz.

Both Mr. Miller and I would be interested in hearing from any reader who has one of these sets, or from any reader who knows exactly what the purpose of this tuner was. Perhaps the engineer who designed this tuner is still alive and will read this story.

The California Historical Radio Society is starting a membership drive. They publish a quarterly bulletin that is among the best I have ever seen. If you would like a sample copy of the bulletin and an interesting booklet on radio collecting, write to Ed Sage, Membership Chairman, 559 Civic Center Street, Richmond, CA 94804 and he will send you one.

Transformerless Sets. Many collectors are buying and restoring radios made after 1932 that don't have power transformers. When radio sales dropped after November 1929, manufacturers began to look for ways to make cheaper radio sets. The cathedral and other small radios were introduced, but most of them still used a transformer. At the time, the transformer was the most expensive component in a radio.

I don't know which company was first to make a radio without a power transformer. It may have been Emerson or International radio; at least they became the leaders in this field. It was simple to connect the filaments of the tubes in series, so long as they all drew the same amount of current. The first sets of this type used 6.3-volt, .3-ampere filament tubes.

The voltages were added together; ie, five 6.3-volt tubes needed 31.5 volts to raise the filaments to the proper operating voltage. The line voltage was nominally 115 volts, so there was a surplus of 82.5 volts. By applying Ohm's Law, we find that 291 ohms in series with the tube filaments would provide the voltage needed. This resistance either became part of the line cord, or a vitreous enamel power resistor was mounted on the chassis. These two methods left something to be desired because there were about 25 watts of heat generated that was harmful to the line cord, radio cabinet and the components inside the cabinet. Also, when rectifying the line voltage for the "B" supply, there were only about 100-VDC available. The tubes in use at this time had been designed to operate with 180 volts as a "B" supply; therefore the sets operated poorly in comparison with the transformer-powered sets.

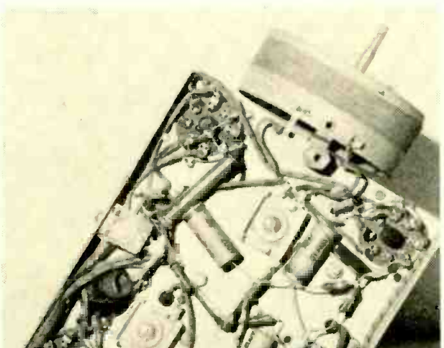
To improve the situation, tube engineers developed tubes that operated with filament voltages of 12.6, 25, 32, 35, 50, 70, and 117 volts DC. Now you could use three 12.6-volt tubes, a 35-volt rectifier and a 50-volt audio output tube. These filament voltages added together equalled the line voltage. You no longer needed resistor type line cords or series filament resistors.

All the heat was generated in the tube filaments, so the plastic cabinets were able to stand the heat buildup. At the same time, the newly developed tubes were made to operate on plate and screen voltages of 100 volts or less. This solved most of the problems, so they were able to build radios that sold for as little as $6.00 retail. A fringe benefit was the fact that without a power transformer the set would operate on 115 volts DC. In the U.S., even as late as the middle 1930s, many areas still had DC in their homes and hotels. This led to calling all transformerless radios AD-DC radios.

Avoiding Shocks. If you examine the schematic of a typical AC-DC radio, you will see that many have one side of the power line connected to the radio chassis. The electrical power plug used with these radios was not polarized, and neither were the wall outlets of the day. So, if the chassis is out of the cabinet and you are standing on a concrete floor or touching any plumbing fixture, or furnace duct while touching the chassis, you could receive the full line voltage. You may think that 115 volts won't harm you, and maybe it won't—but many persons are killed each year by 115 volts. The sudden shock may cause you to recoil sharply and strike an object or fall from a stool and injure yourself, apart from the electrical shock.

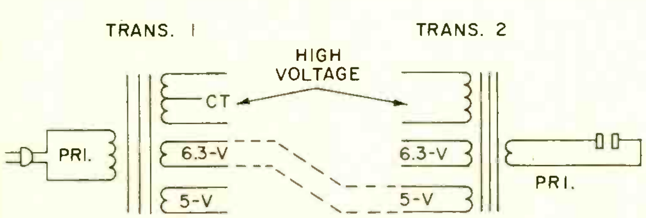
An isolation transformer is the cure

(Continued on page 85)



This view of the underside of the mystery radio's chassis shows octal sockets, wiring.

An isolation transformer such as this one shown in the diagram can be made up easily from parts available from almost any TV repair shop or electronic parts dealer.



BINARY-BCD 7 Segment Converter

Raw binary data is converted for real time LED display

BY DAVE LEITHAUSER

IF YOU'VE done much work with digital IC's, you've undoubtably had occasion to make use of binary counters. These are very useful and versatile components. Unfortunately, they are also the most susceptible to problems with noise, self-annihilating coincidences, too short reset pulses, too slow rise and fall time on input pulses, and related problems.

Some practical means of monitoring counters is needed when troubleshooting digital circuits. Multi-channel logic probes are helpful, but trying to decode a rapidly changing binary count in your head to see if it is skipping any numbers can rapidly lead to mental exhaustion. This is especially true since most binary counters do not have their outputs arranged in an orderly formation for visual monitoring. In addition, multi-channel monitoring instruments can be very expensive.

The best way to monitor binary coded information is with a binary-to-BCD-to-seven-segment converter. The device described in this article accepts binary input and displays it in normal base ten format on (seven segment) LED readouts. The converter has eight inputs 2^0 through 2^7) so it can decode any number from zero up to 255.

The converter can be used in any circuit using binary coded numbers, not only counters. For example, it can be used to determine which address a memory IC is at, so that any address line of a microprocessor can be checked out. In microprocessors using DMA (direct memory access) this technique will solve most troubleshooting problems. In parallel to serial data circuits (multiplexers) such as the 74150, each parallel input line (including the strobe) can be checked using the binary-seven segment converter described in this article. Troubleshooting applications alone make this device very useful. In addition it is worth its weight in gold as a training tool to teach yourself or others how data processing & microcomputer circuits function.

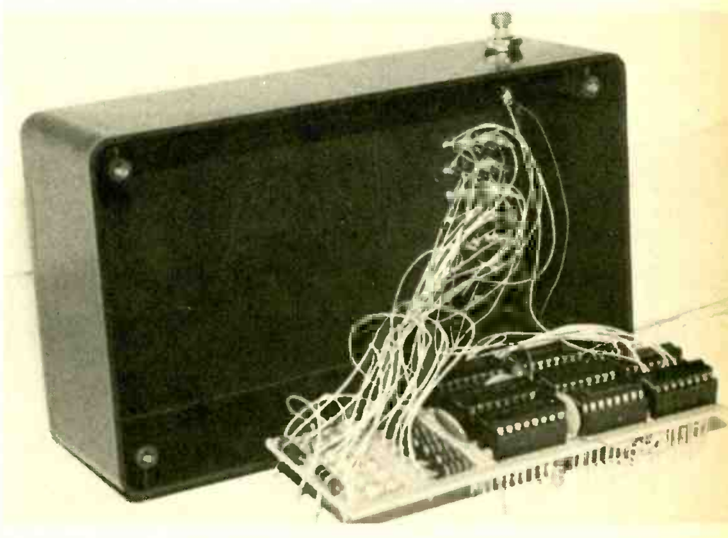
How to Use the Converter. The binary-to-BCD-to-seven-segment converter is extremely simple to use. There is nothing to tune or adjust. It just has ten wires with insulated alligator clips to connect to the part of the circuit you are monitoring.

The first wire has a black insulated alligator clip and should be connected to any ground point on the circuit being monitored. The second wire has a red insulated alligator clip and should be connected to any V+ (5 volts) point on the circuit being monitored. These two connections provide power for the converter. They must be connected before the other eight wires.

The remaining eight alligator clips can be any color. They are labelled 2^0 through 2^7, respectively. These inputs are connected to the corresponding outputs of the counter being monitored. For example, the 2^0 input of the converter goes to the 2^0 (1) or least significant digit output of the counter, the 2^1 input goes to the 2^1 (2) output, the 2^2 input goes to the 2^2 (4) output, the 2^3 input goes to the 2^3(8) output of the counter, etc. If you do not have eight binary outputs, the unused inputs must be connected to ground. If they are not connected to ground, they will read as a high input, resulting in an incorrect display reading.

There is only one button on the converter. This is a momentary contact switch which latches (freezes) the display for as long as the button is held down. This would be used to determine what the count is as a specific event occurs, if the count is changing too rapidly to read.

For example, let's assume that an observable malfunction (such as a sudden heavy power draw) occurs periodically in a circuit. You may wish to determine if the output of a counter in the circuit is the same each time the problem occurs, as a first step in locating the problem. After connecting the converter to the counter, you can watch your instruments for an indication of the malfunction. When it occurs, you press the latch button and hold it. The number on the converter's display is the count when the malfunction (or



Exposed perf-board reveals the 8 ICs, the wire wrap connectors, and 7 resistors for each LED. These 21 resistors, reduce the current driving the LEDs. This model uses 400 ohms. A lower value will produce a brighter display, but more current will be consumed from the power source.

other event) occurred. Note that the latch button does not effect the counter or the circuit being monitored. It merely freezes the display on the converter.

About the Circuit. At the heart of the circuit are three 74185 TTL IC's. These are actually factory programmed ROM's programmed with a binary to BCD conversion table. A single 74185 can convert a six bit binary input to BCD. By cascading the 74185's you can convert as many bits of binary as you like to binary coded decimal (BCD).

Unfortunately, the number of 74185's required goes up exponentially with the number of input bits. A converter that accepts eight input bits requires three 74185's. A converter that accepts 12 input bits requires eight 74185's. To get 16 input bits you need 16 of 74185's. It is unfortunate that a 74185 draws from 40 to 80 mA of current. I have been unable to locate a source of 74LS185's or 74C185's. This means that a converter with 12 inputs would draw about 500 mA just to power the 74185's. Since my prototype draws its power from the circuit being monitored, that is quite a heavy load.

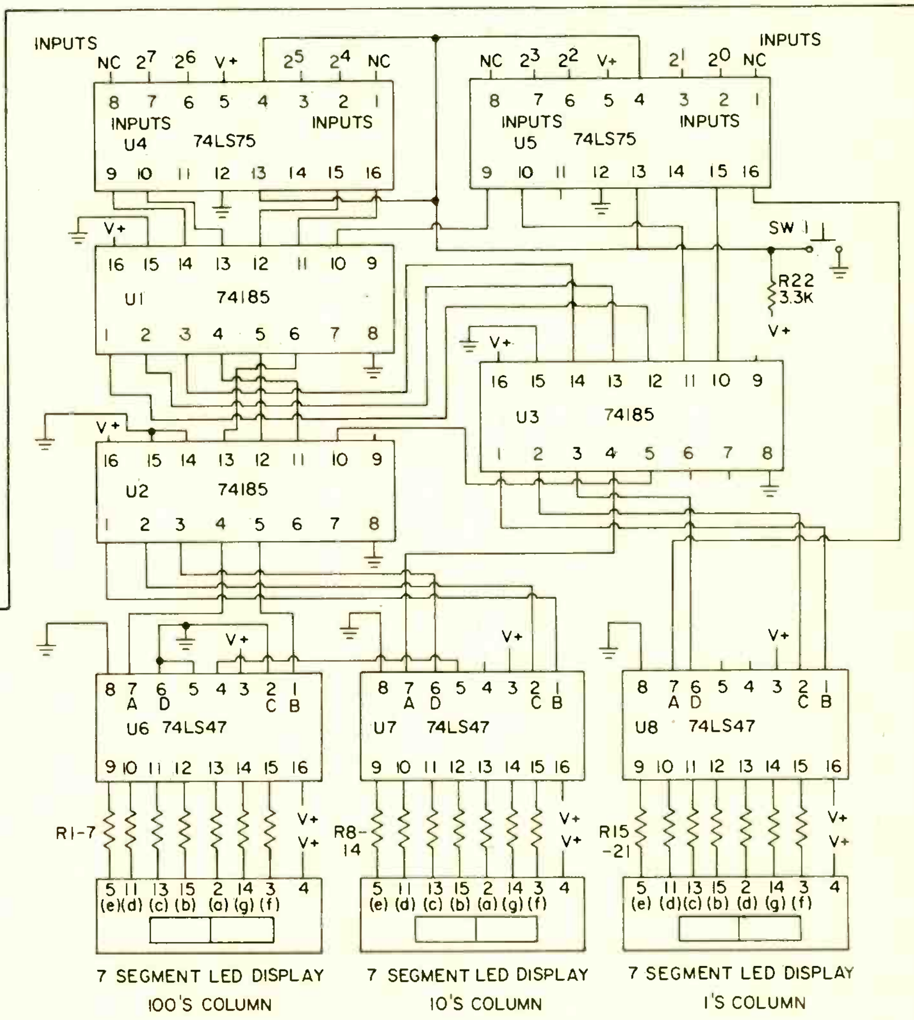
After some debate, I decided to settle for a converter that accepts eight inputs and requires three 74185's. With three 74185's the total converter draws 250 to 350 mA, depending on the binary input. Since eight bits is the output of two cascaded four bit binary counters (such as the 74193), that is quite adequate for most purposes.

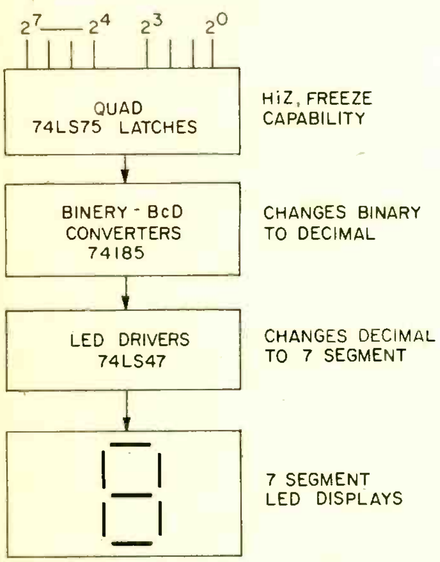
The eight inputs to the converter are actually the inputs to two 74LS75 quad latches. These latches serve two purposes. First, because they are LS IC's they have twice the input impedence of regular IC's. This means that the converter will produce less interference with the circuit being monitored than if the inputs went directly to the 74185's. Secondly, the latches enable you to freeze the display of the converter. When switch 1 (SW 1) is open the enable inputs of the latches are positive and the digital levels at the outputs follow the inputs. When switch 1 is closed the 74LS75's are latched and the outputs are frozen at the values that were at the input at the moment switch 1 was closed.

The outputs of the 74LS75's go to the inputs of the 74185's, where the binary number is converted to BCD. Note that the 2^0 bit bypasses the 74185's and goes directly to a 74LS47. This is because the 2^0 bit is identical in binary and BCD and therefore does not need to be converted.

The outputs of the 74185's go to

(Continued on page 83)





Functional diagram reduces components so that basic theory of the Binary-BCD-7 segment converter is easier to understand.

PARTS LIST FOR BCD CONVERTER

LED 1-LED 3—7-segment common anode display readouts (Radio Shack 276-053 or equivalent)
R1-R21—400-ohm, ½-watt resistor, 10% (see text)
R22—1,000-ohm, ½-watt resistor, 10%
SW1—SPST normally open, momentary contact switch
U1-U3—74185 BCD programmed ROM integrated circuit*
U4, U5—74LS75 quad latch integrated circuit
U6-U8—74LS47 LED driver integrated circuit

Misc. Perfboard, plastic housing, IC sockets if desired, ten insulated alligator clips, wire, solder, etc.
*Available from: Jameco Electronics, 1021 Howard Ave., San Carlos, CA 94070

E/E CHECKS OUT THE...

Heath H17 Disk Drive

CIRCLE 1 ON READER SERVICE COUPON

Maximize your H8 with high speed disk capability.

THOUGH THE CASSETTE data storage system for the Heathkit H8 computer is perhaps the best in terms of speed (1200 baud), ease of operation, reliability, and minimal failure rate—not to overlook the fact that it is the least finicky of any cassette when it comes to input/output levels—nevertheless, it suffers the same problem of data storage as all other cassette systems using an audio recorder do; it is *too slow*.

While it might not be much of an inconvenience to wait several seconds, or possibly even a minute, to load a program or data from cassette, it's another matter when the material you're looking for is near the end of a 30-minute cassette, or divided among several cassettes.

For maximum speed and utilization of a computer, you need a disk system, which can seek and load data in a matter of milliseconds. For the H8 computer, this is done with the Heathkit H17 Floppy Disk System; a *plug-in and run* peripheral if you take the wired rather than than kit route.

Features. The H17 system uses standard 5¼-inch disks (hard sectored)-providing up to 100K bytes of storage in 40 tracks. The basic package consists of a controller, and a single drive installed in a cabinet that can take two drives. The "extra" front panel cutout for the second drive is covered by a trim plate. The power supply for the drive(s), which is on the back of the cabinet, is large enough for both. If you add the second drive at a later time, you simply secure it in place with four mounting screws and plug in the power connector to the power supply. There is no electrical wiring or modification required when you add a second drive.

Not Just A Plug-In. The controller "card" installs inside the H8 computer, plugging into the wiring buss in the same manner as the memory and I/O cards. One thing you'll have to double-check is that you have space for the controller, because the H8's P10 plug cannot be used. If you have four of the old low-density memory cards, the serial/cassette I/O card, and either a 4-port serial or a parallel port card, something's going to have to go if you want to install the disk controller.

(If you're going to add memory to your H8 along with the disk system, use a high density memory card such as the WH8-16 16K memory, which replaces two 8K cards.)

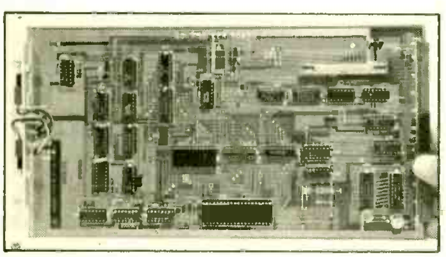
The supplied connecting cable from the controller to the drive has the required plugs for two drives. One end connects to the controller, and the other end connects to the first drive. A few inches from the drive connector is a second connector for the second drive. When you add a second drive, you simply plug it in to the free connector.

The H17 is supplied with one disk which is used for testing the installation. *It contains no software.* To use the H17 system, you'll need the H8-17 Operating System Software, which is priced at $100. It is supplied on a disk with a rather extensive software manual. The disk contains the latest version of Benton Harbor Extended BASIC, which accommodates either the 4-port serial card or the H8-5 cassette-I/O card, a 2-pass absolute assembler, a text editor, a console debugger, and a set of disk utility programs. Features of the software include dynamic file allocation that automatically keeps free space available to permit unlimited file size, and special test systems which provide the user with a visual indication of drive condition, such as speed.

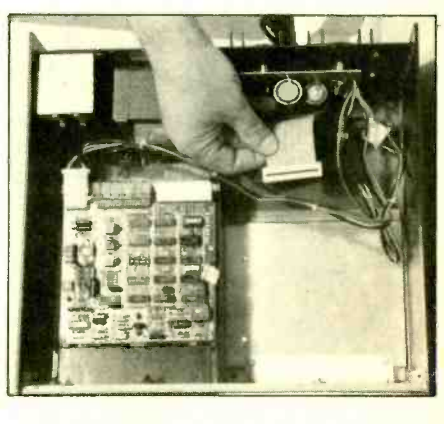
For example, you don't have to guess if the drive is running at the correct speed, for the test program causes the H8 computer's LED display to indicate 1.000 if the drive speed is correct. If the drive speed drifts outside the permitted tolerance—indicated as "0.990" or "1.010"—there is a user adjustment for speed alignment. The drive does not have to be sent out for service to test or adjust the drive speed.

Operation. A major plus for the H17

(Continued on page 85)



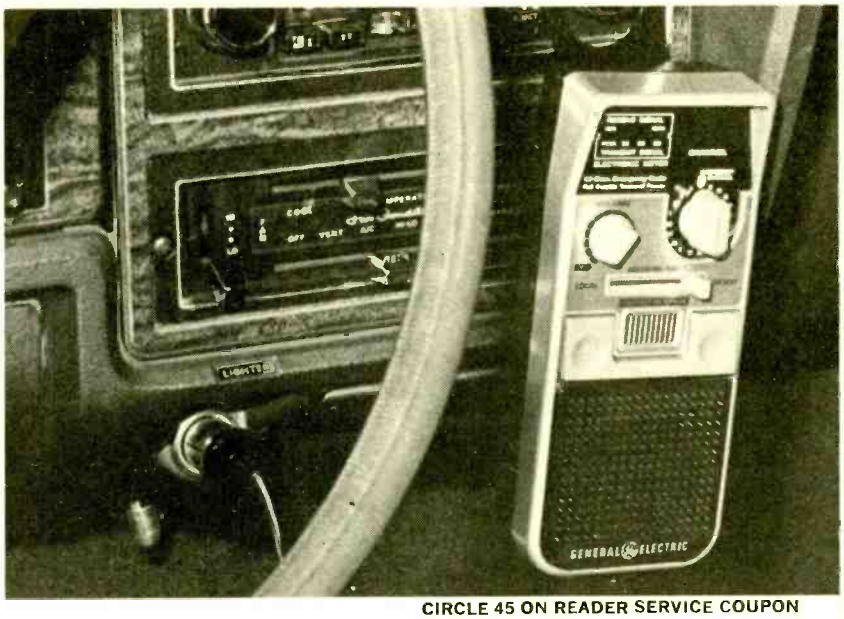
These photos show how the H17 and its interfaces can be easily added to Heath H8 computer. The controller board fits into the H8's board rack in the cabinet, and a flexible connecting cable is added.



E/E CHECKS OUT...

GE's HELP! CB

When you need HELP!
you need it badly



CIRCLE 45 ON READER SERVICE COUPON

OUT OF GAS on a deserted road, the only help miles away? Auto accident on the road ahead, and not a sign of help? Sudden illness while driving, with no help in sight? Power outage at home, and the flood waters rising? Where to find help? Well, help is no further away than General Electric's new self-contained emergency CB package—named, appropriately, HELP! Selling for only $115.95, this new communications product just could be your most important purchase.

First of all, HELP! is a full-service CB transceiver. It covers all forty channels, puts out a full four watts AM, has a good sensitive and selective receiver with the usual squelch circuitry, and a bright LED display. But the resemblence ends there. For HELP! is set up in a handy-talky format. The unit is meant to be picked up in the hand, talked into and listened to much like a portable rig. All the controls are arranged so as to be accessible and visible while the unit is held. And the controls are very much simplified. There is an ON-OFF and VOLUME control, a sliding squelch control (marked DISTANCE-LOCAL, since distant stations mean less squelching than stronger local ones), and a forty position channel selector. There's an interesting LED bar graph meter which measures receiver signal strength and transmitter output, and that's it for controls!

The HELP! package also contains a magnet mount telescoping whip antenna, with a good length of coaxial cable that plugs into the bottom of the transceiver, and a power cord with a cigarette lighter plug on the end to allow quick connection to the automobile's 13.8-VDC negative ground electrical system. This also plugs into the bottom of the transceiver. The cables have noninterchangeable connectors, to eliminate any possibility of confusion. When not in use, everything fits into a compact, almost flat plastic container which is designed to slide under the front seat for invisible storage. All the components have their own compartments inside the container.

The magnetic mount on the antenna base puts HELP! into position to broadcast in a matter of moments. This portability and ease of putting the unit into service is the keynote of the HELP! CB system. It is truly an emergency communications system designed to be within easy reach when it is most needed. Electrical power connection is via a convenient cigarette lighter receptacle, handy to nearly every vehicle.

We tested the unit on the crowded CB band in New York City. Receiver selectivity was excellent. The transmitter checked out at four watts output, and modulation reports were very complimentary. The unit was extremely easy to hook up and use: we just opened the container, plugged in the antenna cable, extended the antenna and slapped it on the roof, and plugged in the power cable. That's all there is to it to get HELP! on the air. If you need help, that's all it takes to get it.

Our only quibble was with the antenna, which, with its relatively short telescoping, is a little feeble. However, those are the limitations if it is to fit inside the compact container. Anyone who really wants to see what HELP! can do should simply hook it up to a full-length CB whip. Antenna, transceiver, and all are very solidly built, and we recommend the units and the packaging idea thoroughly. For more information, please circle number 45 on the Readers Service Card. ■

Electronics Notebook

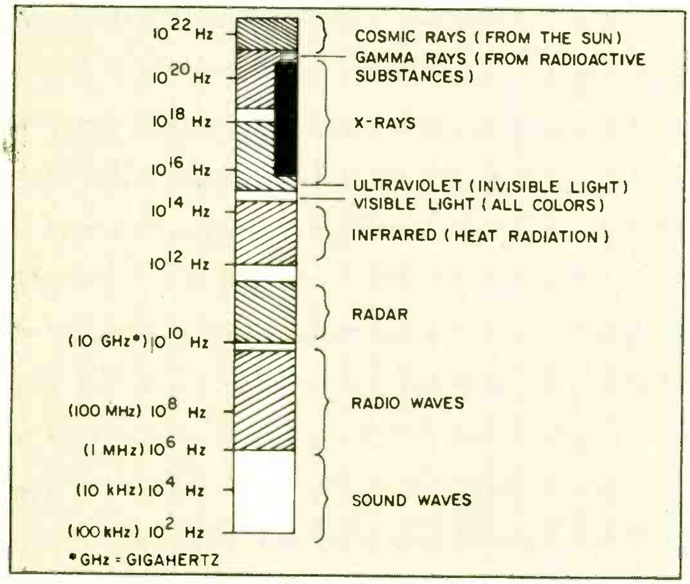
In our last installment we discussed the fundamentals of receivers. Here we will take you through an explanation of the next step: the transmitter and the theory behind it.

WHAT YOU WILL LEARN. When you have finished reading this article you will have learned what the electromagnetic frequency spectrum is, what a radio transmitter is, how it develops a broadcasting signal, and how radio signals are transmitted through space. You will have learned that voice (or music) can be impressed on the radio (carrier) waves. In addition you will have become acquainted with the difference between amplitude modulation and frequency modulation of radio frequency transmissions.

Electromagnetic Radiations

Energy that radiates from a source is said to be an **electromagnetic wave. Gamma rays,** which are given off by radioactive particles such as radium, uranium, or atomic-bomb fragments, are electromagnetic waves. **Cosmic rays** from the sun travel 93 million miles to the earth as electromagnetic waves. All electromagnetic waves, including light, radiated heat, and radio signals, travel through space at the rate of 186,000 miles per second.

THE ELECTROMAGNETIC SPECTRUM



The Electromagnetic Frequency Spectrum

Electromagnetic radiations differ from each other in terms of their frequencies measured in Hertz. (**Hertz,** a term we now use which means cycles-per-second). The frequency of one of these kinds of radiation is the number of times a single cycle repeats itself in one second. An electromagnetic spectrum chart shows the relationship of these different radiations to each other.

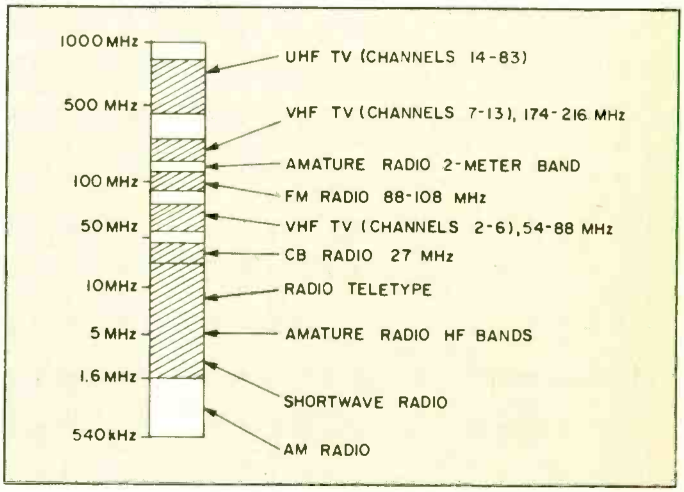
The chart shows that cosmic rays are radiated at a frequency of around 10^{22} Hz (abbreviation for Hertz). (The number 10^{22} is 1 followed by 22 zeroes, or ten-thousand, million, million, million Hz). At the lower end of the radio spectrum, the radiation frequency is under 10^{4}, or ten thousand Hz.

Assigned Broadcast Frequencies

The Federal Communications Commission (FCC) has assigned specific groups of frequencies to different types of communications transmissions. This is shown in an expansion of the radio-frequency portion of the spectrum in the right-hand chart.

Commercial transmitters (radio and television, for example) are assigned a transmitting frequency in the appropriate part of the radio-frequency spectrum. Transmitters broadcasting in the AM radio band, 535 kHz to 1,605 kHz, are required by law to be on their assigned frequency within plus or minus 20 Hz.

THE RADIO-FREQUENCY SPECTRUM



QUESTIONS

Q1. Cosmic rays and radio waves are examples of ....

Q2. Sound (is, is not) electromagnetic radiation.

Q3. Radio waves travel from the broadcast station to a receiving antenna at the rate of ....

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

miles per second.

Q4. .... is the characteristic which distinguishes one electromagnetic wave from another.

Q5. Commercial radio transmissions are at a (higher, (lower) number of Hertz than television.

Q6. A frequency of 1,000 kHz would be assigned to (commercial broadcasting, short-wave) radio.

Q7. CB radio is located (above, below) 30 MHz.

ANSWERS

A1. Cosmic rays and radio waves are examples of **electromagnetic radiations** (waves).

A2. Sound **is not** electromagnetic radiation. Remember? It is changing air pressure.

A3. Radio waves travel from the broadcast station to the receiving antenna at the rate of **186,000 miles** per second.

A4. **Frequency** is the characteristic which distinguishes one electromagnetic wave from another.

A5. Commercial radio transmissions are at a **lower** number of Hz than television.

A6. A frequency of 1,000 kHz would be assigned to **commercial broadcasting** radio. (1,000 kHz is equal to 1 mc.)

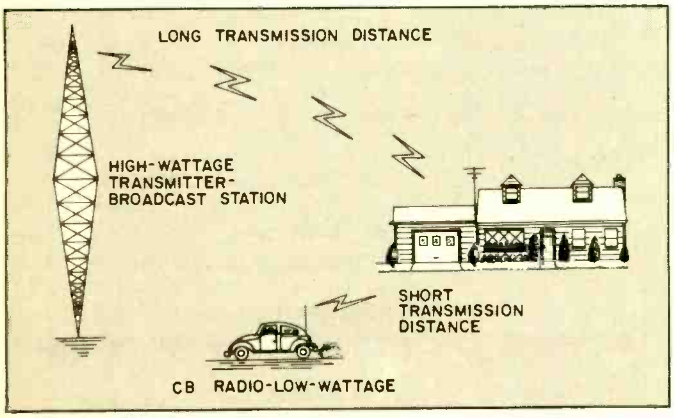
A7. The CB radio channels are **below** 30 MHz (27 MHz).

RADIO TRANSMITTERS

The dial on your home radio receiver is marked off in numbers, probably from 550 to 1,600 kHz (marked 55 to 160 often). By rotating the tuning dial, you select the desired station. Since each local station broadcasts at a different frequency, you are able to select the one you desire. The dial setting indicates the **carrier** frequency of the station.

The channel numbers on CB transceivers (combined transmitter and receiver) may be any from "1" to "40." The channel number selects the exact frequency near 27 MHz. Channel 9, for example, is 27.065 MHz, and channel 11 is 27.085 MHz.

TRANSMISSION POWER AND DISTANCE



Transmitter Power

You have also noted that some stations come in stronger than others. The stronger stations broadcast at higher power (measured in **watts** or **kilowatts**) than the weaker. Or, if one of two stations broadcasting at equal power is stronger than the other, the stronger station is closer to your home.

The drawing shows two radio transmitters, one a powerful commercial broadcast station (AM broadcast stations generally transmit at least 250 watts, and no more than 50,000 watts), and the other a typical Citizens Band transmitter (limited to four watts). Even though the broadcast station is dozens, often hundreds of miles from the receiver, its signal is able to reach across that distance. The CB transmitter, on the other hand, will only go a few miles. Many broadacst stations can be received no farther than 20 or 30 miles away (sometimes less, due to obstructing hills or buildings).

Radio Frequency Carrier and Audio Frequencies

The frequency assigned to a broadcast station is called its **carrier frequency.** The transmitter and its antenna are designed and tuned to that specific frequency. As its name implies, the carrier frequency carries a reproduction of the sound originating in the studio. Actually, there are two frequencies that leave the transmitter, a **radio frequency** (carrier) and an **audio frequency** (sound). Audio frequencies are between 20 and 20,000 Hertz. The frequency range of most human ears, however, is usually no higher than 15,000 Hz.

QUESTIONS

Q8. A home radio receiver (can, cannot) be tuned to 1 megahertz.

Q9. 900,000 Hz (could, could not) be a carrier frequency of a commercial broadcast station.

Q10. The power of one transmitter, station A, is 5,000 watts. Transmitter B broadcasts 500 watts. Which transmitter will be receivable at the greater distance?

Q11. Two broadcast stations are equally distant from your home. Assuming your receiver is OK, what could be a reason you could not receive one of them?

Q12. A human ear (can, cannot) hear a radio frequency.

Q13. A frequency of 600 kHz is classified as a (an) (audio, radio) frequency.

Q14. CB radio transmitters (can, cannot) transmit up to 15 watts of output power.

ANSWERS

A8. A home radio receiver **can** be tuned to 1 megahertz. One megahertz (1,000 Hz) is within the broadcast band.

A9. 900,000 Hertz **could** be a carrier frequency of a commercial broadcast station. It is the same as 900 kHz.

A10. **Station A.** It has much more power.

A11. **One station** is so **weak in power** it cannot transmit the distance.

A12. The human ear **cannot** hear a radio frequency.

A13. A frequency of 600 kHz is classified as a **radio** frequency.

A14. CB radio transmitters **cannot** transmit 15 watts output power (**limit is 4 watts**).

A Basic Transmitter

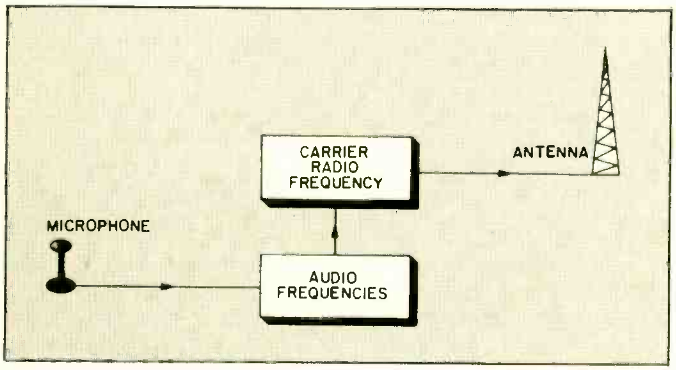
The diagram below shows a **functional block diagram** of a typical radio transmitter. It is called a functional block diagram because each block is representative of a general electronic function and may include several circuits.

The arrowheads between blocks show the direction of signal flow. You can probably already read what the diagram reveals.

Sound enters the **microphone** and is fed to the audio-frequency (AF) section. The sound, because it is too weak for transmission purposes, is amplified (signal amplitude is increased) and then passed to the RF carrier-frequency section

Carrier Frequency—The specific radio frequency (RF) assigned to the transmitter is developed in the carrier-frequency block. Passing through several circuits, the RF signal is boosted in power (increased in amplitude) to the rated wattage output of the transmitter. Just before the RF carrier is fed to the antenna, the AF signal is superimposed on it. Waveforms developed in each block are shown below.

TRANSMITTER FUNCTIONAL BLOCK DIAGRAM



Superimposing the Sound—The process of superimposing audio on the carrier, as shown in this particular example, is called **amplitude modulation** (AM). In amplitude modulation the audio frequency (varying at the changing rate of the original sound) is mixed with the carrier (a constant frequency) in a manner that causes that carrier **amplitude** to vary at the same rate as the audio. The carrier **frequency** remains unchanged.

QUESTIONS

Q16. The drawing here which shows circuit functions is called a (an) .... diagram.

Q17. Sound enters the AF amplifier section from a device called a (an) ....

Q18. .... on a block diagram show the signal direction between blocks.

Q19. Placing an audio frequency on an RF (radio frequency) carrier without changing the frequency is called ....

Q20. In CB radio the carrier frequencies are around .... Hertz. The audio frequencies are between (20 & 15,000, 50 & 5,000) Hertz.

ANSWERS

A16. The drawing is called a **functional block** diagram.

A17. Sound enters the AF section by way of a device called a **microphone.**

A18. Arrowheads on a block diagram show the signal direction between blocks.

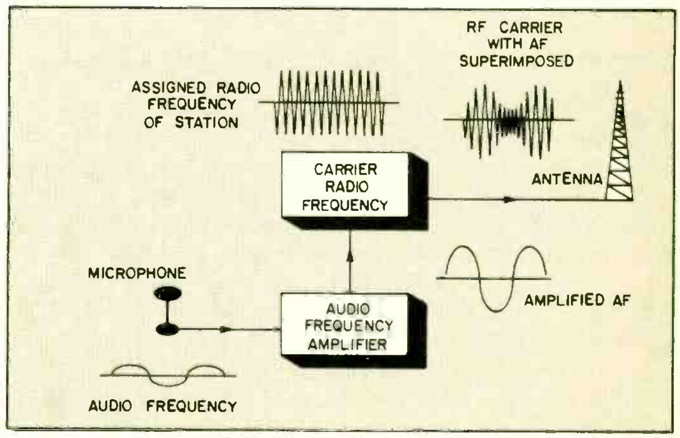
A19. Placing AF on a carrier without changing the carrier frequency is called **amplitude modulation.**

A20. In CB radio the carrier frequencies are around **27 MHz.** The audio frequencies are typically between **50 & 5,000** Hertz.

Carrier-Frequency Circuits

A minimum number of RF carrier-frequency circuits are shown in the diagram below. An actual transmitter has many more circuits to attain the frequency stability and power required. The additional circuits are similar to those shown, however.

TRANSMITTER WAVEFORMS



The Oscillator—The puropse of the **oscillator** is to generate a stable RF signal. The resistance, inductance, and capacitance that make up its input circuit are such that they will not allow the transistor in the oscillator to amplify any other signal but that of the desired frequency. The stable-frequency, low-amplitude output of the oscillator is shown above.

The Buffer—This stage (another name for circuit) is sometimes called an **intermediate power amplifier,** or **frequency multiplier.** In most transmitters it performs three functions. As a **buffer,** the stage isolates the oscillator from the effects of the circuits which follow it. Without this isolation, stray signals may be fed back to the oscillator, causing it to operate at the wrong frequency. As an **amplifier,** the buffer increases the amplitude of the oscillator signal to a level that is between the desired transmitter output and the amplitude of the oscillator signal. In many transmitters, the buffer circuit **doubles** (or even **triples**) the frequency of the oscillator output. The oscillator may not be capable of generating the required high frequency by itself. In order to produce the assigned frequency, a transmitter may require several multiplier stages.

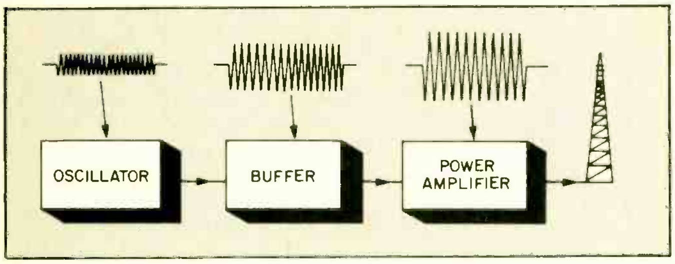
The Power Amplifier—The puropse of the **power amplifier** is to increase the amplitude of the RF signal to the power (wattage) requirements of the station. Several stages of power amplification may be required to achieve this. Normally, the audio signal from the AF circuitry is fed to the final power amplifier and used to modulate the carrier.

Electronics Notebook

QUESTIONS

Q21. A transmitter circuit which amplifiers a signal and increases its frequency is called a (an) ....

RADIO-FREQUENCY CIRCUITS

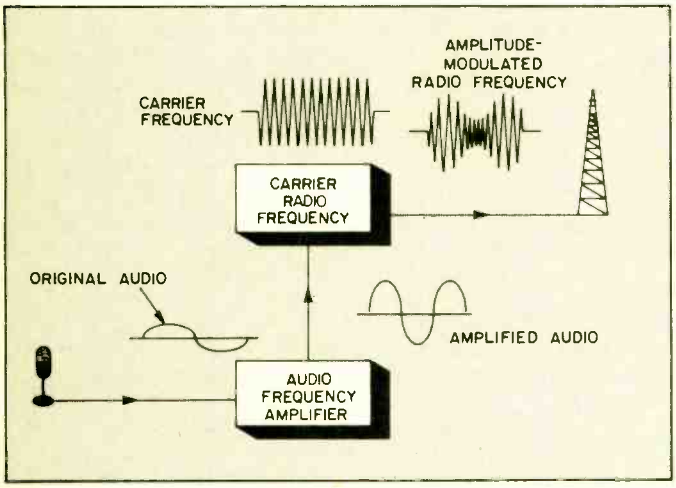


Q22. A (an) .... generates a signal which has a uniform frequency.
Q23. .... amplifier output is measured in watts.
Q24. AF and RF are mixed in what stage?
Q25. The carrier arrives at the antenna with its waveform (amplitude, frequency) modulated.
Q26. If a CB transmitter, employed an oscillator which produced a basic radio frequency of 13.5 MHz, what kind of stage must be used after the oscillator to produce the required output radio frequency carrier of 27 MHz? *(tripler, doubler).*

ANSWERS

A21. A transmitter circuit which amplifies a signal and increases its frequency is called a **multiplier.**
A22. An **oscillator** generates a signal which has a uniform frequency.
A23. **Power** amplifier output is measured in watts.
A24. AF and RF are mixed in **the final stage of the power amplifier.**

MIXING AUDIO AND RADIO FREQUENCIES



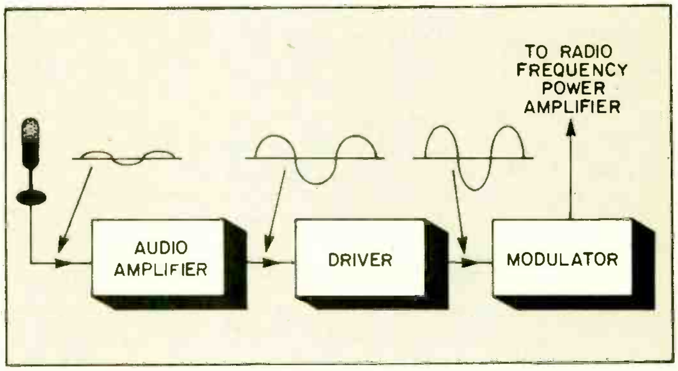
A25. The carrier arrives at the antenna with its waveform **amplitude** modulated.
A26. To produce a CB radio frequency carrier of 27 MHz a 13.5 MHz oscillator would have to be followed by a **doubler** stage.

Audio-Frequency Circuits

The Microphone—Regardless of the many different types of microphones that are available, even the best develop only a weak signal.

The Audio Amplifier—Although a single stage of audio amplification is sometimes all that is necessary, larger transmitters may have two, three, or more stages to obtain the desired undistorted level of amplitude.

AUDIO-FREQUENCY CIRCUITS



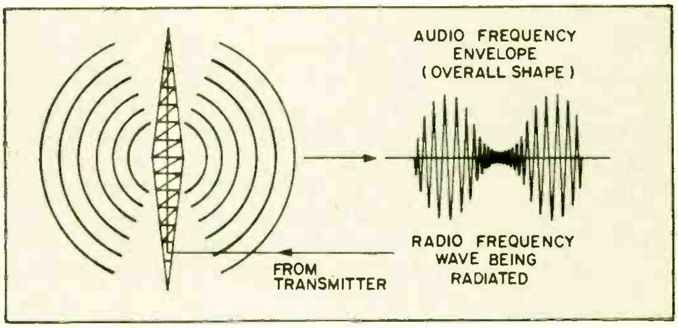
The Driver—Like most circuits, the **driver** obtains its name from its purpose. The driver amplifies the AF to the voltage level required to "drive" the transistors of the modulator. The modulator transistor require large changes in signal amplitude to operate properly.

The Modulator—The **modulator** is a power amplifier quite similar to the final circuit of the carrier-frequency block. It amplifies the audio signal to a power level suitable for modulating (changing) the carrier power in the final power amplifier. Power output of the modulator is fairly close to half the power of the final carrier amplifier.

Antennas

If all circuits are operating properly, an AM (amplitude-modulated) carrier is fed to the antenna.

ANTENNA RADIATION



Power is fed to the antenna in the form of both current and voltage. Voltage sets up an electric field along the length of the antenna. Current, in traveling through the antenna (a conductor), sets up a corresponding magnetic field. Both fields vary at the rate of the car-

(Continued on page 86)

ELEMENTARY ELECTRONICS INDEX TO ADVERTISERS

RS #	ADVERTISER	PAGE
16	A. P. Products	CV2
—	Avanti	17
—	C.I.E.	8-11
—	Communications Electronics	81
8	Digi-Key	81
5	The Electra Company	22
9	Electronic Technical Institute	82
—	Gilfer	16
—	Grantham Schools	3
22	Heath Company	29-31
29	Hustler, Inc.	12
—	Hygain Super Stik	14, 15
11	International Crystal	3
18	Jensen Tools	11
—	Kantronics	3
20	Lamtech	16
—	McGee	12
14	McKay Dymek	11
—	N.R.I. Schools	18-21
—	N.T.S.	39-41
26	OK Machine & Tool	24
24	OK Machine & Tool	CV4
12	PAIA	10
23	Progressive Edu-Kits	CV3
13	Regency Electronics	9
6	Spectronics	10
19	Scientific Systems	17
—	Telex Communications	14, 15
4	Tab Books	1

ELEMENTARY ELECTRONICS HOBBY MART

Alphanetics Digitizer

(Continued from page 62)

in a straight recorder-to-recorder dub, which prevents making backup copies of SYSTEM tapes.

The top scope trace is the digitizer output after it finished processing the audio signal from the tape. It consists of noise free pulses of equal amplitude, regardless of the original levels recorded on the tape. If this signal is now fed to another recorder, it results in a perfect copy of the original tape's computer information (no noise or hum, and equal volume level at all times.) If fed to the computer, the computer sees a perfect digital representation of the tape information, and CLOADS properly every time.

The Alphanetics Tape Digitizer is A.C. powered; it comes in a sloping cabinet approximately 3-in. wide x 2-in. high x 5-in. deep. The front panel has two switches, respectively labeled DATA and COMPUTER CONTROL, and three jacks labeled MASTER TAPE INPUT, TRS-80 EARPHONE PLUG, and COPYING DIGITAL OUTPUT. Coming out of the back, along with the powercord, are two leads for the cassette motor control. One lead has a jack to which the motor control from the computer connects; the other wire has a plug that connects to the recorder's REMOTE CONTROL jack. The front panel COMPUTER CONTROL switch is connected across these wires. When the switch is in the TAPE or open position, the recorder is controlled by the computer. When the switch is in the MANUAL ON position, it shorts the wires, allowing manual operation of the recorder.

A yellow LED labled GOOD DATA is in the center of the front panel.

Using The Digitizer. The plug from the TRS-80 that normally connects to the recorder's earphone jack is plugged into the TRS-80 jack. A patch cord is then plugged in to the MASTER TAPE INPUT jacks and the recorder's earphone jack (a patch cord was not provided with our test model.). Next, the digitizer is matched to the recorder. Any decent software tape is played, and the DATA switch is set to the position that results in thet LED lighting with the *minimum* volume level from the recorder with the switch set to maximum sensitivity. That's the whole set-up. From now on, to insure a good CLOAD, you simply play the tape and advance the volume control until the LED lights, and then give a little extra volume for safety. Actually, our tests indicate you can pump a tremendous amount of extra level without creating loading problems. So figure that as long as the LED is lit, you've got the proper level from the recorder. Once you have the recorder level set so the yellow LED is lighted, you can feed the signal to either the computer, or to another cassette recorder connected to the COPYING DIGITAL OUTPUT jacks.

Testing 1 . . . 2 . . . 3. The tape digitizer worked every time, even when we tried to fool it by deliberately adding hum to the signal, changing recorders, etc. As long as we could get the LED to light we could attain a proper CLOAD. We even were able to load an originally defective commercial software tape, which must have had a sudden volume level loss, that was corrected by the digitizer (the reason you adjust for the yellow light and then give a little extra volume from the recorder). Most important, for the first time we could easily make backup copies of commercial SYSTEM tapes.

The tape digitizer, which is priced at $49.95 postpaid, is compatable with both Level I and Level II TRS-80s. It is available only by mail order from ACU-DATA ALPHANETICS, Box 597, Forestville, CA 95436. You can obtain additional information on the digitizer by circling No. 44 on the Reader Service Card. ■

Swiss Radio International

(Continued from page 36)

experts at project sites and in problem areas in different parts of the world.

Sunday Supplement is heard on the third Sunday of the month. It features in-depth expansions of selected subjects first introduced on the weekday *Dateline* current affairs magazine. On the fourth Sunday, we have an abrupt switch and listen to *Jazz Panorama*—the world of international jazz. Finally, on the fifth Sunday, *Repeat Performance* is heard. This is an encore of a previous program.

Schedules. SRI broadcasts 24-hours a day but, of course, not all broadcasts are in English. The best times for North America (in English) are 1315 to 1345 GMT on 21570 MHz and 0145 to 0215 GMT on 15305, 11715, 9725 or 6135 MHz. Other times where reception is usually good are 1530 to

CB at 900 MHz

(Continued from page 66)

tances from the repeater. (See Fig. 6) A repeater station on a Southern California mountain top can enable a are in opposite directions at equal dis- station in San Diego to communicate with another in Santa Barbara, 200 miles away. In areas where there are no mountaintop repeater sites, communicating range will be less. But, a repeater can be installed on the roof of a high-rise building, or its antenna can be supported by a tall tower.

Repeaters may be owned and operated by user associations for use of members, by public safety organizations and by entrepreneurs. You may also have your own private repeater if you qualify for a license. It is anticipated that the FCC will establish special requirements for getting a repeater license. But you can be sure that there will be repeaters for 900—when and if the FCC finally establishes the band.

The Blessed Event. Surveys of CBers reveal that most favor establishment of the new band. Those that oppose it apparently do not know that the new band would be in addition to the 27 MHz CB band, and not a replacement for it.

Things are not as they were 30 years ago, when the FCC first established the Citizens Radio Service at 465 MHz for Class B stations and the entire 460-470 MHz band for Class A stations. At the time, technology had not advanced to the stage that would have permitted the manufacture of low cost equipment with adequate range.

If the FCC establishes the rules by late 1980, it will probably take another year to two for manufacturers to develop low cost equipment for the band.

While it may seem that the new band is in no man's land, it is the way of the future. Before long you will look back and think that 900 MHz is a relatively low frequency. ■

1600 GMT on 21570 MHz; 0430 to 0500 GMT on 15305, 11715 or 9725 MHz; 1815 to 1845 GMT on 21585 MHz. The last is "iffy," but is worth trying for if the time is more convenient.

If you tune for Swiss Radio International a minute or so before their announced transmission time, you will hear a bar of Swiss music repeated over and over. Then, at the start of the program, the announcer starts with the exact time read from the "Swiss Chronometer." Good listening! ■

Binary/BCD Tester

(Continued from page 74)

three 74LS47's which convert the BCD to seven segment LED display format. The outputs of the 74LS47's are connected to common anode seven segment LED displays through resistors. The values of the resistors depend on the size of the LED displays, the brightness of the displays that you desire, and the amount of current that you are willing to expend on the displays. Normally the resistors should be between 330 ohms and 470 ohms.

The 74LS47's are programmed to provide leading zero suppression.

Construction. The IC's and resistors can be mounted on any type of board you prefer (PC, wirewrapping, etc.).

Connect a long wire (about one foot) to the common V+ on the board, and an equally long wire to the common ground. Solder a red insulated clip (such as Radio Shack catalog number 270-1545) to the other end of the wire to V+, and a black alligator clip to the other end of the wire to ground. These will be your power supply lines for the converter. Connect a 10 μf across these two wires.

Connect a one foot long wire to each of the input pins on the two 74LS47's. These are pins 2, 3, 6 and 7. Solder an insulated clip (any color) to the other end of each of these wires. Label each of these wires near the clip with the notation from 2^0 through 2^7. Figure 1 shows which label goes on the wire to each 74LS75 pin (2^0 for pin 2 of 74LS75 #1, 2^1 for pin 3 of 74LS75 #1, and so on).

The momentary contact switch for the display latch can be mounted anywhere on the housing that is found to be most convenient. ■

Radio Direction Finding

(Continued from page 46)

are used with great success. Let's examine the principles of some of these.

The Yagi. The most common "beam" antenna is the Yagi-Uda array of Fig. 18. In its simplest form, the Yagi consists of three parallel elements. The center element is active, connected directly to the feedline. It is a half wavelength at the frequency of interest. The rear element (reflector) is 1.05 times the length of the active element, and the forward (director) element is .95 times the length of the active element. Elements are separated by a ¼-wavelength between each one.

Although the Yagi has the advantage of high gain and directivity, it has the disadvantage of narrow frequency range, and is generally usable over only a few percent of the center frequency.

The Log Periodic. The log periodic dipole array (LPDA) is very popular in applications where gain, directivity, and wide bandwidth are equally important. Its triangular outline is the key to its secret: The LPDA is actually a cluster of active half-wave dipoles, each cut to a slightly different frequency.

The LPDA can be designed to cover at least a 3:1 frequency range and exhibit good gain and directivity as well. All elements are interconnected by a cross-phase harness, and elements are spaced at .1-wavelength intervals.

The Corner Reflector. By increasing the size of the reflecting surface, an antenna can greatly increase both gain and sharp directivity. The corner reflector is a step in that direction.

While corner reflectors can be built with a variety of angles, from sharply wedged to a plane surface, 90 degrees is the most commonly encountered configuration. It is often usable over a 2:1 frequency range without readjustment.

The dipole element is located .4 wavelengths from the apex and is a half wavelength long for 75-ohm matching, ¾ wavelength for 300 ohms.

While the corner reflector may be a solid surface of sheet metal or a metal grid, it is more commonly a cluster of straight elements. Each element is at least ½ wavelength long at the lowest frequency, and must be no further than .2 wavelength from the adjacent element for the highest frequency of interest.

A variation on the corner reflector is known as the trough, named for its appearance, resulting from a curve rather than a sharp apex at the corner. It possesses a bit slightly higher gain than the corner reflector.

The Parabolic Dish. The highest gain and directivity known are exhibited by the parabolic dish reflector. When properly configured, it captures nearly all of the electromagnetic energy striking it, reflecting that energy to its focal point. A small dipole or cavity collects that energy and feeds it back.

RDF Conclusions. The field of radio detection finding has developed steadily. With the developments electronic technology and a better understanding of the peculiarities of radio waves, RDFing has become an extremely reliable science. ■

Aircraft Scanner

(Continued from page 48)

the upper setting of the tuning dial. Ideally, you will adjust the oscillator coil so that the highest frequency FM station (near 108 MHz) will now be heard at the lowest dial setting (marked 88 MHz).

If the turns of the oscillator coil are fully spread and yet the tuning range is still not high enough to cover the aircraft band, carefully solder two adjacent turns together at one point. It is a good idea to scrape the wire at that point before soldering. Use a sharp blade or sandpaper cautiously.

Another way to increase the tuning frequency of the receiver slightly is to decrease the trimmer capacitance on the tuning capacitor (see Fig. 3). The four small adjustments are the oscillator and RF trimmers for the AM and FM band. Be sure to select the trimmers next to the FM coils! It would be wise to mark the original settings of all trimmers with a felt tip pen in case the wrong trimmers are turned, or in case you wish to return the radio back to an FM receiver later.

A tiny screwdriver will be used to adjust the trimmer capacitors. Note as you turn the trimmer that there will be one setting where the two metallic surfaces of the trimmer will be fully visible. This is the minimum capacitance (highest frequency) setting.

Fine Tuning. Now for the final adjustment! Tune in a weak station near the low frequency (88MHz) portion of the dial and adjust the turns of the RF coil with a non-metallic tool for maximum signal strength. If your particular receiver has sufficient background hiss, you may use that sound for peaking the coil. Tune the receiver dial near its upper setting (108 MHz) and peak the RF trimmer capacitor for maximum background hiss.

By carefully repeating the last two steps (RF coil and RF trimmer capacitor), you will have completed the conversion of your AM/FM receiver into a useful aircraft band monitor. If you live near large airports, the radio will be extremely active. Even if you don't live near an airport, reception over long distances will be heard because of the altitude of the aircraft.

While the radio may not be as good as a receiver designed specifically for the aircraft band, it will give a good accounting of itself. And if you grow tired of aircraft band monitoring, you can always return the radio to its original state as an AM/FM set. ■

Simply Basic

(Continued from page 70)

will search the disk file to see if anything had been entered for that date. The MONTH command is an expanded version of DATE; it will print a listing of all information on the disk file for any month in any year. The STOP command will simply exit the user from the program and return to BASIC.

Although this program was designed to accept 2 lines of data for each date entered in the START or UPDATE mode, the program can be easily modified to accept more. Lines must be inserted in the START mode section (lines 380-570) to input the additional variables. In addition, the extra variables must be added on to each line that inputs or outputs variables from disk (there are many in the UPDATE mode, lines 580-880). All other lines in the program which input or output the data (for example, lines 940 and 1170) must be modified to accept the new variables, and a line must be inserted in between 1430 and 1440 to help sort the new variables.

The program may look complex at first, but it really is simple. Feel free to make any modifications you like. ■

Darkroom Contrast Meter

(Continued from page 55)

their appropriate PC board "holes." Then connect the wires from R1, T1, and finally, connect to PC1.

Apply power then measure the voltage from IC's "+" and "–" terminals to T1's centertap connection. You should indicate ±15 to ±17 volts. If you get any other value, turn off the power immediately and check for a wiring error, or improper installation of either IC1 or IC2.

Using The Meter. Compose the projection from your enlarger and focus it on the easel. Leave the lens' diaphragm open and place the meter's pickup under the maximum light area (representing pure *black* in the final print). Adjust R1 until the meter pointer is over the letter "C" at the end of the scale. Without disturbing any of the enlarger or meter controls, move the pickup to a spot under the minimum light area (representing pure "white"—or maximum highlight—in the print). Give the meter a few seconds to settle down, then read the required paper contrast grade directly from the meter scale.

Since the meter indicates projected contrast range, it doesn't matter whether your enlarger is the diffusion, condenser, or mixing-chamber type. The contrast reading will be correct *at the easel of the enlarger*.

Since developing techniques vary, as does personal preference, you might want to apply your own "fudge factor" to the meter readings. For example, you might give a ½-grade increase on all readings.

Note. Do not attempt to linearize the meter scale in Fig. 1, as contrast densities aren't linear. Also, the use of a log amplifier required to linearize the scale has been avoiding in this project because it would almost double the cost and make precalibration impossible. Use the meter scale exactly as shown in Fig. 3 to obtain the correct results. ■

```
1220 Z$(I)=H$
1230 L=1
1240 I=I+1
1250 GOTO 1160
1260 IF L=1 THEN 1290
1270 PPINT:PPINT "NO LISTINGS FOP THAT MONTH":PRINT
1280 GOTO 270
1290 N1=M:N2=Y
1300 DATA JANUAPY,FEBPUARY,MARCH,APPIL,MAY,JUNE,JULY

1310 DATA AUGUST,SEPTEMBEP,OCTOBEP,NOVEMBEP,DECEMBER
1320 RESTORE:FOP X=1 TO 5:PEAD X$:NEXT X
1330 FOR X=1 TO N1
1340 PEAD B$
1350 NEXT X
1360 CLS:PPINT "DATES FOP MONTH OF ";B$;", ";N2
1370 M=1
1380 FOP I=1 TO M-1
1390 FOR J=I+1 TO M
1400 IF Q1(I)<=Q1(J) THEN 1440
1410 T=Q1(I):Q1(I)=Q1(J):Q1(J)=T
1420 T$=Q$(I):Q$(I)=Q$(J):Q$(J)=T$
1430 T$=Z$(I):Z$(I)=Z$(J):Z$(J)=T$
1440 NEXT J
1450 NEXT I
1460 FOR Y=1 TO M
1470 IF Q1(Y)=0 THEN 1560
1480 PRINT
1490 IF Y/3<>INT(Y/3) THEN 1520
1500 PPINT@1000,;:INPUT "HIT 'C' TO CONT.";Q$
1510 CLS
1520 PPINT "DAY # ";Q1(Y)
1530 PPINT Q$(Y)
1540 IF Z$(Y)="." THEN 1560
1550 PPINT Z$(Y)
1560 NEXT Y
1570 PPINT:GOTO 270
1580 END
```

CB Spectrum

(Continued from page 58)

channel. This instant CH19 selection is particularly handy when traveling in an area with two highway channels. For example, out my way both channels 10 and 19 are used on the superslabs. I keep the main tuning on 10 and punch up 19 directly. As I go through the cloverleafs and connectors I can easily change back and forth between 10 and 19 by simply pressing the CH19 and NORM switches.

One of the really big plus features of the AR 711 is a rugged extension speaker that is supplied, to be used in place of the speaker normally mounted on the underside of the transceiver.

This speaker is installed in a cabinet approximately 4.3-in. square by 2.5-in. deep. It has an adjustable gimballed bracket and a 5-foot connecting cable complete with plug to match the external speaker jack on the transceiver. You can install this speaker on the dash or near the driver, so the sound goes directly to the operator.

A Front-runner. Performance is first-rate all the way. In fact, it's a lot better than much of what we had from some of the older 40-channel rigs.

First off, the transmitter delivers exactly 4 watts to a 50-ohm load. The modulation, which goes to an effective 100%, has notably low distortion 100% modulation limiting, and the talk power is exceptionally clean and crisp.

The receiver section is also excellent. Sensitivity checked out at 0.4 μV for a 10 dB S + N/N (signal plus noise to noise) ratio. Selectivity measured an excellent 65 dB adjacent channel rejection. The AGC action for a test input range of 76 dB measured 9 dB. good nor bad, essentially average.

Received signal clarity through the transceiver's built in speaker was good; and through the external speaker at the driver's location it was great.

The combination S/RF-output meter provides relative indications for both received signal strength and the transmitter's RF output. The S9 mark corresponded to 80μV. at the antenna.

Let's hope that the President AR 711 is the leading edge of a new wave of CB equipment. Hopefully once again CB will mean the very best in radio communication design and features.

The President AR 711 is priced at $139.95 complete with external speaker, DC power cable, microphone and mounting bracket. For additional information, circle No. 70 on the Reader Service Coupon. ■

Heath H17 Disk Drive

(Continued from page 75)

Disk System is that the software maximizes the storage space available to the user on each disk. This is done by permitting the user to preload a disk with only the HDOS (disk operating system) and the specific software needed for a specific purpose. (A disk so prepared is called a SYSTEM VOLUME, to differentiate it from the DISTRIBUTION SOURCE DISK which contains all the software.)

Here's how the free space is maximized. The distribution disk has only 6 sectors of the 400 free. This is no loss because the distribution disk is "write protected" and is not to be used at any time to avoid destroying its files. The first thing the user does is to make a copy, which is used to make other copies. A total copy of the software still is virtually unuseable, because the 6 free sectors allow only 1.5K of storage.

If the user wants a disk for BASIC programs and data, he creates a SYSTEM VOLUME disk that contains only HDOS and the BASIC file (HDOS must be resident on every SYSTEM VOLUME disk). HDOS plus BASIC uses 225 sectors, leaving 156 sectors (representing almost 40K of storage), free for programs and data. (Only 382 sectors out of a possible 400 are available to the user. If the user wants to write assembly programs, the SYSTEM VOLUME would contain HDOS and the ASM (ASSEMBLY) file, which take only 211 sectors, leaving 171 sectors (representing 44K), available for programs and data.

A SYSTEM VOLUME containing BASCOM, a program that permits converting tape storage programs for disk use, takes only 196 sectors, leaving 186 (representing almost 48K), available for use. The minimum SYSTEM VOLUME, with only HDOS, leaves 198 sectors, or 50K, free. If you have a two drive system, only one disk with HDOS need be mounted on a drive; the second disk has its total capacity available for user storage.

Conclusion. As you probably have surmised, the H17 is not a push-the-button-and-go system.

The H17 is available in both kit ($495) and wired ($550) form. The difference in cost is almost insignificant and the wired version is strongly suggested. Optional second drives are priced at $295. The H8-17 software package is $100.00.

For additional information circle number 1 on reader service coupon. ■

Antique Radio Corner

(Continued from page 72)

for this problem. What is an isolation transformer? It is merely a transformer with a like primary and secondary. In other words, you apply 115 volts to the primary, and you get 115 volts on the secondary.

Since a new isolation transformer can cost you $15.00 to $25.00, I discovered a much less expensive way to achieve the same end result. You can take any two identical transformers with a 115 volt primary and identical secondary voltage windings, and connect the two secondaries as shown.

Connect the primary winding of one to an AC line cord and connect the other primary to an AC receptacle.

Safety Rules. There are a couple of simple rules to remember for your own safety. Normally, the transformer primary will have black leads. The 5-volt filament winding will be green, the 6.3-volt winding will be yellow, while the high voltage winding (from 250 to 600 volts) will be red. It would be best to tape the ends of the high voltage winding to avoid the possibility of shock. Connect the yellow wires together, since they usually carry more current than the green ones. You can connect either the 6-volt or the 5-volt windings together and it will work. However, due to internal losses, you will get less voltage out of Transformer 2 than you put into Transformer 1. To compensate for this, try connecting the 6-volt winding of Transformer 1 to the 5-volt winding of Transformer 2. You can also use the voltages from the unused windings. I am sure all this will prove worth while in eliminating shock hazards. ■

Solar Ponds

(Continued from page 28)

water approximately 50 miles long and 11 miles wide: an enormous potential for electricity generation!

A Practical Energy Source. Solar ponds occur naturally in many parts of the world, including the U.S., and they can be man-made as well. While the Ein Bokek project was built in an area where temperatures in excess of 100°F are common, the solar pond is equally viable in more temperate climates.

This ambitious Israeli project is just one example of how the dependence on expensive and potentially hazardous energy sources can be offset by solutions developed from Nature. ■

Understanding Radio Transmitters

(Continued from page 80)

rier frequency and at the amplitude and frequency of its audio envelope.

Both fields expand outward and collapse back to the antenna at the rate of the carrier frequency. The outermost waves continue through space and do not return to the antenna. This action is similar to dropping pebble in a pool. The energy of the waves moves outward in ever-widening circles; the water, however, remains in place.

QUESTIONS

Q27. The weak output of a microphone is fed to one or more stages of .... amplification.

Q28. The output of even the best microphones (can, cannot) be fed directly to the modulator.

Q29. The output of the .... is connected to the carrier power amplifier.

Q30. For proper modulation, the output of the modulator stage must be .... that of the power amplifier.

Q31. Carrier voltage develops a (an) .... field and carrier current develops a (an) .... field on the antenna.

Q32. All of the energy in the antenna fields (does, does not) leave the antenna.

ANSWERS

A27. The weak output of a microphone is fed to one or more stages of **audio** amplification.

A28. The output of even the best microphones **cannot** be fed directly to the modulator. (Even the most powerful microphones develop a signal that is much too weak to drive the modulator.)

A29. The output of the **modulator** is connected to the carrier power amplifier.

A30. For proper modulation, the output of the modulator stage must be **half** that of the power amplifier.

A31. Carrier voltage develops an **electric** field and carrier current develops a **magnetic** field on the antenna.

A32. All of the energy in the antenna fields **does not** leave the antenna. (Only the outermost waves.)

WHAT YOU HAVE LEARNED

1. Radiant energy is given off by electromagnetic waves. The electromagnetic spectrum includes cosmic rays, X rays, visible and invisible light, infrared, radar, as well as radio waves.
2. A radio transmiter is a device that produces electromagnetic waves in the radio portion of the spectrum. Its essential functions are the development and amplification of a carrier frequency and modulating it with an amplified audio frequency. A specific carrier frequency is assigned to each radio station. The distance that the carrier, with its superimposed audio, travels is determined by the power that is developed in the final stage of the transmitter.
3. Energy in the form of voltage and current is fed from the transmitter to an antenna. This sets up electric and magnetic fields around the antenna that expand and collapse at the frequency of the carrier. Part of the energy is in the form of electromagnetic radiations and is transmitted through the atmosphere. The farther it travels, the weaker the signal becomes. ■

Hobbyist's Electronics Test Bench

(Continued from page 35)

reading by a factor of X10 or 100(X). (Most prescalers have only the 10X mode.) The maximum counter range then becomes that of the prescaler. For example, a 144 MHz oscillator that is prescaled 10X would be indicated as 14.4 MHz—the user must "move" the decimal one place to allow for the prescaler's 10X factor. It's all very convenient but it does not mean that a counter wtih a 50 MHz maximum frequency can be prescaled to 500 MHz. If the prescaler has a maximum range of 200-MHz, then that's it for the whole system. Feeding in, say, a 400 MHz signal will produce an erroneous "reading."

Almost all hobbyist and service grade counters have a 1-megohm input impedance, which allows the device to be bridged across most RF circuits because RF circuits are usualy of relatively low impedance. For hi-Z circuits, the 1-megohm impedance allows convenient use of a pickup coil or telescopic whip antenna. A few service-grade, and almost all lab-grade, counters have a 50-ohm input in addition to the 1-megohm input. The 50-ohm input is a bit difficult for the hobbyist to use because it often has a maximum input power of ¼-to-½-watt and tends to load down the circuit being tested. However, all generally available prescalers have 50-ohm inputs; so take extra care when using a prescaler.

Keep in mind that a frequency counter is not a *general use counter.* A frequency counter indicates frequency, directly in Hz, kHz or MHz. A *general purpose counter* indicates directly in both *frequency* and *time.* In addition to the frequency calibration, it will be calibrated in, perhaps, *seconds, milliseconds,* and *microseconds.* It can time the period between events, the period of one or more events or the ratio in time between events. It can also be *gated* to time a specific event. As you might well imagine, a general purpose counter costs a bundle.

The typical hobbyist counter is available with either an AC power supply, a battery power supply with built-in or optional AC adapter, or with a rechargeable NiCad battery power supply. It is a general rule of life—perhaps Murphy's Fifth Corollary—that batteries are discharged when they are needed most. Unless you need a frequency counter for use away from the AC power, get a counter with a built-in AC power supply. There's no point in paying for a battery pack if you don't need it.

We've covered the instruments that are most commonly found on the typical experimenter's test bench. Naturally, as you develop specific interests, you will also accumulate test gear specifically intended for that interest. For example, if you get deeply involved with the technical nitty-gritty of high fidelity sound, you will most likely find that you need a low distortion audio signal generator and a distortion meter. If you get heavily into RF transmitters, you'll probably want a bi-directional power meter and a killowatt 50-ohm dummy load, or maybe a 200-watt dummy load with built in direct-reading power meter.

But regardless of what direction your interests take in the future, the basic hobbyist test equipments will remain the foundation of your test bench. ■

LITERATURE LIBRARY

403. *PAIA Electronics* gives you "Advanced Electronics For The '80s and Beyond." Brochure features computerized music synthesizers.

402. *Technical Electronics* has descriptions galore of all kinds of electrical gadgets—transistors, computer power supplies, and logic probes—in its latest (6-80 B) mail order catalog.

401. *AP Products'* "Faster and Easier Book" is designed to eliminate any problems with breadboarding, interconnection and testing devices. All-circuit evaluators *with power* are featured.

400. *Global Specialties* provides new product info in its catalog of Testing and Design Instruments. A Digital Capacitance Meter and Tri-Mode Comparator are just some of the featured projects.

399. *"Firestik" Antenna Company* has introduced a new and informative product catalog on top-loaded, helically wire-wound antennas and mounts.

398. *Hamtronics, Inc.* has announced a new model R110 VHF AM Receiver Kit which employs an AM detector and a dual-loop agc system. A complete catalog is yours for the asking!

397. *Instant Software, Inc.* is offering a special holiday catalog for all kinds of year 'round software package gift-giving, as well as their regular microcomputer catalog.

396. *Creative Computing's* first software catalog of various education and recreation simulation programs as well as sophisticated technical application packages is available now.

395. *OK Machine and Tool* explains the technology of wire-wrapping, complete with illustrations, in its catalog of industrial and hobby products. The 60-page book (80-36N) is available now.

394. *KEF Electronics Ltd.* is offering two speaker systems in kit form at a significant cost-savings. The Model 104aB and the Cantata can be easily assembled and may be auditioned before purchasing.

389. You can't buy a bargain unless you know about it! *Fair Radio Sales'* latest electronics surplus catalog is packed with government and commercial buys.

388. SWLs need *Gilfer's* Shortwave Mail Order Catalog for economy one-stop armchair shopping. From top-notch rigs to reporting pads, Gilfer supplies all your hobby needs.

327. *Avanti's* new brochure compares the quality difference between an Avanti Racer 27 base loaded mobile antenna and a typical imported base loaded antenna.

362. A new catalog crunched full of military, commercial and industrial surplus electronics for every hobbyist is offered by *B&F Industries.* 44 pages of bargains you've got to see!

384. *B&K-Precision* has issued BK-10, a condensed catalog describing their oscilloscopes, semi-conductor testers as well as test instruments for CB, radio and TV repair.

310. *Compumart Corp.,* formerly NCE, has been selling computers by mail since '71, and is offering a 10-day return policy on many items featured in their latest catalog.

322. *Radio Shack's* latest full color catalog, "The Expanding World of TRS-80," is out now, packed with up to the date information on this microcomputer. Specifications for the new Model II as well as the Model I are included.

386. If you're looking for books on computers, calculators, and games, then get *BITS, Inc.* catalog. It includes novel items.

335. The latest edition of the *TAB BOOKS* catalog describes over 450 books on CB, electronics, broadcasting, do-it-yourself, hobby, radio, TV, hi-fi, and CB and TV servicing.

338. "Break Break," a booklet which came into existence at the request of hundreds of CBers, contains real life stories of incidents taking place on America's highways and byways. Compiled by the *Shakespeare Company,* it is available on a first come, first serve basis.

345. For CBers from *Hy-Gain Electronics Corp.* there is a 50-page, 4-color catalog (base, mobile and marine transceivers, antennas, and accessories).

393. A brand new 60-page catalog listing *Simpson Electric Company's* complete line of stock analog and digital panel meters, meter relays, controllers and test instruments has just come out.

382. Buys by the dozens in *Long's Electronics* super "Ham Radio Buyer's Guide." Good reading if you're in the market for anything from spare fuses to a complete station.

380. If your projects call for transistors and FETS, linear and digital ICs, or special solid-state parts, then look into *Adva Electronics'* mini-catalog for rock bottom prices.

301. Get into the swing of microcomputer and microprocessor technology with *CREI's* new Program 680. New 56 page catalog describes all programs of electronics advancement.

306. *Antenna Specialists* has a new 32-page CB and monitor antenna catalog, a new amateur antenna catalog, and a complete accessory catalog.

377. *John J. Meshna, Jr., Inc.* has a super-saver catalog out (SP-16) featuring walky talkies, police radar detectors, vacuum pump compressors and other fascinating products to choose from.

330. There are nearly 400 electronics kits in *Heath's* new catalog. Virtually every do-it-yourself interest is included—TV, radios, stereo and 4-channel, hi-fi, hobby computers, etc.

392. The opening of the new Software of the Month Club has been announced by *Creative Discount Software,* which is giving out membership enrollment applications now. The Club plans to have separate branches for users of the Apple II, TRS-80, Ohio Scientific, Exidy, PET and CP/M based systems.

390. *Whitehouse & Co.,* your "hard to find parts specialist," offers over a dozen parts and kits in their latest catalogue, featuring an entire section on gunnplexers for Amateur Radio buffs.

313. Get all the facts on *Progressive Edu-Kits* Home Radio Course. Build 20 radios and electronic circuits; parts, tools, and instructions included.

320. *Edmund Scientific's* catalog contains over 4500 products that embrace many sciences and fields.

328. If you are into audio, ham radio, project building, telephones, CB or any electronics hobby you'll want *McGee's* latest catalog of parts and gadgets.

333. Get the new free catalog from *Howard W. Sams.* It describes 100's of books for hobbyists and technicians—books on projects, basic electronics and related subjects.

354. A government FCC License can help you qualify for a career in electronics. Send for information from *Cleveland Institute of Electronics.*

355. New for CBers from *Anixter-Mark* is a colorful 4-page brochure detailing their line of base station and mobile antennas, including 6 models of the famous Mark Heliwhip.

391. A new software products catalog for the Apple II Computer has just been issued by *Charles Mann & Associates.* The booklet contains business accounting, accounts receivable, inventory, BASIC teaching and other special purpose business applications.

359. *Electronics Book Club* has literature on how to get up to 3 electronics books (retailing at $58.70) for only 99 cents each . . . plus a sample Club News package.

311. *Midland Communications'* line of base, mobile and hand-held CB equipment, marine transceivers, scanning monitors, plus a sampling of accessories are covered in a colorful 18-page brochure.

404. *Spectronics, Inc.* offers a complete line of equipment for the shortwave listener. Their catalog lists receivers, a complete SWL library and numerous other accessories, all at discount prices.

405. The *Kester Solder Company* is offering a book on soldering techniques and a handy guide to the various types of solders and their applications. Both are valuable items for the electronics hobbyist working with conductive metals.

ELEMENTARY ELECTRONICS
Box 1849, G.P.O.
New York, NY 10116

SEPTEMBER/OCTOBER 1980
Void After February 21, 1981

Please arrange to have the literature whose numbers I have circled below sent to me as soon as possible. I am enclosing 50¢ for each group of 10 to cover handling. (No stamps, please.) Allow 4-6 weeks for delivery.

301	306	310	311	313	320	322	327	328	330	333	335
338	345	354	355	359	362	377	380	382	384	386	388
389	390	391	392	393	394	395	396	397	398	399	400
401	402	403	404	405							

300 ☐ Enter my subscription to ELEMENTARY ELECTRONICS for 6 issues at $3.98. Check enclosed. Canada and all other countries $5.00. HO1103

NAME (print clearly) ____________________

ADDRESS ____________________

CITY __________ **STATE** __________ **ZIP** __________

Classified MARKET

ELEMENTARY ELECTRONICS—is published Bi-monthly. The rate per word for CLASSIFIED ADVERTISEMENTS is $1.50 payable in advance—minimum ad $22.50. Capitalized words 40¢ per word additional.

ADDITIONAL INCOME

MECHANICALLY INCLINED INDIVIDUALS. Assemble electronic devices in your home. Knowledge or experience not necessary. Get started in spare time. Above average profits. $300-$600/wk. possible. Sales handled by others. No investment—Write for free details. ELECTRONIC DEVELOPMENT LAB, Box 1560EE, Pinellas Park, FL 33565.

SOMETHING we all throw away. Worth as much as $4.00 a pound! $1.00 for Details. Ronald Kelly, P.O. Box 605, Monrovia, CA 91016.

MONEY multiplies if you know the "secrets"! Write Spectron, Dept. H, 420 East 111th Street, Suite 2908, New York, N.Y. 10029.

ALTERNATE AUTO FUEL SYSTEM

PROPANE CONVERSION—Cars—Trucks. The most practical alternative to gasoline. No engine modifications. Either fuel—Propane or Gasoline—Changes over instantly! Versatile—uses refillable cylinders or permanently mounted tank. GUARANTEED PROVEN-TESTED—This system WORKS! Build with hand tools in few days for around $100—All parts locally available—plumbing, hardware stores, etc. Satisfaction UNCONDITIONALLY GUARANTEED OR IMMEDIATE REFUND without question. (We're mighty sure you'll be satisfied!) Complete—Easily understood plans, drawings, part list—RUSHED first class—$10—Fleming Engineering, Dept. COM-3, Remsen, NY 13438.

AUTOMOBILES & MIDGET CARS

GET FREE OIL FOR YOUR AUTOMOBILE! Learn equipment, procedures, sources, business possibilities. Large 15¢ SASE. Matson, 256-EE(9) South Robertson, Beverly Hills, CA 90211.

AVIATION

ANTIGRAVITY PROPULSION DEVICE! Free Brochure. RDA, Box 873, Concord, NC 28025.

BLUEPRINTS, PATTERNS & PLANS

BUILD an LED pendulum for your digital clock. $3.00 for plans to: Lepior, 1572 Balein Ct., Hayward, CA 94544.

UNIQUE Affordable Light Show. Plans $5.00. Send to AE Sound Design. Dept. EUL, 1164 Cottonwood Rd., Winnipeg, CA R2J 1G5.

BOOKS & PERIODICALS

HOW to get started in Carnival Business $7.00. Sidney Wenzel, P.O. Box 1503, Appleton, WI 54913.

BOOKS—learn Electronics, Lasers, Robotics, Computers, TV, Solar, Etc. Catalog 30¢. Dot, 9719E Southwest Highway, Oaklawn, Illinois 60453.

BUSINESS OPPORTUNITIES

CABLE FM BROADCAST STATION. Investment/experience unnecessary. Home operation possible. Excellent income reported! Free details. CAFM, Box 130-GE9 Paradise, CA 95969.

GET Scrap Gold $10.00 ounce—Sell $281.75!! Free Information: Britt, 123-D Scott, Florence, SC 29501.

MAILORDER opportunity! Start profitable home business without experience or capital. Write for free book and details. No obligation. Gil Turk, Dept. 647, Montvale, NJ 07645.

STAY HOME! EARN BIG MONEY addressing envelopes. Genuine offer 10¢. Lindco, 3636-DA, Peterson, Chicago 60659.

STEREO REPRESENTATIVES NEEDED!!! Lowest Possible Prices!!! Over 100 Brands!!! Krasco-Rep, EE, 998 Orange Ave., West Haven, CT 06516.

$600. Weekly. Home mailing program. Goodworld, Box 26233-JIC Tamarac, FL 33320.

$2000.00 Monthly mailing commission circulars. Experience unnecessary. Free details. American, 1108 Colonial, Inkster, MI 48141.

CASH ADVANCE $500/Thousand envelopes stuffed available. No limit! Free information: Rexson 20-03F, Box 1060, Orangepark, FL 32073.

BUSINESS OPPORTUNITIES—Cont'd

$480.00 WEEKLY! "Guaranteed Home Mailing Program." Freedom, Box 30224-DP, Denver, CO 80230.

FREE REPORT! Flea Market/Wholesale Success. TMS9, 600 Welch, Flint, MI 48503.

$1000.00 monthly! Home mailing program! Kashking, Box 485, Randolph, MA 02368.

FREE BOOK "2042 Unique Proven Enterprises." Fabulous "unknowns," second inflation income. Haylings-E12, Carlsbad, CA 92008.

1000% PROFIT Bronzing Baby Shoes, Free Literature. NBC, Box 1904-DG, Sebring, FL 33870.

EASY home income mailing program. Big profits. Free details. Write: Runnel, Box 456, Fairview, OR 97024.

$500 WEEKLY POSSIBLE! Commission Mailing. Pacific, Box 1109(DP), Lake Grove, OR 97034.

FREE Mailorder! BIG PROFITS. Specialty Wholesale Products. Catalogue Available. JRS, Box 626-EE, Long Beach, NY 11561.

$750.00 WEEKLY stuffing envelopes. Guaranteed! Details: Enclose stamped envelope, +25¢: Galaxy, Box 6364-IO9, Corpus Christi, 78411.

AMAZING! Home Business Earns $1000 Per Day. Free Details. J & G Sales, P.O. Box 8171, Stockton, CA 95208.

BUY Where the "Pros" buy for pennies! Sell for Dollars! Free Details. Ratamess Industries, LaSalle Dept. DP, Berwick, Penna 18603.

FRANCHISES. Over 800 companies, complete list including Financial Assistance. $1.50 Refundable. Franchise Research Corp., Box 15286-EE, Chatanooga, TN 37415.

$480 Weekly Possible. Amazing New Mailing Program. Details. Rasmussen DP90, 1747N, 450E. Ogden, UT 84404.

EASY MONEY! Become HIGH PROFIT Commission CIRCULAR MAILER. Free Application. Graham, DPBX, 99371, Tacoma, WA 98499.

$500 CASH advance available. Stuff 1000 envelopes. Information free. Department H, Box 7550, The Woodlands, Texas 77380.

HUNDREDS Weekly! Mailing Letters. Free Postage, Supplies! Free $20 Gift—Write: Publishers, Box 8F, Broken Arrow, OK 74012.

BURGLAR/FIRE ALARMS

FINEST Alarm Equipment for Home, Office, Car. FREE CATALOG! AAS, 186K Oxmoor Road, B'ham, AL 35209.

BUY IT WHOLESALE

400,000 BARGAINS Below Wholesale! Many Free! Liquidations . . . Closeouts . . . Job Lots . . . Single Samples. Free Details Worldwide Bargainhunters, Box 730-IO, Holland, MI 49423.

FREE catalog jewelry, wigs, records, leather goods. Closeout prices. Cash Sales Co., 203 E. Congress, Tucson, AZ 85701.

RINGS, jewelry priced 130% below retail price. Catalog, $1.00 (refundable). Ankaa, 95 Washington, West Warwick, RI 02893.

CB RADIO

BOOST POWER! ADD CHANNELS! 100 watt solid-state booster, high gain beam antenna, 200% modulation booster. Plans $4.00 each, $10/all. FREE CATALOG—kits, plans, do-it-yourself repairs/modifications. PANAXIS, Box 130-GE9, Paradise CA 95969.

BE PREPARED FOR NEW CB CHANNELS! We specialize in Frequency Expanders, boosters, do-it-yourself books, plans, kits. Catalog $1. CB CITY, Box 31500EE, Phoenix, AZ 85046.

DO IT YOURSELF

REPAIR TV'S. ANYONE CAN. Easy. Guaranteed. Free Details. Publication, Box 517X, Brea, CA 926...

DO IT YOURSELF—Cont'd

SAVE 90%. Build your own minicomputer. Free Details. DIGITRONICS CORPORATION, 2723D W. Butler Dr., Phoenix, AZ 85021.

EDUCATION & INSTRUCTION

BECOME ENGINEER, DJ. Start your own radio station, receive FCC license, equipment, records. Free details. "Broadcasting," Box 130-GE9, Paradise, CA 95969.

EMPLOYMENT INFORMATION

JOURNEYMAN CREDENTIALS GRANTED! LEGITIMATE. Write: National Craftsman Union, 210 Fifth Avenue, Suite 1102, New York, NY 10010.

YOUR PERSONAL CAREER GUIDE, inexpensive easy to use format for getting jobs, promotions. Information $1.00. Evans, 74351 Candlewood, Palm Desert, CA 92260.

FOR THE HOME

EXOTIC oriental recipes. $3.99 check or m.o. D. Chang, 1347 So. Oneida, Denver, CO 80224.

FORMULAS & TRADE SECRETS

GUARANTEED 20% return on your investment! Stock Technique. Michael Klappenbach, 1912 14th Avenue, Lewiston, Idaho 83501.

GIFTS THAT PLEASE

MICRO-MADNESS. An actual micro-computer chip enlarged 8000% to become a colorful 10" x 14", 252-piece Jigsaw Puzzle. Order Now! Send $10.00 ppd to Eubanks Engineering, P.O. Box 127, Valencia, PA 16059.

CATALOG. R-T, 1165 E. 54th, P.O. Box 130, Ryder St. Sta., Brooklyn, N.Y. 11234.

GOVERMENT SURPLUS

JEEPS—$19.30!—CARS—$13.50!—650,000 ITEMS!—GOVERNMENT SURPLUS—MOST COMPREHENSIVE DIRECTORY AVAILABLE TELLS HOW, WHERE TO BUY—YOUR AREA—$2—MONEYBACK GUARANTEE—"GOVERNMENT INFORMATION SERVICES," DEPARTMENT E-9, BOX 99249, SAN FRANCISCO, CALIFORNIA 94109.

JEEPS . . . !! $18.88!! . . . 675,000 Items! Buy In Your Area! How! Where! "Moneyback GUARANTEED" 1980 Government SURPLUS Directory"—Including "Buy G-LANDS," "G-Oil/G-Gas LOTTERIES,"—$2.00. GSURPLUS, Box 2009-H, Syracuse, New York 13220.

HOBBIES & COLLECTIONS

ELECTRONICS HOBBYISTS!! Where to send for catalogs of 70 companies dealing in electronic parts. $2. 9591 Baltimore Avenue, Box 897, College Park, MD 20740.

HYPNOTISM

FREE Fascinating Hypnosis Information! Startling! DLMH, Box 487, Anaheim, California 92805.

IMPORT-EXPORT

DYNAMITE "Merchandising Program." Income Unlimited! Write: Phelps, Box 22401-DS1, Cleveland, Ohio 44122.

MARKET 2500 "Fast Selling" products from overseas manufacturers. Free brochures! Ballco, Box 91309-N9, Cleveland, Ohio 44101.

INVENTIONS WANTED

INVENTIONS, patents, wanted cash, royalty. Auto, electro-mechanical, mechanical devices, Housewares, etc. We develop, finance, manufacture and market from an idea to perfected product. Free evaluation and brochure. Request Kit DP, Pixonic Corporation, 22 Walter Street, Pearl River, NY 10965.

IDEAS, inventions, new products needed by innovative manufacturers. Marketing assistance available to individuals, tinkerers, universities, companies with feasible concepts. Write for Kit-EE, IMI, 701 Smithfield, Pittsburgh, PA 15222.

For Greater Classified... Savings... Results... and Profits...

Place your ad in one of our SPECIAL COMBINATIONS: Combo #1, Combo #2 or Combo #3. Each combination is designed to give your ad the largest audience available, for further information write to R. S. Wayner, Classified Advertising Director, Davis Publications, Inc. 380 Lexington Ave., N.Y., N.Y. 10017.

PLACE ■■■ Classified

To be included in the next issue, please send order and remittance to R. S. Wayner
ELEMENTARY ELECTRONICS, 380 Lexington Ave., New York, N.Y. 10017

INVENTIONS WANTED—Cont'd

MANUFACTURER Seeking Inventions. Advantek International, 1100 17th NW, Washington, D.C. 20036.

LOANS BY MAIL

BORROW $25,000 interest-free! Repay anytime. Everyone eligible! Free report: Executive-N9, Box 996, Dundee, FL 33838.

CASH Loans and Outright Grants to individuals refused elsewhere. 98% Accepted. Confidential. Write: Associates, Box 98-D, Brooklyn, NY 11235.

BORROW $25,000 "OVERNIGHT." Any purpose. Keep indefinitely! Free Report! Success Research, Box 29263-SW, Indianapolis, IN 46229.

BORROW Fast. Any amount. Confidential Directory of 150 Quick-Cash and Business Loan Sources $2.00. Moneyfinders, Drawer 1433, Harvey, LA 70059.

THE ARABS HAVE MILLIONS to Loan, Invest. (Not Iranian). Free Brochure. Arab-DC, 935 Main, Vidor, TX 77662.

"BORROW by mail" Signature loans. No collateral! Free Details! Write MBG-DPC90, Box 2298, Sandusky, OH 44870."

$QUICK$ Cash Signature Loans! Advise amount & purpose. Details Free. National, 507-DG Fifth Ave., New York 10017.

MAGNETS

MAGNETS. All types. Specials-20 disc, or 10 bar, or 2 stick, or 8 assorted magnets, $1.00. Magnets, Box 192-E, Randallstown, MD 21133.

MEMORY IMPROVEMENT

INSTANT MEMORY . . . NEW WAY TO REMEMBER. No memorization. Release your PHOTOGRAPHIC memory. Stop forgetting! FREE information. Institute of Advanced Thinking, 845DP Via Lapaz, Pacific Palisades, CA 90272.

MISCELLANEOUS

"PRINTED CIRCUIT boards from sketch or artwork. Kit projects. Free details. DANOCINTHS INC., Box 261, Westland, MI 48185."

FULL COURSE VEGETARIAN MEXICAN DINNER. Send $2.00 with self addressed stamped envelope to: L.B. Sherby, 117 North First, Ann Arbor, MI 48104.

HOTTEST NEW COLLECTIBLE—RARE GEMS! Gemcutter to YOU! Details Free. Taylor's, 113-A Martin, Indian Harbor Beach, FL 32937.

ELECTRONIC Bug Killer. Zaps Bugs Fast. "Guaranteed." Plans $4.50. Bold City Publications, Box 17372-PE, Jacksonville, Florida 32216.

MONEYMAKING OPPORTUNITIES

$45,000 in Three Weeks! Guaranteed! Gene Sanders, 1316DC Lyric, Fort Worth, TX 76134.

$300 WEEKLY SPARE TIME—Mailing Salesletters. Details: Delta, Dept.-D, Box 2902-CRS, Rock Hill, SC 29730.

$60.00/Hundred Stuffing Envelopes (per instructions)!! Offer-details: Worldwide-P 460, X15940, Fort Lauderdale, FL 33318.

VOLCANIC St. Helens souvenir ash. Packaging, promotional material available. 10#—$10.00. Flight Line Industries, 413, Everett, WA 98206.

MAILORDER. WOULD YOU LIKE TO MAKE $30,000 in the next 90 days? Details $1.00. Egan Sales, 3561 Underwood, LT15, Conyers, GA 30208.

MAKE BIG MONEY WHILE ENJOYING LIFE. Send for free information. MBF, Box 6125, Torrance, California 90504.

NOW!! Guaranteed systems ENDS Money problems! $3. D.D.C., W. 508 Alice, Spokane, WA 99205.

$500 CASH advance available. Stuff 1000 envelopes. Information free. Department Y, Box 7550, The Woodlands, Texas 77380.

NEED MONEY—$60,000 in four weeks—Free Details: Robert Vogt, 331 Hazelwood, St. Paul, MN 55106.

FREE REPORTS!!! Millions in mail. "Home mailing program." CWA, Box 6792-EE, Atlanta, GA 30315.

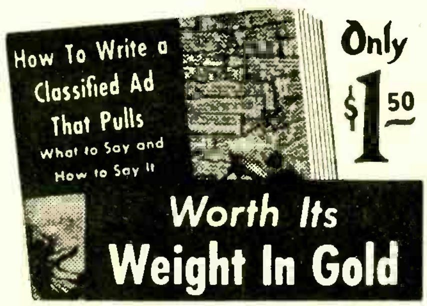
MAKE money at home. Report details Seven Profitable Programs. Only 25¢ and self addressed stamped envelope. Francis Sumney's Enterprises, Box 709, RD #1, 84, PA 15330.

MONEYMAKNG OPPORTUNITIES—Cont'd

SAVE hundreds of dollars on your food bills! SURVIVE financially through food barter! PROTECT your family! Order "The Complete Guide To Storage Food For Survival and Profit." $3.00: SM Systems, Box 10484, Glendale, CA 91209.

FREE—Write now and make millions. Others are. Don-Lee, Division EE, Box 164, Brentwood, Tennessee 37027.

FREE report tells seven ways to make more money. Beat inflation. INCOME ADVISOR, 21172 Gardena Drive, Dept. VC1, Cupertino, CA 95014.



MAKE YOUR CLASSIFIED AD PAY

Get "How to Write A Classified Ad That Pulls." Includes Certificate worth $2.00 towards a classified ad in this publication. Send $1.50 (plus 25¢ postage) to R. S. Wayner, Davis Publications, Inc., Dept. CL, 380 Lexington Ave., New York, N.Y. 10013.

PLEASE Be sure to include your zip code when ordering merchandise from classified advertisments. You'll receive faster delivery.

AUTOMATIC GIFT CLUB needs helpers. Easy weekly cash for the right person. This is not an envelope stuffing program. Details free. Box 4286A, Burbank, CA 91503.

HUNDREDS weekly mailing circulars. Free supplies! Details: stamped, return envelope, +25¢: Galaxy, Box 6364-IOK9, Corpus Christi 78411.

$90,000 Guaranteed in Six Weeks. No investment, no work. Send SASE to: Morton, 3246 Ridgeline, Las Cruces, NM 88001.

EARN Big Money Collecting Names! Easy Work! Start Immediately! Write: Day, 104-HH Third, Salem, Missouri 65560.

DEALERS wanted to sell "Cubic Zirconia" the ultimate simulated diamond. Details $1.00 (refundable). Diamond World, 2412 N.W. 23rd Street, Okla. City, Okla. 73107.

HOW Never to be Broke Again, and Always have Money, or "Become A Millionaire!" Z. Thomas, P.O. Box 1410, N.Y., N.Y. 10017.

$5,000 MONTHLY MAILING PLAN. DETAILS $1.00. HEE SALES, P.O. Box 1145, LT16, Conyers, GA 30207.

PLEASANT spare-time cash: Custom engraved namepins. Business, Clubs, personal. 40% discount. Sample. Holly, Box 3926-H, Hollywood, FL 33023.

CIRCULAR MAILERS needed. Work from home. Earn hundreds $$$ weekly. No experience needed. Dept. 20-02M, Box 1060, Orange Park, FL 32073.

MOTION PICTURE PROJECTORS, FILMS, SLIDES & SUPPLIES

BREATHTAKING Glamour slides, Figure studies, catalog, four samples, $3.00. Photographic Place, Box 806EE, Royal Oak, Michigan 48068.

OLD GOLD WANTED

BUYING Gold, Silver, Platinum, any form! Information write: American Metals, Box 30009, Charleston, SC 29407.

PERSONAL

SINGLE? Lonely? Free Matrimonial Magazine, sixteen pages. Rush stamp! Merit Enterprises, Box 74758-OJ, Los Angeles, California 90004.

BECOME ORDAINED MINISTER Legally. Credentials Free. Use title "Reverend." Write: Church of the God Within, Box 390611, Miami, Florida 33139.

PERSONAL—Cont'd

HAVE CONFIDENTIAL CHICAGO MAILING ADDRESS or branch office. Business, Personal; Since 1944! Mail Center, 323(g) Franklin, Chicago 60606.

SINGLE? Meet sincere, beautiful people—like YOU. Very low fees. Call DATELINE toll-free: 800-451-3245.

PHOTOGRAPHY-PHOTO FINISHING

SAVE HUNDREDS OF DOLLARS!!! Make your own S & M Densitometer. Send $5.00 for detailed drawings and instructions. A must for successful photography in your darkroom. Order direct: S & M Instruments, Dept. EE9, 380 Lexington Ave., N.Y., NY 10017.

PROFITABLE OCCUPATIONS

JOIN OIL FIELD, HIGH PAY, TRAVEL, EXCELLENT BENEFITS. Booklet containing 100+ Drilling Companies, Sample application, General advice. Send $5.00: JH Enterprise, Box 208, Mead, OK 73449.

RADIO & TELEVISION

TV TUBES 35¢ each. Send for Free 48 page color catalog. Cornell, 4217-W University, San Diego, California 92105.

TUBES Oldies, latest. Supplies, components, schematics. Catalog free. (Stamp appreciated). Steinmetz, 7519-EE Maplewood, Hammond, IN 46324.

SAVE 50% build your own speaker system. Write McGee Radio Electronics, 1901 McGee Street, Kansas City, MO 64108.

POLICE Scanners, Crystals, Antennas, Radar Detectors, CB's. HPR, Box 19224, Denver, CO 80219.

"TOP SECRET" Registry of U.S. Government Frequencies 25 to 470 MHz, Second Editionl 3,500+ Listings: FBI, FCC CIA, Treasury, Border, Customs, Secret Service, military, etc. $4.95 ppd. CRB Research, Box 56-EE, Commack, NY 11725.

FREE CATALOG! "Hot," selective receivers, digital frequency displays, antennas, advice. RADIO WEST, 3417 Purer Road, Escondido, CA 92025 (714) 741-2891.

BUILD Distance Crystal Sets. 10 plans—25¢; Handbook—"18 Different"—50¢; "20 Different"—50¢. Kit catalog 50. Laboratories 1477-G, Garden Grove, CA 92642.

CRYSTAL SET builders, shortwave coil EXPERIMENTERS . . . Now Available . . . Limited supply of hard-to-find, fresh, new, double-cotton-covered copper wire. Write today for free sample and price list. Bob Ryan, Box 3039, Anaheim CA 92803.

RECORDS, RECORDERS & SOUND EQUIPMENT

FREE Promotional albums, concert tickets, stereos, etc. Information: Barry Publications, 477 82nd Street, Brooklyn, New York 11209.

SCIENCE & CHEMISTRY

FIREWORKS! Spectacular novelties. Simplified manufacturers textbook. $5.00. Tropic, Box 95M, Palm Bay, FL 32905.

CHEMICALS, apparatus, project books, wide selection. Catalog $1.00 send to: Pioneer Company, 14a Hughey Street, Nashua, NH 03060.

LASER HANDBOOK with burning, cutting, Ruby Reds, Co's, complete plans, books and parts. Send $4.00 to: Famco Dept. EE, Box 1902, Rochester, NH 03867.

SONGWRITERS

SONGWRITERS: Exciting offer! Poems, songs needed. Free evaluation. Creative Music Productions, Box 1943-A9 Houston, Texas 77001.

SONGWRITERS WANTED. Poems set to music—recorded. Pageant Records, Box 7416-DA, Sarasota, FL 33578.

SPECIAL SERVICES

LOAN CALCULATOR. Monthly repayment schedule for any size loan. 1 to 30 years; in quarterly increments, 5 to 25 percent. $3.95; MS Financial Services, Box 1196, Washington, DC 20013.

WATCHES, WATCHMAKING & REPAIRING

WATCH and clock repairing books, tools, materials. Free Catalog. North American, Box 77, EE69, Fox River Grove, IL 60021.

INPUT/OUTPUT

BY HANK SCOTT

> 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**
> **ELEMENTARY ELECTRONICS**
> **380 Lexington Avenue**
> **New York, NY 10017**

Lotta Money

Hank, I spent over $2800 on a computer system that I wanted to have fun with. After a year, I still don't understand assembly, Dbug, Edit, Pascal, and I am at the novice level in BASIC. I didn't lose any money because I bought some good cassette programs which I use in my business. But where is the fun when you can't learn the language?

—A.W., Carbondale, IL

Quit on everything but BASIC for a while. There are several good books and home study courses you can use to learn BASIC. If you devote a minimum of one hour a day for six days a week, BASIC will be mastered in three months. You'll really know it, and will be able to write programs. In the meantime, collect all the literature you can on the microcomputer you have and prepare to take on machine language next. Some find machine language or assembly easy, others find it hard. However, if you can master BASIC, there is no reason why you can't understand all the other languages, at least to a degree.

Loves to Give Advice

I told a friend to take some treatment other than a heart pacemaker implant because the risk is too high. Electronics for use inside the human body have not yet been perfected. Do you agree?

—D.S., Santa Barbara, CA

The human brain is an electrochemical computer, and in your case it's short circuited! How can you presume to offer advice like that when you are not qualified —not even fully acquainted with the medical profession? Pacemakers can and do cause problems. In the natural healing process of the human body, fibrous tissue encapsulates the implant. Sometimes this may cause a problem. The implant may have a defect that appears in the body and not on the test bench. Or, an infection may occur that cannot be controlled. There must be other problems I don't even know about or could understand. But, should a doctor say to me that I would die in the next year without an implant (90% certainty) or live for another ten years normally with an implant (90% certainty), you can bet your bottom dollar I'll be singing the praises of that doctor for the next decade. As for you, my friend, see a good shrink!

Going Way Up

I know all about standard prefixes like deca (10^1) hecto (10^2), kilo (10^3), mega (10^6), giga (10^9), and tera (10^{12}). Hank, what comes next?

—B.N., Marion, OH

Next comes peta (10^{15}) and exa (10^{18}), and that's all I know on that. Only astronomers use peta and exa when counting stars—who else could use these gigantic prefixes?

R/C on Ham Bands

Is it legal to operate radio controlled models on the ham bands?

—J.L., Wichita, KS

The FCC allows R/C operation on 53.1, 53.2, and 53.3 and 53.4 MHz with a ham license. I suggest you get clarification on this direct from the FCC.

Wants a HUG

I heard of a HUG computer program and looked for the program and/or company in many computer magazines without finding it. Do you know where HUG is located?

—D.L., Norcross, GA

HUG stands for Heath User Group, an organization of Heath computer users headquarted in Benton Harbor, MI, affiliated with the Heath Company.

Making the Switch

I can't seem to find a 7912 IC locally. What can I replace it with to get my regulator power supply going again?

—W.S., Columbus, OH

The 7912 is a negative 12-volt regulator. It can be replaced by the LM320. Your power supply may also use a 7812 IC, which can be replaced by an LM340, a positive 12-volt regulator IC.

Clean Replacement

My car radio's volume control is noisy. I give it a shot of contact cleaner periodically, but after a few weeks, I've got to do it again. What else can you suggest?

—J.W., Sunnyvale, CA

Forget about the contact cleaner; it's worth only one shot. If the trouble returns, solve the problem once and for all by replacing the control. I never put much faith in contact cleaners and solvents. In fact, if used on good controls, they may actually create problems.

Can't Fix It

My aunt has a 3-minute egg maker that's many, many years old. None of the electric parts ever burned out. However, my pocket calculator, CB transceiver and portable cassette cannot be repaired. In fact, my mother's steam iron costs less to buy new than repair. What's happening to electronics?

—K.S., Vancouver, B.C.

First off, your mother's steam iron is an electric item, in no way to be confused with electronic gear. Next, your aunt's 3-minute egg maker doesn't have any "real" electric parts in it except for the line cord and two carbon electrodes. A measured amount of water boils when it shorts out the house line power across the carbon electrodes. Heat in the form of steam surrounds the egg until all the water is gone. As for your calculator, transceiver and cassette player — all I can say is "What's happening to electronics"?

Lend a Hand

Here we go again, boys. If you can help, please do so!

△ Dumont Cathode-Ray Oscillograph, Type 274; needs schematic diagram and instruction book; Leonard B. Houlditch, 7436 S. Fawcett St., Tacoma, WA 98408.

△ Electronics Sidebander, 910BE; needs microphone replacement and operating manual; Chris Edwards, P.O. Box 222, Anita, PA 15711.

△ C.S.I. Ultrasonic Detection Unit, Model 6502; helpless without schematic diagram and service information; J. Kiss, Katslosa 13, 27012 Rydsgard, Sweden.

△ Philco AM/FM Radio, Model R422-BE; urgently needs schematic diagram; Richard A. Smith, 7263 Buhayer Rd., Rome, NY 13440.

△ Hallicrafters S-38 Receiver; needs schematic diagram and replacement parts list; Steve Schiel, Pearsall Rd., Uvalde, TX 78801.

△ Jackson Wide-band, High-sensitivity Oscilloscope; Model 573; would like to have copy of the operating manual and schematic diagram; Bill Cummins, 584 Garner Dr., Covington, KY 41015.

△ RCA Oscilloscope, Model WO-33A; service manual and schematic diagram; Edward Herbert WA3NMW, No. 410 Third St., Minersville, PA 17954.

We'd like to thank all those readers who have extended a helping hand to fellow readers asking for help. A few have written to us telling of the assistance received. Everybody connected with ELEMENTARY ELECTRONICS is pleased. ■

BUILD 20 RADIO
AND ELECTRONICS CIRCUITS

PROGRESSIVE HOME RADIO-T.V. COURSE

Reg. U. S. Pat. Off.

Training Electronics Technicians Since 1946

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

- ★ No Knowledge of Radio Necessary
- ★ No Additional Parts or Tools Needed
- ★ 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 useful set of tools, a professional electric soldering iron, and a self-powered Dynamic Radio and Electronics Tester. The "Edu-Kit" also includes Code Instructions and the Progressive 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."

SOLID STATE

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

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

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

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

Progressive "Edu-Kits" Inc., 1189 Broadway, Dept. 604-DJ Hewlett, N.Y. 11557

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

NAME ....

ADDRESS ....

CITY & STATE .... ZIP ....

PROGRESSIVE "EDU-KITS" INC.

1189 Broadway, Dept. 604-DJ Hewlett, N.Y. 11557

CIRCLE 23 ON READER SERVICE COUPON

NEW WIRE-WRAPPING TOOL DOES ALL

WSU-30M

The new WSU-30M "Hobby Wrap" tool performs the complete wire-wrapping function. First, the tool wraps 30 AWG (0,25mm) wire onto standard .025 inch (0.6mm) square DIP Socket Posts. In addition, the tool also unwraps and, finally, it strips 30 AWG wire nick-free.

WSU-30M makes a "modified" style of wrap, in which approximately 1½ turns of insulated wire are wrapped in addition to the bare wire for purposes of added mechanical stability. Designed for the serious amateur, the WSU-30M features compact, all metal construction for years of dependable service. This unique tool is remarkable value performing the work of three separate tools at a fraction of the cost.

WSU-30

WIRE WRAPPING-STRIPPING-UNWRAPPING TOOL

The compact, inexpensive WSU-30 "Hobby Wrap" Tool does the job of three tools at a fraction of their comparable prices. The tool wraps, unwraps, and even strips wire thanks to a unique built-in stripping blade. Designed for use with 30 AWG (0,25mm) wire on standard .025 inch (0,6mm) DIP Socket Posts. Takes minutes to learn to use; makes perfect connections in seconds without solder.

OK Machine & Tool Corporation

3455 Conner St., Bronx, N.Y. 10475 U.S.A.

Tel. (212) 994-6600 Telex 125091

CIRCLE 24 ON READER SERVICE COUPON