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FOR BEGINNERS

MAGNETISM AT WORK

OUR BASIC COURSE

CB PowerMate-

Regulated 13.8-volt DC power supply lets you deliver full RF power at home from your mobile rig (See page 51)

Measure the Wind

Digital LED anemometer counts on its fingers to indicate wind speeds up to 99 mph! (See page 45)

How to Start a CB REACT Team

3 Weeks to a Ham License

Inside Theory on Amplitude Modulation

Tips on 3 Quickie Shortwave Antennas

New Design Twists in Recent Loudspeakers

A DAVIS PUBLICATION

Learning with CIE is

Electronics no picnic.

It takes work. And a few sacrifices. But it's worth it!

The minute you start your CIE course you'll see why CIE is different than other home-study schools.

Because as a CIE student you'll get the kind of electronics training that prepares you for a career, not just a job. We'll give you a meaningful, well-rounded foundation in electronics

Electronics and some people might assume there will be no new frontiers . . . no new worlds to conquer. Not so.

Electronics is still growing. In nearly every one of the new and exciting fields of the Seventies you'll find electronics skills and knowledge in demand. Computers and data processing. Air traffic control. Medical technology. Pollution control. Broadcasting and communications.

Importance of an FCC License

If you want to work in commercial broadcasting . . . television or AM or FM broadcasting . . . as a broadcast engineer, federal law requires you to have a First Class Radiotelephone License. Or if you plan to operate or to maintain mobile two-way communications systems, microwave relay stations or radar and signaling devices, a Second Class FCC License is required.

because the vast majority of CIE students have. In fact, based on continuing surveys, close to 9 out of 10 CIE graduates have passed their FCC exams!

So if you are serious about getting ahead in Electronics . . . if you are willing to put in the extra work . . . get in touch with us.

We have many *career* courses for you to select from. If you already have some electronics training, you may want to skip our beginner-level courses and enroll in an intermediate program. Or, if you're really hot, there's a tough, college-level course called "Electronics Engineering" that can make you even better.

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January-February 1976
Volume 16, No. 1

Cover Illustration by Len Goldberg

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- ★ SIGNAL TRACER
- ★ AMPLIFIER
- ★ SIGNAL INJECTOR
- ★ CODE OSCILLATOR

- ★ No Knowledge of Radio Necessary
- ★ No Additional Parts or Tools Needed
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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 and switches, etc.

In addition, you receive Printed Circuit materials, including Printed Circuit chassis, special tube sockets, hardware and instructions. You also receive a useful set of tools, a professional electric soldering iron, and a self-powered Dynamic Radio and Electronics Tester. The "Edu-Kit" also includes Code Instructions and the Progressive 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

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

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

Robert L. Shuff, 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."

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. 576DJ Hewlett, N.Y. 11557

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

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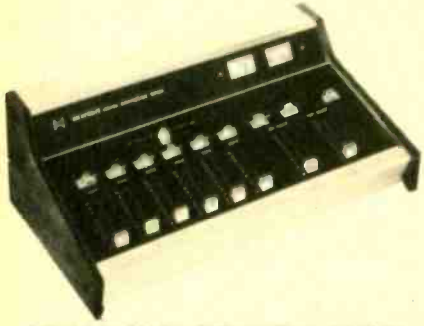
CIRCLE 14 ON READER SERVICE COUPON

Hey, look me over

Showcase of New Products

Heathkit Mike Mixer

The Heath TM-1626 is a low-cost, high-fidelity stereo mixing console for serious tape recording and PA use. The TM-1626 provides a number of professional features including stereo outputs, four high/low impedance mike inputs (one with pan control), two auxiliary inputs, lighted level meters plus adjustable LED peak indicators and much more. Slide controls let you visually "balance" the relative level of the inputs and outputs. Switches above each input control let you assign that channel to the left or right output or switch the input off. The pan control adjusts the apparent location of the fourth mike from left to right or anywhere in between. Since the pan is a slide control, it's easy to visualize what the final mix down will sound like. If six inputs aren't enough for you, mixer bus jacks let you parallel any number of TM-1626's—you can have as many inputs as you want, whenever you want. A pair of lighted Vu meters continuously monitor the output in two switch-selected ranges: +4 or +10 dB. Ordinary meters can't respond to instantaneous peaks quickly enough to prevent tape saturation and increased distortion. To solve that problem, the TM-1626 uses a pair of LEDs which respond to peaks faster than any meter. A pair of controls on the rear panel set the level which the LEDs light, so you can optimize performance with any tape recorder or sound system. The TM-1626 sells for $129.95, plus shipping. The 1975 Heathkit Catalog contains more information on the TM-1626 and over 350 other electronic kits. For a free catalog write to the Heath Company, Benton Harbor, MI 49022.



CIRCLE 31 ON READER SERVICE COUPON

World's Smallest Calculator

Although it's only 2 x 2.8 x 0.4 inch (about one-third the size of a pack of cigarettes) and weighs just 2 ounces, this full-function electronic calculator with 8-digit readout does everything the big ones do. It features an automatic percentage key, floating decimal, constant key, lead zero depression, and more, yet it is priced at just $19.95. The tiny plastic unit operates on two 1.5V Mallory PX-825 camera batteries or the equivalent. Batteries are included and replacements are available at any camera shop. Despite being small enough to comfortably fit in a pocket or purse, the calculator provides plenty of room for most fingers. The world's smallest electronic calculator is available only by mail, $19.95 postpaid, from Edmund Scientific Co., 380 Edscorp Bldg., Barrington, NJ 08007. As with everything Edmund sells, it carries a 30-day money-back guarantee.

CIRCLE 67 ON READER SERVICE COUPON

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Powerful 12v emergency light projects big straight beam visible for 2 miles. Plugs into car's cigarette lighter; only 3½ lbs. Great for motorists, outdoorsmen, emergency crews, security men, campers. Super bright 200,000 candlepower G.E. aircraft landing light in a rugged weatherproof steel housing with baked enamel finish, steel lens grate, polished chrome-plated reflector, on/off switch. 15 ft. extension cord; 6¼ dia. x 11⅛". Keep it handy!

Stock No. 72,093EK ..... $22.95 Ppd.

FUEL MISER RECLAIMS HEAT

Save your 40% wasted heat to warm a basement, garage or rec room at no extra cost! Instead of going "up the chimney" it goes where you want it. Remove part of furnace exhaust pipe, slip heat Exchanger in. At 125° fan automat. forces clean air through unit which heats to over 200°F., can be ducted to 20 ft. from unit. 110v AC. Inst.

No. 19,194EK (5" DIA.) Shpg. 17 lb. ..... $106.00 FOB
No. 19,195EK (6" DIA.) Shpg. 17 lb. ..... $106.00 FOB
No. 19,198EK (7" DIA.) Shpg. 17 lb. ..... $106.00 FOB

HEAT-REFLECTING BED SHEET

Lower the thermostat, skip the electric blanket—our energy-saving Heat Reflecting Sheet keeps you toasty! Uses body heat normally lost thru mattress, reflects it back to you when placed between bottom sheet and mattress. Recycle your body heat with amazing economy device made from space-age materials. Superinsulative coating scientifically reflects heat. Doubles as mattress protector (won't soil, can't wear out!). For twin & double beds.

Stock No. 71,991EK ..... $9.95 Ppd.

ELECTRONIC DIGITAL STOPWATCH: $69.95

A price breakthrough! New pocket size 4 oz. timer acc. to ±2% of reading (1/100 sec. increments). Compares with others twice the price! Instant error-free readouts to 9999.99 sec. (over 2¾ hr). Starts, stops, restarts (accumulates). Mechanical pushbutton & electrical remote on/offs w/ any 3.5-150v AC/DC source. Plug-in jack. Incls. 9v batt. Solid state.

No. 1943EK (2¼ X 4½ X ⅞") ..... $69.95 Ppd.
DELUXE 2 EVENT STOPWATCH (±0.01% OF LAST DIGIT)
No. 1653EK ..... $149.95 Ppd.

SUPER POWER FOR ANY AM RADIO

New antenna assist turns a tiny transistor into a tiger, has pulled in stations up to 1000° miles away! Just set beside radio (no wires, clips, grounding) and fine-tune Select-A-Tenna's dial to same frequency—"gangbusters"! Great for clearing weak signals in radio depressed areas, off-coast islands, crowded frequency stations. Solid state—uses no electricity, batts., tubes.

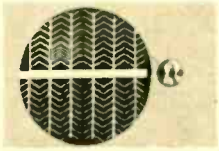
Stock No. 72,095EK ..... $15.95 Ppd.
ULTRA SELECT-A-TENNA
No. 72,147EK (*OVER 1000 MI.) ..... $22.95 Ppd.

WORLD'S SMALLEST CALCULATOR!

Small but mighty! 8-digit, 4-function electronic calculator does everything big ones do—even has automatic % key... for only $19.95. Take it anywhere. Fits in your pocket—⅔ size of cigarette pack. 3½ oz. dynamo features floating decimal, constant key, lead zero depression, more! Includes plug-in rechargeable Ni-Cad battery pack. 2 x 3½ x ¾" with plenty of room for most fingers. Another Edmund first with advanced technology.

Stock No. 1945EK ..... $19.95 Ppd.

WORLD'S LARGEST SOLAR CELL...



And the most powerful silicon. Cheapest dollar per watt! New 4" dia. giant can put out 1 full watt of electricity, over 2 amps of current at .45v. Exposed to light, produces about the same voltage between its 2 terminals; when a lead is connected between them, voltage diff. causes current flow. Operating range: −65° to ±125°C. Rated at 100mW/Cm² light intensity at .45v.

No. 42,314EK (TAB LEADS) ..... $29.95 Ppd.
ONE AMP ½W 3" DIA. CELL
No. 42,270EK ..... $19.95 Ppd.

SEE MUSIC IN PULSATING COLOR

New 3-Channel Color Organ adds to music listening pleasure, lets you modulate 3 independent strings of colored lamps with intensity of your music to create an audio "light show." They flash, vary in brightness related to music's rhythm, pitch, volume—pulsating lighting performance to music! Fully assembled & priced half that of others, the Edmund Sound To Light Control is a terrific value. Plug in, turn on!

No. 42,309EK (ASSEMBLED) ..... $17.95 Ppd.
No. 42,336EK (UNASSEMBLED) ..... $13.95 Ppd.

KNOW YOUR ALPHA FROM THETA!

For greater relaxation, concentration, listen to your Alpha-Theta brainwaves. Ultra-sensitive electrode headband slips on/off in seconds—eliminates need for messy creams, etc. Atch'd to amplifier, filters brainwaves, signals beep for ea. Alpha or Theta wave passed. Monitoring button simulates Alpha sound; audio & visual (L.E.D.) feedback. Reliable, easy-to-use unit comparable to costlier models. Completely safe. Comprehensive instruction booklet.

No. 1635EK (8x3x4"; 24 oz.) ..... $149.50 Ppd.

No. 71,809EK ..... $ 55.00 Ppd.
No. 1652EK DELUXE "ON" TIME MONITOR—Measures & Records % ..... $299.95 Ppd.

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HEY, LOOK ME OVER

Circuit Designer with Power

Continental Specialties is now offering Design Mate 1. This device permits the user to build any circuit as fast as he can think, using solid #22 AWG hookup wire to interconnect any discrete components, including resistors, transistors, linear/digital ICs in TO-5, and/or DIP packages from 8 to 40 pins or more. All connections are made without solder because the components fit directly into one QT-59S Socket and two QT-59B Bus Strips. Plus, Design Mate 1's variable regulated power supply gives 5 to 15 volts DC up to 600ma (9 watts). It is also possible to monitor the DM-1's internal power supply or external circuits via the built-in 0 to 15V voltmeter. The entire package, completely wired, tested and ready-to-use, sells for $49.95. Specifications for Design Mate 1 include: Power Supply: output, 5-15V at 600ma; ripple and noise, less than 20 mv at full load; load and line regulation, better than 1%. Meter: 0-15V DC-5%. Connectors: 1 QT-59S, 2 QT-59B, 2 power supply 5-way binding posts, 2 meter 5-way binding posts. Power Requirements: 117V. AC, 12 watts. For more information, write to Continental Specialties Corporation, 44 Kendall Street, Box 1942, New Haven, CT 06509.

CIRCLE 68 ON READER SERVICE COUPON

Hits from Yesteryear

Radio Shack is offering five new records and tapes featuring great hits from yesteryear. The collections feature Top Hits of the '40's, '50's, '60's in two volumes, and Top Hits of the '70's. The songs on each were specially selected and will be sold exclusively by Radio Shack stores and dealers, nationwide.

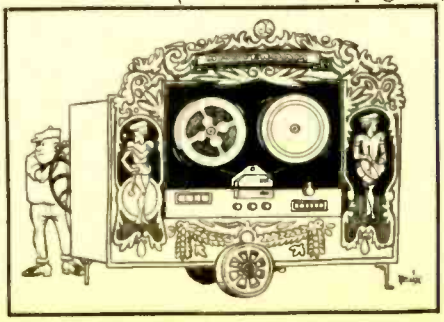
CIRCLE 32 ON READER SERVICE COUPON

Each collection features ten hit songs by the original artists from that period. Among the featured artists are: from the '40's, the Andrews Sisters, Johnny Mercer, and Nat King Cole; '50's, Monotones, Everley Brothers, Marty Robbins; '60's, Gary Pucket, Kingsmen, Byrds, Turtles, Blood Sweat & Tears, Bobby Vinton, and the New Christy Minstrels; '70's, Santana, Mac Davis, Dr. Hook, Poco, and Looking Glass. The record albums are each priced at $2.99. Cassettes or 8-track tapes sell for $3.99 each. Radio Shack has more than 3,500 stores and authorized sales centers, nationwide.

Digital Multimeter

The Sinclair DM2 combines the precision of a digital instrument with the convenience and low cost of an analog meter. The DM2 is designed to appeal to both the professional and the electronic

(Continued on page 14)

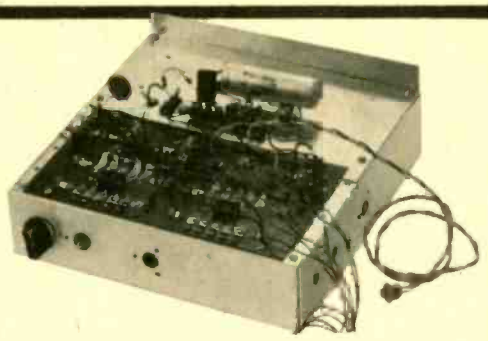


CIRCLE 5 ON READER SERVICE COUPON

good with 7 kits . . . $370

Or low monthly terms

A basic TV/Audio Servicing Course including 7 training kits for your experiments. You build your own solid-state radio, solid-state volt-ohmmeter, and experimental electronics lab. Includes 65 bite-size lessons (16 on color TV), 15 special reference texts with hundreds of servicing short cuts, tips on setting up your own business, etc. This completely up-to-date course covers black & white and color TV, FM multiplex receivers, public address systems, antennas, radios, tube, transistor and solid-state circuits.



better . . . with 11 kits and B/W TV . . . $465

Or low monthly terms

A complete course in B&W and Color TV Servicing, including 65 lessons (16 on color TV), 15 special reference texts and 11 training kits. Kits you build include your own solid-state radio, solid-state volt-ohmmeter, experimental electronics lab, plus a 12" diagonal solid-state black & white portable TV . . . to build and use. At each assembly stage, you learn the theory and the application of that theory in the trouble-shooting of typical solid-state TV sets.

better yet with 11 kits and 19" diag. Color TV . . . $795

Or low monthly terms

The course includes 53 lessons and reference texts plus kits and experiments to build a superb solid-state 19" diagonal color TV receiver . . . complete with rich woodgrain cabinet, and engineered specifically for training by NRI's own engineers and instructors. This handsome set was designed from the chassis up to give you a thorough understanding of circuitry and professional trouble-shooting techniques. You build your own solid-state volt-ohmmeter, and experimental electronics lab.

best . . . with 14 kits and 25" diagonal Color TV . . . $1,095

Or low monthly terms

The ultimate home training in Color TV/Audio servicing with 65 bite-sized lessons, 15 reference texts, and 14 training kits . . . including kits to build a 25" diagonal Color TV, complete with handsome woodgrain console cabinet; a wide band, solid-state, triggered sweep, service type 5" oscilloscope; TV pattern generator; digital multimeter, solid-state radio, and experimental electronics lab.

This Master course combines theory with practice in fascinating laboratory units. Unlike "hobby kits", the NRI color TV was designed with exclusive "discovery" stages for experimentation and learning. Building the set will give you the confidence and ability to service any color TV set on the market. And you'll have a magnificent set for years of trouble free performance.

Plus Advanced Pro Color . . . $645

Or low monthly terms

An advanced Color TV Servicing Course for experienced technicians, 18 color lessons, 5 new "Shop Manuals", and NRI 18" diagonal Color TV training kit are included.

Ever wonder why no other TV/Audio home study school puts its prices in its ads?

Maybe it's because they can't match this value!

No other school gives you a choice of five ways to learn TV/Audio servicing, with complete courses starting as low as $370... with convenient, inexpensive time payment plans. The Master Color TV/Audio training course gives you a unique, engineered-for-training 25" diagonal color set with all the electronic instruments you need for as much as $600 under the next leading home study school's comparable course. NRI quotes its prices because we believe you get the top educational value from NRI.

You pay less because NRI passes

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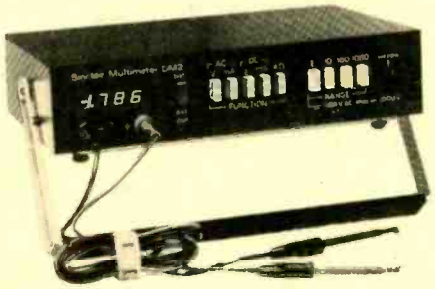
Accredited by the National Home Study Council

Elementary Electronics 6-016

HEY, LOOK ME OVER

(Continued from page 8)

hobbyist. Including an AC adapter, the 3½ digit unit will sell at a price of $149.95. The DM2 can also be powered by a single 9v battery. The DM2 measures AC and DC volts, AC and DC current and resistance in a total of 20 combinations—5 functions each with 4 ranges—with a basic accuracy of 0.4 percent. Operation is by pushbutton selection and contact is made by two clip



CIRCLE 74 ON READER SERVICE COUPON

probes on long leads. The unit features a large 0.3 inch LED display and a violet screen to facilitate contrast in high ambient light conditions. Maximum reading is 1.999. Designed and produced in England, the DM2 employs an MOS integrated circuit, utilizes dual slope integration and features high operational repeatability and reliability. Separate fuses for current and resistance ranges protect the DM2 against severe overload. A carrying case is available as an optional extra, and the unit is covered by Sinclair's traditional one-year parts and labor warranty. For more information, write to Sinclair Radionics, Inc., 375 Park Avenue, New York, NY 10022.

Battery/AC Digital Multimeter

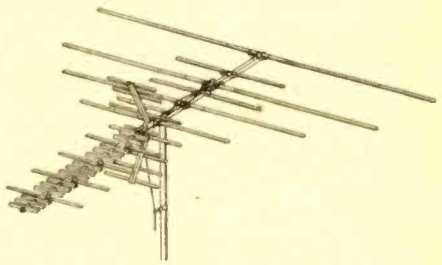
The Micronta Rechargeable Battery/AC Multimeter provides four ranges of AC and DC voltage measurement, three ranges of AC and DC current measurement, and four ranges of resistance measurement. The meter has three full 0.3-inch LED digits for ease in reading measurements even from a distance. It

CIRCLE 32 ON READER SERVICE COUPON

also has an over-range indicator and internal over-range protection. Utilizing the latest in MOS LSI and complementary MOS (CMOS) integrated circuitry, the Micronta Digital Multimeter is said to offer an optimum combination of accuracy, reliability, and durability. To further insure accuracy, both a dual-slope analog-to-digital (A to D) converter and an internal mercury voltage reference cell are used. Designed for either portable or AC operation, the multimeter can be used with either rechargeable or standard, non-rechargeable batteries. It incorporates a built-in battery charging circuit. The Micronta Rechargeable Battery/AC Digital Multimeter is priced at $119.95. It is manufactured for and sold exclusively through more than 3,500 Radio Shack stores and dealers, nationwide.

Bicentennial Antenna

The Finney "1776" is a 37 element VHF-UHF-FM Antenna on a rugged 1-inch square boom 111⅛-inch long. The multiple drive VHF section with reflector elements for both low-band and hi-band assures high gain and excellent front-to-back ratio on the VHF response. The UHF section of the antenna incorporates a broadband yagi type array and a corner reflector type array for flat response

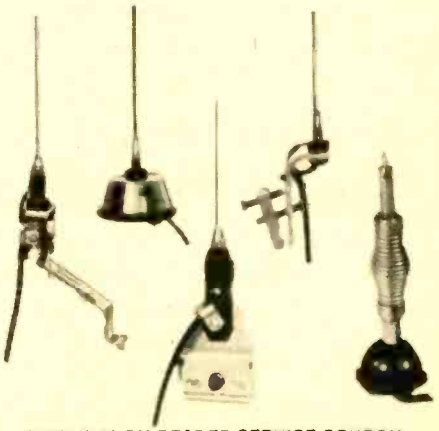


CIRCLE 63 ON READER SERVICE COUPON

and high gain across the entire range of UHF channels. A behind-the-set signal splitter is in each carton. Available from Finney dealers nationwide for $49.50. For more information, write to The Finney Company, 34 West Interstate, Bedford, Ohio 44146.

CB Range Riders

Antenna Specialists has developed a new line of center-loaded CB antennas which offer unique performance advantages. Nicknamed "Range Riders," all models in the line have special tuning tips which allow adjustment without the need for cut-and-try antenna trimming.



CIRCLE 64 ON READER SERVICE COUPON

(Continued on page 18)

"Breaker . . . Breaker . . ."

Break-through with BREAKER!

The New Freedom Line of CB Mobile and Base Antennas and Accessories made in the U.S.A. for communications between people.

A wide selection of "revolutionary" new CB High Efficiency communications antennas of superior strength, electronically and physically, for all the talk power your CB rig will deliver —coming and going in the 27 Megahertz frequency band.

Mobile Breaker antennas for cars, trucks, trailers, sports cars, station wagons, motorcycles, boats. Breaker base station antennas to communicate with mobiles and hand helds . . . all designed specifically for the outstanding transmission and reception of CB signals.

The high quality and materials of the Breaker CB antennas and accessories assure you the maximum in performance for many years and at reasonable cost. Performance-tested Breaker CB antennas offer you these advantages plus more:

- ★ *Easily adjust for lowest VSWR*
- ★ *Long-life stainless steel and fiberglass whips*
- ★ *Highest quality coaxial cable with solderless connections*
- ★ *Innovative engineering designs*
- ★ *Packaged for quick, easy installation to get you on the air fast, complete with cables and hardware*

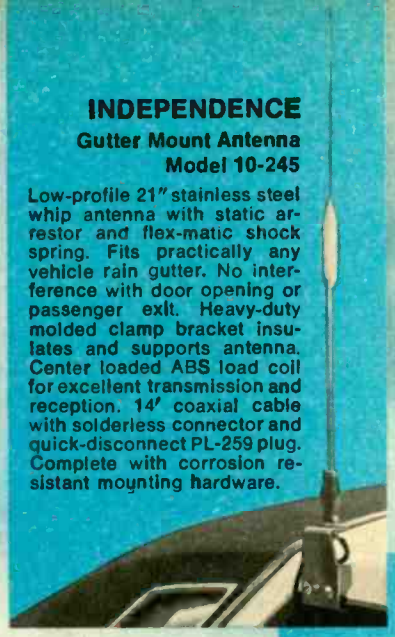
All Breaker antennas are American made in Arlington, Texas. In keeping with the tradition of the Bi-Centennial they are proudly named after our revolutionary heroes and places. Red, white and blue are also the colors of Breaker. Chosen because we too are very proud of our heritage and contribution to making exciting products for use by people communicating with people. See and buy the Freedom line of Breaker antennas and accessories at your nearest electronic distributor. Look for the red, white and blue packaging.

WRITE FOR FREE CATALOG.

INDEPENDENCE

Gutter Mount Antenna
Model 10-245

Low-profile 21" stainless steel whip antenna with static arrestor and flex-matic shock spring. Fits practically any vehicle rain gutter. No interference with door opening or passenger exit. Heavy-duty molded clamp bracket insulates and supports antenna. Center loaded ABS load coil for excellent transmission and reception. 14' coaxial cable with solderless connector and quick-disconnect PL-259 plug. Complete with corrosion resistant mounting hardware.



PAUL REVERE

Roof Mount Antenna
Model 10-215

Special "power-plus" 42" base-loaded roof mount with long-life stainless steel whip, rugged stainless steel shock spring and high-quality 16-ft. shielded coax cable and solderless connections for fast "on-the-air" installation. Named after the famed communicator and hero of revolutionary era.

THE PATRIOT

Omni-directional
¼-Wave Base Antenna
Model 11-101

High in quality, performance and efficiency, low in cost. Has three 108" quarter wave tubular aluminum radials plus a quarter-wave radiator (vertical element). Heavy-duty U-clamp fits mast up to 1⅝" diameter. Built-in lightning protector. SO-239 style connector mount. Mates with PL-259 plug. Shunt loaded coil. Heavy duty insulated molded clamp bracket. Easy to assemble and dis-assemble. Fixed construction.

GEORGE WASHINGTON

West Coast Mirror Mount
Dual Truck, RV Antennas
Model 10-200

Weather resistant dual 57" stainless steel whip antennas with static arrestor tips. Secure horizontal or vertical mounting to West Coast side view truck type mirrors. Twin antennas co-phased for more directional power and easily adjustable for fine tuning. Hermetically sealed, white oversized ABS center load. Dual 18' low-loss coaxial phasing harnesses with solderless connectors and quick disconnect PL-259 plugs. Complete with corrosion resistant mounting hardware.

THE MINUTEMAN

Trunk Mount Antenna Model 10-230

Sturdy, durable, no-hole required in trunk of vehicle. Super 44" stainless steel whip, base loaded low-profile antenna with stainless shock absorbing spring, chrome plated brass bell housing, 18-foot shielded coaxial cable and solderless connections.

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31	32	33	34	35	36	37	38	39	40	41	42	43	44	45
46	47	48	49	50	51	52	53	54	55	56	57	58	59	60
61	62	63	64	65	66	67	68	69	70	71	72	73	74	75

We would like to know about you. Please help us by placing an "X" in the appropriate boxes. • Do you own a CB transceiver? 76 ☐ Yes 77 ☐ No • If your answer is Yes, please check appropriate boxes below if you have one or more of the types indicated. 78 ☐ Base Station 79 ☐ Mobile Unit 80 ☐ Portable • Do you use CB in your work? 81 ☐ Yes 82 ☐ No • 83 ☐ Please enter my subscription for 9 issues at $4.97 and bill me. 84 ☐ $4.97 subscription payment enclosed. Add 78¢ in US Poss. & Can. Add $1.53 for all other countries.

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HEY, LOOK ME OVER

(Continued from page 14)

The "static ball" tuning tip acts electrically as a capacity hat and can be moved up and down on the active element to achieve resonance and optimum performance. Once the desired setting is achieved, the static ball can be secured in position with an Allen wrench that is supplied with the antenna. The new "Range Rider" line also features a completely waterproof center-loaded coil assembly. The coil is pressure molded with the active elements into a single, rugged shaft which offers superior resistance to shock and vibration. Included in the new "Range Rider" line are models for a wide variety of applications, including dual mirror mount types for heavy duty trucks and the A/S "Quick Grip" mount for permanent no-holes installations on passenger car trunk lids. All models are supplied complete with coxial line and connectors plus phasing harnesses when required. Prices range from $19.95 to $39.95. Details on the new "Range Rider" line are available by contacting The Antenna Specialists Company, 12435 Euclid Avenue, Cleveland, Ohio 44106.

Boon for Boom

Here's a new line of radio communications made by Telex. These headsets employ the dual muff headphones sealing out distracting noise. The ceramic microphone has a —55 dB output, and can be used with any mobile or base station with a high impedance mike output. Each model has a push-to-talk switch that can be wired for either push-to-talk relay control or circuit interrupt for voice-operated transmitters. The attached boom mike provides the convenience of hands-free operation, allows for "close-talking", limits ambient noise pick-up, and provides superior intelligibility. With prices ranging from $5.95 to $99.50, there's a headphone or boom mike headset to match any budget. For more information, write to Telex, 9600 Aldrich Avenue South, Minneapolis, MN 55420. ■

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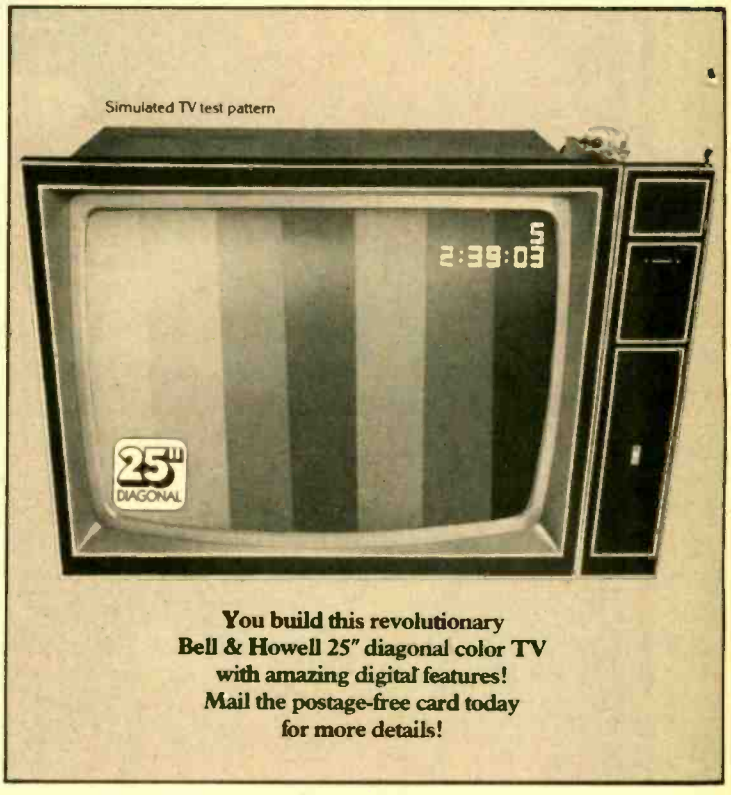
CIRCLE 26 ON READER SERVICE COUPON

IT'S HERE! FROM BELL

A fascinating learn-at-home program that includes this new generation color TV with digital features... you build it yourself!



You build this revolutionary Bell & Howell 25" diagonal color TV with amazing digital features! Mail the postage-free card today for more details!

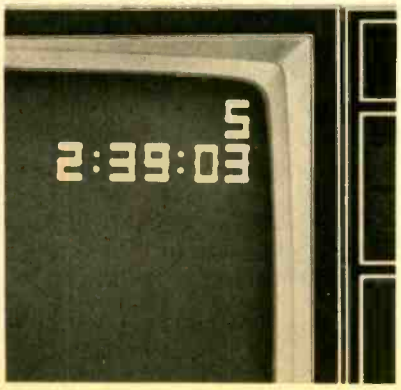
You learn occupational skills in electronics through experiments and testing as you build a color television that's ahead of its time!

You've seen TV's that swivel, TV's with radios built in. TV's small enough to stuff in a suitcase and TV's that have remote control.

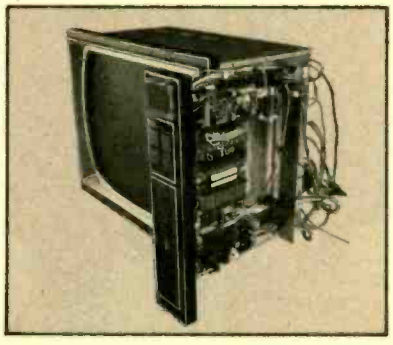
But now comes a color television with features you may have *never* seen before. Features now possible as a result of the new applications of digital electronics ···· features that make Bell & Howell's 25-inch diagonal color TV ahead of its time! You learn about...

Channel numbers that flash big and clear right on the screen. An on-screen digital clock that flashes the time in hours, minutes and seconds with just the push of a button. An automatic channel selector that you pre-set to skip over "dead" channels and go directly to the channels of your choice.

And to insure highest quality performance, this TV has silent, all-



electronic tuning, "state-of-the-art" integrated circuitry, Black Matrix picture tube for a brighter, sharper picture and 100% solid-state chassis for longer life and dependability.



Perform fascinating experiments with the exclusive Electro-Lab® electronics training system. It's yours to build.

Designed exclusively for our students, this Bell & Howell Electro-Lab® training system gives you up-to-date "tools of the trade," including instruments you can use professionally after you finish the program.

A digital multimeter that measures voltage, current and resistance and displays its findings in big, clear numbers. Far more readable than conventional

"needle pointer" meters that require guesswork and interpretation.

The solid-state "triggered sweep" oscilloscope is a "must" for accurate analysis of digital circuitry. Includes DC wideband vertical amplifier and "triggered sweep" feature to lock in signals for easier observation.

The design console is a valuable device for setting up and examining circuits without soldering! Features patented modular connectors, AC power supply and transistorized dual range DC power supply.

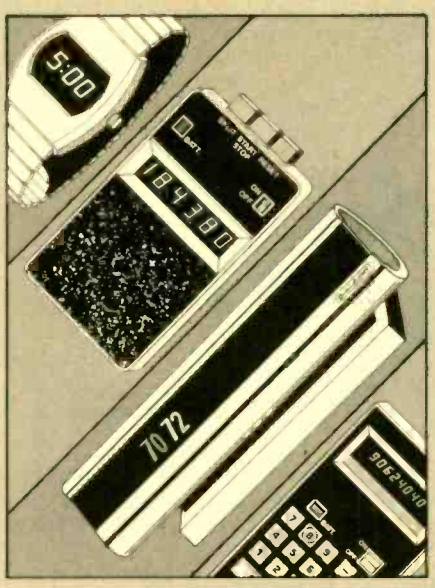
& HOWELL SCHOOLS!

Build it yourself... the perfect way to discover the exciting field of digital electronics!

It's part of a complete learn-at-home program!

Imagine spending your spare time actually building a 25-inch diagonal color TV! It's a project you can work on right in your home. You'll enjoy the challenge...exploring the new systems of digital circuitry and performing experiments to test what you learn.

There's no travelling to classes, no lectures to attend, and you don't have to give up your job or paycheck just because you want to get ahead. When you finish this Bell & Howell Schools program you'll have learned new skills that could put you ahead of the field



Digital electronics is changing our lives!

There's a lot more to digital electronics than just the numbers! True, that's what you see on more and more products like digital calculators, clocks and watches. But behind the numbers lies a fantastic technology that's creating higher standards of accuracy and dependability. The versatility of digital electronics has begun another industrial revolution. Its growth and applications are giving us new and better ways of doing things and spectacular products.

You'll receive a special Lab Starter Kit with your first lesson so that you can get immediate "hands on" experience to help you better understand newly-learned electronics principles. Later, you'll use your new knowledge and

Pick up occupational skills in electronics that could lead you in exciting new directions!

Once you complete this learn-at-home program from Bell & Howell Schools, you'll have the specialized color TV's plus the you can apply to repair me electronics equip- or more practical at- in electronics is avail-

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BOOKMARK
BY BOOKWORM

CB Add-Ons. Most of the accessories discussed in Leo G. Sands' new book, *CB Radio Accessories,* are easily adapted to CB equipment by using plugs and jacks. An add-on S-meter is the only accessory covered that requires opening up the case. Other topics covered in the book are: antenna system accessories, performance indicators, audio system accessories, power supplies and sources, interference prevention, vehicular noise suppression, and receiving accessories. The antenna system is the most important part of a CB transceiver. Therefore, many of the accessories given involve the antenna system. They can be used to make operating the CB equipment more convenient, to increase the range of the CB equipment, and to prevent the CB equipment from interfering with other types of communication. There is also a section on homemade antennas for the CBer who wants to build his own antenna. Published by Howard W. Sams & Co., Inc., 4300 West 62nd Street, Indianapolis, IN 46206.

Soft Cover
128 pages
$4.25

Beyond Beginners. *Transistor Theory for Technicians and Engineers* by Andrew Veronis, is a complete course in semiconductor theory, designed for advanced technicians and practicing engineers. It provides in-depth understanding of semiconductor parameters, device design and fabrication, transistor operation, and modern circuit theory. In its thorough coverage of the subject, this book begins with a complete description of the atomic structure of matter. It progresses to simplified explanations of electron action within atoms, which occurs when doped semiconductors form PN junctions. This material serves as a springboard to an understanding of the physical phenomena that take place in diodes and junction transistors. Published by Tab Books, Blue Ridge Summit, PA 17214.

Soft cover
224 pages
$5.95

Here It Is Again. You saw it before, and here is the second edition: *Amateur Radio Novice Class License Study Guide* by Jim Kyle K5JKX and Ken Sessions K6MVH. This widely acclaimed study course has been completely updated, and is 40 percent larger than the first edition. It now includes the complete FCC amateur radio rules and regulations, plus a sample Novice exam. It incorporates all the latest regulatory changes, all answers to the latest FCC exam questions, and the latest technical information needed to pass the amateur radio Novice examination. It also is a valuable Novice handbook as well—an incomparable source of data useful to any beginning radio amateur. Unlike many FCC study guides, this new book is not just a "memory guide" to the FCC questions. Rather, this study course paraphrases the original FCC question into a much broader one which covers all aspects of the particular subject. The result is a deeper knowledge and understanding of the material by the reader. Published by Tab Books, Blue Ridge Summit, PA 17214.

Soft cover
224 pages
$5.95

Solid-State Devices. A 752-page manual on the theory and applications of solid-state devices, including discrete types and monolithic integrated circuits, is available from RCA Solid State Division. The *RCA Solid-State Devices Manual,* Technical Series SC-16, is a comprehensive reference text that is useful to engineers, technicians, educators, students, radio amateurs, hobbyists, and others interested in solid-state devices and circuits. This manual covers silicon rectifiers, bipolar power transistors (low-, medium-, and high-frequency types), MOS field-effect transistors (MOS/FET's), thyristors (SCR's and triacs), and monolithic integrated circuits (bipolar and COS/MOS types) for linear and digital applications. It provides detailed tutorial information on basic operation, technology, ratings and characteristics, cir-

Soft Cover
752 pages
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(Continued on page 86)

New Albatross single sideband mobile transceiver.

You're on a rescue mission and you're relying on your two-way radio to get through. Otherwise it might be curtains for some guy at the bottom of a canyon.

That's the kind of action and you're the kind of guy we designed our new Albatross single sideband mobile rig for — the CBer who needs the band for effective, dependable communications in emergencies, in heavy traffic, under all kinds of conditions.

The guy who counts on CB.

The Albatross gives you upper and lower sideband selection plus AM on all 23 channels and all the features you'll find in the finest CB equipment.

Yet it costs less than single sideband sets that aren't really in the same league with it.

The new mobile unit features public address capability too, and a sharp high-frequency crystal filter for pinpoint selectivity that helps the receiver cut through all kinds of interference.

The FCC type-accepted Albatross is a precision piece of equipment that looks like it means business under anybody's dash.

And it gives you the performance a serious CBer should demand from single sideband equipment.

If you're one of those people who count on CB communications — sometimes in life-or-death situations — see the new Siltronix Albatross at your dealer's today. It's built for you.

Albatross Recommended Retail Price **$359.95**

SILTRONIX

A Cubic Corporation Company

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Telephone: (714) 757-8860

DX central reporting

A world of SWL info!

BY DON JENSEN

□ "Harim program bilong olgeta pipal ikam long NBC!"

How's that again? It may not look or sound much like English, but it is . . . well, sort of. It's pidgin English, one of the tongues spoken in one of the world's newest nations, Papua New Guinea.

Pidgin English began more than a century ago when European schooner captains first made contact with the native peoples of the second largest island on the surface of the globe. Commercial communication was the origin of pidgin. Merchant traders taught the people an ultra-simplified form of English, which, over the years, developed into a language all its own.

The phrase above, in literal King's English, would come out something like, "Hear him program belong all together people he come along NBC," or freely translated, "Listen to the programs for everyone from the National Broadcasting Commission of Papua New Guinea."

And that's exactly what many SWLs are doing these days, listening in on an unusual network of stations whose programs are directed to domestic audiences in the island nation.

Papua New Guinea has an interesting history. In the 1880's, when European powers were busily grabbing up chunks of overseas territory as colonies, one prime target was this large, lush island just north of Australia. To resolve conflicting colonial claims by Holland, Great Britain and Imperial Germany, New Guinea was divided into three parts.

The entire western half went to the Netherlands and is now a part of Indonesia known as Irian Jaya. The remainder was split between England and Germany. The southern quarter, Papua became a British colony and, later, administration passed to the Australians. The northeastern chunk, plus a number of smaller island groups in the area became German territory. When Germany lost World War I, its New Guinean territories were mandated to Australia. And, under this arrangement, Australia administered the entire eastern portion of the island until, in September, Papua New Guinea was granted independence.

Even today, there are parts of the interior that have progressed little beyond the Stone Age. For this reason, to try to help prepare this remote island of jungle and jagged mountains for independence, some years ago Australia began establishing a chain of shortwave stations on New Guinea proper and on some of the outlying islands, such as New Britain, New Ireland and part of the Solomons group.

During the pre-independence years there were two broadcasting organizations. The domestic Australian network, the Australian Broadcasting Commission operated several moderately powered stations at the Papuan capital of Port Moresby. The second network belonged to the Administration Broadcasting Commission, which operated stations in the remoter communities of the region. Both networks were merged into a new government radio system, the National Broadcasting Commission of Papua New Guinea.

For DXers, perhaps the easiest station to hear is the NBC National outlet, designed to cover the entire country, broadcasting from Port Moresby on 4,890 kHz. Its programs, in English and pidgin languages, can be heard nearly daily here at DX Central. Other frequencies are 3,925, 5,985 and 9,520 kHz.

Often heard nearly as well is Radio East New Britain at Rabaul. Ex-GIs of WW-II vintage may recall Rabaul as a major enemy naval base; Japan's Gibraltar of the South Seas. The Rabaul station, like the rest of the NBC outlets apart from the National station, is designed to serve local and regional audiences. It transmits on 3,385 kHz in the 90 meter band.

Besides Rabaul, there are nine other NBC regional stations in the 90 meter band: 3,220, Radio Morobe at Lae; 3,245, Radio Gulf District, Kerema; 3260, Radio Madang District, Madang; 3,275, Radio Southern Highlands, Mendi; 3,290, Radio Central District, Port Moresby; 3,305, Radio Western District, Daru; 3,322.5, Radio Bougainville, Kieta; 3,335, Radio East Sepik, Wewak; and 3,360, Radio Milne Bay, Alotau. The first five transmit with two kilowatts of power each; the remainder use 10,000 watts and are usually somewhat easier to hear.

The real Papua New Guinea DX targets —considerably harder to hear, but all logged Stateside by SWLs during the past few months at one time or another—are the six NBC stations in the 120 meter band.

They are: 2,340, Radio West New Britain at Kimbe; 2,376, Radio Chimbu at Kundiawa; 2,410, Radio Eastern Highlands at Goroka; 2,428, Radio New Ireland at Kavieng; 2,450, Radio Western Highlands at Mt. Hagen; and Radio Northern District at Popondetta, which operates on 2,468 kHz. All six broadcast with two kilowatts power.

These NBC stations are supposed to be joined by three more in the future: Radio West Sepik at Vanimo; Radio Manus at Lorengau; and Radio Enga at Wabang.

Papua New Guinea is one of those fascinating countries for shortwave listeners that offers a wide range of listening targets, ranging in DX-ability from very easy to very difficult.

So why not see how many of the NBC stations you can "harim?"

DX News Briefs. DXers do their darndest to keep up with the developing world of shortwave broadcasting. But nearly every year, it seems, some exciting new station comes on the air unexpectedly and catches even those who pride themselves on knowing what's happening by surprise.

In 1974, the "surprise" station was the American Forces Antarctic Network's shortwave operation at McMurdo on the frozen southernmost continent. It came as

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DX CENTRAL

a shock when Down Under DXers in Australia and New Zealand began reporting this new shortwave outlet on 6,012 kHz.

Just about a year ago, North American DXers began receiving this station on a few occasions. And those who had no luck in hearing it last season are regularly checking the frequency, between about 0800 and 1100 GMT, right now.

The surprise of the early DX season this year has been a new Mid-East shortwaver, Rado Oman, located at Muscat in the Sultanate of Oman on the tip of the Arabian peninsula. As was the case with AFAN in '74, DXers had no advance information about the new station in Oman.

The first word about Radio Oman broke early in September when the British Broadcasting Corporation's Monitoring Service reported its professional monitors had heard test broadcasts from the new station. This was followed by reports of reception by listeners in Pakistan and Australia. As of this writing, the station has not been heard in North America, but it seems only a matter of time before it is.

The original test transmission schedule was as follows: 0500 to 0815 GMT on 6,174 kHz; 0600 to 0815 and 1400 to 1600 GMT on a nominal frequency of 4,886 kHz (but actually reported by the BBC monitors to be on 4,962 kHz); and 1300 to 1700 GMT on 11,890 kHz. As these were merely tests, in English and Arabic languages, they can be expected to vary in times and, perhaps, frequencies as well.

The announced address of the station is: Technical Director, Ministry of Information and Culture, Post Office Box 600, Muscat, Sultanate of Oman.

But not all the news is good these days. Thousands of SWLs must be dismayed by word that one of the more popular DX-oriented programs, Radio Canada International's DX Club is no more. The public announcement of the termination of the club and the DX program was made at the convention of the Association of North American Radio Clubs, co-hosted by RCI, in Montreal late in the summer. Apparently the economic situation played a major role in the decision.

At the same time, RCI declared a moratorium on QSLing that will last until sometime next spring. During this period, Radio Canada International will not be verifying SWL's reception reports.

By unhappy coincidence, it seems that Radio Australia's verification policy has also been affected by economic conditions. RA has advised some listeners that staffing problems have delayed the sending out of QSLs. However, hopefully by the time you read this, QSL cards will again be flowing out from Australia to SWLs in the U.S. and around the world.

Bandsweep. Frequencies in kHz, times in GMT: **780**—ZBVI, "The Mighty Zed" is a medium wave outlet heard by a number of BCB DXers in the eastern half of the North American continent. It is located at Roadtown, Tortola in the British Virgin Islands. Listen for this one about 1000 when it signs on. . . . **1,020**—For our western BCBers, another "Zeder" (Zed is the way our British friends pronounce the letter "Z") is ZCO on the island of Tonga in the Pacific. Early Monday morning may be the best time to try. . . .

2,510—The 120 meter band is a rough spot to DX. One DX target many veteran listeners are hunting—with occasional success—is the domestic home service outlet of the Korean Broadcasting Service at Taegu. Try for this one about your local dawn, but it will be tough. . . . **4,775**—Afghanistan is one of those Asian countries that, to most DXers, is considered exotic and intriguing. It isn't the easiest country to hear on shortwave, but during the heart of winter, listen for its 1400 sign on. . . . **4,945**—Considerably easier and much closer to home is Radio Colosal, a Colombian shortwaver that normally puts a nice healthy signal into North America. Programming is typically Latin American and announcements are in Spanish. It is fairly easy to identify if you listen for its name, pronounced, "ko-lo-SAHL.". . . . **6,025**—Portugal has been in the news regularly lately. And a good bet for SWLs is Radio Portugal's English language programs from 0230 until 0300. . . . **7,270**—"How can I hear Poland?" We've received that query from a number of readers lately. Well, try the Polish Radio's program, at least part of it in English, at 0300. . . . **9,525**—Perhaps not as widely known as other U.S. private shortwave operations, such as WINB or KGEI, is Family Radio, WYFR. This is a religious-orientation station headquartered in Oakland, CA, although its transmitters are in Massachusetts. You might try the English program at 0100 to 0245. . . . **15,160**—Radio France is another of those international broadcasters that, it seems, many SWLs are looking for. English programs on RFI are rather uncommon, but your best bet is during the transmission to Africa at 1745. . . .

(Credits: Michael Willis, Australia; Bob McCoy, Nebraska; Bill Sparks, California; Sandy Eichenhorn, Michigan; Hadley Cress, Virginia; National Radio Club, P.O. Box 127, Boonton, New Jersey 07005; North American SW Association, P.O. Box 13, Liberty, Indiana 47353).

Backtalk. DX Central reader Ed Malcik of Austin, Texas, writes: "Not speaking Spanish it has bothered me for a long time that I have not been able to get a good verification from a Mexican station because they had no English programs.

"But not any more. At 2050 GMT one recent Sunday I listened to a broadcast from XERMX, Radio Mexico on 15,385 kHz. After some orchestral music, the announcer spoke in English: 'This is a special broadcast of Radio Mexico.'

"He asked for reports to Radio Mexico, P.O. Box 20620, Mexico D.F."

Ed notes that the station promised to send listeners a "banner of Radio Mexico" and several Mexican maps.

Okay, gang, if you need Mexico, take Ed's tip. These English announcements

(Continued on page 89)

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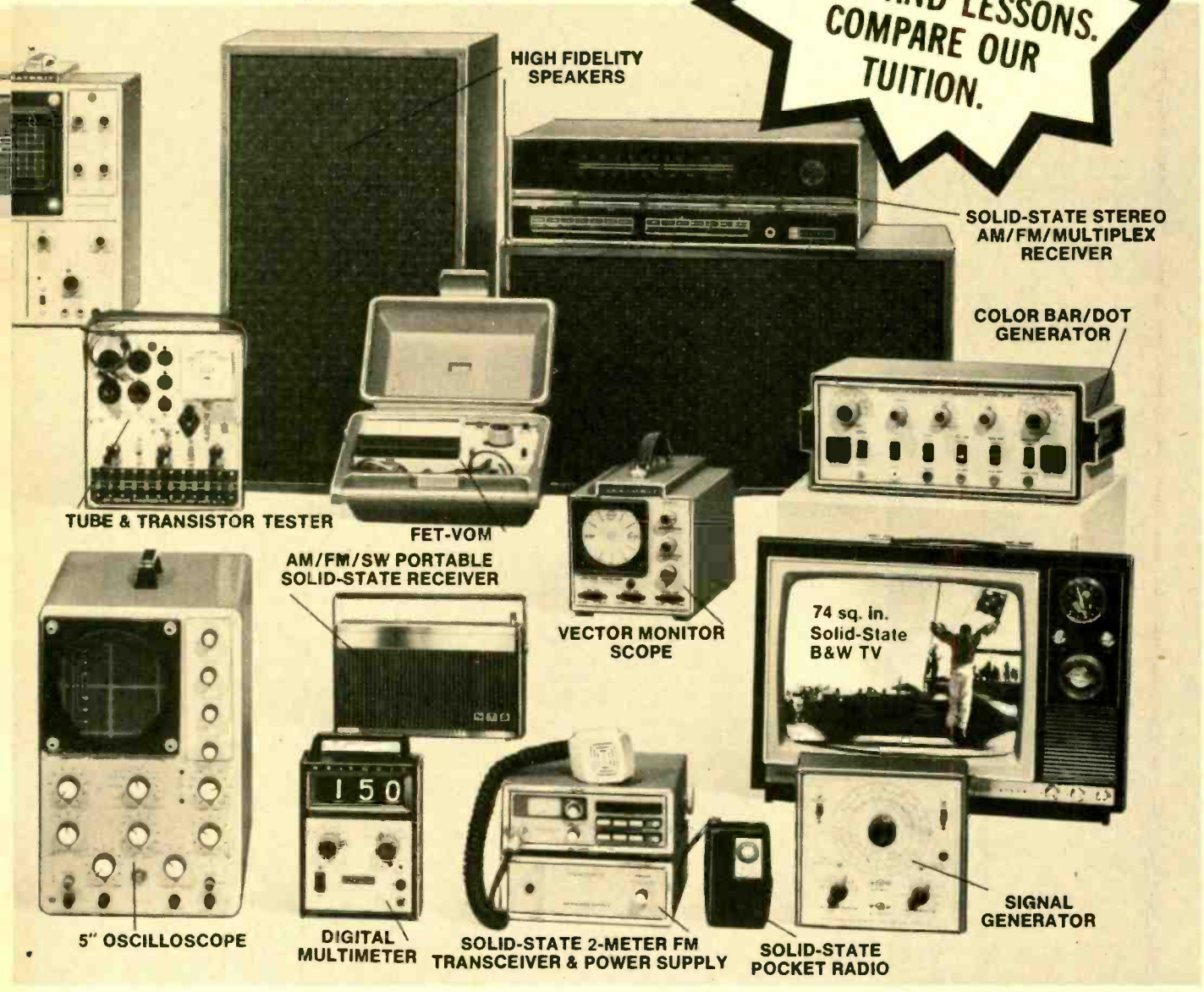

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ASK HANK, HE KNOWS!

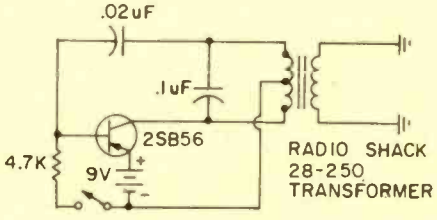
Got a question or a problem with a project—ask Hank! Please remember that Hank's column is limited to answering specific electronic project questions that you send to him. Personal replies cannot be made. Sorry, he isn't offering a circuit design service. Write to:

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

I'll Squeal!

The schematic diagram I am sending you (see below) can be heard without a loudspeaker or headphone. It just squeals by itself. Why?

—K. C., Oroville, CA



The transformer is taking up most of the battery's energy in this circuit by rattling the iron ore laminations. You see, inexpensive transformers have their laminations clamped tightly by a sheet-metal cover. This is good enough for low power circuits. However, if the clamp is not tight, the laminations shake apart each cycle of the oscillating signal producing an audible sound. The reason the laminations separate ever so slightly is because small eddy currents magnetize each lamination alike causing like magnetic properties, thus forcing the laminations apart. Better transformers are securely bolted together (or riveted) producing almost no sound. Sometimes you can hear a 60 or 120 cycle hum coming from a power transformer in a TV set for the same reason.

Worst Class Mail

How come it took over 3 months for me to get information I requested by circling a number on one of your coupons? Tell it like it is, Hank!

—D. W., Amarillo, TX

It took three weeks to get your letter of compaint. If I were to forward it to my brother-in-law in Chicago and he were to answer it, that would chew up another 3 + 3 weeks for a grand total of nine weeks—more than two months. We can't control the mail—that's as straight as I can give it. But don't give up! We have a new computer service here in New York that will speed up the process and chop a few weeks off the time. Believe me, the Editors of ELEMENTARY ELECTRONICS want you to get your requested material as soon as possible.

Who Asked You to Ask Him?

Where can I get a Signetics 555 type C integrated circuit? My TV repairman doesn't carry any and he said they do not make them anymore!

—P. A., Harve A.F.B., MT

The guy who fixed my oil burner said the same thing. To get most popular IC types, visit your local Radio Shack, Lafayette Radio, electronic parts center, or look up mail order advertisers in ELEMENTARY ELECTRONICS. The 555 is the hottest pegboard item in hobby electronic stores today.

You're Welcome

I want to thank you for printing my inquiry for information on a Remler Amplifier. I have had seven replies from good old timers with the information I needed. I have written each a note of thanks. That is what makes ELEMENTARY ELECTRONICS *something "special."*

—F. H. H., Bakerstown, PA

Well, thank you for the thank you. I am happy our readers are lending a helping hand. Bless 'em all.

CB FM OK Maybe?

I just spent $440.00 on a Pearce-Simpson SSB/AM Simba base station. Now I hear talk of CB going FM. Even though this is going to happen, there are so many AM CBers that AM won't be wiped out. Yet, still people tell me FM is better. Give it to me straight, man, did I blow my money for nothing? Should I have held off and bought an FM set?

—M. D. G., Totowa Borough, NJ

You could have waited for FM to come to CB and kept your money in the bank during that time. The interest may bring up the deposited sum to over $1,000. That's some wait. FM for CB is still a long way off. Enjoy your Simba.

Tuff to Believe

Hank, I am a subscriber and an avid reader of ELEMENTARY ELECTRONICS. *I need your help in deciding whether or not to order a Barlow Wadley XCR-30 shortwave receiver. Is it a good receiver? Should I buy it? Please answer by air mail. Thanks.*

—M. H., W. Hurley, NY

First, I don't answer the mail except in this column, so don't ask me to. Next, if you are a subscriber, and an avid reader of ELEMENTARY ELECTRONICS, how come you missed the review of the Barlow Wadley in the Sept./Oct. 1975 issue?

Want to Build Dolby

I want to build my own outboard Dolby unit for audio use. Where can I get the plans?

—J. J., Camillus, NY

No way as far as I know. I have never seen exact circuit details published by Dolby or any magazine. Does anyone have the plans?

Strange Couple

My roommate claims that my CB is

(Continued on page 86)

7400N TTL

SN7400N	.16	SN7451N	.27	SN74151N	1.25
SN7401N	.16	SN7453N	.27	SN74153N	1.35
SN7402N	.21	SN7454N	.41	SN74154N	1.25
SN7403N	.16	SN7459A	.25	SN74155N	1.21
SN7404N	.21	SN7460N	.22	SN74156N	1.30
SN7405N	.24	SN7470N	.45	SN74157N	1.30
SN7406N	.45	SN7472N	.39	SN74160N	1.75
SN7407N	.45	SN7473N	.45	SN74161N	1.45
SN7408N	.25	SN7474N	.45	SN74163N	1.65
SN7409N	.25	SN7475N	.80	SN74164N	1.65
SN7410N	.20	SN7476N	.47	SN74165N	1.65
SN7411N	.30	SN7480N	.50	SN74166N	1.70
SN7412N	.42	SN7482N	1.75	SN74167N	5.50
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SN7420N	.21	SN7490N	.59	SN74176N	.90
SN7421N	.39	SN7491N	1.20	SN74177N	.90
SN7423N	.37	SN7492N	.82	SN74180N	1.05
SN7425N	.43	SN7493N	.82	SN74181N	3.55
SN7426N	.31	SN7494N	.91	SN74182N	.95
SN7427N	.37	SN7495N	.91	SN74184N	2.30
SN7429N	.42	SN7496N	.91	SN74185N	2.20
SN7430N	.26	SN74100N	1.25	SN74187N	6.00
SN7432N	.31	SN74107N	.49	SN74190N	1.50
SN7437N	.47	SN74121N	.55	SN74191N	1.50
SN7438N	.40	SN74122N	.49	SN74192N	1.50
SN7439A	.25	SN74123N	1.05	SN74193N	1.40
SN7440N	.21	SN74125N	.60	SN74194N	1.45
SN7441N	1.10	SN74126N	.81	SN74195N	1.00
SN7442N	1.08	SN74137N	3.00	SN74196N	1.25
SN7443N	1.05	SN74141N	1.15	SN74197N	1.00
SN7444N	1.10	SN 74142N	6.50	SN74198N	2.25
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CD4016	.56	CD4053	2.98	74C154	3.00
CD4017	1.35	CD4060	3.25	74C157	2.15
CD4019	.55	CD4066	1.75	74C160	3.25
CD4020	1.49	CD4069	.45	74C161	3.25
CD4022	1.25	CD4070	.45	74C163	3.00
CD4023	.25	CD4071	.45	74C164	3.25
CD4024	1.50	CD4081	.45	74C173	2.60
CD4025	.25	CD4082	.45	74C193	2.75
CD4027	.69	74C00N	.39	74C195	2.75
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LM305H	.95	NE510K	6.00	LM3900N	.55
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LM308H	1.00	NE536T	6.00	LM5556N	1.85
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LM309K	1.25	NE553	2.50	LM7528N	2.70
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LM319N	1.30	NE567N	1.25	75451CN	.39
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LM320K-5	1.35	LM703CN	.45	75453CN	.39
LM320K-5.2	1.35	LM709H	.29	75454CN	.39
LM320K-12	1.35	LM709N	.29	75491CN	.79
LM320K-15	1.35	LM710N	.79	75492CN	.89
LM323K-5	10.50	LM711N	.39	75494CN	.89
LM324N	1.80	LM723N	.65	RCA LINEAR	
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LM340T-5	1.75	LM741-14N	.39	CA3059	2.45
LM340T-6	1.75	LM742N	.79	CA3060	2.80
LM340T-12	1.75	LM747N	.79	CA3080	.85
LM340T-15	1.75	LM748H	.39	CA3083	1.60
LM340T-24	1.75	LM748N	.39	CA3086	.59
LM350N	1.00	LM1303N	.90	CA3089	3.25
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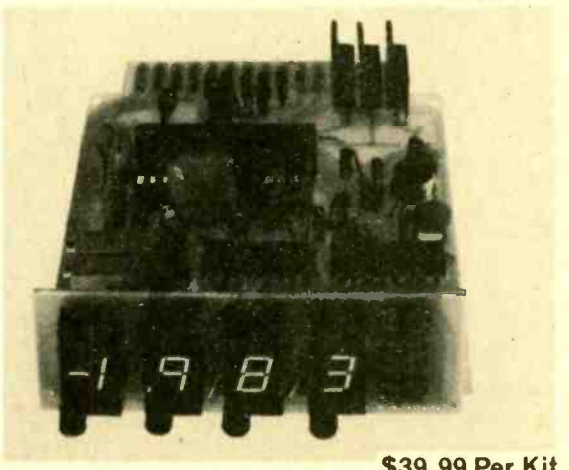
DIGITAL VOLTMETER JE801

DVM



$39.99 Per Kit SINGLE UNIT

GENERAL DESCRIPTION

The JE801 is a three and one half digit, auto polarity digital voltmeter, in a kit form. It features several options not available in any commercial digital voltmeter. Its low cost is perhaps the most important feature, which is achieved by offering it in a kit form. A kit allows the unit to be used by small OEM's where cost effectiveness is an important factor, and by the hobbyist who has to be concerned with cost. The unit also features on card regulators, allowing it to be operated off a single plus and minus fifteen volt, unregulated power supply. The unit has a small size of three inches width, three and three quarters of an inch length, and one and a quarter inch height.

DISPLAY LEDS

FND70	Com. Cath.	.250	.59
MAN 1	Com. Ano.	.270	$1.95
MAN 2	5x7 Matrix	.300	3.95
MAN 3	Com. Cath.	.125	.39
MAN 4	Com. Cath.	.187	1.95
MAN 7	Com. Ano.	.30	1.50
DL33	Com. Cath.	.125	1.95
DL747	Com. Ano.	.625	1.95

DISCRETE LEDS

MV 10	Red	5/$1.00
MV 50	Red	6/$1.00
MV 5024	Red	5/$1.00
MV 5024	Green	4/$1.00
MV 5024	Yellow	4/$1.00
MV 5024	Orange	4/$1.00
MV 50*	Red 1¼" Leads	5/$1.00

IC SOLDERTAIL – LOW PROFILE (TIN) SOCKETS

	1-24	25-49	50-100		1-24	25-49	50-100
8 pin	$.17	.16	.15	24 pin	$.38	.37	.36
14 pin	.20	.19	.18	28 pin	.45	.44	.43
16 pin	.22	.21	.20	36 pin	.60	.59	.58
18 pin	.29	.28	.27	40 pin	.63	.62	.61
22 pin	.36	.37	.36				

SOLDERTAIL STANDARD (GOLD)

8 pin	$.30	.27	.24	24 pin	$.70	.63	.57
14 pin	.35	.32	.29	28 pin	1.10	1.00	.90
16 pin	.38	.35	.32	36 pin	1.55	1.40	1.26
18 pin	.52	.47	.43	40 pin	1.75	1.59	1.45

WIRE WRAP SOCKETS (GOLD) LEVEL #3

10 pin	$.45	.41	.37	24 pin	$1.05	.95	.85
14 pin	.39	.38	.37	28 pin	1.40	1.25	1.10
16 pin	.43	.42	.41	36 pin	1.59	1.45	1.30
18 pin	.75	.68	.62	40 pin	1.75	1.55	1.40

50 PCS. RESISTOR ASSORTMENTS $1.75 per assort.

Each assortment contains 50 pcs. of ¼ watt, 5% resistors

ASST. 1	5 ea:	10 OHM- 12 OHM- 15 OHM- 18 OHM- 22 OHM	27 OHM- 33 OHM- 39 OHM- 47 OHM- 56 OHM		
ASST. 2	5 ea	68 OHM- 82 OHM 100 OHM-120 OHM-150 OHM	180 OHM-220 OHM-270 OHM-330 OHM 390 OHM		
ASST. 3	5 ea	470 OHM-560 OHM-680 OHM-820 OHM- 1K	1.2K	1.5K	1.8K	2.2K	2.7K
ASST. 4	5 ea	3.3K	3.9K	4.7K	5.6K	6.8K
		8.2K	10K	12K	15K	18K
ASST. 5	5 ea	22K	27K	33K	39K	47K
		56K	68K	82K	100K	120K
ASST. 6	5 ea	150K	180K	220K	270K	330K
		390K	470K	560K	680K	820K
ASST. 7	5 ea	1M	1.2M	1.5M	1.8M	2.2M
		2.7M	3.3M	3.9M	4.7M	5.6M

14 PCS. POTENTIOMETER ASSORTMENTS $9.95

Each assortment contains 14 pcs of 10 turn pots.

ASST. A 2 ea: 10 OHM-20 OHM-50 OHM-100 OHM 200 OHM-250 OHM-500 OHM

ASST. B 2 ea: 1K, 2K, 2.5K, 10K, 20K, 25K, 50K

ASST. C 2 ea: 50K, 100K, 200K, 250K, 500K, 1M, 2M

All pots are available in single unit quantities. $.99 ea.

DPST C & K ROCKER SWITCH

They are rated at 125 Vac @ 5A. They are excellent in application such as MicrocomPuter Panel Switches

Dim: 1"x 1"x ¾"

$0.69

PRIME INTEGRATED CIRCUIT ASSORTMENTS	ASST. 8	3 ea	SN7400	7401	7402	7403	7404	SSI/TTL	$5.95 ASST.
			SN7410	7430	7438	7440	7472		
	ASST. 9	2 ea	SN7447	7490	7451	74100	74121	MSI/TTL	$9.95 ASST.
			SN74145	74175	74180	74191	74193		
	ASST. 10	2 ea	CD4001	4002	4011	4012	4013	CMOS	$7.95 ASST.
			CD4016	4017	4019	4023	4030		
	ASST. 11	2 ea	LM301T	301N	307T	307T	309K	LINEAR	$10.95 ASST.
			LM311T	565T	567T	741T	741N		

MICROPROCESSOR COMPONENTS

8008 – $19.95 2102 – $2.95

	CPU'S			RAM'S		
8008	8 bit CPU	$19.95	1101	256x1	Static	$ 2.25
8080	8 bit Super 8008	149.95	1103	1Kx1	Dynamic	2.95
4040	4 bit 4080	39.95	2102	1Kx1	Static	2.95
	UARTS		2107	4Kx1	Dynamic	19.95
AY – 5	1013	6.95	7010	1Kx1	Mimos	79.95
	PROM'S		7489	16x4	Static	2.49
8223	32x8 Prom	3.00	8101	1Kx1	Static	7.95
1702A	2K E Prom	19.95	8111	1Kx1	Static	7.95
5203Q	2K E Prom	14.95	8599	16x4	Tristate	3.49
74S287	1Kx4 Prom	7.95	91L07	1Kx1	Low Power	3.95
	SR'S		7x200	256x1	Static	6.95
2401	2K DSR	9.95	74LS670	4x4	Register	3.95
2533	1K SSR	7.95	93410	256x1	Static	7.95

91L02	1K Static RAM Direct Replacement for 2102-1 with 40% Less Current Drawn	2.49

Vector General Purpose Logic CARD Board 14.95

*Very High Noise Immunity * Holds 12 ea. 14 pin DIPS *44 pin Edge Connection

THE KILOBYTE RAM CARD Per Kit $49.95

*Complete 1Kx8 Memory * High Noise Immunity Components *Single 5v supply *500NS Access Time & Kit includes sockets, ICS & Board

4 PDT SWITCHES, HIGH QUALITY P.B. TYPES .69

KITS EXAR ICS

XR-2206KA SPECIAL $17.95

Includes monolithic function generator IC, PC board, and assembly instruction manual.

XR-2206KB SPECIAL $27.95

Same as XR-2206KA above and includes external components for PC board.

TIMERS		**STEREO DECODERS**	
XR-555CP	SPECIAL $ .69	XR-1310P	$3.20
XR-320P	1.55	XR-1310EP	3.20
XR-556CP	1.85	XR-1800P	3.20
XR-2556CP	3.20	**WAVEFORM GENERATORS**	
XR-2240CP	SPECIAL 3.25	XR-205	8.40
PHASE LOCKED LOOPS		XR-2206CP SPECIAL	4.49
XR-210	5.20	XR-2207CP	3.85
XR-215	6.60	**MISCELLANEOUS**	
XR-567CP	1.95	XR-2211CP	6.70
XR-2567CP	SPECIAL 2.99	XR-2261	3.79

Special Requested Items

RC4194	Dual Track V Reg	$5.95	N8T97	$3.00	2533	$7.95
RC4195	±15V Track Reg	3.25	4024P	2.25	8263	5.95
F9368	Decoder	3.95	2513	11.00	8267	2.75
LD110/111	DVM Chip Set	29.00	2518	7.00	8288	3.15
CA3130	Super CMOS Op Amp	1.49	2524	3.50	8826	3.00
MC1408L7	A/D	9.95	2525	6.00	8880	1.35
F3341	FIFO	8.95	2527	5.00	7497	6.00

ZENERS–DIODES–RECTIFIERS

TYPE	VOLTS	W	PRICE	TYPE	VOLTS	W	PRICE
IN746	3.3	400m	4/1.00	IN4003	200 PIV	1 AMP	.10
IN751A	5.1	400m	4/1.00	IN4004	400 PIV	1 AMP	.10
IN752	5.6	400m	4/1.00	IN3600	50	200m	6/1.00
IN753	6.2	400m	4/1.00	IN4148	75	10m	15/1.00
IN754	6.8	400m	4/1.00	IN4154	35	10m	12/1.00
IN9658	15	400m	4/1.00	IN4734	5.6	1w	.28
IN5232	5.6	500m	.28	IN4735	6.2	1w	.28
IN5234	6.2	500m	.28	IN4736	6.8	1w	.28
IN5235	6.8	500m	.28	IN4738	8.2	1w	.28
IN5236	7.5	500m	.28	IN4742	12	1w	.28
IN456	25	40m	6/1.00	IN4744	15	1w	.28
IN458	150	7m	6/1.00	IN1183	50 PIV	35 AMP	1.60
IN485A	180	10m	5/1.00	IN1184	100 PIV	35 AMP	1.70
IN4001	50 PIV	1 AMP	.09	IN1186	200 PIV	35 AMP	1.80
IN4002	100 PIV	1 AMP	.10	IN1188	400 PIV	35 AMP	3.00

MPS A05	$/1.00	2N3567	$/1.00	2N4249	4/$1.00
MPS A06	$/1.00	2N3568	4/$1.00	2N4250	4/$1.00
2N2219A	3/$1.00	2N3569	4/$1.00	2N4400	4/$1.00
2N2221	4/$1.00	2N3704	5/$1.00	2N4401	4/$1.00
2N2222A	5/$1.00	2N3705	5/$1.00	2N4403	4/$1.00
2N2369	5/$1.00	2N3706	5/$1.00	2N4409	5/$1.00
2N2369A	4/$1.00	2N3707	5/$1.00	2N5086	4/$1.00
2N2411	5/$1.00	2N3711	5/$1.00	2N5087	4/$1.00
2N2906A	4/$1.00	2N3724	5.65	2N5088	4/$1.00
2N2907A	5/$1.00	2N3725	$1.00	2N5089	4/$1.00
2N2925	5/$1.00	2N3903	5/$1.00	2N5129	5/$1.00
2N3053	2/$1.00	2N3904	4/$1.00	2N5138	5/$1.00
2N3055	5.89	2N3905	4/$1.00	2N5139	5/$1.00
MJE3055	5.49	2N3906	4/$1.00	2N5209	5/$1.00
2N3397	5/$1.00	2N4013	3/$1.00	2N5961	5/$1.00
2N3398	5/$1.00	2N4014	3/$1.00	C106B1 SCR	2/$1.00

TRANSISTORS

CAPACITOR CORNER

50 VOLT CERAMIC DISC CAPACITORS

	1-9	10-49	50-100		1-9	10-49	50-100
10pf	.05	.04	.03	.001	.05	.04	.035
22 pf	.05	.04	.03	.0047	.05	.04	.035
47 pf	.05	.04	.03	.01	.05	.04	.035
100 pf	.05	.04	.03	.022	.06	.05	.04
220 pf	.05	.04	.03	.047	.06	.05	.04
470 pf	.05	.04	.035	.1	.12	.09	.075

100 VOLT MYLAR FILM CAPACITORS

.001mf	.12	.10	.07	.022mf	.13	.11	.08
.0022	.12	.10	.07	.047mf	.21	.17	.13
.0047mf	.12	.10	.07	.1mf	.27	.23	.17
.01mf	.12	.10	.07	.22mf	.33	.27	.22

± 20% DIPPED TANTALUMS (SOLID) CAPACITORS

1 35V	28	23	17	15 35V	30	.26	21
15 35V	28	23	17	22 25V	31	.27	22
22 35V	28	23	17	33 25V	31	.27	22
33 35V	28	23	17	47 25V	32	.28	23
47 35V	28	23	17	68 25V	36	.31	25
68 35V	28	23	17	10 25V	40	.35	29
10 35V	28	23	17	15 25V	63	.50	.40

MINIATURE ALUMINUM ELECTROLYTIC CAPACITORS

	Axial Lead				Radial Lead			
.47	50	15	.13	.10	.47	25	15	13	10
1	50	16	.14	.11	.47	50	.16	14	11
3.3	50	15	.13	.10	1	16	.15	13	10
4.7	25	16	.14	.12	1	25	.16	14	11
10	25	15	.13	.10	1	50	.16	14	11
10	50	16	.14	.12	4.7	16	.15	13	10
22	25	17	.15	.12	4.7	25	.15	13	10
22	50	24	.20	.18	4.7	50	.16	14	11
47	25	19	.17	.15	10	16	.14	12	.09
47	50	25	.21	.19	10	25	.15	13	10
100	25	24	.20	.18	10	50	.16	14	12
100	50	35	.30	.28	47	50	.24	21	19
220	25	32	.28	.25	100	16	.19	15	14
220	50	45	.41	.38	100	25	.24	20	18
470	25	33	.29	.27	100	50	.35	30	28
1000	16	55	.50	.45	220	16	.23	17	.16
2200	16	70	.67	.55	470	25	.31	.28	.26

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Big, bright, white numbers you can see from any angle, even across the room. Adjustable in brightness. Positionable anywhere on the screen. Adjustable for time duration of up to 1½ minutes or they can remain on all the time, at your option. The numbers change as you change channels. No other channel readout is as convenient.

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100% Solid-State

And more integrated circuits than any. The only tube in these sets is the picture tube. This sophisticated circuitry gives you less interference, truer colors, more precise, reliable tints, improved sensitivity, greater noise immunity, and better picture definition. Solid long-life performance.

The Differences

Tuning. In the 25v and 21v sizes, you get Total Electronic Touch Tuning. Silent varactor tuners, no moving parts. A programmable digital counter controls the tuning—sweeping up or down the 16 preselected channels. And remote control of all functions is just $89.95. In the small screen sizes, the tuning is all-channel detent type.

One-Button Picture Control in the three smaller sets restores brightness, contrast, color and tint to pre-set levels at the touch of a button. Child-proof performance.

Latest-design Picture Tubes. In the two larger sets you enjoy brighter pictures with greater contrast thanks to the deluxe Black (negative) Matrix tubes. The three table models use picture tubes with the new precision in-line gun and slotted shadow mask for greater light output and picture realism.

Easier to build and service.

Plug-in circuit modules and wiring harnesses make these sets the easiest to build of all. And the new digital-design Dot Generator, slide-out Service Drawer and Test Meter make self-service easier.

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Send for your free Heathkit catalog, choose the model you prefer. Then compare it with any brand — we think you'll agree you get more for your money with Heathkit Digital-Design Color TV.

For as low as $399.95, you can enjoy Heathkit Digital Design Color TV.

NEW High Fidelity AM/FM Table Radio

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NEW Programmable Electronic "Doorbell"

Put a song at your doorstep with this unique kit. Program it to play your favorite song. C through C' "keyboard" with plug-in leads for up to 16 notes. Change your tune when you wish to celebrate a season, anniversary, birthday, or special party. One watt sound power; controls for tuning, volume, speed, and decay characteristics. Kit TD-1089, $44.95

NEW versatile, low cost 5-digit counter

Measures frequency from 5 Hz to 30 MHz, period to 99.999 seconds, counts events to 99,999, and it will operate on 120 VAC or 12 VDC. As a freq. counter it will resolve to 1 Hz; sensitivity is 15 mV above 50 Hz, 50 mV below 50 Hz. In the period mode, it will resolve to 1 msec. Has Overrange indicator; gate lamp; 3-position input attenuator; 10 MHz time base. Kit IM-4100, $129.95

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Heath proudly introduces MODULUS. The totally modular music system that enables you to make of it what you will, change it when you like. With complete freedom. Without obsolescence.

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Your MODULUS custom music system begins with Module I, the AN-2016 Digital AM/FM Tuner/Preamplifier. A superb FM tuner with sophisticated circuitry and exceptional specifications (four ½" LEDs display frequencies; dual JFET, 4-gang tuner with 1.7 μV sensitivity; digital discriminator; LC IF filter with over 100 dB selectivity; phase-locked loop multiplex with over 40 dB separation). AM you'll really enjoy hearing (dual-gate MOSFET tuner and mixer stages; computer-designed 9-pole LC IF filter for no alignment; shielded loop antenna). A superlative preamplifier that functions in stereo or 4-channel modes with specifications unlike any component we've ever offered. Distortion below 0.05% even at full output. Hum and noise are 80 dB below a 0.25 v. input even in the high-level section. A phono preamp with over 94 dB dynamic range — better than most records! Versatile control center. Special speaker protecting circuitry. Four lighted output meters with 40 dB dynamic range. Separate bass, treble, and level controls for front and back channels. Master volume control. 21 pushbutton switches that light when activated. They include: output; inputs (stereo phono, CD-4, aux., tape, tape monitor, dubbing AM and FM); mode (mono, stereo front channels, stereo 4 channels, SQ, and discrete 4-channel); high filter; low filter; loudness; tone flat; squelch defeat; FM Dolby; and power. Use it as a tuner only, as a driver for your present power amps, as a control center for taping, so good you can even use it as a broadcast station monitor. Kit AN-2016, $599.95

Expand your MODULUS system with your choice of stereo power amplifiers. Module II is the medium power AA-1505. Module III is the high power AA-1506. 35 or 60 watts, min. RMS, per channel into 8 ohms at less than 0.1% distortion from 20-20,000 Hz. Styled to match the Module I tuner/preamp. Add one of either power level for a stereo receiver; add two for a 4-channel receiver. Kit AA-1505, $159.95; AA-1506, $179.95

Choose your mode and input. Module IV is the FM Dolby module AD-1504 for reduced noise and greater dynamic broadcast range ($39.95). Module V is the CD-4 Demodulator for the spacious sound of CD-4 discrete 4-channel records ($79.95). Module VI is the SQ Decoder for quadraphonic separation of matrixed material; full logic and variable blend ($49.95). All are housed inside the tuner/preamp module.

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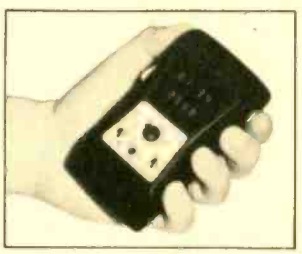
MODULUS is designed for you — the way you live — today and tomorrow. It can grow with you, adapt to your changing life style, flex with changing technology. Whatever your desires in music systems, now and later, MODULUS.

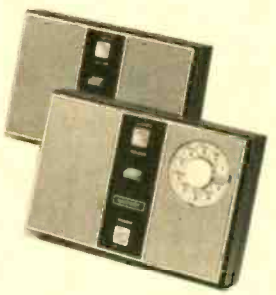
NEW 3-Way Speaker

Looks and sounds like it should cost $100 more! High performance 3-way system has a 10" woofer, 4½" mid-range, 1" dome tweeter. Drives with 10 watts, yet a super-power amp reveals its unusual dynamic range and high power handling capabilities. Enclosure has walnut veneer on all sides and front for use without the black foam grille. Tweeter and front-mounted switch plate are interchangeable for optimum imaging in horizontal or vertical position. Kit AS-1373, $149.95



NEW Digital Stopwatch

Programmable — for the time of your sporting life. You program in a time (up to 9 hours, 59 min., 59 secs.) and it will count *up* to that time or *down* from it to zero. Or it will count 99 hours, 59 mins., 59:99 secs. in the five other functions which include: Start/Stop Elapsed; Sequential; Total Activity; Split; & Start/Stop Activity. 8 digits & 2 IC counters with accuracy to ±0.003% & resolution to 1/100th second. Jacks for external trigger and alarm. Includes nickel-cad. batteries & charger. Kit GB-1201, $99.95



NEW 2-Way Telephone Amps

Amplified "talk" and amplified "listen", with or without dialer. Real hands-free convenience — use from 10' away. VOX control silently switches from built-in microphone to speaker without clipped words or feedback squeals. GD-1112 works with regular phone. GD-1162 with built-in dial and electronic ringer works like an extension phone. Easy to build, convenient for use at home or office. Kit GD-1112, $49.95; Kit GD-1162, $69.95.

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Electronics in the News!

CB Is For Everyone

"CB Radio is my security blanket. . . . I've used it in my car as well as in my home to call for help on more than one occasion. It's better than an insurance policy."

That's the way Sheryl Kovatch, an employee of the Antenna Specialists Company in Cleveland, described her two-year-old love affair with CB radio. Her most recent use of CB involved herself, her in-laws, and the Cleveland Police.

Mrs. Kovatch's father-in-law and mother-in-law were being taunted by some teenagers who had been dumping garbage on their front lawn. One of the youths started hitting the elderly couple with a nightstick, but fled when he heard the Police had been called.

When the Police got there, the gang was long gone. Mrs. Kovatch filed a report and then broadcast a description of the youths' car on her CB. Within minutes, it had been spotted by CBers. Mrs. Kovatch passed the information on to Police who quickly apprehended the young man. Mrs. Kovatch's story received wide publicity within the area, but to her, it was just another routine use of CB. *(Continued on page 86)*

Sheryl Kovatch and the Antenna Specialists Model M-176 antenna she installed on her car. Mrs. Kovatch does all of her own antenna assembly and installation work.

The Defender stands guard over super CB performance

This precision-built test console gives Knights of the Road full command of base station clarity and talk power. It provides constant control of SWR and a constant check on power output and modulation.

SWR adjustments can be made on-the-spot to bring out top performance every time you're on the air.

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CIRCLE 17 ON READER SERVICE COUPON

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Q. What about the job market in electronics?

A. It's good. In fact, it seems to be one of the few fields that stays relatively steady in bad times. Today, for example, estimates indicate that several thousand jobs will be opening up for electronics technicians each year, for years to come. One reason for this is the fact that electronics are the basis of almost all communications, and this is a communications-oriented nation.

Q. What kind of jobs are you talking about?

A. For example, there are jobs available in electronic/industrial automation, electronic equipment repair and servicing, in the broadcast and radio telephone communications field, at airports, and even in medicine and in hospitals, where electronics is rapidly increasing in importance. And there are hundreds of other jobs opening up as electronics continues to make great strides, in new ideas and developments.

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Q. Can such a complicated subject as electronics be successfully taught by the home-study method?

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Q. But I have a job, and as much as I would like to get into electronics, I can't afford to take time off. How do I get around that?

A. You don't have to take time off from your job. You study at home, in your free time. We do advise, however, that you set aside a certain time for your study schedule and stick to it, even if it's only a couple of hours a day. The beauty of the ETI way of learning is that you work at your own pace, making sure you've completed your assignment thoroughly and completely. We think you'll find, as you go along, that learning the ETI way can be fun.

Q. How do my assignments come to me?

A. They are sent to you one at a time. You work on each in the comfort of your home, at a pace that is comfortable and convenient to you. If you feel you need more time, you can go back over the material until you've mastered every point of information. Then you take a brief exam, which helps you to fix the information even more firmly in your mind. This exam is mailed back to ETI, where your instructor reviews it, and makes comments and suggestions that will be particularly valuable when you take up your next assignment.

Q. How long does all this take?

A. If your instructor receives your examination in the morning, in most cases he will have graded it, added his comments and have it on the way back to you that same afternoon. Service like this helps speed up your learning process—keeps your interest high—and puts you closer to your goal, the coveted ETI diploma.

Q. But I was never very big on books and study. I like to work with my hands.

A. With your ETI course, you'll get plenty of work with your hands. In fact, the ETI system of teaching combines hands-on work with study, so that you actually learn by doing. As you move along developing your technical knowledge, you will use, in many phases, specially developed Project Kits. So you apply your knowledge in logical, hands-on sequences, from the first step through completion of basic units.

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A. We wouldn't want you to. In fact, we insist that you check it out first. All you do is fill out the card or coupon and mail it to us. We'll send you a colorful new 48-page ETI Career Book that will give you the facts and the many opportunities ETI can open up for you. If you like electronics, you'll enjoy reading this book.

Q. Do I obligate myself in any way by sending for your book?

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CIRCLE 21 ON READER SERVICE COUPON

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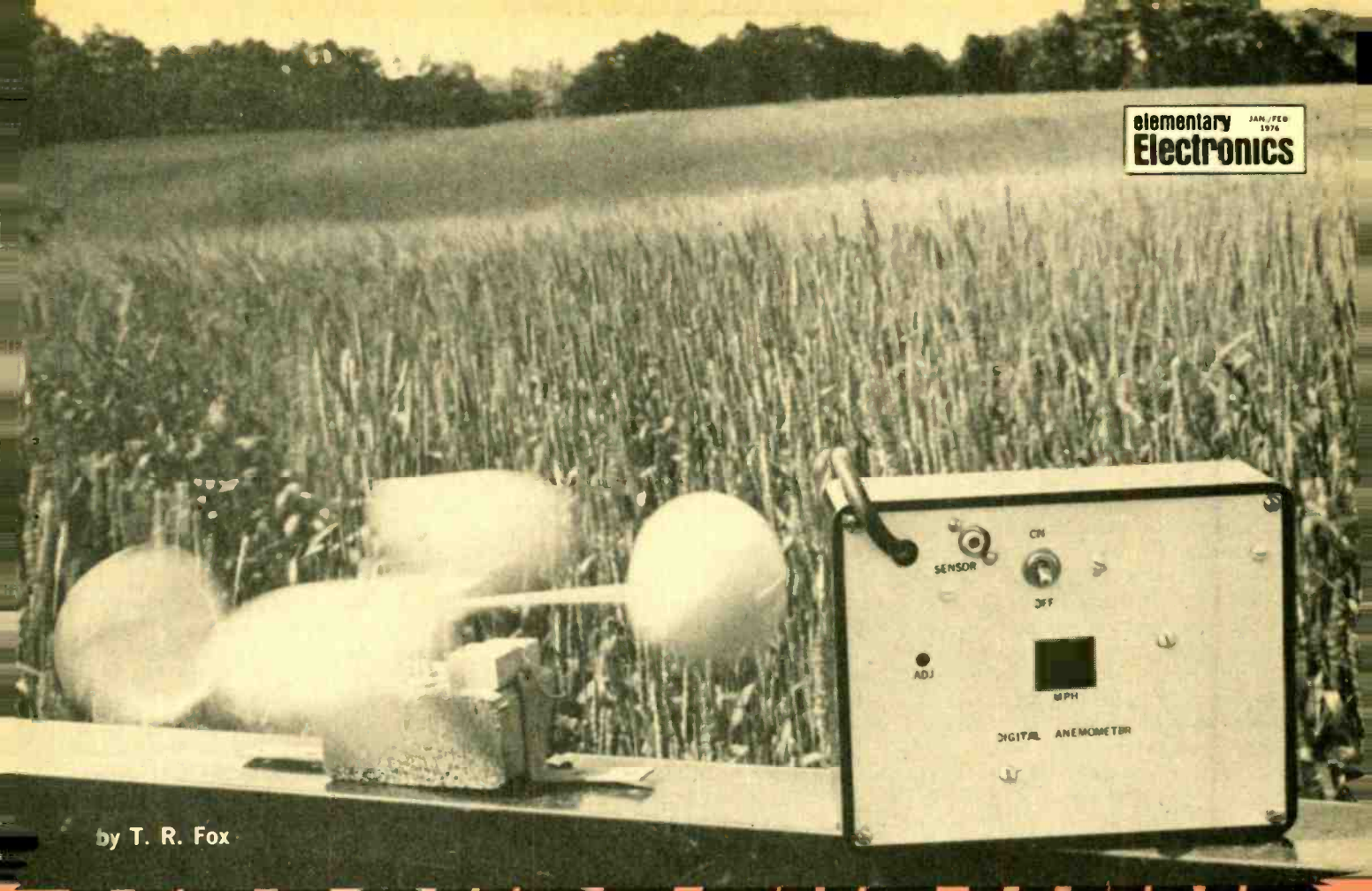


by T. R. Fox

MEASURE THE WIND!

Easy-to-wire, accurate, anemometer uses ICs and LED-readout.

Increasing energy costs have driven many people to thinking of alternate sources of power, such as solar energy and water power. But the technology for these natural energy sources is still quite expensive and complicated to install. It'll be at least several years before the cost of most natural energy systems comes down enough and the parts are easy enough for most people to install. Wind power for generating electricity, on the other hand, has been available for many years. For several decades farmers and others in rural areas have used windmill generators as standby electricity and in some cases, as their main power supply. Windmills and wind-driven electrical generators can be bought off the shelf by anyone, and require no expertise other than the usual home mechanic skills to set up.

Have you wondered if there's enough wind where you live to drive a windmill electrical generator? Do you know if there's enough wind to fly that big kite you've often thought of constructing? Is there enough wind coming over the hills near your area so you can get into hang-gliding? Or do you live in an area where tornadoes or hurricanes sometimes strike? If so, it could literally be a matter of life-and-death for you to read the windspeed easily, with an accurate, easy-to-install anemometer (windspeed meter). That's what the Digital Windspeed Meter is—an accurate anemometer using the latest digital TTL (transistor-transistor logic) integrated circuits.

Though this project isn't recommended for someone who's never built any solid-state projects before, it should be easy enough for anyone who has built one or two simpler projects such as most of those published in *Elementary Electronics*.

In addition, it's the sort of project which will get you started easily in digital logic circuitry, the circuits and components which are the basic building blocks of computers and most other advanced electronics today.

How Anemometers Work. There are two types of electronic anemometers in general use. One type uses air cups or a wind turbine to turn a tiny electric generator whose output is directly connected to a milliammeter. The faster the wind blows, the faster the generator turns and the higher the meter reads. This type of anemometer is simple and reliable but it usually is not accurate.

A more sophisticated type uses air cups to turn a shaft to produce electric pulses. The pulses are integrated by a capacitor and related circuitry to produce a DC voltage whose magnitude is directly proportional to the wind speed. This voltage is also displayed on a meter. This method is easier to calibrate, and thus is more accurate than the simple generator method. By

e/e DIGITAL WIND METER

Using state-of-the-art digital electronics, improvement can be made upon this method of measuring the wind's speed. Instead of the round-about method of adding up the electric pulses by charging up a capacitor, why not just count them directly? The digital anemometer described here does just that. The result is a more accurate sophisticated instrument that is easier to read and cheaper to build.

How It Works. The theory behind the digital anemometer is simple. See Fig. 1. The wind turns a shaft which has streamlined plastic cups attached to it. On one rod that holds two oppositely directed cups are placed two small magnets. A reed switch is mounted on the stationary base beneath the rotating cups so that it will be operated by the rotating magnets above. Each time the cups make a full revolution, the reed switch opens and closes twice. The pulses generated by this reed switch trigger a one-shot multivibrator (TTL-7412) which cleans up the pulses, eliminating contact-bounce and other error pulses. The cleaned-up pulses are then fed to a TTL NAND gate which is controlled by the 555 one-shot multivibrator. The 555's one-shot output pulse is manually adjustable to let us calibrate the anemometer. Another 555 astable multivibrator provides automatic triggering pulses for the 555 one-shot as well as supplying reset and blanking pulses for the counters and decoders. The resulting controlled and cleaned up pulses (which originated in the reed switch) are counted on two TTL decade counters and displayed on two LED displays.

Construction. The rotating wind sensor is made up of 4 plastic cups, mounted with 3/32-in. or 1/8-in. rods to a slot-car motor or similar cheap and readily available bearing. (The brushes of the motor can be removed if desired.) The egg-shaped containers in which *Leggs* nylons are sold are ideal for the plastic cups which catch the wind.

The rods which support the cups can be steel welding rods or (better) copper or brass. One rod should be one foot long and the other two should be six inches long.

Next, obtain a small cylindrical piece of a solid metal that is easily solderable —brass or copper is best. Drill two holes, using bits the same size as the rods, at right angles to each other through this cylinder of metal as shown in Fig. 2.

Now center the 12-in. rod in the cylinder. Insert the two shorter rods in the remaining two open holes in the cylinder, as shown in Fig. 3. Using acid-flux, solder the rods to the cylinder.

Mount the motor, which is used as the bearing, in a 2-in. long piece of two-by-four. To mount the motor, drill and file a hole in the wood large enough to take the motor. Cover the motor's case with epoxy glue and insert it in the hole as shown in Fig. 4.

Using a bit as close to the diameter of the motor's shaft as possible drill a hole about 1/2-in. deep in the bottom of the cylinder (see Fig. 3) which now has rods soldered to it. Insert the motor shaft into this hole and solder it, using acid-core flux.

(If steel is used, secure with epoxy glue.)

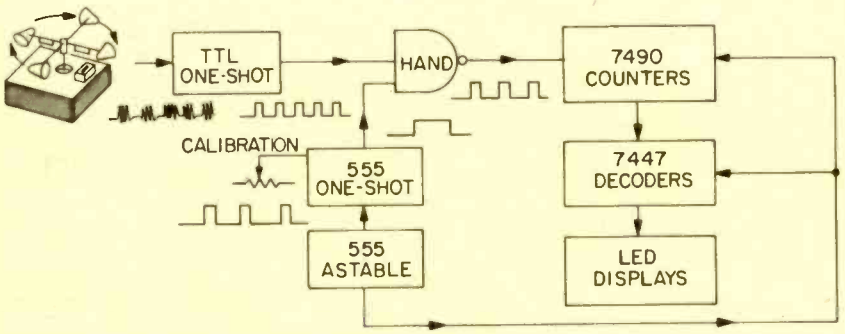
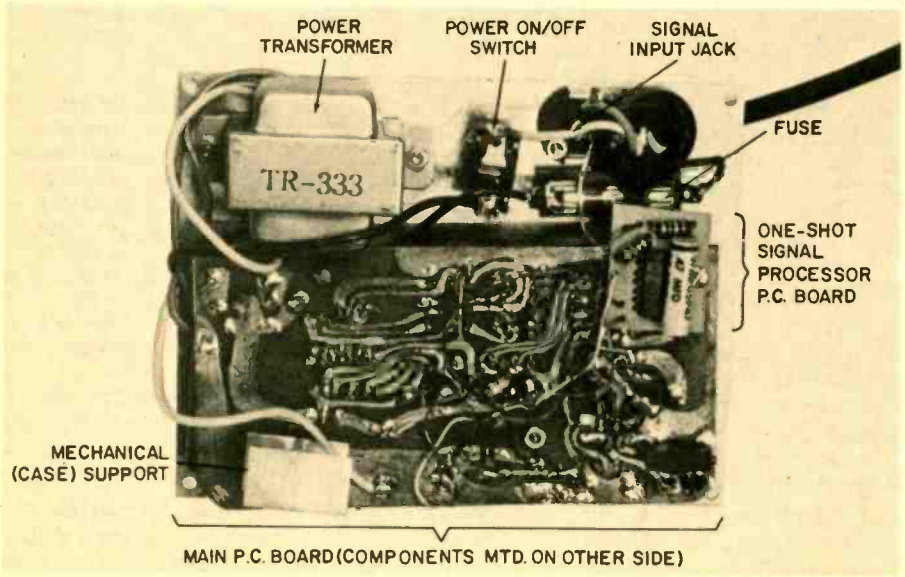


Fig. 1—Block diagram for digital anemometer. As the calibration control is varied it changes the duration of the pulse put out by the 555 one-shot. This acts as a variable window for the pulses coming from the windspeed sensor permitting accurate readout of the LEDs.



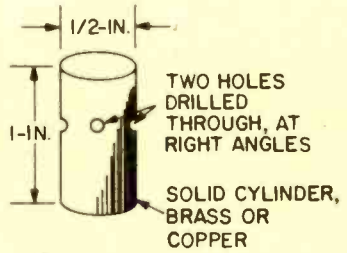


Fig. 2—Centerpiece of windspeed sensor.

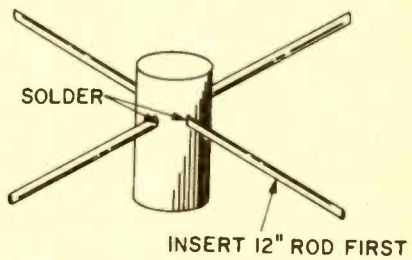


Fig. 3—Assembly of rods and centerpiece to form rotor.

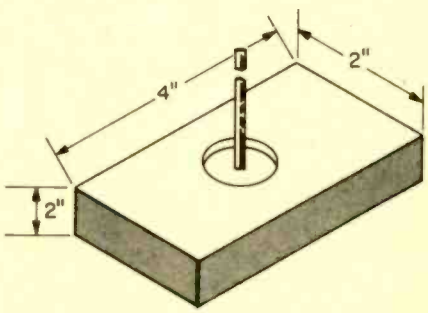


Fig. 4—Wood block mount with bearing.

Now mount the four plastic cups to the rod, taking care to correctly orient the cups. Drill holes in the cups and insert the rods in the holes. Keep the cups in place with epoxy or other good glue.

Next we mount the magnets on the rods. If copper or brass rods are used, great, just solder or glue the magnets to the undersides of two opposite rods, centering them one inch from the pivot. The reed switch is then mounted on the wood base so the magnets pass a quarter of an inch above it.

If the rod is iron or steel, we have a problem because it will distort the magnet's magnetic field. This problem is overcome by using a non-magnetic spacer between the magnet and the rod —¼-in. is enough space. A ¼-in. x 1-in. piece of wood is glued to the rod and then the magnet glued to the wood. Since there is very little weight involved, a good glue will hold the magnet fine. This completes the construction of the wind sensor.

Circuit Assembly. To build the cir-

(Continued on page 88)

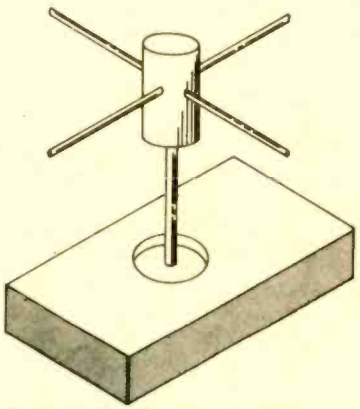


Fig. 5—Rotor in place on bearing.

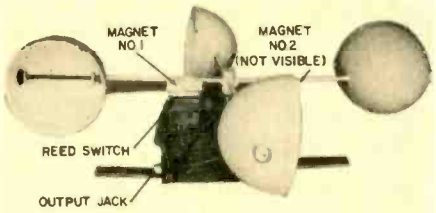


Fig. 6—Completed unit. Adjust height of reed switch so magnets pass about ¼-in. over it or less.

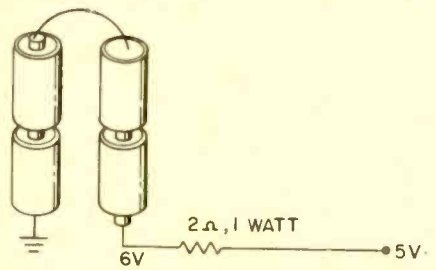
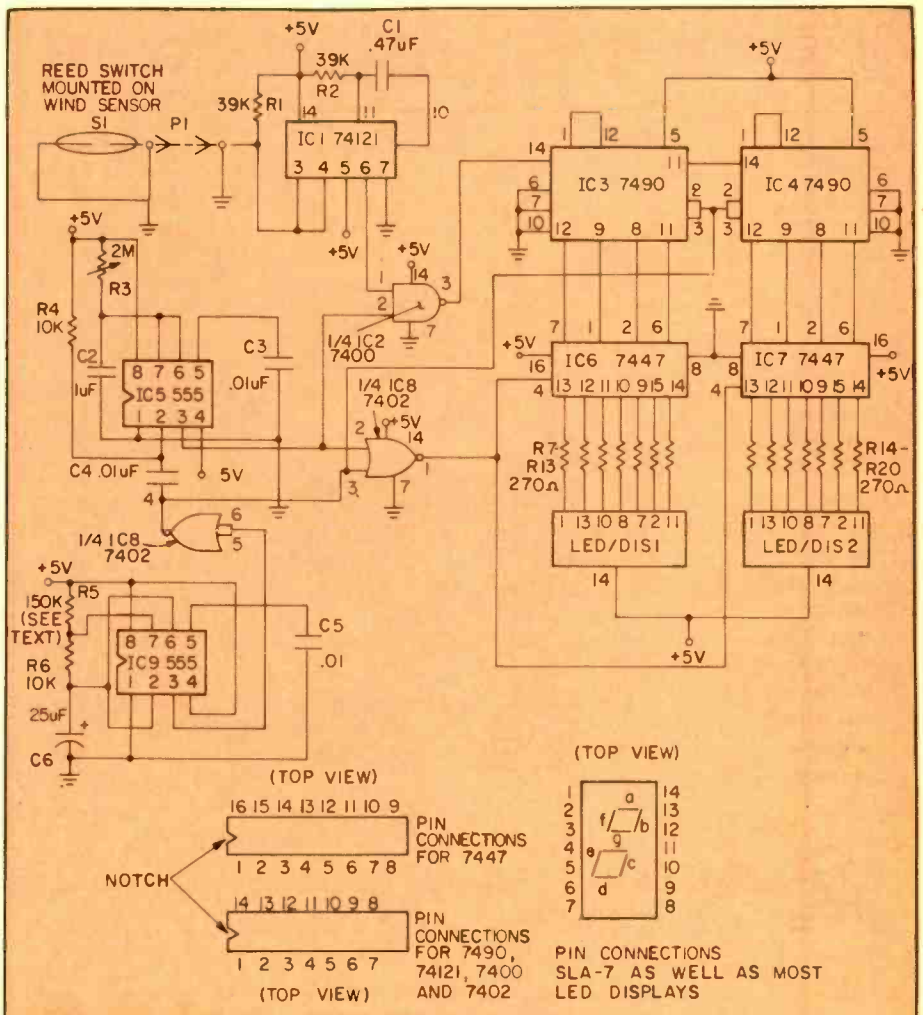


Fig. 7—Temporary battery power supply for use when calibrating the instrument in an automobile.



PARTS LIST FOR DIGITAL WIND METER

C1—0.47-uF, 50-VDC capacitor (Radio Shack 272-1054 or equiv.)

C2—1.0-uF, 50-VDC capacitor (Radio Shack 272-1055 or equiv.)

C3, C4, C5—0.01-uF, 50-VDC capacitor (Radio Shack 272-131 or equiv.)

C6—25-uF, 35-VDC or more electrolytic capacitor (Radio Shack 272-1014 or equiv.)

LED1, LED 2—LED display numerals (Radio Shack 276-053 or equiv.)

IC1—74121 monstable multivibrator integrated circuit, TTL type (Radio Shack 276-1814 or equiv.)

IC2—7400 NAND gate integrated circuit, TTL type (Radio Shack 276-1801 or equiv.)

IC3, IC4—7490 decade counter integrated circuit, TTL type (Radio Shack 276-1808 or equiv.)

IC5, IC9—NE555 integrated circuit (Radio Shack 276-1723 or equiv.)

IC6, IC7—7447 BCD-to-Decimal decoder, TTL type (Radio Shack 276-1805)

IC8—7402 NOR gate, TTL type (Radio Shack 276-1811 or equiv.)

P1—2-connector jack (& matching plug for cable) RCA-type phono plug recommended (Radio Shack 274-332 or equiv.)

R1, R2—39-K, ¼-watt resistor (Radio Shack 271-000 or equiv.)

R3—2-megohm printed circuit board-mounting potentiometer (Allied Radio 854-6287 or equiv.)

R4, R6—10-K, ¼-watt resistor (Radio Shack 271-000 or equiv.)

R5—150-K, ¼-watt resistor (Radio Shack 271-000 or equiv.)

R7—R20—270-ohm, ¼-watt resistor (14 needed) Allied Radio 824-270 or equiv.)

S1—miniature reed switch (Radio Shack 275-033 or equiv.)

Misc—Four plastic cups such as the containers Leggs stockings come in. Two small magnets such as the "Magic" magnets most hardware stores carry. One 12-in. and two 6-in. pieces of copper or brass rod, ⅛- or 3/32-in. diameter (Brookstone, Peterborough, NH 03458 can supply two 12-in. 3/32-in. brass rods at 25 cents each, plus 70 cents for postage & handling). One slot car motor or equiv.), for use as bearing. One piece of copper or brass rod about 1-in. long, ½-in. diameter (solid). One 2-in. piece of wood two-by-four. Epoxy glue, solder, mounting brackets (two) for wood block, screws. Ten IC sockets (Radio Shack 277-027 or equiv.)

PARTS LIST FOR TTL POWER SUPPLY

An ideal power supply for the Digital Wind Meter is the regulated power supply for TTL logic ICs described in ELEMENTARY ELECTRONICS Sept.-Oct. issue. If you want more details on its construction see page 78 of that issue.

ELDERLY CB'ERS FIGHT CRIME

CAN six CB walkie-talkies and a determined group of senior citizens deter crime? Definitely, says Lt. Neil Sullivan of the Hartford, Connecticut police department, provided they have a plan. There is a plan in Hartford's Asylum Hill neighborhood, and in the six months it's been in operation, it's cut crime in the area dramatically—by 80 per cent, according to some figures. In fact, Asylum Hill's Street Watchers program has been so successful that it's being tried in two other Hartford neighborhoods.

The beginning. Hartford's Street Watchers program got started when residents of a three-block area in Asylum Hill complained of sharp increases in purse snatchings and muggings in their neighborhood. The area, once one of the city's best residential neighborhoods, is located just across the street from the historic Mark Twain house. Many elderly people reside there. Recently, many of the fine older homes in Asylum Hill were torn down to make room for apartments or converted to rooming houses, which rented mostly to transients, and with the changing population came an increase in the incidence of street crimes.

City officials initially responded by putting more police into the area, but the increase in police protection seemed to have a negligible effect on the street crime rate. Residents continued to complain to their landlords, and eventually the Hartford Property Owners' Association went to the Hartford Institute for Criminal and Social Justice to see what could be done. The Hartford Institute recommended, instead of flooding the area with police personnel, an electronic surveillance network operated by the residents themselves.

"We came up with the CB walkie-talkie program almost at once," reports Megan O'Neill, the Institute's program director and developer of the Street Watchers program. "Originally, we wanted to supply building superintendents with the CB transceivers, and let the superintendents do the patrolling. But the superintendents wanted to be paid extra for patrolling two hours a night, and that factor became troublesome. Then we got the idea of going directly to the residents themselves, and the response was enthusiastic. They volunteered to do the patrolling, to work out a schedule, and it's been working well ever since."

Freedom of the Streets. "The idea is to make people feel safe on the streets after dinner, so that they can go shopping in the early evening hours while the stores are still open, or can stand around and socialize," says Bob Fedesco, the volunteer who coordinated the program last summer and manned the licensed base station. "We really don't catch many criminals. But the word is out that this isn't a good neighborhood to try anything in." And the fact is that people in the three-block area bounded by Woodland, Marshall and Niles Streets and Farmington Avenue *do* feel safe—at least while the Street Watchers are on duty. Knots of neighbors sit on their front lawns or front stoops to socialize, while just across the invisible boundaries the streets are empty after sunset.

Ms. O'Neill feels that a Street Watcher's program works best if a neighborhood association or block group takes it over. "In Asylum Hill, we created the program first, then an organization developed around it." Late in August, the program volunteers, the Institute, the community center and the police combined to sponsor an outdoor barbecue. The block party was financed by a

grant from Neighborhood Funding, a charitable foundation. For a nickel, residents could buy a hot dog, soft drink, cole slaw and potato salad to eat while they socialized with their neighbors. "Frankly, we were looking for volunteers," Ms. O'Neill said. "But the barbecue was a way of getting people in the neighborhood out onto the street in the evening where they could meet their neighbors and socialize. Volunteers seemed to emerge spontaneously from the community feeling which came from the party."

The beauty of the program, in Ms. O'Neill's view, is not only that it works, but also that it's inexpensive—particularly when there's a neighborhood organization or sponsoring group to provide office facilities. In Asylum Hill, the community center provides the office space and telephone. Fedesco was receiving $25 per week for his efforts until funds ran out late in the summer (he continued on a volunteer basis until college resumed in the fall), and the street watchers themselves are volunteers. The only cost is the cost of the equipment—one transceiver for each watcher, plus the CB base station. In one of the other Hartford neighborhoods considering the plan, the police department expect to provide the electronic equipment with funds from the LEAA.

Ms. O'Neill believes that another key to the success of the Street Watcher's program is keeping the area of coverage small. "The area covered by the Asylum Hill project is only three square blocks and we're not encouraging expansion by adding adjacent blocks, although that could happen," Ms. O'Neill continues. "What we are encouraging is the development of similar three-block areas elsewhere in the city, and that seems to be happening."

The Setup. Fedesco's base station consists of a Realistic TRC-101A 23-channel transceiver, a telephone and a tiny office in the Hill House Community Center. He's on duty from 6 to 8 PM each evening to monitor incoming calls from the three to six Street Watchers on duty at the same time. "Actually, I show up a few minutes early and take the walkie-talkies around to the Watchers who are scheduled to be on duty each evening. If somebody can't make it, I'm responsible for finding a substitute and making sure that he has a walkie-talkie," Fedesco says.

The remainder of the program's arsenal of CB equipment consists of six hand-held units donated by interested citizens, lent by their owners or building landlords, or purchased by the Hartford Institute specifically for the program. They include most of the better-known CB names, but Realistic predominates "because there's a cooperative Radio Shack store manager nearby," says Ms. O'Neill.

None of the program participants, including Fedesco, is technically oriented or interested in CB as a hobby. Vincent Gionfriddo, a retired businessman who patrols Marshall Street, says, "I'm no electronics expert. But I got the hang of this CB thing right away. Even the women have no trouble operating the walkie-talkies."

It's a Winner. The Street Watcher program works on the principle that when streets are deserted, petty criminals are able to operate safely. When there are lots of people on the street, crime rates decline. The police are never far away—marked patrol cars on duty in the area can be summoned in 90 seconds. But the police are free to do routine patrolling, and you don't see

(Continued on page 93)

Volunteer coordinator at central console keeps in touch with Steve Silverman, CB-equipped street watcher (above). In emergency a police car can be on the scene in 90 seconds. Upper left photo shows volunteer Vincent Gionfriddo as he stops to chat with neighbors. Gionfriddo says, "It's a great way to meet your neighbors. I've talked to more people since I've been doing this than I ever did before." Steve Silverman's Realistic Rover 1500 was donated to the Street Watchers program by a landlord on the Gillette Street block where he lives. Silverman and his wife spend several hours a week on the street with the CB unit prominently in view.

REACT Needs CBers. Everybody Needs *REACT.*

Lurking deep down in every man's heart is a desire to do someone a bit of good. Some folks express this desire by performing volunteer work for a local charity. Others work on similar humanitarian tasks without ever being paid, or even receiving a "thank you" for their efforts.

Seems inhabitants of the Citizens Band figured out a way to help all of the people all of the time—under a nationwide program called REACT. The letters of the word REACT stand for *Radio Emergency Associated Citizens Teams.* This program, once sponsored by a private corporation, is now a totally independent non-profit organization known as REACT International, Inc. Support for REACT is growing among business organizations, government bodies, private foundations, and individuals. Some of the official purposes of REACT are:

(1) To develop the use of Citizens Radio Service as an additional source of communications for emergencies, disasters, and as an emergency aid to individuals;

(2) To establish 24-hour volunteer monitoring of emergency calls, particularly over officially designated emergency channels, from Citizens Radio Service licensees, and reporting such calls to appropriate emergency authorities;

(3) To promote highway safety by developing programs for providing information and communications assistance to motorists;

(4) To coordinate efforts with and provide communications help to other groups, e.g., Red Cross, Civil Defense and local public authorities, in emergencies and disasters;

(5) To develop and administer public information projects demonstrating and publicizing the potential benefits and the proper use of Citizens Radio Service to individuals, organizations, industry and government; and

(6) To further the above purposes by chartering local Radio Emergency Associated Citizens Teams who will carry out programs implementing the purposes of this corporation on a local basis.

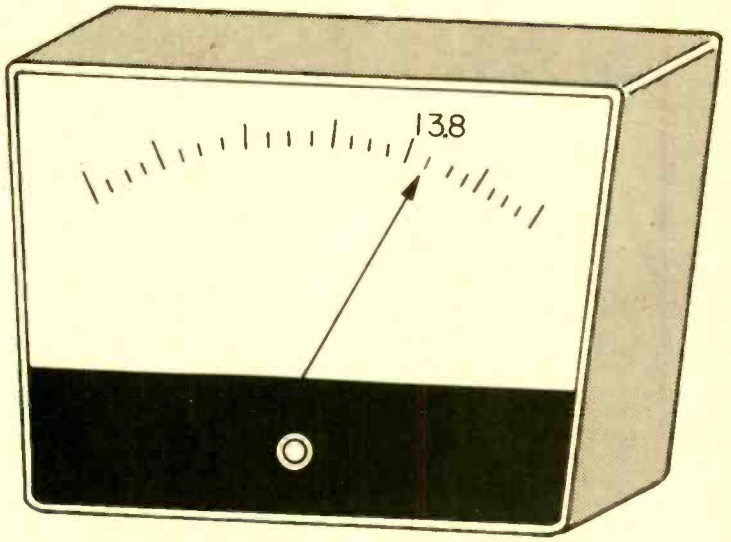
The national REACT headquarters establishes guidelines for the professional conduct of local groups of CBers

(Continued on page 90)

Seen here is the control center console of the Golden Gate area REACT team. The console is manned by volunteer operators 24 hours a day, and helps coordinate team members getting their messages through to police, ambulance, fire, and other official bodies during emergencies.

Stranded woman driver calls help from her automobile, using Channel Nine of the Citizens Band. Above, a REACT team member places a highway flare to warn oncoming cars of an accident while he calls in the details of the mishap to the authorities who will get there faster, due to REACT's teamwork.

CB Power Mate for Maxi-Output



Here's the partner to power your mobile CB rig at home to its maximum capability—four watts RF output.

By Herb Friedman, W2ZLF

So YOU'VE JUST upgraded your Citizen's Band setup with a shiny new transceiver specified to give you four watts out—the legal maximum—or perhaps, if you've converted to the more efficient SSB (single sideband) operation, as many progressive CBers are doing these days, 12 watts, P.E.P. You've paid a couple of hunded dollars for this new equipment and are going to use it at home as your base station—even though it could be operated mobile, in your car, from its 12-volt system.

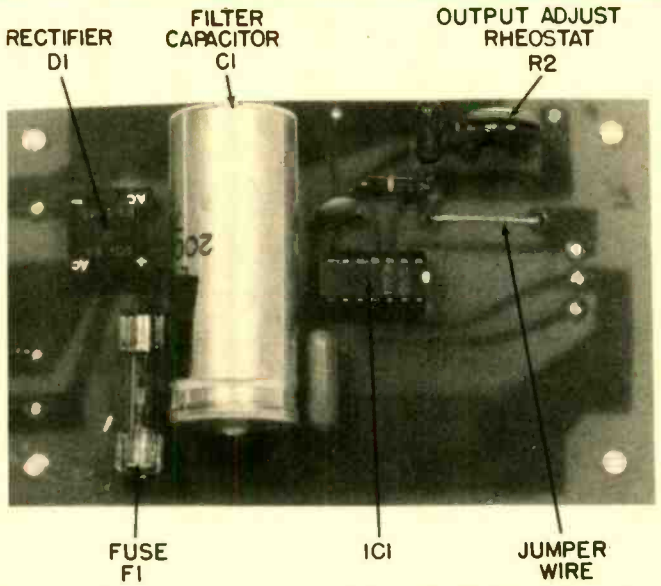
You hook it up to the 12-volt DC power supply you used at home with your old, lower-powered rig and it seems to work fairly well. You contact a few nearby CBers easily enough. But it doesn't seem to be getting out much farther than your earlier transceiver, which has considerably lower power output. What's wrong? Where did the power go?

You're probably not feeding the new set the 13.8 volts it was designed to get from the electrical system of your car when the generator is running, charging the battery, as well as powering the rest of the electrical system in addition to accessories like a mobile transceiver.

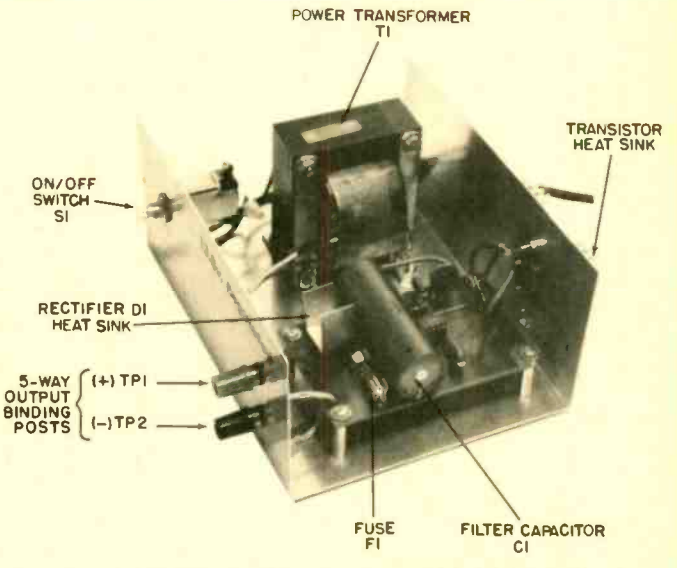
The 117-volt AC to 12-volt DC power supply you used with the earlier transceiver may have supplied it with current at 12 volts, but it can't provide the 13.8 volts, at higher current, which your new set needs to put its rated power on the air.

To be sure, check the actual power supply voltage you're feeding to the CB set.

What Voltage? To check the actual output of your old power supply, get out your voltmeter and measure the voltage being fed to your transceiver. It probably reads around 12 volts (maybe a bit more when the transceiver isn't turned on). You turn the CB set on to *Receive* and get a good solid 12 volts (or maybe as high as 13). So far so good. Now switch the set to *Transmit.*



13.8-volt regulator parts mounted on circuit board. Low-powered (1.5 amp) model does not require heat sink for rectifier.



Complete CB Power Mate, top removed. Higher-current (3-amp model), with U-shape heat sink (homemade) for rectifier. Large heat sink on rear is for transistor.

e/e CB POWERMATE

The input power voltage drops to around 10 volts! Turn it off.

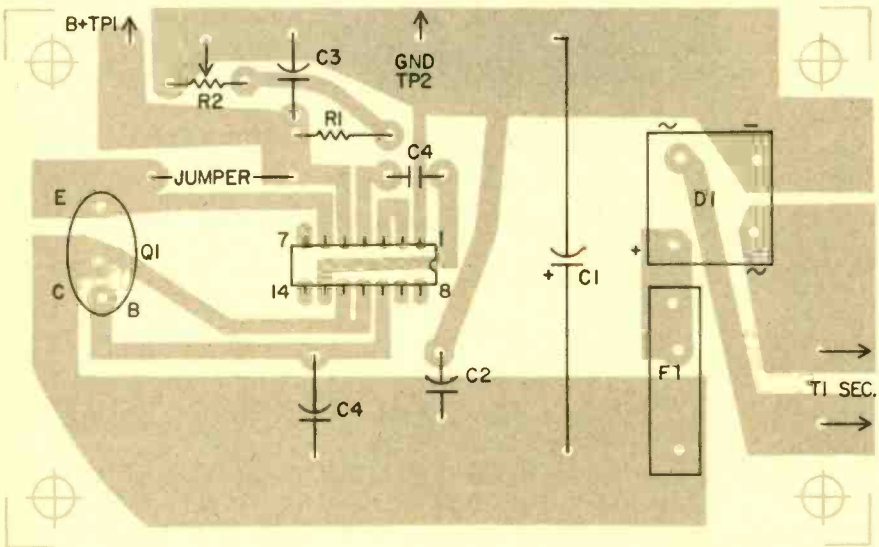
That power supply might have been OK with a lower-powered unit, but it just doesn't make it with this higher-powered job. The four watts of transmitting output you paid for when you bought this new rig is only 2.5 to 3 watts now. This is because your power supply hasn't got the output *voltage regulation* it needs—the ability to put out constant voltage, within its specified limits, regardless of variations in the required current. In addition, your mobile transceiver was designed to work from a DC power supply of 13.8 volts; when the car is running that's what it gets, to charge the battery. (Ever notice how the lights are dimmer when you run them without the motor turning over? That's the difference between 13.8 and 12 volts (or even less, if your battery is on low charge or about to conk out with a weak cell).

It's Only 1.8 Volts. "So what's 1.8 volts?" some people may ask. "Most electronic components are manufactured to a tolerance of 10%, and we see that most schematics have their voltages specified "± 20%."

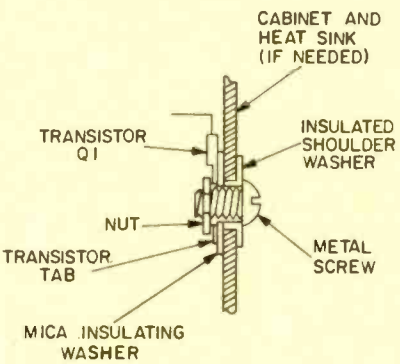
Won't most equipment and circuits operate over a wide range of voltages from their power supplies? Yes, they will often operate, in many cases quite well, but not power output circuits. They just won't deliver the specified output. Equipment which draws substantial current can only produce its rated output when it gets power at the voltage specified by the design engineers. The difference between 12.0 and 13.8 volts amounts to 15% less transmitter power. If the supply puts out only 10 or 11 volts when it's under a heavier-than-usual load the loss can be as high as 25 percent. It could be a lot less. If that power supply's output regulation is so poor that it puts out only eight or nine volts with your new CB transceiver the transmitter might not work at all.

To insure maximum performance from your mobile transceiver when powering it with AC house current, you must use a 13.8 volt *regulated* power supply. Regulation provides exactly 13.8 volts under a wide variety of loads —from full load to no load—and also compensates for AC line voltage fluctuations if they occur.

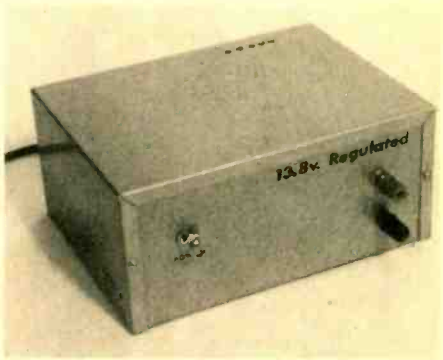
Although a regulated supply can cost from $50 to $100, you can build the *CB Power Mate*, as shown in the photographs for about $20 to $25 (or even less if you're good at scrounging parts or have a junkbox of used components). The same supply can be used as an AC-to-DC power source for high power walkie-talkies (one-watt or more output) which require exactly 12 volts, because this supply can be adjusted at the flick of a finger to any mobile power voltage—even six volts. Your regulated supply can be built to handle any current needed, up to three amperes. The current capacity is determined by the output of the power transformer, T1, and filter capacitor C1, the two most costly items in this project. Thus you can save money by building only the current capacity you actually need.



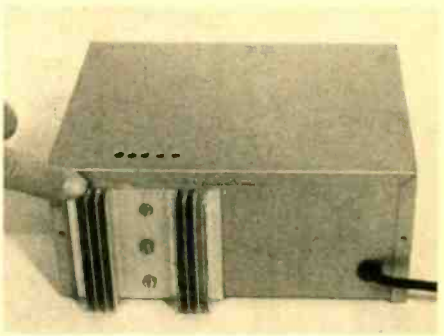
Copper side of circuit board, full size. You can make it easily from kit bought at most parts stores. Components mount on other side of board.



How to mount transistor to dissipate heat into metal cabinet (and external heat sink, in 3-amp model). Use silicone grease on both sides of insulating mica washer. Tape over screw head (outside case) to protect against external short.



Front view of CB Power Mate shows On/Off switch, red (+) and black (—) power output binding posts. Rear view of higher-powered version has finned heat sink to dissipate heat from regulating transistor. Quarter-inch holes are for ventilation.



How It Works. The first section of the CB Power Mate (the 117-volt step-down transformer T1, the rectifier, and the large capacitor, C1) supplies *unregulated* current at between 15 and 35 volts, depending on the number of turns in the secondary of T1. The rest of the supply is the regulator section. The size of the voltage drop across the regulator depends on the resistance of transistor Q1, which varies according to its base bias. The bias is controlled by the action of the IC, which gets its commands from the voltage applied to pin 4. This voltage is taken from the junction of R1 (1800 ohms) and R2 (500-ohm rheostat), which are a voltage divider across the power supply output. Initially R2 is set to provide the desired volt-

age—13.8 or whatever—at the emitter of Q1 (the supply output).

When the load (the transmitter) starts to draw more current, the voltage at the power supply output begins to drop. This lowers the voltage at IC pin 4. The IC then applies a higher (more positive) voltage to the base of Q1 (IC pin 10). Since the transistor is an NPN, the positive-going base signal lowers Q1's collector-emitter resistance, increasing the collector current and raising the voltage at the emitter (power supply output). When a change in load draws less current, tending to raise the supply voltage, this increase is sensed by the voltage divider, which now applies a lower (more negative; less positive) voltage to IC pin 4. This increases Q1's collector resistance, lowering the voltage at the supply output.

This all takes place almost instantly, so the output voltage remains steady, at the value at which it was originally set. This happens even though the transmitter current (the load) is changing all the time.

Two Versions Can Be Built. The schematic diagram shows the supply for loads up to three amperes at 13.8 volts. For lighter loads, up to 1.5 amperes (still 13.8 volts) capacitor Cx is not needed, and the power transformer can be a lighter, less expensive one. In addition, capacitor C1 can be rated at 25 VDC, instead of the 35 or more required for the higher-powered version. Also, the smaller power supply doesn't need heat sinks for the bridge rectifier and the series transistor (also called a "pass transistor") because all the current used by the transceiver passes through it.

Check the Voltage. First you should find out what the power requirement of your transceiver is when you are transmitting. It will usually be one amp or more (*receiving* will take much less current). It may be as high as 2.5 amps. Once you know how much current your transceiver needs, you'll know whether to build the model which supplies up to 1.5 amps or the three-amp one. Now take the parts list and check your junk box for parts you can use.

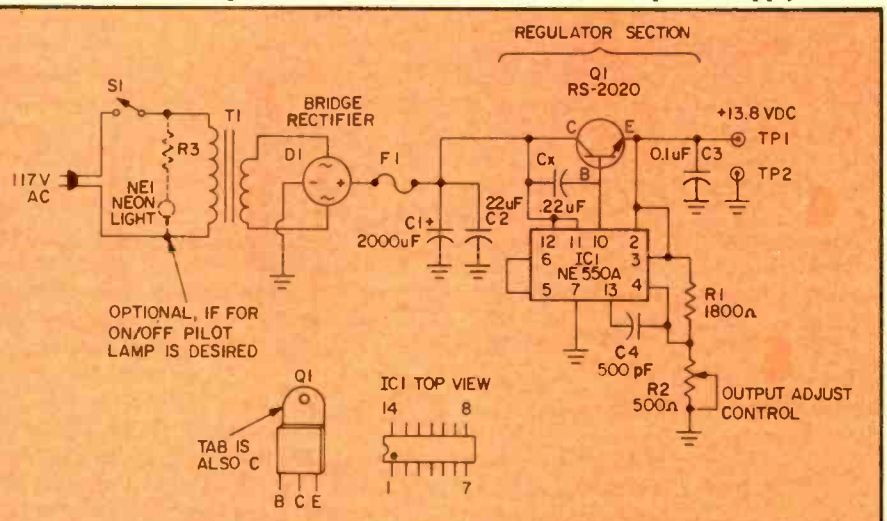
Construction. The heart of the CB Power Mate is the regulator, which consists of integrated circuit IC1, series regulating transistor Q1 (which is controlled by IC1) and their associated resistors and capacitors. C1 is the main filter capacitor, which initially smooths the varying DC supplied by the bridge rectifier from the AC output of the power transformer secondary.

The printed circuit board, which you can easily make with a kit from any parts distributor, has been designed to work in either the 3-amp model or the 1.5-amp unit. The photograph showing the board with its components mounted is the lowered-powered one. The completed supply pictured is the higher-powered unit. You can see that the assembled boards for both versions are almost identical. One difference is that the 3-amp supply (completed unit) has a piece of U-shaped aluminum you can bend to make the heat sink for the bridge rectifier. This is not needed for the lower-current supply. The photograph of the completed unit also shows the fins of the large heat sink for the transistor mounted on the back of the box behind the transistor. This heat sink isn't needed in the 1.5-amp power supply.

Fuse F1 is a fast-acting type which protects the bridge rectifier and the power transformer from blowing out if you should make a wiring error or short-circuit the output. The fuse listed will blow out before the components, so don't use any other kind of fuse, even if it has the correct current rating (three or five amps). Use only type AGX, not slow-blo or 3 AG. Try to get a fuse-holding clip made for soldering to the printed circuit board. That kind is easier to install than those which mount with screws.

Solder the pins of the 14-pin IC socket to the board, but don't insert the IC into its socket until the socket has cooled off. Heat can ruin an IC or a tran-

(Continued on page 94)



PARTS LIST FOR CB POWER MATE

(3-amp model)

C1—2000-uf, 35-VDC or more electrolytic capacitor (Radio Shack 272-1020 or equiv.)
C2—0.22-uF, 100-VDC or more capacitor (Radio Shack 272-1058 or equiv.)
C3—0.1-uF, 100-VDC or more capacitor (Radio Shack 272-1053 or equiv.)
C4—500-pF, 100-VDC or more capacitor (Radio Shack 272-125 or equiv.)
Cx—same as C2, above
D1—bridge rectifier diode package, 6-amp rating, 100 PIV (peak inverse volts) (Radio Shack 276-1148 or equiv.)
F1—Fast-acting fuse, 5-amp rating (Radio Shack 270-1278 or equiv.)
IC socket for integrated circuit IC1 (Radio Shack RS276-027 or equiv.)
IC1—Voltage regulator integrated circuit, NE550 (DIP package, International Crystal Mfg. Co., 10 N. Lee St., Oklahoma City, OK 73102. NE550, or equiv.)
Q1—NPN silicon transistor (Radio Shack RS-2020 or equiv.)
R1—1800-ohm, ½-watt resistor (Radio Shack 272-1000 or equiv.)
R2—1000-ohm printed circuit (end mounting) potentiometer (Radio Shack 271-227 or equiv.)
S1—SPST power switch, 120 VAC (Radio Shack 275-602 or equiv. If self-illuminating switch with built-in neon light is desired, use Radio Shack 275-671 or equiv.)
T1—power transformer, 117-120 V primary, no center tap needed. Secondary 18 to 21 volts at three amps (Allied Radio 705-0133 or equiv.)
TP1, TP2—binding posts, 5-way, one red, one black (Allied Radio 920-0563 and 920-0561, or equiv.)
Misc.—printed circuit board materials, or perf board; fuse clip for mounting on p.c. board; heat sink for transistor Q1; heat sink compound (Radio Shack silicone grease 276-1372 or equiv.); scrap aluminum piece approx. 1-in. x 3-in. x ⅛-in. thick; standoffs (aluminum) four, ½-in. for mounting p.c. board (Radio Shack 270-1394 or equiv.) with machine screws, nuts, and lock-washers.

PARTS LIST FOR 1.5-AMP MODEL

Use all same parts as above, except for the following changes:

C1—same, or use 25-volt rating, which costs less
C2—Cx is not needed
F1—As above, except 3-amp rating
T1—as above, except 12.6 to 16 volts, at 1.5 amps (Allied Radio 705-0121, or equiv.)
Heat sink for transistor not needed
Scrap aluminum for heat sink not needed

the changing world

by Fred Petras

MOST FREQUENT CLAIM in hi-fi component advertisements are those periodic "breakthroughs" in speaker systems. Every year as far back as I can remember there've been pronouncements of yet another breakthrough, usually one guaranteed to make all previous developments (including, strangely, those of the very company doing the talking!) obsolete. The height of ridiculousness was the announcement one year of a "flame" speaker that modulated sound waves via fire—yes, fire! It, like most other so-called breakthroughs are now part of history, indeed non-history, since they never made the grade and are no longer discussed.

However, a look at today's speaker systems shows that some genuine advances have taken place recently, and today's speakers do a fine job of reproducing sound. They do it in most cases the same way they have been doing it for nearly fifty years, namely via a combination of electromagnetics and moving cones, but far better. No matter what the advances, the basics are the same—electrical impulses are transformed into acoustical impulses; sound waves.

Basic variations. A speaker system driver does not have to be in the form of a metal "basket" (frame) holding a magnet structure and a concave cone of paper/fiber/metal/plastic, or what have you. A look at some of the most recent variations shows speaker elements in the form of plastic pleats, tapered metal cones, and cylindrically shaped film, introduced by ESS, Ohm, and Pioneer, respectively.

There are also variations on the previously-universal configuration of the speaker system as a rectangular box. In fact, these variations are sharp departures from the original shape. A look at today's speaker systems shows many of them as spheres, dodecahedrons, squat wedges, thin panels, cubes, and a variety of columns, including tapered, trapezoidal and triangular.

Cabinet materials. Today's speaker systems are only not made of wood solids. More likely they are of less resonant flakeboard, a wood byproduct, covered in either genuine wood veneers or wood-like plastic fabric that is virtually identical in appearance to genuine veneers. Some speaker models even come in contoured, weather-resistant, high-impact plastic housings, for outdoor as well as indoor use. As for finishes, they've changed also. In addition to the favorite—walnut veneer—oak is becoming popular, along with rosewood. Additionally, paint finishes are beginning to appeal to many music lovers wanting something different.

Grille fabrics are no longer limited only to natural-fiber cloth. Plastics are the word today. Plastic in "cloth" or foam form. The foam grilles are not merely flat panes across a speaker system front—more often they are carved into a variety of patterns, geometric or free-form, for a sculptured effect.

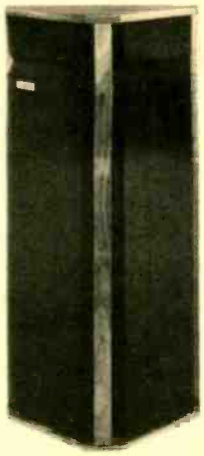
Speaker size, once the measure of a speaker's sound reproduction qualities, is no longer the criterion. Today's speakers produce top sound from one-cubic-foot rectangles, and from 6½-ft. high columns such as the Epicure 1000. However, the trend is gradually toward larger housings, for a variety of reasons, one prominent one being the status appeal of large speaker models, not unlike the status appeal of big deluxe cars compared to the compact models.

Showoffs. The visibility of speaker systems today is considerably different

Loudspeakers are getting better, using new materials and techniques.

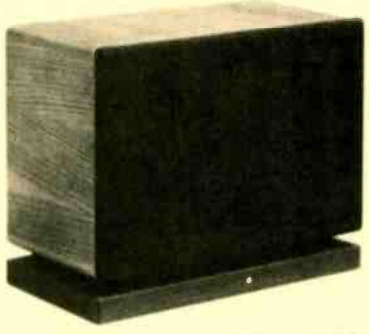
CIRCLE 62 ON READER SERVICE COUPON

Pioneer HPM-200. The tweeter and super tweeter of this unit are high-polymer molecular film cylinders instead of cones. Price, $500.



CIRCLE 61 ON READER SERVICE COUPON

Allison Model One. Six drivers are featured in the Allison One, a triangular column system priced at $360.



CIRCLE 60 ON READER SERVICE COUPON

Jennings Contrara R. Contoured corners highlight the cabinetry of this two-way model, retailing for $125.

# of Loudspeakers

than a decade ago. Today's home decor does not try to hide speaker systems as it did in the past. Today's speaker system is more often placed for high, or even dominant visibility in a room setting. Speakers today are something to show off rather than hide. This is quite evident in their overall appearance. Many systems combine wood and grille materials tastefully, in the manner of furniture as a combination of wood and fabrics. In effect, today's speaker systems are designed to be furniture, a part of home decor, not an intrusion on it.

On the other hand, many new speakers are also designed for the audiophile who likes to see the inside of the system and to show the world the drivers in his systems. You can show off the makeup of most of today's models merely by lifting a top section off, as in the case of the ESS and Ohm models, or releasing a velcro-attached grille panel. Many audio buffs like to operate their speakers with the drivers exposed. Some do it while fantasizing that they are sound engineers listening to studio monitors—whose drivers are generally visible. As a result, some speaker mounting boards are finished to match the outer shell of the housing for a neater look.

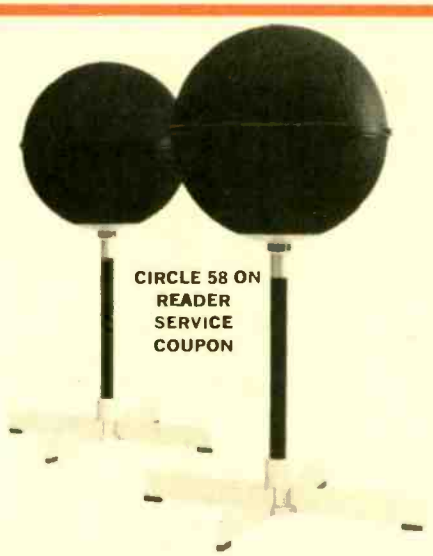
Main trends. There are two main trends underlying today's speaker systems. One is accurate sound reproduction, the other is better dispersion. At one time manufacturers tried to put out speaker systems that had a sound "personality," which meant that the sound they produced had certain characteristics. Some makers aimed for a mellow sound, others a bright sound, some a soft sound, each of which gave certain individual musical instruments or instrumental voicings a certain color. This color appealed to many people in the past, but today it is a no-no. Today's speaker systems aim for uncolored sound, and the finest speakers have *no* personality. They are, in effect, sonically invisible, having virtually no effect on the sound but to recreate it as nearly like the original as possible. In today's test labs the trend is to rate speaker accuracy on a percentage basis—the higher the figure the better.

Relative to dispersion, the trend is to broaden it. This is being accomplished in a variety of ways. In some cases two or more tweeters are clustered so they radiate forward, sidaways, upward, backward, and even downward to some degree, to eliminate that old bugaboo "beaming"; narrow sound propagation. In two of the three new approaches mentioned earlier, ESS and Pioneer, horizontal dispersion figures of 120 and 270 degrees, respectively, have been attained by the tweeter elements. The third, Ohm, achieves 360-degree dispersion for the full frequency range. Bose, the pioneer of broad-dispersion speaker systems, gets the illusion of 360-degree dispersion in its trend-setting, oft-copied Model 901, a direct/reflecting model which utilizes the walls of a room to achieve a kind of concert hall listening effect. Epicure in its 6½-ft. high column, Model 1000, achieves 360 degrees of horizontal dispersion, as does JBL in its Aquarius Q, a 3½-ft. high column. Omnidirectional sound in both the vertical and horizontal planes is also attained by JVC in its pedestal-mounted VS-5313 spherical system, and by Design Acoustics in its 12-sided Model D-12.

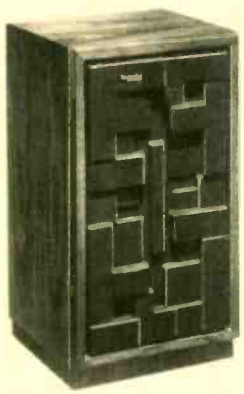
Bass Reflex. While most of the models described are acoustic suspension

CIRCLE 59 ON READER SERVICE COUPON

ESS amt 1A. A tweeter using pleated film instead of a cone is featured in this unit, priced at $396.



JVC VS-5313. Omnidirectional sound is achieved via the use of eight drivers mounted in a spherical housing. Price, $229.95.



CIRCLE 57 ON READER SERVICE COUPON

Technics T-400. Heavy "sculpturing" produce a three-dimensional grille in this four-way speaker system priced at $279.95.

types, the reflex type speaker system, the earliest form of speaker enclosure, is enjoying a comeback. In the acoustic suspension system (developed by Acoustic Research in the mid 1950s, and subsequently adopted by most other speaker makers since then) the enclosed air is used as spring to provide a restoring force for the speaker cone. Thus, a small enclosure can produce solid, linear bass down to the lowest audible frequencies. The trade-off for small size is that higher amplifier power is needed for driving the system. Reflex systems do not absorb the back wave of the cone; instead it is returned via a vent or duct to augment the sound from the front. The reflex approach is more efficient, and low power can often produce "large" sound. The tradeoff is that a larger housing is required.

One reason for the new popularity of the reflex approach is that with advances in technology it is possible to make a highly efficient, big-sounding reflex system in bookshelf size. Another is that with four-channel sound becoming a sonic reality, bass reflex speakers are often chosen because they can operate on less amplifier power, permitting the purchase of lower-cost quadraphonic receivers or amplifiers. While the acoustic suspension concept may lose some popularity in the future, it will continue to be the dominant force in the industry, say the experts. One reason, they note, is that acoustic suspension models are generally less costly to build.

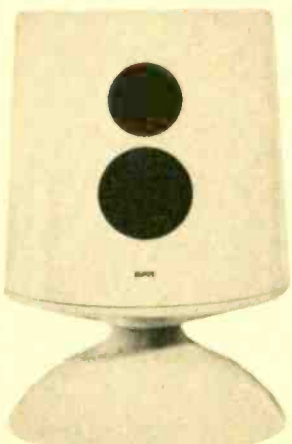
Recent Advances. Recently three companies have come up with the closest advance to what might be called a breakthrough in speaker technology—ESS, Ohm and Pioneer. Let's take a look at what they've wrought . . .

ESS, Inc., uses the Heil air motion transformer in its speaker systems. This device, invented by Dr. Oskar Heil, is essentially a mid-range/tweeter unlike anything in the world of sound reproduction. It is composed of a six-pound magnet structure which encases a diaphragm that is activated by the magnet to produce sound. The diaphragm is a grid of parallel conducting strips embedded in plastic film, gathered into narrow pleats. These pleats have a conducting strip on each face of the fold. When an audio signal passes through the conducting strips, they move so as to vary the spacings between the pleats, causing them to inhale and exhale air from the folds between them, as opposed to the pushing action of the cone in a regular midrange/tweeter. This method of transferring the energy moving the diaphragm achieves large, rapid air movement with very small diaphragm movement. The ratio attained by the Heil unit is five to one, that is, the diaphragm needs to move only one fifth as far as a conventional pushing cone to equal its air movement. ESS claims a frequency response of 35 to 25,000 Hz, plus/minus 3 dB, for its model amt 1A, a system incorporating the Heil driver.

The heart of the Ohm speaker system is a driver unit invented by the late Lincoln Walsh. Basically, its shape is that of a large electrodynamic driver, superficially resembling a woofer with an exaggeratedly deep cone, mounted face down on top of a large enclosure, "wrong" side out and magnet up. The tapered cone itself is made of metal foil (titanium and embossed aluminum). Acoustic output is produced by pulsating the cone radially, with every portion of its surface moving in simultaneously and out simultaneously, in phase with the input audio signal. This output is called "coherent" sound since it is analagous to coherent light as produced by a laser. The sound is a combination of both direct and omnidirectional, with dispersion throughout all 360 degrees. Frequency response is a claimed plus/minus 4 dB from 25 to 20,000 Hz with an unequalized input; flatter with equalization.

A new development from U.S. Pioneer Electronics is a high-polymer film tweeter/super tweeter combination used in the firm's new HPM-200 five-element speaker system. The combination consists of a three-inch super tweeter mounted atop a six-inch tweeter. The individual units are composed of vapor-deposited aluminum-coated high-polymer film with a polyurethane inside backing, all wrapped around a cylinder. The cylinder contains glass wool as a sound absorber. When audio signal volt-

(Continued on page 90)



CIRCLE 56 ON READER SERVICE COUPON

Empire Jupiter 6500. A weatherproof high impact plastic housing permits this three-way gloss-white system to be used outdoors as well as indoors. Price, $139.95.

CIRCLE 55 ON READER SERVICE COUPON

MicroTower Model MT2 from Epicure Products Inc. features speakers on four planes, for omnidirectional sound dispersion. It sells for $129.95.

CIRCLE 54 ON READER SERVICE COUPON

Dahlquist DQ-10. Individual baffles are used for the five drivers used in this panel model. Price, $395.

by Kathi Martin, KGK3916

Kathi's CB Carousel

As most of you CB'ers know, I have always considered the high power walkie-talkie to be one of *the* most flexible rigs. Plug in a PTT mike and the mobile whip's transmission line and you can have a high performance rig right on the car seat; one you can easily pull out for field use. Carry it on a shoulder sling and it's a personal communications system.

But walkie-talkies do have their limitations, the most important one being itty-bitty connectors for the external equipments: connectors that easily become intermittent through a bit of corrosion or dust. Also, many W-Ts do not have the most efficient antennas—*most* are base loaded telescopic whips, though a few W-Ts do have efficient center loaded antennas.

I have often wondered why someone didn't take an ordinary mobile sized rig and convert it into a portable, complete with battery pack, hand microphone, efficient antenna and carrying case. Whenever I got a chance to speak to a CB manufacturer about a "universal portable-mobile" the usual answer I got was the typical mobile was too large because of the internal speaker, the few add-on battery packs were too heavy, or just "the idea won't sell".

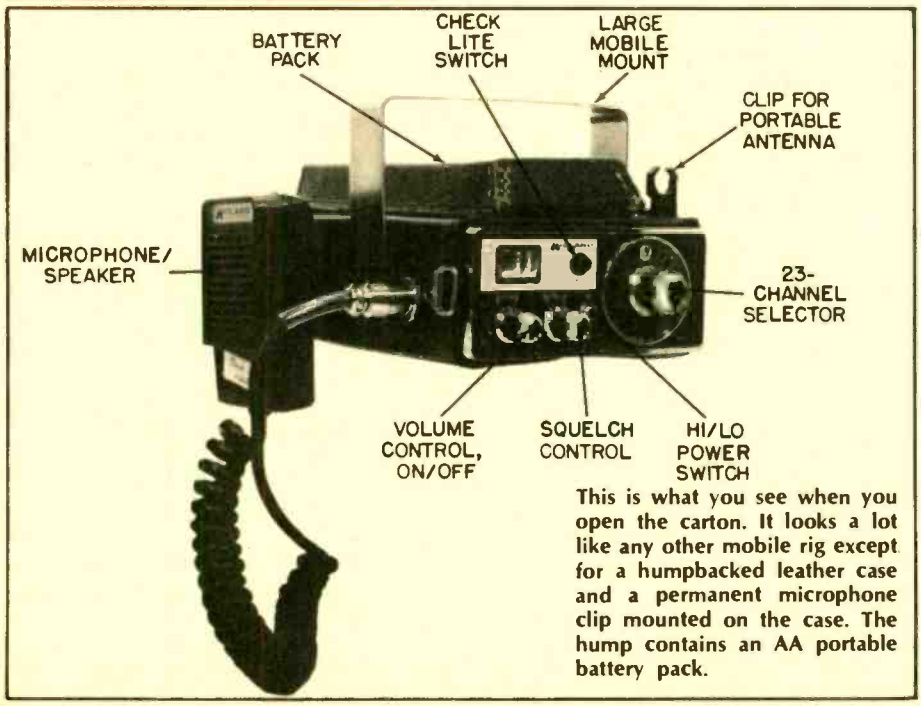
Well, someone up there must like me, or at least heard my pleas, because Midland has come out with a rig with every feature just as I would have designed it. Fact it, I'm looking for a tag or nameplate that says *"Inspired by Kathi Martin"*.

To keep up with the *boss* features of Midland's Model 13-861 it's best you refer to the photographs as I describe them, because most haven't been seen before.

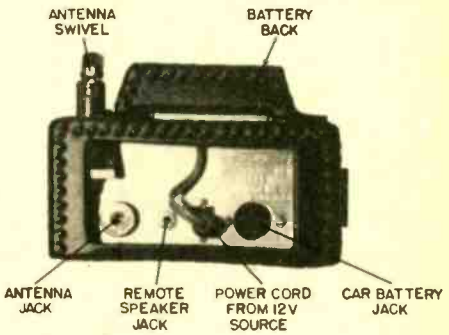
On the Outside. To start with, the basic package is a complete 23-channel subminiature mobile rig measuring only 4⅜-in. wide x 2-in. high x 7½-in. deep back to the end of the antenna connector. It is also unusually light. The front panel looks more or less like any other 23-channel mobile rig, with a channel selector, volume control, squelch control and a small meter with S,RF and battery-condition scales. (The S and RF scales have *relative* calibrations; the battery scale is red-green.) The only obvious differences on the front panel are two miniature switches labled *Check Lite* and *Hi-Lo*. Both switches are power-saving devices I'll explain later.

Turn the rig around and you'll see some obvious differences on the rear apron. First, in addition to the usual RF-output jack there is a small plastic shelf with a screw-connector at right angles to the RF jack: this is the mount for a portable antenna. You'll find a remote speaker jack (this is usual), and a DIN socket for the 13.8 volt (car battery) power source (this is also usual though DIN connectors are rare on CB gear). Then you find another socket labeled *Battery Power 12V*. Two power sockets? Yup! The 13.8 volt socket is for using the car battery; the pilot lamp that also serves as the channel selector

The Midland 13-861 mobile Citizens Band transceiver is made by Midland Electronics Co., Box 19032, Kansas City, MO 64141, and is priced at $164.95. Circle No. 75 on the Reader Service Card for more information.



This is what you see when you open the carton. It looks a lot like any other mobile rig except for a humpbacked leather case and a permanent microphone clip mounted on the case. The hump contains an AA portable battery pack.



Turn the rig around and the back end looks conventional except there's also a 12-volt socket into which the battery pack is plugged, and there's a portable antenna swivel in addition to the usual antenna jack.

Remove a couple of screws and you get two pieces: the case (not shown) and a complete miniature mobile transceiver. An extra, larger, mobile mounting bracket is mounted in your vehicle.

Slip the complete package out of the mobile mount and it's a ready-to-go portable. Note the loading coil on the antenna which winds up in the center (center loading) when the whip is fully extended. Just one more reason why this portable puts out a Big signal. The antenna can be unscrewed from the swivel when mounted in a vehicle, but it's not necessary. Note how the microphone clips to the side of the case.

indicator will turn on with the rig when the 13.8 volt socket is used. Battery packs are plugged into the 12-V socket, which does not feed the pilot lamp—to conserve every milliamp of battery power. To see what channel you're tuned to (if operating in the dark) you depress the *Check Lite* switch on the front panel.

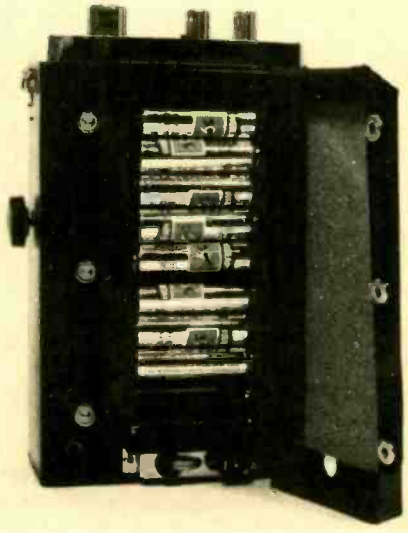
The *Hi-Lo* switch is another battery saver. If you're working at close range and don't need full power output you simply flip the *Hi-Lo* switch, which cuts the output power to 25 percent of its normal value, adding many hours of service to the battery pack. You can also use the *Hi-Lo* switch when working the rig off a car battery, but it isn't necessary.

The speaker? That's the microphone; a small one about 1⅝-in. in diameter such as you'll find in miniature mobile rigs. It does double duty, serving also as the microphone. Contrary to the usual honky or squawk-box sound quality you'd expect from a speaker-mike, this one really sounds good.

Mounting It. Supplied with the transceiver is a small mobile mounting bracket that permits just the basic rig to be mounted under the dash. But in truth there is no basic rig because it is supplied in a leather case that also houses a battery pack of 8 or 9 AA flashlight batteries or rechargeable Nicads. The pack has cutouts and connections for a battery charger, a mobile antenna, a built-in microphone hanger and shoulder sling connectors. And when you look deep down in the shipping container you'll find another slightly larger mobile bracket.

Installed in the case the rig is just about the same size, just an extra inch higher to allow for the batteries. The battery pack cable plugs into the 12-V socket on the back of the transceiver. The extra mobile mount permits the entire package to be mounted under the dash. Simply plug in the car's power cable and the mobile transmission line and the Midland 13-861 is a mobile rig. Pull the power cable and antenna connector and release the two mobile bracket screws and unit is instantly a portable complete with a center-loaded telescopic whip (which can be quickly secured or removed from the package). Clip on the shoulder sling which is supplied with a soft shoulder pad like you find on camera straps and you have a walkie-talkie, one with all the weight except the mike out of your hands. Because of the flat, oversize back end when the rig is in its battery case, it can easily stand upright on the ground, on a car roof, or a boat deck. And if you're on the side of a mountain, or anywhere else you can't find a level surface, you simply let the rig lie down any way you can because the whip has a universal swivel at its base. No matter how the rig is positioned (except on its back) the antenna can be oriented vertically. Featurewise the Midland 13-861 is everything I always asked for and was told *couldn't be done*. Next time some manufacturer's rep tells me something can't be done I'm going to pull out my 13-861 and say, "You told me this couldn't be done either."

On the Bench. As for performance,



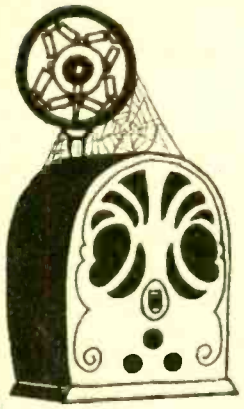
The battery pack holds eight flashlight batteries or ten Nicads. Two fillers are provided for use with flashlight batteries. But read the story to see why I suggest you use nine batteries and one filler.

it's what you'd expect from a decent miniature mobile rather than the usual walkie-talkie, and that's the way it should be because the 13-861 is basically a mobile rig in a portable case.

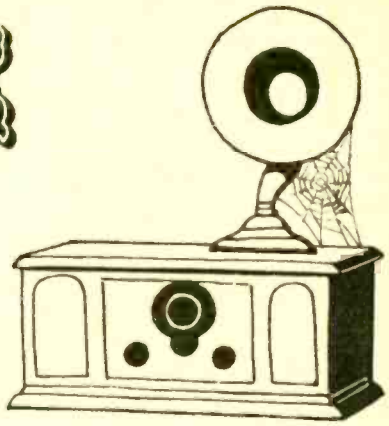
Working off the car's electrical system (13.8 volts) the Midland 13-861 put out a solid 4 watts into a 50 ohm load with the power switch set to *Hi*. With the switch set to *Lo* the output was 1 watt. A typical voice level (−22 dB) produced 85-100 percent modulation, and even though a speaker is used for a microphone the sound quality is really good. There is, however, no 100 percent modulation limiting, which seems to be characteristic of many modern CB transceivers we've run through e/e's test lab.

Normally, 8 AA flashlight batteries or 10 Nicads are used: two dummy fillers are provided when using flashlight batteries. Trouble is, when you add up the voltage from 8 flashlight batteries you get 12 volts, not the 13.6 to 13.8 you get from a car with the engine running. With a 12 volt supply the output

(Continued on page 89)



ANTIQUE RADIO CORNER



by James A. Fred

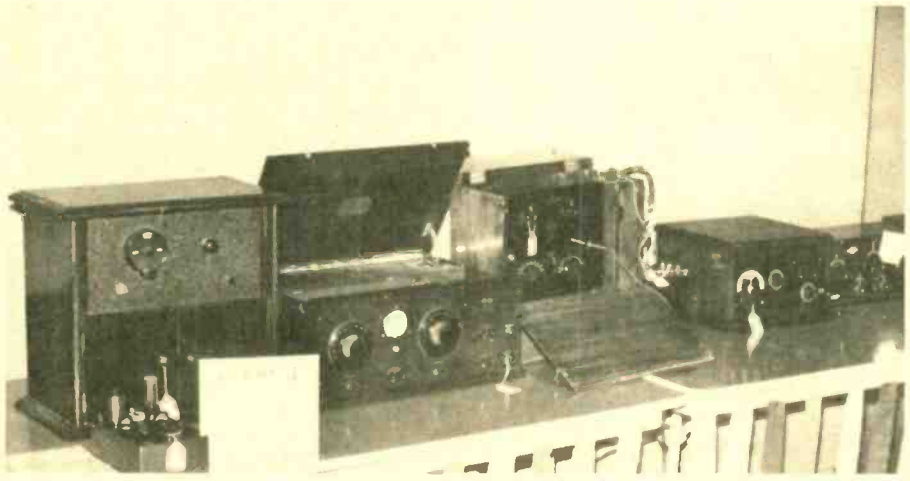
☐ Hello out there in radioland! Did cold weather catch you with a lot of antique radios waiting to be restored? Most of us take advantage of the summer vacation months to look for radios, speakers, etc. and then restore them during the long winter months.

A group of antique radio collectors in and around Winston-Salem, NC are attempting to form a collectors club. It will be affiliated with the AWA. They held their first annual summer meet in July and my wife and I attended it as part of our vacation. They had an exceptionally fine turnout of over 90 interested persons. On Saturday morning visitors were registered and then enjoyed the displays of old radios, tubes, and speakers. In the early afternoon a flea market supplied many fine items for sale or trade. Late in the afternoon there were slide shows, one of which concentrated on loudspeakers and was conducted by Paul Klipsch, inventor of the Klipschorn (in the 40s) which many people believe is the best loudspeaker available. An evening buffet was well attended (over 60 people), after which prizes were awarded for displays and attendance. Wayne Nelson, a well known collector, was the main speaker. Our congratulations go out to the committee chairman, Lew Elias, and his helpers Val Valentine and Frank Owen. We are looking forward to attending another meeting there in 1976.

The Shadowgraph. As we promised in our last column we are continuing our series on tuning indicators. This time we describe the Shadowgraph Tuning Indicator, which was built on the same principle as the milliammeter. When the station was tuned in properly the shadow was narrowest, and when the set was between stations the shadow was widest. I don't know how many radio set manufacturers used the Shadowgraph, but I do remember a Philco cathedral radio my father bought in 1932. In all my years as a radio repairman I don't remember any other brand of radio using it.

Inside the Shadowgraph was an iron vane mounted on an iron disc, a coil of wire, and a ring magnet. With no current flowing through the coil the iron disc and the vane assumed a horizontal position because of the magnetic field of the ring magnet. There was a pilot lamp shining on the vane and on past it to a small translucent screen on the front panel where it cast a shadow of the vane. If current was flowing through the coil a magnetic counter field was produced. With a magnetic counter field equal to the ring magnet field the vane will assume an angle of 45 degrees making a wide shadow.

When a station is being tuned, the AVC (automatic volume control) voltage increases as we approach resonance. At resonance, the AVC voltage is greatest and the plate current in each controlled tube is lowest. This lower plate current flows through the Shadowgraph coil reducing the magnetic counter field. The iron vane now assumes a more horizontal position which results in a narrow shadow on the screen. To sum up the action of the Shadowgraph we can say that a weak signal makes a



Here are five early radios entered in the Class 1 contest for regenerative receivers using three or less tubes at the meeting in West Lafayette, IN.

This Atwater Kent Model Five was found in an attic in Greely, Colorado. It's one of the rarest of all antique radios.

wide shadow and a strong signal makes a narrow shadow.

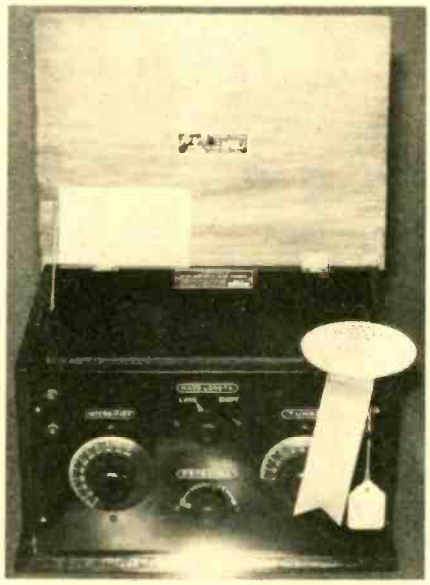
Collecting World. Antique radio collecting has gone world wide. I am now corresponding with collectors in New Zealand, Australia, Japan, the Philippine Islands, Uraguay, Union of South Africa, France, Canada, and Great Britain. One of my most interesting correspondents is Tudor Rees of Bristol, Great Britain. Tudor has a store stocked with old radios, about 50,000 vacuum tubes, parts and literature. He restores and repairs both home and automobile radios. He publishes a monthly newsletter and is forming a club for antique radio and wireless collectors. Collecting radios is on the increase in Great Britain and more collectors and radios are turning up every month. If there is enough interest we can include his address in the next revised Radio Collectors Fact Sheet.

Books. Sometime ago I mentioned the Classic Radio Newsletter and its publisher, J. W. F. Puett. He is now publishing a book titled "Silver Ghosts" that is all about Scott Radios and E. F. Scott. The book will contain 70 pages and sell for $10.00. Many of you will think that $10.00 is quite expensive for a 70-page book. Compared to a popular novel it is, but if you have ever checked prices in a printing shop you will think differently. Special interest books like "Restoring an Atwater Kent Model 40 radio" and "Silver Ghosts" are expensive because of the limited number printed.

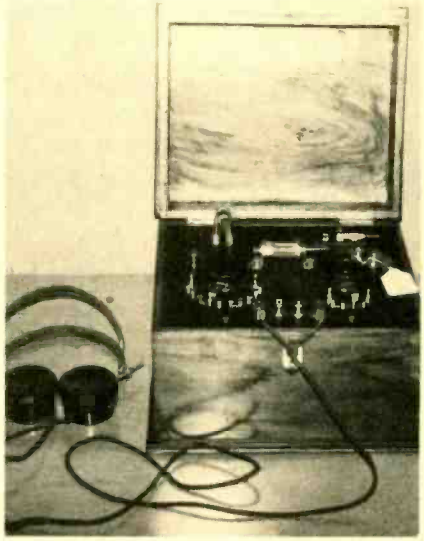
A new British book has been published in two volumes titled "Story of Radio", by W. M. Dalton. I have ordered a copy of each and will make a report to you after I read it.

Another publication available is "A Pocket Guide to Antique Radio Collecting". It's 16 pages and will fit into your shirt pocket. It was written for the beginning radio collector and it assumes the reader knows next-to-nothing about radios. Separate pages are devoted to different perods of time in which certain radios were popular. Some of these are: Crystal radios; 1 tube regenerative; 2-, 3-, 4-, and 5-tube sets; 3-dial tuning; Early AC-operated radios; and Radios of the 30s. Other pages cover vacuum tubes, speakers, etc. Write to Antique Radio Press, P.O. Box 42, Rossville, IN, 46065, sending $1.00. It's postpaid.

Mechanical Television. I would like to hear from collectors who have scanning-disc television receivers made during the middle 20s because I have just acquired the scanning disc/motor assembly for one. It has no name and looks to be homemade. The book "Radio Construction and Repairing" by Moyer and Wostrel has a chapter on scanning-disc television with complete directions on how to build one. I need the short wave receiver and the synchronizing amplifier to make it complete. If any reader has had experience in building or restoring a receiver of this type I would appreciate a letter from him.

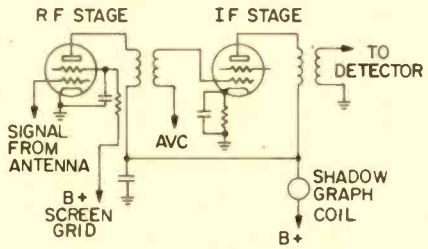


Here's a brand most people never heard of before. It's a Klitzen, manufactured in Racine, Wisconsin in the early 1920s. This set won a prize at the West Lafayette, IN meeting.



This early crystal receiver has no identification as to maker. It is housed in a beautiful rosewood cabinet. Can anyone tell me what it is—who made it—and when? Photo taken at the AWA-IHRS meeting in West Lafayette, IN.

B/C Power Supply. In the July-August issue of e/e I presented a circuit diagram for a simple *B/C power supply*. I have had several letters from readers concerning this supply. Some of the questions received are listed below with my answers. I am including this question and answer section because I believe it is important to many readers who did not write in.



Schematic shows how a Shadowgraph tuning indicator was connected in the B plus return for the RF and IF stages. When strong signals came in the AVC signal was strongest, reducing the B+ current and narrowing the shadow on the Shadowgraph indicator.

Is the wire connected from the junction R1 to T1 a misprint?
Yes, the artist accidentally added a wire here. There should be no connection between the junction of R1-T1 and R2-D1-I1.

You list the secondary voltage of T1 as 135 VAC, but my Stancor catalog sheet lists it as 125 VAC. Is this critical?
Actually this is my mistake. 125 VAC is the correct voltage. From a practical standpoint very little difference would be noted with the higher voltage.

According to my math and Ohms law the ½-watt Zener diodes are seriously overloaded. How about it?
The original circuit diagram called for 1-watt Zeners. The only time the Zeners would be overloaded is when there is no load on the power supply. When figuring the size of the current-limiting resistor (in this case it is the indicator lamp I1) you add 10% to the load current. The Zener takes the difference between what the load takes and 110% of the load current. In other words if your load draws 30 mA, the total current is assumed to be 33 mA. With a 30 mA load the Zener passes 3 mA. If the load goes down to 10 mA the Zener will pass 23 mA. The power rating of the Zener is the current passed by it

(Continued on page 90)

THREE SHORTCUTS TO YOUR FIRST SHORTWAVE ANTENNA

by Hank Scott

BEGINNERS to the shortwave listening (SWL) hobby have no difficulty in obtaining good receivers, either budget jobs or gold-plated specials, when starting their first listening shack. Putting up antennas is their downfall.

Antenna theory is beyond the grasp of most novices. It is very complex at the beginning and rapidly becomes incomprehensible as different antenna types are introduced. So, why not take a shortcut approach to your first antenna installation. Get your new receiver pulling weak signals as you pile up listening hours with exotic DXing. What about antenna theory? It'll come if you work at it by reading theory books, but in the meantime here are three recorded case histories to low-cost antenna shortcuts which may be profitable.

Case No. 1—The Dangler. Harry is a youngster I met while giving a talk to the local high school student body during Science Fair Week. Harry was fascinated by the idea of English language newscasts from far-away places, so he bought a Realistic DX-160 receiver and set up a listening corner in his upstairs room in his folks' Colonial-style house. For an antenna, he dangled an odd length of wire out the window, letting it drop to the ground. The BBC and Radio Moscow came in fine except on rainy nights. In fact, it was a rainy evening when he rang my doorbell for help.

Harry's long wire was long and that's all it had going for it. It was vertically polarized (wrong) by hanging down and shorted out to ground (not good either) on damp nights. What Harry needed was a length of wire extended from the window to a distant pole, outbuilding, garage, or tree. In Harry's case, some sturdy trees outlined the houses's property line and he could run a 60-foot antenna with no difficulties. The antenna pointed due North-West and in his area of the U.S. was able to pull in Europe, North Africa, and the Near East with ease. Here's how we went about licking Harry's problem.

First, I told Harry that a good long-wire antenna should be at least 30 to 100 feet long for good reception performance on 2 to 30 megaHertz (MHz). As mentioned earlier, a 60-foot run was possible. A sturdy tree was selected because it hardly swayed in strong winds at the 20-foot level where the antenna would be secured. Some slack (one foot of droop) was left in the antenna to compensate for tree sway and strong winds. Harry's antenna details can be seen in Fig. 1.

Antenna wire and antenna long wire kits are available everywhere. Harry actually used the Radio Shack shortwave antenna kit (278-758) which consists of 75 feet of bare copper antenna wire, 50 feet of lead-in wire, four insulators, and instructions. Harry had no trouble at all getting the antenna up.

Harry was a little smarter than me. He remembered to protect against lightning. Since shortwave lightning arrester kits are usually not available locally, Harry made do with lightning arrester parts made for TV. The parts available from Radio Shack include the arrester (15-911), ground rod (15-530), 40 feet of aluminum wire (15-035), and other small parts. The TV arrester has two screw-tight terminals with star washers for the 300-ohm TV line, however Harry only used one for his antenna and the other was left unused. The whole lightning installation bit came to about $5.00. That's cheap. To bring the antenna lead-in into the house, Harry used a "Wall-Thru" tube

e/e FIRSTANTENNA

(Radio Shack 15-1200).

Now I don't see much of Harry. Maybe once in a while he's at the Pizza joint with a date, but you can be sure Harry's getting a lot of DXing and veries every week.

Case No. 2—The Specialist. I've known Mort for over 20 years. We knocked about through high school and somehow the paths of our lives are forever crossing. At one such juncture, Mort invited me to his home to see his new shortwave listening shack which sported a brand-new freshly assembled Heath GR-78 receiver. The GR-78 is a hot receiver. Unfortunately, I couldn't say the same for Mort's antenna. Mort was always inclined to specialize, and he had rigged up a dipole antenna with 300-ohm TV antenna lead-in wire. Mort wanted to log the 41-meter band and found it offered poor reception in his area. Besides, the noise was too high. He was asking, if not pleading, for advice.

First of all, I told Mort that dipole antennas are cut to exact dimensions for specific frequency bands as shown in Fig. 2. The dipole consists of a wire of a specific length which is cut in half. At the mid-point and both ends, each half of the wire is insulated from each other and insulated from ground. The lead-in cable from the antenna is actually two wires, and it's best to use a 73-ohm coaxial cable (coax) because it is inexpensive and commonly available. Without getting into theory, let me say that a 73-ohm coax lead-in cable "matches" a dipole antenna with less signal loss than does a 300-ohm TV twin-lead cable. On the design board, dipoles have a 75-ohm impedance and match pretty well into 73-ohm coaxes. The 300-ohm cable Mort was using was a bust.

The equation for determining the overall length for a dipole antenna at a given frequency is determined by dividing the given frequency in kiloHertz into the number 468,000. Or, as seen in the text books:

$$L = \frac{468{,}000}{f}$$

Where L is the overall length of the dipole in feet and f is the desired reception frequency in kiloHertz (kHz). I computed the overall length for dipole antennas to receive the international shortwave broadcast bands using the mid-frequencies of each band and listed them in a table that appears on this page.

When buying materials for a dipole antenna, wire and insulators are the same type as required for the long wire antenna. The lead-in coaxial cable should be RG-59/U or RG-11/U, each of which exhibits 73-ohms impedance. Stay away from unknown coax types or those with different impedances (ohms). As a guide, a table given on this page lists commonly available coax cables and their impedances. Any coax exhibiting an impedance in the 70's is good for the purpose. Let price dictate your selection.

I did not forget the lightning arrester in Mort's antenna. At the window, out of reach of the rain, I installed a Radio Shack coax static discharge unit (21-1049). This gadget requires PL-259 connector on the coax lead-in cable. It's worth the trouble. A grounding screw on the connector attaches to the

(Continued on page 92)

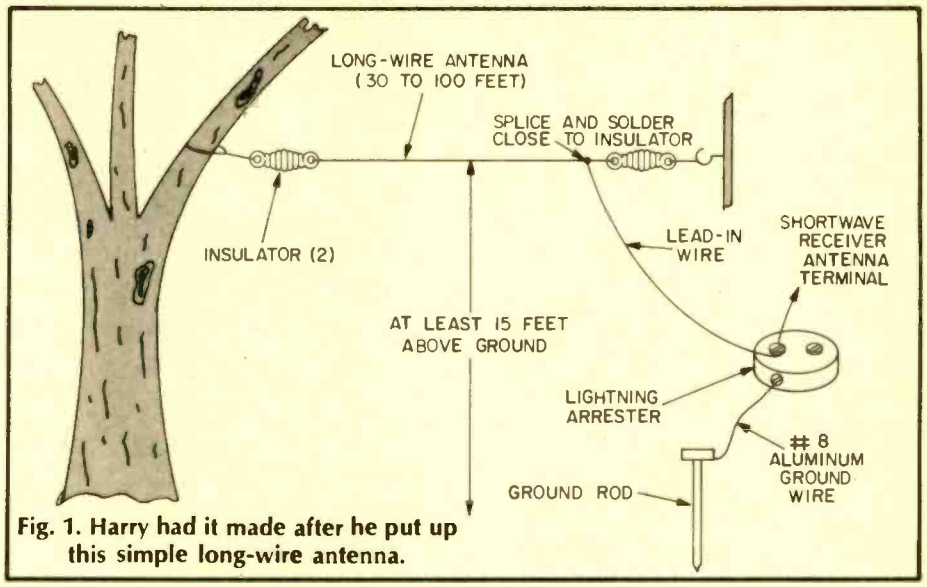


Fig. 1. Harry had it made after he put up this simple long-wire antenna.

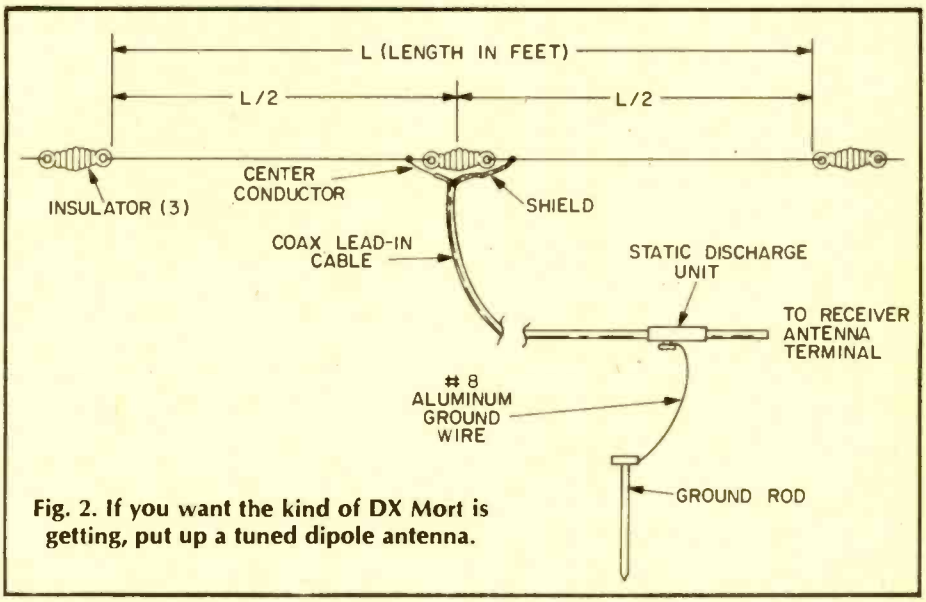


Fig. 2. If you want the kind of DX Mort is getting, put up a tuned dipole antenna.

Dipole Overall Length for the Shortwave Broadcast Bands

Band	Frequencies (kHz)	Mid-Frequencies (kHz)	Length (feet—inches)
120	2300-2495	2397.5	195—2
90	3200-3400	3300	141—10
75	3800-4000	3900	120—0
60	4750-5060	4905	95—5
49	5950-6200	6075	77—0
41	7100-7300	7200	65—0
31	9500-9775	9637.5	48—7
25	11700-11975	11837.5	39—6
19	15100-15450	15275	30—8
16	17700-17900	17800	26—3
13	21450-21750	21600	21—8

Coax Lead-in Cable

Cable Type	Typical Ohms
RG-11/U	75
RG-59/U	73
RG-59A/U	75
RG-59B/U	75
F-11/U	75
F-59/U	73

GETTING THE MESSAGE THROUGH

How a dead carrier can talk, sing, and even dance.

by Norman Crawford

ONE IF BY LAND, and two if by sea . . ." says the famous poem by Longfellow commemorating the midnight ride of Paul Revere in April of 1775. Revere's fellow patriot, who hung the two (if by sea) lanterns in the steeple of the Old North Church of Boston 200 years ago, was engaged in *communicating by modulation,* just as surely as today's CBer who presses the PTT switch on his microphone. For *modulation* simply means *variation,* or *change*—and it's modulation, whether you're changing the number of lanterns hanging in a church steeple, or using electronic circuitry to change the radio wave emitted by an antenna in accordance with your voice.

All communication is by modulation. For centuries, the American Indians sent messages by "modulating" a smoke stream with a wet blanket, and primitive tribes have long communicated by modulating the beat of their jungle drums. Later, semaphore flags were used to send messages by modulating their position. Even these words you are reading can be considered modulation of the surface of a piece of paper with spots of ink.

But almost all of today's long-distance instantaneous communication is carried out by modulating radio waves. In fact, this means of communicating is now so commonplace that even the Man the Street unknowingly refers to modulation when he speaks of "AM" and "FM". These familiar abbreviations stand for *Amplitude Modulation* and *Frequency Modulation,* respectively, and refer to the two common methods of changing a radio wave to make it broadcast words or music from one place to another.

Introducing the Carrier. A radio wave broadcast from the antenna of a transmitter is, in the absence modulation by speech or music, an unchanging, constant sine wave, as shown in Fig. 1. It is as constant and as unchanging as the steeple of the Old North Church, and conveys no more information than a steeple. It simply gives you something to monitor for the possible later appearance of a signal.

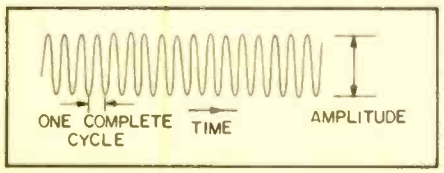


Fig. 1—Unmodulated carrier (RF) wave.

Just as the steeple was a support or carrier on which to hang the information-giving lanterns, so the radio wave becomes the carrier upon which the speech or music is "hung". In fact, the unmodulated wave is usually referred to as the *carrier.*

The carrier may be shown as a simple sine wave, as in Fig. 1.

The height, or amplitude of the wave, indicates the strength of the signal, while the time it takes the wave to complete a certain number of cycles determines the spot on the radio dial where the signal will be received. For example, as shown in Fig. 2a if it takes only a millionth of a second for the carrier to complete seven cycles, then it will complete 7,000,000 cycles in one second, and the signal will appear on a receiver's dial at the 7,000,000-cycle-per-second (7-megahertz) point, which is on the edge of the 40-meter ham band. Such a carrier has a *frequency* of seven MHz.

On the other hand, a carrier taking longer to complete the same number of cycles—say, seven cycles in 10 millionths of a second (Fig. 2b)—would complete only 700,000 cycles in one second, and would be found on the dial at 700 kHz (700 thousand Hertz), which is in the standard broadcast band.

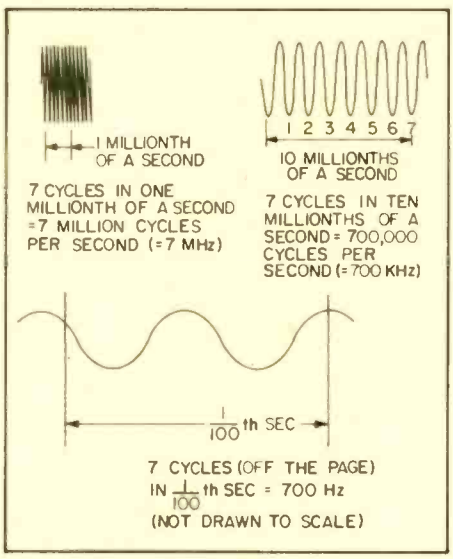


Fig. 2—Three different frequency waves. 700 Hz (bottom) is partial, not drawn to same scale as the two higher frequencies.

As can be seen from the above numbers, carrier frequencies are normally very high—much higher than the speech or music (audio) frequencies which we will cause the carrier to carry. For example, when a flutist plays the note F above middle C, he produces vibrations in the air which can be visualized as in Fig. 2c. Here, the time for 7 vibrations is only *one fiftieth* of a second, which is a frequency of only 350 cycles per second (350 Hertz).

But a constant (*unchanging*) carrier wave conveys no information. Something about the wave must be *varied* (modulated) to convey information to the listener. What can be changed, so that the listener can recognize that a signal has been sent to him?

AM and FM. Looking again at Fig. 1, you can see that a carrier has two obvious characteristics—its height, or *amplitude,* and its *frequency.* Changing either of these can cause a receiver to recognize that a message has been sent. If the amplitude is changed, we call it *amplitude modulation,* or AM. If the frequency is changed, we call it *frequency modulation,* or FM.

A very simple type of AM is shown in Fig. 3. Here the amplitude of the carrier wave has been changed suddenly to half its former value.

This change in amplitude is a simple form of AM, and can convey simple messages. If Paul Revere had been a CBer, he could just as easily have prearranged a code signal which said ". . . one drop in carrier amplitude if by land; two drops in carrier amplitude if by sea . . ." and served the American cause just as well (though Longfellow's

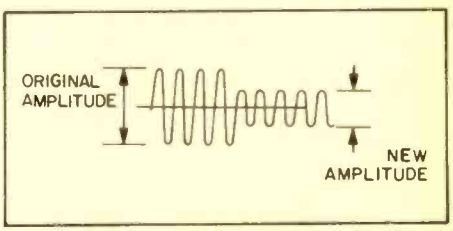


Fig. 3—Simplified amplitude modulation of the RF carrier wave.

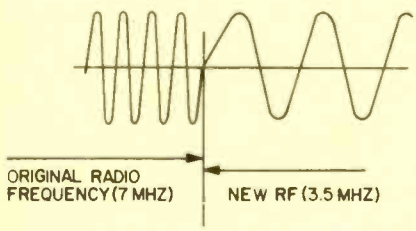


Fig. 4—Simplified frequency modulation of the RF carrier wave.

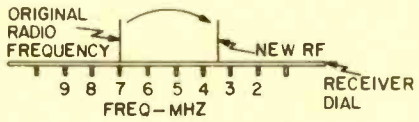


Fig. 5—If the frequency modulation were a simple change from one RF carrier frequency to another, an AM receiver could receive it if retuned.

poetry might have suffered).

The other obvious characteristic of the carrier wave of Fig. 1 is its *frequency*. We can also modulate this characteristic, as shown in Fig. 4. Here, instead of a sudden change in amplitude, there is a sudden change in frequency, from 7 MHz to 3.5 MHz. This is a very simple form of FM, and can also be used to convey simple messages. Since the drop in frequency represents a shift in the carrier's location on the dial, as shown in Fig. 5, two receivers, one tuned to 7 MHz and the other to 3.5 MHz, could detect this shift in frequency, and the listener could interpret it as a signal, according to a prearranged code.

What's PM? While the Man in the Street has made AM and FM household phrases, these modulation methods are only two of the three ways a radio frequency carrier wave may be modulated. The third method, *Phase Modulation*, or *PM*, although virtually unknown to most people, is nonetheless extremely important in such fields as data transmission and color television.

Phase modulation can be visualized as in Fig. 6. Here, neither the amplitude nor the frequency is varied, but the carrier is made to pause for a moment, and then to continue as a sine wave slightly delayed from the original. This delay is called a *phase shift*. Phase shift is usually measured in *degrees*. A phase shift equal to the time needed for an entire cycle is 360°. In the sketch, a sudden phase shift of about 70° (less than a quarter cycle) is indicated. By suitable receiver circuitry (found in every color TV receiver), this sudden change in phase can be interpreted as a signal. In color TV, it might represent a shift in hue from green to yellow.

Amplitude Modulation—A Closer Look. The sudden drop in amplitude shown in Fig. 3 is a good way to show the general scheme of AM, but it fails to tell us very much about how AM is used, every day, in our AM receivers and CB rigs. Here there are (hopefully) no sudden shifts in carrier amplitude, but instead, there is a remarkable recreation of speech and music from a distant transmitter. How is this done?

To explain, let us assume that our flutist stands before a microphone in a broadcasting studio, ready to play his 350-Hz F-above-middle-C. Let's also assume that the broadcasting station is assigned a carrier frequency of 700 kHz. Figure 7 shows how the carrier wave will appear just before the flutist plays, and just after he begins.

As you can see, the 350-Hz audio tone from the flute causes the amplitude of the carrier to rise or fall in ac-

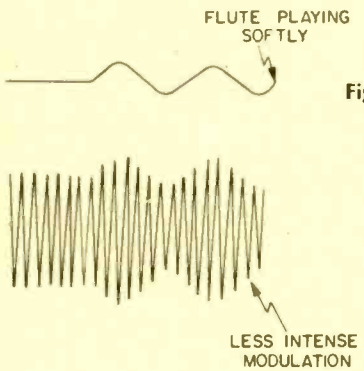


Fig. 8—Smaller audio signal modulates the RF carrier wave less.

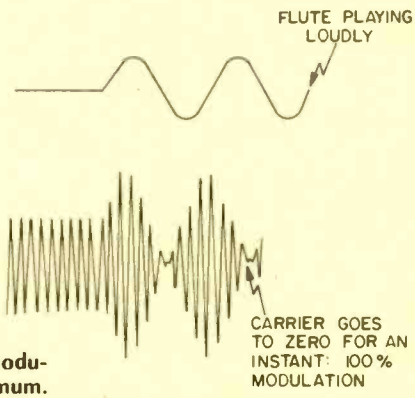


Fig. 9—Louder audio signal (sound) modulates the RF carrier wave to maximum.

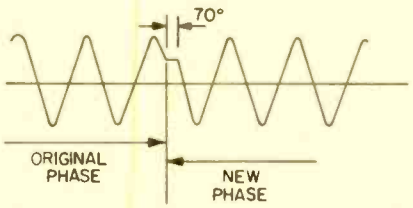
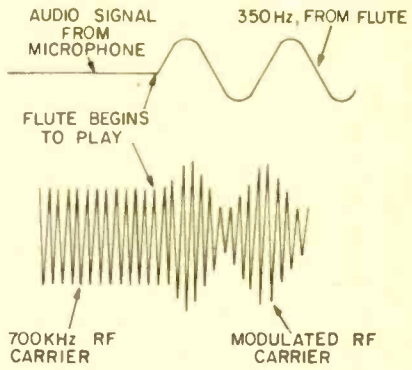


Fig. 6—Simplified phase modulation of the RF carrier wave.

Fig. 7—The audio signal (sound) modulates the RF carrier wave.



cordance with the rise or fall of the flute wave. Note that both the top and bottom of the carrier wave are affected by the flute waveform. It is as though the carrier had been squeezed into a snug-fitting envelope, forcing it to conform to the waveform of the flute sound. The shape thus formed by the tips of the modulated carrier wave is often called the *envelope*.

The envelope of an amplitude-modulated carrier is therefore a good replica of the audio waveform coming from the studio microphone. Every shading, every change, in the sound striking the microphone will be faithfully traced out by the tips of the carrier wave. For example, if the flutist were to play more softly, the result will be as in Figure 8. If he plays more loudly, Figure 9 is the result. You will note that in Fig. 9 the amplitude modulation is so intense that, at one point, the carrier's amplitude goes to zero for an instant. This is called 100% modulation, and represents the loudest sound AM can handle. If the flutist plays even *more* loudly, the result is as shown in Fig. 10. As the figure shows, the envelope is no longer a faithful replica of the original audio waveform, so the listener will receive a distorted sound. This condition is called *overmodulation*, and is undesirable.

Hardware for AM Systems. One of the most-straightforward methods of producing AM is the method invented by the Canadian Reginald Fessenden, in 1905. In his system, a radio frequency generator produced the carrier wave, which was fed to the antenna through a carbon (variable-resistance) microphone. See Fig. 11.

Since a carbon microphone varies its resistance in accordance with the speech or music, the microphone in this primitive system acted as a valve to allow more or less of the RF carrier wave to pass to the antenna. In this way the carrier wave broadcast by the antenna was amplitude modulated by the sound waves striking the microphone.

More Up-to-date Modulation Methods. Although nobody puts carbon microphones in series with antennas any more, the more modern modulation methods, such as those found in AM broadcast transmitters or CB transmitters are still rather similar to the primitive carbon-mike method. The typical modern AM system (Fig. 12), still employs an oscillator (which is crystal-controlled, to ensure that the carrier frequency is constant, and thus is found at a known spot on the dial), and a power amplifier to strengthen the carrier before feeding it to the antenna. The amount of "strengthening" is controlled by the audio signal, and the

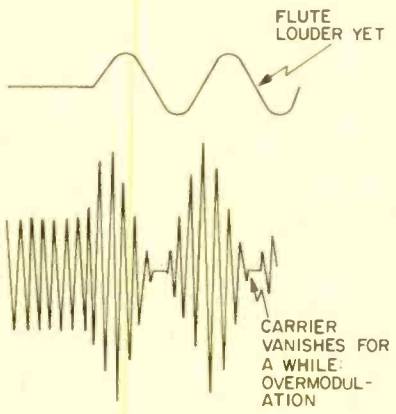


Fig. 10—Further increase in amplitude of audio signal causes overmodulation.

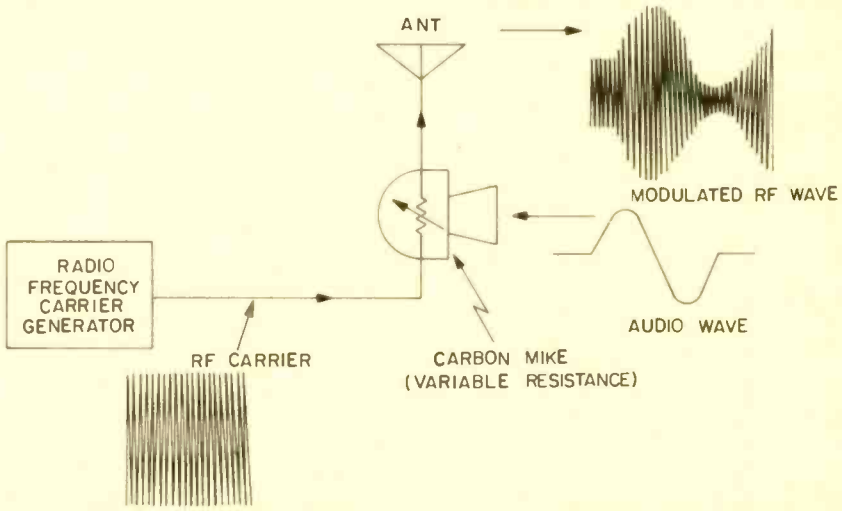


Fig. 11—The first radiotelephone broadcast transmitter, invented by Canadian Reginald Fessenden, who broadcast voice and music to a few ships at sea on Christmas Eve, 1905. It worked, but was very noisy.

GETTING MESSAGE THROUGH

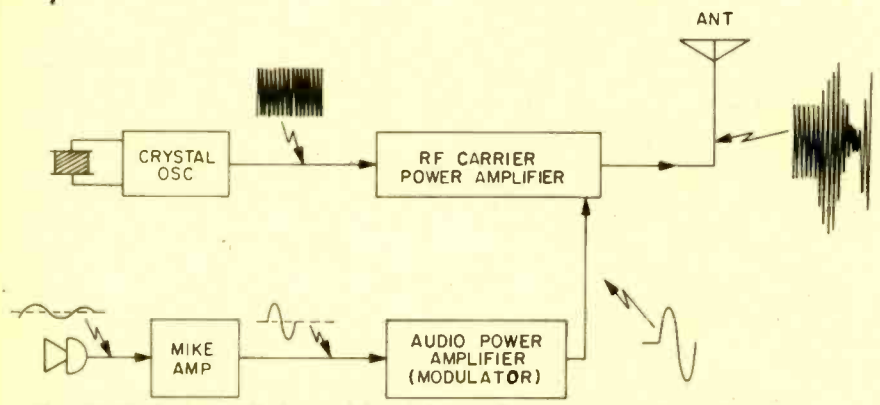


Fig. 12—Typical amplitude-modulated RF (radio frequency) transmitter.

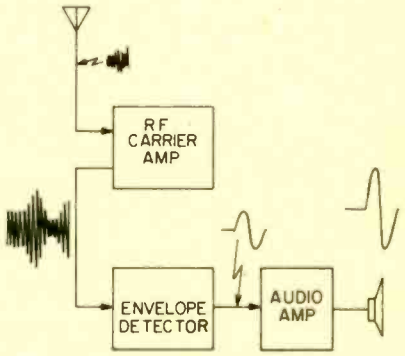


Fig. 13—Block diagram of receiver for amplitude-modulated radio frequency (RF) signals.

power delivered to the antenna is in this way amplitude-modulated and the radiated carrier will convey the speech or music to a distant point.

Receiving the Signal. At that distant point, we all know that the carrier wave may be intercepted by a suitable antenna and applied to a receiver. A simple receiver is shown in block diagram form in Fig. 13. Here, the weak signal from the antenna is first amplified in a carrier-wave amplifier, (an RF (radio frequency) amplifier, and applied to a *detector* which can extract the original audio signal from the amplitude-modulated RF carrier. This audio wave is further amplified and then fed to a loudspeaker, which re-creates the original speech or music.

The Detector—Heart of the Receiver. By looking at Fig. 13, you can see the detector is the heart of the AM receiver which extracts the original signal from the amplitude-modulated carrier. The circuit that does this job is suprisingly simple. It resembles very closely the circuit of a typical power supply. In an AC power supply, when 117-volts AC is applied at the input plug, a DC voltage appears at the output. If, because of a brown-out or for some other reason, the 117 volts at the input drops to, say, 105 volts, the DC output will drop correspondingly. In a power supply, this output drop is undesirable—we want the DC output to remain constant even though the input AC varies. Notice that the drop in voltage of the 60-Hz power line input from 117 volts to 105 volts is *actually amplitude modulation,* of the 60-Hz input sine wave, and *the drop in the output DC has "detected" the AM that occurred at the input!* This is shown in Fig. 16.

So a simple AM detector may be thought of as a power supply arranged to change its output very quickly in accordance with the amplitude changes in the AC (carrier) at its input. And, since these fluctuations in amplitude of carrier represent the original audio signals, the "power supply" (detector) output will be the same as the original audio. It's interesting to note the power supply's undesirable trait, unsteadiness in output when the input is unsteady, is the useful operating characteristic of the same circuit when used as a detector!

AM From Another View. Thus far in our study of AM, we have concentrated on explaining AM in terms of the waveforms, the waveshapes you would see on an oscilloscope connected to appropriate points in the transmitter or receiver. There is another useful way to view AM which concentrates instead on what happens at the dial of the receiver as the carrier is modulated. In the next issue of ELEMENTARY ELECTRONICS we will take a dial's-eye view of AM. From this we will learn about *sidebands*—what they are, how they are generated, and how they behave in an AM system. Still later, this knowledge of sidebands will help us understand FM and PM (phase modulation). ■

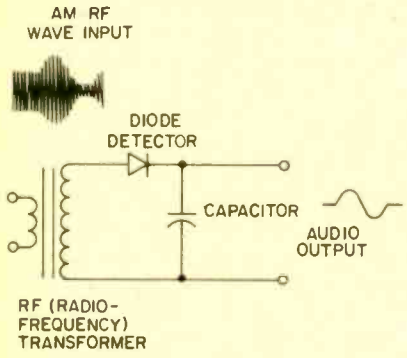


Fig. 14—Simple receiver of amplitude-modulated (AM) RF signals.

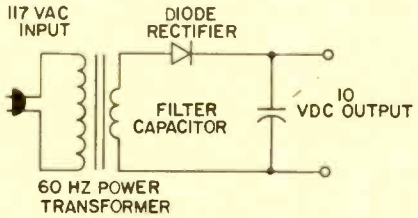


Fig. 15—DC power supply from AC house current has circuit similar to that of the simple AM receiver.

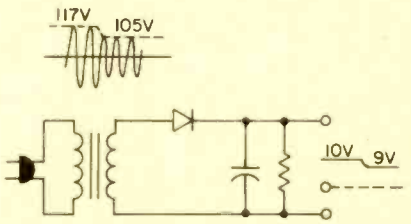
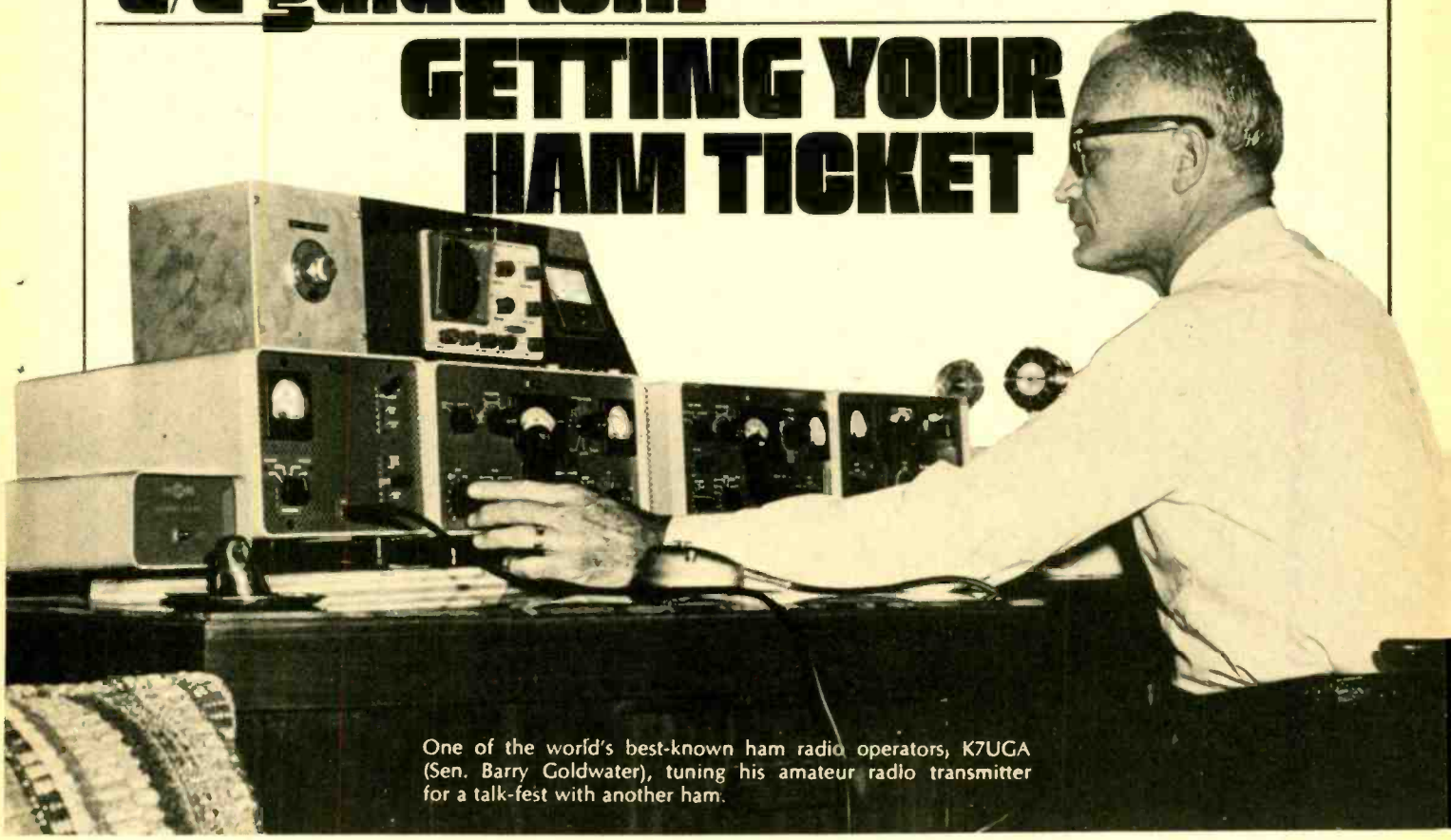


Fig. 16—Changing amplitude of voltage input to power supply provides changed (modulated) output.

e/e guide to....

GETTING YOUR HAM TICKET



One of the world's best-known ham radio operators, K7UGA (Sen. Barry Goldwater), tuning his amateur radio transmitter for a talk-fest with another ham.

Three Weeks to an Amateur License! Anybody Can Do It!

by the Elementary Electronics editorial staff

☐ OVER THE YEARS a myth and legend has been created in which the amateur radio operator is envisioned as the true experimenter. He, or she, is the one who has provided the impetus for modern communications systems, the one fully prepared and equipped for all emergencies, the one who has proved competence by passing a difficult technical exam, the one who continually upgrades his technical knowledge.

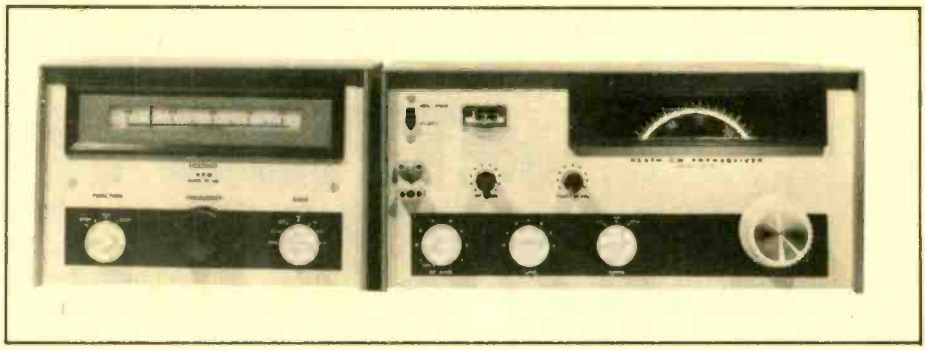
Yes this *was* all true in '30s and '40s. Since about the 1950's, it has been all hogwash. Many of today's amateurs took a mail order exam because they hadn't the drive and determination to pass a 13 wpm (word per minute) code exam. Many got their licenses by simply memorizing a license guidebook. Most use store-bought equipment and haven't the vaguest idea what's inside. Others have absolutely no interest in anything technical, they simply enjoy talking with other people—either local or foreign contacts—and they are really not much different from many CBers in this respect. And speaking of CB, a substantial part of the technology in modern amateur equipment stems directly from the mass-marketing design of CB transceivers, as does much of the modern antenna equipment used by mobile amateurs.

This is why we can say amateur radio lives within myths. In actual fact, there is room in amateur radio for every interest even remotely connected with electronics: everything from chit-chat, to general or specialized personal experimentation, to even a legalized personal telephone connection via an *autopatch* from your mobile rig or handie-talkie directly to the telephone lines. And you can do all this and more without being an electronics genius, without really proving "technical" competence, and without being a "true" experimenter. All you need is a reasonably good memory, about 30 minutes a day for three weeks, and the determination to stick it out for three weeks even when you think you're failing to learn anything at all. At the end of three weeks you should be ready to pass the entry level amateur exam, for the *novice* license. (And I'd like to add that an amateur license—most can be renewed for a lifetime—is more than a pass to a hobby. Many people, including some of our own staff, have been chosen for jobs mainly because they had that valuable radio amateur's license.)

What About It? A novice license has some restrictions. The holder can work only in code on several small band segments, three of which happen to fall in the 80, 40 and 15 meter bands, allowing contacts from local hams to the other side of the world (depending on weather and sunspot conditions). He is also limited to 75-watts input power to the transmitter, but that's no problem because much of the best equipment has the same power capacity, and it is enough to "work the world." Sound dull? *Never!* The novice band segments have the most activity—they are literally jammed with signals and you'll find

e/e THREE WEEKS TO HAM LICENSE

Three things put you well on your way to an amateur radio license: a code course on LP record, the ARRL books "How To Become A Radio Amateur" and "The Radio Amateur's License Manual." The code course is available as a single for learning the novice license code speed and as a two-record senior course for novice and general code speeds to 18 wpm. If you plan to work to a higher license, get the senior two-record course.



The most famous "Novice Pair"—the HW-16 80, 40, 15 meter CW transceiver and the HG-10B VFO. Equipment you'll still be using after you've moved up to a higher license.

many 1 x 2 and 1 x 3 calls (old timers and *extra* class license) working the novice segments because that's where most of the action is. You'll find everyone from the new ham plodding along at 5 wpm (and missing a good part of the copy) to teenagers who can copy 46-65 wpm in their heads and play a game of chess on the side at the same time.

Spend a few months on the novice bands and a few hours a week with the ARRL Radio Amateur's Handbook (and only the ARRL version) and you should be ready for your *general*, or even *advanced* license exam before the season changes. (Fall and winter always seem the best time to start out in ham radio—there's more time indoors for the books.)

The FCC's requirements for a novice license couldn't be easier. First, it's given by a local ham. If you don't know one, the teacher in charge of your local High School Radio Club can probably find someone to give you the exam which is supplied directly to him by the FCC (in a sealed envelope). Secondly, the code speed requirement is 5 wpm. If you spend an honest ten minutes a day listening to a code record or tape, you will pass 5 wpm at the end of five days. Up to about 7 wpm you can learn code at the rate of about 1 wpm/day.

The final part of the novice exam is a few questions concerning rules and regulations and the most basic, elementary theory which any e/e reader who has built a few projects—no matter how simple—will know. What you don't know will take less than a few hours to learn, in bits and pieces a few minutes at a time.

All this will come out successfully if you go about it the right way, and you should be ready for your *novice* license test in one to three weeks.

How To. The most important thing as far as you, the potential ham is concerned, is the code test. Forget that jazz about listening to a receiver. You're not going to buy a receiver just to learn 5 wpm code, nor will it help you correct your mistakes. Get a code training LP record or a cassette tape. There are many types available; virtually all are priced somewhere between $4 to $10. We tested a few for e/e and most seem more suitable for the 13 wpm (and higher) code tests. One of the very best code records for the novice speed of 5 wpm appears to be the Ameco Junior Code Course on LP record #100-33. We tried several code courses on children (ages 11 through 13) and the Ameco seems to be the easiest to handle and learn from. The code speed changes seem just right, and because it's on LP it's easy to reset the phono pickup to the speed you want quickly and easily. The Ameco record also includes a chart so you can check the accuracy of your copy.

Once you have memorized the code—from the preparation book supplied with the Ameco record—about 10 minutes of practice per day should have you slightly past 5 wpm in five days. Admittedly, some—a very few—have extreme difficulty with the code and might take maybe ten days to make 5 wpm. But, it can be done quickly by almost anyone. The plateau, the speed at which code becomes somewhat difficult to copy with accuracy, is 8 to 10 wpm. (That's why the general license calls for 13 wpm. You can really sweat it out if you don't have actual operating experience.)

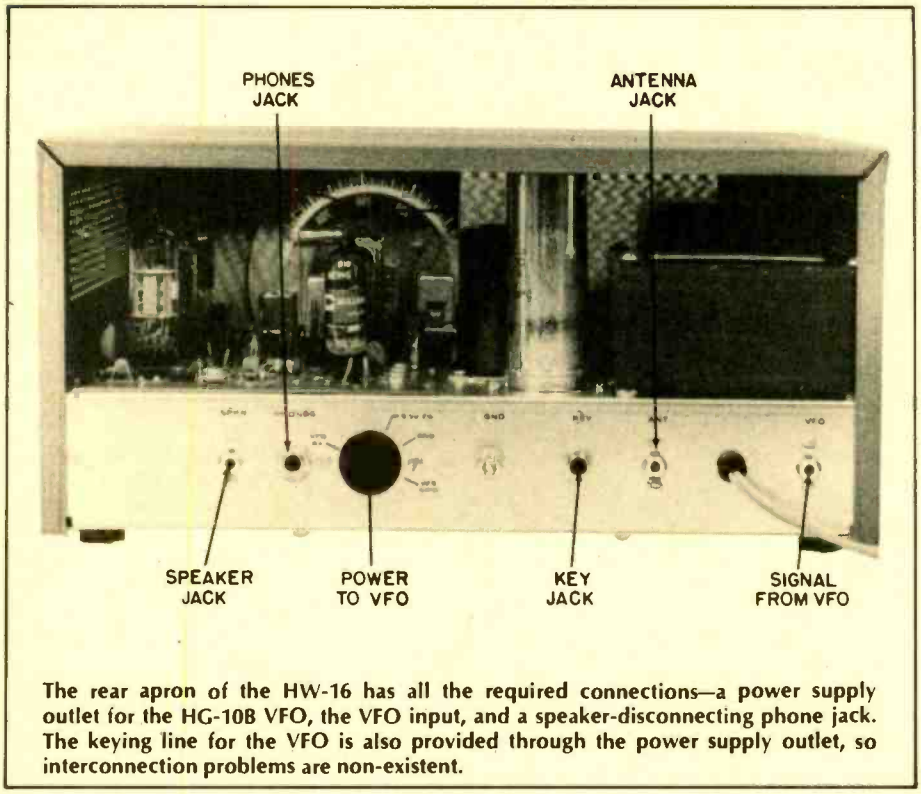
You can spend the remaining 20 minutes of your 30 minute daily amateur radio study time with two books: The ARRL's *How To Become A Radio Amateur* ($1) and *The Radio Amateur's License Manual* ($1).

Review. The first book has the usual filler, construction projects you'll probably never build, some articles of general interest about ham radio, and most important, 34 pages on the fundamentals of radio, which is the best introduction to radio written. This is the very material you can learn in three evenings that educators "rewrite" into school textbooks of a couple hundred pages—making it more difficult every step of the way. Most of what's in the 34 pages will take you through the novice license exam.

The License Manual fills out the rest. It has sample material from all the various amateur tests and the amateur rules and regulations. You will have to virtually memorize the rules to pass the exam, but if you simply read them through three or four times you'll know enough—the FCC doesn't make it hard. The sample novice license questions are almost word for word what you'll get on the exam.

That's the whole bit. A code record, two dollar guidebooks, maybe the ARRL's Amateur's Handbook (if you intend moving up), three weeks time and you should be ready to take the *novice* license exam.

Then you wait six to eight weeks for the license to arrive (the FCC is on



The rear apron of the HW-16 has all the required connections—a power supply outlet for the HG-10B VFO, the VFO input, and a speaker-disconnecting phone jack. The keying line for the VFO is also provided through the power supply outlet, so interconnection problems are non-existent.

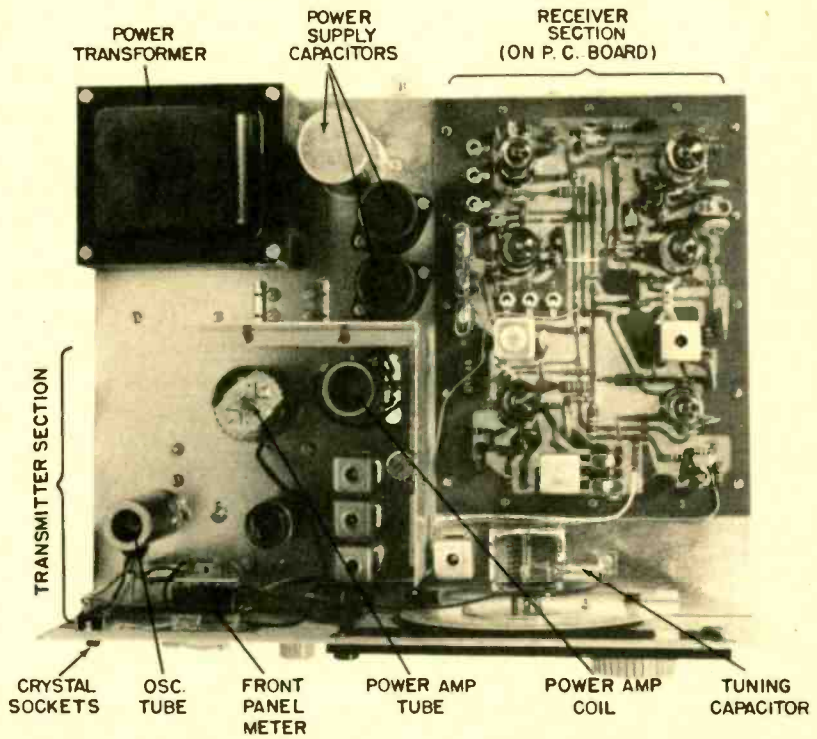
computers). While waiting you can start to build the station; but remember, no transmitting until you get your license. Amateur radio is *not* CB. No one will look kindly on your violations. *The first one to turn you in for unlicensed operation will be another ham.* This is for the good of ham radio—that's how they keep the ham bands free of illegal operators.

Equipment. While waiting for your license the only problem you'll face is what to buy. Unquestionably, you'll find there are receivers that "cover the ham bands" priced anywhere from $100 up and up, up, up. What won't be so easy to find is a transmitter suitable for novice use. True, any transmitter can be used for CW, but there's no reason to buy a sideband rig—at this time—when all you can work is CW. And if you plan on moving up to a higher license, a low cost general purpose receiver is a pain to tune and operate in sideband. There is some equipment around that has a novice power rating and an AM modulator. Forget it. For all practical purposes low power AM is a dead mode.

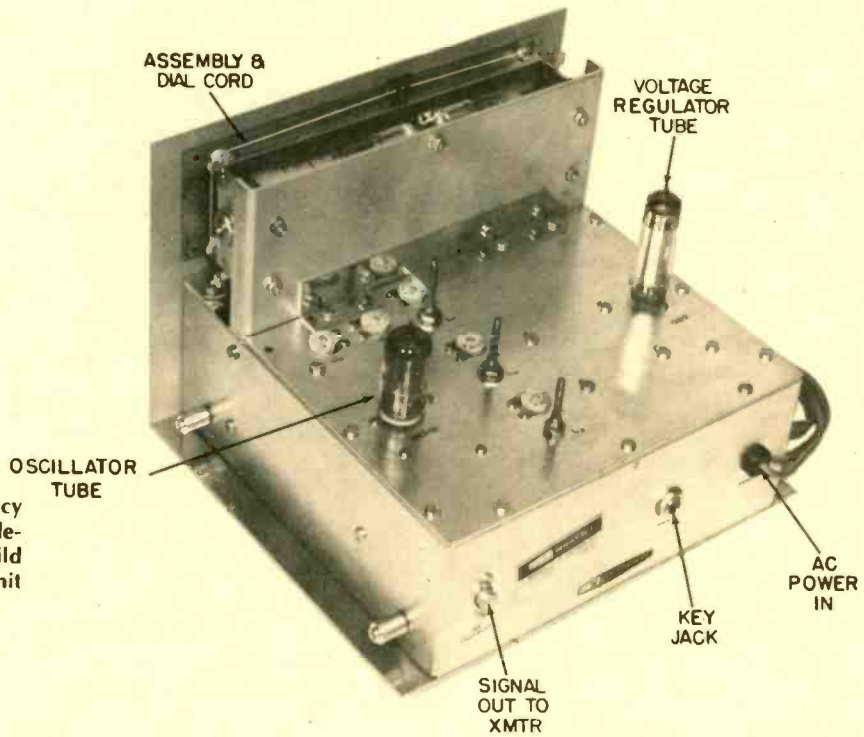
In short, there isn't much available in novice equipment. Fact is, we have found only one novice rig we would recommend to e/e readers; a rig you will still use long after you have moved up to an advanced license; for within its operating range, its performance is equal what you'll get later for five or six times the price.

The rig we suggest to e/e readers becoming novice hams is Heathkit's HW-16 CW Transceiver with the optional HG-10B VFO (variable frequency oscillator). The HW-16 features a crystal controlled transmitter rated up to 90 watts input with an input for a remote VFO (all power supply connectors and the keying line are prewired for the HG-10B VFO). The receiver is crystal-selected to cover only the first 250 kHz of the 80, 40 and 15 meter bands—which includes the three most important and effective novice bands. In the two model HW-16's we tested in the e/e lab, the selectivity—the ability to reject interference from stations near the desired frequency—compares with that of receivers priced well over $300. This is produced by an internal crystal filter very similar to that used in higher priced receivers. The sensitivity on 80 and 40 meters checked out better than 1 uV for 10 dB S + N/N (signal plus noise to noise). On 15 meters, sensitivity is considerably reduced: 1 uV produces output but at very low level. On 15 it's adequate for stronger stations, being no worse than the sensitivity of many budget priced "general purpose" receivers in the same price range.

The big plus of the HW-16 is rock-stable reception. After a five or ten minute warm up there is just no drift, due to the crystal controlled first conversion oscillators (three bands, three crystals). (*Continued on following page*)



Here's the Heathkit HW-16 novice transceiver. Top view shows the printed circuit receiver section which is quite easy to build. The power supply and transmitter are hard-wired directly on the chassis.



The Heath HG-10B VFO (variable frequency oscillator) has only two tubes, in a wide-open layout. It is actually easier to build than the transmitter, yet the assembled unit supplies a rock-stable frequency output.

The receiver is *full break-in* with *sidetone*. This means that when you press the telegraph key the transmitter automatically transmits; when you lift the key the receiver is automatically turned on. There are no send-receive switches, keying relays, or anything. All switching is automatic and instantaneous. Whenever a signal is sent—when the key is depressed—a tone (sidetone) is automatically heard in the user-supplied speaker, or headphones. This sidetone eliminates the need for a separate keying monitor.

The transmitter has simplified single-control tuning and works well into antennas or antenna systems of approximately 50 ohms with SWR (standing wave ratio) up to 2:1. A switch-controlled front panel meter indicates final plate current and has a red scale mark for the novice power limit or relative RF power output. To tune the HW-16 you simply adjust the single tuning control for maximum RF output or *minimum* plate current. If the plate current indicates above the red mark, it can be reduced to the novice value by turning down a front panel control labeled *power level*. Normally, the power level control is left at almost maximum value, and the transmitter can be tuned in about two seconds by adjusting the single *tune* control.

Build It. The HW-16 is available only in kit form, but you should have it ready to go easily before your license arrives. The receiver section, always the most critical part of a transceiver, is entirely on a printed circuit sub-assembly. The power supply and transmitter section is assembled on a combination chassis-main frame. The receiver's PC board is oversize and it is virtually impossible to make a mistake or louse up performance unless you install the wrong parts. This is hard to do because the value of every part is marked on the topside of the PC board.

The transmitter section is similarly easy-to-build, though there are a few tight spots—particularly around the band switch. We would suggest someone under 13 years, or anyone who hasn't built a non-beginner's kit, get some assistance with the bandswitch wiring—either from an adult familiar with tools through home repair, or another electronic hobbyist.

Alignment of both the transmitter and receiver sections is relatively easy—all you'll need is a couple of transmitter crystals, which you can probably borrow. Or, you could borrow a signal generator from another ham, but the results will be no better with a generator than with crystals.

We suggest that for optimum ease-of-operation, the companion HG-10B VFO be assembled with the transceiver as it allows operation anywhere on the band, and you get more contacts when you can zero-beat the other station. The HG-10B is a rock-stable VFO, even with a short five or ten minute warm up. Again, we checked two different units, and found it to be an admirable performer. The dial assembly has essentially zero backlash—once the frequency is set, it remains there.

It's Easy. Construction of the VFO is a breeze. Everything is wide open with plenty of room between components. Just a simple following of instructions produces a notably excellent VFO.

As assembled, the VFO works directly with the transceiver. Just plug in the VFO "power" connector and "output" to matching jacks on the back of the transceiver and it all works together without a rat's nest of wiring.

Together, the HW-16 and HG-10B make up one of the best low band rigs (80 and 40 meter). You'll be using them as a novice, and long after you've moved up to a higher license.

Whatever equipment you decide to use, the point is to get started on your amateur license now. Besides the fun and the friends you'll make, you'll want to be *grandfathered* into any changes the FCC makes in the amateur regulations. Big changes are coming, some might already be in effect when you read this article, and you want to be in before more changes, for the usual procedure is to give all privileges to those already holding a license at the time of the change. Go novice immediately and general as soon as possible. Once you get on the novice bands, the experience combined with what you've already learned as an experimenter will put you well on your way to expanded amateur privileges via a general license.

Okay. Stop wasting time. Get on that code practice right now. ■

Modernistic bust of Marconi at Cape Cod, Massachusetts

WIRELESS FACTS

by George Haymans, Jr.

WE WILL BET you a galena crystal against a coherer detector that most readers of ELEMENTARY ELECTRONICS are firm in their belief that wireless was invented by Guglielmo Marconi. He does deserve full credit for his work; it was necessary, for without it we would not have radio today, but the facts behind its invention and development do need to be understood. Too often we credit inventions to those that are the first to prove practical application and ignore the work of the actual inventor.

To further confuse your thinking, James Watt did not invent the steam engine, nor did Robert Fulton invent the steamboat. But they did build the first practical working models, based on concepts developed by others, and so ended up with the credit of being the inventors. Now, let us look back and explore the work of those whose thinking and experiments guided Marconi to his practical use of wireless.

The Start. A young mathematical genius, James Maxwell (1831-73), developed formulae indicating that light and electricity traveled in "waves" at a speed of 186,000 miles per second. His work as Professor of Experimental Physics at Cambridge University was purely theoretical; he never proved his theories by experimentation. It is his basic theory, however, that led to experiments by others and later to Marconi's practical demonstration of wireless. These same theories are valid today and it is the basic concept with refinements on which our present system of electronic communication is based.

The first experiments that proved Maxwell's theories were conducted by a young German high school teacher, Heinrich Hertz (yes, the same man whose name is honored as the unit of frequency measurement, today). Hertz realized that mathematics is the basis of all science, checked Maxwell's formulae, and then proved them by experiments. In about 1887 his "electromagnetics" experiments proved that waves do travel through space. He used twin coils of wire, each with a "gap" in it, and noted that when he connected a source of electricity to one coil, causing a spark to leap its "gap", a spark would also leap the "gap" of the matching coil a short distance away—without any connection between them—thus proving Maxwell's theory that electricity traveled through space in "waves."

One interesting aspect of Hertz's experiments is that they were conducted utilizing "short-waves" since the coils of wire he used were usually one turn of wire, open at each end, to form the "gap." This resulted in a fundamental frequency of resonance in that spectrum we know today as high-frequency or short waves. Hertz first used frequencies around 60 MHz, while Marconi's initial experiments were made on about 250 MHz. Another interesting item is that Hertz gave no practical value to his own experiments, never realizing their value in communications.

The Idea. It was when he read of Hertz' experiments that Marconi became interested in pursuing them for communications, and after duplicating them, he proceeded to refine them so he could increase the distance between the two resonant coils, until in 1885, he transmitted a "signal" over a distance of more than a mile. Here, again, Marconi used another man's invention—the coherer—developed by Professor Edouard Branly at the Catholic Institute of Paris as the means of detecting signals. The

(Continued on page 94)

Antique radio parts in collection of Wayne Nelson, Concord, N.C. include Audions, transmitting tubes, and coils. Middle (left) shelf displays a spark-gap transmitter similar to one Marconi used in his early Transatlantic contacts.

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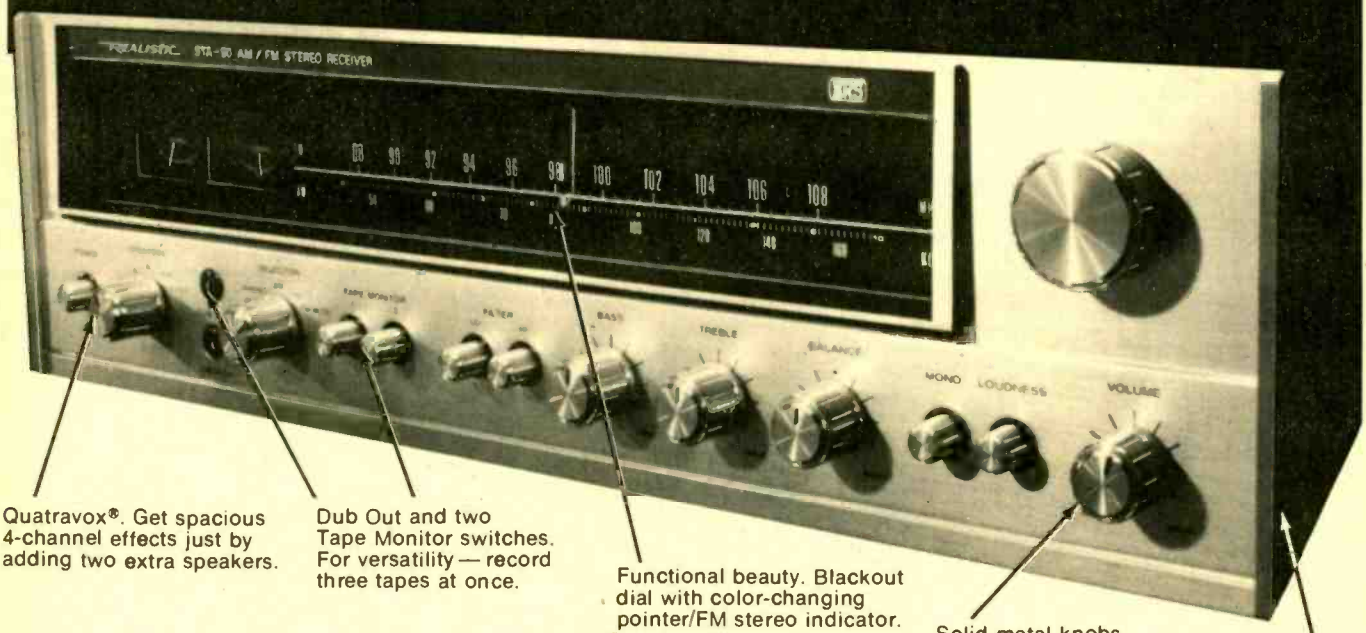

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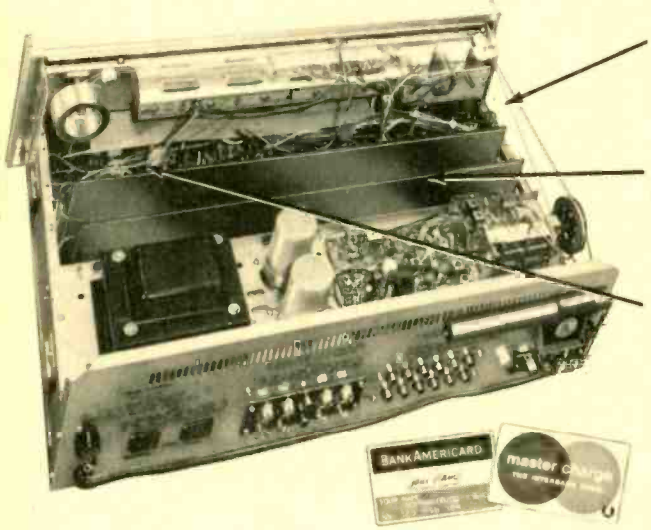

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e/e checks out...

CIRCLE 31 ON READER SERVICE COUPON

HEATHKIT GC 1093 DIGITAL CAR CLOCK

☐ Whether you're a rallye driver who needs to clock the ET (*elapsed time* per event), a traveller looking to the end of a trip, or just someone who wants a conversation piece in the car, the Heathkit GC-1093 Digital Car Clock is the way to go.

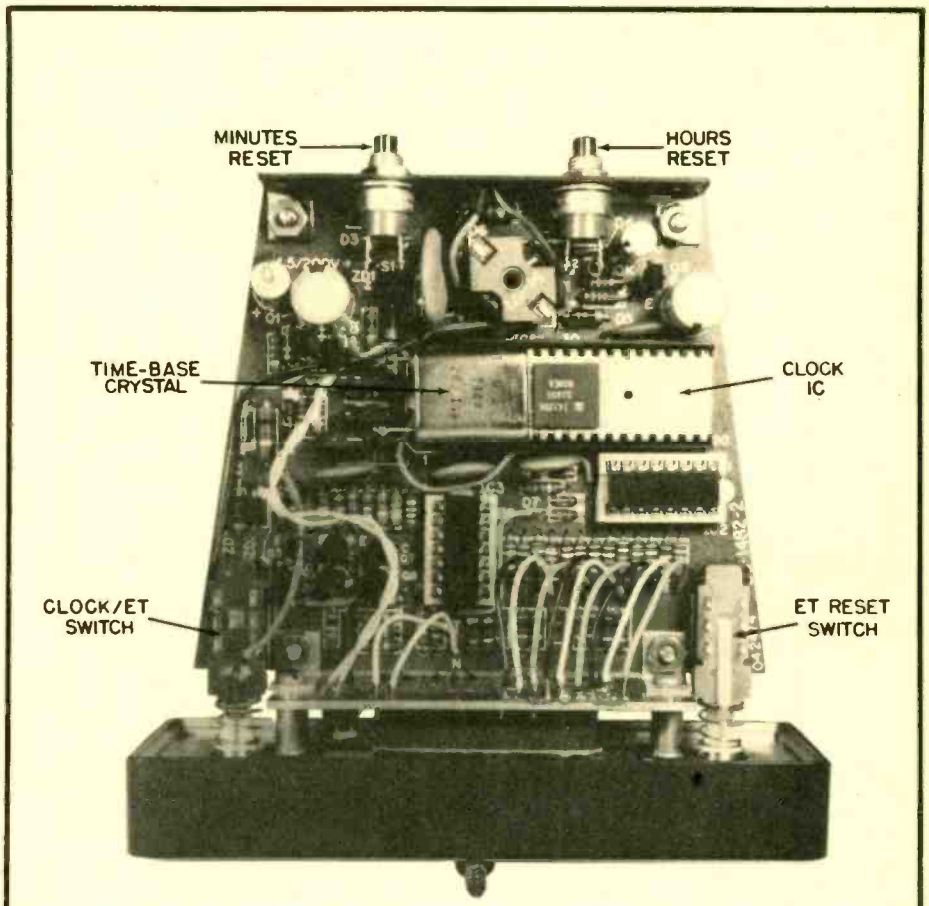
Just as the name implies, the GC-1093 has a digital readout, using what is by now Heathkit's "standard" oversize (about ½-in.) gas-discharge display.

The dual purpose clock is housed in a small cabinet 4⅝-in. wide x 1⅞-in. high x 4¾-in. deep. A mobile mounting bracket similar to the type used for CB transceivers is provided for underdash mounting. If you'd like the clock out for all to see it can be placed on top of the dash. The power source is 10 to 17 VDC with a negative ground.

In addition to the required numerals the digital display also indicates the *colon* as in 12:56, and a.m. or p.m. The a.m. and p.m. indicators are also used to show the clock and ET modes. When the a.m. or p.m. indicator is on, the time is displayed. If the a.m. and/or p.m. indicator is not shown, *elapsed time* is being indicated. In the clock mode, time is indicated in hours and minutes. In the ET mode, the clock counts in minutes and seconds to 9:59, at which point it automatically switches to hours and minutes to a maximum 19 hours and 59 minutes.

Back And Forth. Both the clock and ET counters run continuously regardless of the display selected. For example, if the ET is running and you switch to the "clock" mode for the correct time, and you switch back to ET display, it picks up the correct elapsed time. Similarly, if you switch the display from ET to clock, the correct time is displayed.

Maximum power from the battery—about 300 mA—is consumed when the display is on; but only 30 mA—an insignificant value—is required to run the counting circuits, so the clock has *three* power wires. One wire is ground, the second wire connects directly to the car battery providing full-time power for the counters, while the third wire connects to the battery through the ignition switch. When the ignition is off, the display is off, but the counters keep running, so the correct time is indicated when the display is turned on by the



Looking down on inside of assembled kit shows most of circuit including the three ICs on the main printed circuit board. Even beginners can assemble this clock/ET indicator in four or five hours. Edge of printed circuit board for diplay tubes is at bottom of photo.

e/e DIGITAL CAR CLOCK

ignition switch. Provision is made, as we'll show, to turn on the display even when the ignition switch is off.

The front panel has two pushbutton switches: labeled *CLOCK ET* and *ET RESET*. When the *CLOCK ET* switch is out, the correct time is displayed. When the switch is in, the elapsed time is displayed. The *ET RESET* is a momentary-contact switch that resets the ET timer to zero when depressed. It also serves to turn the display on when the ignition switch is off. For example, if you are sitting in the car and want to know the correct time, you simply press the *ET RESET*. The display goes on and stays on as long as the switch is depressed.

Auto Lumen. To avoid excessive brilliance from the display at night, a photocell sensor built into the display window reduces the display brilliance as the sunlight fades: the display brightness level is lowered to more-or-less match the brightness level of the dashboard lamps.

Two pushbutton switches on the rear of the cabinet are used to set the correct time. One switch advances the hours count each second; the other advances the minute count each second.

If you are at all familiar with standard car clocks, you know they are notoriously inaccurate—that's why few cars come with clocks anymore. But this is not true of the Heathkit GC-1093 which is spec'd for an accuracy of one minute per month at 25°C. The reason for the Heathkit's accuracy is a crystal controlled time-base oscillator whose output is independent of the battery voltage.

All time-keeping functions including the oscillator are provided by a single integrated circuit (IC). Since power is applied full-time to the counters (only the display is turned off) the clock runs at all times and is instantly ready to indicate the correct time when the display is turned on.

The high voltage for the display device is derived from a one transistor DC-to-DC converter similar to the type used for electronic flash units (strobe lights) and emergency vehicle flashers. Since the approximately 270 mA required to operate the converter could conceivably run down a battery that stood idle for several days (more likely a week or two), the power source for the converter—hence, the display—is turned off by the ignition switch.

Most of the assembly is on two printed circuit boards; one for the display tube, the other for just about everything else. Heathkit has made assembly really easy for the beginner by providing the display tube pre-mounted on the PC board, and by using sockets rather than individual pins for the ICs. It's rather difficult to make a mistake.

The GC-1093 Digital Car Clock kit is priced at $62.95 plus shipping. For additional information circle No. 31 on the reader service coupon. ■

HEADS UP ACROSS THE SEA

by Joe Gronk

☐ Some time ago there was an exhibition in Washington, D.C., of drawings and models from the past hundred years or so of the U.S. Patent Office. The interesting thing about the exhibit was how weird and far-out most of these inventions were. But it seems that Americans aren't the only people to keep on inventing fifth wheels. From England, and from France, we have here the latest in "practical" inventions.

The English invention is a new idea to warn motorists and pedestrians of danger: a policeman's helmet with a flashing light on top. The idea has been developed to make policemen in their dark uniforms more conspicuous at night. This should prove particularly useful at the scene of an accident where motorists need to be warned of the danger in good time. If an ordinary police car is not available immediately—one with the normal flashing blue light on top—the flashing helmet makes a good, and very mobile, substitute.

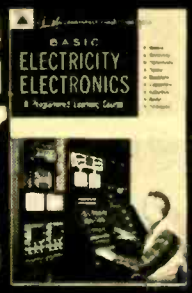
The same applies to traffic jams which happen after dark. The normal procedure is for a traffic policeman to wear a white raincoat, but the blue lamp should make him much more visible. The light is powered by a battery worn on a waist harness, which is the same principle as the lamp on a miner's helmet, and although the battery is quite heavy, the lamp itself weighs only six ounces. The idea has not been put into general use yet, but the Birmingham police think it is well worth considering.

On the other side of the English Channel, in France, they've come up with the idea of eyeglasses with windshield wipers. Anyone who wears glasses knows that after a while of walking in the rain it's almost impossible to see anything. Or, in the winter, walking into a warm house after being out in the cold causes glasses to fog up.

Following the good old principle of windshield wipers for cars, a French manufacturer set out to remedy this problem. The firm came up with glasses with a windshield wiper system that runs on a single very small dry cell battery. In spite of their rather large size, the glasses weigh only about a half ounce more than regular glasses. And, of course, prescription lenses can be fitted in just like normal glasses.

In order to start the windshield wipers working, you press a little button on the holder of the battery case. It's a simple idea, but one that might very well catch on—especially among nearsighted seagulls and others who don't happen to keep a handkerchief. ■

e/e BASIC COURSE IN ELECTRICITY & ELECTRONICS



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

MAGNETISM FOR ELECTRONICS

PART TWO

What You Will Learn. This section explains the fundamental characteristics and typical applications of DC electromagnetism employed in electrical machinery, radio equipment, laboratory and test equipment, automotive devices, television, radar equipment, computer systems, and many others.

When you complete this section, you will be able to visualize and describe magnetic principles for both permanent magnets and electromagnets, perform experiments and describe the actions and reactions observed, and relate the operating principles of relays, motors, solenoids, and meters to electromagnet fundamentals.

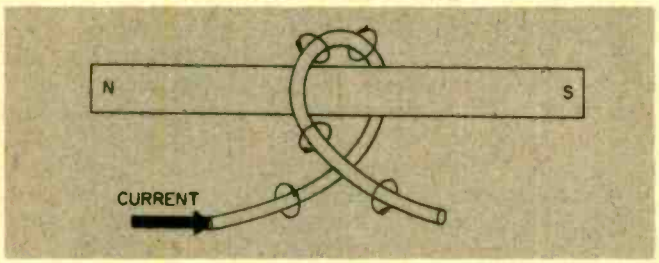
ELECTROMAGNETISM

The magnetic field developed around a straight wire or conductor is seldom strong enough to be useful. However, if the wire is formed into a coil, the magnetic field becomes quite strong.

The figure shows the action that takes place when current flows through a coil. All of the magnetic lines of force enter the coil at one end and emerge at the opposite end.

The strength of the magnetic field is directly proportional to the number of turns in the coil and the current

The Basic Electromagnet

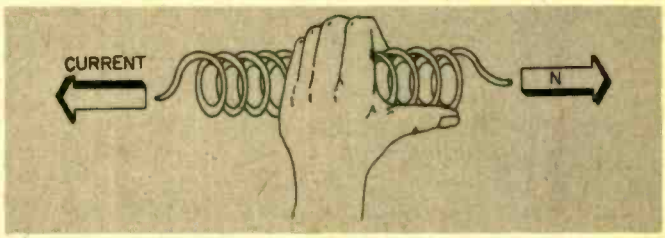


passing through them. A coil with a large number of turns has a magnetic field of greater strength than one with a small number of turns. The magnetic field is greater when a larger current flows through the coil.

Since all magnetic lines of force form a loop, poles similar to those of a permanent magnet are established on the coil. The poles form at each end of the coil and their polarities depend on the direction of current flow.

The left-hand rule is employed to determine the magnetic polarity. Grasp the coil in your left hand with your fingers pointing in the direction of current flow. Your thumb points in the direction of the north-seeking pole of the coil.

Left Hand Rule For Electromagnet



It was stated previously that the flux density is much greater in a block of iron than it is in air. Therefore, if an iron core is added to the current-carrying coil, the magnetic loops will concentrate through the core, increasing the flux density and strength of the electromagnet. The magnetic lines around the coil are called induction lines. Soft iron cores are used in electromagnets because of the high permeability of iron.

QUESTIONS

Q1. What is the field intensity at a distance of 5 inches from the center of a wire carying 100 amps?

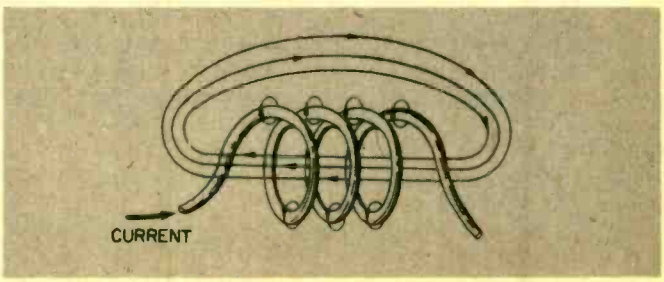
Q2. Why is the magnetic field around a coil stronger than the magnetic field around a straight wire? wire?

ANSWERS

A1.

$$H = \frac{I}{5d} = \frac{100}{5 \times 12.7\ cm} = \frac{100}{63.5} = 1.57 \text{ oersteds}$$

A2. When a straight wire is formed into a coil, the magnetic lines around each turn reinforced.



The strength of an electromagnet can be determined by connecting a coil across a battery and placing an iron rod, suspended by a small hand scale, near the coil. When the circuit is energized, current flows through the coil and the magnetic field that is developed attracts the iron rod. The amount of pull can be read directly on the hand scale after subtracting the weight of the rod.

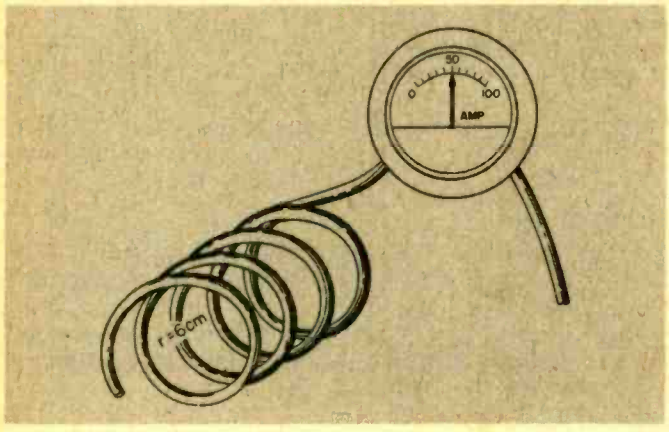
If the overall length of a coil is less than its diameter, the strength of the field can be calculated by the following expression.

$$H = \frac{2\pi NI}{10r}$$

H is the field intensity in oersteds, N is the number of turns in the coil, I is the current through the coil in amperes, r is the radius of the coil in centimeters, π is a constant equal to 3.14.

The two main factors that determine the strength of an electromagnet are the current and the number of turns in the coil. The magnetic field can be varied by altering either factor. The combination of these two factors (I and N) is called ampere turns. An electromagnet with 200 turns of wire through which 1 amp is flowing has a field strength equal to an electromagnet with a 10-turn coil through which 20 amps is flowing. In both cases the number of ampere turns is 200.

Current And Turns Increase Strength



QUESTIONS

Q3. What can be added to a coil of wire to make it a stronger electromagnet?

Q4. What is meant by permeable material?

Q5. Calculate the field strength of the coil shown in the figure.

Q6. What determines the field strength of an electromagnet?

Q7. What is the field strength of a coil having 10 amps of current flowing through it, if the coil has a radius of 2 inches and contains 26 turns?

ANSWERS

A3. Adding an **iron core** to a coil increases the strength of an electromagnet.

A.4 Permeable material is any material that can be **easily magnetized.**

A5.

$$H = \frac{2\pi NI}{10r} = \frac{6.28 \times 4 \times 50}{10 \times 6} = \frac{1{,}256}{60} = \textbf{20.93 oersteds}$$

A6. The **current** and the **number of turns** in the coil.

A7.

$$H = \frac{2\pi NI}{10r} = \frac{6.28 \times 26 \times 10}{10 \times 2 \times 2.54} = \textbf{32.14 oersteds}$$

Magnetomotive Force

Magnetomotive force is defined as the force that produces a magnetic field, and is measured in gilberts. In the design of an electromagnet for a particular application, it is often desirable to determine just how much magnetomotive force is required to create a magnet with a specific field strength.

A convenient method of determining the magnetomotive force in a current-carrying air-core coil is to use the following expression.

$$mmf = 1.257 \times I \times N$$

The term mmf is magnetomotive force in gilberts, I is the coil current in amps, N is the number of coil turns.

The reluctance of air is 1.257 (this number will be different for an iron-core coil). As can be seen, magnetomotive force is directly proportional to the ampere turns.

Residual Magnetism

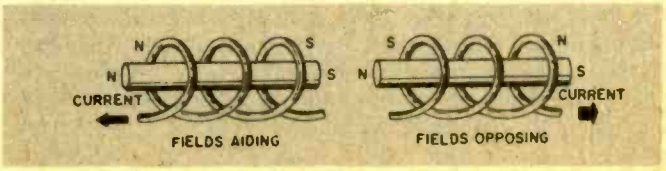
When an electromagnet is de-energized, the magnetic field collapses, but a slight amount of magnetism remains in the core material. This is called residual magnetism.

When the magnetic lines of force surrounding the coil concentrate inside the center of the coil, the force magnetically aligns the molecules in the core material. This is similar to the process of magnetizing a metal bar. If the core material is a bar of steel, the results will be different from those for a bar of iron. Once the molecules are aligned in the steel bar, they tend to remain aligned. The core will then retain considerable residual magnetism after the current has ceased to flow through the coil.

Hysteresis

If the current is reversed in an electromagnet (perhaps many times a second), the magnetic field and the direction of polarization will also reverse. If the core material possesses any residual magnetism, the polarity change in the magnetic field will be somewhat delayed beyond the time when the current is reversed. It is necessary to overcome the residual magnetism before the core can be magnetized in the reverse direction.

Current In An Electromagnet



When current flows through the coil in the direction shown, the north pole of the magnet is on the left, and the south pole is on the right (left-hand rule for a coil). The magnetic polarity of the core material is identical to the polarity of the coil. When the circuit is de-energized, the magnetic field collapses. Any residual magnetism remaining in the circuit retains its original polarity.

QUESTIONS

Q8. What is the magnetomotive force if 2 amperes flows through an 8-turn air-core coil?

Q9. What makes the best core material for an electromagnet?

ANSWERS

A8. The magnetomotive force is:

$$mmf = 1.257 \times I \times N = 1.257 \times 2 \times 8 = \mathbf{20.112\ gilberts}$$

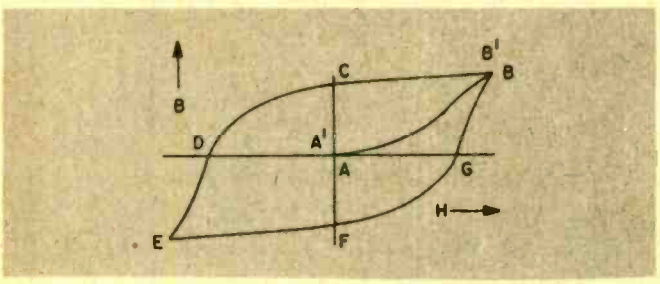
A9. Soft iron makes the best core material because its molecules tend to rearrange themselves easily after the magnetizing force is removed.

If the current through a coil is reversed, the magnetic field also reverses. Before the reverse magnetic field can build up, however, it must first overcome the residual magnetism in the core material of the coil. The residual magnetism opposes the new field, so it is first necessary to reduce the residual magnetism to zero before the new field can be developed. Instead of the magnetic field being developed immediately as the current increases, there is a slight delay. The magnetic field lags the current slightly. This lag is called hysteresis.

Energy is required to align the molecules in the core material. If the current through the coil is reversed frequently, considerable energy is required to realign the molecules first in one direction and then in the other. This energy is lost in the form of heat and is called hysteresis loss.

The hysteresis lag becomes quite evident when a curve of magnetizing force (H) is plotted against flux density (B).

B-H Curve Of An Electromagnet



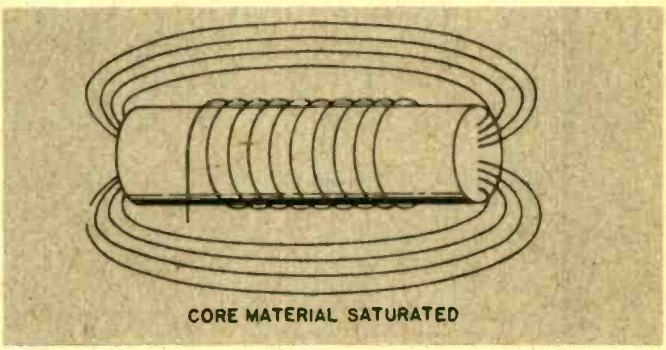
The figure is referred to as the B-H curve. When current flows through a coil, the magnetic field around the coil builds up, as indicated by line A-B. When the current reaches its maximum level, the magnetic field also reaches maximum intensity, as indicated by point B. When the current ceases to flow, the magnetic field collapses along line B-C. When the current reaches zero, the amount of residual magnetism remaining in the circuit is indicated by line A-C.

If the current is reversed in the circuit. the residual magnetism must first be overcome. It falls to zero, as indicated by line C-D. The magnetic field then builds up in the opposite direction along line D-E, reaching maximum concentration at point E. When the current stops flowing in the reverse direction and falls to zero, the magnetic field collapses along line E-F. The distance between points A and F indicates the amount of residual magnetism remaining in the core at that time. If the current were to flow in its original direction, the magnetic field would collapse to zero, as shown by line F-G, and build up to its maximum level along line G-B.

Saturation

The magnetic field develops gradually as the current increases. There is a point, however, where the core material cannot accommodate additional lines of flux. When this point is reached, the core is said to be saturated. Any additional lines of force will have to flow through the air surrounding the core material. Since the reluctance of air is quite high compared to the reluctance of iron, it is difficult to increase the flux density beyond core saturation.

Magnetic Core Can Saturate



QUESTIONS

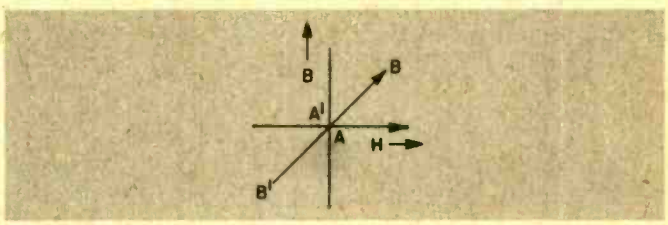
Q10. Will residual magnetism have any effect on the temperature of the core?

Q11. What would the effects be if the core material were removed?

ANSWERS

A10. Yes, when the molecular action increases, the material becomes hot, and energy is expended in the form of heat.

A11. If there were no core material the B-H curve would increase and decrease in a linear fashion and there would be no residual magnetism.



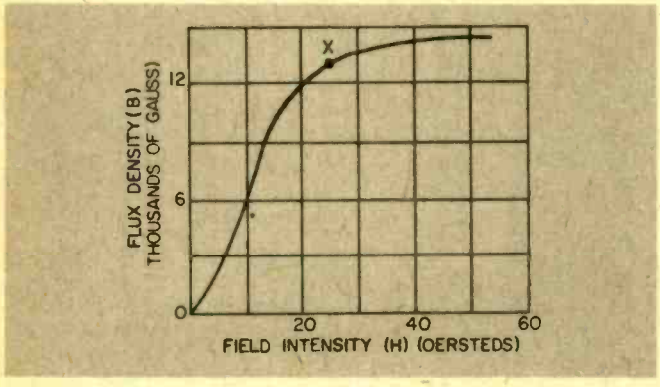
Magnetic Permeability

Compare the B-H curves. Notice that the first curve does not vary in a linear fashion along line A-B or A'-B'. This is true because there is a slight variation in the process of core magnetization. Theoretically, the magnetic field gradually builds up by a definite quan-

tity whenever the magnetizing force is varied by a specific amount.

For example, if the magnetizing force increases by 3 oersteds, the magnetic flux increases by 10,000 maxwells. This is true anywhere along the theoretical curve. In actual practice, however, there is a slight variation. At certain points along the curve an increase of 3 oersteds in the magnetizing force may increase the magnetic flux by only 9,800 maxwells. At other points on the curve, such an increase in the magnetizing force may increase the magnetic flux by 10,300 maxwells. This variation accounts for the nonlinearity of line A-B on the B-H curve.

Flux Density vs Field Intensity



The graph compares magnetizing force and flux density when a steel bar is magnetized.

The flux density increases rapidly with only a slight increase in the magnetizing force when the core material is at a point of low field intensity (only a few thousand magnetic lines of force). At a point of high field intensity, a large change in the magnetizing force is required to cause a small change in flux density. Point X indicates the point of saturation.

Permeability can be determined by the following expression.

$$\mu = \frac{B}{H}$$

The term μ is the permeability (has no unit of measure), B is the flux density in gausses, H is the magnetizing force in oersteds.

When the permeability of a material is low, the reluctance is high, requiring a large magnetizing force to increase the flux density. This can be seen from the following expression for determining flux.

$$\phi = \frac{mmf}{R}$$

The term ϕ is the flux lines in maxwells, mmf is the magnetomotive force in gilberts, R is the reluctance.

QUESTION

Q12. Referring to the graph, would the permeability at the point of saturation be high or low?

ANSWER

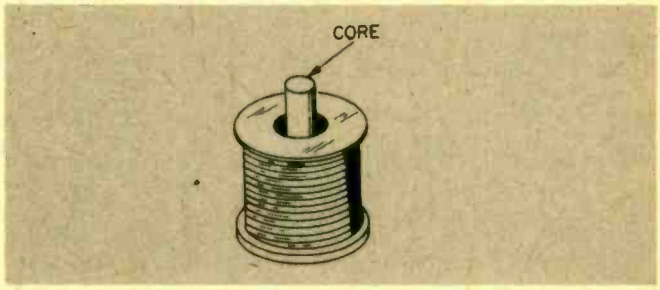
A12. The permeability of the core material at saturation would be very **low.**

Solenoids

A coil wound in the shape of a cylinder or tube is called a solenoid. A solenoid is often provided with a movable iron core, or plunger. In this arrangement, the iron core is pulled into the coil when current flows through the turns. Thus, the core can be used to mechanically move some device.

Solenoids are commonly used in relays or circuit breakers. The magnetic field built up in the center of the coil pulls the core into the solenoid, thereby breaking or making the relay contact(s).

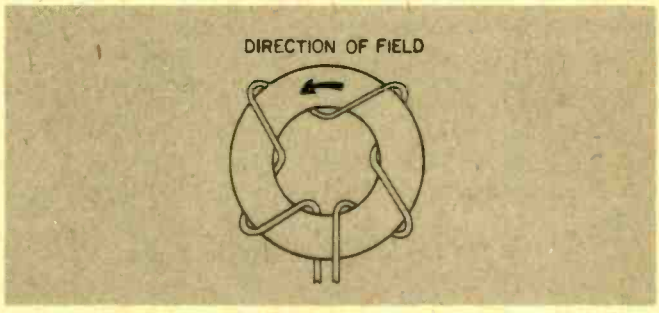
Electromagnet With Moving Core: Solenoid



Toroids

Another type of coil that is used in some applications is the toroid, which has a ring-shaped core on which the turns of wire are wound to form a complete circle. This design concentrates all the lines of force inside the ring. With all the flux inside the ring, the toroid has no external polarity.

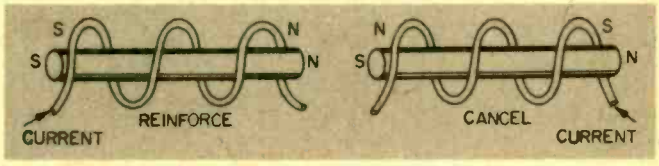
Electromagnet With Round Core: Toroid



Polarized Electromagnets

A polarized electromagnet has a permanent magnet as its core, as shown in the figure.

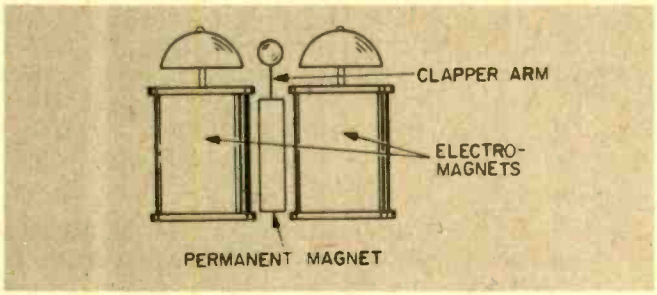
Opposing Or Aiding Fields



When current flows in the coil, the electromagnet will either add to, neutralize (cancel out), or subtract from the magnetic field of the permanent magnet. Polarized electromagnets are used in telephone and telegraph circuits. The next figure shows a diagram of a telephone-bell circuit.

The clapper arm, which extends down through the

A Polarized Electromagnet



center of the electromagnet, is attached to a permanent magnet. The permanent magnet holds the clapper arm in a neutral position between the bells and provides the clapper with a specific polarity. Assume this position holds the clapper arm to the south-seeking pole of the permanent magnet. When current flows through the series-connected coils, the electromagnetic field thus developed adds to the field of the permanent magnet. This combined field pulls the clapper arm to the right, causing the clapper to strike the right-hand bell. When the current is reversed, the magnetizing force of the electromagnet subtracts from the force of the permanent magnet, and the clapper strikes the left-hand bell.

QUESTIONS

Q13. How would you determine which is the north-seeking pole of a solenoid?

Q14. In what position will the clapper arm be when current is not flowing through the electromagnet?

ANSWERS

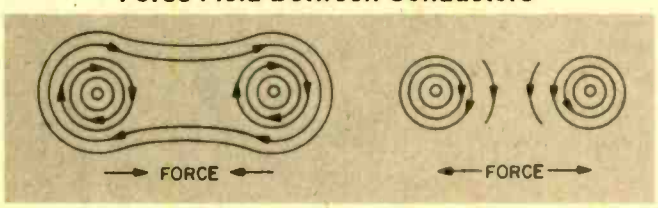
A13. The **left-hand rule** used to find the polarity of a coil may also be used to determine the polarity of a solenoid.

A14. The permanent magnet returns the clapper arm to the **center position** when the current stops flowing.

USES FOR MAGNETS

You may ask why the permanent magnet does not become demagnetized when the electromagnetic field opposes it. Once a permanent magnet becomes magnetized, a strong force is required to disarrange its molecules. The electromagnetic field might be strong enough to do this if it remained for a very long period of time. However, the current through the coil in a specific direction lasts for only a brief period and does not noticeably change the strength of the permanent magnet.

Force Field Between Conductors



When current passes through parallel wires, the magnetic fields around these wires interact. If the currents flow in the same direction, the fields oppose each other between the wires and aid beyond the wires. This tends to move the wires together. If the currents flow in opposite directions, the wires tend to move apart.

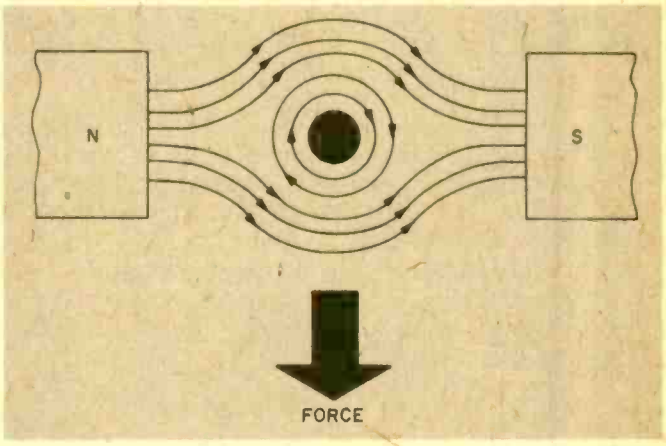
Electric Motors

The principle of attraction and repulsion just shown is used in electric motors and generators. Electric motors are used to provide a mechanical power output from an electrical input. Generators provide an electrical output from a mechanical input.

The force exerted on an electron in a magnetic field is at right angles to the magnetic field. When the electron is placed in both an electric and a magnetic field, the force exerted on the electron is perpendicular to both fields. A right-hand rule is used to determine the direction of force on electron flow in a magnetic and electric field.

The magnetic field around the conductor in the figure is clockwise. The current appears to be coming out of the page. The direction of the magnetic field of the permanent magnet is from the north-seeking pole to the south-seeking pole, or from left to right in the figure. Notice that the lines above the conductor and the lines around the conductor are going in the same direction, reinforcing the field above the electron path. Below the conductor the fields are opposing each other.

Principle Of Electric Motor



QUESTION

Q15. In the figure, the field around the conductor and the magnetic field of the permanent magnet are opposing each other at a point below the electron path. What effect does this have on electron flow?

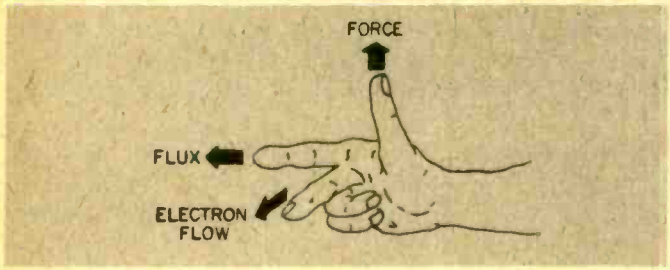
ANSWER

A15. This **weakens the fields** and electron flow is forced in a downward direction.

Right-Hand Rule

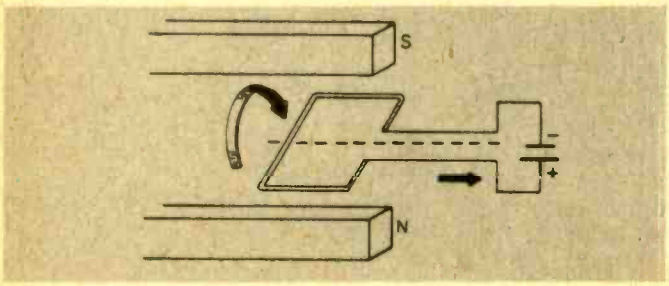
Arrange the thumb, index finger, and middle finger of your right hand as shown in the figure. Point the index finger in the direction of magnetic flux and the middle finger in the direction of electron flow. The thumb indicates the direction of magnetic force on the electron (direction that the wire is repelled).

The Right Hand Rule



If a loop of wire is positioned in a permanent magnetic field, a force acts on the wire each time current passes through it. This force causes the loop of wire to rotate, if it is free to turn, as shown in the next figure.

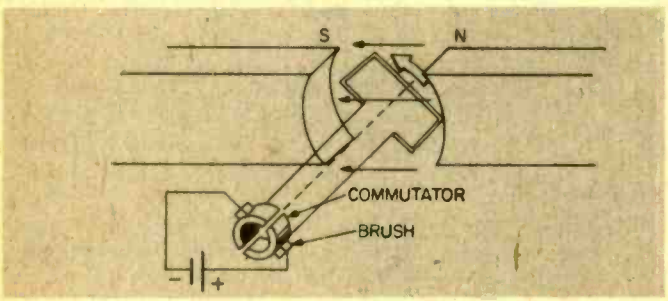
Magnetic Fields Force Rotation



The simple motor shown in the figure is not very practical. The coil cannot rotate very far because the current always moves through the wire in the same direction. When opposing poles appear opposite each other, the loop stops. Furthermore, any permanent connections to the loop of wire will not allow it to rotate very far.

To overcome these objections, the loop is terminated in two contacts that rotate with the loop. These contacts form the commutator of the motor. Electrical connections are made by carbon brushes pressing against the commutator.

Current For Spinning Electromagnet



When current flows through the wire loop, a magnetic field is set up so that the north-seeking pole appears above the loop and the south-seeking pole below. (Check this by employing the left-hand rule for a coil.) The magnetic poles thus created around the loop are attracted by the opposite poles of the permanent magnet; this causes the loop to rotate in a counterclockwise direction. (According to the right-hand rule, the force is downward on the left side of the loop and upward on the right side.)

The loop and commutator rotate together. When the loop has reached a position such that the opposing poles of the electromagnet are adjacent, the commutator will have rotated to a position where the applied voltage is reversed. The current through the loop will now reverse directions, reversing the magnetic field around the loop so that the north-seeking pole of the permanent magnet and the two south-seeking poles will be opposite. The like poles will oppose each other, and the loop will continue to rotate in a counterclockwise direction.

QUESTION

Q16. If a current-carrying conductor is placed in a magnetic field so that the current appears to be flowing into the page and the polarity of the permanent magnet is such that the north-seeking pole is on your right, what will be the direction of force on the electron stream?

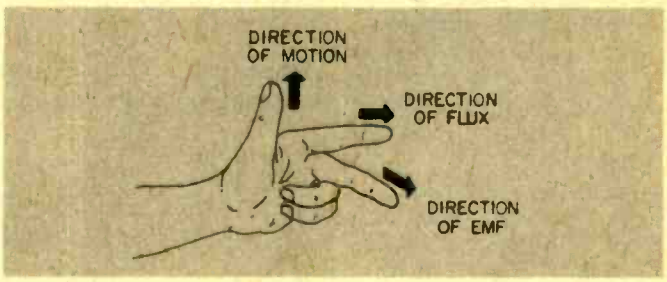
ANSWER

A16. The direction of force on the electron flow would be **downward.**

DC Motors and Generators

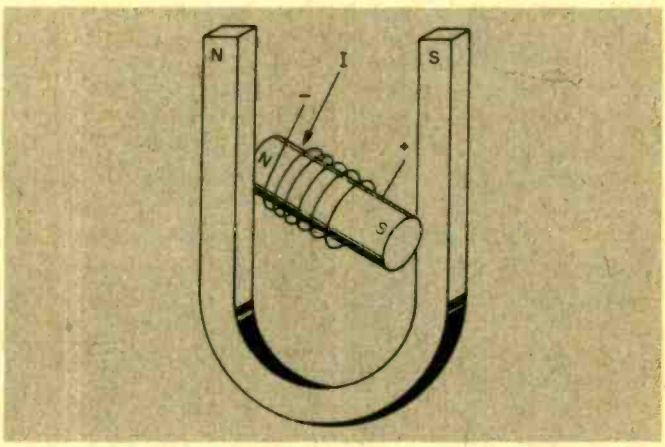
In electric motors many loops of wire are wound around a core. This assembly is called an armature. Each loop is connected to a commutator segment that makes contact with the carbon brushes as the armature rotates. The use of many loops provides smoother operation and considerably more power than a single loop.

Left Hand Rule For Generators



Large electric motors use electromagnets in place of permanent magnets. It is possible to obtain a stronger magnet for the same physical size by using the electromagnet.

Principle Of D'Arsonval Meter



If current flowing through a wire creates a magnetic field, it seems only reasonable that a wire moving through a magnetic field causes a current flow. The

DC generator operates by use of this principle. An armature (similar to one in an electric motor) is rotated in a magnetic field. The turns of wire cut the lines of force, and a current is caused to flow in the wire loops of the armature. Connections to the commutator provide an electric current output.

Another left-hand rule is used to determine the direction of the induced electromotive force in a generator. Place the thumb, index finger, and middle finger of your left hand so that they are perpendicular and at right angles to each other. Point the thumb in the direction of motion (rotation) of the conductor (armature) and point the index finger in the direction of the magnetic flux. The middle finger will then indicate the direction of the induced current (electron flow). This procedure is shown in the figure.

Meters

Both permanent magnets and electromagnets are used in meter movements. Their operation is similar to that of the electric motor previously described. In the meter movement the electromagnet does not rotate through 360° as it did in the motor; instead, it rotates through an arc of approximately 150°

The electromagnet is positioned between the poles of a permanent horseshoe magnet, as shown in the figure.

QUESTIONS

Q16. How long will a single-loop motor rotate?

Q17. If the magnets in a generator are placed so that the north-seeking pole is on the right and the motion of the conductor is downward, what will be the direction of the induced current flow?

ANSWERS

A16. A single-loop motor will rotate **as long as current flows through the loop.**

A17. The direction of the induced current flow is **out of the page** (left-hand rule for generators).

When no current is flowing through the coil, a spring holds the coil in the position shown. When current does flow, a magnetic field is developed around the coil with the north-seeking pole on the left and the south-seeking pole on the right in the figure above (left-hand rule for coils). Thus, the two north-seeking poles and the two south-seeking poles are opposite each other. The like poles repel and the coil rotates. How far the coil rotates depends on the strength of the electromagnet and its ability to overcome the tension applied by the spring. A pointer connected to the moving coil moves across a calibrated scale, making it possible to use the meter as a measuring device.

WHAT YOU HAVE LEARNED

1. Magnetism is a property of certain materials to attract and repel each other.
2. Magnetized materials have north (north-seeking) and south (south-seeking) poles. Magnetic force lines flow from south to north inside the material and north to south outside.
3. Some materials may be magnetized by stroking them with a magnet or by passing direct current through a coil wrapped around them.
4. A permanent magnet has a high retentivity (retains its magnetism). A temporary magnet has low retentivity.
5. Permanent magnets should be stored in a manner which permits the external field to be concentrated in a path of low flux opposition. Bar magnets are stored with N and S poles adjacent. A keeper is placed across the poles of a horseshoe magnet.
6. Reluctance is the opposition offered to the flow of magnetic flux lines. Air has a higher reluctance than iron.
7. Number of flux lines (maxwells) is directly proportional to the magnetomotive force exerted and indirectly proportional to the reluctance of the material through which the flux lines pass.
8. Permeability of a material is a measure of its ability to be magnetized. Low reluctance indicates high permeability.
9. An electromagnet is a device that has been or is being magnetized electrically.
10. Current through a conductor generates a magnetic field. If the thumb of the left hand points in the direction of electron flow, the fingers curl in the direction taken by the flux lines.
11. A coil of wire develops a stronger magnetic field than a single conductor. Field strength is directly proportional to ampere-turns (number of coil turns and the amount of current flowing). Field strength is indirectly proportional to the diameter of the coil.
12. Magnetomotive force of a coil can be determined by multiplying ampere-turns by a reluctance constant. Reluctance for air is 1.257.
13. Residual magnetism is the amount of magnetism remaining in an electromagnet after current flow has ceased.
14. Hysteresis (difficulty in realigning magnetic direction of molecules) causes changes in the magnetic field to lag changes in the current.
15. Each magnetic material has a limit to which it can be magnetized. The limit of magnetic strength is called saturation, and is the point at which a maximum number of molecules have been aligned in the same magnetic direction.
16. Solenoids are electromagnets with movable iron cores.
17. Electromagnets are used in motors, generators, meters, and other devices that make use of the electrical effects of a magnetic field.
18. The right-hand rule for motors states: With thumb, index finger, and middle finger of the right hand at right angles to each other, the index finger pointing in the direction of magnetic flux, and the middle finger pointing in the direction to current flow, the thumb will indicate the direction in which the conductor will move.
19. The left-hand rule for generators uses the same principle: If the left thumb points in the direction of the conductor movement, and the index finger points in the direction of the magnetic flux, the middle finger will indicate the direction of current flow in the conductor.

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.

THE INCREDIBLE SHRINKING MOTORCYCLE

Looks almost like a scene from a grade "B" movie, right? The one where a matter transporter goes screwy and solves the casting problem for a Gulliver's Travels remake.

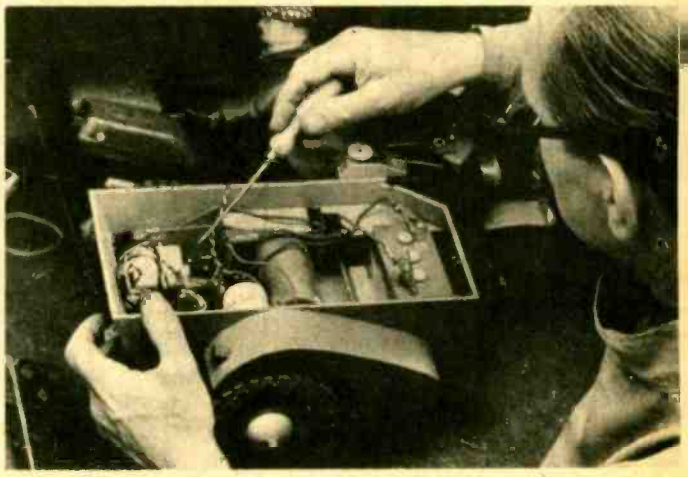
The facts are that this mini-motor bike is a hand carved, one sixth scale, radio-controlled model. It is buzzing down the main street of Lee, a small english town where, it seems, this sort of thing is common.

Anyway, there's always a simple answer and this one is spelled Bob Earwicker. He's a hobby shop owner who likes a challenge and apparently thinks designing, building and operating a radio controlled motorcycle is one. It took master modeler Earwicker two years to perfect. Bob explained that the major difficulty was constructing a drive unit with a correct power-to-weight ratio to keep the bike and side car in a straight line. Remember, we're talking about three wheels, not the usual radio controlled model with four.

Mini Specs. Twelve inches tall and 13-in. long outside with hand carved riders; that's it! On the inside, the side car houses the drive motor and radio control receiver without upset. To get smooth steering action, Bob used a digital proportional radio control system. The transmitter operates in the 27 MHz R/C band with a power output of approximately ½ watt. This gives him an operating range "as far as the eye can see." A six volt wet cell whose capacity is about 6 amp hours, powers the drive motor, while radio control receiver power comes from the usual rechargeable Ni-Cads.

Bob balanced his creation to perfection. But what about those tough trails where a twig seems like a giant redwood? Bob assures us that the gear ratios are designed for off-road cross-country fun. Even muddy ground won't even stop this power package. ■

It has taken Bob Earwicker two years to perfect the radio controlled motor bike seen here. Its operational range is to the limit of the user's vision. Making a 3-wheeler stable over rough ground is a feat.



Hardly content with just one, the builder-designer is working on his Mark II version with more powerful drive motor. He is reporting that he expects to use the same type of R/C system.

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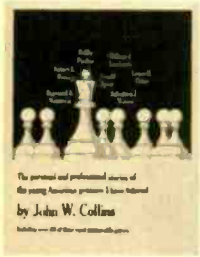
Bookmark

(Continued from page 24)

cuit applications, packages, and handling and mounting considerations for these devices as well as an up-to-date listing of commercial types (including standard-product, high-reliability, and SK-replacement devices) currently available from RCA Solid State Division. This basic reference text is also a useful adjunct to the seven-volume RCA SSD-200 DATA BOOK Series. Copies of the RCA Solid-State Devices Manual (SC-16) are available at $5.00 each. Copies may be ordered from RCA Solid State distributors or by sending checks or money orders to RCA Solid State Division, Box 3200, Somerville, NJ 08876.

Your Move. Several years ago John W. Collins wrote a chess column for ELEMENTARY ELECTRONICS. Nothing much was known about John except that he was devoted to chess and winner of several prestigious chess tournaments. Now we can get an insight into John through his



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new book *My Seven Chess Prodigies*. Naturally, as you would begin to expect, World Champion Bobby Fischer was one of John's students. The book describes the early lives of Bobby Fischer, Bob Byrne, Bill Lombardy, Don Byrne, Ray Weinstein, Sal Matera, and Lew Cohen—one Champion of the World, one Champion of the United States, one Junior World Champion, two International Masters, one USCF Senior Master, and one USCF A Player on his way to becoming a Master. Having known them all before they became champions, John Collins is able to provide personal commentary on the family background, appearance, character, health, mental traits, interests, pastimes and education of these great American chess players. In addition, he provides details on the development of their chess ability (lessons, books read, hours a day spent in study), styles of play, and accounts of the players' most exciting and original games. Published by Simon and Schuster, 630 Fifth Avenue, New York, NY 10020.

Microwave Oven Owners. Two new cookbooks on variable-power and combination microwave cooking are now available from Litton Microwave Cooking Products. *Old-fashioned Goodness With Variable Power Microwave Cooking*, the first cookbook of its type, is included with all Litton variable-power ovens. It contains over 380 recipes. *Discover Combination Microwave Range Cooking* comes with Litton's combination microwave ranges and has over 550 recipes. The cookbooks may also be purchased by sending a check or money order payable to Litton Industries to P.O. Box 851, Maple Plain, MN 55359. ■

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Ask Hank, He Knows

(Continued from page 34)

wrecking the tapes of her tape recordings and the performance of her reel-to-reel tape deck. Tell her it isn't so, Hank, and save a wonderful relationship.

—B. M., Austin, TX

Wow, and they said I was way out when I wore argyle socks with my tux to the prom. I don't see how one has anything to do with the other. The CB transmitter may interfere during periods of common transmission and recording, otherwise—nothing. Keep the peace!

Canadian CB

When I'm in Canada next summer can I use my CB on channel 9 for emergencies like in the U.S.?

—G. M., Olyphant, PA

Sure you can. The Canadian Dept. of Communications permits this usage of CB on channel 9. Also, it is the primary call channel up north. By next summer it may change in Canada to conform with U.S. CB regulations. When you get up there PTT and ask. By the way, I really don't know if it is okay to answer a call across the border. The rules cover in U.S. and in Canada only. Can two cars one mile apart and separated by the border talk to each other?

Peak Reading VU Meter

In the last issue of ELEMENTARY ELECTRONICS we omitted information on the source of the VU meter. The exact text that should have appeared in the parts list is given below.

Note—The Toyo type 67 meter is available directly from the manufacturer, Toyo Corp. of America, 800 West Sixth St., Los Angeles, CA 90017. Price of each meter is $23 plus $2 shipping and handling per total order. If you need integrated circuit MC7824, write to Circuit Specialists, Box 3047, Scottsdale, AZ 85257, for a price.

Can You Help Out?

▲ If you know anything about radio broadcasting in the Phillippine Islands prior to 1950, tell it to James T. Pogue, P.O. Box 972, Lafayette, IN 47902. James is doing research on this subject matter and needs your help.

▲ Paul Prescott needs diagrams and service data for the Contact 23 CB Transceiver. Write to him at Allen Rd., Brookfield, CT 06804.

▲ Don Osmond of 533 Brainerd Avenue, Libertyville, IL 60048, is in need of a schematic/manual for a Knight Kit KN330 AM/FM Stereo Receiver. Can you help him?

▲ J. Jay would like to build a high temperature kiln and anyone with experience and/or technical information please write to Mr. Jay at Rt. #1, Box 73, Deming, NM 88030.

▲ If you can spare an ECC40, contact Ed Podniesinski, 110 Cayuga Creek Rd., Buffalo, NY.

▲ Dennis Gibbs of 9214 Venetian Way, Richmond, VA 23229 needs the schematic diagram for a Dumont 322 Dual-Beam Oscilloscope.

▲ Ed Pow needs the schematic diagram for the DX-150A. He's at 11606-129th Avenue, Edmonton, Alta., Canada T5E-OM7.

▲ Not to be outdone, Andy Campbell of 19 Pleasant Dr., Niantic, CT 06357 wants the diagram for the Realistic DX-160.

▲ Now here's a tough one! Ben Tutt III can't find the schematic diagram for the Model 830 Oscilloscope made by Modern Electronics Co. of New York. If you can help, write to Ben at 222 Stonewall, Memphis, TN 38112.

▲ Harry Loy of Box 303, Altoona, IA 50009 would like the schematic diagram for the Globe Duodyne TRF battery operated receiver #830.

And Hank sends his warmest regards and good wishes to everyone who wrote to him last year and especially those who lent a helping hand. Happy New Year, fellows! ■

Newscan

(Continued from page 38)

"I've been involved in CB for about two years," she explained, "and it's been a life-saver more than once.

"About a year and a half ago," she went on, "two men tried to break into my home while I was there alone. I grabbed my microphone and put out a distress call. Within five minutes, CBers in cars were pulling into my driveway.

(Continued on page 89)

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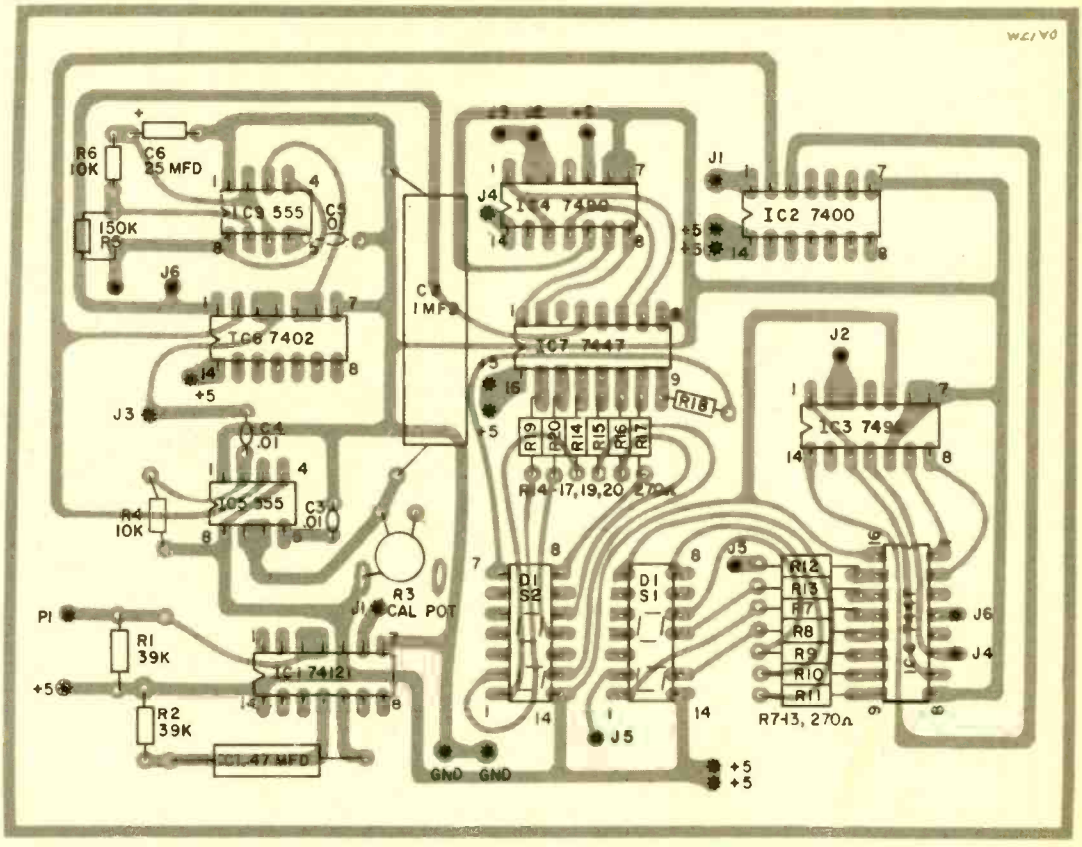
Digital Wind Meter

(Continued from page 47)



Pictorial shows the location of components as seen from the bottom (through the foil pattern) as they would be viewed in soldering to the foil. To get a full size foil pattern send a stamped, self-addressed envelope to: Elementary Electronics, Digital Windspeed Template, 229 Park Ave. South, New York, NY 10003.

cuit use any convenient layout on a perf board. The position of the components is not critical. If you haven't worked with ICs before you'll be better off soldering IC sockets in place on the perf board, and connecting the other components to the pins of the IC sockets. If you've had a fair amount of experience and can solder ICs directly into a circuit without overheating the pins (using a pair of long-nose pliers as a heat sink while soldering to each pin), do it that way.

The main job in wiring the anemometer lies in making the printed circuit board. The pattern shown can be made by using the simple resist method. Simply draw the pattern with a felt-tipped resist pen on the foil side of the printed circuit board, place in etching solution for an hour or so and drill the holes marked. The somewhat more sophisticated, yet still easy, non-camera photo method can also be used.

If a small 25-watt soldering iron is used, the *ICs* can be soldered directly to the board, although IC sockets are less risky. Be sure to orient the notch on the *ICs* as shown in the component layout diagram. It is always wise to use IC sockets when mounting display LEDs. Be sure to either bend back or cut off pin 12 on the socket which is used to mount Display No. 1.

Unless double sided PC boards are used, jumpers made up of hookup or bare wire are needed. Place jumpers between the two J1s, J2s, J3s, J4s, J5s and J6s. In addition, interconnect the +5 VDC points on the PC board with jumpers (6 needed).

Connect the two leads from the remote mounted reed switch to points P1 and to one of the two GNDs.

Connect the plus power supply lead to the +5 point at the top of the board. Connect the other supply lead to the other GND point which is also located at the top of the board.

The 5-volt regulated TTL power supply described by Herb Friedman in the Sept.-Oct. 1975 issue of ELEMENTARY ELECTRONICS is ideal for this project. This power supply is compact enough to easily fit in the same case as the logic unit.

The entire circuit can be mounted in any convenient size bakelite or aluminum case with aluminum panel. For a smart appearance, spray paint the panel with some auto-touch-up white lacquer. Use dry transfer decals for the lettering.

Cut a slot in the panel so the two digit LED display can be readily seen. If desired, the switch to turn on the power can be an inexpensive slide switch but a toggle switch is more reliable and easier to mount. The circuit board and all other components should be mounted to the back of the front panel for ease of accessibility.

If one desires a longer display time, increase R5 from the recommended 150k to 220k or even 270k.

Any type of two-conductor connecting jack can be mounted on the front panel (I used an RCA-type jack) as long as the appropriate plug is used. The two wire cable which connects the rotary wind sensor to the electrical unit must be long enough to reach from the roof to the place in your home where you want to keep the display unit. Any kind of shielded cable, including audio cable or microphone cable is OK. Coax such as RG-59/U is fine, but don't buy it special for this job because it costs much more than other (audio) cable.

Calibration. This anemometer is easily calibrated since there is just one pot to adjust. As an initial test, plug the unit in and connect the wind sensor to the display unit. After a few seconds warmup the unit should show 00 then go momentarily blank. Turn the cups by hand and a number should appear on the display for a second or two and then disappear for a second. Now turn the cups as fast as you can by hand and adjust the calibration pot to read as close as possible to 20. If everything so far works OK, it is time to take the anemometer for a ride. If not, go back to Square One and check your wiring and the seating of the LED display modules.

The anemometer should be calibrated against an accurate automobile's speedometer. Since the anemometer will be away from the regular house supply, you will have to take along a 5-volt

battery supply. In order to drop the voltage to the required 5 VDC, you must connect a 2 ohm resistor in series with a 6 volt battery.

With someone else driving, take the unit in an auto on a nearly calm day and drive as steadily as possible at a certain definite speed, say 30 mph. Drive up and down a quiet road, with the wind sensor held out the window and adjust the calibration pot so the display will read an average value of 30.

Use. The wind sensor should be mounted on a roof or other location where there are few obstructions. Because of the one-shot ahead of the NAND gate, the anemometer may suddenly go blank when winds are of hurricane speed. So if the display one minute shows 75 mph and the next minute 00, don't stick your head out the window to see if something happened to the wind sensor on your roof, a tree might just be sailing by.

A simple way of checking your speedometer is to drive down an expressway at 55 and have someone time you between two mileposts. Then get your hand calculator out and divide 3600 by the number of seconds it took you to travel the mile. The result is your true speed. ■

DX Central

(Continued from page 28)

and programs over Radio Mexico are a sometimes thing, so keep trying periodically.

"I'm 15 years old and have been an SWL for almost a year now," writes Phillip Hamilton, Hickory, North Carolina. Phil uses a Knight Star Roamer II receiver and has logged 32 different countries on shortwave.

One of his catches has been Radio Vilnius on 9,735 kHz, which, he notes at about 2230 GMT.

"They had a very strong signal, but QRM was pretty strong. Their location is in Lithuanian SSR, USSR."

Thanks for writing, Phil. You are right that the programs of Radio Vilnius are produced and recorded in Vilnius, a major city in Lithuania.

Want to join a good shortwave listeners club? Are you interested in other phases of the DXing hobby? Medium wave (BCB) DXing? FM, TV monitoring?

You may be interested in the following list of North American DX clubs, all members of the Association of North American Radio Clubs. The updated list was submitted by Dave Browne, executive secretary of ANARC, headquartered at 557 North Madison Avenue, Pasadena, California 91101.

The organizations affiliated with ANARC are: American Shortwave Listeners Club, Canadian International DX Radio Club; International Radio Club of America; National Radio Club; North American Shortwave Association; Radio California-USA; SPEEDX; SWL International; Worldwide TV-FM DX Association; Handicapped Aid Program; Miami Valley DX Club; Minnesota DX Club; Rocky Mountain DXers Association; Transworld DX Club; University of Manatoba DX Club.

For more information on these hobby clubs, the subject material they cover, membership fees and addresses, send a large sized (No. 10) envelope, addressed to yourself and with ten cents postage affixed to Browne. Ask for the list of ANARC DX clubs—it's free—and tell Dave DX Central sent you. ■

Newscan

(Continued from page 86)

This is just one of many incidents when CB has helped Mrs. Kovatch. She also uses it regularly to help others as a member of the Cleveland Police Auxiliary.

"Every member of our Auxiliary is a CBer," she said. "While we never interfere with the Police or take any action on our own, we think we help them by serving as their eyes and ears.

"I was on the radio one Sunday afternoon trying to locate someone who had First Aid experience to help some accident victims," she recalled. "The man who answered my call eventually became my husband. We didn't start dating until a few months after that call," she said, "but our first meeting was on CB radio."

Nice things involving Sheryl's CB activities just keep on happening. "Last year I was driving through some lonely mountains in Tennessee, when my car broke down. There was no one for miles in any direction. So, I put out a call for help and within fifteen minutes, there were two cars and an eighteen wheeler there to help me. One of the guys was a mechanic and he got my car running again in short order."

Kathi's CB Carousel

(Continued from page 58)

was only 1.5 watts maximum (Hi power switch position), If you put in an extra battery to total 13.5 volts you'll get 2 watts output. If you use Alkaline batteries you'll get 2.5 watts output.

This reduced battery-power output is typical of most walkie-talkies, and I'll never understand why manufacturers use eight AA batteries for 12 volts when their rigs will work off 13.8 volts using the optional auto power cable. My advice is to stick in the extra bat-

tery—you get a solid boost in power output, somewhat better modulation and your signal hangs in there when the batteries start to run low. On the other hand, Nicads have a lower internal resistance, therefore a lower internal voltage drop under maximum load, so you'll usually get optimum performance from the 12-volt Nicad pack (though an extra Nicad battery wouldn't hurt; no one makes room for an eleventh battery. That's my next idea for some manufacturer to pick up.)

On the receiving end the Midland 13-861 measured 0.9 uV sensitivity for a 10 dB signal-plus-noise to noise ratio. Adjacent channel rejection was 26 dB (limited by receiver desensitization; again typical of many miniature rigs). Image rejection was 20 dB. The AGC action was a tight 3.0 dB for an input signal range of 2.0 to 10,000 uV, and you can really enjoy this tight AGC for all signals—from the weakest to the strongest—come out of the speaker at almost constant volume. You don't have to worry about some local down the block blasting your ears if you have the volume cranked wide open to dig out a flea's whisper signal.

As you can tell, I'm impressed and excited by the new Midland 13-861. With just about everyone playing copycat with CB gear—same features, same performance, different cabinet—it's really a pleasure to see and use something that's really new and improved. I'm willing to bet almost every REACT and rescue team adds a Midland 13-861 to their emergency truck.

The complete Midland 13-861 package (less batteries) is priced at $164.95. For more information circle No. 75 on the Reader Service Card. ■

Antique Radio

(Continued from page 62)

times its voltage rating, or P=E x I. In our example the wattage dissipated by the 22-volt Zener would vary between .066 and .506 watts. From a practical viewpoint hardly anyone would leave a power supply turned on without a load, so the Zeners would never be overloaded.

Is the 1000-uF, 150-volt DC capacitor absolutely necessary or could I substitute another size?

Other sizes can be used here. The designer of this supply found that this value gave a very stable hum free supply and this capacitor was readily available at many radio parts distributors. If a Zener diode opened up or the indicator lamp bulb burned out the voltage across the capacitor could exceed 150 VDC. You can parallel two or more capacitors to equal 1000 *u*F, but a single capacitor of 200 to 1000 *u*F rated at 150 to 500 VDC will work.

If you have any other questions about this power supply just send them in.

Well so long, for now. Next time we will continue with our tuning indicator story, bring you more news of collector clubs, and have other interesting information for radio collectors. ■

Changing Speaker World

(Continued from page 56)

age is applied, the film goes into motion, expanding and contracting. The motion is a kind of "breathing," with the outer surface of film pulsating out into the air away from the cylinder core for 360-degree horizontal dispersion. In addition to wide dispersion, Pioneer claims that the high-polymer molecular film transducers exhibit excellent transient response, low distortion, high power handling capability and wide frequency response. As evidence, the HPM-200 is rated at 25 to 25,000 Hz.

Although new materials and methods are constantly being developed and incorporated into high fidelity loudspeaker designs, the mere use of such new refinements does not of itself guarantee better, more realistic sound from such speakers. Tried and true materials and construction methods combined with years of experience may produce a better-sounding speaker in many cases than the most revolutionary space-age techniques.

To get loudspeakers that sound best you must be prepared to (a) spend a bundle of money, and (b) spend considerable time listening to various speakers in the audio showrooms. It's best to compare them by listening to one or two recordings that you're very familiar with. ■

React Team

(Continued from page 50)

who are trained to skillfully handle emergencies that arise in their local communities. REACT's affiliated clubs have the right to use the REACT logo in their letters, publications, and publicity releases. And assisting the local REACT clubs toward achieving the publicity they deserve, the national REACT headquarters provides nationwide publicity through newspapers,

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magazines, and news releases.

There are nominal dues for each member and a five dollar charter fee for newly organized REACT teams. And there are no formal rules to guide the locally structured organizations—the fellows back at REACT headquarters share the opinion that only you and your fellow REACT teammates know which emergency services to provide for your own locale.

Getting Started. To get your own REACT team going simply write to Mr. Gerald H. Reese, Managing Director, REACT International, Inc., 111 East Wacker Drive, Chicago, IL 60601.

REACT is not just another CB social club you join to have fun. It is a serious organization staffed by dedicated individuals serving Teams nationwide. Here are a few of the many accomplishments REACT members are proud of:

- REACT was instrumental in actions which led to FCC establishment of channel 9 exclusively for emergency and motorists assistance communications.
- Since 1962, REACT teams have handled an estimated 55 million emergency calls including approximately 12 million highway accidents.
- Over 200,000 volunteers have provided a total of approximately 100 million man-hours in public service to their communities through local REACT team programs.
- REACT members have assisted in every major natural disaster in recent U.S. history such as Hurricane Camille; the Rapid City, South Dakota flood; Southern California earthquakes; and numerous tornadoes, blizzards, etc.
- REACT pioneered in the development of cooperative programs with state agencies. A two year joint study with the Ohio State Highway Patrol serves as a model which is now being applied in other states.
- A formal cooperative understanding exists between the American National Red Cross and REACT. A large percentage of REACT teams have now taken Red Cross First Aid training and provide emergency communications coordinated through their Red Cross Chapters.

If you are sold on REACT, good! If you want to sell others on the REACT function, let REACT help you. Write to the address previously given and ask for their brochure and other literature. There is also a film on REACT available from the General Motors Film Library that you may borrow at no cost. Request the free loan of this film —titled "Where Seconds Count"—by writing to General Motors Film Library, General Motors Building, Detroit, MI 48202. □

FIRST SW ANTENNAS

(Continued from page 64)

grounding wire and ground rod. An ounce of prevention can save your home.

A dipole has some bonuses. For example, a dipole works equally as well on frequencies three times the designed frequencies. Thus, a 41-meter band dipole which will pull in 7100-7300 kHz signals will also receive 21300-21900 kHz which covers the 13-meter band. Or, if there is sufficient space to string a 195-ft. 2-in. antenna for the 120 meter band (2300-2495 kHz), then you could pull in the 120, 41 and 13-meter bands. Of course, if you want all the shortwave bands, then your best bet is a commercial dipole antenna with built-in wave traps.

Don't see much of Mort anymore except at the supermarket. Seems he's a "stay-at-home" type lately. Happy DX-ing, Mort. ■

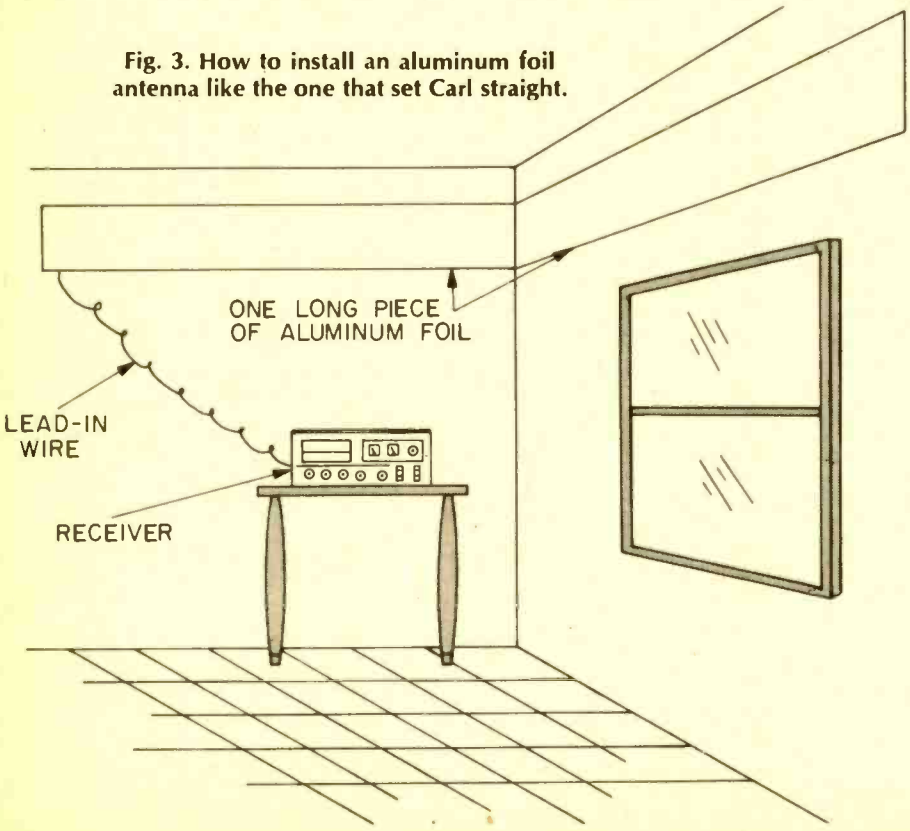

Fig. 3. How to install an aluminum foil antenna like the one that set Carl straight.

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(signed) V. C. Stabile
Vice President and Treasurer

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I certify that the statements made by me above are correct and complete.

(signed) V. C. Stabile
Vice President and Treasurer

Case No. 3—The Cave Dweller. Carl is a fun guy to know except when he's upset. For example, Carl drove over on Sunday afternoon to tell me a story he was barely capable of getting out. He had picked up a used Drake SPR-4 receiver at a fantastic price at a flea market and wanted to get involved with DXing in a hurry. It was important to Carl since he teaches French and German, and shortwave DXing would keep his foreign language skills sharp. Unfortunately, Carl lives on the 14th floor of a 24-story apartment house near the city center. His landlord, actually an agent representing the owner, refuses to let any tenant hang anything out of the windows, let alone permit Carl to install an antenna on his patio. In fact, the American flag is taboo.

I heard his sad story and told him to have his lease available when I visited him the following weekend. When I came to visit, I could see that the lease was "ironclad", so much so that it made baseball's reserve clause seem wishy-washy. That was it, no outdoor antenna for Carl.

I did make him somewhat happy by showing him an old trick. I connected the antenna lead-in wire to the metal finger stop on his phone's dialing mechanism. Reception was good considering the construction of the building, which killed reception even for parts of the AM broadcast band. This was a temporary measure since Carl was soon to get pushbutton phones.

Carl was all set to return to the flea market and unload his Drake receiver. He even told me he had planned to panel his room to give the listening shack a comfortable air, but now he wouldn't. "Now just a minute, before you quit," I said to Carl, "let's give it a try." We swiped his wife's kitchen roll of wrapping aluminum and hung it on the wall with masking tape. Two walls were outside walls, so this is where we placed the foil. Fig. 3 shows what we did. It looked kind of silly until we attached a clip lead from the foil to the antenna post of the receiver. Wow! Carl practically cried as he tuned the bands. His wife practically cried too when she saw the wall but calmed down once she realized that wall panels were going up. This antenna cost only 59¢ for the aluminum foil and $45 for the wall panel job.

The last I heard from Carl was he was planning to move to the suburbs where he had purchased an old homestead on six acres. I wonder what he had in mind. ■

CB Fights Crime

(Continued from page 49)

blue uniforms on the street. What you do see are silver-haired ladies and gentlemen carrying walkie-talkies. Most of the older volunteers sit in front of their homes in a position where they've got a clear view of the block, and where the antennas of their transceivers reflect the last rays of the sun and the cold blue glint of the street lamps. In addition to these, other volunteers watch the streets from their apartment windows during the early evening hours, on the lookout for any unusual or suspicious activities.

What happens when a street watcher spots a suspicious character? "Well, it's only happened to me once," says Steve Silverman, who, with his wife, occasionally patrols Gillette Street. "There was a report of some kids tipping over garbage cans on the next street, and I saw them heading my way. I called the base station and the police picked them up before they could get way." The Silvermans, somewhat younger than most other volunteers, make a point of walking up and down the block at regular intervals. "It's good exercise, and I

make sure I'm seen," he says.

When Fedesco gets a call, even if it's simply a suspicious-looking loiterer, he phones police headquarters, and a message is on the air to a prowl car in the area immediately. Volunteers are not encouraged to take part in any action which ensues. "It's our job to report to the police. After we do that, it's up to them," Fedesco says. In addition to emergency calls, Fedesco contacts each watcher once every hour, simply for a check that they're on duty and the equipment is functioning. Communication among watchers over the radios is not encouraged. "We're told not even to use our names on the air," Silverman said. "All of our communication is with the base station, not with each other." Approved CB call procedures are always used. Supplementary observers, who watch what's going on from their apartment windows, have Fedesco's phone number, and can alert him by phone if they see something overlooked by ground-level observers.

"The apartment watchers serve several purposes," Ms. O'Neill observes. "Many of them are elderly persons who are confined to their apartments. They don't have much to do otherwise, and watching gives them a feeling of being useful. Because they have a different perspective on street activity, they're sometimes able to pick up something the street watcher doesn't see. And since a would-be criminal doesn't know where the street watchers are or how many we have on duty, he's not likely to take the chances he might if he thought that all he had to do was to fool the person on the street."

Ms. O'Neill believes that the Asylum Hill project is the first of its kind in the nation. It is the first program aimed at deterring crime and putting people back on the street rather than apprehending people who have committed crimes. So far, most inquiries about the program have come from other Hartford neighborhoods, but inquiries from other parts of the country are expected now that the program has proved successful. It's certainly a constructive way of putting Citizens Band radio to work on behalf of people. ■

Wireless Facts

(Continued from page 73)

coherer took the place of the visual spark discharges of Hertz along with Samuel Morse's key and inker formerly used to record them. This successful work convinced Marconi that a practical use of Hertz' experiments existed, and since it had no connecting wires, it became known as wireless.

Marconi's work continued with increasingly better results over longer and longer distances until, in 1901, signals from his station at Poldhu (Cornwall, England), were heard by him at a receiving station he had built at St. John's, Newfoundland. These signals were the letter S repeated over and over on a schedule, and confirmed by him, by cable, back at Cornwall. It is interesting to note that, as Marconi increased his workable distance, he used longer and longer wave lengths, or as we say now, lower and lower frequencies. It was left to Amateur Radio Operators to prove the worth of short waves when, in 1923, they were successful with two-way communications across the Atlantic on 100 meters.

Again, it was the work of an amateur, Major Armstrong, that made long distance transmissions more reliable when he invented the sensitive superheterodyne circuit for the U.S. Army Signal Corps in 1918.

So, let us give Marconi full credit for his work in proving the practical use of wireless but not forget the work of the scientists whose basic concepts gave him the foundation for his wireless system. ■

CB Power Mate

(Continued from page 53)

sistor. Also be sure to hold each transistor lead with a pair of long-nose pliers as a heat sink when you solder to the transistor leads.

For the high-current CB Power Mate the bridge rectifier has a hole in the center to which you can secure the homemade heat sink. To make this, take a piece of scrap aluminum the width of the sink or larger and bend it in a U-shape with the ends sticking up in the air about an inch. Secure the sink to the rectifier with a #6 screw, a lockwasher between the screw and the rectifier, and a lockwasher and a nut on top of the heat sink. (The screw feeds in from the terminal or lead side of the rectifier.)

Also, for the high-current Power Mate the transistor uses the special heat sink with fins on the back of the cabinet (as shown in the picture). Q1 is installed the same way for both models. Drill a ¼-in. hole through the sink and the cabinet. Bend Q1's leads outward, away

from its mounting tab. Using a mica insulator from a power rectifier (preferably) or a power transistor mounting kit, coat both sides of the mica with silicone heat sink grease. Position the insulator over the hole in the cabinet and place an insulated shoulder washer (from a 5-way binding post) in the cabinet hole, from outside the cabinet, and pass a #6 screw through the sink, the cabinet, and the mica insulator. Then install Q1 and a lockwasher and a nut. Tighten the screw slightly more than hand tight. Check with an ohmmeter to be sure there's no short between the tab of Q1 and the cabinet. You should read infinity—no connection. If you have a short (one ohm or less) look for an improperly-seated shoulder washer or for a metal chip from the drilling.

Final Assembly. Before final assembly, with the parts *not* mounted in the box, drill a row of five ¼-in. holes in the cabinet directly over Q1, and five more holes in the lower left of the cabinet, near the transformer. These will provide adequate ventilation. Then put a small piece of tape over the head of the screw which secures the transistor, to prevent a (possible) external short.

Complete all wiring before installing the IC. Plug it into its socket so that pin 1, which has a dot molded next to it, faces the edge of the printed circuit board farthest away from the rectifier. Pin 1 should be toward the wires going to the board from the transistor. Install the fuse in its clips, set the rheostat, R2, to its mid-position, and connect the voltmeter to the output of the power supply (the binding posts). Plug in the CB Power Mate's AC cord and observe the meter. It should rise to some value and stay there. If it wanders, or rises and falls back down to zero, disconnect the AC power and check for a wiring error. If the voltmeter remains steady, adjust R2 very slowly for the desired voltage, 13.8 volts (or 12, or whatever depending on the set you are going to power with it). That's it—your CB Power Mate is ready to use.

Optional Protection. If you want to build-in the *maximum current limiting* (to make sure the supply will turn off if a short suddenly appears outside it), you can substitute a resistor for the jumper on top of the board. To figure the value of the resistor, follow these steps:

1. Find the value in ohms of the resistor, which we will call "R." The formula is: $R = \frac{0.6}{X}$ where "X" is the current the transceiver draws when transmitting.

2. If the current is 2 amps, then the formula gives us: $R = \frac{0.6}{2} = 0.3$

3. Now we must find the power rating of the resistor. Power is $W = I^2R$, where I is the current. Since we know that R is 0.3 ohms, and that the current is 2 amps, we get: $W = 2 \times 2 \times 0.3$ or $W = 4 \times 0.3 = 1.2$ watts. For safety we double the rating, giving us 2.4 watts.

4. So, we need a 0.3 ohm, 2.4 watts (or more, since that exact wattage isn't available). The nearest larger wattage rating should be used. Two 0.6 ohm, 2-watt resistors in parallel would do nicely.

In Use. Now plug your CB Power Mate in: connect the positive and negative leads of the 13.8-volt power supply to the Plus and Ground connections on your transceiver and start contacting your fellow CBers . . . with the maximum legal power which you paid for with your new set. Why not get it?

Of course the CB Power Mate is only needed in your home. In your car the transceiver will be getting the 13.8 volts it needs, if that electrical system is operating correctly.

Caution: Don't try to use the CB Power Mate at settings higher than 13.8 volts with a transceiver which requires that voltage. Trying to increase a transmitter's RF power output that way will probably result in blowing out components in the transceiver, because many transceivers are designed to just accept 13.8 volts, with not much safety factor above that. Be sure the Power Mate is set for exactly 13.8 volts before you turn on the transceiver, not any higher.

If you're not certain that your voltmeter is reading DC volts accurately, you can calibrate it very closely by using several new flashlight cells (not nicads—just ordinary, good condition—tested in flashlight—batteries). These cells, in good condition, put out exactly 1.56 volts each. Four cells in series should read 6.24 volts. 8 x 1.56 V = 12.48 V. Or you can get 13.94 V from nine cells. ■

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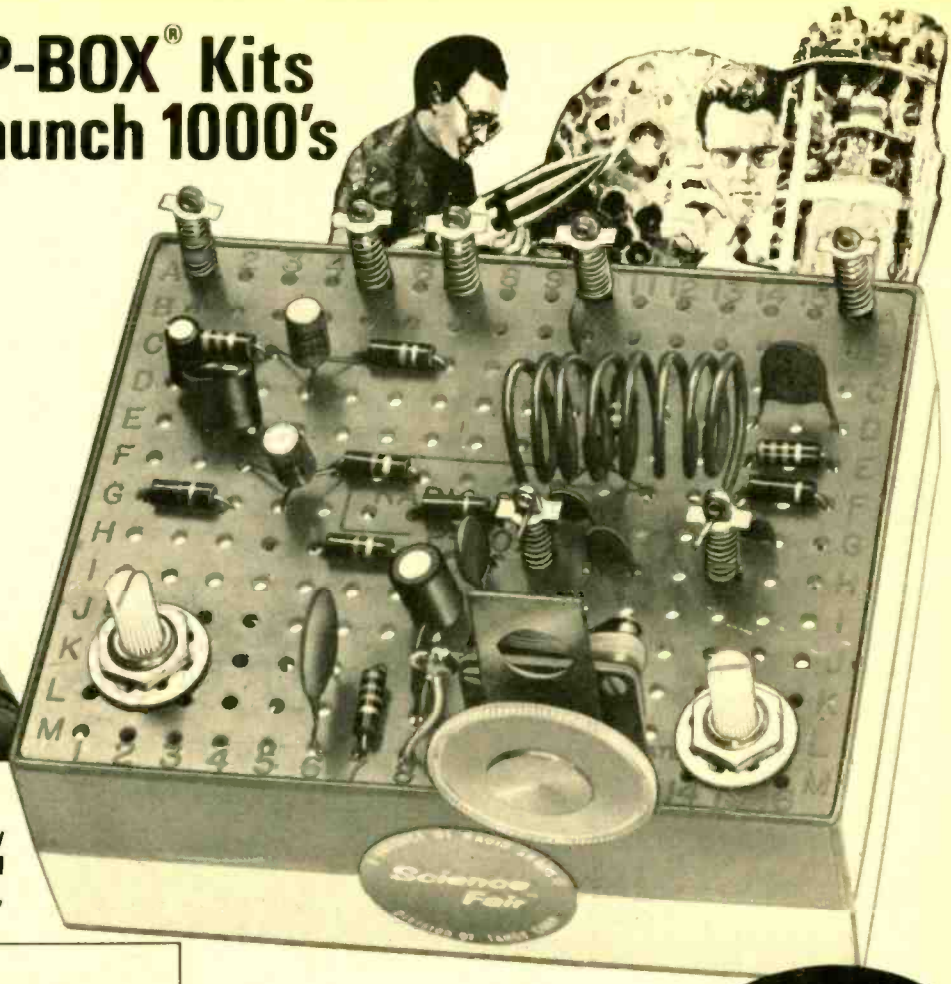

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102. *International Crystal* has a free catalog for experimenters (crystals, PC boards, transistor RF mixers & amps, and other comm. products).

103. See brochures on *Regency's* 1976 line-up of CB transceivers & scanner receivers (for police, fire, weather, & other public service emergency boadcasts).

104. *Dynascan's* new *B & K* catalog features test equipment for industrial labs, schools, and TV servicing.

105. Before you build from scratch, check the *Fair Radio Sales* latest catalog for surplus gear.

106. Get *Antenna Specialists'* catalog of latest mobile antennas, test equipment, wattmeters, accessories.

107. Want a deluxe CB base station? Then get the specs on *Tram's* super CB rigs.

108. Compact is the word for *Xcelite's* 9 different sets of midget screwdrivers and nutdrivers with "piggyback" handle to increase length and torque. A handy show case serves as a bench stand also.

110. *Turner* has two booklets on their Signal Kicker antennas. They give specifications and prices on their variety of CB base and mobile line. Construction details help in your choice.

111. *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.

112. The *EDI (Electronic Distributors, Inc.)* catalog is updated 5 times a year. It has an index of manufacturers literally from A to X (ADC to Xcelite). Whether you want to spend 29 cents for a pilot-light socket or $699.95 for a stereo AM/FM receiver, you'll find it here.

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115. *Trigger Electronics* has a complete catalog of equipment for those in electronics. Included are kits, parts, ham gear, CB, hi fi and recording equipment.

116. Get the *Hustler* brochure illustrating their complete line of CB and monitor radio antennas.

117. *Teaberry's* new 6-page folder presents their 6 models of CB transceivers (base and mobile): 1 transceiver for marine-use, and 2 scanner models (the Innovative "Crime Fighter" receiver and a pocket-size scanner).

118. CBers, *GC Electronic's* 8-page catalog offers the latest in CB accessories. There are base and mobile mikes; phone plugs; adaptors and connectors; antenna switchers and matchers; TVI filters; automotive noise suppressor kits; SWR Power and FS meters, etc.

119. *Browning's* mobiles and its famous Golden Eagle base station, are illustrated in detail in the new 1976 catalog. It has full-color photos and specification data on Golden Eagle, LTD and SST models, and on "Brownie," a dramatic new mini-mobile.

120. *Edmund Scientific's* new catalog contains over 4500 products that embrace many sciences and fields.

121. *Cornell Electronics'* "Imperial Thrift Tag Sale" Catalog features TV and radio tubes. You can also find almost anything in electronics.

122. *Radio Shack's* 1976 catalog colorfully illustrates their complete range of kit and wired products for electronics enthusiasts—CB, ham, SWL, hi-fi, experimenter kits, batteries, tools, tubes, wire, cable, etc.

123. Get *Lafayette Radio's* "new look" 1976 catalog with 260 pages of complete electronics equipment. It has larger pictures and easy-to-read type. Over 18,000 items cover hi-fi, CB, ham rigs, accessories, test equipment and tools.

127. There are *Avanti* antennas (mobile & base) for CB and scanner receivers, fully described and illustrated in a new 16-page full-color catalog.

128. A new free catalog is available from *McGee Radio*. It contains electronic product bargains.

129. Semiconductor Supermart is a new 1976 catalog listing project builders' parts, popular CB gear, and test equipment. It features semiconductors—all from *Circuit Specialists*.

130. There are over 350 kits described in *Heath's* new catalog. Virtually every do-it-yourself interest is included—TV, radios, stereo & 4-channel, hi-fi, etc.

131. *E. F. Johnson* offers their CB 2-way radio catalog to help you when you make the American vacation scene. A selection guide to the features of the various messenger models will aid you as you go through the book.

132. If you want courses in assembling your own TV kits, *National Schools* has 10 from which to choose. There is a plan for GIs.

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135. The latest edition of *Tab Books'* catalog has an extensive listing of TV, radio and general servicing manuals.

137. *Pace* communications equipment covers 2-way radios for business, industrial and CB operations. Marine radiotelephones and scanning receivers are also in this 18-p. book.

138. *Shakespeare's* new pocket-size catalog lists and describes their full line of fiberglass CB antennas, mounts and accessories offered in 1976.

142. *Royce Electronics'* new full-color catalog updates information on their CB transceivers (base, mobile, handheld). It also describes new product lines—CB antennas and a VHF marine radiotelephone.

144. For a packetful of material, send for *SBE's* material on UHF and VHF scanners, CB mobile transceivers, walkie-talkies, slow-scan TV systems, marine-radios, two-way radios, and accessories.

145. For CBers from *Hy-Gain Electronics Corp.* there is a 50-page, 4-color catalog (base, mobile and marine transceivers, antennas, and accessories). Colorful literature illustrating two models of monitor-scanners is also available.

150. Send for the free *NRI/McGraw Hill* 100-page color catalog detailing over 15 electronics courses. Courses cover TV-audio servicing, industrial and digital computer electronics, CB communications servicing, among others. G.I. Bill approved, courses are sold by mail.

152. Send for the new, free descriptive bulletin from *Finney Co.* It features the Finco line of VOM multi-testers (and accessories) for electronics hobbyists and service technicians.

153. *MFJ* offers a free catalog of amateur radio equipment—CW and SSB audio filters, electronic components, etc. Other lit. is free.

154. A government FCC License can help you qualify for a career in electronics. Send for information from *Cleveland Institute of Electronics*.

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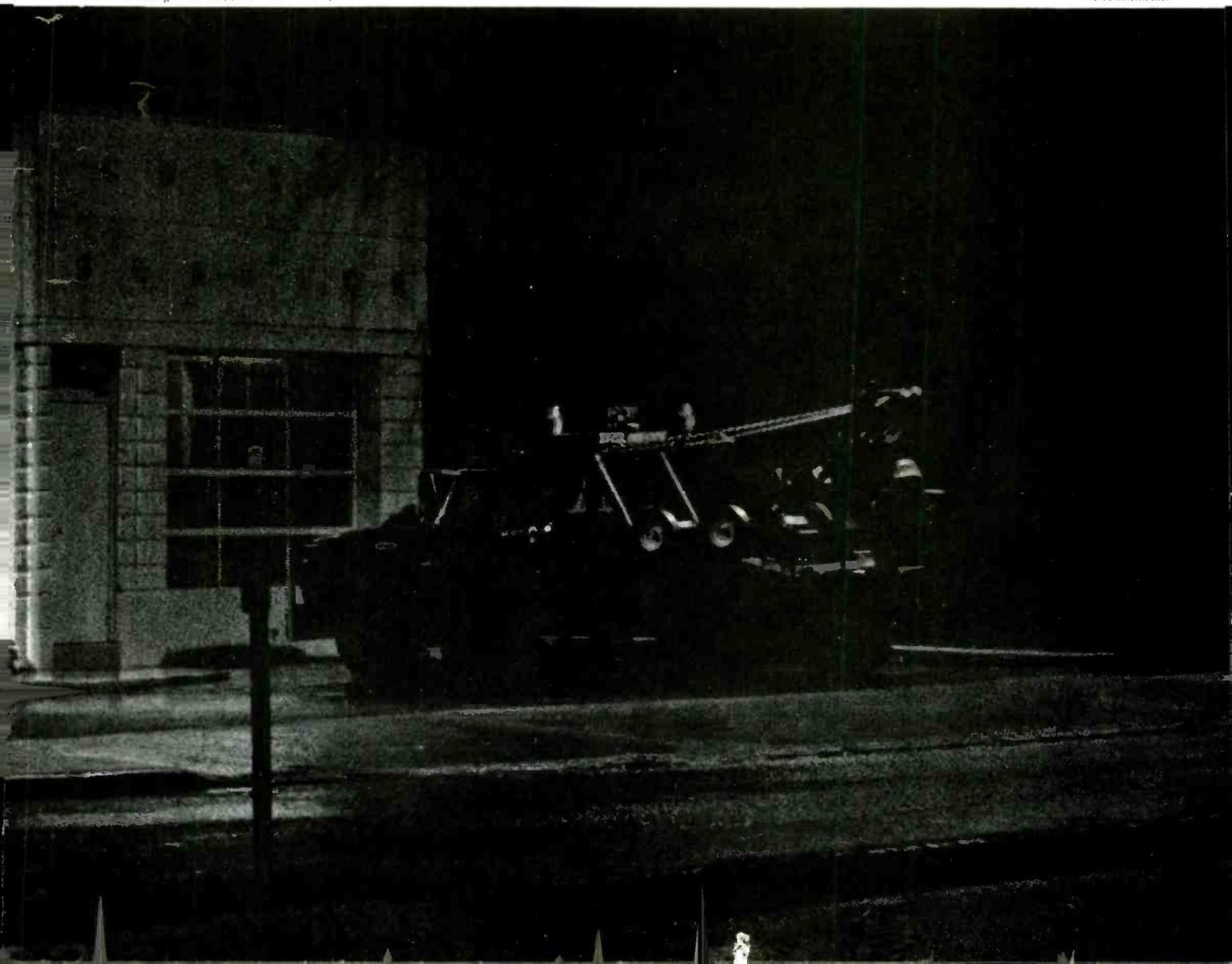

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