CB MEETS SWL IN GOOF-PROOF PROJECT see page 47

Elementary Electronics

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MARCH-APRIL
1975
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Pulse-width modulated mini-audio amplifier boosts pocket radio sound to dancing level.

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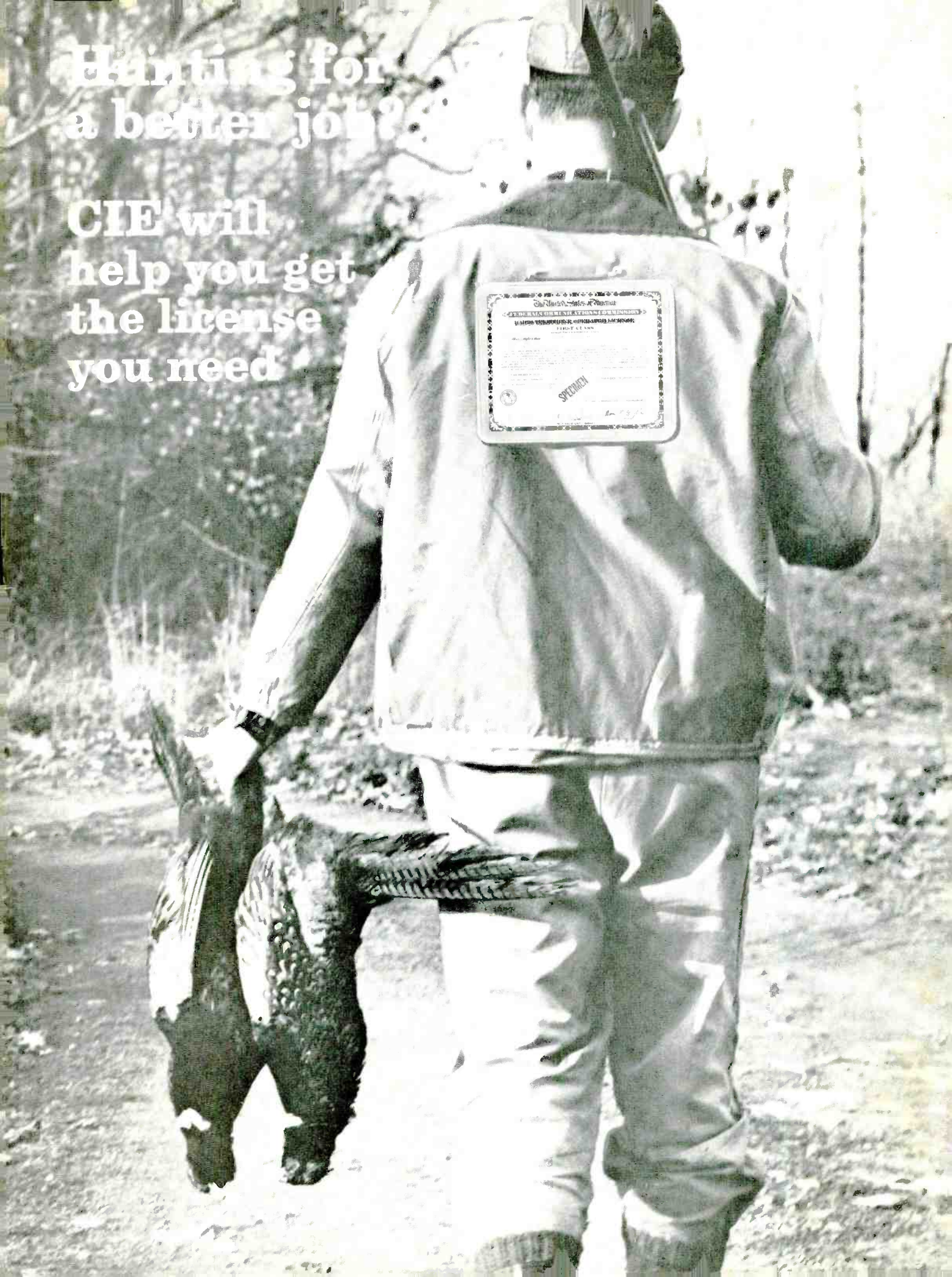
Hunting for a better job?
CIE will help you get the license you need
SPECIMEN

A Government FCC License can help you qualify for an exciting, rewarding career in ELECTRONICS, the Science of the Seventies. Read how you can prepare for the license exam at home in your spare time — with a passing grade assured or your money back.

IF YOU'RE OUT TO BAG A BETTER JOB in Electronics, you'd better have a Government FCC License. It will help you track down the choicest, best-paying jobs in the growing field of Electronics.

Demand for people with technical skills is growing twice as fast as any other group, while jobs for the untrained are rapidly disappearing. Right now there are thousands of new openings every year for electronics specialists. And you don't need a college education to qualify!

But you *do* need knowledge, knowledge of electronics fundamentals. And there is only one nationally accepted method of measuring this knowledge . . . the licensing program of the FCC (Federal Communications Commission).

Why a license is important

An FCC License is a legal requirement if you want to become a Broadcast Engineer, or get into servicing any other kind of transmitting equipment – two-way mobile radios, microwave relay links, radar, etc. And even when it's not legally required, a license proves to the world that you understand the principles involved in *any* electronic device. Thus, an FCC "ticket" can open the doors to thousands of exciting, high-paying jobs in communications, radio and TV broadcasting, the aerospace program, industrial automation, and many other areas.

So why doesn't everyone who wants a good job in Electronics get an FCC License?

It's not that simple. You must pass a Government licensing exam. A good way to prepare for your FCC exam is to take a licensing course from Cleveland Institute of Electronics.

Our training is so effective that, in a recent survey of 787 CIE graduates, better than 9 out of 10 CIE grads passed the Government FCC License exam. That's why we can offer this famous Money-Back Warranty: when you complete any CIE licensing course, you'll be able to pass your FCC exam or be entitled to a full refund of all tuition paid. This warranty is valid during the completion time allowed for your course. You get your FCC License – or your money back!

And with CIE, you learn at home in your spare time. With AUTO-PROGRAMMED® Lessons, you'll pick up the facts, figures and electronics theories you may have considered "complicated". . . even if you've had trouble studying in the past.

CIE Grads get licenses . . . better jobs

The value of CIE training has been demonstrated time and again by the achievements of our thousands of successful students and graduates.

An outstanding example is Ed Dulaney of Scottsbluff, Nebraska. He passed his 1st Class FCC License exam soon after completing his CIE course. Today, he owns two companies . . . one to manufacture and distribute two-way radio equipment, the other to maintain and repair such equipment along with home radio, TV and stereo sets. He says: "In the last three years we sold more than $1,500,000 worth of equipment through dealers in every state plus Canada, South America and Europe."

Richard Kihn, Anahuac, Texas, worked in the engine room of a tugboat when he started his CIE training. He reports, "Before finishing, I got my FCC License and landed a job as broadcast engineer at KFDM-TV in Beaumont, Texas. I was able to work, complete my CIE course and get two raises . . . all in the first year of my new career in broadcasting."

Send for FREE books

If you'd like a chance to succeed like these men, send for our FREE book, "How To Get A Commercial FCC License." It tells you all about the FCC License . . . requirements for getting one . . . types of licenses available . . . how the exams are organized and what kind of questions are asked . . . where and when the exams are held, and more.

With it, you will also receive a second FREE book, "Succeed in Electronics." For your convenience, we will try to have a representative call. Send for both books today.

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2. Your school catalog, "Succeed in Electronics."

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March-April 1975
Volume 15, No. 2

Cover photo by Leonard Studios

AUTHORS IN THIS ISSUE

Jay Arthur, James A. Fred, Louis E. Frenzel, Jr., Hugh Gordon, Joe Gronk, Don Jensen, C. R. Lewart, Kathi Martin, Charles Rakes, Joe A. Rolf, Jack Schmidt, Hank Scott, Thomas R. Sear, Malcolm K. Smith, Thomas R. Sundstrom, Art Trauffer, and the ELEMENTARY ELECTRONICS editorial staff.

ELEMENTARY ELECTRONICS is published bi-monthly by Davis Publications, Inc. Editorial and Executive offices: 229 Park Ave. So., New York, NY 10003; all subscription orders and mail regarding subscriptions should be sent to P.O. Box 2600, Greenwich, CT 06830. One-year subscription (six issues)—$3.95; two-year subscription (12 issues)—$7.95; three-year subscription (18 issues)— $11.95; and four-year subscription (24 issues)—$15.95. Add $1.00 per year for postage outside the U.S.A., its possessions and Canada. For change of address, please advise 4 to 6 weeks before moving. Send us your current mailing label with new address. Advertising offices: New York, 229 Park Avenue South, 212-673-1300; Chicago, 520 N. Michigan Ave., 312-527-0330; Los Angeles; J. E. Publishers' Rep. Co., 8732 Sunset Blvd., 213-659-3810. Second-class postage paid at New York, NY and at additional mailing office.

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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.

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• 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. 516EN 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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Hey, look me over

Showcase of New Products

Automatic Direct-Drive Turntable

The Technics by Panasonic model SL-1300 turntable combines the outstanding performance of direct-drive design with the convenience of fully automatic, single-play operation. When the start switch is activated, the platter begins to rotate and the stylus is set down in the lead-in groove of the record. After play is completed, the arm is lifted off and returned to its rest position, and the motor is turned off. This was achieved without any sacrifice in such characteristics as low wow and flutter, low rumble,

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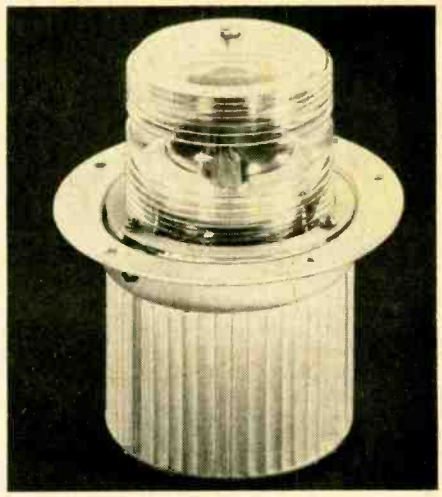
long-term speed stability, reliability, or any of the other widely recognized virtues of direct-drive design, formerly available only in manual turntables. In this efficient design, less than 4 watts of power is used by the entire turntable, with most of that amount being consumed by the control circuitry and the stroboscopic lamp. Less than 0.1-watt is consumed by the motor. This contributes greatly to stability by minimizing heat effects. Costs only $229.95. For more information, write Panasonic, 200 Park Avenue, New York, NY 10017.

Aircraft Strobe Light Kit

The new Heathkit OL-1155 Aircraft Strobe Light has many versatile uses as an emergency vehicle warning flasher, on boats, or as a marker light for towers, etc. The unit comes with a clear lens for aircraft use as an anti-collision or supplemental beacon, and can be used as a direct replacement for standard 3¾-in. rotating beacons. As an aircraft strobe light, it meets requirements set forth regarding aircraft anti-collision lighting. It operates on 12 VDC negative ground



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supply drawing a nominal current of 1.5 A. An internal trimmer adjusts flashing frequency of the strobe. For other than aircraft uses, optional red and amber lenses are available at additional cost. Kit goes together easily in a few hours—even by beginners. Kit is mail-order priced at $54.95 F.O.B. factory. For further information, write Heath Company, Benton Harbor, MI 49022.

New Speaker Series

The Kenwood KL-series of stereo speakers, which is currently being introduced, includes three moderately priced units, engineered for linear response, minimal distortion, and wide dispersion. The top-of-the-line KL-77 is a three-way system incorporating a 12-in. low-frequency driver, responsible for low frequency reproduction down to 27 Hz and attenuated above 1 kHz to eliminate dispersion problems in the mid-range frequencies. A mid-range driver includes a ¾-in. voice coil diameter and a heavy magnet structure for improved efficiency and power

CIRCLE 61 ON READER SERVICE COUPON

handling capability. A 2-in tweeter extends useful reproduction to above 18 kHz. The other two speaker systems in the new line, the KL-55 and KL-44, are two-way models utilizing a 10-in. low frequency drive and a 3½-in. direct radiator with dome which provides flat response as well as wide angle dispersion throughout its operating range. Crossover networks of all Kenwood speaker systems are designed for each model and

(Continued on page 8)

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Can Bio-rhythm tell you? We're not sure, but we're told that vast mood shifts are caused by your body's Internal Time Clock whose rhythms can be charted ahead to possibly warn you of "critical" days. Some are great, some blah. Maybe it's your physical, emotional & intellectual rhythms converging at the right or wrong time. Compute your cycles with our Bio-rhythm kit and judge for yourself. Incls Charting kit, metal Dialgraft Calc., instrs.

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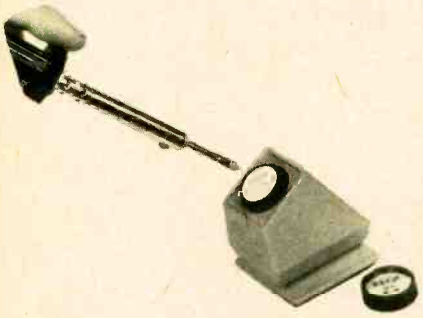
Hey, Look Me Over

(Continued from page 6)

full-capacitor-inductor systems are used for symmetrical roll-off characteristics and to minimize intermodulation distortion. With suggested prices of $149.95, $109.95, and $89.95 each, respectively, the KL-77, KL-55, and KL-44 are available with brown grille or in decorator blue or red at a slight additional charge. For more information, write directly to Kenwood Electronics, Inc., 15777 S. Broadway, Gardena, CA 90248.

Tip-Top Cleaner

Instant cleaning of soldering iron tips is assured with all new Re-Tip from GC Electronics. Pictured is the Re-Tip Base and Cartridge, Cat. No. 9482, with self adhesive bottom for adhering to workbench in shop or plant. Re-Tip is simple and easy-to-use. Merely insert hot iron tip into Re-Tip and then withdraw—all



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contaminants are instantly removed. Re-Tip uniformly cleans tips up to ¼-in. diameter, prevents contaminated solder joints and prolongs tip life—tips solder faster, longer. Price approximately $10.50. Also available is a Portable Re-Tip, Cat. No. 9483, for hand-held use, and a Base Refill Cartridge, Cat. No. 9484 at about $4.50. For more information and catalog, write to GC Electronics, Division of Hydrometals, Inc., 400 South Wyman, Rockford, IL 61101.

Roll Out the Barrel

The old wooden beer barrel has always been a visual delight, but now it speaks for itself. It's the new Schlitz Beer Barrel Speaker, which combines great looks with great sound. It is the latest and most exciting innovation in speakers for the home stereo and hi-fi systems.

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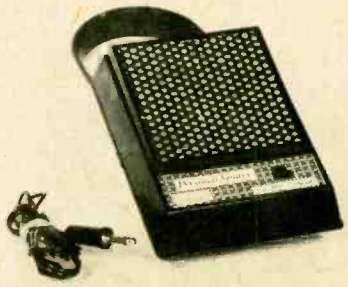
Molded of high density weatherproof polyurethane with realistic dark oak woodgrain finish, it contains an 8-in. two-way speaker system and volume control with frequency response range of 50-18,000 Hz. The barrel diameter is 19½-in and 6½-in. deep, with an easy wall mount installation. The Schlitz Beer Barrel Speaker is available in audio, radio and TV, department and specialty stores at $49.95. This is the first of a line of decorative audio accessories to be produced by Acoustech, Inc., 4111 N. Port Washington Ave., Milwaukee, WI 53212.

Personal Security Alarm

The constant companion that never stops protecting you is the Personal-Sentry, a product of Audiotex Division, GC Electronics. The unique, dual purpose alarm

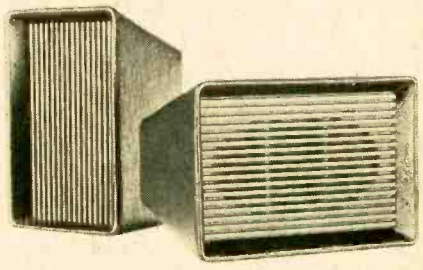


CIRCLE 63 ON READER SERVICE COUPON

easily attaches to any door at home, or in hotel or motel when traveling, to provide protection from burglars or intruders. When you leave, it can be carried with you for constant self-protection. Lightweight and easy to use, Personal-Sentry operates on two AA size dry cells, and fits in the palm of your hand. Sells for $7.95. More information can be had by writing to GC Electronics, 400 South Wyman, Rockford, IL 61101.

Mini-Car Stereo Speakers

The answer to easily installed, beautiful stereo in mini-cars, sport cars, and compacts—or, quad sound in wagons, bigger cars, and vans—comes from Utah Electronics in their new SA53 stereo speaker kit. Only 6-in. wide and 3¾-in. deep, the new wedge-shaped speaker enclosures can be securely mounted at any angle on vinyl and other fabric surfaces, as well as metal, by using the special hook-and-pile fasteners included with each kit;

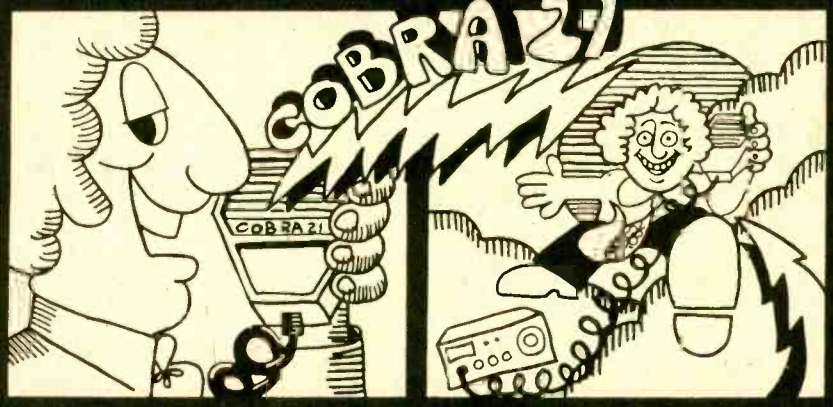


CIRCLE 66 ON READER SERVICE COUPON

no holes have to be cut or drilled for mounting. Each enclosure is fabricated from acoustic fiberboard to preevnt unwanted resonances. The 3 x 5-in. high fidelity speakers utilize heavy ceramic magnets for smooth, wide-range response; are rated at 8 ohms; and, are pre-connected to 10½-ft. of color-coded

(Continued on page 14)

Now there's a CB radio with too much talk power.



Put punch in your voice, from a block away to the fringes of your range. New Dyna-Mike gain control puts out absolute modulation. So much talk power you'll have to turn it down.

An important feature, but only one that makes this fantastically low-priced CB radio the best CB value on today's market.

The Cobra 21 with crystal filter, dual conversion receiver; transmits and receives on all 23 AM channels. Features 60 dB adjacent channel rejection that completely eliminates bleedover.

Extra large Power S Meter let's you monitor your set's performance easily even when it's tucked under the dashboard.

And you get switchable automatic noise limiter, P.A./external speaker jack, large built-in speaker and detachable mike.

It's all wrapped up in a beautiful, compact cabinet only 6" wide x 2½" wide x 7½" deep. Meets FCC requirements.

Ask your CB Dealer for the Cobra 21. The radio with too much talk power for not much money.

COBRA 21
WITH EXCLUSIVE DYNA-MIKE

Product of DYNASCAN CORPORATION · 1801 W. Belle Plaine, · Chicago, Illinois 60613

CIRCLE 8 ON READER SERVICE COUPON

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 $312... 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 $650 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 its savings on to its students.

NRI pays no salesmen. We buy no outside "hobby kits" for our experiments or training kits. NRI designs its own instruments and TV sets... to give you great performance plus real training that you can put to practical use. The result is low tuition rates without the penalty of exorbitant interest charges for time payments. We pass the savings on to you.

More than 1 million students have come to NRI for home training.

Home study isn't a sideline with NRI. We've been its innovating leader for 60 years. More than one million students have enrolled in our many career courses. NRI is one of the few home study schools with a full-time staff of engineers, authors and editors to help you with any problem. NRI graduates will tell you: you can pay more, but you can't buy better training.

15 Electronic courses available... including digital computer training and complete communications.

Send for the free NRI electronics catalog and check out the full spectrum of courses available, including Color TV, FCC Licensing, Complete Communications Electronics, Computer Electronics, Marine and Aircraft Electronics, Mobile Communications, etc.

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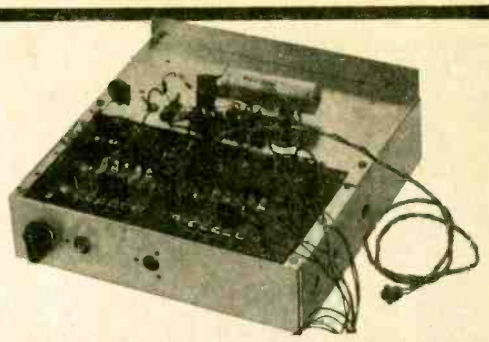
good with 7 kits . . . $312

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 . . . $425

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 . . . $695

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 . . . $535

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.

Hey, Look Me Over

(Continued from page 8)

wire for fast hook-up. Each SA53 car stereo speaker kit features two speakers mounted within acoustic fiberboard enclosures, hook-and-pile fasteners, and complete instructions for quick, easy installation. Priced to sell at $44.95. More information available from Utah Electronics, 1124 East Franklin St., Huntington, IN 46750.

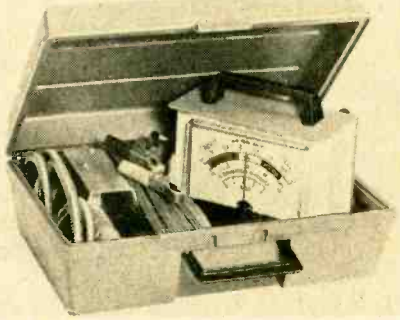
Traveling Playback and Record

The Clarion 812 car cassette player adds a record capability to its extensive repertoire of features. It's ideal for businessmen or other professional men on-the-go who wish to utilize valuable traveling time. The 812 comes complete with a microphone that has an on/off switch for stop/start dictating and spring tension cord for in-car recording. Some features are: automatic reverse and fast forward/rewind controls, automatic or manual program switching, program indicator lights which indicate tape direction at a glance. It is designed for stable playback even while driving over the roughest roads. Costs only $154.95. For further information, write the Clarion Corporation of America, Dept. P., 5500 Rosecrans Avenue, Lawndale, CA 90260.

CIRCLE 74 ON READER SERVICE COUPON

Exhaust Gas Analyzer

With the new Heathkit CI-1080, you can check exhaust emissions of your car to make sure the motor is tuned for minimum pollution levels and maximum fuel efficiency. Unit indicates relative combustion efficiency, air-fuel ratio and percent of carbon monoxide from the exhaust emission of 4-cycle automotive engines. Best results are obtained when readings are taken before and after engine tune-up. Color-coded battery clips attach to any 6- or 12-volt auto battery. The meter is designed to hang on a partially open car window or sit on any flat surface. Flexible stainless steel tubing directs exhaust gas from tailpipe to the sensor. Kit goes together easily—even by beginners. The CI-1080 kit is mail-order priced at $59.95 F.O.B. factory. For further information, write Heath Company, Benton Harbor, MI 49022.



CIRCLE 1 ON READER SERVICE COUPON

Heat Alarm

A convenient, self-contained fire alarm, designed to protect any home or business from fire, is the Heat-Sentry, offered by Audiotex Division, GC Electronics. Heat-Sentry protects by sounding a built-in alarm horn when the temperature reaches 131° F. Easy-to-install

CIRCLE 68 ON READER SERVICE COUPON

—simply place the unit on a wall in a potential fire area, or room where danger of fire is present, and plug in. It features 120 VAC operation. Costs only $14.95. Under its Audiotex label, GC Electronics offers a variety of burglar/fire alarms and accessories for home, business, auto, and self-protection. Get all the facts by writing to GC Electronics, 400 South Wyman, Rockford, IL 61101.

New Clean Look

Sansui has decided to inaugurate the clean look in its new AM/FM-stereo tuner, Model TU 5500. The tuning dial, slanted to prevent glare, is etched in white lettering against a dark background, making station number identification easy and positive. There are two tuning meters, large, accurate and illuminated. Both the stereo indicator and dial pointers use light-emitting diodes.

CIRCLE 67 ON READER SERVICE COUPON

The sensitivity of the TU 5500 is a low 1.9 microvolts, the result of using a metal oxide field-effect transistor in the front end. The tuner has a three-stage IF amplifier using two newly developed linear-phase bi-resonator ceramic filters, plus an IC in the limiter stage. The result is elimination of group-delay and phase distortion, a sharp limitation of signals from adjacent stations and the removal of beat interference. Retail price of the TU 5500 is $279.95. For further information, write to Sansui Electronics Corporation, 55-11 Queens Blvd., Woodside, NY 11377 and tell 'em ELEMENTARY ELECTRONICS sent you. ■

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491

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- Electronic Metronome
- Telephone Amplifier
- IC AM Radio
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- Electronic Thermometer
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- "Rise-Fall" Siren
- Photo Night Light
- Wireless AM Mike
- Transistor AM Radio
- One-Tube AM Radio
- 2-Transistor FM Radio
- Solar-Powered AM Radio
- 3-Way Code Oscillator
- OTL Audio Amplifier
- "Goofy-Lite" Flasher
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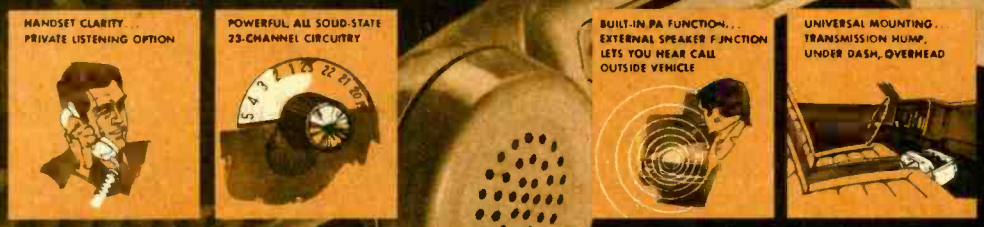
CIRCLE 32 ON READER SERVICE COUPON

if you've been wondering what the next great step in CB will be... you're off the hook.

Messenger 130 . . . so radically new in design and performance that citizens band radio will never be the same again. Inside this prestigious "radiotelephone" package is a unique all solid-state chassis that provides unparalleled operating advantages. From handset reception clarity . . . to automatic speaker silencing for private listening . . . this is truly an innovation in CB mobile radio performance. An innovation that's available only from your E. F. Johnson dealer.

Messenger® 130

CB mobile radio will never be the same again.



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16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
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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 8 issues at $3.98 and bill me.

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Name (print clearly) _____

Address _____

City _____ State _____ Zip Code _____

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

Sneak Circuit

I own a good CB receiver with an external crystal jack. I would like to know if I can build a simple circuit to use with the crystal jack so that I can have a variable frequency selection other than the CB channels.

—B.W., Cincinnati, OH

What you are looking for is a VFC (variable frequency circuit) that is not permitted on CB. Want to ham it up? Get a license first, then you'll know what to do.

Know the Code?

Is there any code for dual-in-line ICs? If there is, I would like to know what it is because I have 35 of them and don't know what they are. They do have funny markings on them.

—S.B., Newark, NJ

Those funny markings are production codes that manufacturers don't like to talk about. Why give away secrets?

Dunno

Hank, what is the operating frequency of the Memphis, Tennessee police department? They won't tell me.

—J.P., Memphis, TN

I won't either, only because I don't know. You could go to one of a few services that claim they know, but all they'll tell you is the frequencies assigned. Let's say Memphis police have six frequencies. One is a general call channel, two seldom used, and three held in reserve. Which frequency should you buy a crystal for? I dunno. But the guy selling monitor receivers in Memphis does 'cause he's selling lots of them. Why not ask him. He's the guy standing next to a Regency hi/lo band monitor at the local electronics store.

Let Go of My Shoe

How can I make a clock radio from an electric alarm clock and an electric radio? I would like to wire it some way so that when the alarm goes off the radio will automatically come on and play.

—R.S., Duaite, CA

You're pulling my leg, aren't you? I priced an inexpensive clock-radio on sale for only $19.95 and bought it—the price was right. Considering the time and expense you have to go through on your proposed project, you must be pulling my leg. Let go!

From the Known

I would like to know if I need some kind of a license for the E. F. Johnson Messenger 130 CB rig? If so, how do I get one?

—L.S., Prospect, VA

Pick up a copy of the 1975 CB YEARBOOK at your local newsstand or send $1.35 to this magazine with your request. It's all in there. What you actually have to do is fill out an FCC Form 505 and mail $20 with the form to the FCC. The CB YEARBOOK gives complete facts.

What's to Scan

Where can I get a scanning monitor to cover the CB band?

—K.L., Brooklyn, NY

All you need is a one-channel CB rig left on receive all the time. Any channel you turn to will be crowded in Brooklyn. How in the world could a scanner step up to the next channel when the 20 odd (I mean odd) stations never cease to transmit? Yack, yack, yack, etc., yack.

From the Unknown

What's the matter, Hank? I get the impression that you don't care for hobby CBers! We're not all that bad!

—B.B., No Town, USA

You got something there. Of course you're not all bad. In fact, there's a lot of good in all of you. But hobby CB is not in the rules unless you write them yourselves. But, if anyone can write the rules, bye bye broadcast radio and everything else. And, I'd like to ask a question—why didn't you sign your name and give your address?

Play Ball

I have seen advertised in a novelty magazine a device for $14.98 which, when placed on top of an AM receiver, will bring in stations from a distance of 300 to 500 miles. I love baseball and since Oklahoma City does not carry any major league games, I am considering buying one. My question is, do such gadgets work as they are supposed to and, if not, do you know where I can purchase a more reliable one?

—G.S., Oklahoma City, OK

You've got to be OK if you like baseball. As for the gadget you are writing about, try it; if it doesn't work, break it open and place the innards around the roots of your rose plants. That's all it will be good for. I suggest you string an outdoor antenna. The results will be much better and cheaper.

AC Blues

There is an AC switch that when turned on causes a loud crack in my sound system and so far I have been unable to eliminate it. The AC is a momentary contact switch which is normally open. Sometimes, if I take the volume down on the preamp, press the switch and bring up the volume it will not make the noise. But that is not very often.

—P.H., Marysville, PA

I don't know much about where the AC switch is—is it in one of the components, or part of the house wiring? If possible,

replace the switch. Maybe the spring snap action is not working fast enough and an unnecessary spark is drawn. Otherwise, connect an 0.5 uF, 600-volt ceramic disc capacitor across the switch terminals. If this doesn't work, pull the fuse.

Wrong End

I installed a VU meter on my FM receiver and some of the local FM stations are overmodulating their signals. Should I report them to the FCC?

—F.J., Waco, TX

Save your stamps! A transmitter's clipping should be measured at the transmitter, and not at your receiver. All you are measuring is volume, and your ears can do the job better.

What Channel?

I saw nude forms and naked women's bodies on TV late at night. Why does the FCC allow this?

—H.D., Bronx, NY

We may have seen the same program on breast cancer. I believe the FCC allows this because it will save the lives and health of many women. I'm not the kind of guy that goes to X-rated pictures, but this program, and others like it, are A-OK with me.

Needs More Speed

My turntable turns too slowly, and records sound awful. I've checked the capstan drive and idler wheel and they show no signs of wear. What could be wrong?

—G.M., Austin, TX

A clean-up job with some alcohol will do it. It seems your turntable (or is it a changer?) has an idler wheel whose rubber has gone hard. Wash it in alcohol until all the black smudge comes off. Also, apply the spirits to the inside of the turntable rim and drive shaft you call a capstan. When dry, assemble turntable and enjoy it. If the rubber is too far gone, you may need a replacement.

Changing Cycles

I heard that all agencies of our local fuzz are going from their present 30-50 megs to a higher band. This will make my beloved lowband Bearcat III an 8-channel flashing ornament. Is there an adapter I can install to raise the frequency span?

—V.S.L., Lima, OH

You have been out-fuzzed by modern day communications. 30 MHz is dying. But all is not lost! The Bearcat III features a plug-in interchangeable RF module for each band, so you can get a new module and jump on the high band wagon *now*. For info write to Electra Company, Cumberland, IN 46229.

Save the Paper Work

Hank, I threw away the literature that came with my multi-element TV color antenna and now I have no idea what the impedance is. Can you help?

—G.C., Rome, NY

TV antennas are designed for 300-ohm twin-lead cable. Why not for 75-ohm coax I'll never know. As for the color antenna—since when can they tell the difference between color and black-and-white transmissions? Only your color TV set can do that.

His Cycles Hertz

I'm doing some loudspeaker testing. Amateur stuff, you know, and I find that my signal generator does some strange things at low frequencies. I put about 50 cycles (Hertz to you) in and raise the level. Well, as the sound gets louder, the frequency jumps to 100 cycles above a certain sound level input. My oscilloscope says nothing is wrong with the generator, but my hearing says yes. What am I to believe—my eyes or my ears?

—I.N., Los Angeles, CA

Your ears, because the loudspeaker is doubling the frequency after the level gets too high for the cone to faithfully follow the 50 Hertz (cycles to you) sweep. This is loudspeaker distortion. You'll find this distortion decreases as the frequency increases. Hey, fellah, you're beginning to get into what's wrong with cheap audio systems. Now you'll appreciate the better loudspeakers.

He Wants to Practice

Enclosed you will find a schematic of an electrical stimulator used in acupuncture which I took to a radio parts store for the parts listed. They supplied all the parts listed except the wire coils, and they said the coils would have to be hand wound. What am I to do?

—M.G., Jacksonville, FL

I'm not publishing the schematic because I don't want to lose any readers. As for your patients, Doc, don't build the gadget and you won't lose any, either.

Needs Lots of Work

Hank, what is the best kind of home study course to take? I know very little about electronics and want to go all the way.

—T.T., Newton Falls, OH

The best course to take is the one you will complete. Too many youngsters begin home study courses and quit after a few lessons when they discover self-education takes work, dedication to their goal, continuous effort, and drive. Get started and stick to it. You'll thank me in 15 years—you said all the way!

To Be Young Again

I am just 12 years old, and interested in electronics. I'm thinking of buying a "Science Fair P-Box" shortwave radio kit. Could you tell me if it's any good?

—K.K., Winnipeg, Canada

First, OM, let me say welcome to shortwave listening and electronics. Since you are a smite young, the kit you mentioned is great. As you gain age, experience will demand bigger and better products. Get started today, and welcome to the club.

Don't Ask

I've got a question for you Hank that I believe you can't answer because you have to be an antique radio buff to know the answer. Who can help me?

—R.S., Menands, NY

I dab in antique radio, but you are right, I'm not a buff. So why not direct your question to Jim Fred, our Antique Radio

(Continued on page 24)

15 exciting new projects for '75

GR-500

Simulated TV pictures

GR-300

GR-400

15, 17 & 19" (diagonal) Color TVs with On-Screen Digital Readout

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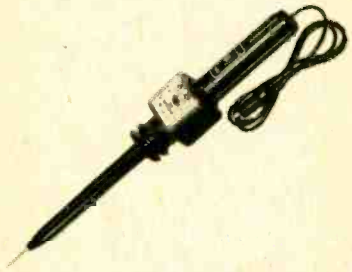

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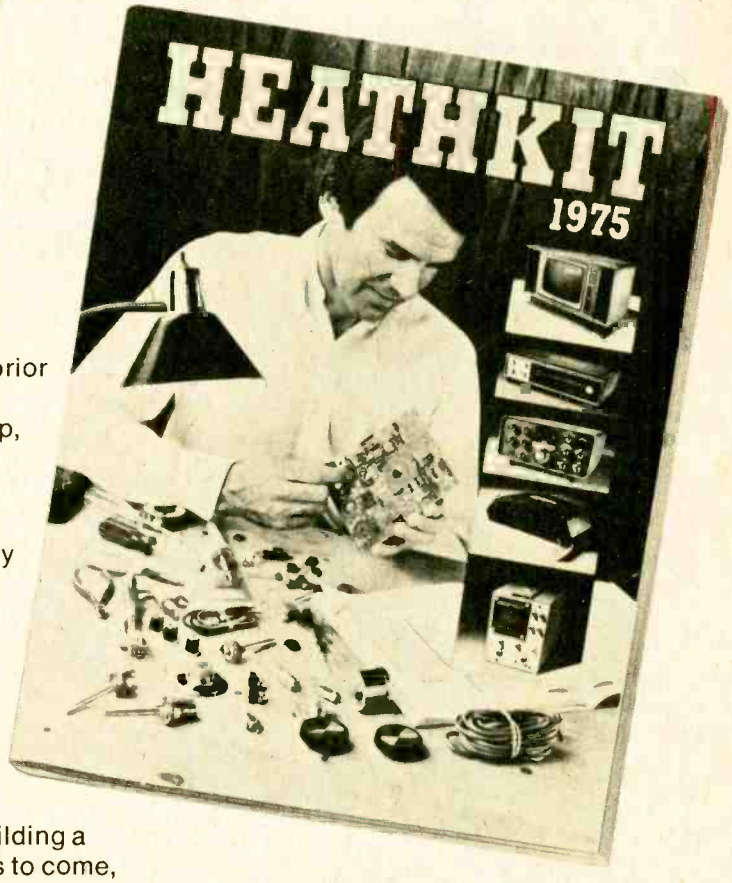

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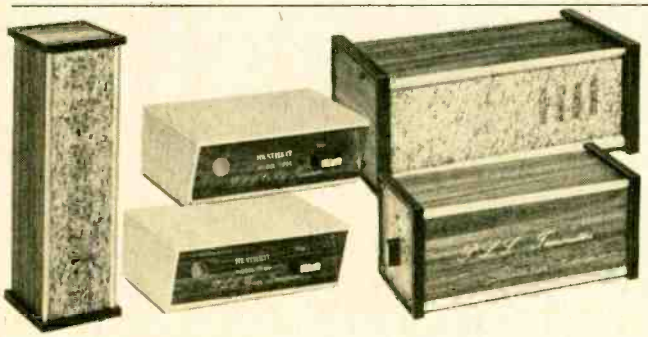

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CIRCLE 1 ON READER SERVICE COUPON

ASK HANK, HE KNOWS!

(Continued from page 19)

columnist for ELEMENTARY ELECTRONICS. If he doesn't know the answer, there are very few, if any, who do. You can write to Jim in care of this magazine.

You Arrived

I do a lot of DXing and SWLing and I pick up a lot of stations. But how do I get mailing addresses of these stations to ask for a pennant?

—K.G.G., Chicago, IL

Just keep on reading, pal, you're in the right magazine now. Enjoy!

Just the Facts, Please

Every night I receive a SW station called Radio Today. Could you please tell me where it broadcasts from and if possible, how I could get a QSL card.

—R.M., Prescott, Canada

There is no shortwave station known as Radio Today. Conceivably it might be a program of that name, but I've never heard of it. Without a frequency or time, how can I help you? In fact, with all the facts, it's a fact that our fact finding Shortwave Editor of ELEMENTARY ELECTRONICS, Don Jensen, *can* help you. You can write to him in care of this magazine—we're one big happy family.

Mighty Low

I have just purchased a new car (an Audi 100LS) and it came with a three-band radio. On one of these three bands, marked "L," the dial reads 1.5 to 2.9. I have no idea if this might be 150 to 290 kHz or not. Could you please tell me what frequencies these really are? If it will help, I received stations CRK at 2.1 and CCZ at 2.5 and MKP at 2.8 on the dial.

—J.F.R., Pittsburgh, PA

The stations you're hearing are LF air radio beacons. They transmit their calls repeatedly in morse code and are used by planes for checking location and direction. Many of them operate in approximately the 200 to 400 kHz range. Normally a dial marked 1.5 would indicate 1.5 MHz, 1,500 kHz. But apparently in this case, the Audi people intend it to mean 150 to 290 kHz. Incidentally, in Europe, some long-wave broadcasting stations use these frequencies, for example, the one-million-watt Radio Luxembourg outlet on 236 kHz and the BBC's Droitwich station on 200 kHz.

Nothing to Do With Skip

Why do AM broadcast stations reduce their output power at night? Is it because the signals skip too far?

—T.H., St. Joseph, MI

Broadcast band ground waves travel further when the air is humid, heavy, and cool. In short, ground waves, the waves we listen to mostly on the AM band, travel more efficiently at night than they do during the day. That's why two 10,000-watt stations can operate only 500 miles apart during the day, and one or both must reduce power at night.

Listen to CB?

How do I go about monitoring CB radio? There are no call books that I know of, and most of the CBers don't use their calls anyway.

—D.R., W. Palm Beach, FL

You got to be kidding. I tuned in channel 9 the other night and it sounded like New Year's Eve. And this is the emergency call channel. The other channels are worse. And who cares if Black Bart in downtown Phoenix is pouring in on channel 11 except the FCC? Don't waste your time. Get into serious SW or broadcast band monitoring. If you like action, monitor the fuzz or the fire department.

Foiled!

My dad won't let me install an outdoor antenna and I know the lack of one cuts down on my reception. Don't tell me to tie a wire to my bed spring because I have a mattress made of sponge rubber. What can I do?

—R.S., Augusta, GA

Ask your Mom to donate a roll of kitchen aluminum foil. Install the foil along two adjacent sides of your room with thumb tacks. Use one long foil strip about 20 feet long if possible. Connect a lead from your receiver's antenna terminal to the foil at one end. Bet you notice a big difference. And ease off Dad until he fully understands that your hobby is more than a lark and you are very proficient. Eventually he'll come around to your way of thinking. In fact, let him listen to some foreign English-language newscasts. He may get bitten by the bug, too!

Getting Started

Hank, what kind of beam antenna should I get? I plan to get involved with SW monitoring.

—T.F., Norfolk, VA

Forget the beam—stick with a long wire until you consider yourself a hotshot. I fooled with a beam for a while until I discovered I spent more time rotating the antenna than listening to DX. Leave the beam stuff to the CIA and scoop in the world of DX with your long wire.

Way Down Low

What was the lowest frequency station you ever heard?

—D.G., Evanston, IL

Voice of America from Munich, Germany on 173 kHz—and 1,000,000 watts(!) power. I repaired a longwave receiver for a friend and got to play with it for several evenings. It was fun. I'm only sorry I didn't try for QSLs.

It Was a Long Wait

When will the sunspots be at their lowest?

—A.R., Little Rock, AR

We should hit a low spot in the cycle about summer, 1975. Sun spots vary from day to day, and even at the height of activity a few sun-spot-free days may occur permitting DXs that normally would not occur. Sun spots introduce considerable atmospheric noise and, when very active, break down the normal pattern of ionized layers surrounding earth, causing communication havoc. ■

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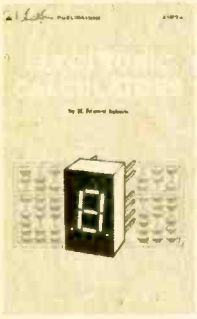
Electronic Calculators. Although there's a scattering of published information on calculator design, fabrication, and repair, no complete source of all this information has been available. In *Electronic Calculators,* Author H. Edward Roberts has gathered together this data—and more—into convenient book form. The book begins with a discussion of the evolution of the electronic calculator. In easy, lucid style, the author also explains calculator memories, displays, design, fabrication, component selection, interfacing with hard-copy equipment, and servicing. The book progresses from the origin and history of the calculator to the intricacies of electronic calculator technology. Published by Howard W. Sams & Co., Inc., 4300 W. 62nd Street, Indianapolis, IN 46206.



Soft cover
176 pages
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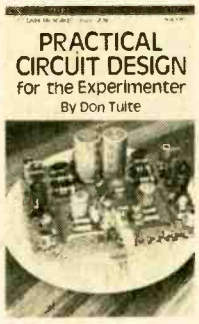
Putting Theory to Work. Here's the "missing link" between technician and engineer for any experienced hobbyist with a high-school math background. It's Don Tuite's *Practical Circuit Design for the Experimenter.* Don introduces the engineer's tools of analysis and design that are usually presented only in a four-year engineering course. And all the reader needs to assimilate this extremely valuable material is a fundamental ability to work with algebra. The tools of electronics design begin with Kirchhoff's laws. These are presented from a dc standpoint so they can be clearly understood before applying them to complex impedances and time-varying parameters. A comprehensive section on trigonometry and some exotic algebra should serve as memory joggers for readers who've been out of school a few years. This opens the door to understanding complex quantities and phase relationships. The math ideas are not presented as they would be in a mathematics textbook, but are limited to just those ideas needed as a prerequisite to understanding the principles of design. For more information and catalog, write to Tab Books, Blue Ridge Summit, PA 17214.



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119 illustrations
196 pages
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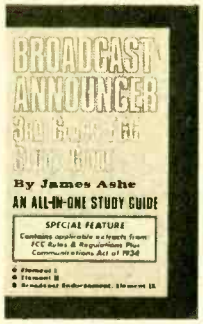
Getting Started. *Broadcast Announcer 3rd Class FCC Study Guide* by Jim Ashe is a comprehensive all-in-one FCC study guide for the Third Class FCC permit. The text includes coverage of elements 1, 2, and 9, plus applicable FCC Rules and Regulations and extracts from the Communications Act of 1934. The law requires a Third Class ticket as a practical minimum for many radio station jobs in the broadcasting business. An engineering degree isn't required to get a Third Class permit, but an applicant must know some basics relating to how a radio broadcast station works and what it does. But there's a problem about acquiring those basics: The broadcast game is a rather closed circle. At one side of the circle there is the law: a condensed set of rules about how things are to be done. At the other side there is the practical on-the-job work

and responsibility. Each is connected to the other in such a way that to the beginner who knows little about either, the whole business doesn't add up to much sense. Available from Tab Books, Blue Ridge Summit, PA 17214.



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19 illustrations
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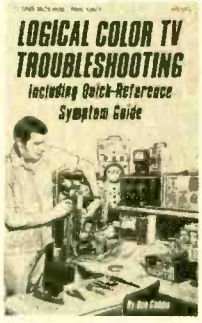
For TV Fixers. Here's an unusual book, *Logical Color TV Troubleshooting—Including Quick-Reference Symptom Guide* by Ben Gaddis that combines TV theory and repair know-how, and covers every aspect of TV circuit troubleshooting from a practical common-sense point of view. Starting with a systems approach to color TV, author Gaddis concisely explains the receiving and transmitting sub-systems and how the TV signal conveys information between them. Then, it's on to a functional description of the color TV receiver and a down-to-earth introduction to troubleshooting. The author shows how to use the receiver itself as a valuable test instrument for TV troubleshooting. The screen becomes, in essence, an "oscilloscope" any servicer can use to interpret symptoms with unerring accuracy. Published by Tab Books, Blue Ridge Summit, PA 17214.



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151 illustrations
240 pages
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Make It Solid. The best way to describe *How to Custom Design Your Solid-State Equipment* by M. J. Salvati is to call it a "cookbook" of linear solid-state circuits. It contains a number of predesigned "building block" circuits which can easily be combined to produce a complete high-performance device. The unusual feature of this book is that detailed information is provided on how to modify the operating characteristics of the building blocks to suit your own requirements. In short, this book provides not only a tool for the hobbyist and experimenter who wants to go a step beyond the usual "build it like this" hobby-project book but also a convenient reference source for technicians. The author does away with all needless math and theory, making his work ideal for the experienced hobbyist as well as the circuit designer. Published by Hayden Book Co., Inc., Rochelle Park, NJ 07662. ■

Soft cover
146 pages
$5.50

"I'm getting close to the trouble. It has to be in the fuses!"

DX central reporting

A world of SWL info!

BY DON JENSEN

☐ As DX Central Reporting goes to press this month, another African nation stands on the brink of independence. For Angola, the independence questions are when and who, not if. For Lisbon already has promised freedom to the territory. But the timing of independence seems to depend on how quickly three rival black Angolan parties can sort out who will lead the new nation. And some African experts predict extended pre-liberation conflicts as the factions jockey for position.

What does this all have to do with DXing? Well, for years Angola has been a top DX target for SWLs. There have been a number of challenging DX stations to tune for, including the government network outlets, nearly a score of private, commercial stations, and a religious broadcaster. Angola is one country where it has not been too difficult to tune one or two stations, but many veteran DXers have gone for years without being able to hear and QSL all the SW stations.

So, for the listener, Angola's independence raises a big question. What will an independent Angola do about the broadcasting situation? Will this wide range of stations continue to operate separately? Or will the new government do as other emerging nations have done, that is, incorporate all these stations into a single public network? The latter course, frankly, would take much of the fun out of Angolan DXing.

With the future in doubt, and assuming that independence has not been granted as you read this, there may still be time to chase some fascinating African DX outlets. One of the best bets is the government's station, *Emisora Oficial*, which can be heard signing on in Portuguese at 0500 GMT on 9535 kHz. Some West Coast SWLs hear this station around 1445 GMT on 11875 kHz, with an English announcement. You may find it signing on the air with a ten-note interval signal and identification, "Aqui Angola, Emisora Oficial," on 4820 kHz.

Like Emisora Oficial, another station located in the Angolan capital of Luanda is *A Voz de Angola*, the voice of Angola. This 10-kilowatt station has been reported heard on 9660 kHz around 0500 GMT and, in the western part of the U.S., about 1600 GMT.

Among the other Angolan stations which offer more of a challenge to listeners, but which still are reported fairly frequently, are *Radio Clube do Moxico* in Luso, 5192 kHz; *Radio Clube do Huambo*, Nova Lisboa, 5060 kHz; and *Radio Ecclesia*, a Roman Catholic missionary station at Luanda on 4985 kHz. Others logged Stateside occasionally include *Radio Comercial*, 4795 kHz; *Radio Clube do Uige*, 4850 kHz; *Radio Clube do Lobito*, 4848 kHz; *Radio Clube de Malange*, 4942 kHz, plus several regional outlets of Emisora Oficial elsewhere in Angola.

The best times to log Angolan shortwavers are just after sign on, usually either 0400 or 0500 GMT, depending on the station, and just before sign off, usually 2300 GMT. Most programming is in Portuguese or African languages. Deserving special attention is *A Voz de Cabinda*, broadcasting on 5033 kHz, which is the only station in the Cabinda district of Angola. Cabinda, though an administrative part of Angola, is an enclave, a tiny territory separated from the rest of the colony by a narrow strip of the neighboring African country of Zaire.

In Cabinda the political situation becomes even more complex. The three rival Angolan factions want Cabinda as part of their new state . . . its off-shore oil wealth is a good dollars and cents reason. But many Cabindans would rather go it alone, favoring separate independent status. So, though experts think it unlikely, there is a chance that tiny Cabinda could also become a separate nation in its own right, thus giving country-hunting DXers yet another listening target.

Whatever the future for Angola, there should continue to be some interesting listening for SWLs coming out of this part of Black Africa.

Cashing In. Back twenty-some years ago, top entertainer and recording star Johnny Cash was a DXer for Uncle Sam. Surprised? So was I when I came across that interesting little item in Cash's biography, "Winners Got Scars Too," by author Christopher Wren. Back in the early '50s, while in the Army, Johnny Cash was assigned to the 2nd Mobile Radio Squadron in West Germany as an "intercept operator."

Wren writes that Cash's military job was monitoring coded ground and air traffic of the Soviet Air Force using a sophisticated receiver. Cash, it seems, was one of the best "intercept operators"—military DXers —around and was assigned to handle difficult transmissions which other operators couldn't handle.

Why was Cash such a whiz? According to Wren, back in high school in Cash's home town of Dyess, Arkansas, someone had stuck a pencil in Cash's left ear, surprisingly leaving his hearing abnormally acute. Frankly, I don't know if Johnny ever cashed in on this special talent for DXing after he returned to civilian life. But if he ever does return to listening, DX stardom seems a leadpipe cinch! Needless to say, the old pencil-in-the-ear bit is definitely not recommended DX procedure!

And speaking of celebrities, Senator Barry Goldwater is one of the world's best known radio amateurs. Many hams have worked the Arizona senator on the air, usually on single sideband. Goldwater operates as K7UGA from his Phoenix, Arizona home, or as K3UIG when in Washington.

Some time back, I had occasion to ask Sen. Goldwater what value he thought the radio hobby has for young people. "I feel today as I felt when I started in this business," he replied, "that radio is, as much as any hobby or service that I have ever

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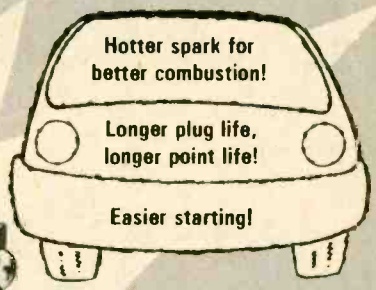

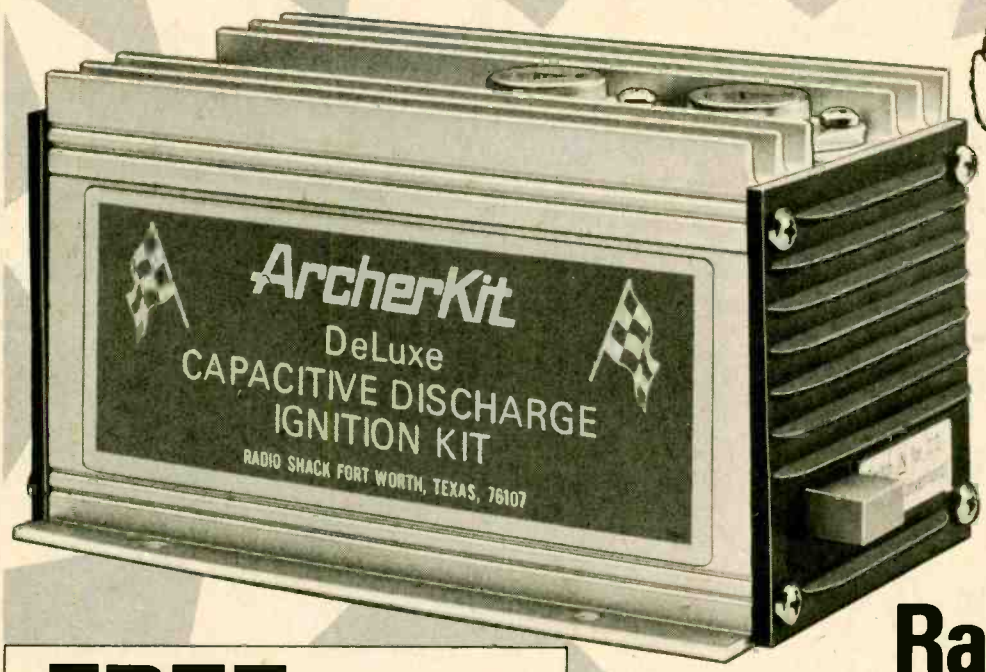

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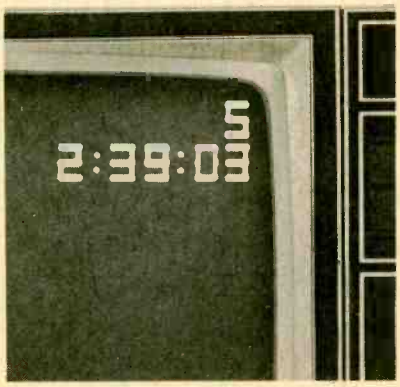

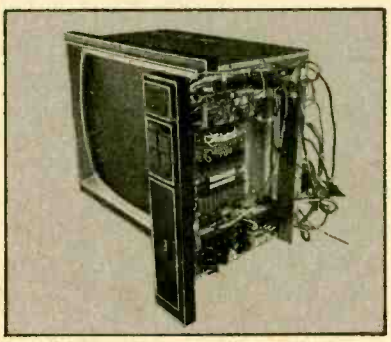

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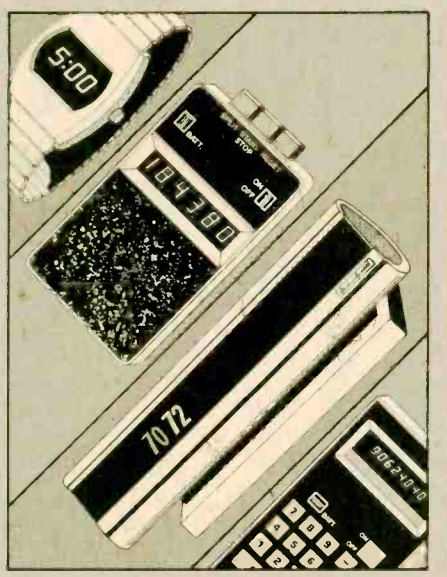

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597 R8

DX CENTRAL

(Continued on page 28)

engaged in, to the betterment of the individual and the community. Certainly there is no better way to learn electronics or communications, and what is a better way to get acquainted with the world?"

A New Voice. A paradox in the broadcasting world today is that some countries seem to be turning away from overseas shortwave operations while others are moving full tilt to expand their transmitting facilities. Rumors abound concerning the future of French SW broadcasting. Depending on the story one hears, ORTF, the French government broadcasting service is (1) about to abandon all SW services, or (2) is going to drastically cut back foreign programming. At any rate, it seems that France is seriously considering lowering its SW profile in the world.

On the other hand, the British Broadcasting Corporation is continuing to add to its relay transmitter bases around the globe. For several years there have been rumbles about a new BBC relay site to be established in the Caribbean area. Recently the official announcement came that plans are nearly completed for a transmitter on the West Indian island of Antigua. According to the announcement made on a BBC World Radio Club program from London, construction of the new station will begin shortly and the on-the-air date may be in late 1975.

Bandsweep. (Frequencies in kHz, times in GMT) This month a special look at a number of shortwave outlets broadcasting in English: **3250**—This domestic outlet of the South African Broadcasting Corporation at Johannesburg is a fairly easy target station. There's usually good listening music with announcements in English (and Afrikaans) from about 0130 until 0300. Another SABC channel worth tuning is **3980** . . . **4770**—*ELWA*, at Monrovia, Liberia, is another English-speaking African voice on shortwave. It is a religious gospel station and you may find it around 0600 . . . **4890**—One of the most consistent stations from the Pacific region is the outlet at Port Moresby, Papua-New Guinea. Signals in much of North America are often at "arm chair level" copy around 1200 to 1300 GMT . . . **5995**—Throughout the world there are Roman Catholic broadcasting stations. Earlier I mentioned Angola's *Radio Ecclesia*, and there are such shortwave voices located in various parts of the world from Latin America to the Philippines. But the key voice of Catholicism on the air is *Vatican Radio*, which airs a religious program in English at 0105 GMT . . . **6012**—Oh, happy day! And for some lucky American DXers, last October 23 was a particularly happy one. In an earlier column, you may remember, I mentioned a new American Forces Radio-TV station at McMurdo Base, Antarctica, and suggested reception Stateside would be extremely tough. Well, on that one day, at least a half dozen SWLs managed to catch a rare opening to the bottom-of-the-world continent and logged the elusive American Forces Antarctic Network station around 1030-1200 GMT . . . **6065**—A good bet for the SWL with only a simple receiver is the Voice of Spain, *Radio Nacional de Espana*, broadcasting in English to the U.S. and Canada at 0100 . . . **7395**—The *Israel Broadcasting Authority* inaugurated a new DX program for SWLs not long ago. It is aired every second Saturday during the regular letterbox program, around 2030 or 2040 GMT. It is, like the rest of this month's *Bandsweep* specials, in English . . . **9022**—A nice find for many SWLs is Iran's *Radio Teheran*, transmitting in English at 2000 GMT . . . **9580**—Listeners in various parts of the country have reported the Voice of the Philippines, now IDing sometimes as *Radio Philipinas*, in English during the early morning period, say around 1200 or 1300 . . . **9690**—There are only a handful of Latin American stations that transmit English language programs. One is *RAE*, the Argentine government broadcasting outlet at Buenos Aires. A good time to listen is around 0630 . . . **11780**—And English broadcasts can also be heard from *Radio Nacional Brasilia*, located outside the Brazilian capital. This station airs English to European audiences between 2100–2200

(Credits—Glenn Thompson, New Mexico; Robert Zilmer, Wisconsin; Charles Brunner, Pennsylvania; Mike Peraaho, Minnesota; Charles Wooten, Maryland; Jerry Berg, Connecticut; Oliver P. Ferrell, New Jersey; Ralph Perry, Illinois; Serge Neumann, Indiana; Gerry Dexter, Wisconsin; North American SW Association, Box 8452, South Charleston, West Virginia 25303) ■

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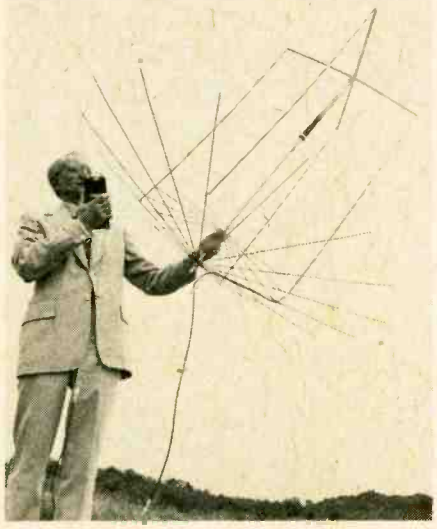
CIRCLE 32 ON READER SERVICE COUPON

newscan

Electronics in the News!

Long Distance Call

With an antenna fashioned from a golfer's umbrella, a General Electric engineer beamed a walkie-talkie message more than 50,000 miles to demonstrate the dramatic potential of space satellites for search-and-rescue missions. The long-distance transmission, originating from a walkie-talkie with a typical range of only five miles, showed that simple radio gear and a collapsible antenna—plus a space satellite orbiting somewhere overhead—could enable persons in distress to summon help from any point on earth. The five-watt radio was identical to the VHF walkie-talkies carried by law enforcement officials, firemen, and foresters. For the demonstration, however, its transmitter and receiver had been tuned to the satellite's broadcasting frequencies.



By beaming a message more than 50,000 miles with an ordinary walkie-talkie and an antenna built upon the frame of a golfer's umbrella, Roy E. Anderson, engineer at the General Electric Research and Development Center in Schenectady, NY, demonstrates the dramatic potential of space satellites for search-and-rescue missions.

To boost the tiny radio's reach by more than 10,000 times, Roy E. Anderson, an engineer from the GE Research and Development Center, relied on a special antenna, constructed on the frame of a golfer's umbrella, and the services of a geostationary space satellite orbiting at an altitude of 22,300 miles over the Amazon River in Brazil. Mr. Anderson sent a message in Morse code from NASA headquarters to the ATS-3 geostationary satellite, which then relayed the signals to GE's Radio-Optical Observatory near Schenectady, N.Y.—a total distance greater than 50,000 miles. After receiving the message, Observatory personnel transmitted voice signals back through the satellite to the GE engineer. This showed that downed pilots, the survivors of shipwrecks, and others in need of help could readily receive a voice reply from a search-and-rescue station, acknowledging the SOS and providing rescue information.

Mr. Anderson sent his Morse code signals by depressing the walkie-talkie's "press to send" key. By equipping future geostationary satellites with a modified antenna, reliable voice signals could be transmitted from a person in distress to the monitoring station. Unlike conventional long-range radio transmissions, these signals would not be significantly affected by changes in atmospheric conditions. Very compact radio and antenna units based on the principle demonstrated could serve a wide variety of other monitoring and locating applications without interfering with the routine use of a satellite. For example, it would be possible to transmit weather data from buoys or balloons, or even monitor the physical condition and movements of wildlife.

The Irish Get a Crown

"One of our four new Crown DC-300A amplifiers provides as much power as the full six we had before," reports Phil Chasey, audio consultant and transmitter engineer for WSBT-TV at Notre Dame, Indiana. Phil was responsible for the basic layout and selection of components for a new public address/audio system that was recently installed at Notre Dame Stadium. In addition to the Crown amplifiers, the new system is comprised of a Spotmaster 5 BEM-2005 audio console, a Crown VFX-2 filter and Electro-Voice speakers and microphones. With the exception of the speakers and microphones which are completely compatible with the new components and which still produce top-quality sound, the system is completely new. It replaces an audio setup which had been in operation for over 28 years at the stadium.

The Crown DC-300A is a dual channel

This shot of the audio control room at Notre Dame Stadium shows the four Crown DC-300A amplifiers, as well as the Spotmaster 5 BEM-2005 audio console and Crown VFX-2 filter.

high power amplifier designed for precision amplification of frequencies from DC to 20 kHz. A simple wiring change converted the four new Crown stereo amplifiers at Notre Dame into 8 monaural amplifiers. Six of these are used to drive the system's speakers (one each for the four main speakers, one for two end zone speakers, and one for five smaller speakers located under the press box). The remaining two amplifiers are kept as spares. In an emergency situation, one of the Crown amplifiers would have enough power to drive three of the speakers.

The new system greatly increases the effectiveness and flexibility of sound pick-up and reproduction at Notre Dame Stadium. Previously, there were only two access channels to which microphones could be connected, and one of these was always being used by the game's announcer. This left only one to roam the field for game, half-time and special ceremony activities. Now, ten access channels allow the system to pick up sound in all areas of the stadium simultaneously. And the new Crown VFX-2 filter produces a clearer, sharper sound by eliminating highs and lows, and matching the audio system to the input.

The new system has also been designed to facilitate the hook-up of a major TV network into the stadium audio system for a nationally televised game. All solid-state components assure high system reliability and a complete monitoring capability is built into the system. During the 1974 Notre Dame home-opener against Purdue, the first time the new system was in operation, the maximum sound variation around the entire stadium was less than three decibels.

Chess Computer-League

While it may never represent a threat to Bobby Fisher, a minicomputer did tackle several giant mainframe machines in the recent World Computer Chess Championships in Stockholm, Sweden, and did surprisingly well. Bob Prinsen, of Interscan Data Systems, Ltd., United Kingdom, programmed a Computer Automation Naked Mini computer for the competition, using only 16,000 words of 16-bit core memory.

"I'm no expert at chess, in fact, I'm just an average amateur, but I love to play with computers," Prinsen said. "Even so, I was surprised indeed to finish tied for 12th in the competition."

His surprise was well-founded, considering the nature of the competitors. The first-place winner, for example, was a large-scale English-built ICL 4/70 computer using a program called KAISSA. Entered by the Moscow Institute of Control Science, the machine and its programming had been prepared by a team of 10 full-time people for more than two years. An American team from Northwestern University finished second.

Prinsen spent about 300 hours over an eight-month period programming the Naked Mini, using a BASIC assembler language. Although the championships were held in Stockholm, the Naked Mini stayed in England. Communications between Prinsen and the computer were established using international telephone lines and an acoustic coupler. Other equipment included a teletype and on-line visual display unit.

Elated with his success, Prinsen said he hopes that a European or British Chess Computer Championship can be arranged for next year.

"If it occurs, I'm confident the Naked Mini computer will greatly improve its position in the Chess Computer League with a bit more core memory and programming effort," he said.

Dealing with Wet Feet

While suntanned surfers rode the waves at popular Makapuu surfing beach in Hawaii on a recent Saturday afternoon, several other young aquatic enthusiasts were making telephone calls from an underwater phone booth anchored nearby. The unusual booth, built specifically for an undersea test, was anchored in a temporary location 25 feet below the surface of the Pacific Ocean here. A telephone was installed in the booth to permit scuba-diving experimenters to converse with their associates on the shore 150 feet away.

The experiment was conducted by mem-

(Continued on page 97)

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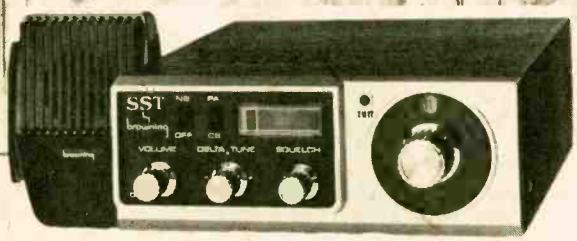

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CIRCLE 3 ON READER SERVICE COUPON

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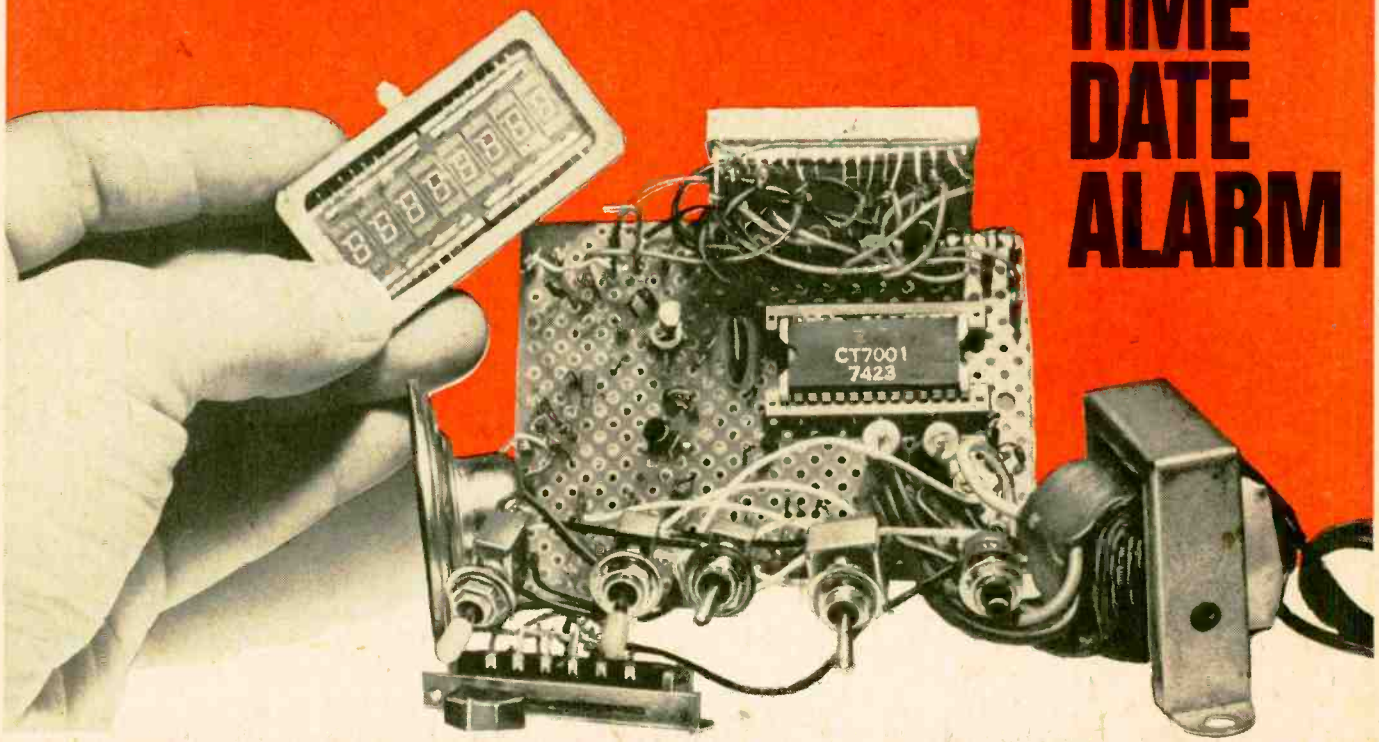
INFLATION-BUSTING DIGITAL CLOCK PROJECT...

TIME DATE ALARM



MAXICLOCK

The basic parts—IC, display, transformer, and IC socket—actually cost one half as much as you can pay for similar items used in our last clock!

by C. R. Lewart

TIME FREEZE! What's time freeze? To tell you the truth, nothing that great . . . we think it's everything *else* about this digital clock that's so great!

First of all, it's even simpler to build than our first clock project—a very popular one published over a year ago. Secondly, you'll find that even fewer parts do more jobs.

But today the best feature is one that is uppermost in everybody's mind—the major parts cost. In fact, the overall clock cost is just about *half* the price of our previous clock project. *It's the least expensive electronic digital clock we could find*—kit, project, or assembled—that has just about every feature you can think of in a line-powered digital clock.

It is a 6-digit clock. It is a calendar. It is a 24-hour alarm clock. It has a 10-minute snooze alarm. It has provision for internal battery power operation. It can be operated in either the 12- or 24-hour mode. It knows the days of the month (you update just once every four years at leap year). It is simple to build *without* a printed circuit board because there are no driver transistors for the display. It uses a standard low-cost "calculator" type display, and the display is internally wired—only 13 connections operate all 42 segments of the six-digit display. And all the display connections are made to an IC connector for ease of assembly.

It all adds up to one thing: You should be able to build this clock for a price considerably lower than digital clocks with fewer features. And, oh yes, about time freeze: It's the simple "seconds hold" feature you get with this clock. With it you set the time ahead a minute or two, wait for your time standard (WWV, local radio, Ma Bell, etc.) to count down to zero, flick the function switch, and watch your clock start counting from "00" seconds every time. A small feature, perhaps, but something everyone appreciates.

Other features of the clock are as follows: You can select between time, date, alarm "set" time, or time/date display (a time display for 8 seconds followed by a date display for 2 seconds). A 50 or 60 Hz switch and the time freeze feature let you set time with ease (in the 50 Hz position, the clock will run 20 percent faster on a 60 Hz line). You also have a "snooze" button to recycle the alarm by ten minutes. *There is only one switch for setting hours, minutes, days, and months!* Ad-

MAXICLOCK

ditional features are an "alarm is set" red LED indicator, leading zero blanking, and a green LED to indicate p.m. The clock also provides an optional 24-hour display, stand-by battery power, and display brightness control.

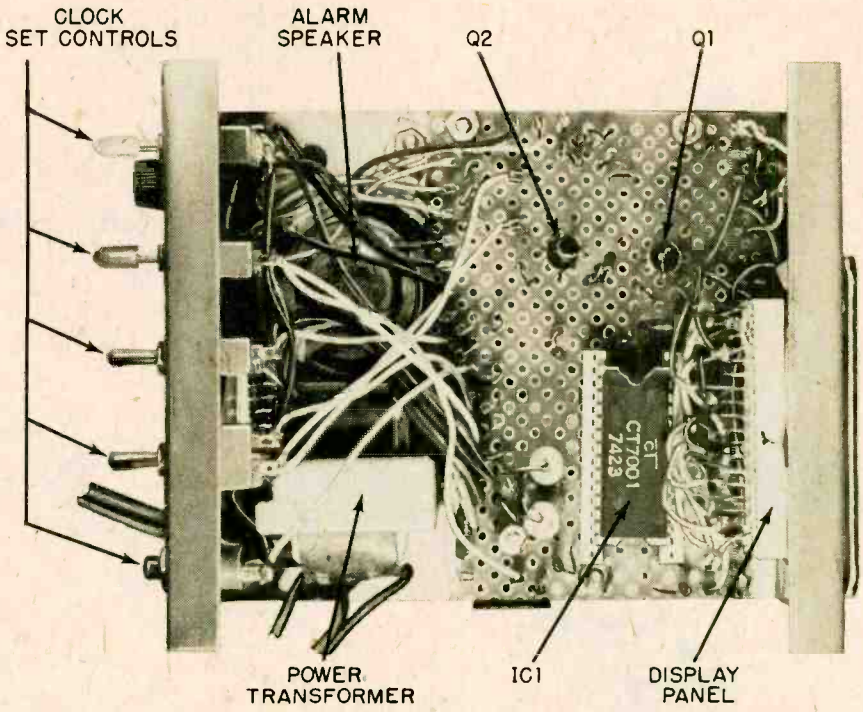
How Does It Work? The brain of the clock is the Cal-Tex CT7001 integrated circuit consisting of thousands of transistors; it counts down the line frequency to seconds, minutes, days, and months. Internal memories record the number of days in each month and the alarm settings. To avoid large numbers of wire leads, the display digits are multiplexed, which means that "gating" signals (digit turn-on signals) are applied in sequence to the "control" grid of each digit. But it happens so fast you "see" a continuous 6-digit display. The display segments of all digits are connected in parallel right inside the display case. It comes pre-wired that way in its compact enclosure.

The first transistor, Q1, turns the leading zero *off* when the "SF" segment (see schematic) appears—this is the only segment not required to form digits 1 and 2. The second transistor, Q2, is a programmed unijunction transistor which drives the speaker to sound the alarm. You can change the sound of the alarm by making C1 smaller or larger as you desire.

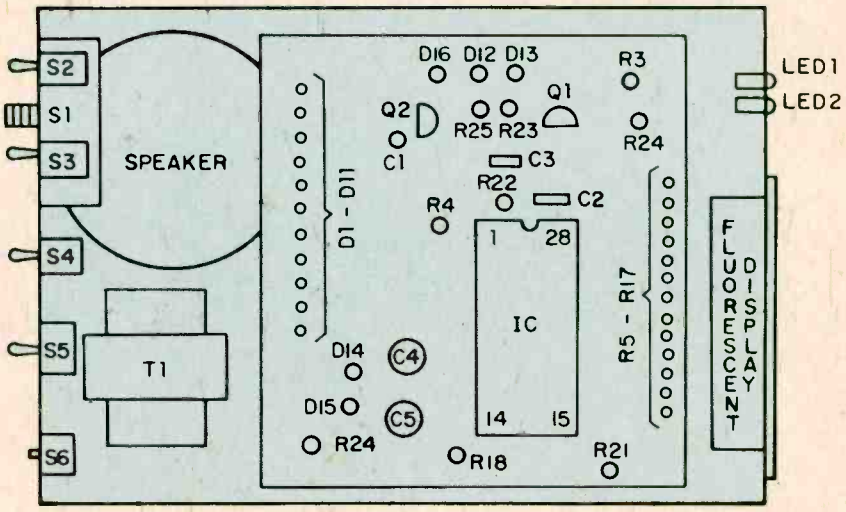
Construction. To build the clock we used point-to-point wiring on a 3 x 4-in. perf board. The clock fits into a 3 x 4 x 5-in. cabinet, but you may want to build it in a slightly larger cabinet with different styling. If your soldering skills are limited, we would recommend a 4 x 5 x 6-in. cabinet. All external connectors are brought out to push-in terminals at the edge of the perf board.

Be careful handling the integrated circuit. A socket for the IC is a must. Install the IC in the socket only when you are finished with all the wiring to prevent a static charge from damaging it.

The display is quite sturdy, though dropping it on its edge on the concrete basement floor (as we did during construction) will definitely wipe it out! Cut a hole in the front of the cabinet for the display and attach it with a bracket, glue, or masking tape. All display connections are brought out on pins similar to a 14-pin dual in-line IC. The pins have to be bent slightly to fit into the IC socket. To improve visibility, we recommend putting a sheet of smoked or green-blue plastic or glass in front of the display.

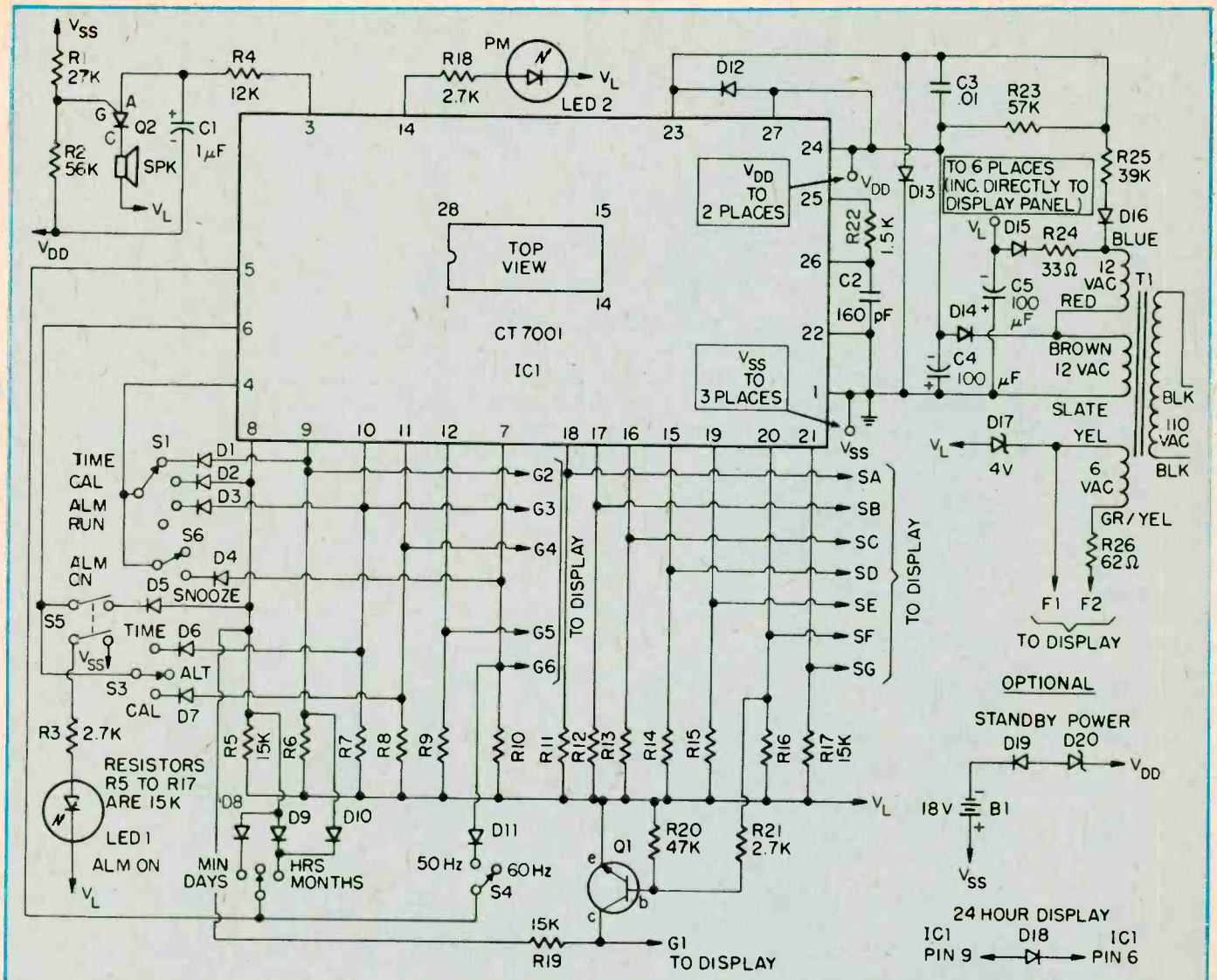


Birds-eye view of major parts location in a compact and very tight design. Consider building your clock in a more original setting for wall (or even built-in) display with hidden power cord.



Optional Features. You may want to drop some of the features provided in the basic clock to simplify its construction. You may also want to add a few extra features if you feel strongly about them. Mix and match; it's up to you.

- Leading or blanking zero in the 24-hour mode. If you prefer a leading 0 (05 15 45 instead of 5 15 45) leave out Q1 and R19 to R21.
- Display brightness. If you would like to control the intensity of the display, replace R24 with a 500-ohm potentiometer connected as a rheostat.
- Twenty-four-hour display. You can choose the 24-hour mode instead of the 12-hour mode simply by connecting D18 as shown on the schematic. The clock must be reset when switched from 12- to 24-hour display.
- Stand-by battery power. A couple of 9-volt batteries as shown on the schematic will provide stand-by power. When the AC is *on* they do not supply any current to the circuit. When the AC is *off* the drain on the batteries is only about 3 mA. Though the display will be off, an internal oscillator will keep the counters running so that the correct time and date will be displayed when the power returns. For this option, replace R22 with a 5000-ohm potentiometer connected as a rheostat. Adjust it by unplugging the clock for one minute at a time (with a stand-by battery installed). Then, check whether it is fast



B1—pair of 9-volt transistor radio batteries. Note: required only when standby battery power option is included.

C1—1 uF capacitor, any type, 50 VDC or better (Radio Shack 272-1055 or equiv.)

C2—150 or 160 pF disc capacitor, 50 VDC or better

Note: You can parallel-connect a 100 pF and 47 pF to obtain an approximate value.

C3—0.01 uF disc or tubular capacitor, 50 VDC or better (Radio Shack 272-1065 or equiv.)

C4, C5—100 uF electrolytic capacitor (Radio Shack 272-1044 or equiv.)

D1 to **D11, D16, D18**—General purpose silicon diodes such as 1N914

D12, D13—General purpose germanium diodes such as 1N34 (Radio Shack 276-821 or equiv.)

D14, D15, D19—1-amp, 200-volt silicon diodes, 1N4003 (Radio Shack 276-1102 or equiv.)

D17—4-volt, ½-watt zener diode (Radio Shack 276-620 or equiv.)

D20—6-volt, ½-watt zener diode (Radio Shack 276-621 or equiv.)

IC1—time/date/alarm clock-on-a-chip (Cal-Tex CT7001, do not substitute.)

LED 1—red light emitting diode, alarm-on indicator (Radio Shack 276-042 or equiv.)

LED 2—green light emitting diode, p.m. indicator (Radio Shack 276-044 or equiv.)

Q1—npn silicon transistor, HEP S0007 (Radio Shack 276-2016 or equiv.)

Q2—programmable unijunction transistor, HEP S9001 (Radio Shack 276-119 or equiv.)

R1—27,000-ohm, ½-watt resistor (Radio Shack 271-000 or equiv.)

R2, R23—56,000-ohm, ½-watt resistor (Radio Shack 271-000 or equiv.)

R3, R18, R21—2700-ohm, ½-watt resistor (Radio Shack 271-000 or equiv.)

R4—12,000-ohm, ½-watt resistor (Radio Shack 271-000 or equiv.)

R5 to **R17, R19**—15,000-ohm, ½-watt resistor (Radio Shack 271-000 or equiv.)

R20—47,000-ohm, ½-watt resistor (Radio Shack 271-000 or equiv.)

R22—1500-ohm, ½-watt resistor, see text (Radio Shack 271-000 or equiv.)

R24—33-ohm, ½-watt resistor, see text (Radio Shack 271-000 or equiv.)

R25—39,000-ohm, ½-watt resistor (Radio Shack 271-000 or equiv.)

R26—62-ohm, ½-watt resistor (Radio Shack 271-000 or equiv.)

Note: You can use ¼-watt resistors which are smaller (but more expensive) if space is limited in the case you use.

S1—4-position, single-pole rotary or slide switch

Note: You can use one of the 4-position, 3-pole rotary switches available such as Calectro E2-166, Malory 3134J, or Allied 851-1534; simply leave extra poles blank.

S2—spdt center-off toggle switch

Note: This switch can be selected with spring return-to-center (International Rectifier TS 105C or equiv.) or with manual return (Radio Shack 275-325 or equiv.)

S3—spdt center-off toggle switch (Radio Shack 275-325 or equiv.)

S4—spst toggle switch (Radio Shack 275-324 or equiv.)

S5—dpst toggle switch

Note: You can use another dpdt here; simply leave unused contacts blank.

S6—normally open pushbutton switch (Radio Shock 275-1547 or equiv.)

T1—power transformer, P8361 (Stancor)

Z1—7-segment, 8-digit fluorescent display with internally strapped segments for multiplex display system, ISE DP89A used by author

Misc.—Small 3.2- or 8-ohm speaker used only if alarm option is included (Radio Shack 40-262 or equiv.); cabinet (author used 3 x 4 x 4½-in. unit but suggests larger size for novice builders such as Radio Shack 270-253 which is 5¼ x 3 x 5⅞-in.); wire, solder, hardware, 14-pin DIP IC sockets for display (2 required), etc.

A partial kit of parts consisting of a Cal-Tex CT7001 (IC1), the ISE DP89A display panel (Z1), and a 28-pin socket for IC1 is available from Photolume Corp., 118 E. 28th Street, New York, NY 10016 for $26.95 postpaid. Power transformer T1 can be added to the basic kit for an additional $3 *at the time of your original order only* (total for 4 items noted in this offer is $29.95 postpaid). Postal money order will speed delivery. Otherwise allow 6 to 8 weeks for delivery. (New York residents must add sales tax.)

or slow when the AC power is again applied and adjust R22 in the direction which will reduce error.

Operation. Set the time, date, and alarm by turning S1 to the proper position (either *time, date, or alarm*). Then flip and hold S2 in the *hour/months* or *minute/day* position—whichever you wish to set. You will notice that the function you have elected to set will increment at one digit per second for as long as S2 is in the off-center position. You will also notice that setting one function will not affect any other function. This feature allows you to set February 29 in a leap year without upsetting any other function. You will also note that moving S1 to *time* stops the clock. When S2 is then actuated, seconds will reset to 00. These two imaginative features make for precise and easy time setting. After making all your settings, return S1 to its normal *run* setting.

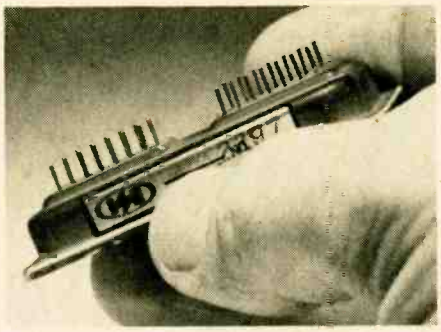
The display mode, *time*-only, *date*-only or *alternate* (time and date), is selected with S3.

The *alarm on* switch S5 also turns on a red LED to make you aware that the alarm is set. The warning light may save you from being awakened at 7 a.m. on a weekend.

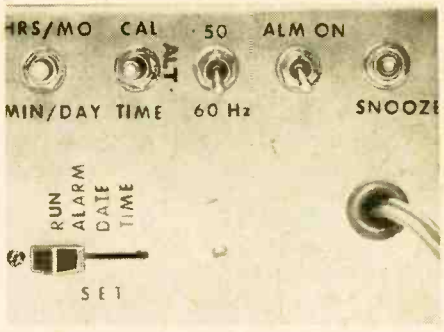
The alarm can be set up to 23 hours, 59 minutes in advance (let the alarm ring for a minute, or better still, just turn it off for a minute before flipping S5 back *on* for tomorrow morning's greeting). Switch S6 is the snooze button and will give you another ten minutes sleep in the morning if you can manage to give it a nudge.

When you set *time* or *alarm*, the p.m. light will indicate whether your setting corresponds to a.m. (light off) or p.m. (light on).

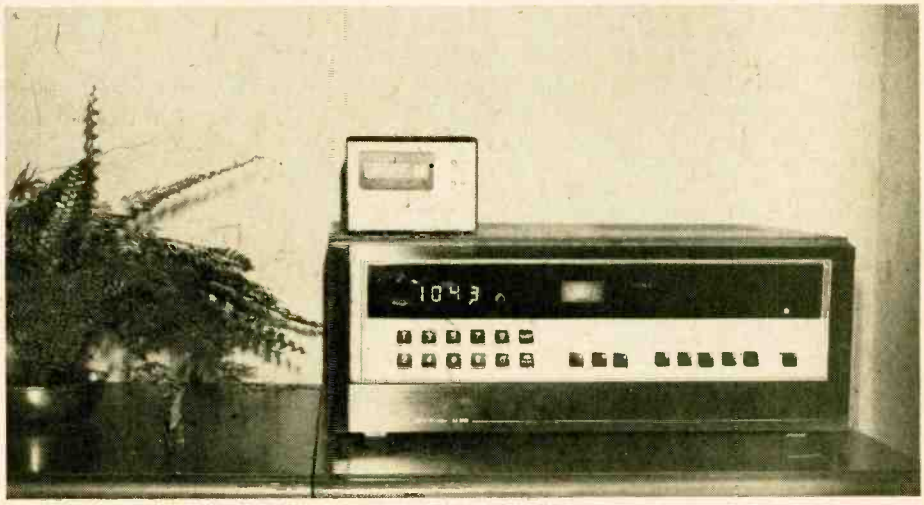
The Wrap-Up. So that's it! A clock project that gives you more for less *is* e/e's style. Our supplier of hard-to-find items has promised to hold the line on prices (see the parts list), so we expect these optional features and useful functions to bring our readers the best clock their inflation-fighting dollars can buy. ■



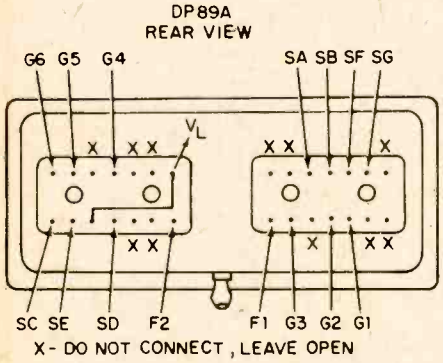
Just a pair of 14-pin dual-in-line IC sockets are needed to connect this compact display with the circuit board. Display is actually an 8-digit device originally for calculator use. Here we blank the third and fifth digits to separate hours, minutes, and seconds.

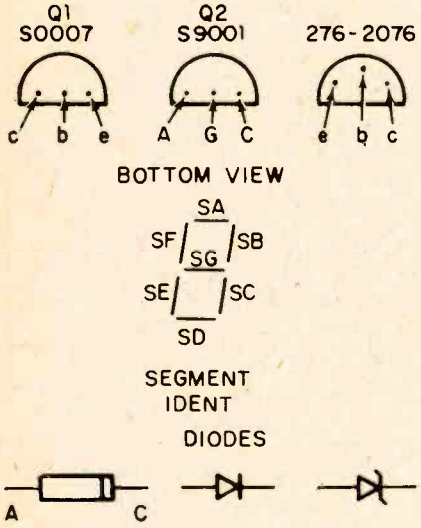


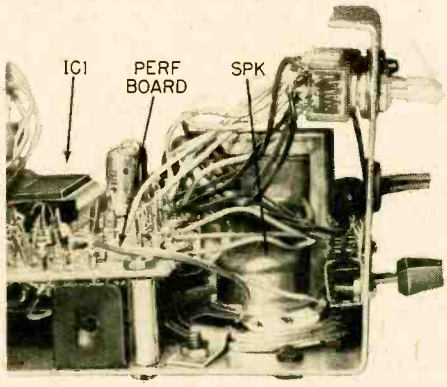
"Set" switch S1 (see the schematic) tells the clock which of its three functions you want to adjust with the left hand switch (S2). Just hold S2 in the up position to set hours or months; hold it down to adjust minutes or day of the month.



This hi-fi setting is strictly digital with your home-brew digital clock and Heath's AJ-1510 "digital" FM tuner. Hi-fi fans can even add Infinity Systems' Class D Switching Power Amp.



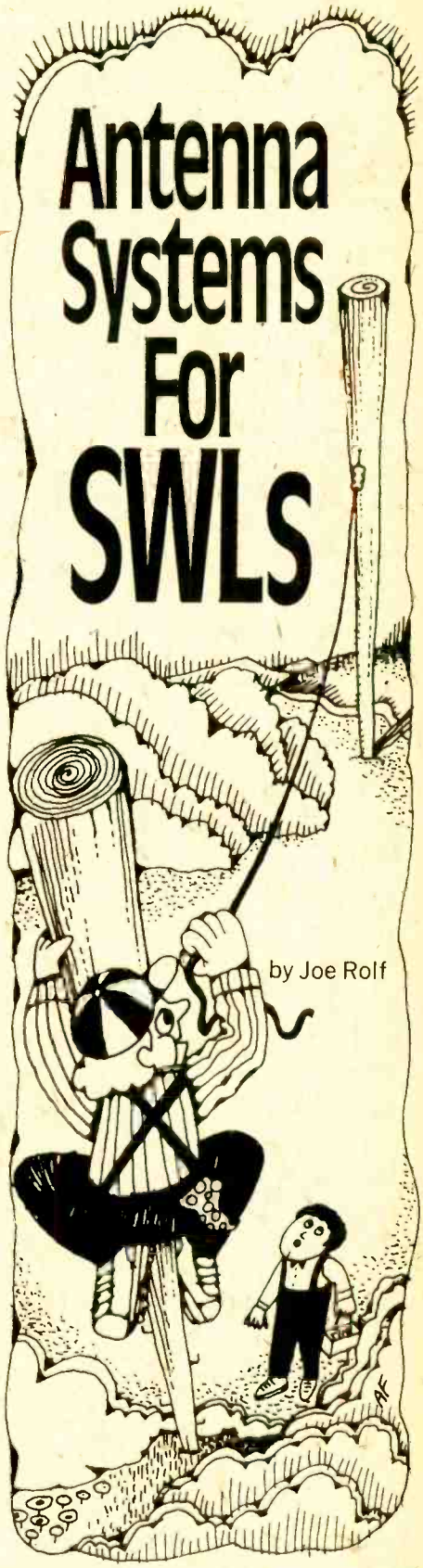




Perf board mounting is simple enough if you use spacers, screws, and nuts as shown. You can mount the display panel (Z1) with anything from double-sided tape to epoxy glue. If you select the alarm option, you must use a small speaker; it can face downward (as shown) or forward for more sound. The kit of basic parts includes the 28-pin IC socket—see parts list for details.

Antenna Systems For SWLs

by Joe Rolf



These antenna ideas will help you pull in those elusive shortwave stations.

IF YOU'RE AN armchair shortwave (SW) traveler, you've probably already read through the shortwave stations listed in White's Radio Log, located in e/e's sister publication COMMUNICATIONS WORLD. Maybe, with mouth-watering anticipation, you've tried to hear Rabaul, Upper Volta, Yemen, Hanoi, or Vientiane. If you haven't been successful, be patient; because that's what it takes—patience—*plus* a good SW antenna. We can't supply the patience, but here are some good antenna ideas which are sure to help.

No matter what shortwave receiver you're using, a good antenna is a must to bring in those distant stations. If it weren't, the manufacturer wouldn't have supplied antenna terminals! The problem is what kind of antenna—a hunk of wire? or maybe something more scientific? We'll help you make the decision by telling you a little about SW antennas and how they work.

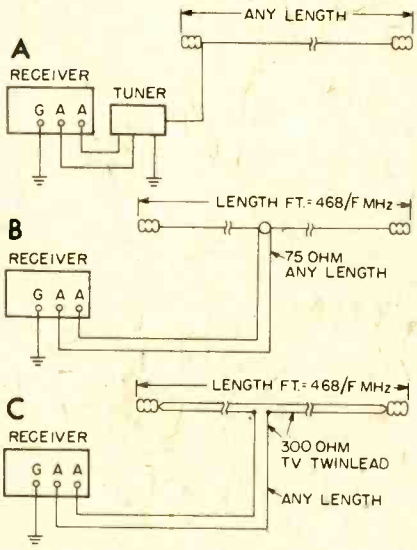
Shortwave antennas can be short and simple or they can be complicated and cover several acres. For shortwave listening most of us are limited to the short and simple ones—those that fit in a backyard and don't cost too much. But even a simple antenna, properly designed and installed, can work wonders.

Fig. 1 shows several commonly used SW antennas with lengths shown for the SW broadcast bands. The antenna in Fig. 1A is known as an unbalanced end-fed longwire. It can be hung horizontally or vertically, or a combination of both. When hung horizontally it has some degree of directionality, while it tends to be omnidirectional when vertical. This antenna will work well on all frequencies if it is made long enough, or it can be cut to operate at only certain frequencies. It works best with an antenna tuner that can be located at the receiver, since the lead-in is part of the antenna's total length. The longwire has a high terminal impedance and always operates best with a tuner that matches the antenna to the receiver. With an antenna tuner, it is an ideal antenna to run around the eaves of the house, or across the attic.

Another Type. Figs. 1B and 1C show the popular centerfed balanced dipole. This antenna can also be hung vertically or horizontally and uses two balanced leads to the receiver that can be any length. This antenna is always cut to a resonant length, though it will also work well at three times the resonant frequency. For instance, an antenna that works in the 90 meter SW band (3.2-3.4 MHz) will also work for the 31 meter band (9.5-9.7 MHz). If space is limited, its ends can be bent down (or even back) as much as 25 percent before reduction in performance becomes serious. Fig. 1B shows a single-wire dipole fed with 75-ohm feedline which can be plastic appliance cord. Fig. 1C shows the folded dipole version built from 300-ohm twinlead. The folded dipole, incidentally, will work well at half the resonant frequency.

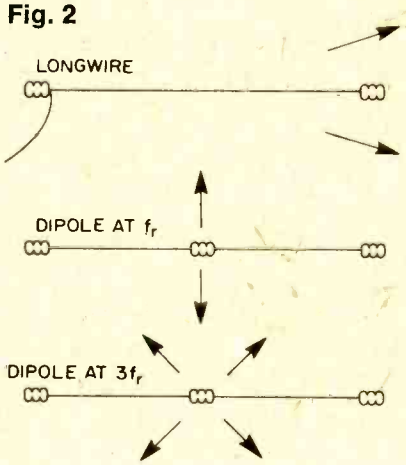
As previously mentioned, a vertical antenna tends to be omnidirectional, while a horizontal antenna tends to have directional characteristics. For general around-the-globe listening the vertical antenna is probably best, though low frequency resonant antennas are difficult to orient in this position because of their length.

Fig. 1



Directionals. If you are interested in DX from a particular part of the globe, however, the directional characteristics of a horizontal antenna can work for you. Fig. 2 shows the direction of maximum pickup for the horizontal longwire and dipole. By looking at a globe and determining the shortest path to the

Fig. 2



area you want to hear, you can position your antenna and use its directional characteristics to advantage.

Fig. 3 shows how directionality can be further increased by bending the ends of the dipole inward. This type of antenna can be easily built by using a center support, such as a TV mast, and bringing the ends in and down toward the ground. For best results, the ends of the antenna must be 10 feet or more above the earth.

A more elaborate antenna that will "look" in any one of four directions can be made by mounting two dipoles in this manner at right angles and connecting the lead-in to different elements to achieve the desired direction. This deluxe array has a disadvantage in that you must have easy access to the top, or center part, in order to change lead-in connections.

Fig. 3

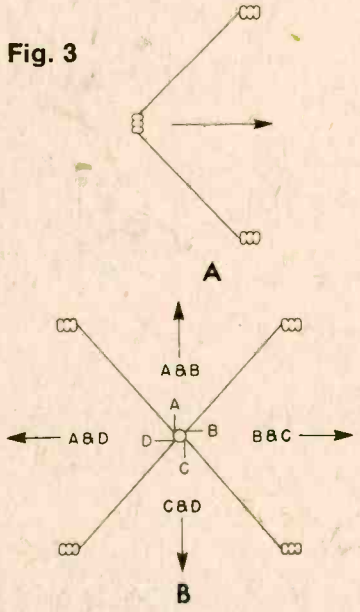
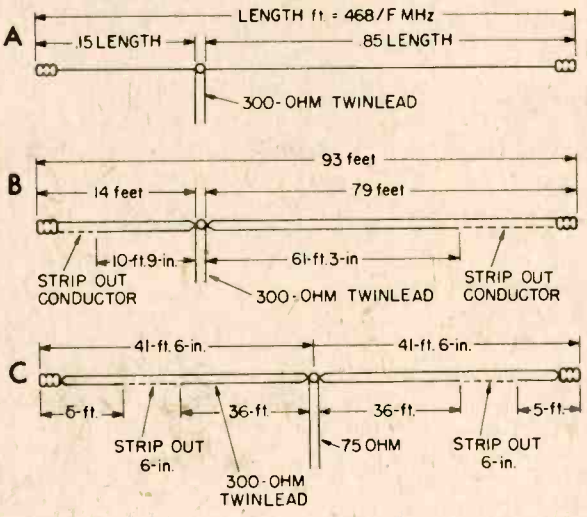


Fig. 4



Three porcelain antenna insulators are used for antenna A. One separates each section of the antenna at the point of feedline connection. The other two insulate the antenna ends from the supporting structure. The antenna at B uses 300-ohm twinlead for the transmission line and the antenna elements. Only the ends at the feedline connections are wound together and soldered. Outside ends are separated, with one partially removed as shown. At C the use of 75-ohm line is called for.

Still Around. The basic antenna shown in Fig. 4A was popular in the 1930s, and is known as the "windom" antenna. It can be fed with 300-ohm TV twinlead, and works well on even harmonics of the fundamental frequency.

Figure 4B shows how, by using 300-ohm twinlead, two antennas can be connected to the same lead-in to give satisfactory performance on the 60, 49, 41, 31, 25, 19, 16, 13, and 11 meter bands. This permits coverage of 9 of the 11 international broadcast bands with a single antenna. By tying the lead-ins together at the receiver and using an antenna tuner, this antenna becomes a longwire, making it probably the most versatile SW antenna available.

Another multiband antenna shown in Fig. 4C consists of two centerfed dipoles made from 300-ohm twinlead connected to the same feedline. This antenna has the advantage of being short (nice for small city lots, or apartment dwellers) and performs well on the 60, 49, 41, 25, 19, 16, 13, and 11 meter bands. Again, it can be connected as a longwire at the receiver and used with an antenna tuner.

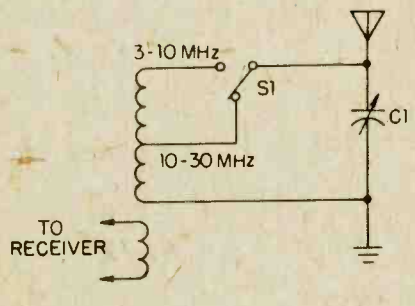
The circuit of a simple SWL antenna

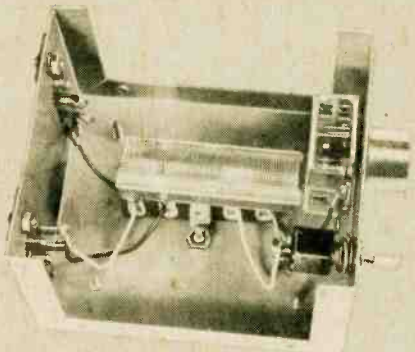
(Continued from page 93)

BUILD A SIMPLE SWL ANTENNA TUNER

Here's a simple antenna tuner any SWL can whip together in an evening and use for a lifetime. Neatness counts when monkeying with low level RF, so mimic the author's model for best results. Keep solder connections clean.

Fig. 5





PARTS LIST FOR A SIMPLE ANTENNA TUNER

C1—365 pF miniature variable capacitor (Radio Shack 272-1341 or equiv.)

L1—31 turns/in., ⅝-in. diam. coil stock, B&W 3008, Air Dux 532T, etc. Note: Measure coil and cut ½-in. from one end. Remove one turn in either direction. Measure ½-in. and solder tap to one turn (bend adjacent turns inward for access). Coil ends mount to terminal strip for stability.

S1—spdt toggle switch (Radio Shack 275-326 or equiv.)

Misc.—2-lug terminal strips for antenna, ground and receiver connections, knobs, wire, solder, 3¼ x 2¼ x 4-in. cabinet (Radio Shack 270-251 or equiv.), etc.

e/e checks out...

The YAMAHA CR800 AM/FM Stereo Receiver

☐ You're tuning an FM receiver until the signal strength meter indicates maximum signal; then you hone in on the station's frequency with the center-channel indicator pointing straight up, and still the station sounds lousy! Why?

It does not necessarily follow that minimum distortion or maximum stereo separation is attained at center scale. Quite often we find that optimum tuning is slightly off the meter-indicated center channel. We don't mean to imply that the reception is poor; rather, it is not necessarily the best reception that can be obtained from center-scale tuning.

One ingenious system we've run across that assures minimal distortion coincident with maximum stereo separation is the automatic AFC (automatic frequency control) found in Yamaha's model CR800 AM/FM-stereo receiver. When the tuning knob is grabbed or touched, the AFC is automatically disabled and the FM signal is tuned for a center-scale meter indication. When the tuning knob is released, the AFC cuts in automatically and "trims" the tuning for minimal distortion coincident with maximum separation.

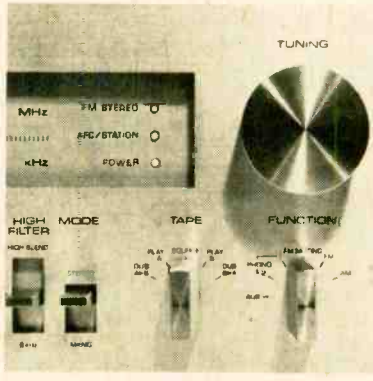
Understand that FM tuning can often be set for minimum distortion *or* maximum separation, not necessarily both together. Quite often, minimum distortion might occur to the left of the center-scale calibration mark while maximum separation is on the right side of the scale calibration (or vice versa depending on the factory alignment). As far as we can determine, the CR800 tunes itself to provide the least distortion for the most separation, and depending on the particular model, they might coincide.

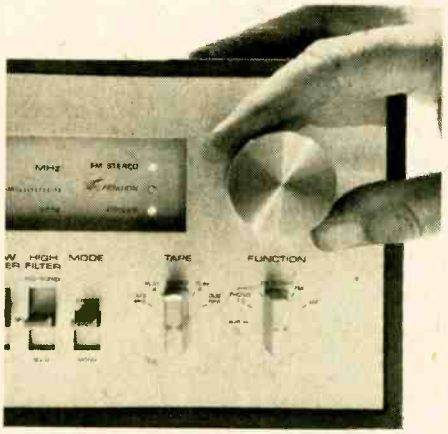
A front-panel lamp shows the condition of the AFC circuit. This lamp is one of three positioned on the right side of the tuning dial. The bottom lamp is the power indicator. The top lamp is the AFC indicator. When the tuning knob is touched, the AFC lamp dims, indicating the AFC is off. The user tunes the station for center-scale meter indication. When the tuning knob is released, the AFC activation is indicated by the AFC lamp increasing to full brilliance.

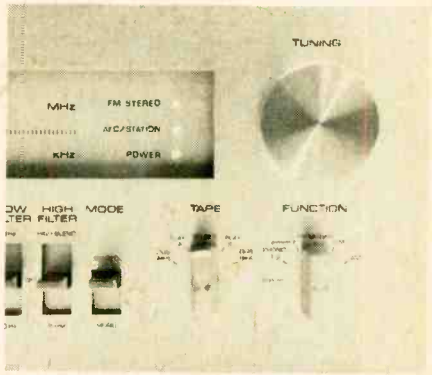
Unlike most AFC circuits that switch on and off, the AFC action is very gradual, taking several seconds, and the user can actually watch (via the tuning meter) and hear the tuning being "pulled" to the optimum distortion/separation balance.

There's More. The CR800 has some standard receiver features and some not-so-usual features in addition to automatic AFC. In addition to the usual magnetic phono (two), aux and two tape inputs, and two speaker, two tape and headphone outputs, the CR800 provides automatic switch-selected dubbing between two tape recorders, as well as having preamplifier outputs and main-amplifier inputs for connection of intermediate optional accessories such as Dolby or equalizer. The preamplifier outputs can also be used for tape recording when it is desired to have tone and/or volume control, or filter effects in the signal path.

Another unusual feature is a user-adjustable loudness compensation—actually an equalized low-level volume control. It works this way: The volume control is set to the maximum volume desired by the user. To lower the volume, the user can use the loudness control which provides increasing bass and treble boost as the volume is reduced. Because the loudness compensation is not referenced to a particular setting of the volume control—as is the case when the loudness compensation is switch-selected—the user can establish the compensation for a specific listening condition, rather than a mechanical condition determined by the position of







Touch the tuning control and the AFC is automatically disabled while the FM station is tuned for a center-scale indication on the tuning meter. The AFC/station panel lamp to the left of the tuning knob dims, indicating the AFC is off. When the tuning knob is released, the AFC/station lamp glows brightly, indicating the AFC has automatically switched on.

e/e YAMAHA CR-800

the volume control and by speaker efficiency.

Sound Filtering. Other unusual features are dual-range low and high filters. The low filter provides 12 dB per octave attenuation below 70 Hz or 20 Hz (subsonic), as determined by a selector switch. The high filter selector switch provides 6 dB per octave attenuation above 8000 Hz, or high-frequency blend. The high blend is used for noise reduction of weak FM-stereo signals and does not affect the frequency response.

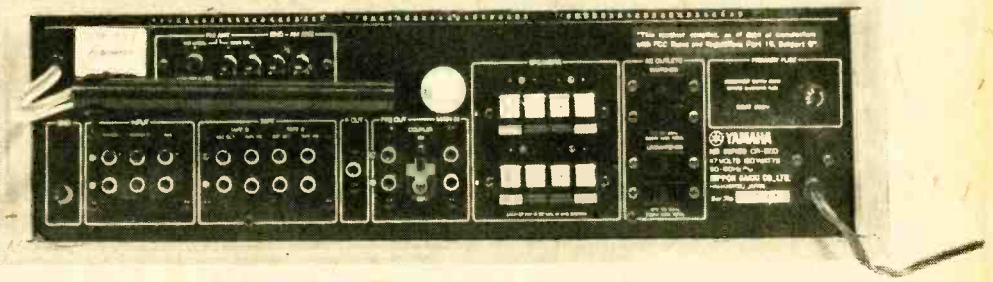
A mono microphone input is provided, with its own volume control. The microphone signal can be blended with other signal sources for special recording effects.

Tuner Performance. The CR800 FM tuner sensitivity measured 1.5 uV IHF with full limiting at 3.5 uV. The high fidelity sensitivity (60 dB quieting) was 7 uV. Full mute release was attained with 10 uV. At standard test level the frequency response measured +0/−1 dB from 20 to 15,000; distortion was 0.45% THD; signal-to-noise ratio was 70 dB. Stereo separation measured 38 dB. Selectivity was excellent. The AFC is full-time. Touching the tuning knob automatically disables the AFC. After the station is tuned, removing the hand from the tuning knob automatically restores the AFC, which pulls the tuning precisely to the point of best stereo separation and minimum distortion. The AM tuner performance is average, as most good AM tuners are.

Amplifier Check-Out. The power output per channel at the clipping level at 1000 Hz with both channels driven measured 69.7 watts RMS into 4 ohms, 57.2 watts into 8 ohms and 37.5 watts into 16 ohms. The maximum power per channel 20 to 20,000 Hz into 8 ohms was 50 watts RMS. The frequency response at 50 watts/8 ohms measured +1.4/−0 dB from 20 to 20,000 Hz at a distortion no higher than 0.075% THD at any frequency.

The tone-control range measured ±15 dB at 50 Hz; ±9 dB at 10,000 Hz. The magnetic input hum and noise was −72 dB; separation was 55 dB.

Aside from the Yamaha CR800's noteworthy performance, the automatic AFC alone is worth a trip to your local audio showroom to see how it works. For more information on the Yamaha CR800, circle number 70 on the Reader Service Coupon on page 17. ■



Rear view of the Yamaha CR800: There are stereo inputs for two magnetic phono, aux, and two tape, outputs for two speaker systems, two tape, and phones, as well as an FM detector output.

TRACE SIGNALS WITH YOUR TAPE RECORDER

by Hugh Gordon

☐ A signal tracer can be easily improvised by using a cassette tape recorder (any tape recorder will do), a capacitor, and an earphone (or loudspeaker), connected as shown in the diagrams. Use the "monitor" switch to hear the output, or connect a loudspeaker or earphones, as shown. Connect the input to the auxiliary jack if tracing high level signals, and to the microphone jack if tracing low level signals.

Switch the recorder to the *record* mode to trace signals. It may be necessary to defeat the "erase protect" sensing lever in cassette recorders by pressing on it before pushing down on the *record* button. Otherwise, operate the recorder with a cassette in place.

How It's Done. Probing with the capacitor lead at the collector and base of each transistor in a circuit, in turn, allows the signal to be traced through the circuit; and faults, such as a dead stage, can be found in a few minutes.

If the amplitude of the input signal is too high, simply connect an attenuator (Fig. 2) across the input terminals to the tracer, as shown, and adjust the potentiometer for correct volume.

While the circuit is useful for tracing the audio sections of an amplifier or receiver, you may also want to trace the radio frequency (RF) sections. This may be done by replacing the capacitor with a simple diode demodulator probe, a sketch of which is shown in Fig. 3.

Fig. 1

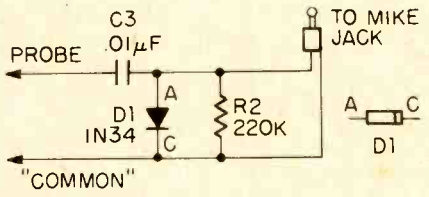


Fig. 2

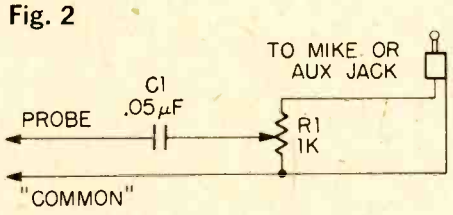
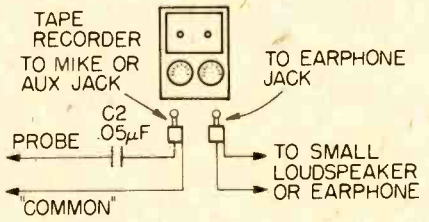


Fig. 3



Safety First. One good guide by which you should govern yourself when puttering about an apparently defective TV set, is not to perform any adjustment, poking, prying, snooping, cleaning, etc., that you would not permit a six-year-old child to do. After all, why is a child's life dearer than yours when TV service technicians are available to do the task efficiently and safely? ■

PARTS LIST FOR A SIGNAL TRACER

C1, C2—0.05 uF capacitor (Radio Shack 272-1068 or equiv.)
C3—0.01 uF capacitor (Radio Shack 272-1065 or equiv.)
D1—general purpose germanium diode, 1N 34 (Radio Shack 276-821 or equiv.)
R1—1000-ohm potentiometer, any convenient type
R2—220,000-ohm, ½-watt resistor (Radio Shack 271-000 or equiv.)

YOUR CB CAN TELL TIME

Tired of all those fancy experimenter projects good for everything but a CB shack? Here's a goof-proof project that puts SW broadcasts on a CB without modifications!

by Malcolm K. Smith

THE receiver in your CB transceiver is almost certainly an excellent signal grabber with good selectivity and sensitivity. But, it's crystal controlled to receive only the CB channels. There is, however, a simple way to make your CB serve as a high quality rig for VHF monitoring, short wave listening, checking the National Weather Service forecasts, or getting an accurate time and frequency signal. All you need is a simple device called a converter that requires no changes to the inside of your rig. And, best of all, building a converter is a breeze, because it can be made from low cost modules available in kit form.

There are many exciting signals you can receive on your CB with a converter, but the most useful ones are the precision time and frequency broadcasts sent out by CHU in Canada and the National Bureau of Standards station WWV in Fort Collins, Colorado. Let's say you've just built the e/e MAXICLOCK—a first class digital clock; surely you need something better than a DJ's idea of the time to set your clock. Or, if you're interested in accurate calibration of a receiver or transmitter, you need the precision standard frequency given by WWV. And now, if you'd like to tell time with your CB using a converter, what is a converter, and how does it work?

A converter mixes together an input signal—let's say CHU at 7.335 MHz—with a signal from a "local oscillator" (LO) in the converter itself. When two signals are mixed, out come new signals at the sum and difference of the original frequencies. Suppose you mix the 7.335 MHz signal from CHU with an LO signal of 19.730 MHz; one of the output signals is their sum—27.065 MHz, the frequency of channel 9.

Simplex Circuit. Take a look at the block diagram which is nearly the schematic of a converter; the 7.335 MHz signal is amplified by the RF amplifier and fed into the mixer where the LO signal (19.730 MHz) is added to it. The sum frequency (27.065 MHz) is fed into the antenna input jack of your CB (tuned to channel 9), and from the speaker you now hear the time signals. You have "converted" 7.335 MHz to 27.065 MHz!

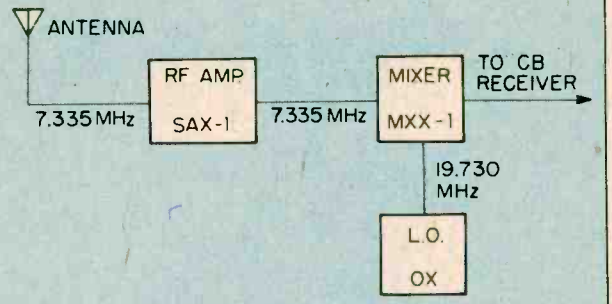
Incidentally, the workings of CB receivers were well described in e/e for July-August 1974. If you have that issue, the article on page 45, "Discover Your CB Receiver," gives a good explanation of converters.

Our CB time converter uses three easy-to-build and low-in-cost modules available from the International Crystal Mfg. Co., 10 North Lee, Oklahoma City, Okla., 73102. Each module performs one function and consists of a transistor, a tuned "LC" circuit, and other components mounted on a printed circuit board. The three kits needed here are: SAX-1, the RF amplifier; MXX-1, the RF mixer; and OX, a crystal controlled local oscillator. You will have to buy an "EX" crystal for each frequency to be received unless you have one of the old tunable receivers such as the Lafayette Comstat 19, which can be manually tuned over a range of about 300 kHz. In that case, you would require only one crystal to cover this 300 kHz range.

Pinpoint Hertz. How do you calculate the required crystal frequency? First, determine the frequency you wish to

e/e CB TIME CONVERTER

With three easy to construct and inexpensive kits, which come with an etched and drilled PC board, you can electronically "slide" your CB receiver down to pick-up short wave broadcasters like WWV, CHU, or even the Voice of America.



receive; let's say WWV on 10.0 MHz. This is a good first choice since WWV seems to come in well at most times. Next, decide on the channel to use; channel 9 is probably best, since there will be very few strong CB signals to leak through and interfere with the converter signal. The frequency of channel 9 is 27.065 MHz.

The next step depends on whether you are going to convert "up" or "down." Here you are converting up to a *higher frequency*, and so you *subtract* the desired frequency from the channel 9 frequency to get the LO frequency as follows—channel 9 frequency (27.065 MHz) minus the desired signal frequency (10.000 MHz) gives the "LO" frequency, 17.065 MHz.

Now suppose you want to receive a frequency higher than channel 9, say a National Weather Service Station on 162.55 MHz. Incidentally, NWS weather and many other VHF signals are frequency modulated (FM). Your CB rig is not designed to receive FM, but, surprisingly enough, it does a pretty good job (don't try, however, to build a converter for the FM broadcast band; your CB rig can't handle their large frequency shifts).

Here you get the LO frequency by subtracting the channel 9 frequency from the desired frequency, since this is "down" conversion, as follows—desired signal frequency (162.55 MHz) minus the channel 9 frequency (27.065 MHz) gives the "LO" frequency 135.485 MHz.

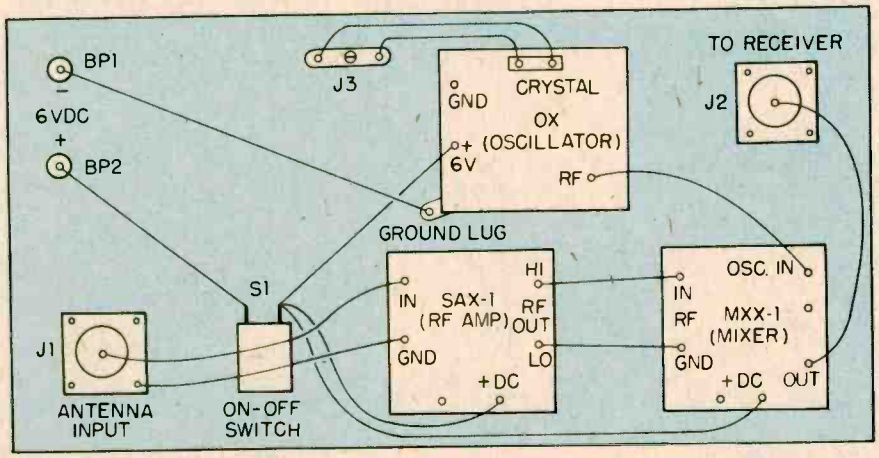
3-Way Cut. So, you want a crystal of frequency 135.485 MHz, right? Wrong! There is a slight complication in using the OX oscillator at frequencies over 60 MHz. You can't use the basic or fundamental frequency of the crystal. You have to use what are called its harmonics—frequencies which are two or three or more times the fundamental. Here you use the third harmonic—three times the fundamental. Therefore, the crystal frequency should be *one third* the LO frequency. The NWS crystal is, therefore, 135.485 ÷ 3 = 45.1617 MHz. The table gives crystal frequencies for a few other common signals.

In addition to the International Crystal modules and EX crystals, you'll also need a few small parts and a box or cabinet for mounting. The cabinet requirements are not critical; a small metal box or one with a metal cover should serve well. The common bakelite box with aluminum cover is fine. A box about 4 x 8 x 2½-in. is good because it gives you plenty of room for batteries, connectors, etc.

The ICM kits are quite complete; you'll need only wire and solder to build the modules. International Crystal provides detailed instructions for selecting the right components from the ones they supply and for assembling the individual modules. The diagram shows you how to connect the modules together to produce a converter. Before mounting the boards, check your soldering carefully. Look very carefully at the joints where the input and output terminals meet the copper foil. They can easily work loose; it's a good idea to solder each one individually. Use the bolts and spacers supplied to mount the modules on a metal chassis; drill four ⅛-in. holes in a square 1⅜-in. on a side for these bolts.

Input-Output. SO-239C coaxial jacks handle the coax cables to the antenna and the transceiver. An spst switch and a snap-type battery clip take care of power connections. A nine-volt transistor radio battery is an adequate power source. However, we prefer to use four AA cells in a holder; the rig works fine on six volts and these cells last longer than the nine volt battery. For long term monitoring you may want to use an external AC power supply; the two

Here's why we stamp this project "goof-proof." Three little sure-fire PC board project kits and a few wires to plug them together pick up short-wave broadcasts and "convert" them to CB channel 9. That's where your CB set takes over. It "picks up" the converted signal; that's why no modification to the CB set is ever required.



PARTS LIST FOR CB TIME CONVERTER

BP1, BP2—5-way binding posts (Radio Shack 274-662 or equiv.)
J1, J2—chassis-mount, SO-239, coaxical jacks (Radio Shack 278-201 or equiv.)
J3—optional crystal socket for "EX" (HC-6/U) type crystals (Amphenol 9748-16-10 or equiv.)
S1—spst toggle switch (ON-OFF) (Radio Shack 275-602 or equiv.)
Misc.—four-cell AA battery holder such as Radio Shack 270-383, cabinet with metal cover about 4-in. x 8-in. x 2-in. such as Radio Shack 270-232, PL-259 coax connectors for input/output signals, wire, solder, etc.

In addition, the following "Experimenter" kits will be required from International Crystal Mfg. Co., Inc., 10 N. Lee, Okla. City, OK 73102: OX oscillator @ $2.95, MXX-1 mixer @ $3.50, SAX-1 RF amplifier @ $3.50, and the proper EX crystal (see text) @ $3.95. Postpaid.

COMMON CRYSTAL FREQUENCIES

Station	CHU	WWV	NWS weather	Marine calling, distress
Freq. (MHz)	7.335	10 5	162.55 162.40	156.8
Crystal (kHz)	19,730.000	17,065.000 22,065.000	45,161.666 45,111.666	43,245.000

binding posts are for this connection.

One last refinement, that is not necessary but certainly is convenient, is an external crystal socket. As shown in the diagram, mount the socket near the OX module and connect two leads (as short as possible) from the OX socket to the terminals of the new socket. This allows you to change frequencies over a narrow range without removing the unit from its case.

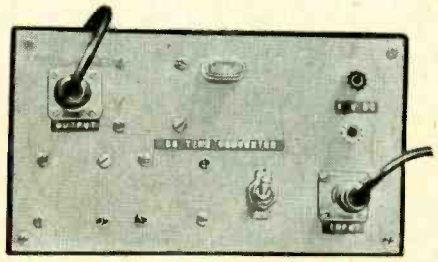
A special word here about using your converter on different frequencies: You should follow the ICM instructions carefully in choosing the right coil and capacitor for the kits. For the OX oscillator, the "yellow dot" coil will probably cover the range you want for time listening. However, with the SAX and MXX, the yellow dot has to be matched with the right capacitor: the 100 pF capacitor tunes the range 5.4 to 8.5 MHz—just right for CHU. For WWV you need the 47 pF capacitor that tunes 8.5 to 13 MHz.

When the modules are securely mounted, make the connections between the units as shown in the diagram. Note that the negative battery terminal is connected to chassis ground with a solder lug. Connections to the boards are made with the little connectors supplied. Take it easy and work carefully with them. First cut your wire to the right length, then strip about ¼-in. of insulation from each end. Hold the "open" end of the connector with long nose pliers; squeeze the connector around the wire end. Secure the wire in place by flowing in some solder. Careful! Don't let solder get into the round end that mates with the pin on the PC board.

Setup. For testing and adjusting your converter, an RF signal generator is useful, but not essential. The tuned circuits in the SAX and MXX can be peaked using an on-the-air signal from CHU or WWV. Adjust the slugs in the coils for maximum volume from the speaker.

Of course, your converter needs an antenna to function properly. When radio propagation conditions are good, almost any piece of wire connected to the center (ungrounded) input will serve. We get good results by connecting both wires from a monitor antenna to the center terminal. This is, in effect, a long vertical antenna. Your CB antenna will probably not work well, since most good CB antennas are effectively grounded for any frequencies except the CB channels (good for lightning protection, but not for receiving 10 MHz).

Shortwave Fix-Tuned. There are many shortwave broadcast stations around the world you might try to snag with a fix-tuned receiver like the one here. The radio can be left "on," always tuned exactly to the broadcaster's frequency. When "skip" on the shortwave bands is just right, and the station is broadcasting, you will be ready to copy. While a separate crystal for every possible frequency is a financial impossibility, and not very practical anyway, you can keep a crystal or two around for your most often used frequencies.



A front panel mounted crystal socket permits moderate shifting of the received frequency without internal retuning. If you use an external 6-volt supply, be sure to remove the dry cell.

Here is a selected list of shortwave broadcast stations which may interest you. Of course, you should confirm reception in your area with a regular tunable shortwave receiver before sinking your good bucks into a crystal.

Voice of America, Greenville, N.C., 15160 kHz, 2345 GMT, relaying programs of the Organization of American States; Greenville, N.C., 15235 kHz, 1900 GMT.

Canadian Broadcasting Corporation, Sackville, N.B., 11720 kHz, 0200 GMT, Northern Service newscast; Sackville, N.B. 15190 kHz, 0100 GMT, Radio Canada International's foreign service in English.

CFRX, Toronto, Ontario, 6070 kHz, can be heard during the evening hours in North America with programs of CFRB, sounding much like a popular music format U.S. commercial BCB station.

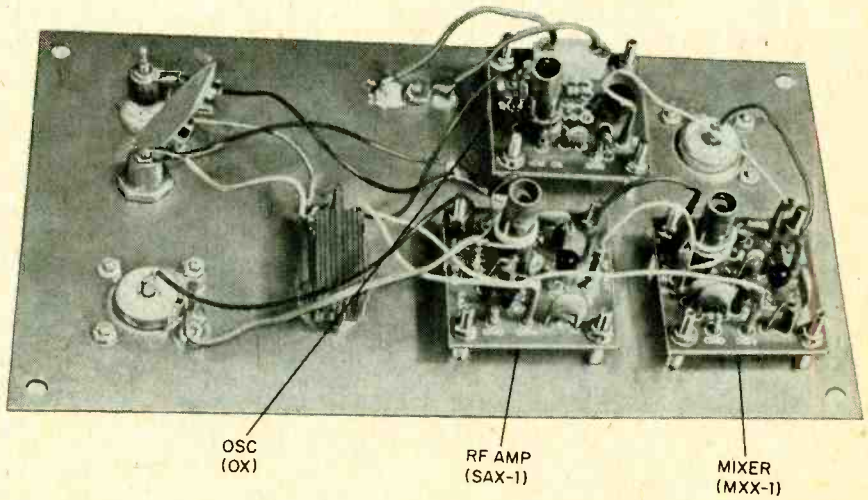
Voice of the Andes, HCJB, Quito, Ecuador, 11745 kHz, English may be heard around 0300 GMT. Or, in the mornings, try 15115 kHz about 1300 GMT.

Radio Peking, Peking, People's Republic of China, 15060 kHz. You can find this station broadcasting in English around 0200 GMT.

Radio Australia, Melbourne, Australia, 11785 kHz. Plenty of English programs from this down under station; listen in about 1400 GMT.

Radio Tahiti, Papeete, Tahiti, 15170 kHz. With music that runs the gamut from U.S. pops to Polynesian melodies, listen for this station from its sign-on at 0300 GMT.

This little converter now makes your CB into a red hot receiver. With the right LO crystals, you can cover your favorite frequency-stops from 3 MHz to 170 MHz. Good signal hunting! ■



RADIO HISTORY

by Art Trauffer

☐ Here are some ideas suggesting how to make novel pen sets that bring back fond memories to old-timers in wireless and radio. The pen sets also fascinate newcomers in radio and electronics, and they make nice gifts.

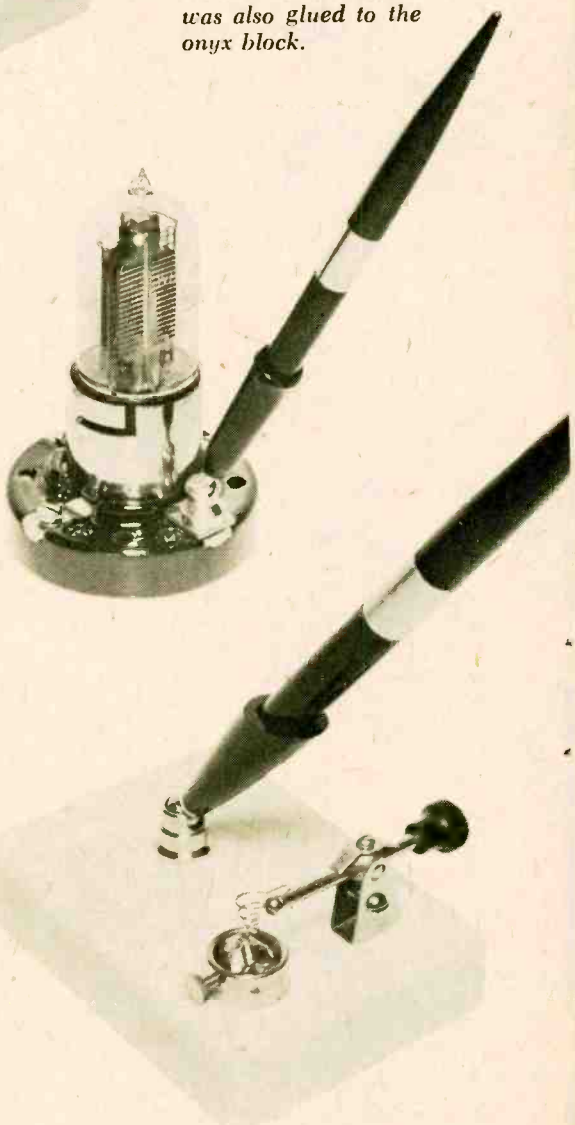
As shown in the illustrations, an early wireless or radio item such as a vacuum tube, crystal detector stand, or spark gap is mounted on a block of marble, onyx, or wood, and then a funnel and pen is added to complete the desk pen set.

Old-timers in radio might want to use the crystal detector they made or bought for their first crystal set, or the first tube they used when they graduated to tube sets, or the spark gap they made or bought to use with their Ford spark coil transmitter. Newcomers in radio and electronics can purchase the above early items from antique radio collectors, or they can make their own crystal detector stands and spark gaps using the illustrations as guides.

Marble and onyx blocks can sometimes be found at sales, or they can be purchased from large electric lamp supplies firms, or from firms that make sports trophies. Funnels and pens can be purchased from the larger hobbies and crafts dealers. The table gives some purchasing tips.

To mount items on marble and onyx blocks you can either drill holes using high-speed drills (at slow speeds), or masonry drills, or you can simply cement the items on the blocks using epoxy glue or the new industrial "wonder glues." ■

Here is a Western Electric 216-A triode tube mounted on a block of onyx purchased at a sale for a few cents. The four pins on the bottom of the tube base were soldered to a small brass disc and then the brass disc was cemented to the onyx block with epoxy glue. The ball joint of the pen funnel was also glued to the onyx block.

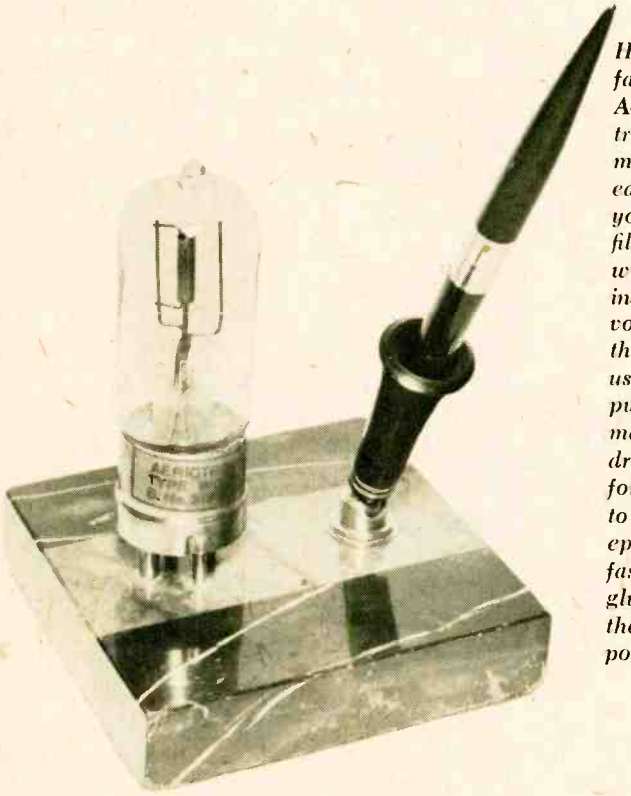


A novel pen set idea is a Western Electric 203-D triode (similar to a VT-1) mounted in an RCA UR-542 porcelain bayonet-type socket. One of the binding post screws was removed from the socket and a 6-32 x ¾ in. flat-head machine screw was passed through the hole to hold the ball joint of the pen funnel. If desired, you can cement the pen funnel to the socket using epoxy, or "miracle glue." Four small felt pads were added to the bottom of the socket.

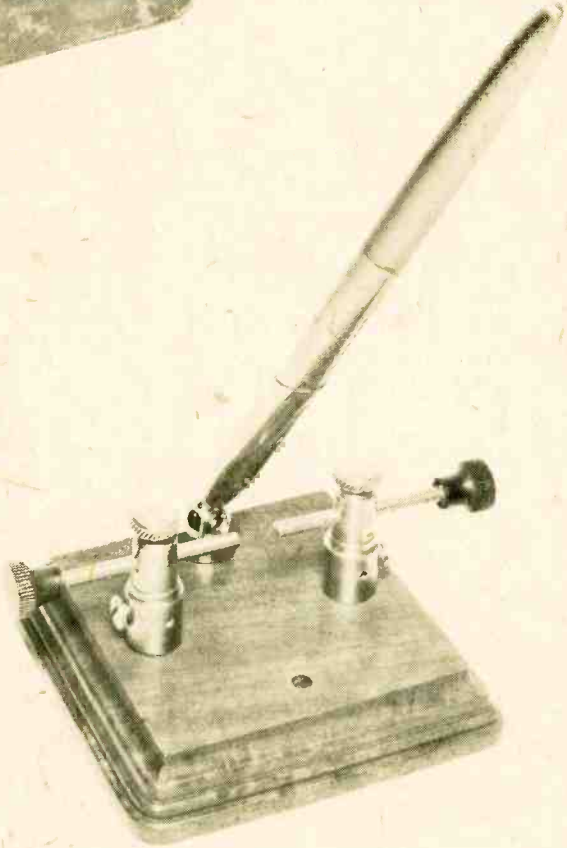
The author used a marble block removed from a discarded basketball trophy purchased for 75¢ at a Salvation Army store. The hole in the block was used for mounting a funnel and pen. The crystal detector parts were glued to the block with epoxy glue.

ON YOUR DESK

Bring back the days of "wireless" glory with these fascinating and useful souvenirs!



Here we have the famous Westinghouse Aeriotron (WD-11) triode tube which made a big hit in the early 1920s because you could heat the filament (1.1 volts) with a 1½-volt drycell instead of using a 6-volt storage battery. In this case, the author used a desk pen set purchased at a rummage sale for 50¢, and drilled four small holes for the tube base pins to fit in, and then used epoxy glue to hold it fast. Green felt was glued to the bottom of the marble to protect polished desk surfaces.



Here is a home-brew stationary spark gap, such as used in the early days of radio—known then as "wireless." Many of you old-timers will recall using a Ford Model-T spark coil to provide the high voltage for the spark! Assembly is easy. Simply pass a machine screw through one of the mounting holes in the base of the spark gap to hold the ball joint of the pen funnel. Glue felt to the bottom of the base to protect polished desk surfaces.

POSSIBLE SOURCES FOR DESK PEN SET MATERIALS

Marble and Onyx Blocks

Salvation Army, Goodwill Stores, auctions, rummage sales

Gilbert & Miller, Inc., 239 New Main St., Yonkers, NY 10701. (This company supplies marble and onyx blocks, as well as pens and pen funnels. Write for catalog.)

Pens and Pen Funnels

Gilbert & Miller, Inc. (see address above) Large hobbies and crafts supplies stores

Green Felt

Notions and yard goods departments of department stores

Early Vacuum Tubes

Antique radio collectors (The following two antique radio newsletters also might be helpful: Antique Radio Topics, published by Antique Radio Press, P.O. Box 42, Rossville, IN 46065—50¢; and The Horn Speaker, published by Cranshaw Publications, P.O. Box 12, Kleberg, TX 75145—also 50¢.)

Watch ads in Collectors News, Antique Trader, etc. for antique radio collectors and dealers wanting to sell early radio vacuum tubes.

Crystal Detector Stands

Modern Radio Labs., 1477-G, Garden Grove, CA 92642

Bill Baker, Route 3, Box 1134, Troutdale, OR 97060 has some Kilbourne & Clark crystal detector stands (circa early 1920s) to sell. Write him for prices.

Crystals

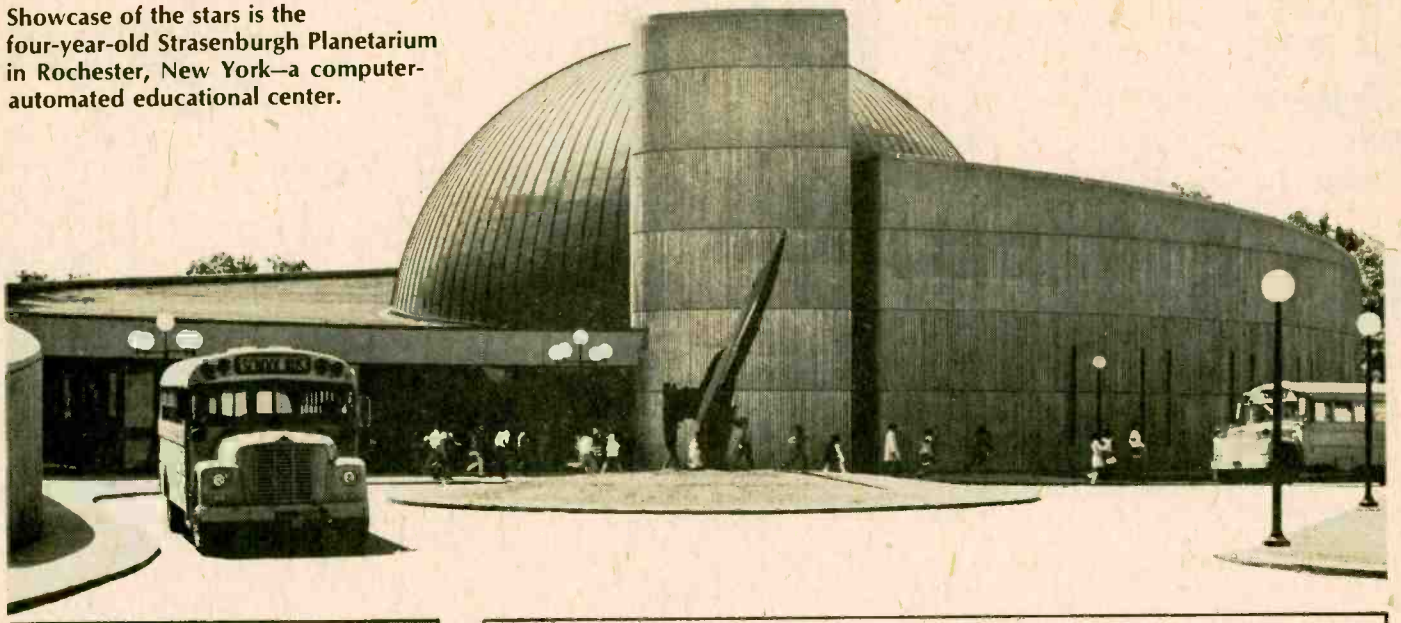
Modern Radio Labs. (see address above) sells various types of crystals. Write for details and prices

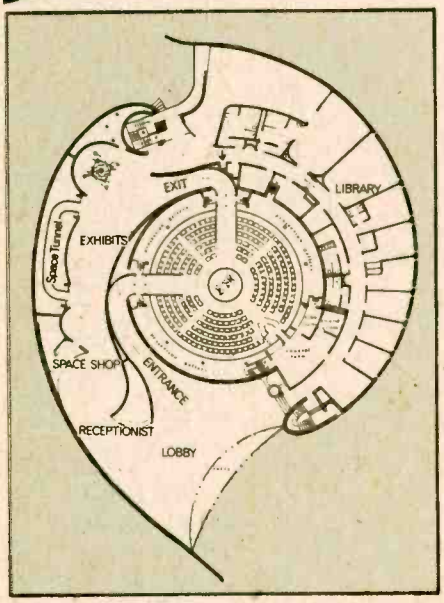
Art Trauffer, 120 Fourth Street, Council Bluffs, IA 51501 sells genuine MPM (Million Point Mineral) unmounted galena crystals in original factory boxes (circa early 1920s) at 50¢ each, plus postage.

Spark Gaps

Buy from antique radio collectors and dealers.

Showcase of the stars is the four-year-old Strasenburgh Planetarium in Rochester, New York—a computer-automated educational center.

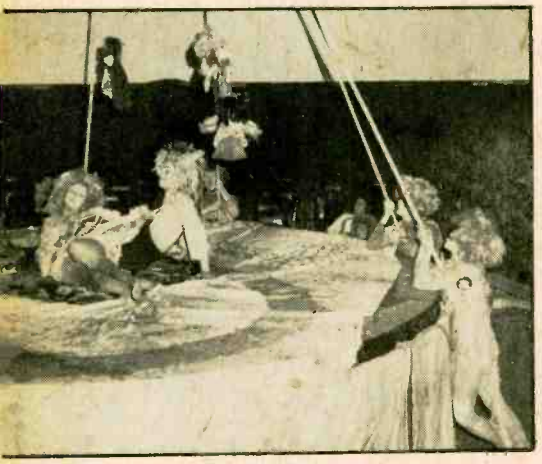


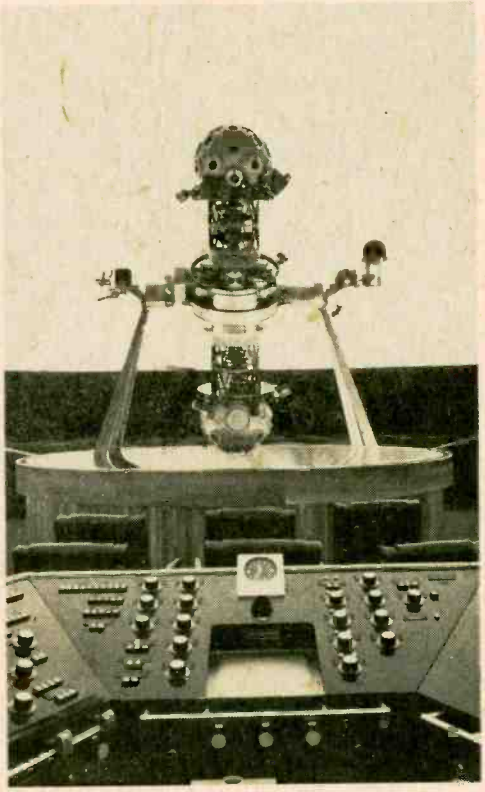


PLANETARIUM FOR THE PEOPLE

Optical magicians, audio genii, entertainment magi make this planetarium a galaxy of special effects!

by Jay Arthur





The Planetarium is a highly functional building with a shape suggestive of a spiral galaxy, as the floor plan shows. The Zeiss star projector (center-left) emerges from a well for "star" shows. It sinks away for special performances such as "A Midsummer Night's Dream" (far left). Both types of presentations can be enhanced with many projection devices time synchronized.

THE STAR-LADEN NIGHT SKY over the audience is interrupted, rather madly, just above the horizon by a proscenium-like frame of light bulbs. Within that frame, incredibly, stands a lovely young lady, vocalizing about a flight to the moon. As she sings, the lunar orb looms ever larger in the sky until the audience finds itself "landing" on its surface, the crater-pocked landscape spreading out on either side of the chanteuse.

Suddenly she is led by a jazz quartet, barely visible near the center of the audience, into "Here Comes the Sun," and a sunrise begins its ascent over a magically materialized city skyline. The girl follows with "Soon It's Gonna Rain," and the audience virtually feels the drenching downpour that appears to cascade from heavens instantly come alive with thunder and lightning. The storm tapers off, and a magnificent arc of colors emerges to the strains, naturally, of "I'm Always Chsing Rainbows."

Hallucinogenic scenes from a crazy, way out movie? No. In reality, a segment from another mixed-media show in a swinging, way out planetarium.

A New Star Is Born. Ever since it opened some four years ago in the upstate New York city of Rochester, the Strasenburgh has been to other planetariums what Stanley Kubrick's "2001" is to a Walt Disney celluloid romp through nature.

The traditional star show at most planetariums has been essentially an illlustrated lecture on astronomy. Perhaps the first to break out of this mold was New York City's Hayden Planetarium, which many years ago began mounting productions like one masterpiece on the end of the Earth, complete with wailing sirens and all-consuming fire.

But the Strasenburgh has gone to new lengths. Its approach to the knowledge business at the adult level is very similar to the way public television's Sesame Street and The Electric Company tackle children's education. Explains the Strasenburgh Planetarium's director, Don Hall:

"Our purpose is not to teach astronomy but to create enjoyable entertainment in this special environment. The audience is learning at the same time."

The technical challenge of such an approach is awesome, particularly when it has to be done on a shoestring budget. But the problems just seem to bring out the creativity of the Strasenburgh's youthful staff.

As in any other planetarium, the central item of equipment is the Zeiss projector, a $260,000 complex of lenses, shutters and gears that creates the main images of the universe and the solar system. One of the most up-to-date instruments of its kind in the world, it can simulate such phenomena as the twinkling of a star or the pitch, roll and yaw of a spacecraft.

Making It Believable. But to John Paris, the planetarium's inventive technical director, it's just "another special effect." He's got a lot more special-effects units—some 300 of them—to call on. Virtually all of them are conventional slide projectors that Paris and his whiz-kid assistants have adapted to their highly specialized needs.

For example, a miniscule chunk of hammered metal—a bit smaller than a dime—mounted on a tiny rotating spindle within a projector's optical path makes a totally believable asteroid tumbling through the void. And when the Strasenburgh's young wizards needed some sort of diffusion device to create a ring of celestial fire, they resorted to the bottom of a baby food jar with awesome results. Another time, they needed a bunch of special wide-angle lenses and couldn't locate them on the regular optical market. They resolved this problem by purchasing a bunch of surplus eyepieces from old Army tank periscopes.

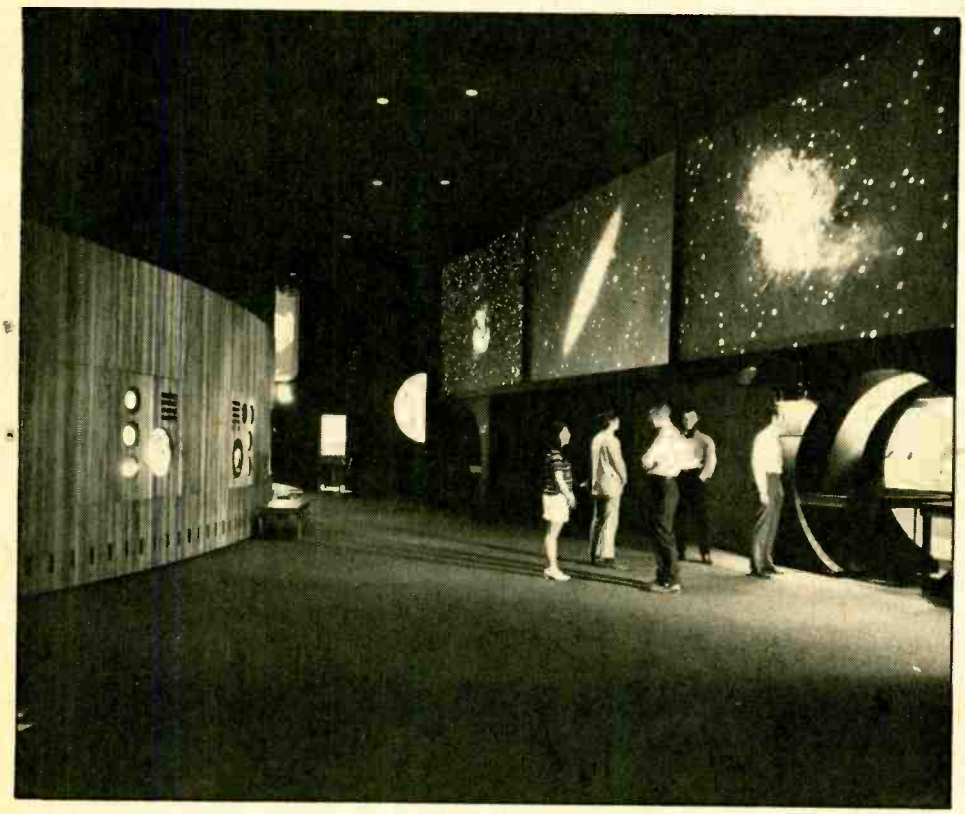
Most of the special-effects projectors at the planetarium are mounted in a gallery, six feet wide, that surrounds the Star Theatre just under the horizon line. The electric outlets for the projectors are fed by numbered circuits. These come together in a huge patchboard. The board, in turn, is tied into the main control console so that each projector can be programmed either manually or by the Strasenburgh's own computer.

A second, catwalk-like gallery encircles the Star Theatre four feet above its horizon line. Projectors mounted here shine through the perforated aluminum dome, creating images on the opposite side.

Way Out Audio. Backing up this maze of visual gear is a sound laboratory worthy of a fine commercial recording studio. Its equipment includes a mini-Moog synthesizer for creating ethereal sounds and a variety of aural pyrotechnics. A battery of the customary tape recorders, phonograph turntables, and sound-mixing equipment completes the audio lab.

The ingenuity that marks the visual work is equally evident in the Strasenburgh's audio efforts. For example, an

(Continued on page 92)



Astroscreens provide warmup space show, complete with music and narration, for guests waiting to enter the Star Theatre of Strasenburgh Planetarium. Guest actuates rear-projection screens by pushbutton. At lower right, beneath screen, is entrance to black-lighted Space Tunnel, in which dramatic, animated displays depict facts about the Universe.

Both young and old radio buffs usually start out with a crystal set . . .

OATMEAL BOX CRYSTAL

Fig. 1
Sliding contacts made from brass and steel.

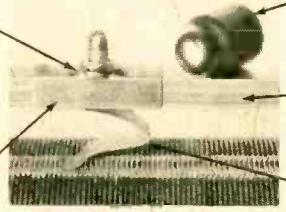
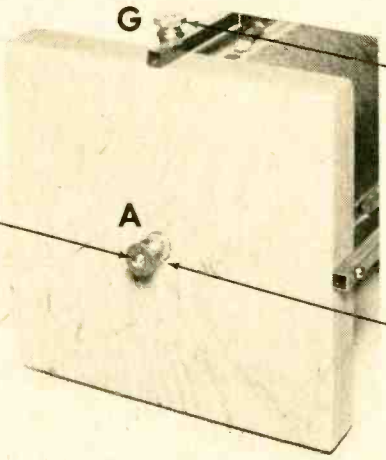


Fig. 2 Antenna and ground end of the Quaker Oats radio.



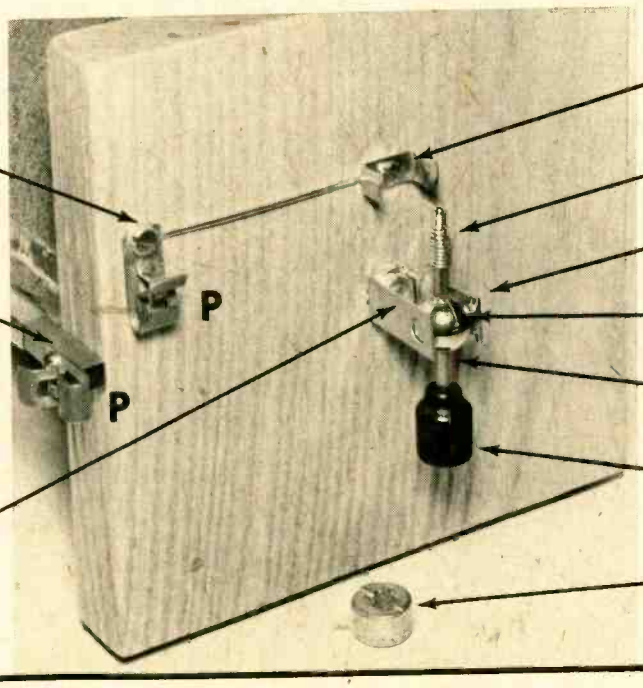
ASK JUST about any radio old-timer, including this writer, and he will probably tell you that his first radio was a home-brew slide tuning coil wound on an oatmeal box, a cat whisker and galena crystal detector, and a pair of earphones. This picture story shows how to make such a radio, and it looks much like the writer's first radio built not long after World War I.

First, make the coil. Remove the two end covers from an 18-ounce, round Quaker Oats box, and cut the tube to a length of about 6½-in. Give the tube a coat of shellac inside and out to moisture-proof it.

The writer used #21 single-cotton-covered enamelled copper magnet wire, and after the coil was wound the cotton was colored green by painting it with India ink to make it look like the old-time green silk-covered wire which is no longer being made. If you prefer, use #20 or #21 enamelled or nylon-coated copper magnet wire, and one pound should easily do it.

Get Going. Punch two small holes through the tube at each end, about ½-in. from the ends, to anchor the ends of your coil. To do a tight, smooth and neat job of winding the coil, tie the end

Fig. 3
Crystal detector end of the Quaker Oats radio.



if your "taste" dates to earlier days, try–

RADIO

by Art Trauffer

of the wire to some object outdoors where there is plenty of room, and unwind a couple hundred feet of wire, and pull the wire tight to stretch out any bends in the wire. Cut off the wire and anchor the end in the two small holes near one end of the tube, and dab a bit of cement to hold it fast. Now wind the coil by turning the tube slowly while you walk towards the tied end of the wire, and when the tube is full of wire cut off the wire and anchor the end in the two holes at the other end of the tube and put on a dab of cement. This trick will give you a neat professional-looking coil.

As shown in the photos, the two wood end blocks for the coil measure 5 x 5 x ¾-in. and are sanded smooth, stained, and varnished. The writer's first project used oak.

Bore a 3/16-in. hole through the exact center of each wood block; these are for the length of 8-32 threaded brass rod that passes through the coil and holds the wood end blocks. One end of the threaded rod holds the U-bracket of the crystal detector (Fig. 3), and the other end of the rod serves as the antenna binding post (Fig. 2).

Note in Fig. 2 that the end of the coil nearest to the antenna binding post passes through a small hole in the wood block and is clamped between the two washers of the antenna binding post; this automatically connects the coil end to the U-bracket of the crystal detector also.

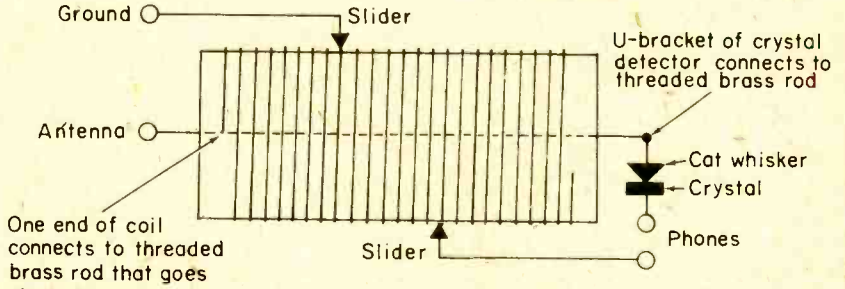
Figs. 2 & 3 give details for mounting the slide rods, the earphone Fahnestock clips, the ground binding post, and the clamp that holds the galena crystal. The simple hook-up is shown in Fig. 4. Fig. 1 gives all details for making the two sliders that will contact the coil.

Contact. Perhaps the hardest job of all is to do a neat job of removing the insulation from the coil when making the two bare wire paths for the sliders. Use fine sandpaper and be careful not to sand off too much of the copper. When you are through brush away any fine copper dust between the turns of the wire. You will get a neater job if you use enamelled wire instead of cotton-covered wire.

For best results with this crystal radio, use a long antenna, a cold water pipe ground, a sensitive galena crystal, and a sensitive high-impedance pair of magnetic earphones. ■

Your basic materials may be the same, but the bucks required to buy them have certainly bounced upward from bygone days! It cost the editor 49¢ for this box which had four different prices on the top ranging from 49 up to 55¢.

Fig. 4 Simple schematic for the crystal radio.



BILL OF MATERIALS FOR QUAKER OATS BOX CRYSTAL RADIO

1 round Quaker Oats box (18 oz.)
1 lb. #20 copper magnet wire, for winding coil (see text)
2 pieces 5-in. x 5-in. x ¾-in. oak, walnut, or mahogany (for coil end blocks)
1 foot of 8-32 threaded brass rod (to pass through coil form)
1 8-32 brass hex nut (holds crystal detector U-bracket to wood block)
2 12-in. lengths 7/32 OD square brass tubing or solid rod (for slider tracks)
3 ¾-in.-long round-head wood screws (hold brass rods to wood blocks)
1 8-32 x 1½-in. round-head brass machine screw, with hex nut and ornamental thumb nut to fit (for ground binding post)
3 inches of square brass tubing to fit snugly over slider rods (for making the two sliders)
2 6-32 x ¼-in. flat-head brass machine screws (to hold knobs to top of sliders)
3 inches ½-in.-wide brass band (for slider)
4 inches of ¼-in.-wide brass band (for making slider contact blades)
2 medium-size fahnestock clips (for phones binding posts)
1 ½-in. long flat-head wood screw (holds one fahnestock clip to wood block)
1 unmounted crystal detector stand (K/D Stand 9-14, Modern Radio Labs.)
1 mounted galena crystal for above detector stand (9-1 MRL Steel Galena, Modern Radio Labs., P.O. Box 1477, Garden Grove, CA 92642)
1 ½-in. long flat-head wood screw (holds crystal clamp to wood block)

Note: Those who do not have near-by hobby shops or large hardware stores can get most of the above hardware from MRL, P.O. Box 1477, Garden Grove, CA 92642. Send them 25¢ for a copy of their catalog.

FAR-OUT DX

DX is distance. And distance lends enchantment, it's said. DXers know the thrill of tuning signals from halfway around the world: *All India Radio,* South Africa's *Radio RSA* or, maybe, *Radio Peking*. The far-off stations are fascinating, but is distance everything in shortwave listening? Have you tried *Far-Out DXing?*

Far-out DX is tough to define. It might be a faltering signal from some never-never land. It could be that illicit little station that the kid in the next block operates—until the FCC clamps down—from his basement. Maybe it is a program in some weird or seldom heard dialect that happens to capture your imagination. The signal may come from near or far, but the distance factor is not really the key. Whatever it is, it is to you, for some reason, odd, off-beat, exotic, weird, wacky or unusual . . . in short, *far-out!*

It could be a program in the Eskimo language. You've probably tuned stations broadcasting in Spanish, French and German, perhaps Chinese or Arabic. But how about Basque?

Ice Cube Land. The Canadian Broadcasting Corporation has a daily domestic shortwave service directed to listeners in the far north. *Northern Service* programs feature, in addition to the usual entertainment fare, some personal messages—a sort of radio postal service—for those living in the remote Arctic territories. Programs are in English, French, and for the original Canadians of the northland, Eskimo.

From a Hotter Place. Programs in the Basque language can be heard over a mysterious shortwave station called *Radio Euzkadi*. It is operated by a shadowy Basque government in exile, headquartered in Paris, but the station's transmitters broadcast secretly from a South American location.

The Basques, most of whom live in the Pyrenees Mountain region of northern Spain, once were independent and for several centuries have struggled, sometimes in battle, to regain autonomy. *Radio Euzkadi*'s foe is the Spanish government and its programs are intended to keep the independence movement alive.

Basque is one of the oldest and oddest languages around. To the non-Basque it seems all "x's" and "k's" and "z's." Those who study this sort of thing say the Basques and their strange language came from Asia Minor over 4,000 years ago. But legends persist that the Basques are the last survivors of the lost continent of Atlantis.

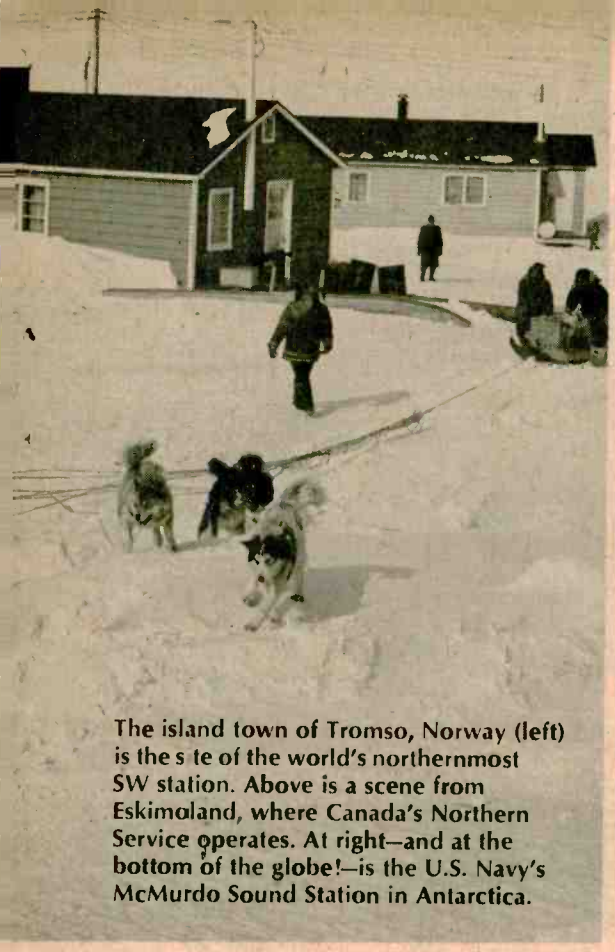
Wild Blue Yonder. And speaking of Atlantis, there was a real *Radio Atlantis* on the air recently. Not long ago, European listeners reported hearing its programs in English and Dutch on a medium wave frequency of 1331 kHz.

But *Radio Atlantis* operated from above, not below the ocean waves. It was one of the blue-water pirates, an unlicensed shipboard station that broadcast popular music to Europe from an off-shore anchorage in international waters.

Your best bet to log "Atlantis" today is to tune *Emissor Regional dos Açores,* a shortwave station at Ponta Delgada, Azores. There are, after all, claims that the Azores, in mid-Atlantic, are all of the mystical (mythical?) sunken kingdom that remain above the waterline.

Across much of North America, this one-kilowatt transmitter on 4,865 kHz can be heard, with careful tuning, especially during late winter afternoons. It is, however, a very difficult catch for West Coast SWLs.

As Far as You Can Go. Any other far out global spots that grab ya? Shades of "Lost Horizon," what about the forbidden city of the Himalayas, Lhasa? For more than a score of years, Tibet has been an integral part of Mainland China and its shortwave stations part of the vast Chinese broadcasting system.



The island town of Tromso, Norway (left) is the s te of the world's northernmost SW station. Above is a scene from Eskimoland, where Canada's Northern Service operates. At right—and at the bottom of the globe!—is the U.S. Navy's McMurdo Sound Station in Antarctica.

From pole to pole are scattered exotic, weird, wacky and unusual shortwave stations that make your hobby the most fascinating in the world. by Don Jensen, Shortwave Editor

The *Lhasa Broadcasting Station, Hsi Tsang Jen Min Kwang Po Tien Tai*, can be heard around dawn on 9,490 kHz, with a relayed Chinese home service program from Peking.

There's plenty of off-beat music to be heard on shortwave if you're a bit tired of the current Top 40 or the Golden Oldies. The belly-dancing beat of Arabic music is aired by stations from Cairo to Kuwait and beyond. Andean music of South America—popularized here by Simon and Garfunkel's "El Condor Pasa" —can be heard over Peru's *Radio Progreso* and Ecuador's *Radio Luz y Vida* to mention but two outlets.

Like Alphabet Soup. From A to Z there's exotic DX.

A is for Afghanistan, and *Radio Afghanistan*, at Kabul, is not beyond the shortwave reach of even a relatively inexperienced SWL. On some frequencies the station uses a hefty 100,000 watts of power and at least some programs are in English.

Z? How about Zanzibar, a somewhat harder catch on shortwave due to lower frequency and transmitter power. But experienced listeners agree that when "conditions" are favorable to Africa, *Radio Tanzania-Zanzibar*'s 10-kilowatt transmissions in Swahili may be heard around 0330 GMT.

For the Record. If the well-known Guinness Book of World Records included a section on shortwave listening, it might open up new vistas in *Far-Out DXing.*

The world's highest DX? That honor might go to one of a number of SW outlets in La Paz, capital of Bolivia. At two and a half miles above sea level, La Paz is the highest capital city in the world.

A religious station that has found its way into many SWL log books is *La Cruz del Sur, Southern Cross Radio.* From La Paz it broadcasts on 4,875 kHz in the 60-meter band and has been heard in Spanish recently during both the early evening and pre-dawn listening periods.

Or, when it's on the air, which seems to be only every now and again, another La Paz broadcaster, *Radio Altiplano* puts a solid signal into North America on 5,045 kHz.

The most northerly shortwave broadcasting station in the world is the Tromso transmitter of Norway's *Norsk Rikskringkasting.* Tromso's latitude, 69.41 North, is several degrees above the Arctic Circle. The station on 7,240 kHz relays the medium wave domestic programs to Norwegian seamen and fishermen in the icy northern waters. You may find it signing on at 0500 GMT.

At the other extreme there's Antarctica and the South Pole. That is not only as far south as you can go, but it's also the coldest place on earth. In 1960. the thermometer sank to 126 below at Vostok, the Soviet Antarctic station.

There are no programs as such broadcast from Antarctica. So who'd listen? An audience of penguins? But several nations which maintain scientific research bases on the coldest continent have communications transmissions which can be heard by DXers.

Among the most commonly heard with communications traffic, usually in single sideband (SSB) transmission mode, are *NGD*, the U.S. Navy's station at McMurdo Sound (which sometimes identifies as *"Operation Deepfreeze"*) and *VNJ*, a five-kilowatt transmitter at Australia's Casey Base.

There is a regular traffic link by radio between New Zealand and that country's Antarctic station at Scott Base. The Russian's frigid Vostok is reported to use communications frequencies of 8,300 kHz, 10,830 kHz, and other channels.

The ultimate in southerly reception would have to be logging *NPX*, a U.S. Navy SSB station on 11,255 kHz. Its location is South Pole Station.

e/e FAR-OUT DX

This is Way Out. There may be many opinions as to what constitutes far-out DXing. But a prime candidate for top honors as the farthest of far-out DX has to be a shortwaver called *Ecos de Puerto Martinez*. A river, the Atrato, rises on the slopes of the South American Andes and flows through the jungles of Colombia to the Caribbean. In the wilds, nearly 200 miles upstream, is a settlement, in Spanish, a "pueblito," known as Puerto Martinez. It can be reached only by boat or canoe and is so tiny it can't be found on most maps.

Yet here is one of the world's strangest little radio stations. *Ecos de Puerto Martinez* is primitive. It lacks even a tape recorder and its home-brew transmitter pops along at something under 100 watts. Its absentee owner, one Oswaldo Martinez Chaverra, lives in Quibdo, a town 80 miles away by river, but he has given a crash course in broadcasting to three non-technical types at Puerto Martinez and they handle the day-to-day operations.

Ecos de Puerto Martinez is a non-commercial, non-profit station, apparently something of a hobby for Sr. Martinez, designed to serve the back-country population of the remote area.

It is a good bet that no other Latin American station is located in such a small, out-of-the-way spot. And few stations running so little power have been heard in North America. Still, on occasion, *Ecos de Puerto Martinez* has been logged with fairly good signals on 5,568 kHz by American SWLs. Now that's really far-out DXing! ■

Some far-out QSL cards include Radio Euzkadi, Radio La Cruz del Sur, and Radio Luz y Vida.

FAR-OUT DX TUNING-IN DATA

Station	Location	Freq. (kHz)	Time (GMT)
ODD PROGRAMMING			
Radio Euzkadi "Voice of the Basque Underground"	Believed to be in South America	13,200-13,300 (varies)	1830, 1930 2030
Canadian Bc. Corp. "Northern Service"	Montreal, Canada	5,960 11,720	0000-0400 1200
NEVER-NEVER LANDS			
Em. Reg. dos Acores	Ponta Delgada, Azores	4,865	2200-2300
Lhasa Bc. Station	Lhasa, Tibet	9,490	Around dawn
OFF-BEAT BEATS			
Radio Cairo	Cairo, Egypt	9,475, 9,805 15,065	Afternoons, evenings 1530
Radio Lebanon	Beirut, Lebanon	11,965, 15,210	0200, 2000
Radio Jordan	Amman, Jordan	11,810	1800, 2000
Radio Kuwait	Kuwait	15,415	Afternoons
Radio Luz y Vida	Loja, Ecuador	4,825	0400
Radio Progreso	Piura, Peru	5,060	0500
ALPHABET DX			
Radio Afghanistan	Kabul, Afghanistan	4,775 15,195	1300 Various times including 1200
Radio Tanzania-Zanzibar	Zanzibar	3,339	0330
THE OUTER LIMITS			
Radio La Cruz del Sur	La Paz, Bolivia	4,875	1030, 0230
Radio Altiplano	La Paz, Bolivia	5,045	0400 (Irregularly)
Norsk Rikskringkasting	Tromso, Norway	7,240	0500
NGD, U.S. Navy	McMurdo Sound, Antarctica	11,255	Hours of Darkness
VNJ, Australian Station	Casey Base, Antarctica	9,940	Hours of Darkness
Ecos de Pto. Martinez	Pto. Martinez, Colombia	5,568	0200 (Irregularly)

Power amplifiers of the future! Build one now...

CLASS "D" PULSE POWER

by Charles Rakes

YOU PROBABLY KNOW that integrated circuit technology is sweeping "digital" electronics techniques into every phase of our technical lives. There are the digital computers, digital circuits in calculators, digital integrated circuits in cars monitoring your seat belt latch, there's even a digital readout kitchen range!

And now there's a digital audio amplifier; one that processes the sound in pulse amplifier circuits similar to those found in digital computers. Not the same, of course, but similar. In fact, there is now a 250-watt-per-channel stereo amplifier using digital amplifier circuits that weighs, without cabinet frills, just about ten pounds. With cabinet frills, including power supply, it's just 24 pounds. You can expect a conventional "analog" amplifier of equal power to weigh nearly 100 pounds.

Why, you may be thinking, if it's so great, aren't all amplifiers made this way? The answer for us is simple enough. It takes time. There will probably be a big switch some day; but right now an equivalent digital amplifier requires a whole new ball game for manufacturers—tough new designs, new packaging, and new circuits on new printed circuit boards. So what we've done for e/e readers is to take standard "off the shelf" parts and put together a hobbyist's low power digital amplifier. It's useful for boosting mini power portables to a respectable sound level, or just for experimenting with new ideas. This is an amplifier that operates completely differently from anything you've ever laid eyes on.

What You See is not what you hear. Fig. 1 illustrates what is present at the speaker's voice coil without an input signal to the amplifier. Since both positive-going and negative-going elements of the waveform are equal, no sound is heard. With a mike or other audio signal feeding the the amplifier input, the output will look something like the drawing in Fig. 2. Still not much help? Okay, move on to the expanded graph in Fig. 3. The top signal in this drawing represents a sine wave signal feeding the input of the amplifier. The second signal is the one present across the speaker coil, and the bottom waveform is not seen on the scope, but is what the speaker produces to give an audio sound similar to the input sine wave signal.

A close look at the drawing will show that the upper portion of the sine wave input signal corresponds to the *wide* pulses at the output of the amplifier, and the lower part of the sine wave to the *narrow* signal pulses, but the *frequency* of the square wave remains the same at all times. The speaker responds to the output waveform by seeing the high-frequency square wave as a power source which varies in step with the input audio signal but, of course, at a much greater power level.

How Our Circuit Operates. IC1 operates as a high frequency generator (about 25 kHz) to supply a constant frequency drive pulse to the clock input of IC2, which is connected in a pulse width modulator (PWM) circuit. The audio signal is fed into the modulator input at pin 5 from the mike pre-amp, IC3, or directly through the optional hi-/lo-level switch from a small portable transistor radio.

The pulse output from IC2 is coupled to the base of Q1 through limiting resistor R10 and speed-up capacitor C7. The output of Q1 is connected to the bases of Q2 and Q3, the power output transistors. Audio output power is

It costs no more in battery power to crank the gain wide open. If portable sound is your bag, try hi-efficiency pulse power!

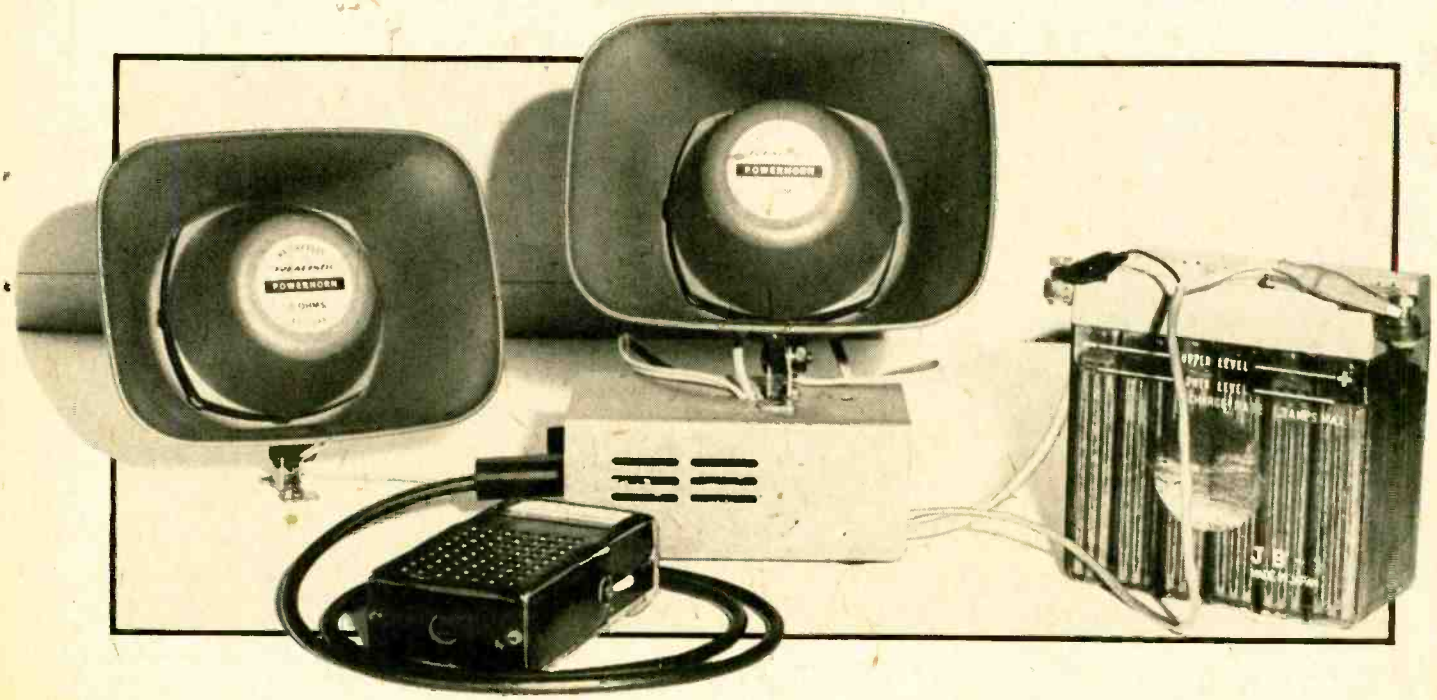


Fig. 1

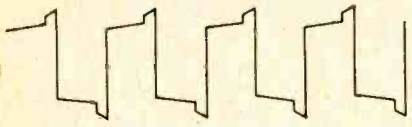


Fig. 2

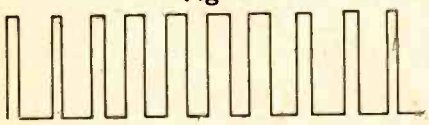
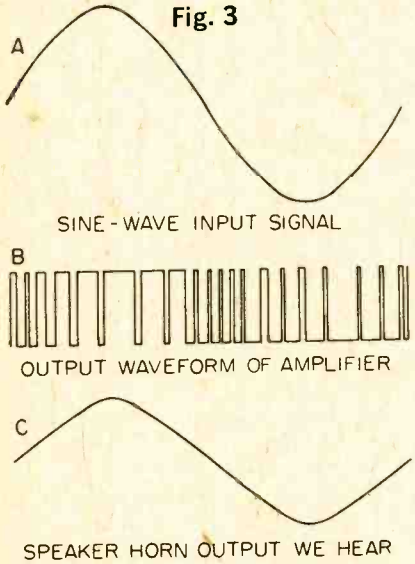


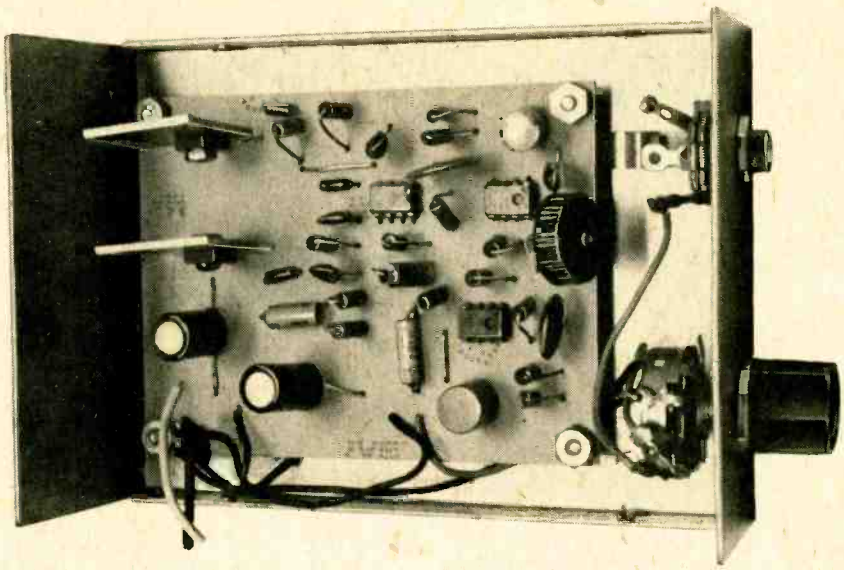
Fig. 3



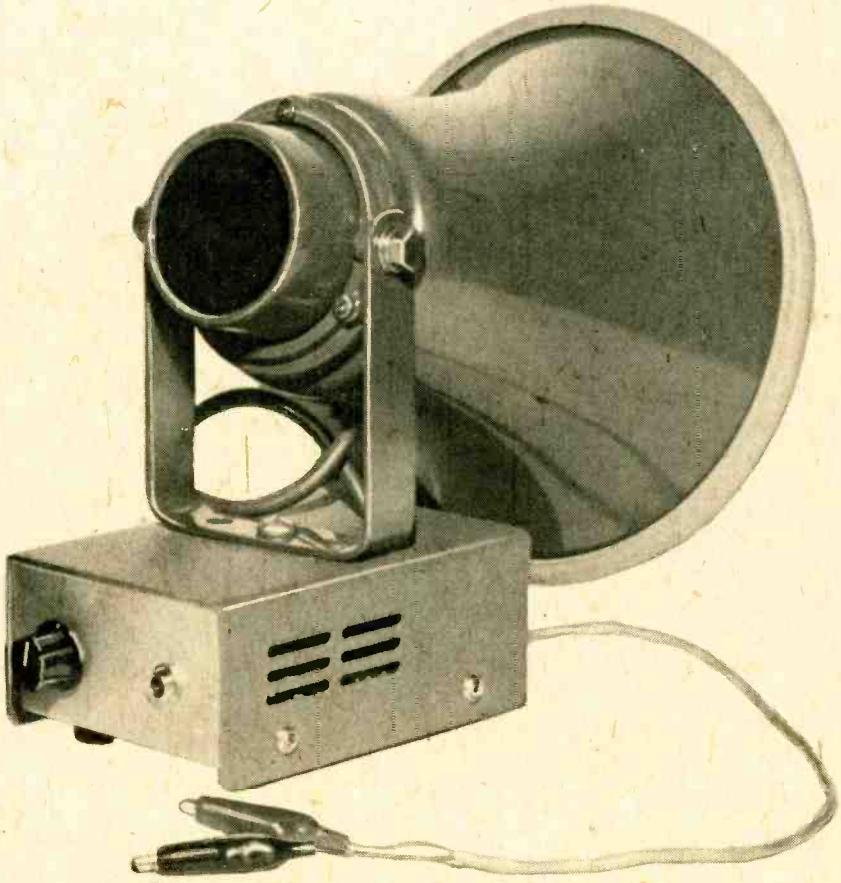
coupled from the emitters of Q2 and Q3 through coupling capacitor C12 to the speaker. Capacitor C13 supplies a feedback path to help keep the amplifier stable.

Construction. When building the amplifier, the simplest method is to construct the circuit on a printed circuit board. This approach will help eliminate any high-frequency pulse coupling troubles or simple wiring errors. Our amp is housed in a metal utility cabinet that measures 4-in. deep x 2⅜-in. high x 5⅞-in. long. The volume control and mike input are located at one end. A speaker horn can be mounted to the top of the two-piece cabinet. Incidentally, since power output increases with a decrease in speaker impedance, you can connect two 8-ohm speakers in parallel for added efficiency.

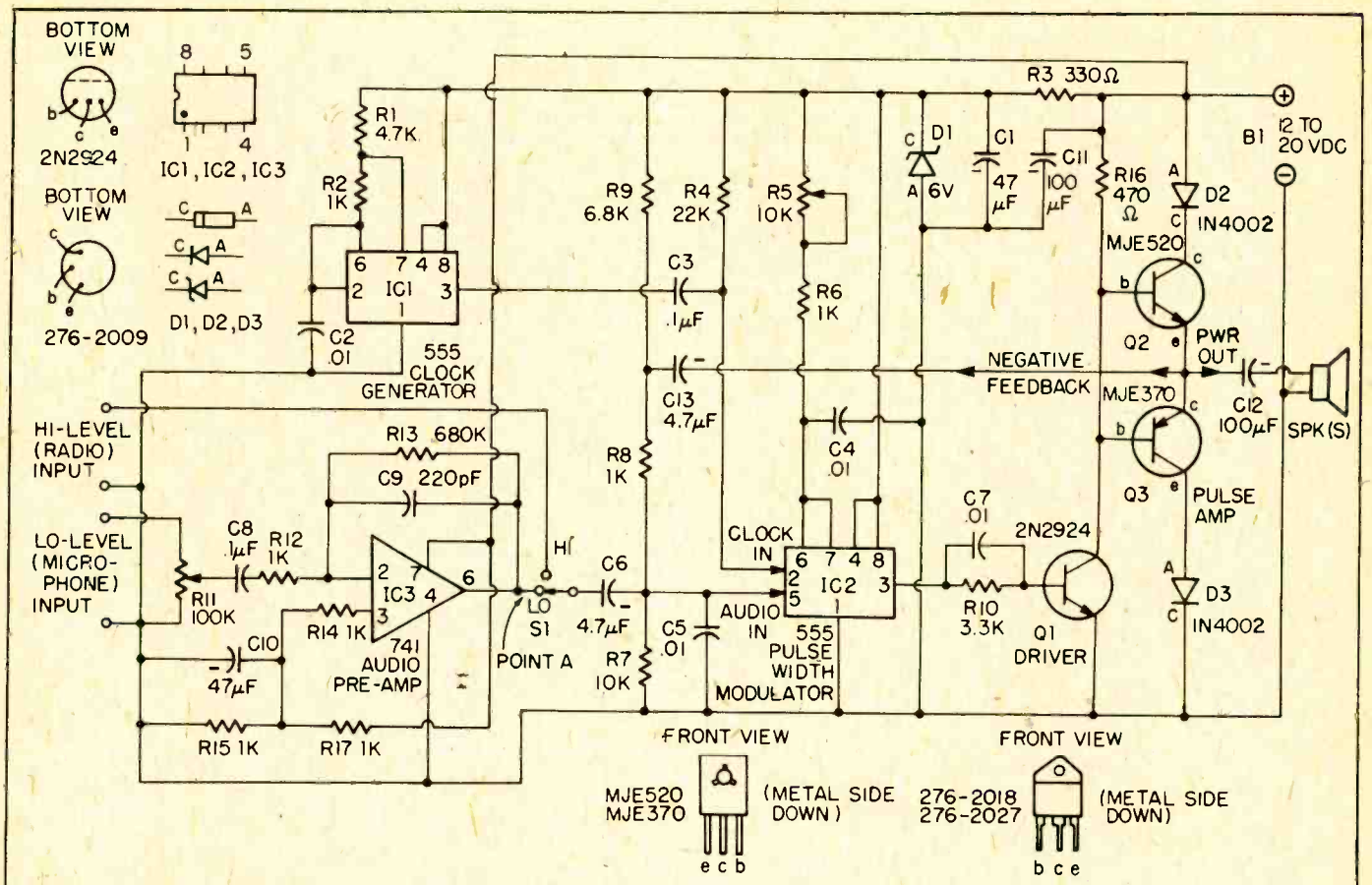
Making It Talk. If you have an oscilloscope available, use the following set-up method. Set R5 to its center position and connect the vertical input of the scope to pin 3 of IC2. Set the horizontal sweep rate to 10 *u*S per division (or 0.1 mS total sweep). Adjust R5 until the waveform is equal in both halves (a perfect square waveform). If the adjustment of R5 is too far off, the audio will



The minus power lead, speaker common lead, and PC board "common" all connect to a solder lug mounted to the case or PC board mounting assembly as shown here.



Suggested operating configuration when IC microphone pre-amp circuit is included. This is a 15-watt horn, but less expensive, lower power units will be well within the amplifier power output potential which is about 4 watts with a 20-volt DC supply.



PARTS LIST FOR PULSE POWER

B1—12 to 20 volt DC power supply
Note—For 12 volt portable operation you can use eight "C" or "D" size dry cell batteries in series or a "motorcycle" wet cell with charger as shown in the photo.
C1, C10*—47 uF electrolytic capacitor, 10 to 35 VDC (Radio Shack 272-954 or equiv.)
C2, C4, C5, C7—0.01 uF capacitor 100 VDC or better (Radio Shack 272-1065 or equiv.)
C3, C8*—0.1 uF capacitor 100 VDC or better (Radio Shack 272-1069 or equiv.)
C6, C13—4.7 uF electrolytic capacitor, 16 to 35 VDC (Radio Shack 272-1001 or equiv.)
C9*—220 pF disc capacitor (Radio Shack 272-124 or equiv.)
C11, C12—100 uF electrolytic capacitor, 50 VDC (Radio Shack 272-1044 or equiv.)
D1—6 volt, ½-watt zener diode (Radio Shack 276-621 or equiv.)
D2, D3—IN4002 1 amp silicon diode (Radio Shack 276-1101 or equiv.)
IC1, IC2—555-type timer (Radio Shack 276-1723 or equiv.)
IC3*—741-type operational amplifier, 8-lead mini dip package for PC board use (Radio Shack 276-007 or equiv.)
Q1—2N2924 npn transistor (Radio Shack 276-2009 or equiv.)
Q2—MJE520 Motorola npn power transistor (Radio Shack 276-2018 or equiv.)
Q3—MJE370 Motorola pnp power transistor (Radio Shack 276-2027 or equiv.)
R1—4700-ohm, ½-watt resistor (Radio Shack 271-000 or equiv.)
R2, R6, R8, R12*, **R14***, **R15***, **R17***—1000-ohm, ½-watt resistor (Radio Shack 271-000 or equiv.)
R3—330-ohm, ½-watt resistor (Radio Shack 271-000 or equiv.)
R4—22,000-ohm, ½-watt resistor (Radio Shack 271-000 or equiv.)
R5—10,000-ohm potentiometer for PC board (Radio Shack 271-218 or equiv.)
R7—10,000-ohm, ½-watt resistor (Radio Shack 271-000 or equiv.)
R9—6800-ohm, ½-watt resistor (Radio Shack 271-000 or equiv.)
R10—3300-ohm, ½-watt resistor (Radio Shack 271-000 or equiv.)
R11*—100,000-ohm potentiometer, audio taper (VOLUME) (Radio Shack 271-1722 or equiv.)
R13—680,000-ohm, ½-watt resistor (Radio Shack 271-000 or equiv.)
R16—470-ohm, ½-watt resistor (Radio Shack 271-000 or equiv.)
S1*—spdt toggle switch for optional hi-/lo-level input (Radio Shack 275-603 or equiv.)
Misc.—microphone input jack, radio input jack, small trumpet speaker or "outdoor" speaker(s) such as Radio Shack 40-1244, metal case about 4 x 3 x 6-in. deep (Radio Shack 270-252 or equiv.), knob, wire, solder, etc.

*Note—For hi-level (radio) input only, eliminate C8, C9, C10, IC3, R11, R12, R14, R15, R17, and S1.

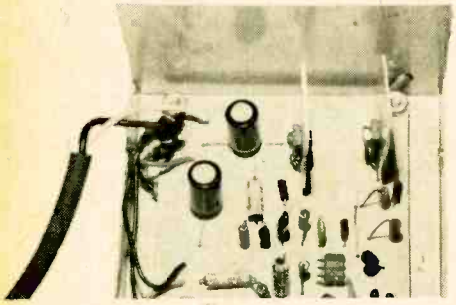
An etched and drilled printed circuit board for this project is available from Krystal Kits, P.O. Box 445, Bentonville, AR 72712 for $3.95 postpaid. Postal money order will speed delivery. Otherwise allow 6 to 8 weeks for delivery. Canadians add $1.50 for additional postage.

be distorted on peaks. If an oscilloscope is not handy, connect a DC voltmeter to the emitters of Q2 and Q3 and set R5 for a voltage equal to one half the supply voltage.

If the amplifier is to be used as a mini PA amplifier, nearly any dynamic or crystal mike will work, and a 12-volt battery pack makes an ideal power source. For greater audio output a power supply of 20 volts is the best choice—either battery or AC pack. Also, a metal speaker horn or an outdoor-type speaker should be used for this amplifier—a paper cone speaker is usually taboo since "birdies" caused by beats of the 25-kHz clock frequency might be heard.

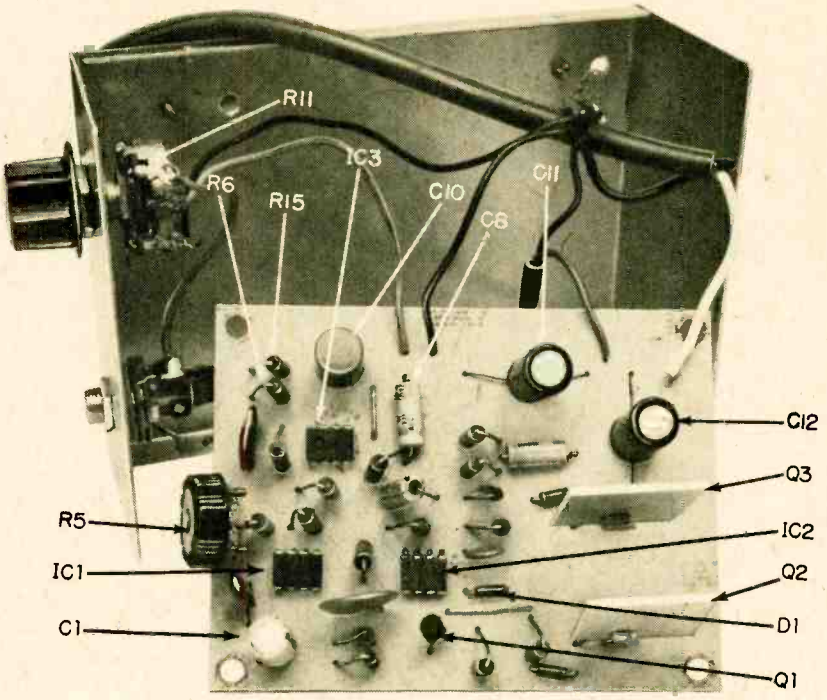
More Info. Until now, virtually all entertainment electronics—TV, radio, hi-fi—have employed "analog" circuits: transistors and tubes that amplify and control *continuous* signals. Of course, class D circuits (as they are called) have been used in military and industrial high power applications for some years. However, class D circuitry is a new principle in amplifying moderate-power audio signals. Instead of using transistors as ordinary analog amplifiers (as everyone else does), the transistor is used as a switch: either it's on or it's off. Audio inputs to this amplifier are converted to pulses of varying widths that switch the output transistors on and off in excess of 25,000 times a second.

e/e PULSE POWER

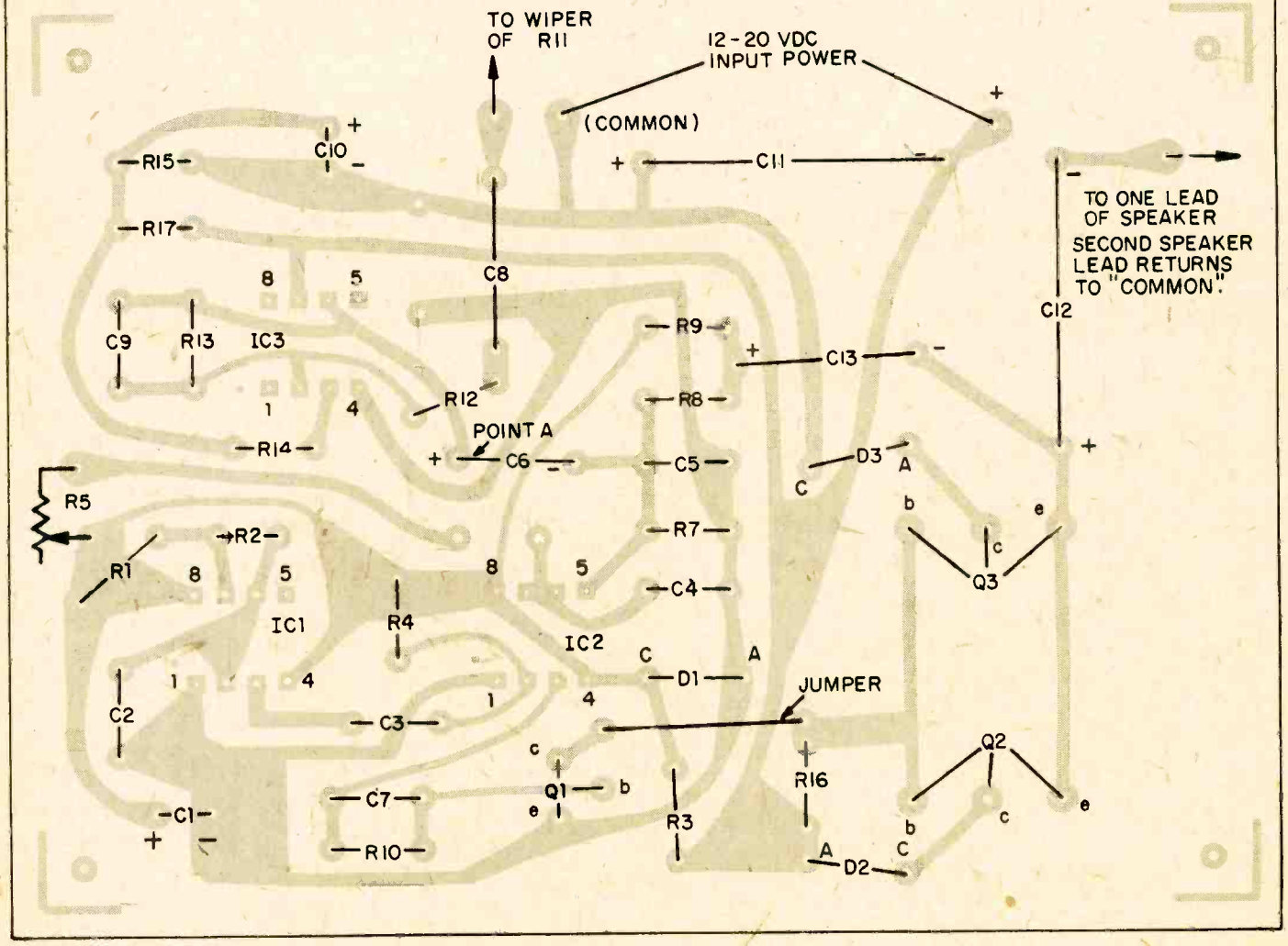


Power switching transistors Q2 and Q3 get slightly warm when operating at maximum supply voltage due, primarily, to the high 25-kHz switching frequency. Such transistors become less efficient as their maximum operating frequency is approached. A small heat sink made from a piece of aluminum which is fastened to the metal side of a transistor will serve adequately to cool the transistors.

(Continued on page 90)



This X-ray view shows where to place parts on the circuit board. The view is of the top of the PC board where all parts but R11 fit.



by Kathi Martin, KGK3916

Kathi's CB Carousel

☐ What do you do after you have improved your product to the point where no further technical advancements can be incorporated while retaining a competitive price? A farfetched thought, you say? Not in the least, for this is the very problem faced by our CB equipment manufacturers. They have indeed reached the virtual limit of performance at popular prices. The equipment is, generally speaking, excellent, and any further technological improvement would require a price only the oil barons could afford.

But the marketplace requires new models periodically, for that's what the consumer has come to expect. (It also hurts to pay an inflated price for "last year's" transceiver.) Well, if you can't improve what is already excellent, the next best thing is to start adding operating conveniences to the basic high-quality transceiver package; and operating conveniences are "what's new" in CB.

The Midland 13-883 Citizens Band transceiver is from Midland Electronics Company, P.O. Box 19032, Kansas City, MO 64141 and is priced at $199.95. Circle No. 60 on the Reader Service Page for more information.

But there are operating conveniences and operating conveniences! Some are worthless and some are winners. A good example of how to upgrade equipment with *important* features is the Midland 13-883 AM mobile/PA transceiver.

Inside And Out. The basic 13-883 package has a double-conversion receiver with a ceramic filter in the second IF amplifier. Full-23 channel coverage is provided through a frequency synthesizer. The power supply is 12 VDC with either a positive or negative ground. The unit is housed in a cabinet 7-in. wide x 2⅓-in. high x 8⅔-in. deep. Typical "extra" features include CB or PA operation, a noise blanker, and a combination S/RF-output meter. The rig is normally supplied with a plug-in microphone, a mobile bracket, DC power cables and all crystals.

All this by itself is typical of a high performance AM transceiver, but there's more to come.

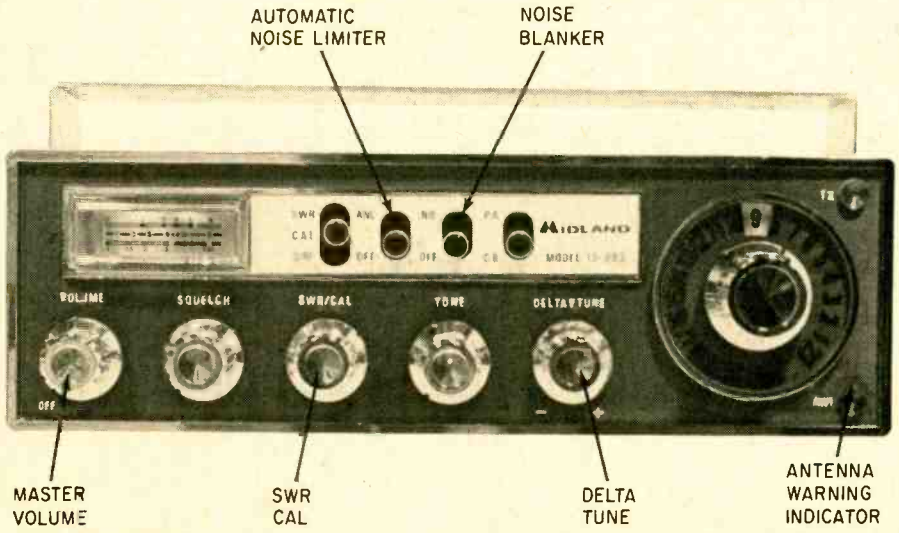
First, there's a volume control for the receiver mounted directly on the microphone—a feature I find particularly attractive for mobile-in-motion. As you can see from the photograph, the microphone has a small "control" mounted in one corner of the microphone's case. This control is a sub-master volume control; if the volume control on the transceiver itself is turned full-open, total-range volume control is provided by the sub-master at the user's fingertips. Of course, the master volume control on the transceiver itself could be set to a mid-volume position, but then the sub-master can provide a range only from *off* to the maximum volume allowed by the master volume control.

If you consider that the average mobile transceiver is mounted approximately in the center of the under-dash, you can understand why I consider the remote sub-master volume control so important. Instead of having to lean across the seat to adjust the volume while driving, the CBer need only flick the index finger holding the mike to adjust the volume level.

More. Another extra feature of the 13-883 is a treble-cut tone control. Even the best of noise limiters and blankers pass some type of fatiguing background, which consists primarily of high frequency noise. The tone control can be used to further attenuate the noise while having little effect on the received signal. At most, it will make the signal sound slightly bassy.

Moving on we find the combination S/RF-output meter does triple duty as an SWR meter. A selector switch on the front panel sets up the meter for S/RF, SWR calibrate, and SWR reading. The SWR calibrate control is on the front panel. Normally, the SWR meter is an important aid both in setting up the transceiver/antenna installation and in maintaining antenna system performance—at least you'll know for certain whether the antenna system is working properly. But the Midland 13-883 goes one step further. In the lower right corner there is a small indicator lamp labled AWI for antenna warning indicator. This lamp is controlled by the SWR meter operating voltage. If the antenna

(Continued on page 68)



All functions are right up front on the panel, even the SWR calibrate control. The single meter does triple-duty for received signal strength, RF output, and SWR. The small lamp in the lower right hand corner labled AWI goes on if the SWR rises well above a normal operating value.

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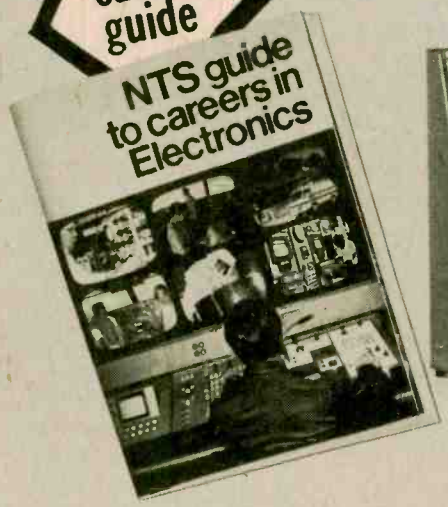

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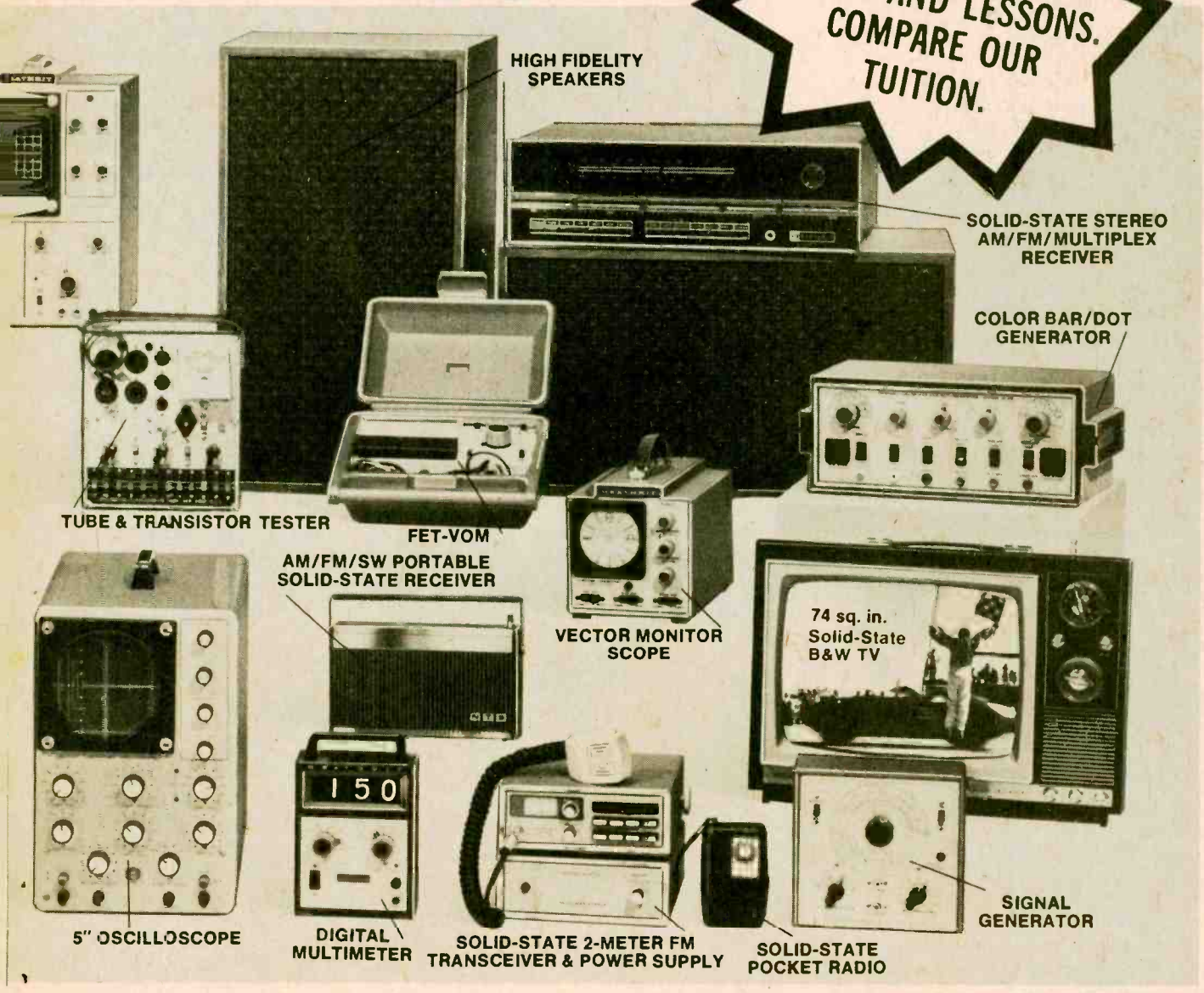

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KATHI'S CAROUSEL

(Continued from page 63)

system should open, or if the SWR should increase well above the normal SWR range, the lamp goes on to instantly alert the operator that something's wrong. Intermittent failure of the antenna system connections, a common problem in mobile installations, would cause the AWI to blink.

And yet another extra is delta tuning, which provides ±1.5 kHz each side of the "center channel" tuning of the channel selector. A while back, many AM transceivers had delta or some similar form or variation of fine tuning. But with inflation this feature has been moved to, generally, the gold-plated AM and the SSB rigs. It's good to have delta tuning back in a transceiver.

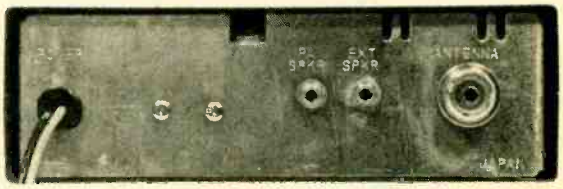
On The Bench. Getting into the actual performance of the Midland 13-883 was our next task; here's how it shaped up. The receiver sensitivity measured 0.9 *u*V for 10 dB (S+N)/N. The AGC action for an input signal range of 2 to 10,000 *u*V was 8 dB; not outstanding for solid state, but not poor either. The selectivity was 40 dB. Actually, it is considerably greater than 40 dB as far as the important adjacent channel rejection is concerned, but 40 dB produces receiver "desensitization," and I consider the selectivity rating the worse-case of the two.

Highlight feature of the Midland 13-883 is the sub-master volume control built right into the microphone, allowing easy adjusment of the received signal's volume level.

The image rejection checked out at 40 dB. The S-meter is calibrated to indicate S9 with a 30 *u*V signal at the antenna terminals. The meter calibrations are relative at other S-values.

The transmitter delivered 3.2 watts RF output to a 50-ohm dummy load. The modulator's overall gain is very sensitive and a −38 dB microphone input level was all it needed for 100 percent modulation (−25 dB is average sensitivity). However, the transmitter is not limited to 100 percent modulation and an excessively loud voice level produces considerable distortion—so speak low.

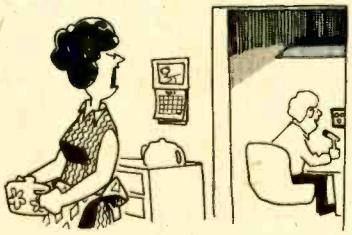
The Midland 13-883 is priced at $199.95. For additional information circle No. 60 on the Reader Service Coupon. ■



The usual exciting rear view, folks! Made to be functional, not cute. Two-wire power cord, PA and EXT speaker jacks, and standard antenna jack round out the goodies.

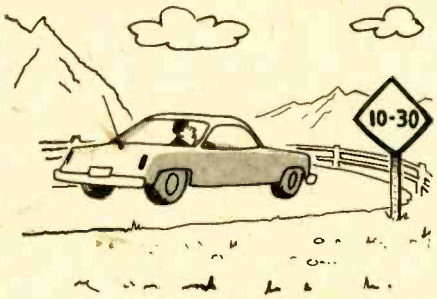
THE CALL OF THE 10-CODE

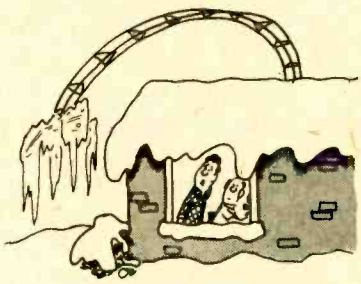
by Jack Schmidt



"For the last time, 10-3! Dinner is ready."

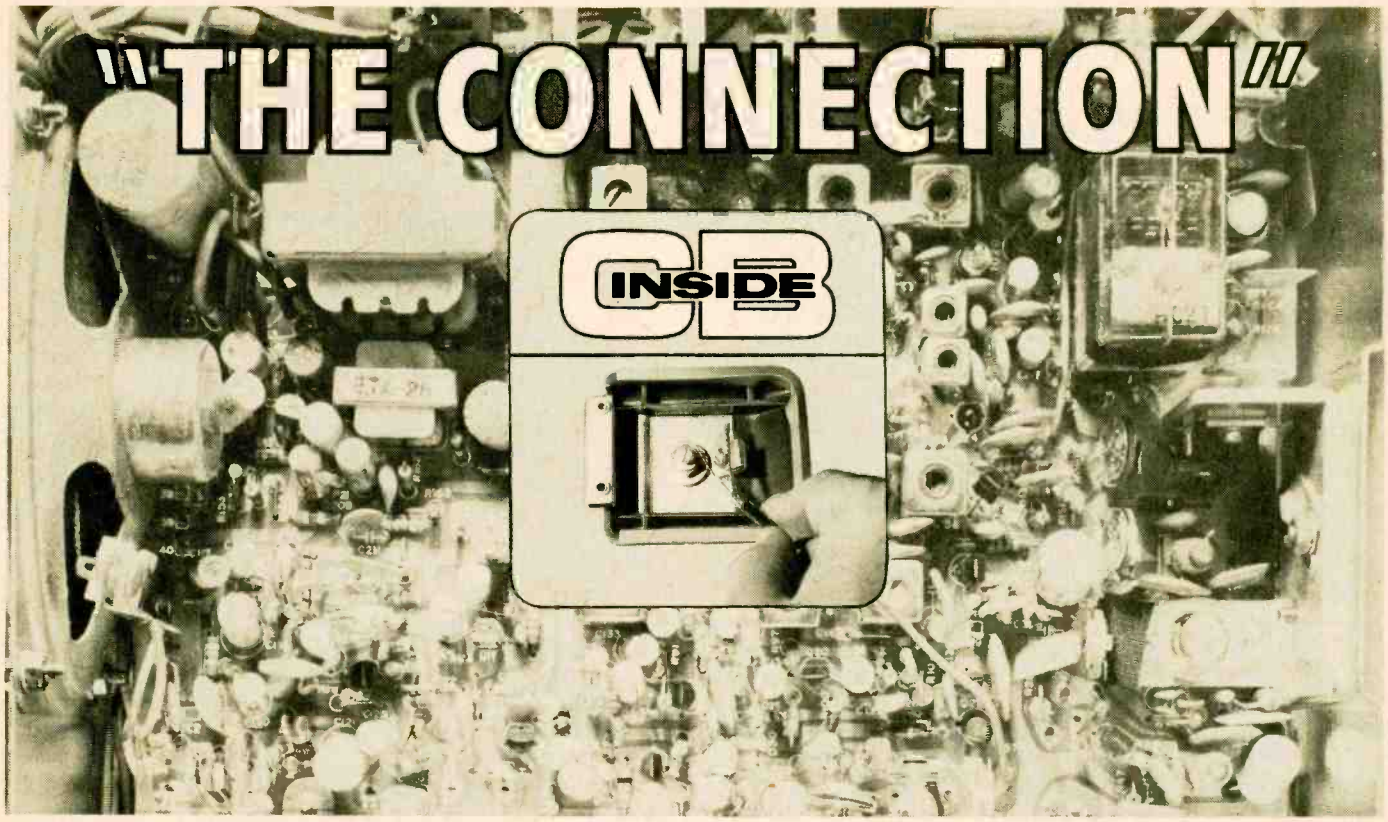
"... change my 10-26 ..."





"... guess that explains all those 10-1's!"

10-Code Unraveled: 10-1—Unable to hear you, 10-3—Stop transmitting, 10-6—Busy, 10-8—In service, 10-26—Detaining subject, 10-30—Unnecessary use of radio.



Follow these technical antenna tidbits for the most efficient mobile transmission in your area

by the Elementary Electronics Editorial Staff

☐ We've looked at the circuits and features that go into the typical AM and SSB transceivers, and now it's time to put it all together in terms of consistent "10-4" contacts.

First, and most important, you get the most from the transceiver itself by keeping your hands off the innards. Unlike older tube-type transceivers which had user adjustments for RF output tuning and loading, the modern solid-state transceiver has sealed RF output tuning controls—sealed in the sense that they are inside the cabinet and not readily accessible to the user. The reason for this is two-fold. FCC regulations absolutely prohibit anyone except licensed technicians from adjusting frequency-determining circuits, and solid-state circuits are so finicky with regard to tuning that the slightest error can often destroy the RF output transistor(s) or turn the modulation into mush.

Regardless of what you have read to the contrary, the factory tuning for solid-state transceivers is optimum for a 50-ohm antenna system—*you* can't do better, and later we'll show you how to transfer all the RF power output into the antenna system.

Along with sealed adjustments for the final RF amplifier, the modern transceiver also has sealed "control" circuits. The transmit-receive relay is no longer an open frame construction which permits so-called cleaning of the relay contacts. Modern relays have plastic dust covers and any service you attempt on the contacts is certain to cause damage. Similarly, except for the few transceivers that permit the user to plug in specific crystals, crystals are generally soldered into the circuit. Even where the crystal is the plug-in type, removing and re-inserting the crystal does not clean anything; more than likely it will loosen the crystal socket's spring contacts, causing intermittent failure when the transceiver is subjected to vibration—such as in a mobile installation. In short, other than for a major repair, there is no reason to remove a transceiver from its cabinet.

Pack It In. The first step in equipment installation is to install the transceiver—and there's no need to go into "keep the rig away from radiators," or "use a firm under-dash mounting." Any place you could mount an ordinary radio is suitable for a CB transceiver. If a mobile transceiver has two power leads—one *positive* and one *negative*—just make certain the negative lead is secured to the car body; if necessary, scrape away any paint that might serve as an insulator and use a lockwasher to secure the wire. There's no need to run the ground lead all the way to the battery. The car's electrical system gets its ground through a ground-strap from the battery, and if it's good enough for the rest of the car, it's good enough for the CB rig. (The positive power can be taken off the ignition switch terminals, the *accessory* fuse block terminal, or even the cigarette lighter power wire.)

If your CB transceiver doesn't have a *negative* power wire it means the ground connection is made through the transceiver's cabinet, so be certain at least one mounting screw between the transceiver and dashboard is free of paint, and use a lockwasher.

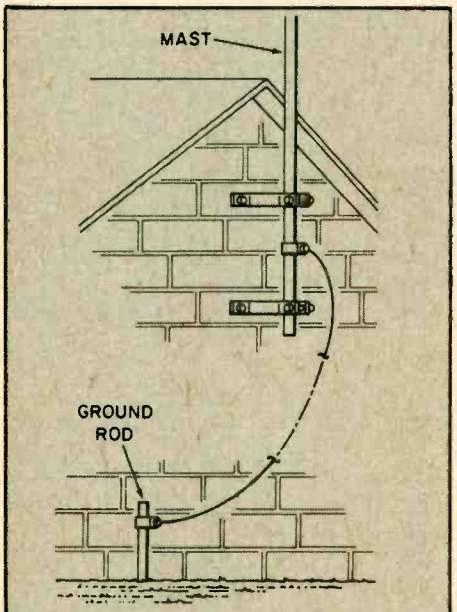
Don't depend on the antenna system coaxial cable *shield* to provide the ground connection. Often, the shield connection works loose at the antenna end and you wind up with a considerable voltage drop through the shield—with resultant intermittent operation or reduced RF power output. (Receivers always seem to work.)

Base Antennas. You've got to work really hard to louse up a base station antenna system. The gain type antenna—greater than ¼ wavelength—is always 50-ohms impedance, as are coaxial antennas and almost all directional beams. A handful of inexpensive ground plane antennas might be somewhat less than 50-ohms impedance, but they're close enough, and we'll show later how to check them out.

All you have to do is secure the antenna to a mast (ordinary TV antenna mast is fine), connect the coaxial cable, tape the cable to the mast at several points so it can't sway in the wind, and run the line down to your rig. For cable runs up to 50 feet, ordinary, inexpensive RG-58-A/U is perfectly satisfactory; the difference in RF losses between RG-58A/U and RG-8U (or some super low-loss coaxial cable) doesn't amount to a flea's whisper up to 50 feet. Actually, there isn't much difference in effective line losses up to 100 feet, but 50 feet is a good limit for the fussy CBer.

Quite often moisture can work its way into an antenna cable connection between the shield and the inner conductor's insulation at the antenna connection, or water can get into a coaxial connector (if your antenna uses one). Not only does the moisture corrode the shield and its connection, it upsets the system's SWR (standing wave ratio). The problem can be avoided by packing the connection with General Electric RTV silicon rubber adhesive. Use only the G.E. product. Some similar adhesives are virtually dead shorts at RF frequencies.

Okay, you've got the antenna up, its coaxial cable is connected at both the antenna and transceiver ends and you're ready for operation. Right? Wrong! The system will work all right but you haven't made provisions for your own safety.



Though few CBers bother to ground their antenna system, for your own safety the supporting mast should be connected through (at least) No. 8 copper wire to a copper rod driven into the ground. TV supply stores generally stock the ground rods. Grounding the antenna system should be standard practice even if it isn't the highest structure in your neighborhood.

Antenna masts should always be grounded with, generally, No. 8 copper wire to a copper ground rod (which you drive into the ground with a hammer). Yes, yes—it's quite true that, (a) the masts for the TV antennas next door aren't grounded and, (b) you have no intention of stringing a ground wire down the side of the house. Neither attitude is correct, but that's the way things usually are. However, keep in mind that the new FCC regulations permit antenna heights to 60 feet for some CB antenna types (non-directional). If you use a tower or a high mast your CB antenna is probably going to be the highest point in your neighborhood, and you know what lightning usually seeks out . . . the highest point, or easiest path, to ground. If your CB antenna is king of the hill, it had better have a ground!

For those still too stubborn to go through the grounding procedure, there should be at the very least a solid (No. 8 copper wire) ground between the metal transceiver cabinet and a water pipe. A device known as a "blitz-bug," which connects between the coaxial cable and the transceiver's antenna jack, also provides lightning protection as well as a "bleed" for high electric charges that might build up during an electrical storm. The device provides a ground for the coaxial shield (and transceiver cabinet) as well as a "spark gap" for the cable's center conductor.

Mobile Antennas. Now here's something that can often create enough problems to drive the strongest person up the wall. The average full length whip antenna (108 inches) mounted on the rear bumper or fender usually has an impedance of 25 to 35 ohms, not 50 ohms. The shorter "loaded" whips, such as used in the center of the roof, often have a matching coil as part of the antenna which provides the 50-ohm matching impedance.

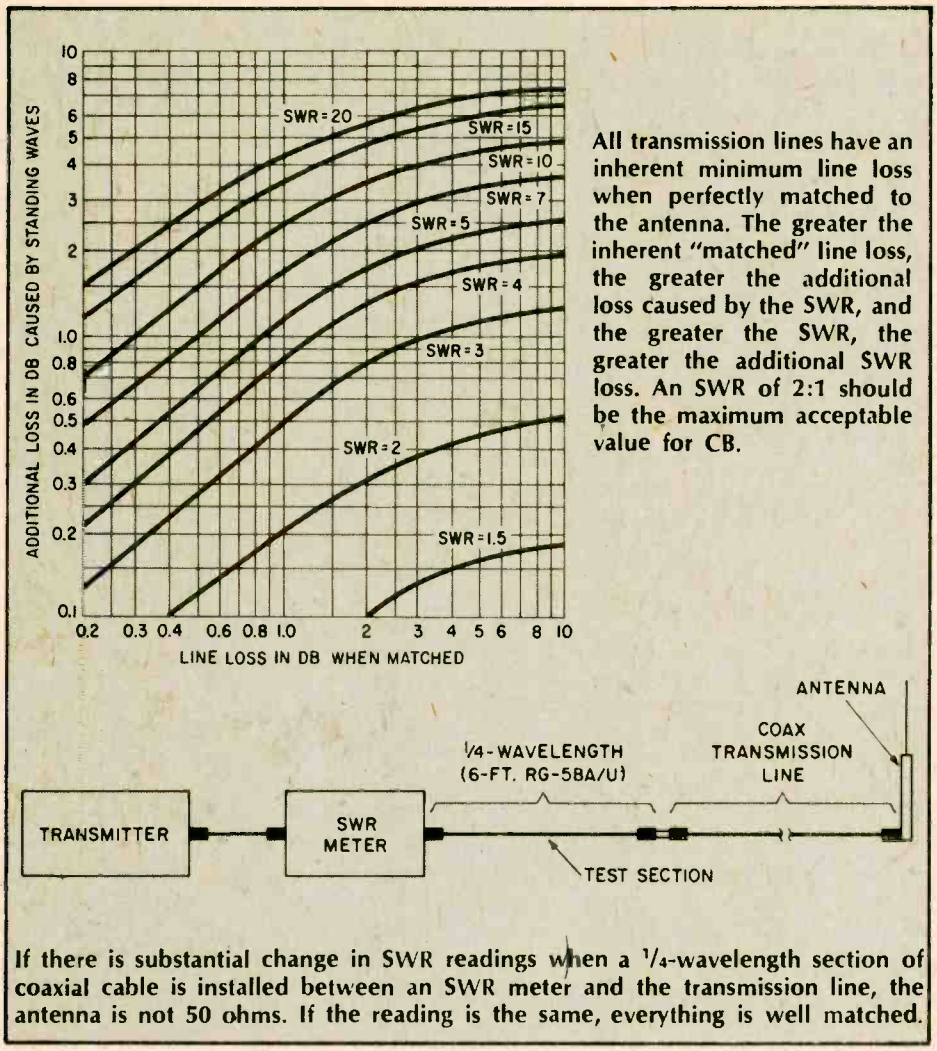
Here's another rub: a 50-ohm antenna might not be 50 ohms where you decide it should be installed. Regardless of the actual or rated impedance, maximum power transfer from the transmitter occurs if a ½-wavelength matching section of coaxial cable is used between the transmitter and your mobile antenna. For RG-58A/U cable, a ½-wavelength at the CB frequencies is 12 feet. Without getting too technical, the matching section is needed because, should there be a mismatch between the transmitter output and antenna (as there would be if the antenna was anything other than 50 ohms), the SWR factor could cause the impedance looking into the transmission line to be considerably beyond the value into which the transmitter could efficiently transfer its power output. A half-wavelength transmission line (or a multiple of a half-wavelength) acts as a *repeater* transformer which transfers, at the input to the line, exactly what appears at the output where the antenna is connected. (Excess coaxial cable can be coiled in the trunk.)

Most mobile antennas which employ loading coils (or "matching" coils) are supplied with the appropriate length of matching transmission line. If you make your own antenna, however, from "bits and pieces," or use a full length 108-in. whip with bumper or body mount, make certain your RG-58A/U transmission line is 12 feet.

Getting the Soup Out. The SWR meter is the best and possibly only device available to the CBer which indicates directly whether the power coming from the transmitter is reaching the antenna. (Once it gets to the antenna you can be reasonably certain it's being broadcast to the waiting world.) The SWR meter works on a very simple principle. If all the power coming from the transmitter flows into the antenna, none is reflected back to the transmitter. If the antenna is not the same impedance as the transmission line, all the energy is not absorbed by the antenna; rather, some is reflected back to the transmitter in proportion to the degree of mismatch. The SWR meter indicates this reflected power in terms of SWR (actually, VSWR); in fact, some SWR meters have two calibrations—one in SWR such as 2:1, 3:1, etc., the second in terms of actual forward and reflected power.

Fig. 1 shows how much power you lose through an antenna mismatch. Note that the total loss depends on the original loss in the transmission line; for example, RG-58A/U can have a loss of 3 dB per 100 feet. This means that if your transmitter puts out 4 watts of RF into a perfectly matched antenna system with 100 feet of RG-58A/U, 2 watts *maximum* would actually get to the antenna. But look what happens (Fig. 1) if the SWR is 3:1. You get an additional loss of 1 dB, and under optimum conditions with a 3:1 SWR only 1.6 watts gets to the antenna; and as the SWR increases, less and less power reaches the antenna. It's obvious from Fig. 1 that the SWR should be less than 1.5:1 (2:1 worst-case) if you want essentially all the transmitter's "soup" to get to the antenna.

To check SWR you need only install an SWR meter or "bridge" between the transmitter output and the transmission line as shown in Fig. 2. However, the SWR meter readings are invalid if the



All transmission lines have an inherent minimum line loss when perfectly matched to the antenna. The greater the inherent "matched" line loss, the greater the additional loss caused by the SWR, and the greater the SWR, the greater the additional SWR loss. An SWR of 2:1 should be the maximum acceptable value for CB.

If there is substantial change in SWR readings when a ¼-wavelength section of coaxial cable is installed between an SWR meter and the transmission line, the antenna is not 50 ohms. If the reading is the same, everything is well matched.

transmission line is an exact half-wavelength or multiple because, as we said, a half-wavelength line behaves as a "one to one" matching transformer. You could have a 10:1, 15:1 or 20:1 actual SWR and still get a 1:1 SWR reading with a half-wavelength line. So you must be certain to "break up" or "tune out" a half-wavelength line. This is done by inserting a ¼-wavelength section of transmission line after the SWR meter—the section indicated as "X" in Fig. 2.

Tuning Out. Install coaxial connectors (solderless type is okay) at both ends of a 6-foot section of RG-58A/U. Connect the SWR meter to the transmitter using the smallest length of coaxial cable (6 inches at most). Connect the ¼-wavelength section to the SWR meter and, using a "splice" connector, connect the ¼-wavelength line to the transmission line. Measure the SWR and note the reading. Then remove the ¼-wavelength line and again note the reading. If there is no difference between readings, or very little difference, the meter reading is the SWR. If there is a wide difference between readings, the higher reading is the SWR, or actually *lower* than the true SWR.

If there is no difference in readings and the SWR is less than 1.5:1, you have a great antenna system. If the reading is between 1.5:1 and 2:1 you have a fairly good antenna system. Keep in mind that some directional antennas are optimum at 2:1. If the reading is greater than 2:1 there's something wrong at the antenna if it's a base antenna. If you cannot lower the SWR by "retuning" the antenna try to use a multiple half-wavelength transmission line. Prepare 12 feet of RG-58A/U with solderless connectors at both ends. Install this length between the SWR meter and transmission line. Note the SWR reading. Cut off 3 inches from the ½-wavelength section and again note the SWR. Keep removing 3-inch sections until you have attained the lowest possible SWR. Leave the section in the line, remove the SWR meter and connect the 6-in. SWR connecting cable to the trimmed ½-wavelength section (with a coaxial connector). You will now have a matched antenna system which is optimum for the particular antenna.

Using the ¼-wavelength section, test your mobile installation's SWR. Again, the higher of the two readings more closely approximates the actual antenna match. If your mobile antenna has some form of tuning adjustment, use the transmission line arrangement that gives the highest SWR reading and tune the antenna for minimum SWR. Get it as low as possible and then remove the SWR meter and the ¼-wavelength section so that the transmission line is exactly 12 feet. If you want to keep the SWR meter in the line permanently, measure the distance from the output jack of the SWR meter all the way back to the transmitter's output jack and trim this amount off the coaxial transmission line; the total length of the transmission line, plus the SWR meter, plus the SWR meter's connecting cable to the transmitter should equal 12 feet. If your transmitter has a built in SWR meter forget it; use 12 feet of coaxial cable.

If your mobile antenna cannot be tuned because it is a standard length whip, you might wind up with an SWR as high as 3.5:1, and there is nothing you can easily do to correct it. If the SWR meter shows close to 1.2:1 *with the 12 foot cable* it's as good as you're going to make the system, short of replacing the antenna.

Another Step. Now just because you have attained a low *system* SWR by trimming the coaxial cable to a half-wavelength or its multiple does not mean the transmitter is putting out all

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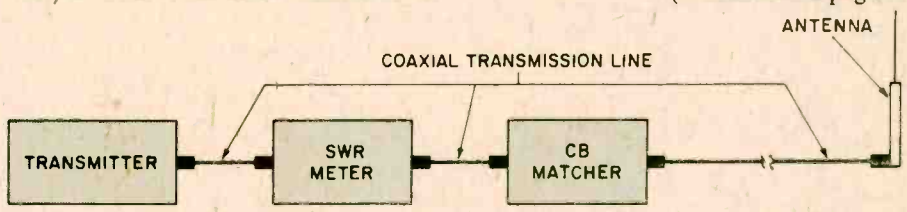


After the antenna system is tuned, this is the correct instrument arrangement for adjusting an antenna tuner (CB matcher). Adjust the matcher for minimum SWR between the transmitter and matcher, coincident with maximum forward power. Best results are attained if the transmission line is 12 feet or an exact multiple of twelve feet such as 24, 36, etc. And remember, a matcher cannot improve what is already an excellent antenna system. All coaxial transmission cable is 50 ohm.

Electro Motive Force Multiplier

Try your voltage multiplier theory this new way!

by Thomas R. Sear

WHEN YOU NEED a power supply for a high voltage, low current application, your best bet is a voltage multiplying type power supply. They are simple. They are inexpensive. And you can develop almost any voltage you want by selecting the transformer used and cascading basic multiplier stages. The only limiting factor is the ratings of the components you can obtain.

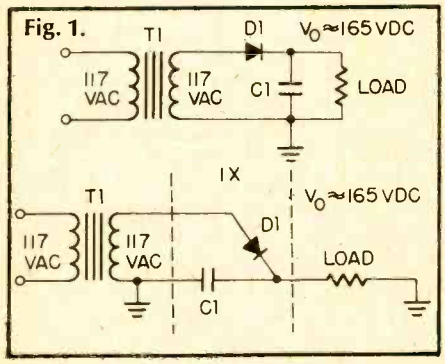
Basically, a voltage multiplier circuit consists of simple, inexpensive diodes and capacitors connected in such a way as to develop a DC output voltage that is some multiple of the peak value of the input voltage. Only one diode and one capacitor are required for each time you want to multiply the voltage. As a safety factor, a transformer should be used to isolate the power supply from the line voltage. But part of the beauty of using voltage multipliers to obtain high voltage is that you don't have to begin with an expensive high voltage transformer.

How It Works. Voltage multiplier circuits will operate with any type of waveform as the input. The only factor that might be considered is the switching time of the diodes used. The rise time and fall time of the input signal must be slower than the time that the diodes require to reverse conduction—sort of like the frequency response of an amplifier. However, since most power supplies operate from 60-Hz power, this factor will not affect most experimenters. The reason the frequency of the input is interesting is because the ripple content of the power supply output can be reduced by operating the circuit at a higher frequency.

Referring to Fig. 1, note that the basic voltage multiplier circuit is none other than our old friend the humble half-wave power supply. This simple circuit forms the basis for a complete family of voltage multiplying circuits, and is shown both in the standard schematic format and a simplified form that will facilitate the development of additional multiplier circuits.

The standard half-wave power supply.

Fig. 1.



With little or no current required from this power supply, the value of the DC output voltage will approach the peak value of the AC input voltage. For example, if T1 were simply an isolation transformer, with primary and secondary voltages of 117 Vrms, the theoretical DC output from a half-wave power supply would be 1.414 x 117, or about 165.4 VDC.

In practice, because of circuit losses, the actual output voltage will decrease as more current is required from the circuit. We will discuss how to estimate the output voltage of a given circuit shortly.

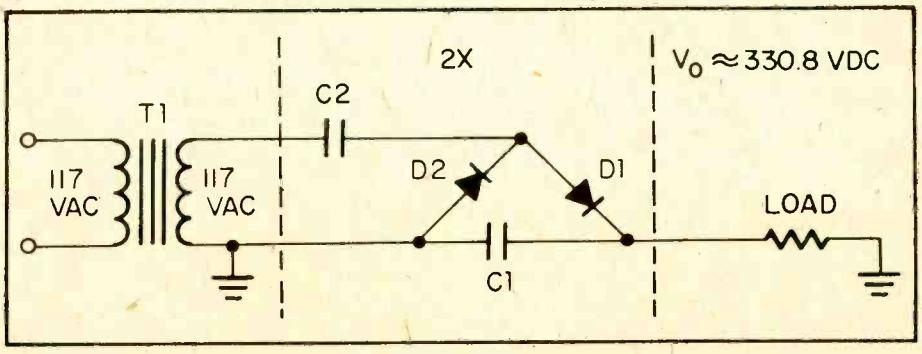
Double Up. By adding a second diode and capacitor combination to the basic half-wave circuit, as shown in Fig. 2, it becomes a voltage doubler circuit—effectively multiplying the peak value of the input voltage by two. Notice that the new diode, D2, and capacitor, C2, are connected in series (cascade) with the original diode, D1, and capacitor, C1, and are between them and the transformer, T1.

The circuits shown in Figs. 1 and 2 are the basis of all voltage multiplication. The voltage tripler circuit shown in Fig. 3 is merely the doubler circuit shown in Fig. 2 connected in cascade with the half-wave circuit shown in Fig. 1. Likewise, the quadrupler circuit shown in Fig. 4 is simply two doubler stages connected in cascade. To multiply a voltage five times just cascade two doubler circuits with a half-wave circuit. To multiply a voltage six times just cascade three doubler circuits. And so on. As most things are, it is simple once you see the patterns involved.

The Fog Lifts! Notice the basic pattern that forms voltage multiplier circuitry. Beginning with the half-wave circuit shown in Fig. 1, and moving from the load toward the transformer, each additional stage of multiplication is simply a diode and a capacitor connected as follows: The diode that is being added to the circuit has its cathode connected to the anode of the previous diode, and its anode connected to the "opposite" side of the circuit; the capacitor being added is connected to the anode of the previous diode on one end, and to the transformer at the other end. Notice also that the capacitors being added alternate from one side of the circuit to the other.

This basic pattern can be continued until the input voltage has been multiplied as many times as desired. The ultimate value will, of course, depend upon the voltage ratings of available components.

Fig. 2. Basic voltage doubler circuit.



Component Ratings. When building voltage multiplier circuits there is one basic rule to follow: *all* components should be rated for at least *two times* the peak value of the input voltage. For example, if the secondary voltage of T1 is 200 Vrms, the peak-inverse voltage (PIV) of all diodes and the working voltage (WVDC) of all capacitors should be at least 1.414 x 200 x 2, or 566 volts. Most transformers will satisfy your requirements as built, but it is always good practice to verify the voltage rating of the windings to preclude problems.

At voltage values of 1000 volts or more, special consideration should be given to wiring insulation and physical

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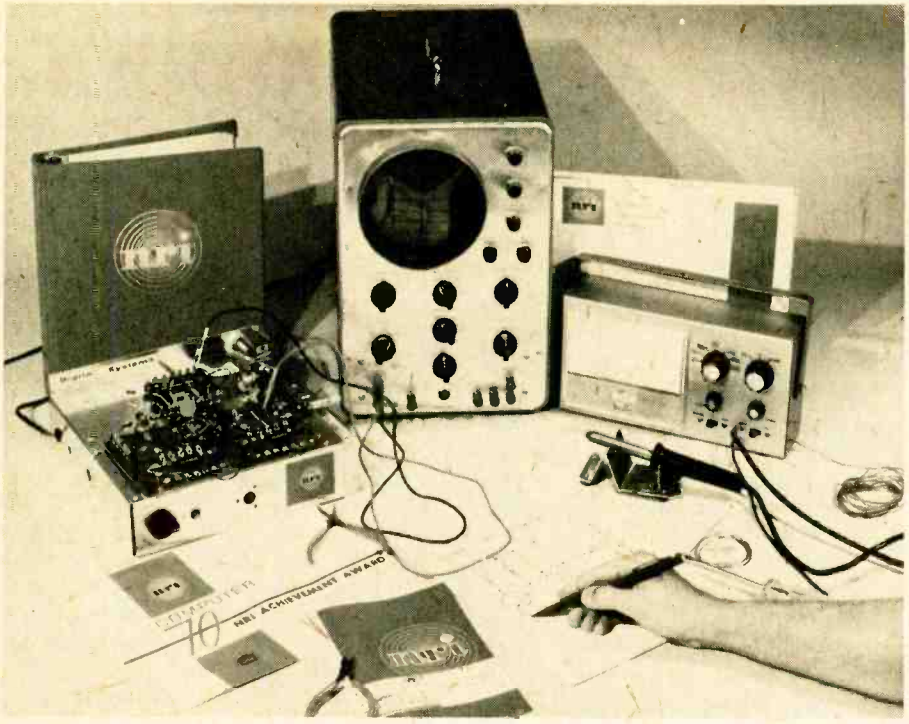


HOME GROWN SKILLS... BEYOND TV

by Louis E. Frenzel, Jr.

ELECTRONIC home study schools teach other subjects besides color TV. There are some really interesting courses in other electronic areas available, but you have to look hard to find them. Maybe one of them is for you.

A home study course is still one of the most effective, efficient and interesting ways to get training in electronics. College tuitions have risen nearly out of sight. And even if the tuition is reasonable, the school may not offer evening courses for those of you who have to work during the day. Then again, maybe the school doesn't even offer the types of courses you want or need. Home study schools still have reasonable tuitions for the amount of education and training they give you. And you can take them completely independently and at your own pace. A variety of electronic programs are available to meet almost any need you have. In addition, most courses come with valuable electronic equipment that can be useful to you once you complete the program. A home study course is one of the best educational values available today.

The home study procedure is simple. You enroll in the course of your choice and the school sends you all of the instructional materials that you need. You will read lesson texts, perform experiments with various kits, and take appropriate examinations which you send to the school for grading. Instructors are available to help grade your exams, answer your questions, and solve your study problems. Once you have satisfactorily completed the course, you are awarded a diploma.

Check It Out. Why take a correspondence course? Well, you just may want to prepare yourself to get a new job in electronics. You may wish to update or add to your knowledge in order to improve your present job performance or prepare yourself for advancement. Then again, you may wish to simply satisfy your curiosity about some phase of electronics.

Many people take a home study course in electronics as a leisure time activity. Knowing more about electronics can not only help you to take advantage of new job opportunities but also can lead to greater enjoyment of electronics as your hobby.

If you take a close look at the home study school ads in this magazine, you will see that most promote their courses in color TV. The major feature of these courses is a 25-in. color TV set kit. Many of the schools include the new Heathkit GR-2000 digital color TV receiver kit; one school uses its own design made specifically for learning. These courses also include other useful pieces of equipment such as digital voltmeters, oscilloscopes, and a variety of experimental hardware. When you complete the course, you have a fine color TV receiver to enjoy, several pieces of valuable test equipment, and a good knowledge of electronics and TV servicing. These courses are truly the one way to have your cake and eat it too. (Many guys take advantage of their VA benefits to take these programs. In this way, the government pays for 90% of your training.)

Color TV servicing is still one of the biggest and most lucrative fields of electronics, but your real need in electronics may be different. Your interest may lie more in communications, audio, digital computers, or circuit design. However, if you dig a little deeper by writing for the catalogs from the various home study schools, you will find that there are many other interesting courses available that can meet your specific training needs. Let's consider some of these unique programs.

- ***CIE Electronics Technology.*** Cleveland Institute of Electronics (CIE) offers a variety of programs in electronics technology primarily in the field of communications. While each course is designed for a particular specialty, a common philosophy runs through these programs. All of the CIE programs prepare you to pass the Federal Communications Commission first class radiotelephone license exam.

A commercial FCC radiotelephone license is one of the best credentials that an electronics technician can have. By passing the government's comprehensive exam in electronic fundamentals, you prove to yourself and to others that you have a certain minimum level of knowledge and capability in electronics. Many employers recognize a commercial FCC license as undisputed verification of an individual's knowledge and ability. In many job situations the FCC license is as good as a diploma

from an electronics school.

An FCC license is a mandatory requirement for many jobs in electronics. In the field of radio communications, which is regulated by the FCC, all of the equipment must be installed, maintained, operated, and repaired only by someone with the appropriate FCC license. By setting minimum standards, through licensing, for those individuals maintaining the equipment, the government can be assured of competent work.

If you are anticipating a job in AM, FM, or TV broadcasting, aircraft or marine radio, navigational equipment, or mobile radio, an FCC license is necessary. The largest and fastest-growing field of specialization in communications is mobile radio. Millions of FM radio transceivers are used in taxicabs, police and fire vehicles, and in a wide variety of other government services and industrial applications. FCC-licensed technicians are required to install, maintain and repair, and periodically adjust and service this mobile radio equipment.

Any of CIE's electronic home study programs will prepare you to pass the FCC license exams. The programs provide a solid electronics and math background along with the specialized coverage of a specific field. An optional kit supplement including a VOM and experimental hardware is available.

• ***Grantham Degree Programs.*** The courses offered by the Grantham School of Engineering (GSE) lead to a formal degree in electronics. Grantham School of Engineering is authorized by the State of California to grant both Associate and Bachelor's degrees in electronics to those individuals that complete their programs. These programs are intended primarily for individuals already working in the field of electronics.

To receive the Associate in Science in Engineering Technology (ASET) degree, you must complete a comprehensive program in electronics, mathematics, physics, computers, and technical writing. In addition, you must have at least one year of hands-on training or experience in electronics work.

By continuing your studies in advanced mathematics and engineering circuit analysis and design, you can prepare for the Bachelor of Science in Engineering Technology (BSET) degree. To receive the BSET degree, you must also have college credit for courses in English, history, social science, business, psychology, and related non-technical areas. These can be credits received at another college or university and transferred to Grantham School. Many of these credits can also be obtained through special examination programs such as the College Level Examiniation Program (CLEP)*. Attendance at a 3-day residence seminar at the school is required before the degree is awarded.

Further studies in general engineering science, control systems, communication systems, statics and dynamics, mechanics of materials, thermodynamics, and engineering economy prepare you for the Bachelor of Science in Engineering Electronics (BSEE) degree.

Except for the one year experience requirement and the minimum 3-day residence seminar required at the school, all work for these degree programs is accomplished strictly by home study. This is a great advantage to those who cannot attend a school.

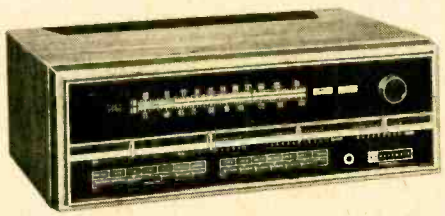
Of What Value is an engineering degree obtained through correspondence study? That question can be answered in several different ways. First, the possession of a legitimate degree regardless of its source is generally more valuable than no degree at all. The recognition accorded your home study degree will depend greatly upon the individual or employer considering it and naturally can vary widely from some recognition to full acceptance.

The primary value of a degree is that of opening the door to those jobs requiring a college degree. Usually any degree, regardless of its source, will help you to pursue jobs not available to non-degreed individuals. Once you have achieved the desired position, it is up to you to prove that you can handle the work. Your success or failure then depends not merely upon the fact that you have a degree, but upon the learn-

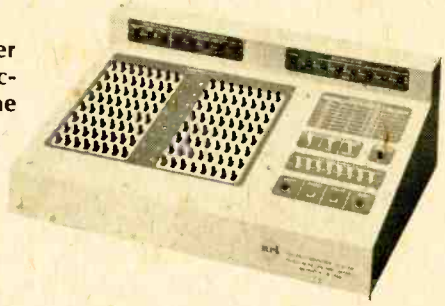
(Continued on page 86)

*College Level Examination Program, Box 1821, Princeton, NJ 08540

The solid-state multi-meter and transistor tester supplied with the NTS audio course is a Heath IM-17.

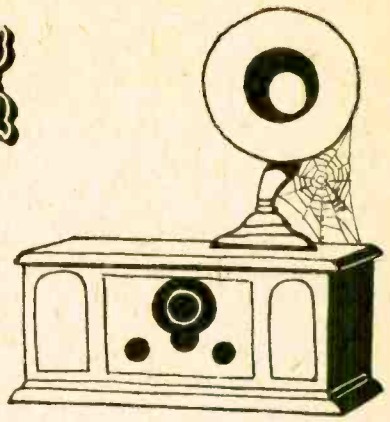


The Heath AR-1302 60-watt AM/FM-stereo receiver supplied with the NTS audio course provides hands-on experience.



The NRI Model 832 digital computer is one of the sophisticated and effective training kits available in a home study course.

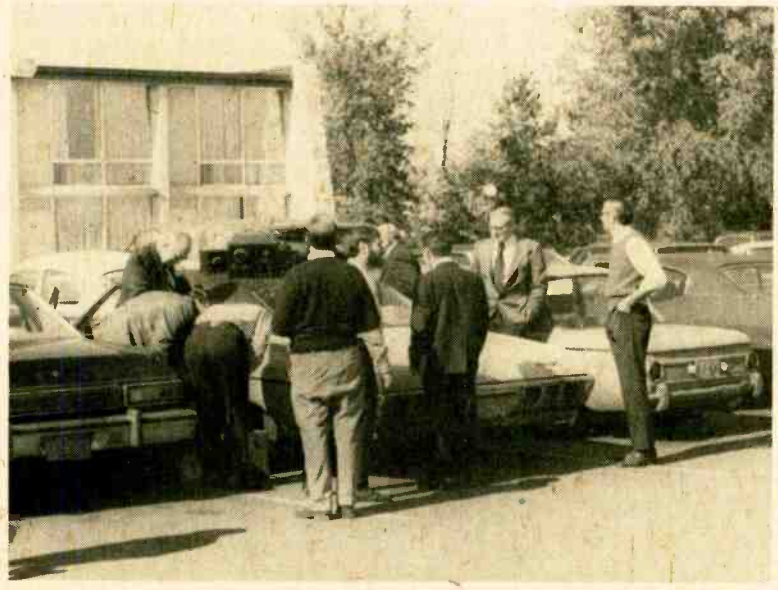
ANTIQUE RADIO CORNER

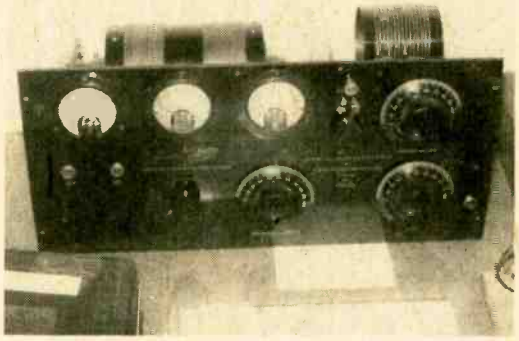


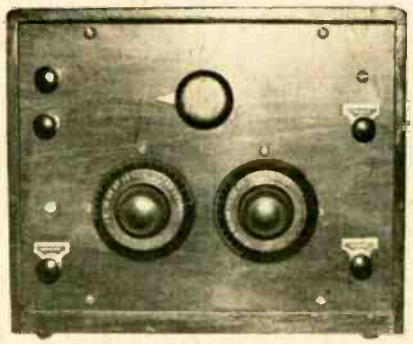
by James A. Fred

☐ Hello out there in Radioland! Here we are back again with news and views on collecting old radios and wireless equipment. Winter is fast drawing to an end and spring will soon be here. I suppose that you all have been busy restoring all of the radios you picked up last summer. I want to thank all of you for sending information to me in regard to Norman Baker of Muscatine, Iowa and W. K. Henderson of Shreveport, LA. The information I have collected on Mr. Henderson isn't quite complete so I will give his story in a later column. I especially want to thank J. N. Clapp of DeWitt, Iowa for the newspaper clipping he sent me about Norman Baker.

Norman Baker was a controversial figure who claimed he could cure cancer. He was blessed by those who thought he had cured them and disparaged by the rest of his patients. He started his career with his own small road show traveling the country roads and playing small towns. Later he founded the Tangley Calliope and Caliphone manufacturing business. This company was highly successful and if Baker had been satisfied to run this company properly he could have made a fortune. Instead he opened a department store, a variety store, and a radio station. His radio station had the call letters of KTNT and was one of the most powerful in its day. He advertised the merchandise he sold in his store and later promised to cure everyone of cancer. In 1929 he opened the Baker Cancer Hospital in Muscatine, Iowa. The AMA and Baker were constantly at odds over the claims of cancer cures that Baker made over his radio station and through the newspaper he had founded. Finally Baker sued the AMA for half-a-million dollars and lost the case. In the middle thirties the FCC pulled his station license so he moved the station to Nuevo Laredo, Mexico, just across the U.S. border. Here he established and operated XTNT, one of the most powerful stations on the North American continent. In 1938 he secretly moved his Cancer Institute to Eureka Springs, Arkansas. A few years later he was convicted of mail fraud and spent over three years in Fort Leavenworth







There were times when the parking lot at the Sheraton Inn, where the Antique Wireless Association Convention was held, looked like a flea market. Every time a trunk lid was opened or a radio was placed on display a crowd quickly gathered. Among the radios to be seen were the Zenith-built "Airplane Transmitter & Receiver" (above right), used by the McMillan Arctic Expedition in 1925. Just below the Zenith is a fine example of a homemade one-tube radio from the mid-'20s, made of solid wood with a wood-grained metal panel.

Penitentiary. He died in September 1958.

I am sure all you old timers can remember hearing KTNT and XTNT since they covered nearly the whole United States.

AWA Meet. I attended the annual convention of the Antique Wireless Association at Canandaigua, NY. Over 300 members of this organization of collectors of antique radio and wireless equipment were there. The convention covered two days of slide shows, informative lectures, an old equipment contest, a two hour auction of old radio equipment, and a banquet with Morgan McMahon as the featured speaker. Mr. McMahon is the publisher of Vintage Radio books. This is a very worthwhile meeting to attend because almost every collector can gain some knowledge on radio equipment he has never seen as well as enjoy the fellowship of other collectors.

The AWA has secured a building, that was formely an academy for young ladies, in East Bloomfield, NY for a new museum. The building is being extensively renovated by AWA members with the hope that they can be moved in during 1975. A preview was held of that portion that had been completed. From the looks of this part I feel sure that they will have one of the outstanding museums in the United States.

We stopped in to visit the Lauren Peckham museum near Breesport, New York. He has a very extensive collection of radio and wireless equipment as well as a fully restored coin-operated Seeburg player piano. If you are in his neighborhood he will be happy for you to call him for an appointment to see his collection.

Marconi Memorial. At the Cape Cod National Seashore Park near South Wellfleet, MA there is the Marconi Shelter House, which is a memorial to Guglielmo Marconi. It was at this Cape Cod site that Marconi built his wireless station that transmitted the first transatlantic message on January 18, 1903. The signal was transmitted from four antenna towers, each 250 feet high, made of wood, set into concrete, in a square around the transmitter house. The towers were guyed to anchors also set into concrete. During World War I the station was closed because of military censorship, coupled with the invention of the vacuum tube.

In the shelter house is a scale model of the complete wireless station, including the transmitter house, power house, towers and dormitory where the telegraph operators lived. On October 14, 1974 a bronze bust of Guglielmo Marconi was unveiled and dedicated. Co-sponsored by the Marconi Centennial Committee, and the National Park Service, the dedication marked the 100th anniversary year of Marconi's birth.

A very informative booklet has been prepared, describing the Marconi Wireless Station built between 1901 and 1903, and is on sale at the Cape Cod National Seashore Visitors Centers in both Eastham and Provincetown, MA. The booklet can also be purchased by mail from the Chatham Press Inc., Box 281, Chatham, MA 02633. There is no price marked on the booklet, but I am sure it was less than $2.00.

Just before leaving Cape Cod we stopped in to see Alan Douglas at Pocasset, MA. Alan is one of our outstanding young radio, wireless, piano, and organ collectors. Alan is a budding author who has had several Tech-Tips published in Antique Radio Topics, and is now preparing a booklet for publication showing and telling how to restore an Atwater Kent and other early A K radios. He is also working on a tube manual that will be invaluable to all radio collectors. These publications will

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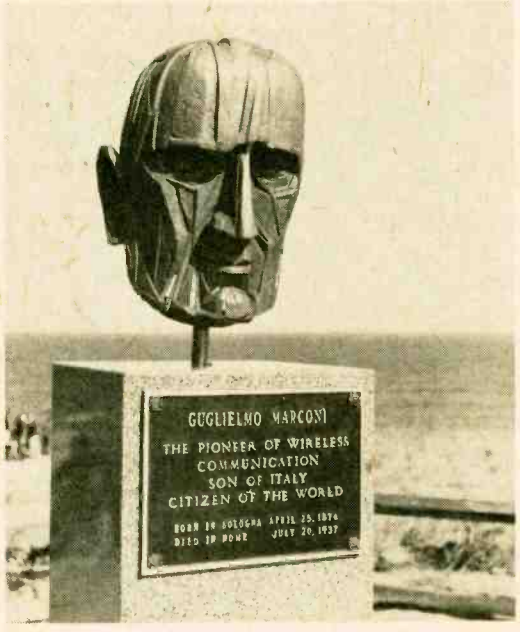
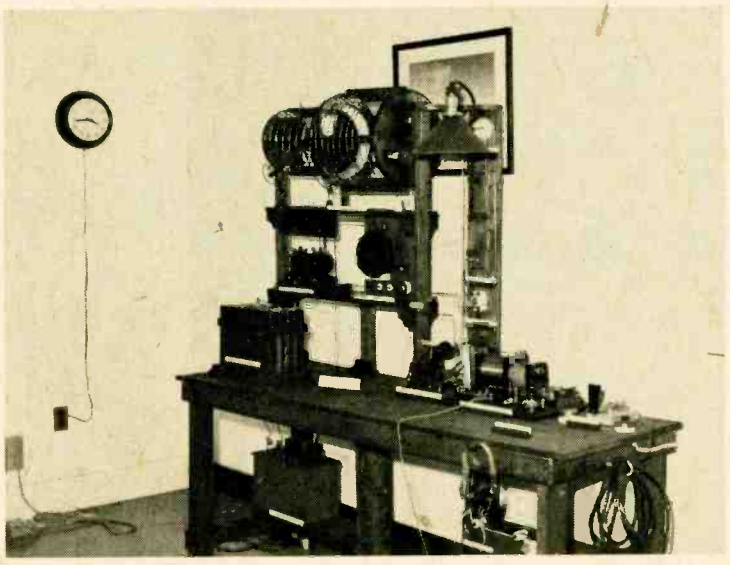


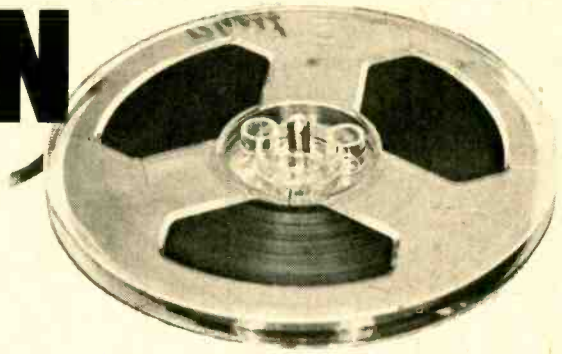
Guglielmo Marconi, the great radio pioneer, was born a hundred years ago last April in Bologna, Italy. The bronze bust of Marconi (above), unveiled last year, was sculpted by Joan FitzGerald, a native of Salem, MA.

The first transatlantic wireless message was transmitted by Marconi on January 18, 1903 from a site on Cape Cod near South Wellfleet, MA. James Wilson, one of the original Marconi station operators, and Frank Caswell, also a former telegraph operator of the period, spearheaded the gathering of authentic parts of wireless equipment to complete a 1/6-inch working replica of the Marconi transmitter. The model is on permanent display at a spot near the original Marconi station site.



Shortwave Listening's Instant Replay...

TAPE DOWN TOUGH DX



A pro plays back mag tape methods for all!

by Thomas R. Sundstrom

HAVE YOU EVER wanted an "instant playback" of a radio or television show you've enjoyed? Are you an SWL (shortwave listener) who had to leave the radio at a crucial moment of a station identification or in the middle of preparing a reception report? You say you don't know how to describe the audio quality of your friend's CB set? The answer, reader, is easy . . . use a tape recorder!

No matter what your reasons for recording a program, the principles and techniques of making good tapes do not change. The purpose of this article is to highlight some of the possible uses of a tape recorder by SWLs (but much of this is also applicable to CBers), to discuss the advantages and disadvantages of the different types of recorders, and to tell how to take good tapes "off the air."

One of the most useful accessories to the serious SWL is his tape recorder. Some SWLs let a tape recorder run continuously whenever the receiver is on and being used; the idea is that not even a momentary fragment of an identification would be lost when tuned in. Quite frequently, rare catches are not discovered until the tape is carefully gone over to pick out any weaker stations that might have been in the background. Illustrative of this point is my logging of IBF, a time and standard frequency station on 5000 kHz, in Turin, Italy. I was taping WWV on one channel of a stereo tape recorder during the early morning hours in the fall of 1972, using WWV to time a program being taped on the second channel, and the next morning I found several clear identifications that came over WWV as the signal from IBF peaked in strength just before dawn in Italy. It was totally unexpected, and a surprise logging here on its 5 kW power.

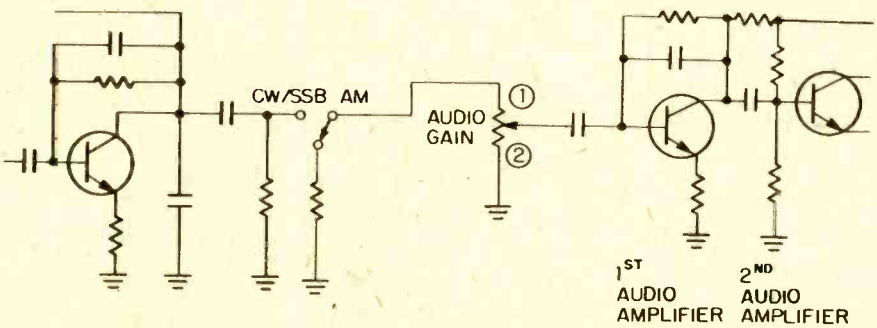
The Use. SWLs use the tape recorder in preparing written reception reports. A written program log should usually contain a minimum of a 15-to-30-minute log of program material. Shorter reports are usually acceptable under unusual circumstances if those reasons are explained in the report. A tape recording of the program will help in preparing a detailed verbatim program log on short sessions. In addition, while the program is being taped you can concern yourself with the timing of the show, signal reception conditions, and identifying the interfering station(s) *and* frequencies. The program log can be prepared in detail later, at your leisure, when the tape can be replayed—and replayed—until your report is complete.

An example or two of this can be illustrated by Radio Pakistan's General Overseas Service and Radio Seychelles. Pakistan runs its GOS in English at 1530-1545 GMT (Greenwich Mean Time) on 17935 and 15325 kHz to the Middle East and at 1745-1800 GMT on 15325 and 11672 kHz to Europe. A short program, it consists entirely of news items read twice at dictation speed! I'm no whiz at shorthand, and the tape recorder lets me get items verbatim for reporting. Radio Seychelles is difficult to hear (the station is in the Indian Ocean), and at best the signal is only fair at 1745-1800 GMT on 11955 and 15330 kHz beamed to the Middle East. This English transmission again is mostly news, and a detailed program log is often difficult to take.

The Programs. SWLs DXing (i.e., listening to) the international SWBC (shortwave broadcast) stations, are probably familiar with the excellent programs for DXers wherein up-to-the-minute tips on new stations, changes in schedules and frequencies, and other data are given. Several SWBCers have such programs, and two of the finest are from Radio Australia (Sundays at 1300 GMT on 9580 and 11710 kHz) and Radio Sweden (Tuesdays during all half-hour broadcasts; try 1400-1430 GMT on 17815, or 0030-0100/0200-0230 GMT on 9665 kHz). DX tips on these and other broadcasters' shows come fast and furious, and it is virtually impossible to take down all information given. Once on tape, you've got it.

The annual publication *World Radio and TV Handbook* includes details on when these types of shows are broadcast. Much other useful information is also included in this handbook available in January each year. Write Gilfer Associates, P.O. Box 239-EE, Park Ridge, NJ 07656 for a catalog and specifications sheet.

Broadcast band (BCB) DXers tuning the standard AM band of 535 to 1605 kHz also can make extensive use of a tape recorder. A frequency can be monitored for several hours with no attention to the receiver or the tape recorder if the listener's schedule does



Nearly all of today's new receivers are transistorized. This typical schematic shows your audio take off points. Hook the inner conductor to 1, shield to 2.

not permit him to be in the vicinity of the equipment.

For example, several SWL clubs preschedule tests of broadcast stations who are interested in their coverage or who are planning to be on the air anyway for equipment maintenance or the like. All are scheduled for the early morning hours, usually on Mondays when most of the 24-hour stations go off to service and test equipment.

The Method. In this listening post, the tape recorder is plugged into a timer that can start the machine, run up to six hours, and shut itself off. For those early morning tests when I cannot stay awake, I let the tape recorder do the DXing—having preset both the receiver and tape recorder controls.

Interference on the BCB is severe, and much good DX can often be "found" through the replaying of garbled and distorted tapes through different audio filters, headphones, and speakers until a positive identification can be made. For example, 1 kW WCGB on 1050 kHz in Pastillo, Puerto Rico, ran a DX test as described above, and only a tentative logging was made "live." Upon "dissecting" the replayed tape (which had a lot of interference from 50,000-watt WHN in New York City and 50,000-watt CHUM in Toronto, both on 1050 kHz, present with me in New Jersey) I found three good morse code IDs and one good voice ID clustered around the longitude that I thought I heard the first time around on a "live" basis. I wonder how I missed them to begin with.

Other uses of a tape recorder are in the preparation of taped reception reports and in "tapesponding." Both are worthy of separate dissertations, but will only be briefly discussed here.

The Data. In summary, a taped reception report is similar to a written report except that a 10-to-15-minute tape of the program heard is sent in lieu of the written program log detail. A covering letter with all other details should be enclosed. A taped report is most useful when there is only a tentative identification (verifications have been obtained for as little as the station announcer recognizing his own voice when the tape is otherwise so poor, for one reason or another, that program material is not listenable) by the DXer, or the language is unfamiliar to the DXer. The tape is usually prepared at 3¾ ips (inches per second) or 7½ ips recorded in one direction on a 3-inch or a 5-inch reel (these details will be explained later).

Tapesponding is a growing hobby, both inside and outside the SWL world. Verbal "letters" are exchanged between correspondents on an unlimited variety of subjects. Tape mailers for these hobbyists are readily available, providing tape and hard-case mailers.

And finally, another application of taping has recently begun to spread through the country. As every SWL knows, the postage rates are rising steadily and the costs of acquiring verifications are high. Some DXers are assembling IDs on tape as "proof" of hearing the station rather than obtain a written verification or QSL card. The "taped verification" is cheaper and so is gaining popularity. Unfortunately, there is a controversy among the memberships of the SWL-DX clubs over the "acceptance" of taped verifications counting toward awards offered by various clubs and related organizations; it has not been resolved to date, and only written verifications count. You, the reader, have a choice to make that is determined only by your time and your wallet.

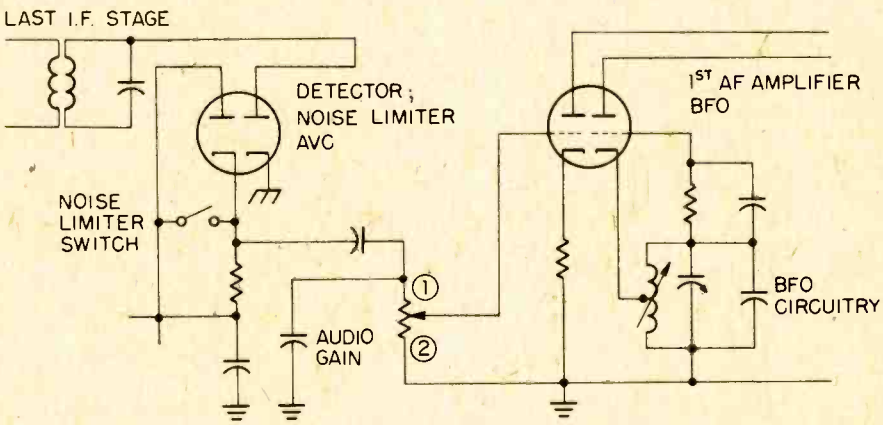
The Equipment. "Okay," you say, "I'm convinced, but what kind of machine do I want?" "Easy," I say, "you have two types of tape recorders to choose from, and each has its advantages and disadvantages. Although the cassette machine is gaining wide popularity among the public in general, the reel tape recorder is probably preferred by the majority of serious DXers."

There are many, many models of tape recorders marketed in a variety of sizes and shapes, all of which contain a wide choice of features. The reel tape recorder is available in three versions: monaural, stereo, or 4-channel. Monaural equipment is difficult to find, at best, and 4-channel is relatively new to the audio scene and still, by comparison, relatively expensive, so let's limit this discussion to stereo reel-to-reel tape recorders. I should emphasize that we are speaking about tape recorders and *not* tape decks which lack the self-contained amplifiers and speakers for playback.

Tape reels come in 3-, 5-, and 7-inch diameter sizes. Except for sending taped reports and tapesponding, the smallest size is of little use. The 5-inch reels are a compromise between having maximum capacity and portability; and, frankly, if you are contemplating the purchase of a tape recorder, one that can handle 7-inch reels is the best choice. The transistor and IC technology have lightened even the biggest machines considerably, not to mention making the electronics more efficient and durable.

The most popular reel size is the 7-inch; common tape footage lengths available are 1200, 1800, 2400, and 3600, with a few manufacturers producing 4800. Tape is either acetate, polyester, or mylar.

The Types. Acetate tape is inexpensive, relatively thick at 1.5 mil, and supposedly breaks before it stretches. Polyester will stretch before it breaks, is a bit more expensive, and thinner (usually 1.0 mil). Mylar is the ultra-thin stuff at 0.5 mil, and therein lies its advantage in making up the 3600- and 4800-foot lengths. If the tape transport mechanism (which starts, stops, and moves the tape over the record/play and erase heads) is not functioning properly, mylar tape can snap easily. But tape technology has improved remarkably over the past few years, and tape produced by major companies nowadays can virtually be chosen on the basis of length desired versus price. Your audio dealer can speak to this sub-



Many tube-type communications receivers are around and in first class shape. If you are still using one of the classics, connect to points 1 and 2 (ground).

ject handily; just remember that fidelity is not the forte of shortwave receivers and it is not necessary to use the higher-cost super-low-noise tape now available.

Most reel tape recorders function on 3¾ ips and 7½ ips. Larger machines may extend the range of speeds downward to 1⅞ ips and a very few to 15/16 ips; several also have adaptor kits to get up to the broadcasting industry speed of 15 ips. The faster the tape speed, the wider the frequency range recorded. The greater increase takes place on the top end. In this writer's experience, 3¾ ips is quite adequate in terms of reproducing whatever comes through the receiver (which actually limits audio response to a relatively narrow band of frequencies going no higher than 3,000 Hz at the widest bandpass setting) and giving me the flexibility of using virtually any other tape recorder to edit and copy tapes.

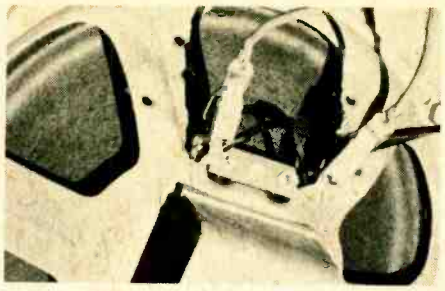
The Choices. Reel size and tape speed have a bearing on how long a reel of tape will record or play going in one direction. The tape reel can be "turned over" for recording or playing in the other direction. Obviously, then, a stereo tape recorder has four tracks of information (two in each direction), and you can double the following times. Recording in the stereo mode, we have the following options:

Recording Time in Hours

Tape Length	1⅞ ips	3¾ ips	7½ ips
1200′	4	2	1
1800′	6	3	1½
2400′	8	4	2
3600′	12	6	3

It should be noted that if you send taped reception reports and you use a stereo tape recorder to prepare them, be sure to use only the left channel amplifier and that your tape is clean, i.e., erased with a bulk tape eraser, before starting. The configuration of each track mandates using only one channel and recording in only one direction; to do otherwise would cause multiple audio tracks to be heard on a monaural broadcast studio tape machine your listener (probably the chief engineer or an announcer) would use, making it totally unintelligible. For a further discussion of this aspect (stereo versus monaural), there are many books published by electronics publishers that are available through your local library or that can be bought through electronics jobbers.

Some features which are desirable on tape recorders are the following: (1) A



The second best way to get "clean" tape recordings is with a patch cord clipped to speaker terminals. If your receiver is the AC/DC type, and you don't use an isolation transformer, wire like this.

VU meter to determine the recording level would be preferred over an electric "eye" that closes, for ease of setting the level. (2) Separate input jacks for microphone and radio/TV would be better than a universal input jack; not all "plug anything in" jacks work properly off some communications receivers. (3) An output jack, to feed a second tape recorder when preparing duplicate tapes or to feed a stereo amplifier. (4) A pause control, to momentarily stop the tape movement without taking it out of the record or play mode. (5) A tone control, for a pleasing quality in playback; most tape recorders bypass the tone control in the record mode. (6) An external speaker jack. (7) A stereo headphone jack.

Obviously, you should find two each of items 1, 2, 3, 5, and 6 on a stereo machine, one for each channel.

A check of catalogs from the major electronics houses handling mail orders will seemingly show that few, if any, complete tape recorders are available. A local audiophile store should have ample catalogs to show you what reel-to-reel tape recorders are obtainable, or some clean used equipment can be bought at very reasonable prices. A good tape recorder service technician should be able to evaluate the proposed purchase, and tell you what needs to be done to it, if anything. It is true that the tape recorder market is changing, and the cassette tape recorder has invaded en masse. The easy-to-use compactness of the cassette, with fidelity equaling that of the "cheap" reel machines under $100 or $150, has virtually wiped out the latter. The low-noise version (called the "Dolby system") of the cassette is providing stiff competition for reel machines, and reel has countered by increasing quality of its own while maintaining prices by dropping the electronics, that is, everything following the pre-amps (witness all the reel tape decks in the catalogs).

The nominal cassette tape recorder is a compact, all-transistorized portable machine that uses a plastic cartridge which is approximately 4 x 2½ x ½ inches LWH containing tape ⅛-inch wide (which contrasts with reel tape of ¼-inch in width). The advantage of the cassette is that the entire tape mechanism is self-contained, thus eliminating threading, and it can be slipped into and out of the recorder easily with one hand.

The cassettes come in varying lengths: 30, 60, 90, and 120 minutes in length. Each plays for half the above time before turning the cassette over. Readers should be cautioned in using the 120-minute cassette on less-expensive tape recorders as the tape transport may not be refined sufficiently to handle the ultra-thin tape which can snap quite easily when compared to the 30-to-90-minute cassettes.

The advantage of the cassette tape recorder is that it is compact and easy to use. Most have either a single play-record-stop control or a set of push-button switches. Some have a recording level meter or ALC ("automatic level control") which stabilizes at one recording level the varying signal level coming in through the input jack. Most of the portable units have a universal input jack for both microphone and radio, and provisions for an AC adaptor. Some have an output jack for feeding another audio device, and others have an external speaker and/or headphone jack.

The primary disadvantage of cassettes is fidelity. The ⅛-inch tape runs at a speed of 1⅞ ips, and most of the portables under $100 or so have a maximum response of 80 to 10,000 Hz. The Dolby systems have extended the frequency response range and reduced the innate "hiss" present in standard cassette systems; however, the Dolby is costly and probably not worth the expenditure for SWLing alone.

Virtually all cassette tape recorders are monaural (stereo seems to be limited to Dolbyized decks and cassette tape players for the automobile). As such, there is a disadvantage if two signals are to be taped simultaneously (as illustrated earlier).

Another disadvantage of cassettes is that tape splicing is considerably more tedious than repairing breaks in reel tape. Although some firms now market tape splicers intended to handle the ⅛-inch tape, the user still must disassemble the plastic case (and some cheaper cassettes are welded together, rather than bolted) and untangle the two spools before affixing the splice.

A major advantage of cassettes lies in the fact that taping can begin at a

moment's notice. Once hooked to the receiver, I just have to insert a cassette and push the record button—no worrying about recording level or threading of a reel of tape—when I'm in a hurry.

A further choice has to be made by the user. As it has been shown, reels of tape can run for lengths of time considerably longer than cassettes without attention. If you are the type of SWL who is always present when taping, cassettes are no trouble to take out and turn over . . . quickly. Reel machines can be cumbersome with remounting of reels, rethreading of the machine, and checking the setting of the variety of knobs and switches to make sure one wasn't bumped in the operation.

If you listen for long periods of time and tend to monitor single frequencies (as opposed to scanning the bands), a reel tape recorder would be the logical choice.

In this listening post, I have both a reel and a cassette tape recorder. For all-night sessions the stereo tape recorder is utilized to monitor either two different frequencies or to time the tape (with WWV on one channel) while scanning the AM or SW bands. The cassette tape recorder is utilized for short DXing session of 15 to 30 minutes when spot-checking for a specific station or taping a list of frequencies and times as is often announced at the start of SWBC transmissions directed to North America. Too, my collection of edited identifications representing some of the best catches is kept on two cassettes; a handy package to quickly load to play for visitors to this "shack" who are interested. Both types of machines are useful, but your wallet will dictate which type you'll have to choose as a starting point.

"But now that I have a tape recorder, how do I make the tapes? Do I just set the microphone in front of the speaker?"

The answer to that last question is an emphatic "no!" Although the microphone on its stand in front of your equipment is the easiest method of taping, it is the worst because not only will all other room noises and noises from elsewhere in the house be picked up, all the faults of the receiver's audio section, the speaker, and the microphone will have a bearing in the quality of the tape.

A better solution for some people may be the use of a telephone pickup coil, such as is available from any of the large electronics mail order houses. By positioning the coil near the audio output transformer or output tube, the coil should pick up the electromagnetic fields generated by the transformer or tube. Its best position has to be determined by experimentation. The advantage of this taping method is that no direct connection has to be made to the receiver, and room noises are eliminated.

I should say that this writer cannot recommend the use of a telephone pickup coil, however. In experimenting with one here, I find I cannot get enough gain to adequately feed a tape recorder until the receiver's gain control was at full gain. It may be due to the fact that there is more than the normal amount of shielding present in my receivers; in any case, I found the pickup coil worked best when affixed to the top of the audio transformer. It may work with your equipment (and the investment—$1.20 average—is not great), so you may like to give it a try.

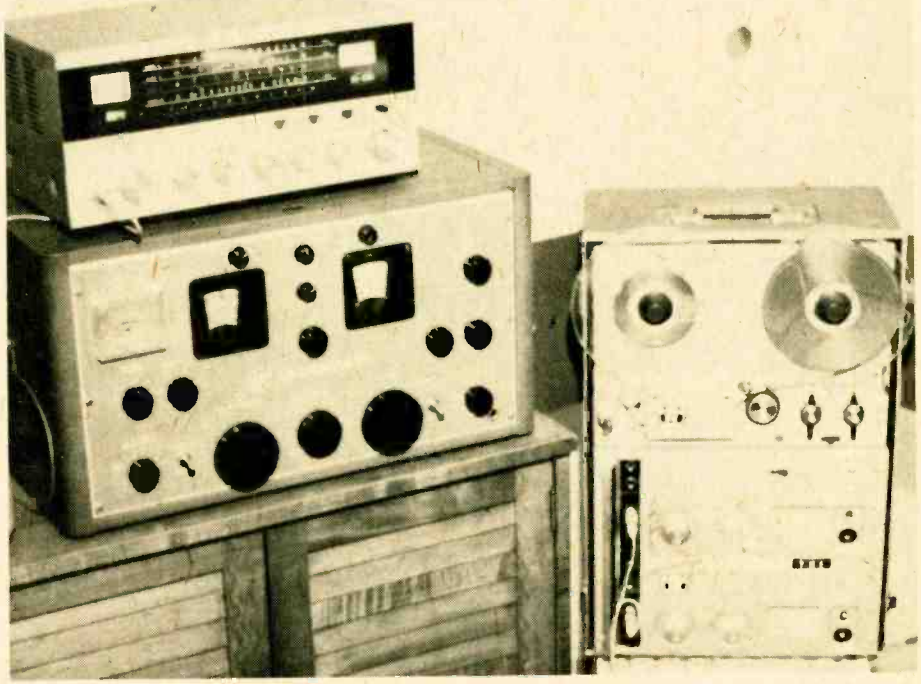
A better solution for good tapes with no outside noise is by use of a patch cord. The patch cord consists of a plug to fit the tape recorder input on one end and two alligator clips on the other end. The clips are attached to the speaker leads where they terminate at the solder lug terminals on the speaker frame. To use, you must have the receiver volume turned up to a listenable level before setting the record level; once set, the receiver volume should not be changed. The disadvantage is that you have to listen to the program on the speaker which could cause a problem in the household for the DXer that listens all night. Defects in the audio system, if any, would be picked up. Fortunately, neither disadvantage is serious and this is perhaps the best compromise between making good tapes and ease of setting up a recording session.

An alternative method is to tape out of the headphone jack. Depending upon the tape recorder, as the receiver's speaker would be silenced, the DXer would have to listen to the program via a "monitor" switch on the tape recorder or connect headphones and the tape recorder through a "Y-adaptor" to the receiver's headphone jack. Many adaptors are available so that standard phono cables can be "made up" to fit all kinds of different plugs and jacks that may be encountered on the equipment at hand.

The best method involves some minor surgery on the receiver. It should only be done on a transformer-powered receiver—not an AC/DC set! There is a shock hazard on an AC/DC set!

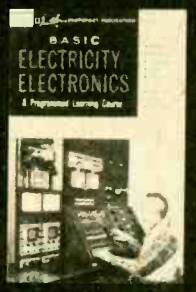
Only two parts are needed, a short length of lightweight shield cable and a phono jack. The jack is mounted on a clear spot on the back apron of the receiver chassis as near to the volume control as possible. Connect one end of the inner conductor of the wire to the "hot" side of the volume control (watch that you pick the volume control lugs

(Continued on page 89)



A Roberts 721 reel tape recorder is placed in a convenient spot next to this writer's Hammarlund HQ-150 and Realistic DX-150A. To the left is a B&W #370 SSB (single sideband) adaptor and some home-brew equipment.

e/e BASIC COURSE IN ELECTRICITY & ELECTRONICS



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

UNDERSTANDING SEMICONDUCTORS

What You Will Learn. In this part you will learn about N- and P-type semiconductor materials, what the differences are between them and what happens when the two are joined to form a PN junction. You will also learn about the elements of a transistor and what the arrow head on the emitter lead is all about. You will learn the difference between forward and reverse bias. Of course, diodes and their characteristics are discussed. In Part 2, you will learn about how a transistor is biased and how it amplifies. The three basic types of transistor amplifiers are also discussed along with transistor specification sheets.

WHAT IS A SEMICONDUCTOR?

Materials can be classed in three groups according to their electrical properties—conductors, semiconductors, and insulators. Metals such as silver, copper, and aluminum have many free electrons. This makes it easy for current to flow through them. For this reason these metals are called **conductors.**

Materials such as glass, rubber, and many plastics have practically no free electrons. This makes it very difficult for current to flow through them. These materials are known as **insulators** and are used in a variety of applications ranging from the covering on conductors to the dielectric in capacitors.

Materials such as selenium, silicon, and germanium have some free electrons—more than an insulator but fewer than a conductor. These materials are generally referred to as **semiconductors.**

WHY SEMICONDUCTOR MATERIALS ARE IMPORTANT

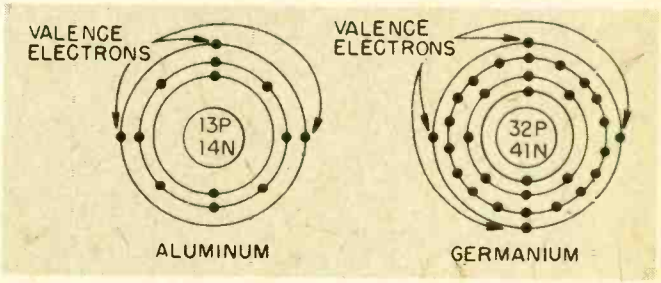
A diode made of semiconductor material is called a **solid-state** diode. Semiconductor materials are also the basic ingredients of transistors. Solid-state diodes can replace vacuum-tube diodes, and transistors can replace vacuum-tube triodes. Why is this important? Solid-state diodes and transistors are smaller, weigh less, and use less power than their vacuum-tube counterparts. They are also more rugged and last longer than vacuum tubes. In addition, they do not require a filament-supply voltage.

How do solid-state diodes and transistors work? How can a solid substance maintain unidirectional current flow in the same manner as a vacuum-tube diode? How can a solid substance amplify like the triode? To answer these questions we must first go back and examine the basic building blocks of matter—atoms.

The Aluminum Atom

The aluminum atom has thirteen electrons circling in orbits around a nucleus of thirteen protons and fourteen neutrons. The negative charges on the thirteen electrons are exactly balanced by the positive charges on the thirteen protons. It is a natural characteristic of an aluminum atom that three **valence** electrons in the outer shell, or ring, are loosely bound to the atom and

Diagrams Of Aluminum And Germanium Atoms



are easily dislodged. This is important. These three loosely bound electrons are the reason why aluminum is a conductor. It is a dislodging of these electrons and their subsequent capture by another atom that is the basis of electrical flow. An electron can pass from one orbit to the next until it eventually arrives at the positive terminal of a power source, say a battery. Of course, this shifting and exchanging of electrons does not start until some external energy is applied. It could be in the form of light, heat or, as in our illustration, a battery that provides electrons from its negative terminal.

Aluminum has a valence of plus 3. This means that aluminum easily gives up the three electrons—also called free electrons—in its outer ring.

The Germanium Atom

The nucleus of the germanium atom is larger than the aluminum nucleus. It has thirty-two protons and forty-one neutrons. There are thirty-two orbiting electrons, of which four are in the outer ring. These four electrons make germanium a semiconductor. The germanium atom can either give up these electrons or take on more to complete its outer ring.

QUESTIONS

Q1. Copper is a - - - - - - - - -.

Q2. Glass is an - - - - - - - - -.
Q3. A conductor has many - - - - - - - - - - -.
Q4. Silicon is a - - - - - - - - - - - - -.
Q5. The electrons in the outer shell of an atom are known as - - - - - - - electrons.

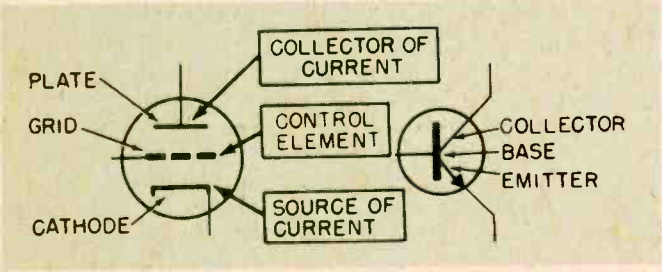
ANSWERS

A1. Copper is a **conductor.**
A2. Glass is an **insulator.**
A3. A conductor has many **free electrons.**
A4. Silicon is a **semiconductor.**
A5. The electrons in the outer shell of an atom are known as **valence** electrons.

THE TRANSISTOR

In a sense, a transistor is a valve. It controls the movement, or flow, of either positive or negative charges through the semiconductor crystal of which it is made. The transistor can be compared to a triode. In fact, it is convenient to think of the transistor as a solid-state triode.

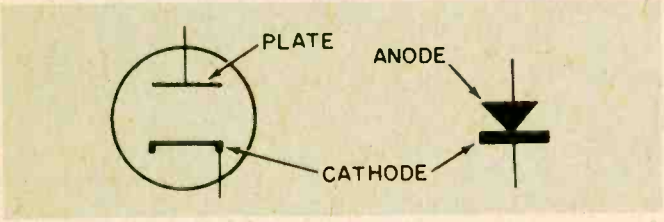
Comparison Of Transistor And Triode Tube



The symbols for the triode and the transistor can be compared in the figure. Each has three elements, one of which acts as a source of current. In the triode, this element is called the cathode; in the transistor, this element is called an **emitter.** (The arrow in the symbol points in the direction of positive charge—called *hole*—movement.) Both the transistor and triode vacuum tube have a control element. In the triode, it is called the grid, and in the transistor it is called the **base.** The tube and transistor each have a current collector, called the plate in the triode and the **collector** in the transistor.

In a similar fashion, a solid-state diode may be compared to a vacuum-tube diode. Here there are only two elements.

Comparison Of Tube And Solid-State Diodes



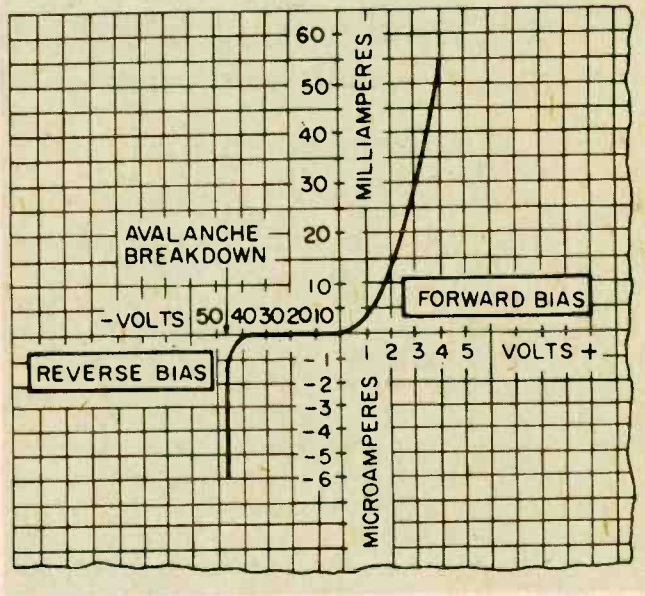
DIODE CHARACTERISTICS

Some of the important characteristics of a solid-state diode will be examined. These are the current-voltage, resistance, temperature, and capacitance characteristics.

Current-Voltage Relationships

The graph represents the amount of current that will flow through a typical diode when various voltages are applied. The positive-voltage region is the area in which the diode is forward-biased and current flows.

Current-voltage Characteristic Curve



The reverse-bias region is to the left of the origin. Remember that the diode will not conduct in the reverse direction. This is true on the graph up to almost 40 volts of reverse bias. Above this value, small currents in the order of a few microamps start to flow. This current flow is due to the leakage. When the reverse bias reaches about 45 volts there is a sharp increase in reverse current. This is called **avalanche breakdown.**

Resistance

The resistance of solid-state diodes varies with the applied voltage. Resistance is high for low forward-bias voltages and is low for high forward-bias voltages. For reverse biases, the resistance is very high until avalanche breakdown occurs.

Temperature

Solid-state diodes have a negative temperature coefficient. This means that as the temperature increases, the resistance of the diode decreases. Within certain limits, the effects of resistance changes due to temperature change are not detrimental to the operation of the diode. However, when a very high temperature is reached, the resistance of the diode decreases so much that the current through the diode may be high enough to permanently damage the crystalline structure. This action is called **thermal runaway** and presents a serious problem in circuit design.

QUESTIONS

Q6. The condition in which the current through a reverse-biased, solid-state diode sharply increases is called - - - - - - - - - - - - - - - - - -.
Q7. The resistance of a solid-state diode varies with the - - - - - - - - - - - - - -.

Q8. Solid-state diodes have a - - - - - - - - temperature coefficient.

ANSWERS

A6. The condition in which the current through a reverse-biased, solid-state diode sharply increases is called **avalanche breakdown.**

A7. The resistance of a solid-state diode varies with the **applied voltage.**

A8. Solid-state diodes have a **negative** temperature coefficient.

Capacitance

Two conductors separated by a dielectric constitute a capacitor. A solid-state diode is a capacitor in which an NP junction serves as the dielectric. At low frequencies the effects of this capacitance need not be considered. At high frequencies, however, this capacitance (in the order of about 3 to 5 picofarads) becomes an important factor.

SEMICONDUCTOR-DIODE DATA

Most electronic parts catalogs have several pages devoted to semiconductor diodes. An example of some of the data you will see in such a catalog is shown in the table below. Notice that diodes are designated 1N34, 1N58, etc. Just as with vacuum tubes, manufacturers have agreed to call diodes having the same characteristics by the same type number.

SEMICONDUCTOR DIODE CHARACTERISTICS

TYPE	Peak Inverse Volts	Ambient Temperature Range—°C	Forward CURRENT Peak mA	Forward CURRENT AVERAGE mA	CAPACITY pF
1N34A	60	−50 to +75	150	50	1.0
1N58A	100	−50 to +75	150	50	1.0

The table shows some of the characteristics for the 1N34A and 1N58A. Peak inverse voltage (PIV) is the reverse bias at which avalanche breakdown occurs. The ambient temperature range is that range of temperatures over which the diode will operate and still maintain its basic characteristics. Forward current values are given for both the average current (that current at which the diode is usually operated) and the peak current (that current which, if exceeded, will damage the diode). The only difference between these two diodes is in the peak inverse voltage. Therefore the 1N34A could be substituted for the 1N58A in applications involving signals of less than 60 volts peak-to-peak.

SEMICONDUCTOR TYPES

There are two types of semiconductor material of interest to us—P-type and N-type. This simply means that a slice or piece of semiconductor, say N-type germanium, has been atomically altered to include an extra electron in the orbits of some of the atoms. So, whenever a current is passed through an N-type semiconductor, it is the result of *excessive* free electrons moving from orbit to orbit.

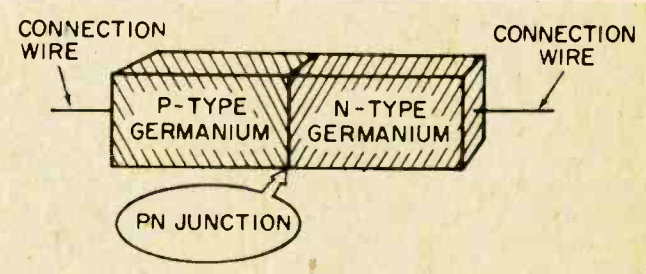
On the other side of the coin, a piece or slice of P-type germanium has been atomically altered to have one *less* electron than normal in some of the orbits. Whenever external energy is applied to a P-type semiconductor, the shifting and exchanging of electrons again takes place, but it does so by filling and then emptying the holes caused by the missing electron.

So, a double view of electrical flow in a P-type semiconductor is possible. Electrons still flow toward the positive energy source, but holes also effectively flow in the opposite direction—toward the negative energy source.

DIODE OPERATION

Early radios used crystal diodes to detect radio signals. These diodes allowed current to flow in one direction but not in the other. This **unidirectional** current capability is, of course, the distinguishing feature of the diode.

Diagram Of Solid State Diode

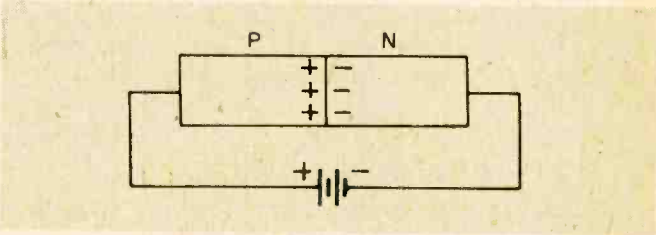


A solid-state diode consists of a section of P-type semiconductor material joined to an N-type section. The activity occurring at the junction of the materials is responsible for the unidirectional property of the diode. The contacting surface is called the **PN junction.**

Forward Bias

In order to produce a flow of current across the junction, the diode is forward biased by a battery connected as shown. The negative terminal connects to the N-type semiconductor while the positive terminal connects to the P-type. Free electrons in the N section

Forward Biased Diode

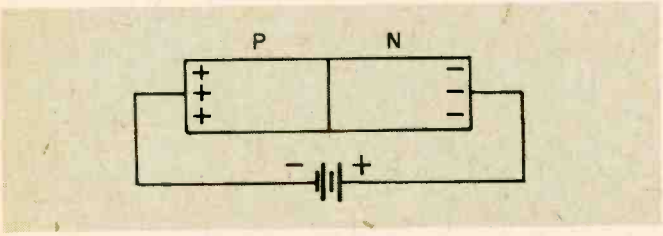


move toward the junction because they are repelled by negative voltage from the battery. Simultaneously, holes in the P-type semiconductor are forced toward the junction by the positive battery voltage. If the voltage applied to the diode is great enough to overcome a natural junction barrier (about 0.3 volt for germanium), electrons from the N-type semiconductor will begin to fill holes in the P-type. For each electron-hole combination at the PN junction, an electron enters the diode from the negative battery terminal, while another leaves the diode for the positive terminal. Thus, current flows through the diode.

Reverse Bias

When the battery connections are as shown, the diode is reverse biased. With the negative battery terminal connected to the P-type semiconductor, holes are attracted away from the junction. At the same time,

Reverse Biased Diode

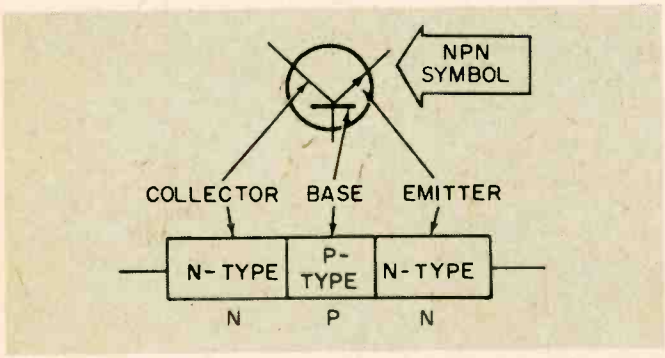


the positive battery voltage attracts free electrons in the N-type semiconductor *away* from the junction. The result is an absence of current flow because electrons and holes are not at the junction area and cannot, therefore, combine.

NPN TRANSISTORS

By sandwiching a very thin piece of P-type germanium between two slices of N-type germanium, an NPN transistor is formed. A transistor made in this way is

NPN Transistor Symbol—Junction Type



called a **junction transistor.** The symbol for this type of transistor showing the three elements (emitter, base, and collector) is shown. The three elements correspond to the cathode, grid, and plate, respectively, of a vacuum-tube triode.

PNP TRANSISTORS

By placing N-type germanium between two slices of P-type germanium, a PNP junction transistor is formed. A PNP **point-contact** transistor can be made by fusing two catwhiskers to a large N-type base.

The symbol for the PNP transistor is almost identical to that of the NPN transistor. The only difference is the direction of the emitter arrow. In the NPN transistor it points away from the base, and in the PNP it points toward the base. Electrons always flow *into* the arrow. If the arrow points toward the base, the electron flow is from the collector through the base to the emitter.

QUESTIONS

Q9. The capitance of a solid-state diode must be considered at - - - - frequencies.

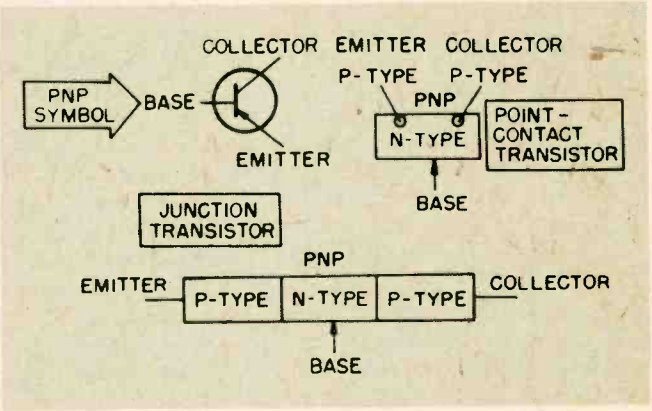
Q10. The three elements of a transistor are the - - - - - - -, - - - -, and - - - - - - - - - -.

ANSWERS

A9. The capacitance of a solid-state diode must be considered at **high** frequencies.

A10. The three elements of a transistor are the **emitter, base,** and **collector.**

PNP Transistor Symbol—Point And Junction Type



WHAT YOU HAVE LEARNED

1. Semiconductors are materials that are neither good conductors nor acceptable insulators.

●

2. Transistors and solid-state diodes replace vacuum tubes because they are smaller, weigh less, are more rugged, use less power, and have a longer useful life.

●

3. Holes behave as though they were positively charged particles.

●

4. Current flows through a forward-biased PN junction but not through a reverse-biased PN junction.

●

5. Transistors function like valves to amplify signals,

●

6. The emitter, base, and collector of a transistor correspond to the cathode, grid, and plate of a triode tube.

●

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.

when I planned to **retire before fifty**

this is the business that made it possible

a true story by John B. Haikey

Starting with borrowed money, in just eight years I gained financial security, sold out at a profit and retired.

"Not until I was forty did I make up my mind that I was going to retire before ten years had passed. I knew I couldn't do it on a salary, no matter how good. I knew I couldn't do it working for others. It was perfectly obvious to me that I had to start a business of my own. But that posed a problem. What kind of business? Most of my money was tied up. Temporarily I was broke. But, when I found the business I wanted I was able to start it for a small amount of borrowed money.

"To pyramid this investment into retirement in less than ten years seems like magic, but in my opinion any man in good health who has the same ambition and drive that motivated me, could achieve such a goal. Let me give you a little history.

"I finished high school at the age of 18 and got a job as a shipping clerk. My next job was butchering at a plant that processed boneless beef. Couldn't see much future there. Next, I got a job as a Greyhound Bus Driver. The money was good. The work was pleasant, but I couldn't see it as leading to retirement. Finally I took the plunge and went into business for myself.

"I managed to raise enough money with my savings to invest in a combination motel, restaurant, grocery, and service station. It didn't take long to get my eyes opened. In order to keep that business going my wife and I worked from dawn to dusk, 20 hours a day, seven days a week. Putting in all those hours didn't match my idea of independence and it gave me no time for my favorite sport—golf! Finally we both agreed that I should look for something else.

"I found it. Not right away. I investigated a lot of businesses offered as franchises. I felt that I wanted the guidance of an experienced company—wanted to have the benefit of the plans that had brought success to others, plus the benefit of running my own business under an established name that had national recognition.

"Most of the franchises offered were too costly for me. Temporarily all my capital was frozen in the motel. But I found that the Duraclean franchise offered me exactly what I had been looking for.

"I could start for a small amount. (Today, less than $1500 starts a Duraclean dealership.) I could work it as a one-man business to start. No salaries to pay. I could operate from my home. No office or shop or other overhead. For transportation, I could use the trunk of my car. (I bought the truck later, out of profits). And best of all, there was no ceiling on my earnings. I could build a business as big as my ambition and energy dictated. I could put on as many men as I needed to cover any volume. I could make a profit on every man working for me. And I could build little by little, or as fast as I wished.

"So, I started. I took the wonderful training furnished by the company. When I was ready I followed the simple plan outlined in the training. During the first period I did all the service work myself. By doing it myself, I could make much more per hour than I had ever made on a salary. Later, I would hire men, train them, pay them well, and still make an hourly profit on their time that made my idea of retirement possible —I had joined the country club and now I could play golf whenever I wished.

"What is this wonderful business? It's Duraclean. And, what is Duraclean? It's an improved, space-age process for cleaning upholstered furniture, rugs, and tacked down carpets. It not only cleans but it enlivens and sparkles up the colors. It does not wear down the fiber or drive part of the dirt into the base of the rug as machine scrubbing of carpeting does. Instead it *lifts out* the dirt by means of an absorbent dry foam.

"Furniture dealers and department stores refer their customers to the Duraclean Specialist. Insurance men say Duraclean can save them money on fire claims. Hotels, motels, specialty shops and big stores make annual contracts for keeping their carpets and furniture fresh and clean. One Duraclean Specialist recently signed a contract for over $40,000 a year for just one hotel.

"Well, that's the business I was able to start with such a small investment. That's the business I built up over a period of eight years. And, that's the business I sold out at a substantial profit before I was fifty."

Would you like to taste the freedom and independence enjoyed by Mr. Haikey? You can. Let us send you the facts. Mail the coupon, and you'll receive all the details, absolutely without obligation. No salesman will ever call on you. When you receive our illustrated booklet, you'll learn how we show you STEP BY STEP how to get customers; and how to have your customers get you more customers from their recommendations.

With no obligation, we'll mail you a 24-page brochure explaining the business. Then you, and you alone, in the privacy of your home, can decide. Don't delay. Get the facts before your location is taken by someone else. Mail the coupon, now.

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WITHOUT OBLIGATION mail letter and 24-page illustrated booklet explaining how I can increase my income and family security with a Duraclean Dealership. No salesman is to call.

Name_____

Address_____

City_____ State & Zip_____

BEYOND TV

(Continued from page 74)

ing that you obtained from the school and your ability to apply it in solving the problems of your employer.

A second important consideration is that methods of a non-traditional educational nature are becoming far more widely recognized and accepted in all areas. There has been a substantial growth over the past years in the development of extension programs for adults and mature individuals where academic degrees can be obtained entirely through extension or correspondence work. Today many accredited colleges offer college degrees through individual instruction on an extension basis. It appears that these current trends toward increased recognition of non-traditional methods, including home study, will receive increased attention. Your Grantham degree or any home study school diploma will no doubt increase in value as these trends continue.

• ***NRI Computer Electronics.*** The National Radio Institute (NRI) Computer Electronics course is designed to train computer field service engineers and digital technicians. Digital techniques are now widely used in all areas of electronics. Even consumer electronic devices such as television and hi-fi/stereo receivers and electronic calculators use digital circuitry. In addition, the trend in test equipment is clearly toward the use of digital circuitry. For that reason, today's electronic technician must be thoroughly versed in digital techniques.

The availability of low cost digital integrated circuits is responsible for this growth in the use of digital techniques. Just as significant has been the effect of such ICs on the computer industry. Because of the sophisticated ICs available today, digital computers have gotten smaller, lower in cost, and more powerful. The modern mini-computers, and more recently the MOS-LSI microcomputers, are so small and low in cost that they can be adapted to applications which before were reserved only for the most complex and expensive equipment. A technician working in electronics quickly learns that a knowledge of digital and computer techniques is necessary for his survival and advancement. NRI's Computer Electronics course certainly supplies all of the training necessary to meet these requirements.

• ***Course Insights.*** The NRI Computer Electronics course begins by providing you with an excellent background in electronic fundamentals. Later you are introduced to digital techniques. The binary number system, logic circuits, and all of the most important digital applications are covered in detail. The latter part of the course deals with digital computer organization, operation, and application. Even digital computer programming and analog computers are considered.

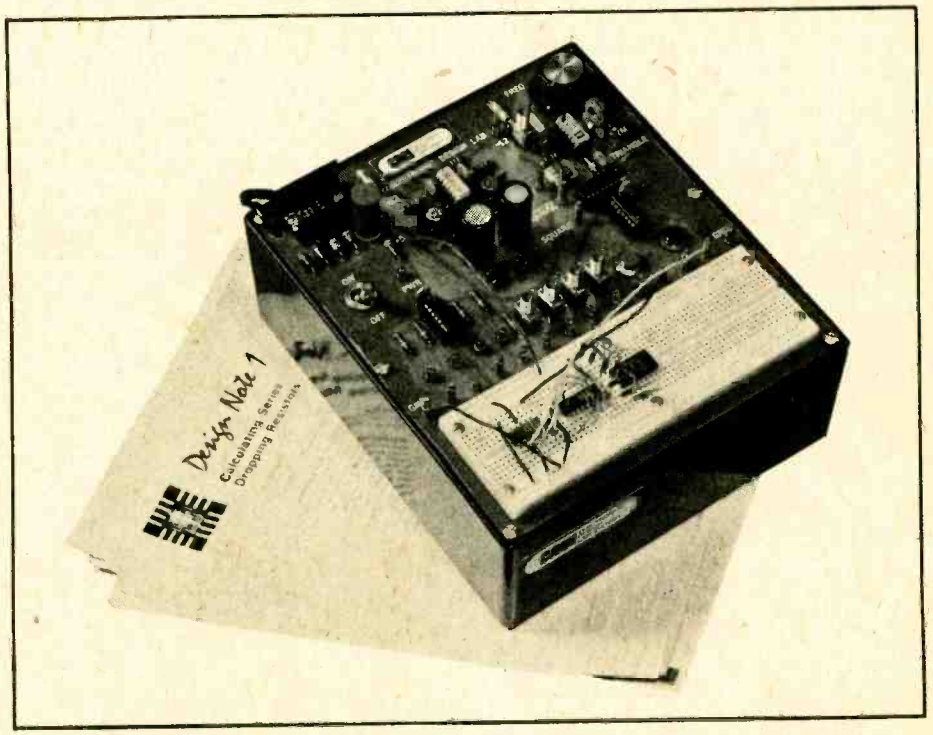
Also supplied with this program is a series of ten training kits that help you to put words into action. The most unique feature of the NRI Computer Electronics course is the fact that you actually construct and operate a *real* digital computer. This machine features 68 integrated circuits. It has an 8-bit data and instruction word, and a repertoire of fifteen basic instructions. The computer contains sixteen 8-bit words of programmable read-only memory (PROM). Another sixteen 8-bit words of semiconductor memory are available as an option.

The Model 832 digital computer constructed as a part of this course is a real digital computer in every sense of the word. It is a fantastic learning device. There is no better way to learn computer operation and programming than by actually using a real computer.

When you complete the NRI program you have a thorough understanding of digital, computer, and programming techniques. The experience and confidence you obtain by building and using the digital computer is extremely valuable. There is nothing like training with the components and techniques that you will use later on the job.

• ***NTS Audio Electronics Servicing.*** The primary purpose of the National Technical Schools (NTS) Audio Electronics Servicing course is to prepare you for a job as an audio technician. Audio technicians service, maintain, install, and repair a wide variety of home entertainment and commercial sound equipment. A large percentage of all electronic equipment today is used for audio or sound applications. These include public address systems, sound systems for theaters and clubs, intercoms, sound systems for drive-in theaters, and the various audio systems associated with radio/TV stations and recording studios.

One of the most glamorous and interesting phases of the audio field is, of course, hi-fi/stereo equipment for home entertainment. Literally millions of these systems are in use in homes today. Because of their specialized nature and high performance, a skilled technician is needed to install and service this sophisticated equipment. Discriminating owners insist upon high quality and only a competent technician can make the proper adjustments and repairs. A qualified technician can readily find work in this field because of the extensive demand for audio equipment



The Designer is a universal breadboarding system for both linear and digital circuits. Logic pushbuttons and switches plus LED indicators make logic operations simple. A decade counter with 7 segment LED display supplied with the program is shown wired on the breadboarding socket.

This digital multi-meter is supplied with the NTS audio course for experienced technicians' shop and home use.

servicing.

The NTS course prepares you for audio servicing work by first giving you a solid background in electronic fundamentals, AM and FM radio circuits, and audio amplifiers. Test equipment, measuring techniques, and troubleshooting procedures for audio equipment are considered in detail. The latest FM-stereo multiplex techniques and quadraphonic sound methods are covered. Sophisticated digital readout techniques now being used in many hi-fi receivers are also considered.

The electronic equipment supplied with this program permits you to try out the things you learn in the written lessons. You receive a Heath solid-state FET volt-ohmmeter, an in-circuit transistor tester, and a solid-state 60-watt AM/FM-stereo receiver with two 8-inch speakers.

A version of this course covering only the pertinent audio subjects is available for technicians who already know electronic fundamentals. With this program you receive the Heath solid-state 60-watt stereo receiver, the twin stereo speakers, and a digital multimeter. The course not only provides you with the necessary technical training but also includes the equipment and instruments that you will need to experience quality hi-fi and to service audio equipment.

• **CREI Program.** Capitol Radio Engineering Institute (CREI) courses are comprehensive college-level programs in electronics engineering technology. The CREI programs are designed to train advanced technicians, engineering technologists, and engineers. The emphasis is on a solid theoretical and mathematical background and practical circuit and system design. The CREI program is flexible so that it permits you to major in one of several key areas such as computers, communications, avionics, TV, automatic control, radar/sonar, nuclear electronics, satellites-missiles and spacecraft electronics, and CATV.

The CREI programs have two unique features. The first of these involves the award of college credit for CREI home study work completed. Affiliated with CREI are a number of colleges and universities throughout the country that recognize CREI work and award full college credit for it toward an Associate or Bachelor's degree in electronic technology. By completing a CREI program, you can obtain from approximately one quarter to one half the credit required for a degree. While you may opt for a home study course because it provides you with advantages over a resident college, it is comforting to know that at a later date this CREI work will be accepted for credit toward a degree at a good number of institutions.

Another unique feature of the CREI courses is the Design Lab. The Design Lab is an option to the regular CREI programs. It is the hardware phase of the course. With the Design Lab equipment supplied, you put into practice the theory and design information you learn in the lessons.

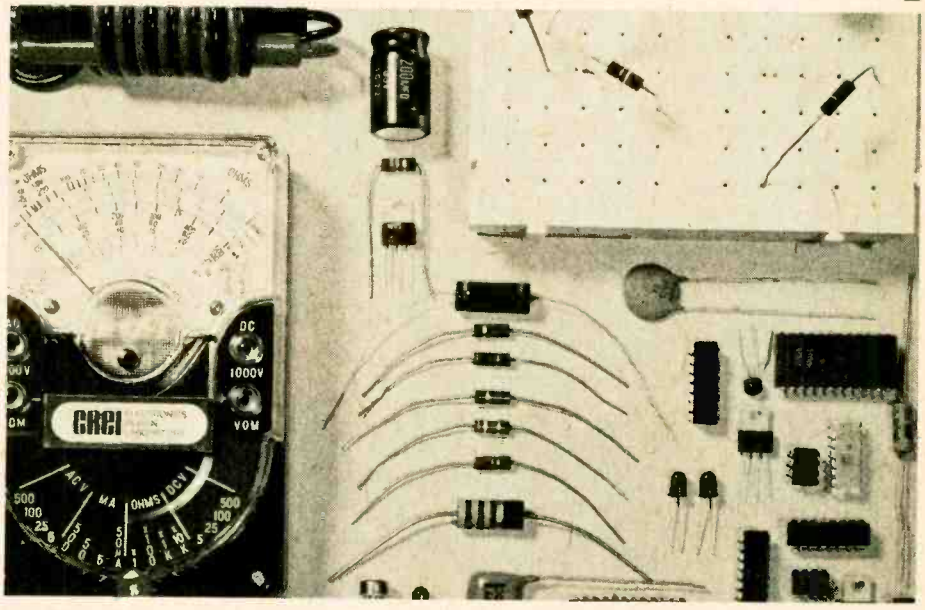
The equipment supplied with the program consists of a standard 20,000 ohms per volt VOM, a direct coupled, triggered sweep oscilloscope, and a universal breadboarding unit called the Designer. Neither the VOM nor the oscilloscope are kits. Both are supplied fully wired, tested, calibrated, and ready to use.

The Designer is a quickly assembled kit. This unit contains several power supplies, a function generator, a breadboarding socket and other useful features. The Designer provides the basic hardware support for all of the experiments in the program and can also be used later on the job or at home for experimenting purposes.

Along with the Design Lab option comes a wide variety of the latest electronic components. Diodes, transistors, SCRs, FETs, LEDs and a variety of linear and digital integrated circuits are supplied with the program. The student demonstrates component operation and characteristics and then uses these components to design practical electronic circuits. The overall result is that the CREI graduate can do professional electronics design work with modern MSI and CMOS digital circuitry, op amps, and even IC phase locked loops.

Finally. All of these programs offer the potential home study school student some very exciting, interesting, and valuable alternatives in continuing education. Each course is accredited by the National Home Study Council in Washington, DC. There just may be some other equally good programs that meet your needs buried in amongst the color TV ads. It can be an interesting project to ferret them out.

You can get more information on the courses described here by simply sending in the insert or reader service cards in this magazine. Take a look at what the various schools have to offer. It doesn't cost you anything and you may find a program suited to your current or future requirements. Good hunting! ■



The 20,000-ohm/volt VOM, experimental breadboard, and some of the components supplied with the CREI course with Design Lab option.

LITERATURE LIBRARY

101. Kit builder? Like weird products? *EICO's* 1975 catalog takes care of both breeds of buyers at prices you will like.

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* 1975 line-up of CB transceivers & scanner receivers (for police, fire, weather, & other public service emergency broadcasts).

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.

105. Get *Antenna Specialists'* cat. of latest CB and VHF/UHF innovations: base & mobile antennas, test equipment (wattmeters, etc.), 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 colorful booklets on their Signal Kicker antennas, which are computer optimized for CB. Another booklet covers their communications microphones.

111. *Midland's* line of base & mobile CB equipment, marine transceivers & accessories, and scanner receivers are illustrated in a new full-color 16-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.

113. Get all the facts on *Progressive Edu-Kits* Home Radio Course. Build 20 radios and electronic circuits; parts, tools, and instructions included.

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; TV1 filters; automotive noise suppressor kits; SWR Power and FS meters, etc.

146. *Robyn International* has 4-color "spec" sheets for each model of their CB (base and mobile) transceivers and monitor-scanner lines.

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

119. *Browning's* mobiles and its famous Golden Eagle base station, are illustrated in detail in the new 1975 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* 1975 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" 1975 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.

124. *Mosley Electronics* reports that by popular demand the Model A-311 3-element CB beam antenna is being reintroduced. Send for the brochure.

125. *RCA* Experimenter's Kits for hobbyists, hams, technicians and students are the answer for successful and enjoyable projects.

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

129. Semiconductor Supermart is a new 1975 catalog listing project builders' parts, popular CB gear, and test equipment. It features semiconductors—all from *Circuit Specialists*.

130. *Heath's new* 1975 full-color catalog is a shopper's dream—chock-full of kits and gadgets everyone would want to build and own.

131. *E. F. Johnson's* new full-color catalog for CB transceivers and accessories is now available. Send for a free copy. They also have a free brochure on their line of scanner receivers.

126. *B&F Enterprises* has an interesting catalog you'd enjoy scanning. There are geiger counters, logic cards, kits, lenses, etc.

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.

133. Get the new free catalog from *Howard W. Sams*. It describes 100's of books for hobbyists and technicians—books on projects, basic electronics and related subjects.

134. *Sprague Products* has L.E.D. readouts for those who want to build electronic clocks, calculators, etc. Parts lists and helpful schematics are included.

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

137. *Pace Communications* has a packet of information for you. The "Citizens two-way radio" answers all the questions from how to operate one to how much they will cost to operate. A booklet on Pace's scan/monitors to keep you informed is included.

138. *Pearce-Simpson* has a booklet, "Citizens Band Radios & Scanners," which pictures and describes the various models in this line. A section on CB antennas is included.

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.

147. *Telex's* 4-page, 2-color folder illustrates their new line of boom microphone head-sets for CBers and hams, as well as their line of communications headphones.

149. *Cush Craft* has a catalog on Citizens Band Antennas for every purpose. The Ringo base antenna is featured, as is the new Superfire 8-element horizontal/vertical power beam.

Elementary Electronics, Box 886
Ansonia Station, New York, N.Y. 10023

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Voltage Multiplying

(Continued from page 72)

spacing of all components to prevent arcing within the power supply.

As load requirements increase, adequate ventilation must be considered. The diodes, and to some extent the capacitors, dissipate heat because of forward-drop, switching, and leakage losses. This heat must be removed to prevent the diodes from going into thermal runaway.

Capacitor values should be as large as practical, but some values may become too expensive to be considered for your application. Though filtering and regulation will be improved by using large values of capacitance, there is a point beyond which the improvement isn't worth the cost. The optimum value of capacitance can be calculated using (for you math whizzes)

$$C = \frac{N^3 \ I_o}{720 \ (NV_P - V_o)} \qquad (1)$$

For simplicity, all capacitors should have the same value and voltage rating. The value computed using formula number (1) is not absolute; the nearest value available at your parts house, or found in your junk box, will suffice.

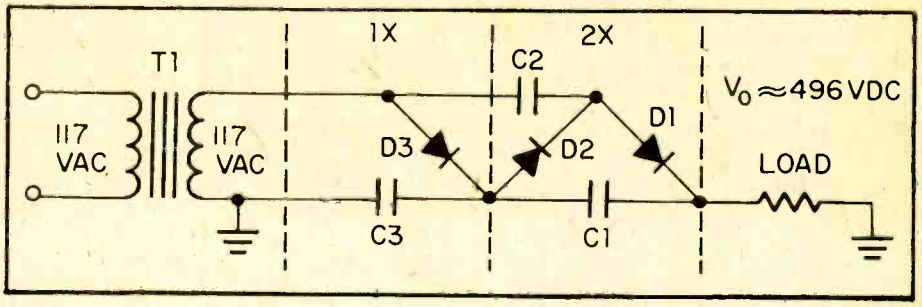
Determining Output Voltage. The output voltage of any multiplier circuit with a load is a function of the input voltage, the source impedance, the capacitor values, the forward voltage drop of the diodes, and the frequency of the input voltage. By assuming that the diodes are ideal (no voltage drop across them in the forward direction) and if the values of all capacitors are made equal (generally the best way to go) the approximate output voltage from a given circuit can be calculated using

$$V_o = NV_P - \frac{N^3}{720(C)} \ I_o \qquad (2)$$

if the input frequency is 60 Hz—as will be the case in most instances.

If you have decided to use a specific circuit configuration (say a tripler), know the output voltage that you want, and have selected the capacitors that you "must" use, you can calculate the required input voltage using

Fig. 3. Voltage tripler circuit—basic half-wave and a doubler.



$$V_{IN}\ (PEAK) = \frac{V_o + \frac{N^3 \ I_o}{720(C)}}{N} \qquad (3)$$

In formulas (1), (2), and (3)

C = the value of the capacitors used in the voltage multiplier circuit. All capacitors should have the same value.

I_o = the amount of current required from the power supply.

N = the number of diodes used in the voltage multiplier circuit.

V_o = the output voltage expected from the voltage multiplier circuit.

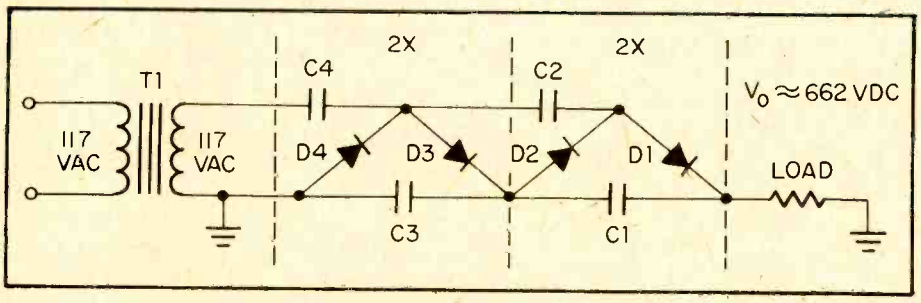
V_P = the peak value of the transformer secondary voltage.

If a negative output voltage is desired merely reverse all the diodes in a voltage multiplier circuit. All other considerations remain the same.

If the math leaves you cold, you can still build voltage multiplier circuits by making some educated assumptions. Use the largest values of capacitance that you can locate, say 10 to 20 microfarads, and assume that the voltage output will be approximately 70 percent of the theoretical value if the power supply were unloaded. This procedure will provide valid results, and the power supply output will be within normal tolerances for most applications.

One last word of caution. These supplies can add up to a lethal dose of the old EMF. Take care. ■

Fig. 4. Voltage quadrupler circuit—two voltage doublers.



Tape DX

(Continued from page 80)

and not the on-off switch attached to the back of the control); the volume control lugs are three in number, and one end lug will no doubt be grounded. The "hot" lug is the one on the other end of the array. The shield of the phono cable is connected to the grounded volume control lug. Route the cable over to the phono jack just mounted, keeping away from the power supply and other electrical components, and then connect the inner conductor to the center of the phono jack and the shield to the jack's ground lug.

If the wiring is done correctly, the setting of the receiver volume control will have no effect on the level of the audio coming out of the phono jack into the tape recorder. By tapping the audio early in the receiver, use of speakers, headphones, or volume setting have no effect on what goes to the tape.

Occasionally, depending upon the input impedance of the tape recorder chosen, you may encounter a very slight loss of audio as it appears in receiver's speaker or headphones. In no way does this affect the sensitivity or alignment of the receiver, nor does it damage the audio sections of the receiver. Just turn up the volume a little if you want to listen—remember the setting makes no difference for taping. In this listening "shack" I notice the effect only with my cassette unit on two tube receivers, but not when it is connected to a transistor communications receiver; tape quality is unimpaired and I have plenty of reserve audio gain.

Extracting audio ahead of the receiver's volume control is the *best* way to tape, period. It is a shame that manufacturers don't include the tape jack as standard equipment, but as the investment is a paltry 50¢ at the most,

there is virtually no reason that the SWL who tapes does not install a tape jack himself. The operation should take no more than 15 minutes, and most of that time will be spent in uncovering and then recovering the receiver's chassis wiring.

Taping your DX as you listen is a "good" way to go. This article has only begun to scratch the surface on the subject of tape recording. There are many texts on the subject available in the local library or on the bookstands of electronics jobbers. The texts will talk about the features of tape recorders in detail, and what accessories are useful to the operation and maintenance of the machine; examples are tape splicers for editing tape, head demagnetizers for "cleaning" the heads of stray magnetic fields, bulk tape erasers to remove unwanted material previously recorded on the tape (much better than using the built-in erase head), leader tape for beginning and ending tapes, labeling, and timing them.

Tape recorders are available for as little as $20 or $25. Even if you are a beginning SWL with a limited budget there are several cassette tape recorders in this price range that shouldn't dent the wallet too badly. Throw in another couple of dollars for a couple of 60- or 90-minute cassettes and either a patch cord or the phono jack and the shielded wire, and you can walk out of the store for less than $30, tax included.

The use of the equipment in DXing is only bounded by your imagination. DX can be replayed for your friends, or you can save tapes containing unidentified stations until someone can be found to translate that foreign language, or who knows?

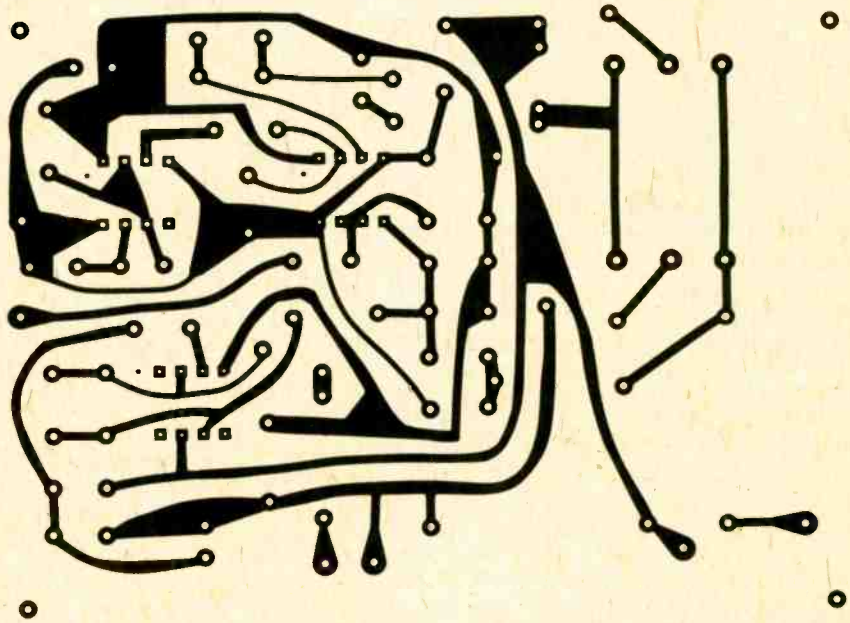
In a short period of time, I'm sure you'll agree . . . a tape recorder is the DXer's best friend. Give it a try! ■

Pulse Power

(Continued from page 62)

By having the audio signal control when the transistor switches the power supply to the load, the signal is amplified.

A transistorized digital amplifier can amplify an electrical pulse in the most efficient manner possible—either with a transistor fully on or fully off (conducting or cut off). Conversely, a transistor operating in the analog mode is always swinging between these two conditions without ever reaching either state. That's why the single-ended class A audio analog amplifier is so inefficient (on the order of 20%). It burns up (dissipates) most of the power in itself as it meters out some of the power to the load (the speaker). But when a transistor is fully on (saturated) there is very little power lost (as heat) in the transistor. Virtually all power is passed through to the load. Also, when the transistor is off, very little power is "leaked" to the load. This accounts for the very high potential efficiency (about 95%) of a class D digital amp. ■



This is the bottom (copper) side of your PC board. You can either etch your own by placing this over a piece of carbon paper and a piece of copper clad board (trace the image onto the copper, fill the lines in with a "resist" pen and etch in solution) or you can buy a pre-etched and drilled board.

Inside CB

(Continued from page 71)

the RF power it's capable of delivering. If the antenna is actually 25 ohms the transmitter will put about 50 percent to 75 percent of its potential power into the antenna system, depending on the design of the transmitter output circuit.

The only way you can get maximum power output from the transmitter when the actual transmitter to antenna mismatch is greater than about 2:1 is by using a matching device that will make the antenna system *appear* as a 50 ohm load to the transmitter. Such a device often goes under the description of CB Antenna Tuner, CB Matcher, CB Antenna Matcher, or some similar term. The important part of the description is "CB." Antenna tuners or couplers designed for other communications services can be "longwire" matching devices; for CB we need a device that matches a transmitter to a transmission line, not a transmitter to a random length of wire.

The CB matcher (at least those presently available) makes the overall antenna system load appear as 50 ohms, so the transmitter delivers all its potential energy into the matcher. The matcher then couples *all* this energy into the antenna system. If the transmission line is a half-wavelength or multiple, all the energy flows into the antenna. This is true for base and mobile antenna systems.

Keep in mind, however, that the matcher does nothing if the system is matched to begin with, for it cannot improve what is already optimum. You know it will work for you if, (a) adding a ¼-wavelength section changes the SWR reading *and,* (b) if the transmission line is a half-wavelength or multiple. You must have both conditions.

If you use a matcher, the transmission line is measured from the output of the matcher to the antenna, with the SWR meter between the transmitter and the matcher—using short connecting cables. If you can set up this type of installation *after* you have adjusted the antenna system for minimum SWR, adjust the matcher for minimum SWR *between the transmitter and matcher* (which will usually also correspond to maximum forward power output).

And Then Modulation. Your final adjustment is the modulation. All CB rigs will work if you talk into the mike, but the clarity of the modulation will be determined by the overall microphone gain built into the transceiver. Too much gain and you get distortion, even with so-called compressors, for they have an optimum working range. Some CB rigs do not have modulation limiting, and too high a voice level produces excessive distortion. Too low a voice level will barely be heard. Somehow, somewhere, borrow a modulation meter—it doesn't have to be laboratory grade. Hold the mike in your normal position and speak in a normal voice. Is the signal less than 100 percent modulated? If so, either raise your voice level or use an amplified mike (see next caution).

If the meter indicates 100 percent modulation try lowering your voice. Does it still indicate 100 percent modulation?

Reduce your voice level still further. If a whisper still produces 100 percent modulation you can be certain the distortion at normal voice level will turn your signal into hash or mud when it's coming in just above the noise level. Have a technician reduce the overall microphone sensitivity so your normal voice level just about produces 100 percent modulation on peaks. If your rig has a built in compressor, "range boost-

ELEMENTARY ELECTRONICS INDEX TO ADVERTISERS

Our objective is to serve as best we can the ever broadening interest in the electronics and comunications field. *Elementary Electronics* is made available nationally on all leading newsstands and in Radio Shack stores. Should, for some reason, copies of E/E not be available, or are sold out at your favorite location, we shall appreciate your letting us know by dropping a card in the mail to the Publisher, *Elementary Electronics*, 229 Park Avenue S., NY, NY 10003.

er," "talk power booster," or some such similar compression device, you'll find a moderate to loud voice level will give 100 percent modulation. This is normal. You have problems only when you must shout or whisper for 100 percent modulation.

Wrap Up. These hints for optimum CB performance conclude this series of articles designed to give you a better insight into your personal choices in CB equipment. But it doesn't conclude CB coverage by ELEMENTARY ELECTRONICS. In every issue Kathi will still be keeping you informed on the latest developments in CB gear, and periodically we'll be bringing you the latest in CB construction projects, new regulations, and the use of the new regulations for better CB communications. With the FCC revamping a good part of CB operations and procedures there's a whole new world of equipment waiting in the wings, and ELEMENTARY ELECTRONICS will be on top of all the CB action as it happens. ■

Planetarium

(Continued from page 53)

electric can opener, recorded by a close-up mike with the level controls wide open, has provided the satisfyingly real thunder of rocket engines for several space epics. A tape recording of a group of staff members, humming in choral unison, was converted into a mysterious "space" sound through manipulation on the mini-Moog.

All audio materials—narration, music, and sound effects—are recorded on a master multi-channel tape recorder for synchronized playback with the vast array of projectors.

Computer Automated. Most star shows created at the Strasenburgh are run through under manual control only once. This is actually a recording session, during which all the switching sequences are "memorized" by the computer. Regular showings for audiences are literally computer controlled, virtually untouched by human hands under most normal conditions.

Live Performances. The unique possibilities offered by the Strasenburgh's design and its equipment are too tempting for people with the theatrical flair of director Hall and his creative crew to restrict to the classic world of astronomy. So they've gotten involved in entertainments that range from the mixed-media presentation of a jazz combo to a new form of theatre in the round.

"Now that you know the way, don't be such a stranger!"

Instead of the usual, pit-like "stage" of regular theatre in the round, the Strasenburgh provides a raised circular platform at the center of the audience, the decked-over well of the fully retracted Zeiss projector. Aisle space around the platform serves as a lower-level stage area. When a script calls for a balcony or window scene, the upper projection tier becomes an elevated stage, the performers on it made visible through the perforated dome by clever feats of lighting.

The Star Theatre's projection facilities give a scenic designer extreme latitude. In a production of Berthold Brecht's "Galileo," one scene called for a public demonstration, and some of the demonstrators carried blank placards. Projected artwork filled in the placards. For a presentation of Aristophanes' "The Birds," smoke was spewn into the air by ceremonial fires, and a parade of lights and clouds streaked across the "sky."

Undoubtedly the most offbeat presentation ever offered at the Strasenburgh Planetarium was a concoction titled "Cine Dreams." Literally a giant slumber party that ran from 11 p.m. to 7 a.m., "Cine Dreams" consisted of a phantasmagoria of images, constantly changing on the sky dome. The object was to see whether they could help to shape the dreams of an audience deliberately lulled to sleep. A figurative as well as literal sleeper of a show, "Cine Dreams" surprised the staff by selling out two nights running. Whether a breakfast thrown in for the price of admission helped its popularity is hard to say.

A Word from the Critics. How do conventional planetarium people feel about the relatively wild and woolly ways of the Strasenburgh? There's a certain amount of tongue-clicking about the totally unorthodox, non-astronomical offerings. And there are critics who

consider the star shows a bit too "spaced out," too mechanical.

One such critic is Dr. Henry King, director of Canada's distinguished McLaughlin Planetarium in Toronto.

"Running a show as a lecturer gives me a tremendous sense of satisfaction," he says. "The use of tape lacks a personal touch, and I believe the fewer special effects, the more reliable the program.

"At Strasenburgh, the educational message is heavily gilded, shrouded and sugared. It is a combination entertainment-educational facility. Ours is more educational, in the nicest sense, giving accurate information about astronomy."

But Dr. King concedes the computerized show has come to stay and is even finding its place in the McLaughlin universe.

A considerably more enthusiastic commentator is Mark Peterson, curator of Denver's Gates Planetarium.

"The key to planetarium programming," he declares, "should be believability. You should use every audio-visual means you can afford and do everything possible to make the audience feel what you are trying to put across. Then you can fill their little shell pink ears with all kinds of information. This is the thing they do best at Strasenburgh."

Does it work? Countless local science teachers think so enough to make the Rochester Planetarium's school presentations a regular part of their curricula. And the Strasenburgh's public shows have racked up attendance records that the directors of other planetariums would gladly eat their budgets for. ■

Antique Radio Corner

(Continued from page 76)

be available through Antique Radio Press, Midco Enterprises, and Alan Douglas.

Clean Up Those Dials. Many of you readers have written in asking how to restore the white filled markings on radio dials, knobs, and panels. There have been several methods describing how to do this in the AWA Old Timers Bulletin, and in Antique Radio Topics. For the benefit of those readers who haven't seen these accounts I will give you my version of how to do it.

To do the best job it is necessary to first remove all the old white material remaining in the lettering. A sharp instrument such as a hat pin, a needle, a toothpick, or other sharp pointed tool can be used. You can also use a stiff bristled brush or a stainless steel brush such as the ones sold by Brookstone Company, Peterborough, NH 03458. When the depressed lines are clean there are several materials that can be used to fill the lines again. Some of them are white crayon, white paint, chalk dust mixed with white glue, and white lacquer sticks. The lacquer stick makes the neatest job of all the materials I've tried. Lacquer sticks can be obtained from paint stores, hobby shops, hardware stores, etc. Carefully fill the lettering and or lines as neatly as possible, then using a soft cloth gently rub the excess from the knob or panel. In extreme cases you may have to moisten the cloth with lacquer thinner or lighter fluid to remove the surplus material. Before using any solvent always try some on a part of the item where it won't show. Some materials will be disolved by these solvents.

By the time you read this column another book will be available from the publisher of Vintage Radio books. Titled *A Flick of The Switch*, it will cover radios built between 1930 and 1950. It will contain many old time radio ads and photographs of over 1000 radio sets that will soon become collectors items. As soon as I receive a review copy I will report more fully on its contents. As usual it will be available from Antique Radio Press, P.O. Box 42, Rossville, IN 46065. It will come in two versions, the hardback copy will sell for $9.95 and the softback handbook will sell for $6.95. It will be shipped postpaid.

Why Not AC Radios? Along these lines I would like to talk a little bit about collecting AC-powered radios made after 1928. I have met many collectors who would not consider keeping an AC radio, they want only battery sets made before 1928. If the number of antique radio collectors increases as much as I think it will there won't be enough battery radios for everyone. Many of our younger collectors with limited budgets are getting a thrill out of finding a pre-World War II AC radio that equals the thrill experienced by the older collector when he found his first battery radio. Let's not look down our nose at the collection of a person who only has AC radios. There is room enough for all in the hobby of collecting old radios. If some of the collectors who have hundreds of battery radios would share with the new collector, how much happier everyone would be!

In years to come there will be many AC radios that will become very desirable to collectors. Now there are specialists who are collecting E. H. Scott, McMurdo Silver, certain models of Capehart, cathedral radios, early short wave radios, and other rare and valuable models. In future years the shoe will be on the other foot. The collector who has spurned the AC radio will be eager to trade his battery radios for them. So my advice to AC radio collectors is to "hang in there," pick up all the AC radios you can find at the right price, restore them, and wait for the future.

I would like to congratulate Davis Publications, Inc., and in particular the Editor-in-Chief, Julian S. Martin, of ELEMENTARY ELECTRONICS magazine, for it's new size and new look. I am proud to be a contributor to a magazine as progressive as this one is.

So long for now! I will be back in the next issue with more news and views on collecting old radio and wireless equipment. ■

Antenna Systems for SWLs

(Continued from page 44)

tuner that you can easily build is shown in Fig. 5. Details of the tuner built in a small utility box is shown in the photographs. This SWL antenna tuner can be used to improve the performance of any longwire antenna. Select the proper range for C1 with S1 and peak C1 for best S-meter output on your receiver. Fig. 6 is a photo of the completed SWL antenna tuner ready for connection to your antenna system and receiver.

Summing Up. The best antenna for you depends on the type of DX hunting you want to do and the space available. A long-wire with the antenna tuner shown will work well for general listening. If you're interested in a particular part of the work and a particular band, a single frequency dipole pointed in the right direction will give excellent results. If you want one antenna that will do as much as possible, use a multi-band antenna. In any case, those hard to log DX stations will come a lot quicker with any of these antennas, mounted as high as possible. ■

Fig. 6

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Newscan

(Continued from page 37)

bers of Kamalii O'Kai, the marine science club at Pearl City High School, to determine whether telephone booths could be used in the underwater communities being contemplated for possible human habitation in the future. Hawaiian Telephone Company, a subsidiary of General Telephone & Electronics Corporation, supplied the communications equipment and provided technical advice for the project.

"Several phone booths could be anchored to the ocean floor at strategic points around an underwater habitat and linked by waterproof cable to each other, to the habitat, and to surface support facilities," said Dexter Cate, the students' marine science teacher who directed the experiment. "Divers working on the ocean floor would use the phones to communicate with other points on the miniature marine telephone network."

While suntanned surfers rode the waves at popular Makapuu surfing beach on a recent Saturday afternoon, several other young aquatic enthusiasts were making telephone calls from an underwater phone booth anchored nearby. The experiment was conducted by members of Kamalii O'Kai, the marine science club at Pearl City High School, to determine whether telephone booths could be used in the underwater communities being contemplated for possible human habitation in the future.

In the recent experiment, members of Kamalii O'Kai (Hawaiian for "children of the sea") constructed an airtight wood-and-steel booth three feet square and four feet high. They included glass portholes to permit occupants to view fish swimming by. The booth was equipped with a wall-model telephone and a desk phone for the topside dock use. The instruments were connected by 300 feet of waterproof cable and were powered by a small amplifier unit.

Members of the club lowered the booth into the water, chained it a few feet above a steel anchor on the ocean floor, and filled it with compressed air from a scuba tank. The telephone, wrapped in a plastic bag, was taken down to the booth and installed. Mr. Cate than dove down to the booth to make the first call to the students on the dock. This is how he described his initial reactions: "The air in the booth is warm and humid. The booth is swaying back and forth slightly in the current, but not uncomfortably. Our phone connection is surprisingly clear. I don't know why, but I expected the voices to be somewhat hazy."

During the experiment, which continued for four hours, members of Kamalii O'Kai took turns diving down to the booth and talking with others back on the dock. The booth was constructed with only four sides and a top so that the divers could enter through its open bottom which was suspended a few feet above the ocean floor.

Following the successful experiment the booth was raised from the water and taken back to Pearl City High School. Although there are no further plans for the booth at this time, the club is considering advancing into the development of an underwater habitat. There is now an urgent need for waterproof wooden nickels.

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Poles Have a Future

A life span of a couple of decades may not be much for you, but for a telephone pole it's old age. Though more and more telephone lines are buried underground all the time, more than 300,000 new or replacement wooden telephone poles are needed every year. And each pole must be chemically treated to insure the longest service life possible.

Raw wood poles, when exposed to rain, heat, freezing, fungus, and insect (especially termite) attack, will not last longer than a few years. So timber product specialists specify treatments for the poles to make them reach the oldest age possible. By making the wood last longer, industries help preserve one of the nation's greatest natural resources.

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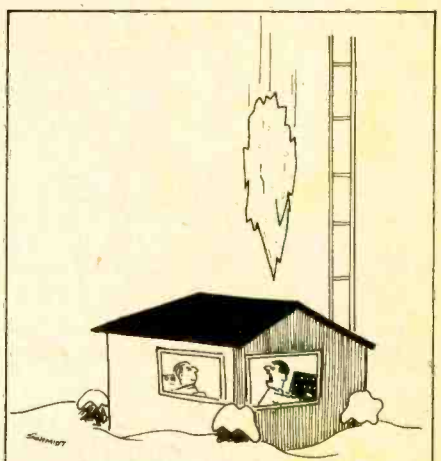

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