

elementary Electronics

JANUARY-FEBRUARY 1978 \$1.25

FOR BEGINNERS
SIMPLE PROGRAMS

Solve all your reactance, capacitance, and inductance problems with REACT, our newest computer program

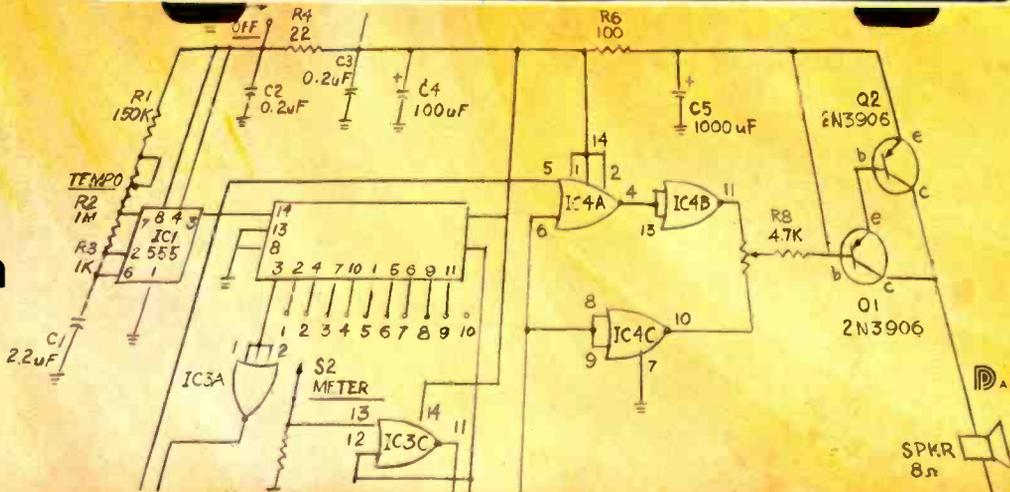
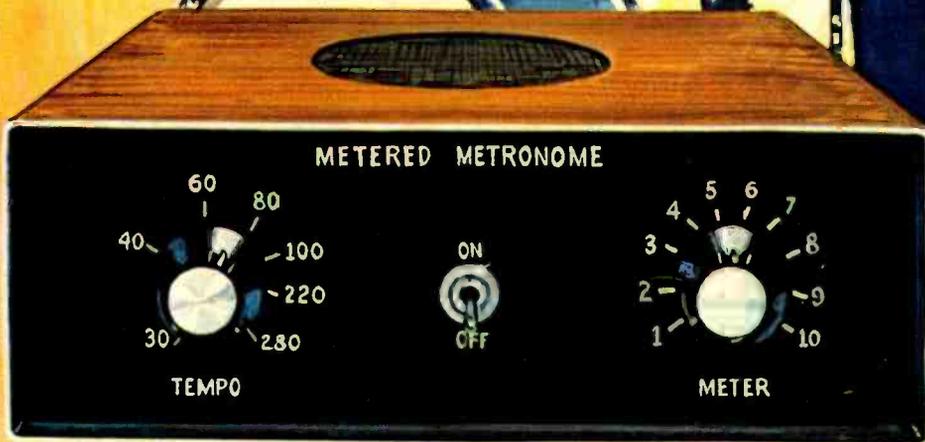
Home Computer Galaxy

How to pick 'em
page 79

Where to buy 'em
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Way to use 'em
page 81

Mighty Met means right-on rhythm



Each problem...
page 35

Repeaters
On
rs
D

Midget Digit
Brightens
Your Darkroom



Read what the U.S. Dept. of Labor* says about these growing career fields:

1. Electricians (Construction and Maintenance)

In selecting apprentice applicants or trainees, employers look for young people who have manual dexterity and are interested in learning how electrical equipment functions. Applicants also need good color vision because electrical wires are frequently identified by color. Although physical strength is not essential, agility and good health are important. Employment of construction electricians is expected to increase rapidly through the mid-1980's. Employment of maintenance electricians is expected to increase moderately through the mid-1980's because of the growing amount of electrical and electronic equipment used in industry.

2. Auto Mechanics. For entry jobs, employers look for young persons with mechanical aptitude, and a knowledge of automobiles. Generally, a driver's license is required. Courses in automobile repair offered by many high schools, vocational schools, and private trade schools are helpful. Courses in science and mathematics help a person better understand how an automobile operates. Employment is expected to increase because expansion of the driving age population, consumer purchasing power, and multicar ownership will increase the number of automobiles.

3. Accountants. Greater use of accounting information in business management, changing tax systems, and growth of large corporations all point to excellent opportunities for accountants. People planning a career in accounting should have an aptitude for mathematics. Neatness and accuracy also are necessary. Employers seek applicants who handle responsibility and work with little supervision. Employment of accountants is expected to increase rapidly through the mid-1980's as businesses and government agencies continue to expand in size and complexity.

4. Engineering and Science Technicians. Industrial expansion and increasing complexity of modern technology underlie the anticipated increase in demand for technicians. Those interested in a career as a technician should have an aptitude for mathematics and science, and enjoy technical work. An ability to do detailed work with a high degree of accuracy is necessary; for design work, creative talent also is desirable. Employment opportunities are expected to be favorable through the mid-1980's.

5. Air-Conditioning, Refrigeration, and Heating Mechanics. Increases in household formations and rising personal incomes should result in a very rapid increase in the number of air conditioned homes. Air-conditioning in offices, stores, hospitals, schools, and other buildings also is expected to increase. Employers prefer high school graduates who have had courses in mathematics, physics, and blueprint reading. Mechanical aptitude and an interest in electricity are important qualifications. Good physical condition helps in lifting and moving heavy equipment. Employment is expected to increase very rapidly through the mid-1980's.

6. Draftsmen. Those planning careers in drafting should: be able to do detailed work requiring a high degree of accuracy; have good eyesight and eye-hand coordination because most of their work is done at the drawing board; be able to function as part of a team since they work directly with engineers, architects, and skilled workers; and be able to do free-hand drawings of three dimensional objects. Employment of draftsmen is expected to rise rapidly as a result of the increasingly complex design problems of modern products and processes. Prospects will be best for those having post-high school drafting training.

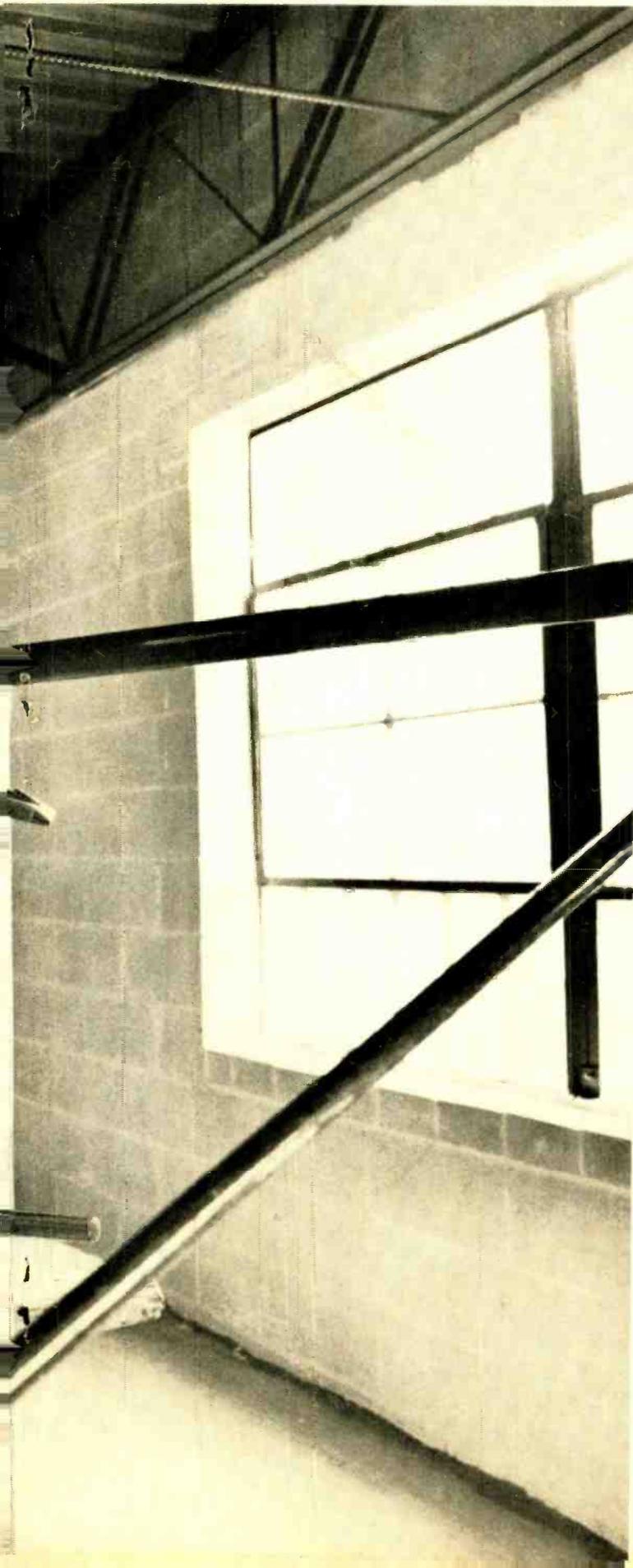
* Bureau of Labor Statistics, *Occupational Outlook Handbook*, 1974-75 edition.

SIX GOOD JOBS FOR

Electrician

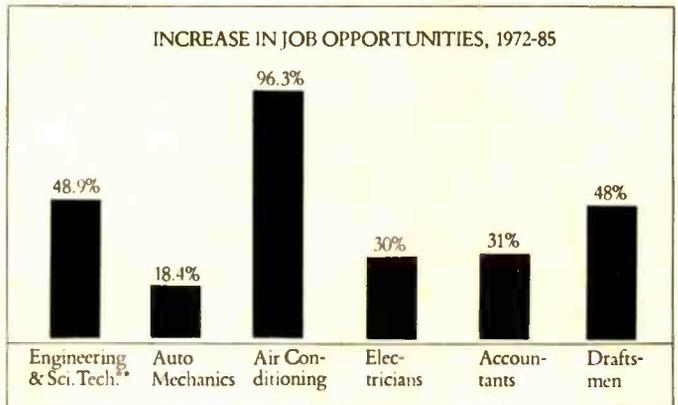


THE 70's & 80's



If you're looking for a new career, you should keep in mind that some job fields will grow faster than others over the next ten years. (Some, such as barbers, railroad workers, meat-cutters, etc., will actually decline.)

Why do we tell you this? We're ICS—International Correspondence Schools—and we offer career training in fields the government experts say are likely to increase over the next decade.



Source: U.S. Dept. of Labor, Bureau of Labor Statistics, *Occupational Manpower and Training Needs*, Revised 1974. * This category includes electronics and a variety of engineering fields available through ICS, as well as some technical fields which ICS does not offer.

Of course, we can't guarantee you a job—no school can do that. But we can give you the first-rate training you need, especially if you're interested in one of the growing career fields where ICS concentrates its training.

You could even earn a college degree without going to college. The ICS Center for Degree Studies is authorized by the Pennsylvania Department of Education to grant the Associate in Specialized Business degree in Accounting and Business Management, and the Associate in Specialized Technology degree in Civil, Mechanical, Electrical, and Chemical Engineering Technologies.

These degree programs are not mere stepping-stones to higher education nor are they primarily intended for transfer toward more advanced degrees. They are practical, career-oriented programs designed to help you reach your objectives without further academic training.

As an ICS student, you study at home, at your own pace. But you're never alone. If you ever want to talk to an instructor, you can call ICS from anywhere in the continental United States or Canada, using our toll-free Dial-a-Question* service.

Since 1890, millions of men and women around the world have turned to ICS for career training. More than 70 of America's largest 100 corporations (including Bethlehem Steel, 3M, Union Carbide, Weyerhaeuser, International Paper) use ICS training for their own employees.

No one can promise success, but if you *want* more—more money, more security, more day-to-day satisfaction and more future—our free Career Booklet and free Demonstration Lesson can help you get started in the right direction. Just check the box next to the field that interests you most and mail the card or coupon today. There's no obligation.

ICS International Correspondence Schools, Scranton, Pa. 18515

Please mail me the Free Career Booklet and Free Demonstration Lesson for the field I have checked below. I understand I am under no obligation.

- | | | |
|---|---|--|
| <input type="checkbox"/> Electrician | <input type="checkbox"/> Air Conditioning & Refrig. | ICS Center for Degree Studies Associate in Specialized Business Degree in: |
| <input type="checkbox"/> Engineering | <input type="checkbox"/> Automotive Mechanics | |
| <input type="checkbox"/> Accounting | <input type="checkbox"/> Business Management | <input type="checkbox"/> Accounting <input type="checkbox"/> Business Mgt. |
| <input type="checkbox"/> Drafting | <input type="checkbox"/> Airline/Travel | Associate in Specialized Technology Degree in: |
| <input type="checkbox"/> Electronics Technician | <input type="checkbox"/> Interior Decorating | <input type="checkbox"/> Civil Eng. <input type="checkbox"/> Electrical Eng. |
| <input type="checkbox"/> TV Service & Repair | <input type="checkbox"/> Income Tax | <input type="checkbox"/> Mechanical Eng. <input type="checkbox"/> Chemical Eng. |
| <input type="checkbox"/> Surveying & Mapping | <input type="checkbox"/> Motel/Restaurant Management | <input type="checkbox"/> Electronics <input type="checkbox"/> Mechanical Design |
| <input type="checkbox"/> Construction Electrician | <input type="checkbox"/> Appliance Servicing & Repair | |
| <input type="checkbox"/> Diesel Mechanics | <input type="checkbox"/> High School | |

Print Name _____ Age _____

Address _____ City _____

State _____ Zip _____ Telephone _____

Veterans: Taken for career purposes, ICS Programs qualify for VA Benefits.

XA103M

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elementary electronics

January/February 1978

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Illustration by Len Goldberg



THIS ANTENNA WILL NOT KILL!!

HUSTLER'S NEW HOMING PIGEON™ THE FIRST ALL-INDOOR CB BASE

ANTENNA IS A TIMESAVER, WORKSAVER, .. AND LIFESAVER!



Patent Pending for Homing Pigeon™. Other Hustler antennas are protected by one or more New-Tronics patents: 3287732, 3513472, 3327311, 3419869, 3599214, 3873985, 3582951.

We don't drive you up a wall, outside, to install an antenna where power lines, wind gusts, and slippery footing can make installation dangerous or fatal.

Instead, the Hustler Homing Pigeon™ sets up and adjusts quickly, indoors, between floor and ceiling, just like a pole lamp. Takes only 1-1/2 square inches of floor space. Also, it covers 23 or 40 channel CB, AM or SSB. No fuss. No muss. No risk. **And it's perfect for apartments, condominiums, or anywhere an outdoor antenna is prohibited.**



Model HP-27



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tronics
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brookpark, ohio 44142
(216) 267-3150

.. AND THIS ANTENNA WON'T KILL EITHER!



It won't dart off like magnetic mounts can so it can't hit a passing car or pedestrian, leading to lawsuits — spin the knob to remove!



TRUNK LIP MOUNT

Stainless steel 48" or 55" heavy duty antenna, Hustloff™ mount, 17' cable. Installed connectors.

RAIN GUTTER MOUNT

Fiberglass 42" antenna, Hustloff™ rain gutter mount, complete with 17' cable, installed connectors.



The whole team wondered what Ron Brown was up to in his basement.

Word has it he was up to something mighty special. And when he didn't show up for bowling practice one Wednesday night, the Lucky Strikers (that was the name of his neighborhood team) began to wonder, too.

So it was that a bunch of the boys decided to pay their "star" a visit, and talk him out of his secret project and back into action. It didn't happen that way, though.

Matter of fact, it was Ron Brown who talked the Lucky Strikers out of their bowling night and down into his workshop. What was it... what could be exciting enough to keep a bunch of ten-pin tigers from their favorite pas-time? One of the most fascinating learn-at-home programs in the world, that's what!

Actually build and experiment with a new big-screen color TV in ASI's fascinating learn-at-home program. It will help you develop new skills as an electronics troubleshooter.

You'll set up your own electronics laboratory to discover first-hand the technology behind the most exciting innovations in the world of home entertainment electronics.

In fact, as part of the program, you'll actually build and experiment with a beautiful, integrated circuit 100% solid state color TV.

But most important of all will be the new skills you'll develop all along the way... the kind of skills that could lead you in exciting new directions. For example, like many of ASI's 140,000 graduates, once you complete the program you could use your training:

1. To provide part-time income
2. To start a business of your own
3. To seek out a job in the electronics industry
4. To upgrade your current job
5. As a foundation for advanced programs in electronics

Go exploring at home, in your spare time. No traveling to class. No lectures. No one breathing down your neck.

ASI wants to make it easy for you to get to know the exciting world of home entertainment electronics. You'll be able to develop new skills in your own home on whatever days and hours you choose. So you don't have to give up your present job or paycheck just because you want to prepare yourself for some future opportunities.

What's more, we believe that when you're exploring a field as fascinating as home entertainment electronics, reading about it is just not enough. That's why you'll get lots of "hands on" training experience with some of the most impressive electronic training tools you've ever seen!

No Electronics Background Necessary

That's one of the advantages of this program. We start you off with the basics and help you work your way up, one step at a time. You'll start right off using your hands as well as your head. That's because ASI firmly believes that one of the best ways to develop skills is the exciting "hands on" way.

Each time you receive new materials you will assemble and experiment with the kind of fascinating electronic equipment that will guide you with tests and experiments and will help you become familiar with operations and applications. With ASI you BUILD, EXPERIMENT, and KEEP:

- Signal Generator—This important tool helps you explore AM alignment and signal injection. This is a source of modulated or unmodulated signals. It provides a wide range

of frequencies for use in AM, FM, TV, LW and SW broadcast bands.

- Transistorized Radio Receiver—Build your radio in a spread out format directly on a large schematic diagram. You will learn how transistors, capacitors, resistors and other parts work together to receive radio signals and convert them into sound.
- VTVM (Vacuum Tube Voltmeter)—Build and troubleshoot measurements of DC+, DC-, AC rms and peak-to-peak voltages.
- Solid State Triggered Sweep Oscilloscope—See the heartbeats of tiny integrated circuits with one of the most universal of all testers. You'll experiment with displays of voltage waveforms found in audio devices, television receivers, transmitters and other electronic equipment.
- Vectorscope—Patterns for converging, adjusting and troubleshooting color television receivers. Solid state circuitry and integrated circuits are used for accuracy, stability and reliability since this will be a key instrument for troubleshooting and servicing color television receivers.
- Color Television Set—As you build, you explore automatic fine tuning, plug-in circuit boards, the cathode ray tube and all the components and circuitry used in the late model color receivers.

Besides these, you will also receive a pre-wired and assembled multi-tester plus a professional quality set of electronic hand tools and tool box.

And Only ASI Offers Audio/Visual Aids Too!

You will receive a filmstrip projector, filmstrips and records that SHOW and TELL you the proper way to perform some of the fascinating tests and experiments you'll do in the program. Only ASI offers this exciting way to combine theory with practice... and our graduates tell us that these aids are some of the most helpful and interesting parts of the program.

We try to give more personal attention than other learn-at-home programs.

1. Toll-free phone-in assistance. Should you ever run into a rough spot, we'll be there to help. While many schools make you mail in your questions, we have a toll-free line for questions that can't wait.

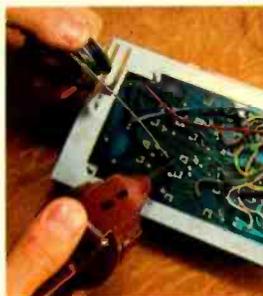
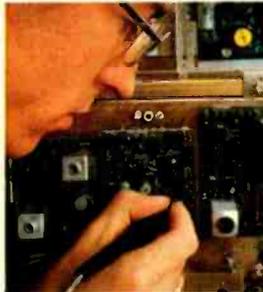
2. Every student is assigned a Personal Technical Advisor. He'll follow your progress and be available whenever you want to "talk shop" or bounce around an idea or two.

Send for free details today—for a more secure tomorrow.

Whether your goal is higher-paid job skills...extra income from part-time work...being your own boss...or simply to become your own electronics expert and experience the comfortable confidence that comes with having another marketable skill to fall back on, in case of hard times...ASI can help you reach it.

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Exclusive "Breaker Beam" lights when you key your mike... for any good buddy to see. "When antenna is recessed, beam is not visible."



The Antenna You Can Bank On

Breaker Beam the new fully automatic AM/FM/CB antenna has all the features you never knew existed, and always wanted. Breaker Beam offers more! Compare these outstanding features: 1. Turn your radio on and the antenna goes up, turn your ignition off and it goes down automatically. No antennas to unscrew, nothing to flip or flop. Nothing to "advertise" you have a CB. 2. CB will only operate when antenna is fully extended, eliminating transistor blow-out. 3. Pre-tuned signal splitter to separate frequencies. 4. Center loading coil for maximum performance. 5. Plug-in wiring for easy installation, hardware included. 6. Totally dependable in extreme weather conditions... and more.

Breaker Beam® ... the last antenna your car will ever need. You Can Bank On It. Ask for further details; see your local dealer or contact:

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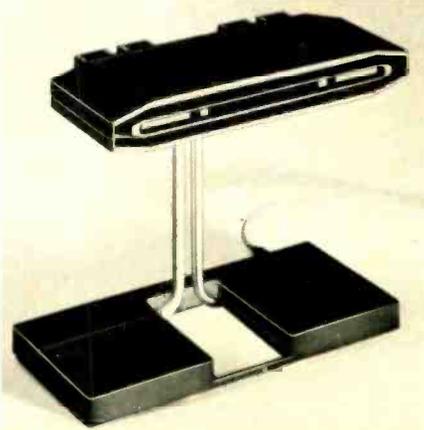
CIRCLE 38 ON READER SERVICE COUPON

Hey, look me over

Showcase of New Products

Negative Air Ionizer

A negative Air Ionizer is being offered by Edmund Scientific, Barrington, NJ. Some believe that when the number of nega-



CIRCLE 72 ON READER SERVICE COUPON

tive ions are increased in the atmosphere, contaminated air is subjected to a disinfecting process. Although Edmund has gathered material on the subject, the company makes no claim as to the medical effectiveness of the negative air ionizer. However, they are interested in the findings of experimenters. Researchers point out that ions are electrically charged particles that fill the air around us and, because of the effects of the solar rays, these atoms constantly gain and lose electrons. When they gain an electron, they become negative ions and have negative electrical charges. A lost electron forms a positive ion with a positive charge. A Reader's Digest article in October 1960 (limited research at that time) pointed out that negative ions might relieve depression and pains from burns. In biorhythm analysis, some researchers think it works to offset "low" cycles. Edmund's Negative Air Ionizer is a table-top model that emits a faintly sweet odor charged with negative air ions (does not emit ozone). It measures 6 3/4 x 3 1/2 x 6 1/2-in. and uses 110 VAC. The Negative Air Ionizer is priced at \$99.95 Ppd. (stock no. 72,280) and is available by mail from Edmund Scientific Co., 555 Edscorp Bldg., Barrington, NJ 08007.

Minicassettes

The 3M Company has introduced its first Norelco/Philips compatible minicassette, featuring Scotch brand Master low noise, high output tape. The Scotch brand

RD-30 minicassette is available in audio and office products outlets. The cassettes have the exclusive tensilized polyester backing with "Posi-Trak" coating, a sonically sealed precision shell, sensing foil for end of tape audible alert, and Scotch brand Master low noise, high output tape. The minicassettes work in any machine using the rim/spindle drive



CIRCLE 70 ON READER SERVICE COUPON

Norelco/Philips format, and are built with tight specifications. Both sides of the minicassettes have permanent brown and tan labels with space for indexing. Each minicassette is in an album type clear plastic box with a reversible index card. Scotch RD-30 minicassettes are blister packed two to a card and have a suggested retail price of \$7.99. The back side of the card indicates other minicassette recorder brands compatible with the Scotch RD-30 minicassette. Get details from 3M Company, Scotch Tape, P.O. Box 33600, St. Paul, MN 55133.

New Low-Cost Programmable Calculator

Sinclair Radionics has a personal, programmable calculator with a suggested retail price of just \$29.95. The Sinclair



CIRCLE 62 ON READER SERVICE COUPON

"Cambridge Programmable" offers the combined facilities of a powerful, straightforward arithmetic calculator, an advanced scientific calculator and a 36-step keyboard entry program. With a 36-step keyboard entry program memory,

(Continued on page 16)

President CB.

Because there are those who won't settle for anything less than the best.

That's why every President model has 40 channels.

That's why every President gets thoroughly tested to make sure it works perfectly before it leaves the factory.

That's why every President comes with all the power the law will allow. And why every President comes

with sophisticated electronic features like Phase Lock Loop circuitry for superior on-frequency performance.

That's why you'll find that our engineers have done just about everything known to man to give you

a better, stronger, clearer signal.

And that's why—no matter who you are or how much money you have to spend—you might as well start by looking at the best.



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CIRCLE 25 ON READER SERVICE COUPON

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In Canada: Lectron Radio Sales Ltd., Ontario



Learn digital computer

NRI is the only school to train you at home on a real digital computer.

Learn computer design, construction, maintenance and programming techniques on your own programmable digital computer.

Qualified technicians are urgently needed for careers in the exciting new field of digital and computer electronics . . . and the best way to learn digital logic and operations is now available to you in NRI's Complete Computer Electronics Course.

This exclusive course trains you at home on your own digital computer! This is no beginner's "logic trainer", but a complete programmable digital computer that contains a memory and is fully automatic. You build it yourself and use it to define and flow-chart a program, code your program, store your program and data in the memory bank. Press the start button and the computer solves your problem and

displays the result instantly.

The NRI digital computer is one of 10 kits you receive in the NRI Complete Computer Electronics Course. You build and use your own TVOM, and experiment with NRI's exclusive Electronics Lab. You perform hundreds of experiments, building hundreds of circuits, learning organization, operation, trouble-shooting and programming.

New NRI Memory Expansion Kit

The Model 832 NRI Digital Computer now comes with a new Memory Expansion Kit. Installed and checked out in 45 minutes, it doubles the size of the computer's memory, significantly increasing the scope and depth of your knowledge of digital computers and programming. With the large-scale IC's you get the only home training in machine language programming . . . experience essential to trouble-shooting digital computers.



electronics at home.

NRI offers you five TV/Audio Servicing Courses

NRI can train you at home to service Color TV equipment and audio systems. You can choose from 5 courses, starting with a 48-lesson basic course, up to a Master Color TV/Audio Course, complete with designed-for-learning 25" diagonal solid state color TV and a 4-speaker SQ™ Quadraphonic Audio System. NRI gives you both TV and Audio servicing for hundreds of dollars less than the two courses as offered by another home study school.

All courses are available with low-down payment and convenient monthly payments. All courses



provide professional tools and "Power-On" equipment along with NRI kits engineered for

training. With the Master Course, for instance, you build your own 5" wide-band triggered sweep solid state oscilloscope, digital color TV pattern generator, CMOS digital frequency counter, and NRI electronics Discovery Lab.



*Trademark of CBS Inc.

NRI's Complete Communications Course includes your own 400-channel VHF transceiver

NRI's Complete Communications Course will train you at home for



one of the thousands of service and maintenance jobs opening in CB; AM and FM trans-

mission and reception; TV broadcasting; microwave, teletype, radar, mobile, aircraft, and marine electronics. The complete program includes 48 lessons; 9 special reference texts, and 10 training kits. Included are: your own "designed-for-learning" 400-channel VHF transceiver; electronics Discovery Lab™; CMOS digital frequency counter; and more. You also get your all

important FCC Radio-telephone License, or you get your money back.



CB Specialist Course also available



NRI also offers a 37-lesson course in CB Servicing with your own CB Transceiver, AC power supply, and multimeter. Also included are 8 reference texts and 14 coaching units to make it easy to get your Commercial Radiotelephone FCC License.

You pay less for NRI training and you get more for your money.

NRI employs no salesmen, pays no commissions. We pass the savings on to you in reduced tuitions and extras in the way of professional equipment, testing instruments, etc. You can pay more, but you can't get better training.

More than one million students have enrolled with NRI in 62 years.

Mail the insert card and discover for yourself why NRI is the recognized leader in home training. Do it today and get started on that new career. No salesman will call.

If card is missing write:

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McGraw-Hill Continuing
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3939 Wisconsin Avenue
Washington, D.C. 20016

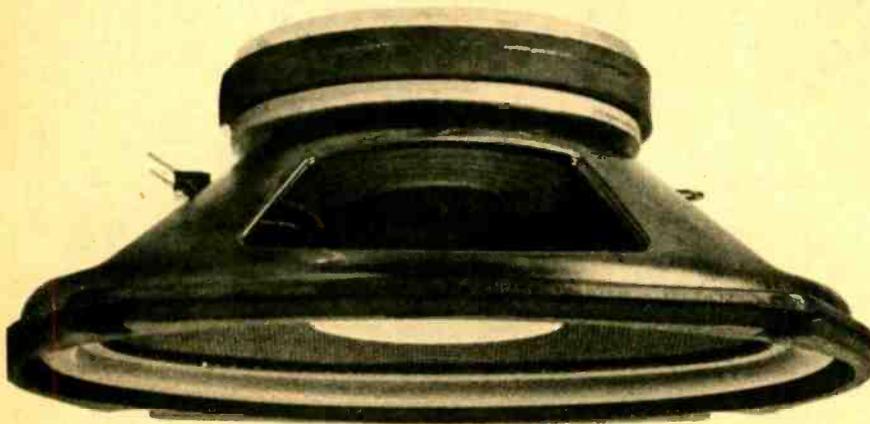
HEY, LOOK ME OVER

(Continued from page 10)

the Cambridge Programmable is able to handle a broad spectrum of the most frequently used calculations in finance and statistics, mathematics, physics, engineering and electronics, which Sinclair has compiled in a four book, 294 program library, priced at \$9.95 for the full set. The calculator features conditional and unconditional branch instructions, such as "go to" and "go if negative." A step facility allows the operator to assure that the program is correct during

entry. A "learn" key enables corrections to be made without affecting the accuracy of the program. Mathematical capabilities are: +, -, X, ÷, √ X, 1/X, X², 2X, sign change and algebraic logic; 8-digit floating point notation up to 99,999,999; scientific notation from 10⁻⁹⁹ to 9.9999999 × 10⁹⁹; 3-function memory; brackets and constant. Scientific capability covers: sin, cos, tan, arcsin, arccos, arctan, (all operating on radians); radians/degrees conversion; natural logs, and antilogs, e^X; scientific/floating point notation change. For more information, write to Sinclair Radionics, Inc., 115 E. 57th St., New York, NY.

"PERFECT BALANCE" sound - clean, clear and brilliant



MODEL 8971

You can drive 30 watts RMS through our 6" x 9" coaxial speakers all day, and they'll just keep cookin'.

Frequency response, power handling and efficiency are balance-blended to provide superb sound definition from the smallest stereo radios to 60 watt power amplifiers.

Let your ears be the judge. If you listen to a **KLASSIC™** speaker, you'll buy it.



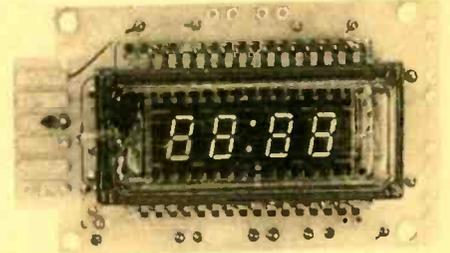
afs Kriket Acoustic Fiber Sound Systems, Inc.
Indianapolis, Indiana

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CIRCLE 5 ON READER SERVICE COUPON

12 VDC Digital Clock Module

Now you can add an electronic digital clock to your car, truck, boat or other 12 VDC vehicle with the new MA1003 Digital Clock Module available from Radio Shack stores. The digital clock module features a four-digit, 0.3-inch green vacuum fluorescent display with a blinking colon activity indicator. Accuracy is about ±0.5 seconds per day.



CIRCLE 32 ON READER SERVICE COUPON

Automatic display control circuitry turns off the display with ignition off, reduces brightness to 33% with park or headlights on and follows the dash lamp dimmer control setting. A lens may be used to filter the display color to blue, blue-green, green or yellow. The digital clock module is ready to use with the addition of three switches to control the "hours set," "minutes set" and "display on" functions. The "display on" switch is used to display the time when the ignition is off. The MA1003 Digital Clock Module for 12 VDC vehicle or portable applications is priced at \$24.95 and can be found at Radio Shack stores and dealers in all 50 states and Canada.

Accurate Turntable

The Sansui SR-838 Quartz-Servo Direct Drive Turntable incorporates a highly sophisticated PPL servo-control system, utilizing a quartz crystal oscillator, specially selected transistors and exclusively designed ICs, to control the 20-pole, 30-slot DC brushless direct drive motor, for



CIRCLE 63 ON READER SERVICE COUPON

the best wow and flutter specifications in Sansui's line: 0.025%! The large, heavy die-cast platter and precision-finished spindle is controlled by this advanced drive system to a speed deviation of less than 0.002%. The new "Mass Concentrated Fulcrum" S-shaped manual tone-

(Continued on page 18)

BUILD 20 RADIO and Electronics Circuits

Reg. U. S.
Pat. Off.



Training Electronics Technicians Since 1946

PROGRESSIVE HOME RADIO-T.V. COURSE

Now Includes

- ★ 12 RECEIVERS
- ★ 3 TRANSMITTERS
- ★ SQ. WAVE GENERATOR
- ★ SIGNAL TRACER
- ★ AMPLIFIER
- ★ SIGNAL INJECTOR
- ★ CODE OSCILLATOR
- ★ No Knowledge of Radio Necessary
- ★ No Additional Parts or Tools Needed
- ★ Solid State Circuits
- ★ Vacuum Tube Circuits

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

The "Edu-Kit" offers you an outstanding PRACTICAL HOME RADIO COURSE at a rock-bottom price. Our Kit is designed to train Radio & Electronics Technicians, making use of the most modern methods of home training. You will learn radio theory, construction practice and servicing. THIS IS A COMPLETE RADIO COURSE IN EVERY DETAIL. You will learn how to build radios, using regular schematics; how to wire and solder in a professional manner; how to service radios. You will work with the standard type of punched metal chassis as well as the latest development of Printed Circuit chassis.

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

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

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

THE KIT FOR EVERYONE

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

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

PROGRESSIVE TEACHING METHOD

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

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

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

THE "EDU-KIT" IS COMPLETE

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

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

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.

FREE EXTRAS

• SET OF TOOLS

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

SERVICING LESSONS

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

FROM OUR MAIL BAG

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

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

SOLID STATE

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

Progressive "Edu-Kits" Inc., 1189 Broadway, Dept. 588DJ, Hewlett, N.Y. 11557

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

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CIRCLE 14 ON READER SERVICE COUPON

Armchair Copy



Shortwave Listening

Our ONLY occupation is supplying everything you need to tune the mediumwave and shortwave bands—and identify what you hear. Our NEW mini-catalog details Barlow Wadley, Drake and Yaesu receivers, WORLD RADIO TV HANDBOOK, logs, receiving antennas & tuners, calibrators, FM or TV guides, AM pattern maps, QSL albums, ITU publications, RTTY displays, CONFIDENTIAL FREQUENCY LIST, clocks and all SWL books.

GILFER ASSOCIATES, INC

P.O. Box 239, Park Ridge, NJ 07656

CIRCLE 30 ON READER SERVICE COUPON

HEY, LOOK ME OVER

(Continued from page 16)

arm is designed for increased stability. Both the arm and the base are engineered and insulated to reduce extraneous vibrations and reduce the possibility of howl. Even the universal headshell connector contacts are goldplated to prevent deterioration of the signal quality. The sleek, black piano lacquer finish base is made from two-inch thick solid board. Newly-designed rubber feet provide superior feedback isolation. All controls are right up front for convenient operation, including an extra-wide, oil damped cueing lever for the easiest operation of any turntable. Complete with a removable, transparent dustcover with automatic hinges. Approximate nationally advertised value: \$390.00. For more information, write to Sansui, 55-11 Queens Blvd., Woodside, NY 11377.

250 Watt Per Channel Receiver

Designated as the Model 2500, the new Marantz stereo receiver delivers an unprecedented 250 watts per channel minimum RMS into eight ohms, from 20-20,000 Hz, with no more than 0.05% THD. The Model 2500 is capable of producing 330 watts per channel minimum RMS, into four ohms, from 20-20,000 Hz, with no more than 0.08% THD. A built-in oscilloscope provides the most accurate means of tuning indication and

determination of signal strength and FM modulation. In addition, this exclusive Marantz signal analysis system provides a precise indication of multipath rejection, stereo separation, phase relationships and turntable rumble or feedback. Another exclusive feature is the turbo-flow heat dissipation system derived from the popular Marantz 510 professional power amplifier. Turbulent airflow breaks up the insulating boundary layer of air which increases cooling efficiency by as much as 500 percent. By using the highly efficient pin-fin heat sink design, Marantz has overcome the size and weight



CIRCLE 56 ON READER SERVICE COUPON

problem generated by the use of conventional heat sinks. The result is a receiver which is remarkably compact and lightweight for the amount of power it can deliver. The 2500 also has LED indicators for peak power indication, a Bessel derived 18 dB per octave high and low filter, a full complementary direct coupled amplifier section, and an independent tape copy facility. It sells for \$1750. Get the full story direct from Marantz Co., Inc., 20525 Nordhoff St., Chatsworth, CA 91311.

Compact VOM

The new B&K-Precision 30,000 ohm/volt compact Model 115 VOM features a five ohm mid-scale range for checking the rather low resistances of coils, transformers and motor windings. All four

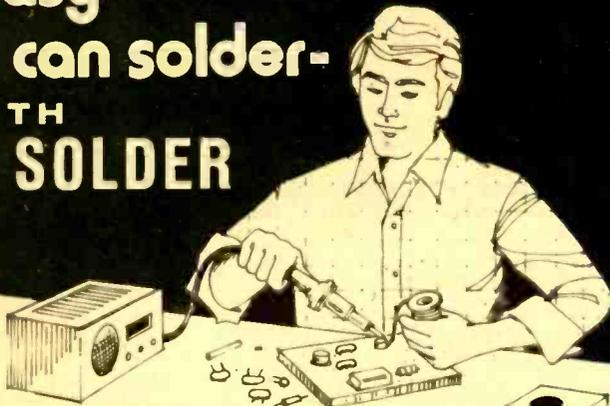


CIRCLE 65 ON READER SERVICE COUPON

resistance scales (0-500 ohms, 0-50K ohms, 0-500K ohms and 0-5 megohms), are fuse protected. For checks of thermocouples and oil burner controls, four DC current ranges are included (0.03 mA, 0.06 mA, 60 mA and 600 mA). DC and AC voltage measurement extends to 1200 volts, or 12kVDC with the optional HV-12 high-voltage probe adapter. A full-arc mirrored scale eliminates parallax errors. A 6 x 4 x 1.75-in., Model 115 is small enough to fit into most tool kits. Test leads and instructions are included. A carrying case is optional. The B&K-Precision Model 115 is user priced at \$37.50 and available for immediate delivery at local distributors. For more information, write to B&K-Precision, 6460 W. Cortland Ave. Chicago, IL 60635. ■

This is easy-
anyone can solder-
WITH
KESTER SOLDER

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SOLDER



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DO-IT-YOURSELFERS!**

Let Kester Solder aid you in your home repairs or hobbies. For that household item that needs repairing—a radio, TV, model train, jewelry, appliances, minor electrical repairs, plumbing, etc.—Save money—repair it yourself. Soldering with Kester is a simple, inexpensive way to permanently join two metals.

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KESTER SOLDER

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CIRCLE 9 ON READER SERVICE COUPON

IF YOU'RE WAITING FOR SOLDERLESS BREADBOARDS TO BE FASTER, EASIER, MORE VERSATILE AND LOWER-PRICED...

Incredibly inexpensive. EXPERIMENTOR solderless sockets begin at \$5.50* (\$4.00* for the 40 tie-point quad bus strip). A spool of solder costs more.

Microprocessors and other complex circuits are easy to develop. Each EXPERIMENTOR quad bus gives you four bus lines. By combining quads, 8-, 12- and 16-line address and data buses can be created, simplifying complex data/address circuits.

Infinitely flexible. Circuits can go in any direction, up to any size. All EXPERIMENTOR sockets feature positive interlocking connectors that snap together. Horizontally and/or vertically. And un-snap to change a circuit whenever you wish.

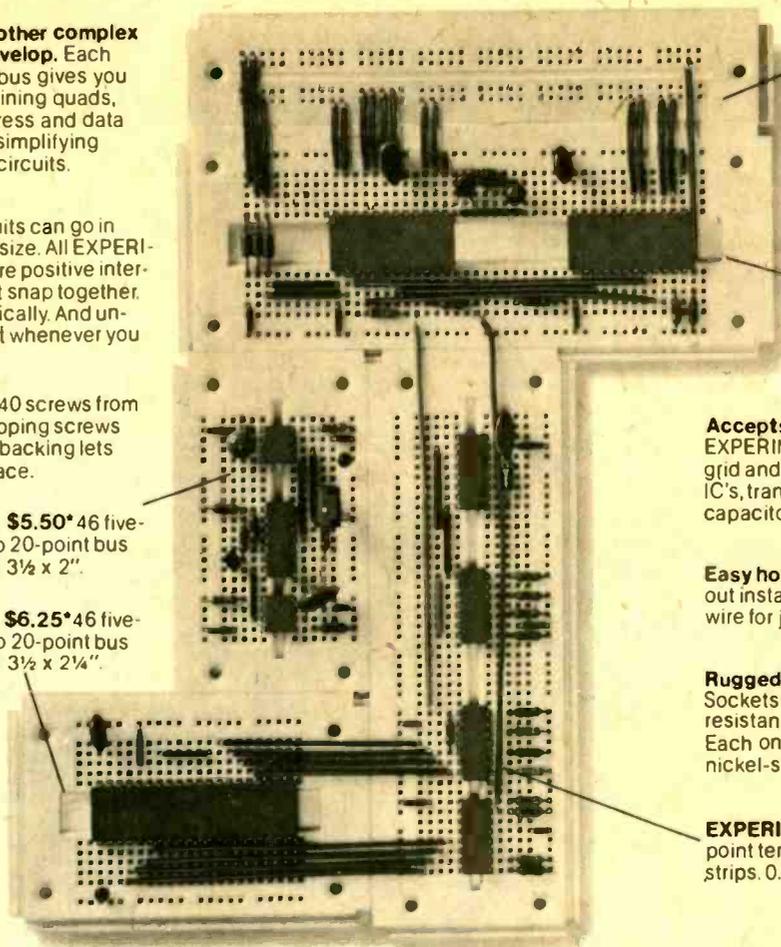
Easy Mounting. Use 4-40 screws from the front or 6-32 self-tapping screws from the rear. Insulated backing lets you mount on any surface.

EXPERIMENTOR 350. \$5.50* 46 five-point terminals plus two 20-point bus strips. 0.3" centers; $\frac{3}{8}$ x 3 $\frac{1}{2}$ x 2".

EXPERIMENTOR 650. \$6.25* 46 five-point terminals plus two 20-point bus strips. 0.6" centers; $\frac{3}{8}$ x 3 $\frac{1}{2}$ x 2 $\frac{1}{4}$ ".

Mix and match. Use large and small chips in the same circuit without problems. There are two sizes of EXPERIMENTOR sockets with 0.3" and 0.6" centers.

Full fan-out. A CSC exclusive. The only solderless breadboard sockets with full fan-out capabilities for **micro-processors** and other larger (0.6") DIP's.



EXPERIMENTOR QUAD BUS STRIP \$4.00* Four 40-point bus strips. $\frac{3}{8}$ x 6 x $\frac{3}{4}$ ".

Designated tie-points. Simplify translation from breadboard to PC-boards or wiring tables.

EXPERIMENTOR 600. \$10.95* 94 five-point terminals plus two 40-point bus strips. 0.6" centers; $\frac{3}{8}$ x 6 x 2 $\frac{1}{4}$ ".

Accepts all standard components. EXPERIMENTOR sockets conform to an 0.1" grid and are DIP compatible. Also accept IC's, transistors, diodes, LED's, resistors, capacitors, transformers, pots, etc.

Easy hookup. Components push in and pull out instantly. Use #22-30 solid AWG wire for jumpers.

Rugged, dependable construction. Sockets are constructed from abrasion resistant materials and withstand 100°C. Each one features non-corrosive nickel-silver contacts.

EXPERIMENTOR 300. \$9.95* 94 five-point terminals plus two 40-point bus strips. 0.3" centers; $\frac{3}{8}$ x 6 x 2".

WHAT ARE YOU WAITING FOR?

Discover today how solderless breadboarding can save time and money on every circuit you build. Get acquainted with EXPERIMENTOR™ sockets* and how they simplify circuit design, assembly and testing. Eliminate the hassles and component damage of soldering. No special hardware or jumper cables required, either. And the price is so low, it's hard to believe.

See your CSC dealer today. Or call 203-624-3103 (East Coast) or 415-421-8872 (West Coast) for the name of your local stocking distributor and a full-line catalog.

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Feltham, Middlesex, England, 01-890-8782 Int'l Telex: 851-881-3669
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Holiday Special !

Here's your chance to re-live those fascinating days of radio. Discover the rewarding hobby of radio collecting. Find gold in your attic or local swap meet!



VINTAGE RADIO, 1887-1929: Pictorial story of pioneer days, 1,000 photos, 263 pages. \$10.95 hard-cover, \$8.95 soft.

A FLICK OF THE SWITCH, 1930-50: Fun picture reference of home, military, Ham, professional radio-TV-electronics, 312 pages. \$10.95 hard-cover, \$8.95 soft.

RADIO COLLECTOR'S GUIDE, 1921-32: Data book with 50,000 facts on 9,000 models by 1,100 makers, 264 pages, \$6.95.

SAVE \$4.00! We'll send you **VINTAGE RADIO** (hard-cover), **A FLICK OF THE SWITCH** (hard-cover) and **RADIO COLLECTOR'S GUIDE** all for \$24.85.

Send check or money order today to Vintage Radio, Dep't. E, Box 2045, Palos Verdes, CA, 90274. Offer ends December 31, 1977. Add 6% in Calif.

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IDEAL HOLIDAY GIFTS!

Special-Save \$4!

DX central reporting

A world of SWL info!

BY DON JENSEN

The future is already here. For years, shortwave listeners have dreamed about accurate frequency readout at a glance. Frequency readout? That's the ability of a communications receiver to directly display the frequency to which it is tuned.

For example, you're listening to a certain SW station. You want to know its exact frequency. With direct frequency readout you can look at your receiver and immediately have this information. Conversely, a desired SW station transmits on a known frequency and you may want to hear it when it signs on the air. A receiver with direct frequency readout makes that a snap.

First Digital Readout. During the past summer I had the opportunity to preview a Japanese-made portable receiver with—you guessed it—electronic digital readout. Yes, it was a real "kick" giving a twist to the SW tuning dial and watching the changing little red numerals as I swept across a shortwave band.

At the time I tried my hand with this new receiver, it was being sold in Japan, but had not yet been introduced to the North American market. But that introduction was expected before years end. And, in August, it was being questimated that the selling price of this rig would be somewhere between \$200 and \$250.

Though not as convenient as those little red numbers flashing back at you, there is a decades-old technique used by SWLs to determine frequencies tuned with reasonable accuracy. It is a simple technique and, best of all, it will cost you only pennies.

As you know, with most medium-priced receivers, it has been difficult for a listener to tell if he is tuned to, say, 6,000 or 6,100 or even 6,200 kHz. Hitting a frequency to an accuracy of plus or minus 50 kHz is a pretty good trick with most receivers.

You want a frequency such as 6,065 kHz? That can be a bit tough to do, but you can locate frequencies such as this using a series of easily constructed graphs, one for each of the major SWBC bands.

This graph technique will work with any shortwave receiver having a bandspread or fine tuning dial. Often, especially with the older sets, this bandspread dial is calibrated only for ham radio bands. That doesn't help the shortwave listener tuning the broadcast bands. But, luckily, the dial usually has markings for a logging reference scale, marked from 0 to 100.

Constructing the Graphs. Ready to pre-

(Continued on page 22)

IN WIRE-WRAPPING **ok** HAS THE LINE.....

MODEL **WD-30**



PATENT PENDING

WIRE DISPENSER

- 50 FT. ROLL OF 30 AWG. KYNAR® WIRE-WRAPPING WIRE
- CUTS THE WIRE TO LENGTH
- STRIPS 1 INCH OF INSULATION

AVAILABLE IN FOUR COLORS

- WD-30-B BLUE WIRE
- WD-30-Y YELLOW WIRE
- WD-30-W WHITE WIRE
- WD-30-R RED WIRE

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EACH

MINIMUM BILLING \$25.00
ADD SHIPPING CHARGE \$1.00
NEW YORK STATE RESIDENTS
ADD APPLICABLE TAX

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CIRCLE 12 ON READER SERVICE COUPON

ELEMENTARY ELECTRONICS/January-February 1978

SHOP YOUR NEARBY RADIO SHACK FOR QUALITY PARTS AT LOW PRICES!

Top quality devices, fully functional, carefully inspected. Guaranteed to meet all specifications, both electrically and mechanically. All are made by well known American manufacturers, and all have to pass

manufacturer's quality control procedures. These are not rejects, not fallouts, not seconds. In fact, there are none better on the market! Count on Radio Shack for the finest quality electronic parts.

TTL Digital ICs

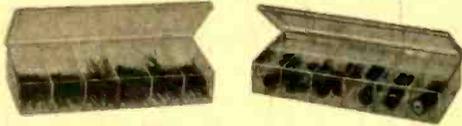
First Quality

Made by National Semiconductor and Motorola



| Type | Cat. No. | ONLY |
|-------|----------|------|
| 7400 | 276-1801 | 35¢ |
| 7402 | 276-1811 | 39¢ |
| 7404 | 276-1802 | 35¢ |
| 7406 | 276-1821 | 49¢ |
| 7410 | 276-1807 | 39¢ |
| 7413 | 276-1815 | 79¢ |
| 7420 | 276-1809 | 39¢ |
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| 7432 | 276-1824 | 49¢ |
| 7441 | 276-1804 | 99¢ |
| 7447 | 276-1805 | 99¢ |
| 7448 | 276-1816 | 99¢ |
| 7451 | 276-1825 | 39¢ |
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| 7474 | 276-1818 | 49¢ |
| 7475 | 276-1806 | 79¢ |
| 7476 | 276-1813 | 59¢ |
| 7485 | 276-1826 | 1.19 |
| 7486 | 276-1827 | 49¢ |
| 7490 | 276-1808 | 79¢ |
| 7492 | 276-1819 | 69¢ |
| 74123 | 276-1817 | 99¢ |
| 74145 | 276-1828 | 1.19 |
| 74150 | 276-1829 | 1.39 |
| 74154 | 276-1834 | 1.29 |
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| 74193 | 276-1820 | 1.19 |
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Resistor and capacitor kits in handy plastic storage boxes you can use over and over again. Stock up!

½ Watt, 10% Tolerance Resistors. 271-601 Pkg. of 350/9.95

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Tantalum Capacitors

Maximum capacity in smallest size. Low ESR, highly stable electrical characteristics and low leakage. Radial leads.



| Cat. No. | µF | Each | Cat. No. | µF | Each |
|----------|------|------|----------|------|------|
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| 272-1402 | 0.22 | 39¢ | 272-1408 | 3.3 | 45¢ |
| 272-1403 | 0.33 | 39¢ | 272-1409 | 4.7 | 49¢ |
| 272-1404 | 0.47 | 39¢ | 272-1410 | 6.8 | 49¢ |
| 272-1405 | 0.68 | 39¢ | 272-1411 | 10.0 | 49¢ |
| 272-1406 | 1.0 | 39¢ | | | |

Nos. 1401-1408, 35WVDC; 1409-1411, 16WVDC.

PC Board Accessories



8-piece photographic PC board processing kit — fastest, easiest way to produce perfect printed circuit projects.

276-1560 12.95

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Build an LED Digital Clock



12-HR LED Clock Module. Just add a transformer and switches for a complete clock with 0.5" LED display. 277-1001 14.95

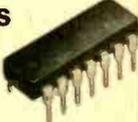
Transformer for above. 120VAC 60 Hz. 273-1520 3.99

SPST Miniature Pushbutton Switch. 275-1547 5/1.99

Display Case. 1 1/2"x4 3/8"x4 7/16". 270-285 3.95

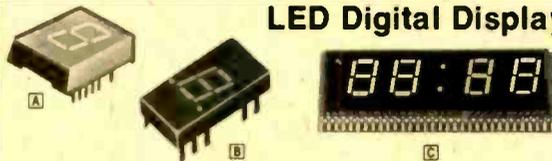
CMOS ICs

100% guaranteed electrically and mechanically



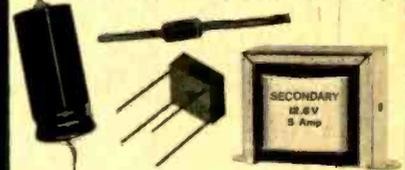
| Type | Cat. No. | ONLY |
|--------|----------|------|
| 74C00 | 276-2301 | 49¢ |
| 74C02 | 276-2302 | 49¢ |
| 74C04 | 276-2303 | 49¢ |
| 74C08 | 276-2305 | 49¢ |
| 74C74 | 276-2310 | 89¢ |
| 74C76 | 276-2312 | 89¢ |
| 74C90 | 276-2315 | 1.49 |
| 74C192 | 276-2321 | 1.69 |
| 74C193 | 276-2322 | 1.69 |
| 4001 | 276-2401 | 49¢ |
| 4011 | 276-2411 | 49¢ |
| 4013 | 276-2413 | 89¢ |
| 4017 | 276-2417 | 1.49 |
| 4020 | 276-2420 | 1.49 |
| 4027 | 276-2427 | 89¢ |
| 4049 | 276-2449 | 69¢ |
| 4050 | 276-2450 | 89¢ |
| 4511 | 276-2447 | 1.69 |
| 4518 | 276-2490 | 1.49 |

LED Digital Displays



| Digits | Size | Drive | Cat. No. | ONLY |
|--------|------|-------|----------|--------|
| Ⓚ 1 | 0.6" | Anod. | 276-056 | 2.99 |
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| Ⓚ 1 | 0.3" | Anod. | 276-053 | 1.99 |
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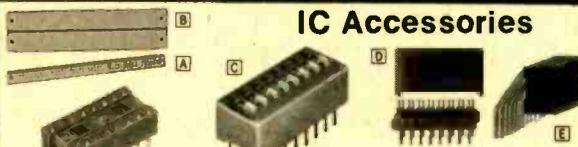
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IC Accessories



| Item | Cat. No. | Price |
|---------------------------------------|----------|-------|
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| Ⓚ Experimenter Socket. 276-172 | 276-172 | 9.95 |
| Ⓚ DIP Switch. 275-1301 | 275-1301 | 1.99 |
| Ⓚ DIP Header. 276-1980 | 276-1980 | 1.29 |
| Ⓚ Right Angle 14-Pin Socket. 276-1985 | 276-1985 | 1.49 |

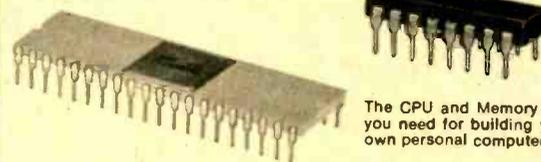
| Low-Profile DIP Sockets | Pins | Cat. No. | Price |
|-------------------------|------|----------|---------|
| Ⓚ | 8 | 276-1995 | 2/69¢ |
| Ⓚ | 14 | 276-1999 | 2/89¢ |
| Ⓚ | 16 | 276-1998 | 2/89¢ |
| Ⓚ | 28 | 276-1997 | Es. 89¢ |
| Ⓚ | 40 | 276-1996 | Es. 99¢ |

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| 555CN | 276-1723 | 79¢ |
| 556CN | 276-1728 | 1.39 |
| 566CN | 276-1724 | 1.69 |
| 567CN | 276-1721 | 1.99 |
| 723CN | 276-1740 | 69¢ |
| 741CN | 276-007 | 49¢ |
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| 7549N | 276-1701 | 99¢ |
| 7549Z | 276-1702 | 99¢ |
| 7805 | 276-1770 | 1.29 |
| 7812 | 276-1771 | 1.29 |
| 7815 | 276-1772 | 1.29 |

Computer Chips

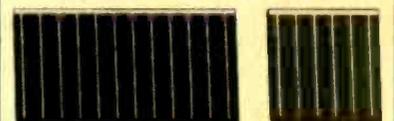


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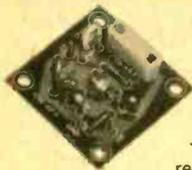
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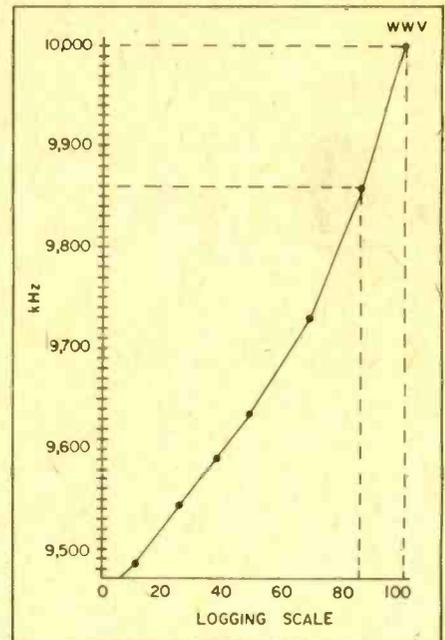
DX CENTRAL

pare your first frequency graph? Okay, let's start with the popular 31 meter band for openers. On a sheet of graph paper, label the vertical scale and mark off the frequencies as shown in the illustration. Label the horizontal scale "Logging" and mark the appropriate points from 0 to 100.

Next tune in the first key station, in this case, WWV, the standard time and frequency station on 10,000 kHz. Now set your receiver's fine tuning or bandspread dial to 100. You'll probably lose the WWV signal, but by careful tuning of the main tuning dial you'll find it again. WWV now appears at 100 on the logging scale.

Transfer this data to your graph. Plot a point corresponding to 100 on the horizontal scale and 10,000 kHz on the vertical.

Then tune a number of other stations, eight or ten, whose frequencies you know or which are announced on the air. In a similar manner, plot their "point" on the graph. When you have a number of points



Note how WWV, 10,000 kHz, corresponds to 100 on the logging scale and a station known to operate at 9,850 kHz is found to correspond to 85. The points plotted on the middle and low sections help insure the graph's fidelity throughout its range.

for your key stations, connect the dots with a line. This line may be curved or straight, depending on the linearity of your receiver's tuning.

Similarly, you can make graphs for other bands. Use WWV's 5,000 kHz signal as a key station for your 60 meter graph. For the 19 meter band, plot the WWV 15,000 kHz signal against 0, not 100, on the log scale, since 15,000 kHz is at the bottom of the band in this instance. A 41 meter chart can be compiled using the Canadian time station CHU as a marker. The 49 meter band may be graphed using

(Continued on page 87)

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Electronics in the News!

Computers Measure Noise

Computerized monitoring systems that can distinguish jet aircraft noise from the din caused by trucks, lawn mowers and barking dogs have been installed in communities bordering major airports in California, Hawaii and Washington, D.C. to help find solutions to noise problems.

The systems rank the severity of aircraft noise in comparison with other sounds in neighborhoods adjacent to the airport. This provides investigators with a better understanding of the contribution jet aircraft make to total ambient noise levels in a given area. As a result, it has been possible to establish flight plans and landing procedures that reduce the level of noise disturbance in the communities surrounding the airports.



Hydrospace-Challenger, Inc., San Diego, has designed an aircraft noise monitoring system employing Varian minicomputers. The system can distinguish jet noise from normal neighborhood sounds.

Noise abatement officials of the Los Angeles Department of Airports say that the system, which incorporates remote microphone installations monitored by a Varian Data Machines minicomputer calculates an updated noise index from data that is continually recorded, processed and compared with previous data results.

This index is used to analyze cost-effectiveness of such noise relief programs as the two segment landing approach, by which a landing aircraft descends from a six degree to a three degree glide slope during approach, instead of a steady three degree approach. Thus, the airplane flies higher and quieter over populated areas near the airport. (Continued on page 26)

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NEWSCAN

Designed by EG&G Hydrospace-Challenger Group of San Diego, these systems employ Varian minicomputers to perform four major functions: data acquisition and processing, visual and aural display, identification of exceptionally loud noises from individual aircraft, and data printout.

Strings of remote monitoring subsystems (RMS) are located at various sites in local communities ranging from one to five miles from the airport runways.

There are twelve RMS at Los Angeles, three at Ontario, twelve at San Diego, seventeen at Honolulu, and ten at Dulles International Airport. These RMS have weatherproof ceramic microphones mounted on specially installed poles. They communicate with the minicomputer at the airport via leased telephone lines.

The computer is programmed to distinguish between aircraft noise and other community noise. This is accomplished using a tracking and screening program taking into account such factors as sound duration, its shape (how it builds up and falls off) and its route from site to site. Take-off sounds last longer than landing sounds.

The computer keeps two separate noise-level tallies, one for community average noise levels and one for aircraft average noise levels. Every hour, for every site, the computer produces noise level averages for the community and the aircraft. In addition, daily, weekly, and monthly totals are made that weight evening noise higher because it is more noticeable and disturbing to community members.

Individual aircraft can be identified by recordings made through the system of the actual noise picked up at a site plus the tower-to-aircraft conversations identifying the flight number. Operators may also listen to specific sites using a separate telephone line.

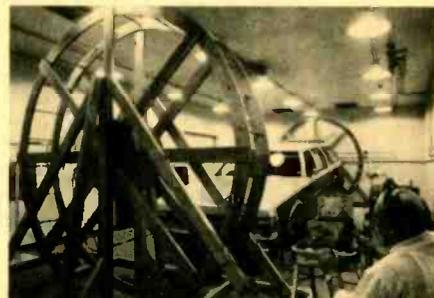
According to a court ruling reserving jurisdiction to the federal government, the state cannot penalize airlines for exceeding certain noise levels by specific aircraft. The state can, however, set long-range guidelines for airports and these new minicomputer-controlled noise monitoring systems will measure the progress toward the goals of quieter airports and aircraft.

Wonder Wheel

A weird pair of "ferris wheels" in a General Motors laboratory are actually Helmholtz coils bracketing a test car

on a dynamometer. The Ferris wheels create a 60-cycle magnetic field comparable to roadside utility power lines for testing all types of automotive electronic systems under real world conditions.

Within the shielded walls of General Motors' electromagnetic interference facility in Warren, Michigan, this electronic torture chamber enables electronic engineers to immunize from

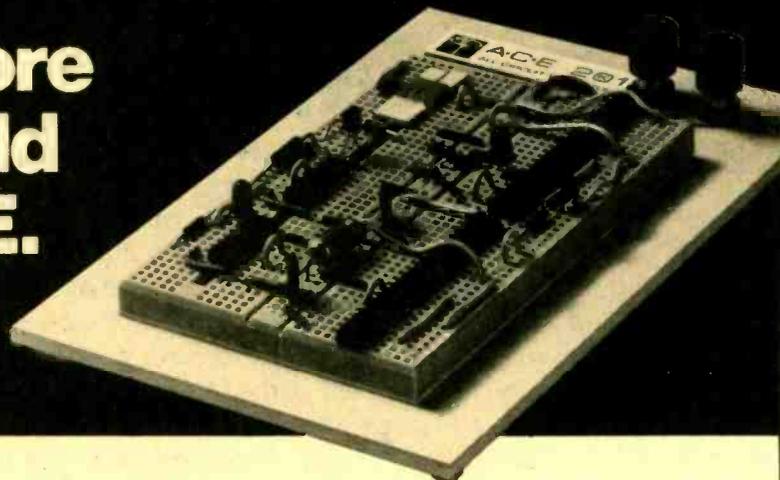


A new 1978 station wagon is tested for effects by outside power line radiation. GM also measures RF noise generated by auto.

electromagnetic interference such automotive electronic items as wheel lock controls, fuel injection systems or engine control digital computers (microprocessors). In addition to susceptibility tests, electromagnetic radiation levels from a test car also are monitored

(Continued on page 99)

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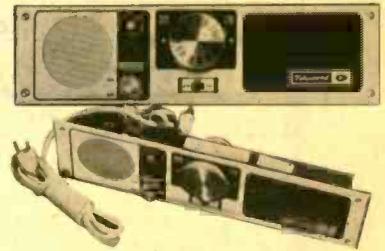


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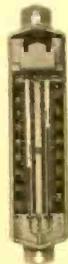
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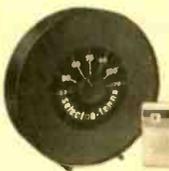
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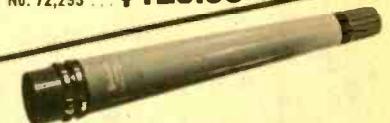
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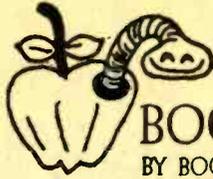
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The books two authors, Leslie Solomon and Stanley Veit, have excellent credentials in the field and an enthusiasm for computing that is ably communicated to the reader. Solomon has been an editor in the electronics field for many years and has the distinction of having introduced the first personal computer, the Altair. More recently, he introduced the first vocal interface between man and his machines, and the popular line of Sol computers is named after him. Stanley Veit is the owner of Computer Mart of New York, one of the most well-established stores in the field. He has been a technical writer, in-

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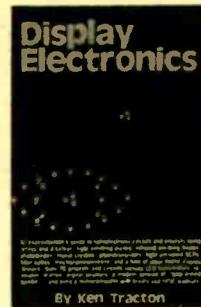
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structor and consultant to computer service firms. Solomon and Veit give their reader a concise, well-thought out and supremely interesting introduction to personal computing. They begin with a brief history of the computer, from the abacus through MANIAC, to the 8080 and 6800 chips of today.

One of the most interesting chapters in the book is that which, in many other books, makes for pretty dry reading—their chapter on "How To Communicate With a Computer." The authors unravel the tangled skein of binary, octal and hexadecimal numbers in a diagram-illustrated, conversational manner which makes an often obscured topic crystal clear. They then move on to equally precise explanations of computer systems, memory devices and peripherals. Very helpful to the budding computerist are the chapters which detail what equipment is available to be purchased; what advantages each system may have, and what drawbacks. The book closes with short discussions on software, applications, and a look to the future of computers, a future filled with bubble memories and home computer networks. Published by Ridley Enslow Publishers, 60

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Optoelectronics for Experimenters. *Display Electronics* by Ken Tracton is a one volume library of circuits, construction, and design data on the newest of the new in optoelectronic circuits and projects using arrays and displays, light-emitting diodes, infrared-emitting diodes, photodiodes, liquid crystals, phototransistors, light-activated SCRs, fiber optics, electroluminescence, and a host of other exotic display devices. A microcomputer with binary and octal readouts is included among over 70 projects. Glowing digital displays, in-



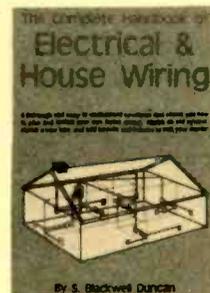
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trical contractor the text is for those who want to know more about electrical wiring, or who want to save a bundle by doing their own wiring in their own home or workshop. It's a complete 14-Chapter manual on electrical wiring that shows how to wire anything, from a junction box to a

(Continued on page 92)



**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**

Ring of Fire

My power vacuum machine for the shop is not working properly. I looked at the motor and a ring of fire emanates from the point where the brushes touch the commutator and the fire circles the commutator as the motor turns. What's wrong?

—R. W., Ludlow, MA

I assume you have good brushes in the machine, and if new ones were inserted, they were broken in properly. If the "fire" still exists, then phase the brushes. This is done by loosening a few screws so that the frame holding the brushes can be rotated about the commutator a few degrees. Do this while the motor is running and adjust for minimum fire or glow. Tighten screws.

Foreign Types

I have several foreign-made receivers and tape machines that need solid-state parts. When I go to order them by mail, I have to order from several suppliers. Is there one place I can go to?

—D. N., Wichita, KN

Write to Fugi-Svea Enterprise, P.O. Box 40325, Cincinnati, Ohio 40325 and tell them Hank sent you. They have a very good product line and should be able to handle 100% of your needs. They require a minimum order of ten dollars.

Sounds Better

I added a 3½-inch loudspeaker to my CB and it sounds great. How come the speaker in my mobile unit sounds so bad?

—S. S., Des Plaines IL

You'll find that the speaker in your mobile rig is of a much smaller diameter and hasn't much weight in the magnet. In fact, as the volume goes up, the speaker is driven to high distortion. The replacement speaker you used sounds better because it's larger, has a heavier magnet, can handle the power, and is housed in a baffle that enhances the sound. What ever you do, don't connect the CB to a hi-fi speaker because you'll hear squeaks, squeals and hisses that will drive you nuts. Best bet is a communication add-on speaker available at CB shops.

Clocking the Clock

I took my car to a diagnostic center and discovered my speedometer reads 50 mph when I'm doing 55. How can I adjust the speedometer?

—L. M., Dover, DE

Put more air in your tires! Really, the air pressure in your tires and the depth

of tread has a lot to do with speed. Your best bet is to time your speed through several highway mile markers to determine what your speed is. It takes 66⅔ seconds to travel one mile at 55 mph. Therefore, it should take three minutes and twenty seconds to travel three miles. I admit most mile markers are approximately located. But check a few three mile runs and you'll get a good indication. Also, you could call your state police and ask them to tell you where there are "measured mile" markers that are accurate. These measured miles are provided by most state highway departments just for a speedometer check. To vary the speed setting on your speedometer requires the adjusting of one or more small magnets, but you'll still need a measured mile to check accuracy. Also, what are you going to do when you switch over to snow tires?

One from Our Side

Hank, I have a foreign rig that uses an ASZ15 transistor. Do you know the exact U.S. type replacement?

—D. G., Berkeley, CA

Try the 26553. Also, understand that no two transistors can be considered as an exact equivalent unless the manufacturer's specs are identical. However, most substitutions offered in "guide" books are suitable and generally serviceable in non-critical circuits. In most instances the packaging configurations are identical unless otherwise noted.

Lend a Hand, Boys

Here's another round of buddies in your hobby area requesting help to make their hobby more enjoyable. Help 'em out!

Δ Heathkit model QF-1 Q-Multiplier: schematic diagram and installation instructions requested by Robert Lawton, 28 Locust St., Warwick, NY 10990.

Δ Hammarlund HQ-110C receiver: Frederick J. Onucki of 63 Highland Avenue, Metuchen, NJ 08840 would like to receive copies of the operator's manual and schematic diagram.

Δ Atwater-Kent Model 55-C receiver: copies of owner's manual and diagrams requested by Duane Benson, 1403 So. 7th, Kelso, WA 98626.

Δ Hallicrafters SX-101A amateur radio receiver: schematic diagram and manual urgently needed by Vic Ruvshinoff WB3-JGX, 1103 Starway Ct., Baltimore, MD 21228.

Δ Vactrol VT10150 optoisolators: advise Dave Morton, 9185 Highland, Chanutte, KS 66720 of source and unit price. ■

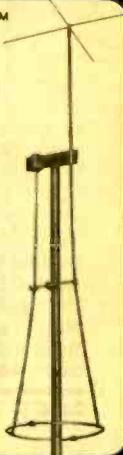
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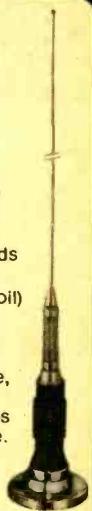
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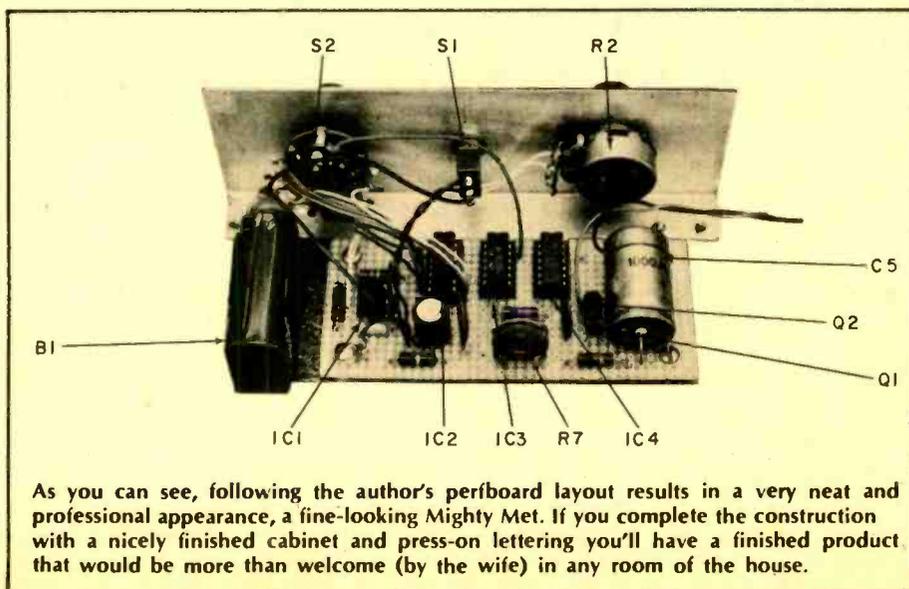
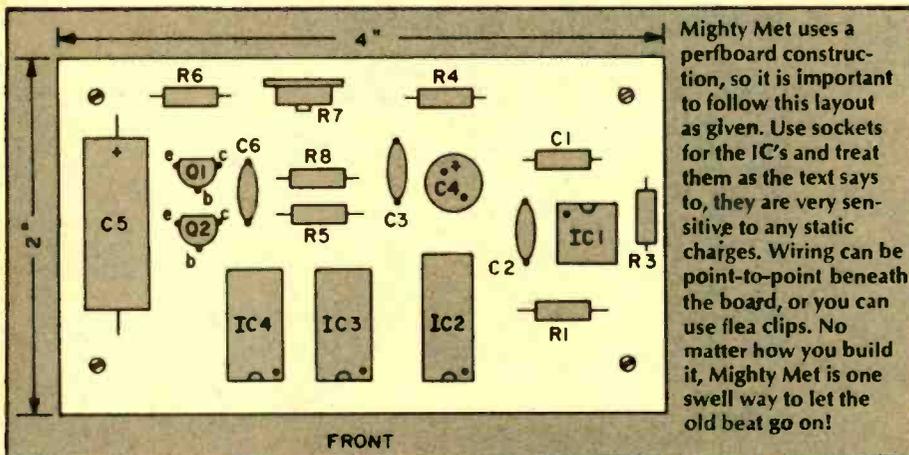
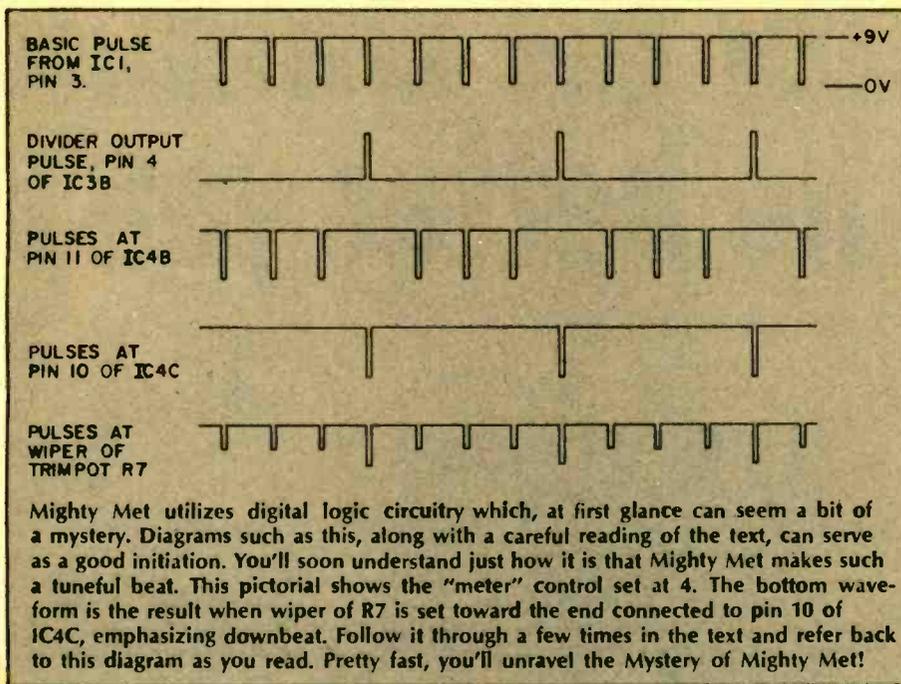


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R3 is negligible). A different range may be had by changing the values of R1, R2, or C1. R1 determines the upper tempo limit, while R2 determines the lower limit. Changing C1 will affect the overall tempo range. The sound quality of the clicks can be changed by increasing or decreasing the value of R3, which changes the width of the pulse from IC1. Do not make R3 less than 200 ohms, however.

To make Mighty Met louder, substitute a larger speaker for the one suggested. Since fidelity is not a concern in this application, an inexpensive speaker can be used. On the other hand, if the clicks are too loud, increase the value of R8.

If the unit is to be used as a dark-room timer, the tempo control, R2, can be a trimpot. Also the divider can be simplified. For example, if every fifth click is to be emphasized, then pin 13 of IC3 can be connected directly to pin 1 of IC2 and S2 and R5 can be eliminated. Similarly if every tenth click is to be emphasized, pin 13 of IC3 can be connected to ground, and S2 and R5 eliminated. Another possibility is to replace S2 with an SPST switch to select either every fifth or every tenth click, leaving R5 in.

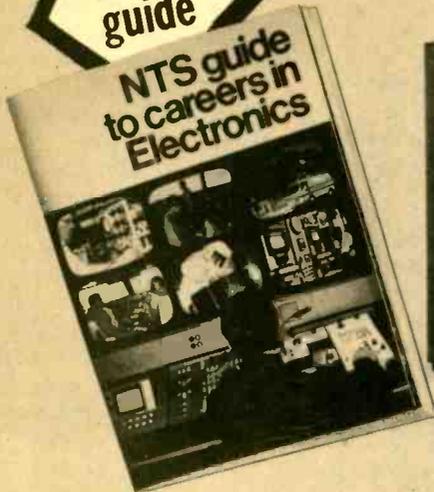
On Composition. First, a word about precautions which should be observed when working with CMOS IC's, like those used in this project. CMOS IC's can be damaged by static electricity or other excessive voltage. Although this is true to some degree for all types of IC's, the CMOS type are particularly susceptible. They should be left in their protective packaging until they are needed and should not be handled unnecessarily. The use of sockets is highly recommended for the three CMOS IC's in Mighty Met. They should not be inserted until all wiring is completed, and should be inserted or removed only with power off. When inserting or removing a CMOS IC, first "ground" your body to the circuit by touching your free hand to the wiring or by a similar method. This helps to avoid a difference in potential or static charge between the IC and the socket.

Construction of the Metered Metronome is straight-forward. Most of the parts values are not critical. Use a linear-taper pot for R2, as specified, rather than an audio taper. An audio taper would result in excessive crowding of the scale at the upper end of the tempo range. In the prototype, most of the circuit was assembled on a piece of perforated board, about 2 x 4 inches. If you use this method, be sure to get a board with holes spaced 0.1 in. apart

(Continued on page 88)

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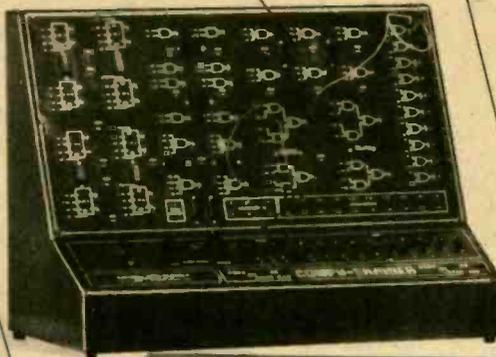
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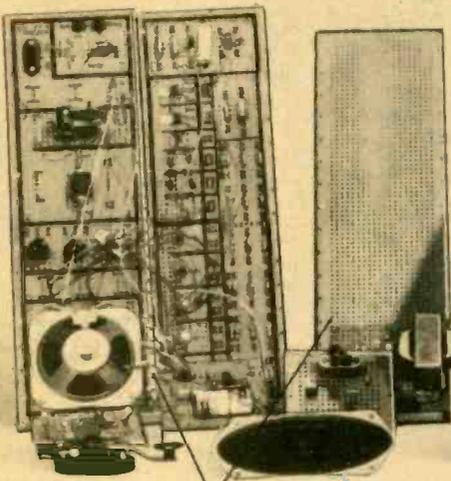
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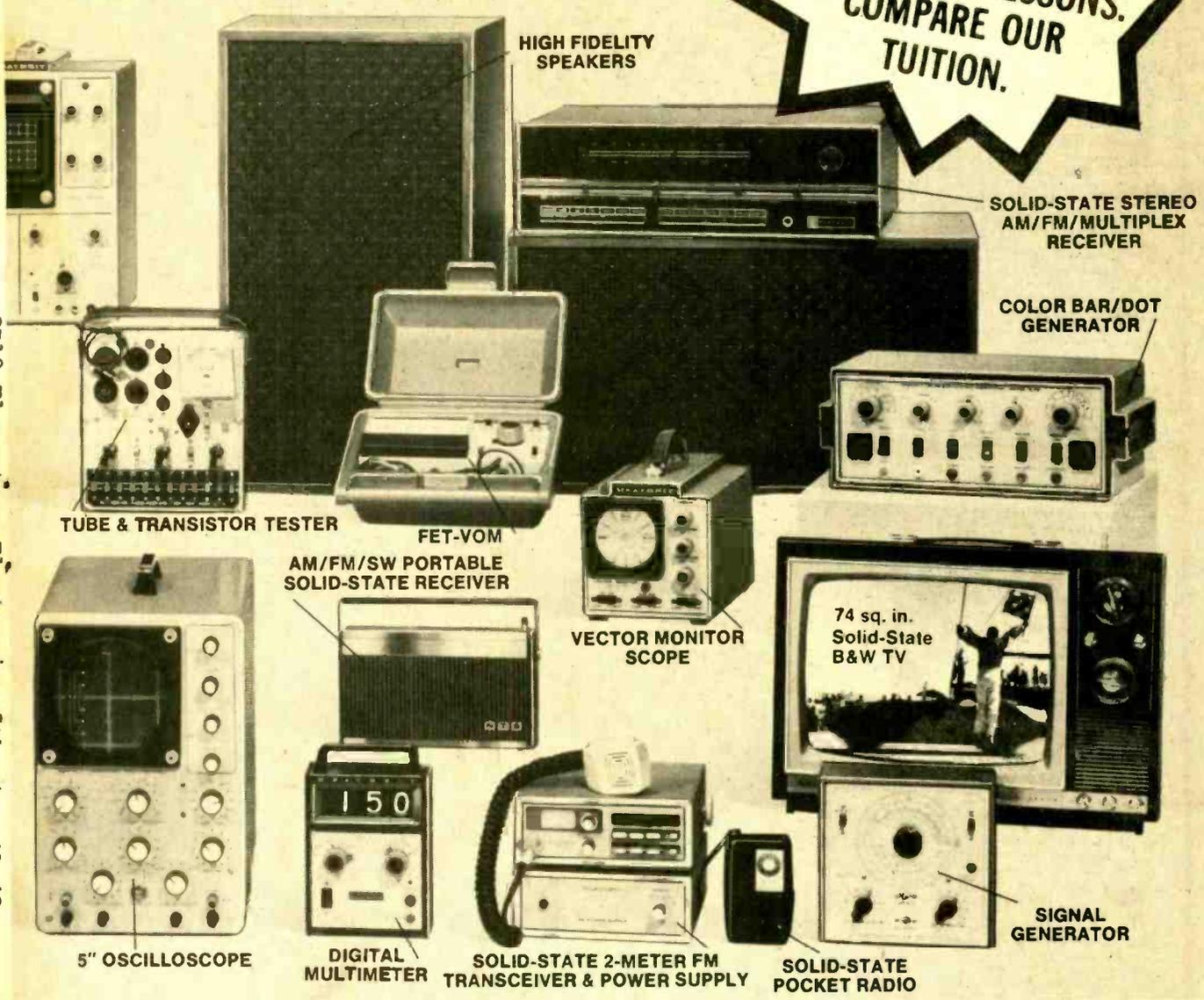
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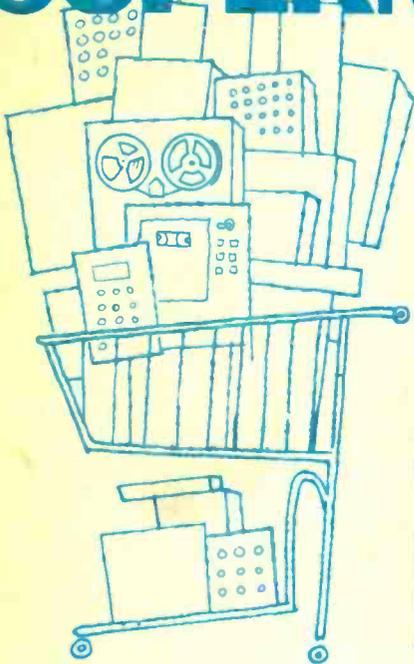
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COMPUTER SUPERMARKETS



by Herb Friedman



Go shopping where prime computers are your very best choice.

□ For the average electronic hobbyist the fastest way to get turned off to personal computing, or the way to spend a lot of unnecessary money, is to walk into the wrong type of computer store. Depending where you go, you might wind up more confused than when you walked in. The reason is that there are three distinctly different types of computer stores selling personal computing equipment, only one of which truly meets a hobbyist's needs.

The first type of personal computer store is essentially a retail parts dealer who caters to the advanced computer hobbyist—generally a college-level computer technology student designing or building a computer from scratch. The store stocks a wide assortment of computer theory and construction books as well as most commonly used solid-state devices, and special tools such as wire-wrap guns, pencils, boards, and sockets. The one thing these stores don't sell is hobby computer kits or accessories such as printers, recorders, etc. When they do have computer hardware it is generally industrial surplus which calls for considerable technical ability to get it operating in a hobby or personal computing system.

The second type of computer store caters primarily to the well-heeled customer. It wants to sell complete small systems including software (programs) to small businesses whose bookkeeping,

billing and inventory systems are too small for a standard minicomputer but too large for a couple of office assistants. As a general rule, these stores handle some of the higher priced and higher quality equipments used by more advanced personal computer hobbyists; for example, many of them stock a CRT terminal that sells for about \$1,000 which offers little advantage over a hobbyist-grade terminal that sells for around \$500-\$600. Another problem we've run across with these stores is that they simply don't understand the needs of the personal computer *hobbyist*. As an example, one local store sells the SWTP 6800 computer but virtually none of the accessories needed by the budget-conscious hobbyist.

Problems Solved. Finally, we come to the *real* personal computing store, the store with the staff and components for everyone—from the rank beginner to the small businessman. Note we have listed *staff* first, for without the correct staff an off-the-street customer will end up in a fog. Any decent personal computing store has on-staff (not a few hours a week) at least one person well versed in hardware—their use, interconnection, applications and, most important, *debugging* (someone might have to find your mistakes in a kit), and a specialist in software (programs). Both might be the same person, but there

must be someone who can handle software, hardware, and debugging problems. Often, college-level technology students are the specialists.

A look at the Computer Mart of New York is a good example of what a personal computing store, catering to electronic hobbyists, should be like. The pictures shown were taken at the Computer Mart.

Firstly, the store must handle a broad line of equipments, starting at the budget end. For example, the Computer Mart handles basic computer kits that can be expanded by the builder as needed or as the budget will allow. They have wired systems complete with a resident high level language (usually BASIC); and minicomputer systems suitable for small businesses. Similarly, a good computer store for personal computer hobbyists can supply peripherals ranging from budget priced terminal kits to color CRT terminals.

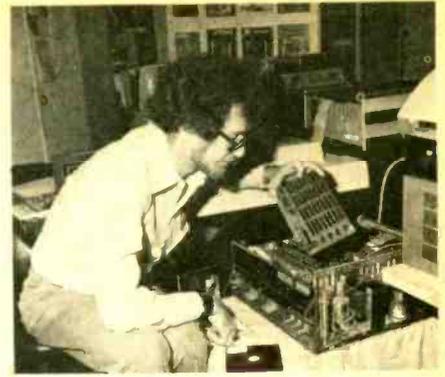
Most important, a true experimenter's store should be able to start you off inexpensively. For example, you might not be able to afford, or even need in the future, a recording system (for recording or feeding programs), but how will you initially load a language such as BASIC into your computer? A good hobby computer shop will tell you about an inexpensive teletype paper-tape reader where you pull the tape through by hand. There's no fancy mo-



E/E's Technical Editor, Neil Shapiro (left) and Editor-in-Chief Julian Martin (right) check out the display of software and popular, hobby computing magazines.



Just killing time? Try a game of Blackjack on a Compucolor Computer. The cards are dealt in full-color along with wisecracks from the computer-dealer.



What to do if you build your own and have trouble? At Computer Mart, Josef Bernard checks out a customer's memory board in a working Imsai computer.



You should find a broad selection of accessories and prototype boards for all computers stocked. Neil and Julian look over the latest wirewrap boards.



If you need a demonstration it should be very easy to get any system in a computer store up and running. Here Julian and Josef Bernard check out the BASIC language in a SOL computer. Almost every terminal sold can be used by the prospective buyer for purposes of comparing the features and the "feel" of varying brands.

tor drive but there's no fancy price, either, and you can load TTY paper tape programs at budget prices.

A store such as the Computer Mart will provide for extensive hands-on experience. Several different systems will be arranged so they can all be in operation at the same time, allowing several hobbyists or groups to get the "feel" of different computers and peripherals. At the Computer Mart they have an island with several complex systems, and individual stand-alone computers arranged out of the way on a shelf. One or two users don't tie up all the demonstration equipments.

Accessories, such as program tapes and cassettes, small devices such as a gadget that converts video output from a terminal to a RF signal that can be fed into a TV receiver, or a hand-operated paper tape reader, will usually be found in a glass display case. Unlike the stores that are primarily interested in complete systems for business installations a good personal computer store will usually stock or handle a wide range of accessories for each of the computers they sell even when not made by the computer manufacturer. For example, at the time we made the pictures at the Computer Mart, they sold the complete SWTP computer line and the Smoke Signal Broadcasting disc system for the SWTP computer. Simi-

larly, the store sold Seals memories for several types and brands of computers, as well as development/circuit boards for the SWTP computer and computers using the S-100 bus (Imsai, Altair, etc.).

All the Extras. A good hobbyist store should have an extensive selection of books and magazines specifically intended for the beginner, and the reading material should accommodate *what the customer knows he wants*, not what the owner of the store believes the customer should have. For example, there are the computer hardware *nuts* who want to know the ins and outs of every electron flowing in the system. Fine, there are many books and magazines for the hardware specialist. On the flip side of the coin are the *programmers* who don't give two hoots how a computer works, they just want to be able to press a button and have a system come to life. The programmers are the end users and they need lots of books on programming and programs. A good selection of programmer oriented books can be the most difficult thing to come by. Often, the selection represents the store owner's level—too basic or too advanced. A good experimenter's store should handle both ends, and everything in-between, with a thorough selection of the personal computing magazines, not just the two with the largest circulation.

Next, we come to specialized tools and support hardware. Resistors, capacitors and even most solid-state devices used in computers can be obtained from electronic parts distributors. But, what if all you want is one mini-floppy disc, which sells for about \$5? Standard pack is 5-for-\$25. A good personal computing store should be willing to break the pack and sell you one. Need data cassettes (a higher quality Philips-type cassette)? Again, a good hobbyist store will have them in stock or get them for you on short notice. Has the computer manufacturer updated his BASIC program (higher language)? A store like the Computer Mart will have its order in just as soon as it's announced.

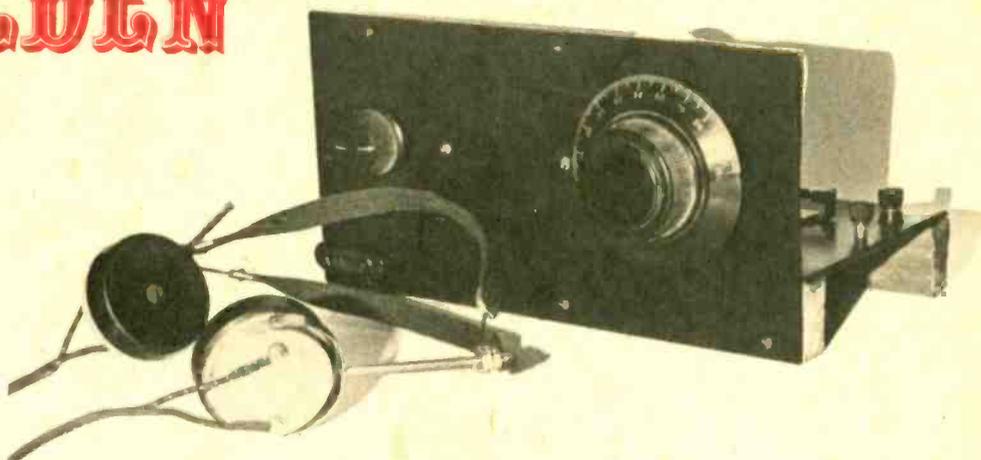
Building a computer kit? There's no reason you have to go to an electronics parts distributor for sockets and connectors. A decent computer shop stocks sockets and connectors for all the heavy equipment, and provides some sort of technical service. Many personal computer stores will check out a kit board purchased from them at no charge by plugging it into a working computer. Many stores also provide extensive repair service, usually at charges representing the time spent undoing your soldering errors. As a rule of thumb, unless you have a lot of backup support

(Continued on page 98)

BREADBOARD/AMER IS A GOLDEN OLDIE

One-tube authentic depression-days receiver pulls in plenty of stations.

by Newt Smelser



THE GOLDEN AGE OF RADIO was an era plagued by a depression which was followed by World War II. Nevertheless, during those troubled times there was plenty of wonderful entertainment available if one could afford to buy a radio, or was clever enough to *make* a receiver.

The Main Parts. Junked radios had little cash value in those days so it was no trick to beg, borrow, or buy a power transformer out of a used set, a few capacitors (we called 'em condensers) and a "powerful" "Electric Current" No. 27 detector tube. We wound our own coils and winding them was the most intriguing part of the construction. Earphones were usually the hardest part to get. Often it meant mowing a multitude of yards, and moving lots of junk for neighbors to earn the big dollar or so that phones cost. Nonetheless many of us managed

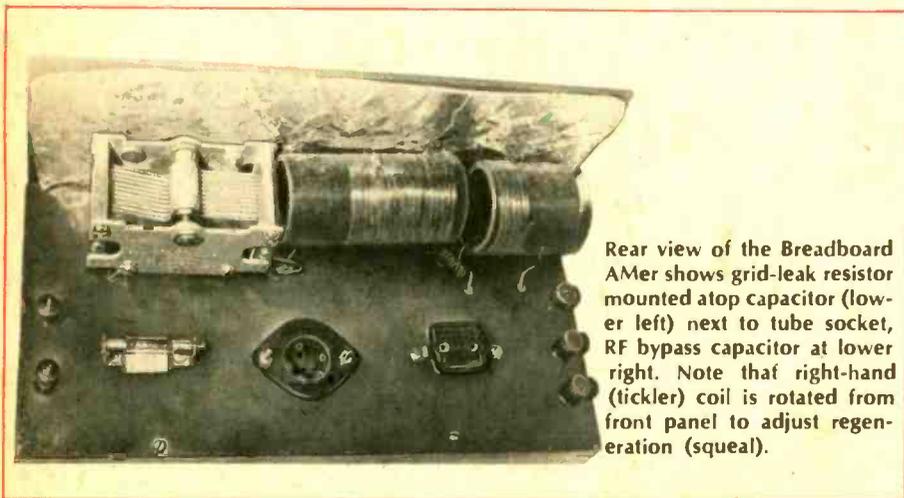
to get the parts and we also managed to make a radio capable of giving us entertainment far greater than anything going on "downtown." Yes, Amos and Andy, Lum and Abner, T. Texas Tyler, Sam Morris, Captain Midnight, Tom Mix, Jack Armstrong, Joe Louis fights, and Roosevelt's fireside chats—they were all great for us, and we will never hear their like again.

You Can Build One Too. If, like many of us, you're hooked on old-time radio, you can tune in AM stations from all over with the Breadboard/AMer. It's a one-tube broadcast-band receiver which uses an old circuit called the regenerative (or simply "regen") which was popular for some time before the superhetrodyne circuit which is universally used today. The superhet was developed by Edwin Armstrong, who by the way originated this circuit, and also later invented FM radio. It's exactly what

boys made during the 30s depression. I rigged this one up a few nights ago, and got stations all over the dial. It is able to drive an old-time high impedance speaker with powerful WWL, New Orleans. For a one-tube set, that is some accomplishment. There are two ways to get into this antique radio project. You can substitute modern parts for those hard to find, or you can make some of the parts and buy the antique parts wherever you can find them.

Looking for Collectors, Parts, or Clubs? If you're interested in receiving a list of newsletters, books and other places you can learn about antique radio collectors and clubs, which is a good place to start looking for old sets and parts, send a stamped addressed envelope to "Antique Fact Sheet, ELEMENTARY ELECTRONICS magazine, 229 Park Ave. South, New York, NY 10003, and we will send it to you free of any charge. The Fact Sheet also includes a list of Public Radio and Wireless Museums.

Occasionally at a Goodwill store you will find a 1930s radio for a few bucks that you could afford to buy to get the transformer and No. 27 tube from. And Salvation Army stores often have old radios in the basement that are beyond fixing, and can be had for nearly nothing. Be sure what you buy has a No. 27 tube. It may be labeled 227 or 327, but those are the same tube. While you are at it, be sure to get a socket to match, because you can't cram this oldie into an octal, loctal, miniature, or compactron socket. It must be an old-style, 5-pin socket. For the young, and also

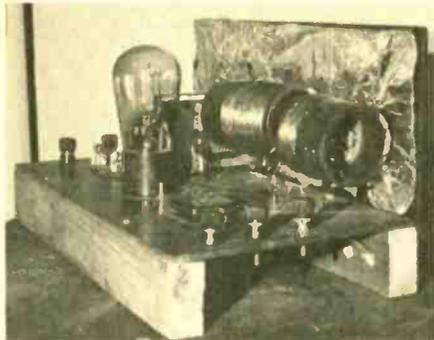


Rear view of the Breadboard AMer shows grid-leak resistor mounted atop capacitor (lower left) next to tube socket, RF bypass capacitor at lower right. Note that right-hand (tickler) coil is rotated from front panel to adjust regeneration (squeal).

oldsters who have forgotten, I have drawn a diagram of how to determine pin numbers on a five pin tube.

If you can't find a 27 tube but happen onto a 37 you can use it off the 110-volt AC line by connecting a 40-watt light bulb in series with it.

The grid leak resistor and capacitor, R1 and C2, may be found on junked old-time radios, or you can use modern counterparts and hide them under the chassis to preserve the antique flavor. Or you can fabricate them. The drawing shows the details. For the grid-leak resistor hide a one-megohm, small-wattage resistor inside a short piece of a clear plastic drinking straw, with black paper surrounding the resistor. Solder the leads to cut pieces of light sheet metal to form ends. The capacitor can be made from four pieces of thin sheet metal, such as tin can metal, two with long projections to bend upward to support the grid leak resistor, and two with shorter projections for the connecting screws. They are separated with pieces



Breadboard AMer with 27 tube in place has tinfoil on rear of front panel to reduce capacitance effect of hand when you tune.

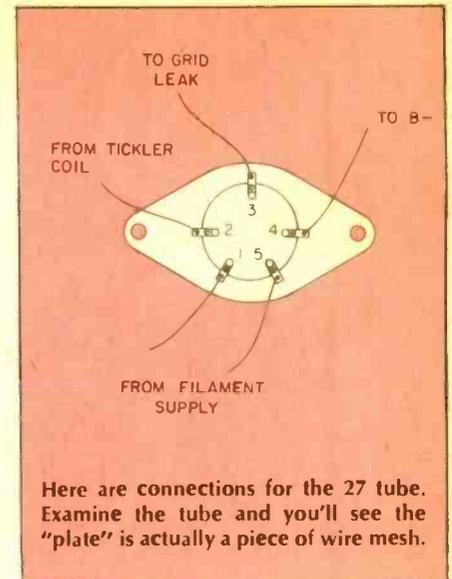
of milk carton material or waxed paper. Screws connect the metal plates of the capacitor to the circuit below the chassis, and the uprights connect the resistor in parallel with the capacitor. Nuts below the chassis connect to wires that lead to pin three of the tube socket on one end and to variable capacitor C1

on the other end. If you decide to use modern components, a one megohm resistor is OK but anything up to four megohms can be used. A 270 to 470 picofarad (pF) capacitor is fine for C2. Bypass capacitor C3 may also be homemade, like C2. Just add two more plates on the left and two more on the right with appropriate plastic insulation between. You can purchase a 600 pF capacitor for C3 if you prefer. 600 pF is the same as .0006 uF (microfarads).

Making the Coils. The coils are not purchasable items. Use 2-in.-diameter plastic cold water pipe, cutting one 2-in. long for tickler coil L3, and the other piece 3½-in. long for L2 and L1. This plastic pipe can be sawed with a hand saw or hacksaw, and holes in it are easy to make with an icepick or drill. L1 and L2 are close wound, using #20 enameled wire. Smaller wire such as 24 or even 30 may be used with only slight loss of volume. Antenna coil L1 is wound so as to face toward the variable capacitor, with 20 turns, then a tap for ground, and then without a space begin L2 and wind 60 turns. The high end of L2 must be toward the tickler coil, and should end ¼-in. from that end of the plastic. It is imperative that L2 and L3 be close together. L3, the tickler coil, is 25 turns of the same kind of wire on the 2-in. form.

To make the tickler adjustable use a holt of sufficient length. ¼-in. in diameter so a standard knob will fit on it. Nuts at A and B lock the coil form and hold it secure. Flat washers at C and E, with a short piece of door spring D between them, hold the coil form rigidly in place as it is turned. Washer F allows slippage against the front panel. Nut G secures the whole assembly. It takes considerable adjusting to get it just right.

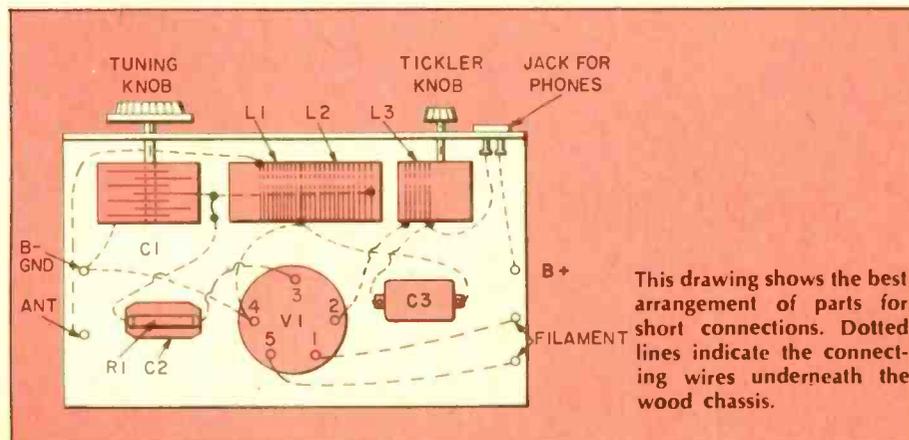
Now mount the longer coil form with L1, L2 on it to be the same distance behind the front panel, and as close to L3 as possible without touching L3, when L3 is rotated. Bolts, spacers, etc.



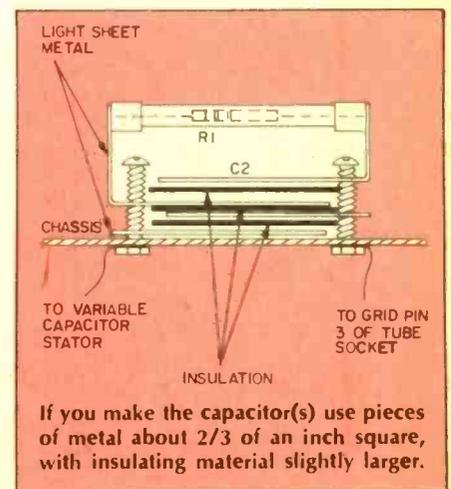
Here are connections for the 27 tube. Examine the tube and you'll see the "plate" is actually a piece of wire mesh.

attach L1 and L2 to the front panel.

Build the Panel and Chassis. Bakelite would be the ideal material for the panels as it was the standard radio building material in the old days. But it's hard to find. A fair substitute is double-tempered Masonite. And even plywood will do. Paint it black to look good. My Breadboard/AMer was built on masonite panels, but you can use almost anything, certainly including a bread board. Dab black enamel with a cloth on the panels, and while it is tacky hold it high over a gas flame, *carefully* so as not to set the house afire. This instant drying will give you a dull, Bakelite-like finish, similar to what we boys used to make the radios with. Shiny bakelite can be faked with enamel, sprayed, then and allowed to dry overnight. The front and chassis panels of my Breadboard/AMer 6-in by 12-in., but this is not critical. The wooden bottom supports are 1-inchers. None of the wiring is critical, except that the tickler and L2 coils must be close together physically. A sheet of aluminum foil directly behind the front panel will prevent tuning



This drawing shows the best arrangement of parts for short connections. Dotted lines indicate the connecting wires underneath the wood chassis.



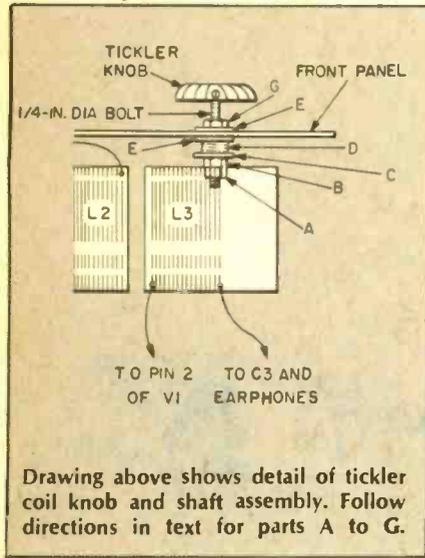
If you make the capacitor(s) use pieces of metal about 2/3 of an inch square, with insulating material slightly larger.

junked 1930 to 1940 radio has a large variable capacitor in it. Use the larger section of two-section superhet types. It will be the correct, 365 pF size.

Your Breadboard/AMer can be connected to power supply, antenna, etc. with five-way binding posts, fahnestock clips, or just plain wire. You could operate this set with batteries, using 22½ volts for the B supply and 3 volts for the heaters with a series resistor of about 0.3 ohms in the heater circuit, but since a 27 tube draws 1.75 amps the A battery would soon give up. It's best to find a junked radio of the proper vintage, very early electric, and use its power supply. As an alternate you could construct the power circuit shown. If you wish to use a more modern tube in the set you can construct it with a 6SF5 instead of the 27. Use an octal socket. Pins 7 and 8 are heaters, 3 is the grid, 5 the plate, and 2 is the cathode. A higher plate voltage can be used with this modern tube, and you'd need a modern heater transformer supplying 6.3 volts at 0.3 amps for the 6SF5.

With a 27 tube set the value of R3 can be determined by experimentation. I use a value high enough that 22 to 25 volts of DC are at the plate of the tube. I put the switch only on the power supply and not at the radio, but you can adapt it several ways.

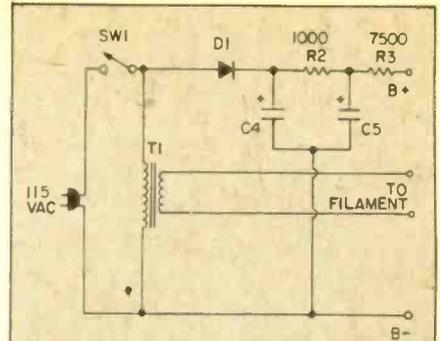
Tuning In Stations. This regenerative radio requires a bit of patience in oper-



Drawing above shows detail of tickler coil knob and shaft assembly. Follow directions in text for parts A to G.

changes when you touch the knobs. Make sure the coil wires do not rub against this shield.

If you are not fortunate enough to find an old 0-100 dial use a more modern pointer type and paint on a scale. Tuning capacitor C1 need not be an oldtimer. Radio Shack 272-1341 miniature variable will work as well, it just doesn't look quite right. Many a



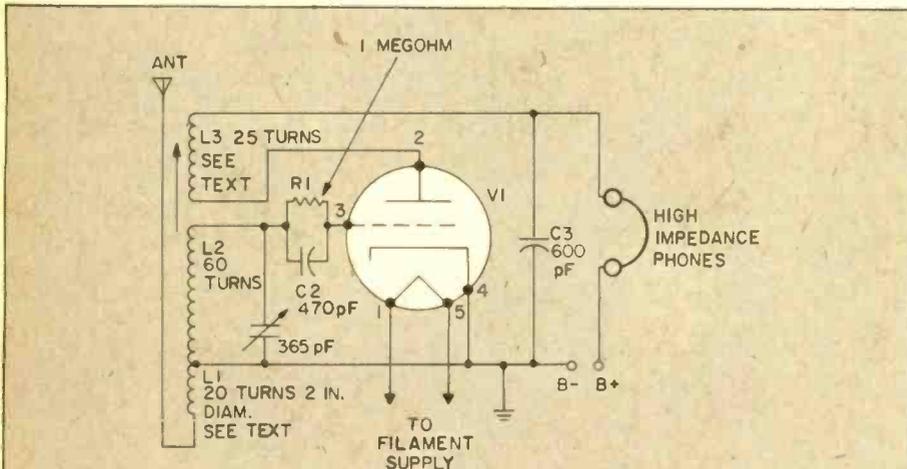
PARTS LIST FOR POWER SUPPLY

- C4, C5—40- μ F, 150 or more VDC electrolytic capacitor (Radio Shack 272-104 if not otherwise available at lower voltage)
- R2—1000-ohm, 2-watt resistor (Allied Electronics 832-1356 or equiv.)
- R3—7500-ohm, 2-watt (or more) resistor (Use Allied Electronics 2500-ohm, 5-watt resistor catalog #962-8416 in series with 5000-ohm, 5-watt resistor #962-8466 if 7500-ohm, 2-watt not available)
- T1—115 VAC primary, 2.5 VAC, 3-ampere secondary, from old radio (available from Allied Electronics as 705-0110)

ation. A good outdoor antenna is essential, up to 100 foot for good DX reception. Unless you use batteries to power it, no ground is needed as the set grounds through the household power supply. Try the plug in the wall both ways for best reception. As you advance the tickler adjustment the Breadboard/AMer will howl in your ear. Learn to get it just shy of the squeal and you will be amazed at its performance. If you don't get much volume or squeals when the tickler is lined up parallel with the tuning coils, you have the leads on the tickler reversed. The side next to the L2 winding must go to the plate of the tube, and the side out to the right must go to the earphones and bypass capacitor. This makes for greatest squeal. Then back off with adjustment of the tickler knob on the front panel until the squeal just disappears. Lower settings will lower the volume to very loud stations. As with any electrical device, practice safety by unplugging the power supply any time you touch live parts. Cutting some turns off of L2 will allow you to get short wave if you prefer, instead of the regular AM band.

Headphones To Use. We have not yet talked about earphones. You must use high impedance phones, not the 8-ohm ones used with hi-fi sets. 2000 ohms is fine, but 4000-ohm phones are better yet.

So there you have it. With some ingenuity, and an old parts bin you can make a real Depression Era radio. ■



PARTS LIST FOR THE BREADBOARD/AMer RECEIVER

- C1—365-pF variable tuning capacitor (Radio Shack 272-1341 or equiv.)
- C2—470 to 500-pF capacitor (Radio Shack 272-125 or equiv.)
- C3—500 to 600-pF capacitor (Radio Shack 272-130 or equiv.)
- R1—1- to 4-megohm, ½-watt or ¼-watt resistor (Radio Shack 271-000 or equiv.)
- V1—Type 27 triode radio tube (see text for sources)

Misc.—Coil forms—2-in. plastic water pipe; 5-pin tube socket (antique type); high-impedance phones (2,000 to 4,000 ohms); 5-6 feet of #20 enameled wire (#20 preferred, but #22 or #24 acceptable); five binding posts or clips for connecting power, antenna, phones (Radio Shack 274-661 or equiv.) panels (two), 1-in. wood strips for base, nails or wood screws, solder, paint, wire, etc.

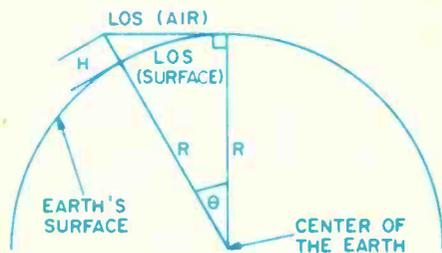
LINE OF SIGHT ANTENNAS

In SWLing, what your antenna "sees" can be what you get!

by Daniel J. Flak

□ The TV, FM, or Action Band DXer is constantly concerned with the line-of-sight (LOS) limitations imposed by the curvature of the earth and the combined antenna heights of the receiver and transmitter.

The figures presented here represent only the actual line-of-sight distances. This is because we can generally ignore refraction effects in this discussion. It's possible to do this because the wavelengths we encounter are very short when compared to the size of the earth. Also, the angle of incidence with the horizon is practically zero. There will be some diffraction due to man-made obstacles and terrain variations. This usually works in favor of increasing



This figure illustrates the geometry on which the charts and diagrams are based. Note that r is measured from the center of the earth and H is the height of the antenna.

propagation distance, but typically account for less than a 10% increase in overall range. The antenna heights calculated here will guarantee reception of a clean signal which is caught "on the fly."

Since the triangle within the figure shown is a right triangle, the relationship $\cos \theta = r/(r+h)$ must be true. The radius of the earth (20,873,998 ft.) is r and the antenna height is h . Each degree measured along the surface of the earth is 69 statute miles therefore, the line-of-sight along the surface of the earth (as opposed to through the air) is given by $69 \times \text{arc } \cos \theta$. This information is presented in both tabular and graphic form.

This information can be used to determine what stations are within range of your antenna, or how high your antenna should be to receive a particular station. You will need to know antenna heights and geographical features in your area. Antenna information can be found in Spot Radio Guide which can be found in the business and commerce section of larger libraries, or by contacting the station involved. The best way to determine geographical features is to look them up on a topographical map either from an atlas at the library, or from some other source such as an Aeronautical Sectional Chart. The Sectional Chart sells for

about \$2.00, and can give you both antenna heights and topographical information if you know the location of the antenna. If you cannot obtain this information, you can make an educated guess as to the antenna height (800-1000 ft. for TV, 500 ft. for larger FM stations and 150 ft. for firehouse or police station antennas).

How to Work The Tables. Case I; (station and receiver at same elevation):

How high must an antenna in eastern New Mexico be to clearly receive a west Texas TV station (antenna 1200 ft.) which is 50 miles to the east.

LOS due to receiver = Distance - LOS due to transmitter; = 50 m. - 42.39 (from table); = 7.61 mi

Going back into the tables, we see that the required antenna height is between 30 and 40 ft. tall. We can pick off about 38 ft. from the graph.

Case II; (station and receiver at different elevations):

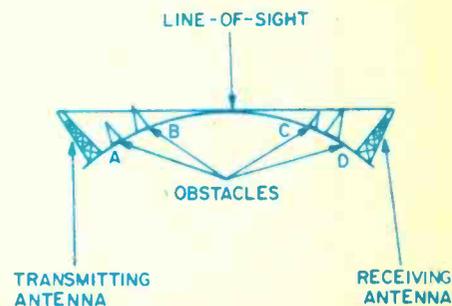
How high must an antenna in San Bernadino, California (elev 1000 ft.) be to receive an FM station near Los Angeles, California (combined antenna and mountain = 4000 ft.) which is 75 miles away?

Since the antenna has a 3000 ft height advantage over the receiver, we will enter the charts at 3000 ft.

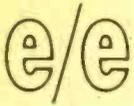
LOS due to receiver = Distance - LOS due to transmitter

LOS due to transmitter = 75 mi - 67.03 = 7.97 mi

Again, from the graph, we see that



There are four possible ways obstacles may be positioned between a receiving and a transmitting antenna. Note that A and C are below line-of-sight between the antennas.



LINE OF SIGHT

the antenna should be about 43 ft. tall. If the receiver has the elevation advantage over the transmitter, subtract this advantage from the antenna's required height.

Special Problems. Difficulties involving "looking over" an obstacle between you and the transmitter may not always be practically overcome, but the calculations for this problem are as follows.

If the obstacle is within the LOS of the transmitter, compare the height of the antenna to the height of the obstacle as follows:

| | | |
|-----------------------|---|----------------------|
| Height of transmitter | ? | Height of obstacle |
| LOS of transmitter | | Distance to obstacle |

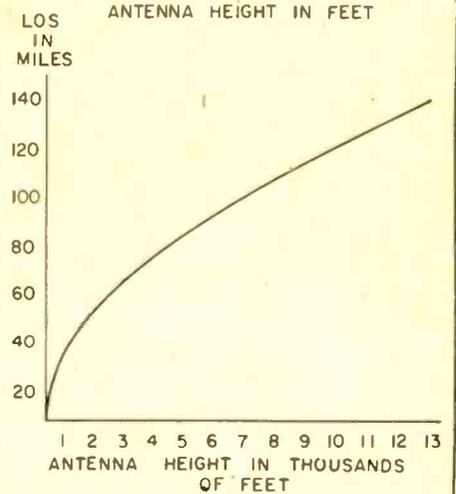
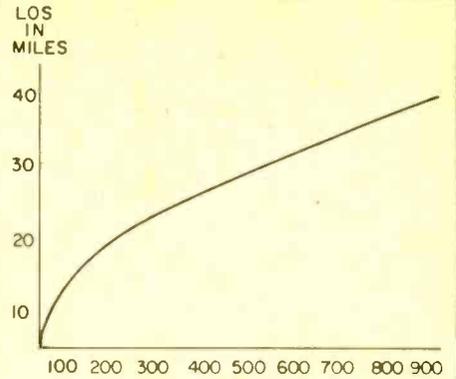
If the right hand side is greater than the left hand side, the obstacle is below the line-of-sight of the transmitter, and it is no factor.

If the left hand side is greater than the right hand side, the receiver antenna's required height must be increased by the following factor:

(Continued on page 94)

Line-Of-Sight Tables

| Antenna (ht./ft.) | LOS (mi.) | Antenna (ht./ft.) | LOS (mi.) |
|-------------------|-----------|-------------------|-----------|
| 10 | 3.87 | 1200 | 42.39 |
| 20 | 5.47 | 1300 | 44.12 |
| 30 | 6.70 | 1400 | 45.79 |
| 40 | 7.74 | 1500 | 47.40 |
| 50 | 8.65 | 1600 | 48.95 |
| 60 | 9.48 | 1700 | 50.46 |
| 70 | 10.24 | 1800 | 51.92 |
| 80 | 10.94 | 1900 | 53.34 |
| 90 | 11.61 | 2000 | 54.72 |
| 100 | 12.24 | 3000 | 67.03 |
| 110 | 12.83 | 4000 | 77.40 |
| 120 | 13.41 | 5000 | 86.54 |
| 130 | 13.95 | 6000 | 94.80 |
| 140 | 14.48 | 7000 | 102.39 |
| 150 | 14.99 | 8000 | 109.46 |
| 200 | 17.31 | 9000 | 116.11 |
| 300 | 21.20 | 10000 | 122.39 |
| 400 | 24.47 | 11000 | 128.36 |
| 500 | 27.36 | 12000 | 134.07 |
| 600 | 29.98 | 12500 | 136.84 |
| 700 | 32.38 | 15000 | 149.83 |
| 800 | 34.61 | 20000 | 172.99 |
| 900 | 36.71 | 30000 | 211.83 |
| 1000 | 38.70 | 35000 | 228.77 |
| 1100 | 40.59 | | |



This table will give you all the data you need to compute the height of your antenna if you know the Line of Sight distance from the transmitter, or visa versa.

CB Mobile-to-Base Power Unit

□ CB mobile transceivers and 3 to 5-watt CB handie-talkies are easily converted to base station operation with this 13.8 volt regulated power unit. Transformers T1 and T2 should be rated 2 amperes. When T1 and T2's secondaries are connected, test the transformer(s) output voltage with an AC voltmeter. If the meter indicates approximately 6.3 volts, reverse the connections of either transformer's primary or secondary,

but *not both*. The meter will then read about 18 VAC. Complete the rest of this project only after you are certain the output voltage from the transformer(s) is about 18 VAC.

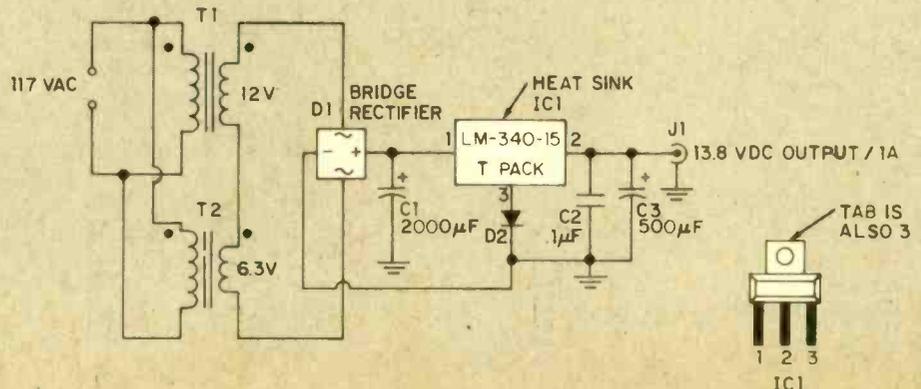
IC1 must be heat sinked to the cabinet. Note that IC1's tab is a "hot" terminal; make certain it is insulated from the cabinet with a power transistor insulator or a mica washer. Coat both sides of the insulator (washer) with silicon heat sink

grease. And make certain the mounting screw is insulated from the cabinet; use fiber shoulder washers under the screw.

Connect rectifier D2 exactly where shown in the circuit. D2 should be rated at least 50 PIV at 3 amperes. Bridge rectifier D1 is rated 50 PIV at 6 amperes. Do not substitute a 3 ampere bridge rectifier for D1 unless you heat sink it to the chassis.

CB MOBILE-TO-BASE POWER UNIT

- C1—2000- μ F, 25-VDC electrolytic capacitor (Radio Shack 272-1020 or equiv.)
- C2—0.1- μ F capacitor (Radio Shack 272-1401 or equiv.)
- C3—500- μ F, 25-VDC electrolytic capacitor (Radio Shack 272-1019 or equiv.)
- D1—6-A, 50PIV bridge rectifier (Radio Shack 276-1180 or equiv.)
- D2—3-A, 50PIV silicon rectifier (Radio Shack 276-1141 or equiv.)
- IC1—2-A, 13.8-VDC voltage regulator (Allied Electronics 569-2726 or equiv.)
- J1—Grounded output connector (Radio Shack 274-346 or equiv.)
- T1—12-volt, 2-A filament transformer (Radio Shack 273-1511 or equiv.)
- T2—6.3-volt, 2A filament transformer (Radio Shack 273-1510 or equiv.)

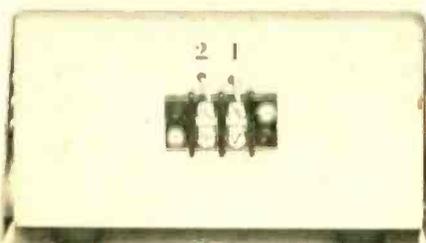


□ With today's increasing crime rate, and the increasing need for security, many police departments are expanding the number of frequencies on which they transmit information. In most scanners you can only fit either eight or ten different frequencies, and the task of changing crystals when the ones you have installed are temporarily out of use, is bothersome, especially in a mobile unit!

Of course, instead of changing crystals you could always buy one of the sixteen-channel synthesized units, and pay in excess of \$300! Or you could solve the problem of changing crystals by building and installing the "Channel-Changer." It's small and easily installs on either a mobile or base scanner, and requires no external power source. It provides you with capability of changing crystals at the flip of a switch. For this project I used a Realistic Patrolman PRO-14, but the principle can be easily adapted to work with most major crystal-controlled scanning monitors.

What it Does. The Channel-Changer is a low-cost switching device which performs the task of changing crystals in a scanner. It does this by using a 12-position, single pole, rotary switch to change from one crystal to another. This gives a maximum of 12 possible frequencies for one crystal position in the scanner. The only limitation is that all crystals in the Channel-Changer must be in the same frequency band, i.e., all frequencies installed in the device must be either in the 30-50 MHz (VHF low), 150-174 MHz (VHF high) or 450-512 MHz (UHF) range. Do not install several crystals from one of these bands and several from another band in the Channel-Changer at the same time, as this may damage the crystal, the scanner, or both. This rule of thumb only applies to the crystals installed in the Channel-Changer itself; the other nine crystal sockets in the scanner may be used with crystals in any frequency band.

Construction. All components are mounted in a metal utility cabinet using the base of the box as the chassis.



This back view of the Changer shows the barrier terminal strip and its two interconnection points to connect to the scanner.



CHANNEL CHANGER

Soups Up Your Scanner

Add the versatility and excitement of extra frequencies to your Public Service Band monitoring.

by Louis A. Smith II

First mount S1, the crystal-selector switch, on the front panel of the case. Exact placement isn't critical, but it should be mounted near the center of the panel.

Next comes the crystal holder. For this purpose I utilized a 22-pin edge card connector. The edge card connector is excellent for this purpose because firm contact with the crystals is essential. Before mounting the connector on the chassis, some wiring must be done. Connect the first twelve terminals on one side of the connector together, using #20 gauge wire. After this wiring has been completed, the connector may be mounted in the center of the chassis base, parallel with the front and back panels. It should be mounted on one-inch aluminum spacers, with the side with the terminals connected facing the back panel of the case.

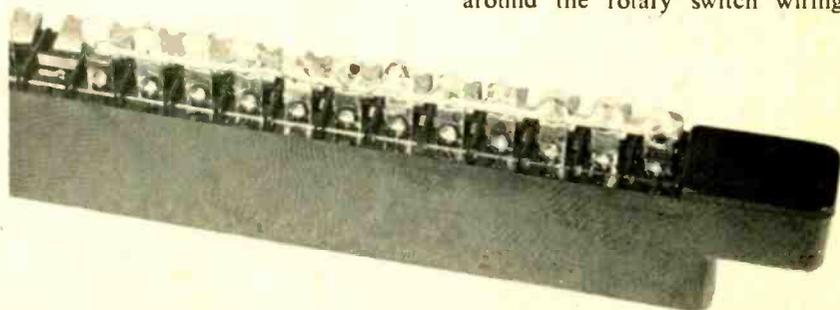
Lastly, mount the 2-terminal barrier strip on the outer side of the back panel, near the center. Drill two 1/8-inch holes in the back panel, one above each terminal.

Now attach some type of indicator knob on the shaft of S1. I used a communication knob. The shaft of S1 will have to be shortened to accommodate such a knob.

Wiring the Changer. When the components are mounted, it is time to finish the construction by wiring the project.

The first step in wiring is to connect a wire from the common (innermost) terminal on S1 to terminal 1 on the barrier strip.

Next S1 must be wired to the edge card connector (crystal holder). When looking at S1 from a rear view, choose one of the 12 outside terminals which is approximately at the 6 o'clock position. Connect a wire from this terminal on S1 to the first terminal on the edge card connector, (that is, the terminal facing the leftmost of the twelve which were previously wired together.) This will be the connection for crystal socket #1 in Channel-Changer. Continue around the rotary switch wiring the



Wire the first twelve terminals of an edge-card connector together, as shown above. Some of the terminals opposite those wired are bent down for greater clarity.

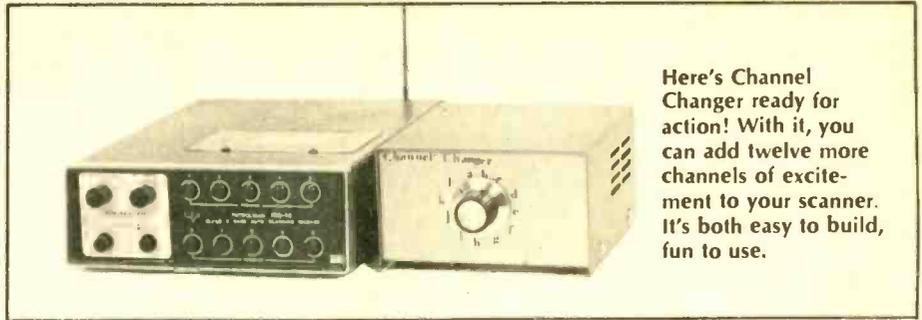
e/e CHANNEL CHANGER

next terminal on S1 to the next terminal on the connector, going from left to right on the connector, and clockwise around S1. Continue wiring in this manner until all twelve positions on S1 have been wired to the corresponding twelve terminals of the crystal holder.

The final connection to be made in wiring is to connect a wire from one of the twelve terminals on the connector which were wired together, to terminal 2 on the barrier strip. Consult the schematic diagram.

Interfacing with the Scanner. After the wiring is finished, install up to twelve crystals in the twelve wired positions in the edge card connector. The position furthest to the left will be position #1, the next, position #2, and so on. Although Channel-Changer has the capability to hold 12 crystals, it may be used to switch any number from 2 through 12. Now the Changer is ready to be attached to the PRO-14.

First, remove the crystal compartment cover, located on top of the scanner. Choose the channel to which you want to connect the device and remove a crystal, if one is already present in the socket. Next, move the "Band Select Switch" for that channel to the specific band in which all the crystals in the Channel-Changer are. If the channel you selected is channel 1 through 5, connect a wire (#20 gauge) from terminal 1 on the barrier strip to the *lower* pin in the socket. If the selected channel is 6 through 10, con-



Here's Channel Changer ready for action! With it, you can add twelve more channels of excitement to your scanner. It's both easy to build, fun to use.

nect a wire from terminal 1 on the barrier strip to the *upper* pin in the crystal socket. Instead of inserting a plain wire into the crystal socket, it is better to use some type of metallic terminal. The pins on these terminals are .042 inches in diameter, so I recommend pinching them slightly with long-nosed pliers to fit in the crystal sockets which are made to accommodate the pins on a crystal which are approximately .038 inches in diameter. (See schematic diagram for definition of upper and lower pins in the socket.)

Next connect a wire to terminal 2 on the barrier strip and fasten the other end of this wire to the outside of the crystal compartment cover with electricians tape. Strip about 1/4-inch of the plastic covering on this wire off the end which is attached to the compartment cover. These two wires running from terminals 1 & 2 on the barrier strip to the crystal compartment of the PRO-14 can be of any length, but it is best to keep them short to avoid possible interference with the FM broadcast band.

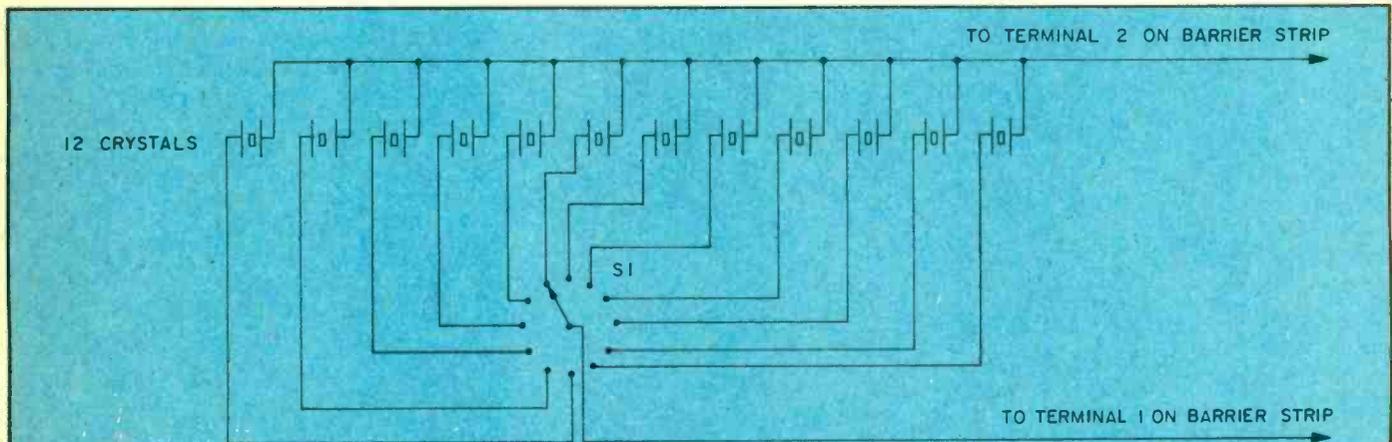
After these connections have been made in the compartment, the cover

can be replaced. Be careful not to tighten the cover screws too much as this may cut the wire running from terminal 1 on the barrier strip to the inside of the scanner, and thus short out the connection.

A few final construction hints: It is advisable to label the positions of S1 on the front panel, so that it can be easily seen which crystal is connected to the scanner at any given time. Labeling should be done before replacing the cover of the utility case, while looking at the back of S1 to see which crystal is connected when S1 is in any of its twelve positions. Dry-transfer lettering works well on the surface of the utility case.

Testing it Out. When construction is completed, Channel-Changer is ready to be tested out. Before turning power in the scanner on, check all wiring against the schematic diagram, and correct any errors.

With a National Weather Service crystal, (or any other continuous broadcasting crystal in your area, such as mobile telephone, etc.) installed in the changer, set S1 so that this continuous broadcasting crystal is connected in



Parts List For Channel Changer

S1—Rotary switch, single-pole, 12-position, shorting (Radio Shack 275-1385 or equivalent)

XTAL holder—Edge card connector, made to accommodate 22-pin card (Radio Shack 276-1551 or equivalent)

Misc.—aluminum spacers (Radio Shack 270-1393 or equivalent), barrier terminal strip, 2 terminal (Radio Shack 274-656 or equivalent), communications knob (Radio Shack 274-391 or equivalent), crystals, see text for

options, dry-transfer lettering, hook-up wire, gauge 20 (Radio Shack 278-1294 or equivalent), metal utility cabinet (Radio Shack 270-253 or equivalent), metallic terminals (Radio Shack 270-1392 or equivalent).

RADIOTELEPHONE (RCC) FREQUENCIES

These VHF and UHF frequencies are used by mobile telephone systems across the country.

VHF "High" Band

| Receive | Transmit | Channel Designator |
|---------|----------|--------------------|
| 152.03 | 158.49 | 1 |
| 152.06 | 158.52 | 3 |
| 152.09 | 158.55 | 5 |
| 152.12 | 158.58 | 7 |
| 152.15 | 158.61 | 9 |
| 152.18 | 158.64 | 11 |
| 152.21 | 158.67 | 13 |

UHF Band

| | | |
|---------|---------|----|
| 454.025 | 459.025 | 21 |
| 454.050 | 459.050 | 22 |
| 454.075 | 459.075 | 23 |
| 454.100 | 459.100 | 24 |
| 454.125 | 459.125 | 25 |
| 454.150 | 459.150 | 26 |
| 454.175 | 459.175 | 27 |
| 454.200 | 459.200 | 28 |
| 454.225 | 459.225 | 29 |
| 454.250 | 459.250 | 30 |
| 454.275 | 459.275 | 31 |
| 454.300 | 459.300 | 32 |
| 454.325 | 459.325 | 33 |
| 454.350 | 459.350 | 34 |

Thanks to Channel Changer, you're going to have a lot of extra frequency requirements in your scanner. The radiotelephone bands can make for some real exciting listening. Here's the lowdown—our compliments.

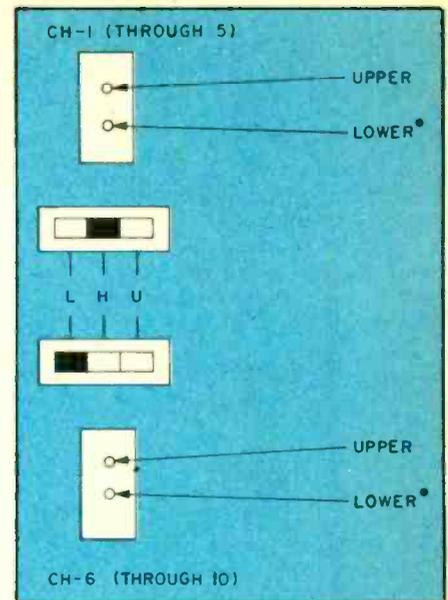
the circuit. Turn the scanner on, and manually stop the scanner on the channel to which the Changer is connected. The scanner should now be receiving the frequency of the continuous broadcasting crystal. If reception is poor, or doesn't exist at all, switch the connections at the terminals on the barrier strip. If this doesn't correct the problem, a bit more of the plastic covering should be removed from the wire which was taped to the crystal compartment cover. Also, make sure that the wire in the crystal socket is securely in place. This should improve reception.

Installing the Changer. Channel-Changer can be easily mounted in either a base or mobile installation. It should be kept in mind that the two leads extending from the terminals of the barrier strip should be kept as short as possible.

To install Channel-Changer on a base installation, it can be set either on top or beside the scanner after the wiring between the Changer and the Scanner has been completed.

If you want to install the Changer in a vehicle, it can easily be bolted under the dash board next to the scanner after all interconnections have been made.

Channel-Changer is very useful for scanner-owners who live in major metropolitan areas, or in areas in which police departments have several frequencies, but who primarily use one for general communications, and hold



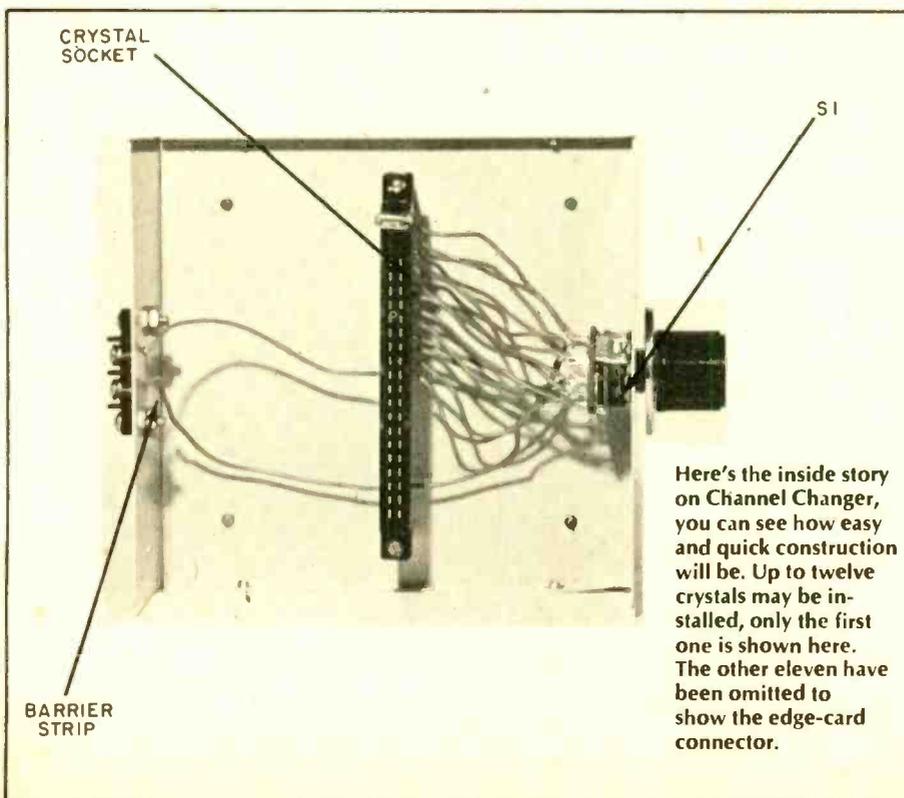
If you're interfacing Channel Changer on your scanner's channels 1 through 5 (inclusive) connect a wire from terminal one on the barrier strip to the lower pin in the socket. If to channels 6 through 10 (inclusive) then the wire goes from the terminal to the upper pin in the socket. Make certain you don't do it backwards.

the others in reserve for special or emergency messages. It is also useful when installed on a mobile unit, for people who commute from one area to another, because the crystals of the police or fire departments of another locality could be installed in the Changer, and switched to only when you drive within receiving range.

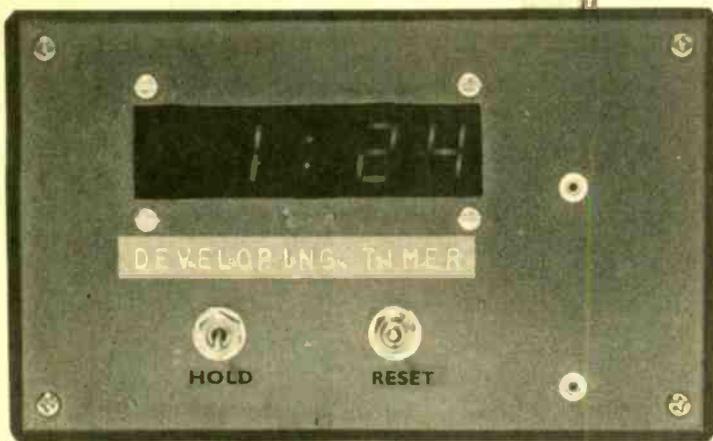
Operation. After the PRO-14 scanner is turned on, set the control knob (S1) on the Changer to the desired crystal position. The scanner will scan 9 crystals installed in the scanner itself plus the one crystal in the desired position of the Changer. The PRO-14 will not scan all twelve crystals in the Changer at the same time, but only the one to which S1 is set. When a transmission is received on the selected crystal in the Changer, the channel indicator light on the PRO-14 will light corresponding to the channel in the scanner to which the Changer is connected.

As an example if the Channel-Changer is connected to channel 3 on the scanner, the indicator light for channel 3 will light when a transmission is received on the crystal selected in the Changer. The Changer can be cut out of the scanning circuit altogether by simply locking out the channel on the scanner to which it is connected.

Now that you've built the Channel-Changer, you've solved your crystal change problem! Happy PSB listening!



Here's the inside story on Channel Changer, you can see how easy and quick construction will be. Up to twelve crystals may be installed, only the first one is shown here. The other eleven have been omitted to show the edge-card connector.



MIDGET DIGIT -IT'S THE BIG TIME

Here's a little device to save a photographer big headaches!

by Herb Friedman

□ At first thought a digital time clock that only indicates to nine-minutes fifty-nine-seconds might not appear to have any particular value; yet commercial models sell for up to \$150, so there must be something in 9:59 that's commonly overlooked.

Actually, the 9:59 digital clocks are really timers with push-button reset to zero while running, and a hold control that permits several short time intervals to be accumulated.

Radio stations, recording studios, and tape fans use them to time records and program segments when preparing tapes. More importantly, photo hobbyists use the 9:59 time clock when developing color film and prints.

Here's a typical use: Assume you're using the Besseler color system to make color prints. The first developer needs two minutes, the second developer needs one-and-a-half minutes. You set the timer running, pour the developer into the tank and then roll the tank to start the developing. At the instant your hand rolls the tank your other hand hits the reset switch on the timer. The timer resets to zero and starts counting. At two minutes you dump the first developer and the time clock keeps running. You pour in the second developer and roll the tank. At the instant the tank is rolled you hit the reset switch, the timer returns to zero, and you follow the timing to one minute and thirty seconds.

Until the moment you need to reset to zero you can simply ignore the timer and concentrate on developing. If you want to totalize developing time you simply press the hold switch after each procedure. At the end you'll have a total elapsed time to 9:59.

The reason commercial 9:59 timers run upwards of \$100 to \$150 is because they are jam-packed with integrated circuits. Most models were designed when IC technology was still in its in-

fancy. By using a modern clock module that utilizes large-scale integration you can now build a slightly better timer than the commercial model for about \$20 to \$25, and all the parts are available at Radio Shack stores.

In fact, our Midget Digit can also be used as a Black and White enlarger exposure timer because the red glow of the 0.5-inch LED digits won't fog B&W paper.

Building Midget Digit. The timer consists of a twelve hour LED display, digital electronic clock module, a DPDT spring-return switch (or a push-button switch), a SPST toggle switch for hold, a power transformer for the clock module, and any cabinet you care to use. Though the clock module is the standard twelve hour type, by connection of the switches to existing terminals you can time minutes and seconds without making any modifications to the module.

The first step is to prepare a cabinet for Midget Digit. Use anything you prefer: a plastic cabinet, a Minibox, a utility case, etc. Don't worry about a protective red filter for the clock's LEDs; it's already part of the clock

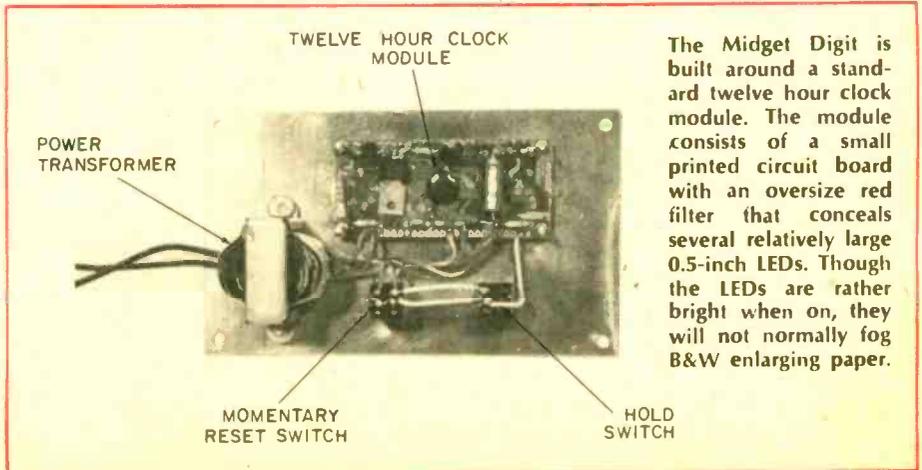
module.

Before installing the module in the cabinet install a set of fine wire jumpers from terminals 24 to 14, and 14 to 7. We say fine wire because you can't squeeze two ends of standard #22 hook-up wire into the #14 terminal.

All terminals, from 1 through 24, run along the bottom edge of the module and the instructions supplied very clearly indicate which terminal is what number. Just double check your count before soldering. The terminals are plated-through so you can solder to either side of the module's printed circuit board.

To avoid shorting the module's wiring to a metal panel use an 1/8-inch spacer or stack of washers between the panel and the module at each mounting screw.

The color-coded wires for the matching power transformer had absolutely no relationship to the instructions on the transformer itself. We don't know if this is true for all transformers in all stores, or just the ones in our local store. So follow this procedure: The black wires are 120 VAC; the two red (Continued on page 88)



The Midget Digit is built around a standard twelve hour clock module. The module consists of a small printed circuit board with an oversize red filter that conceals several relatively large 0.5-inch LEDs. Though the LEDs are rather bright when on, they will not normally fog B&W enlarging paper.



Kathi's CB Carousel

by Kathi Martin, KGK3916



CIRCLE 67 ON READER SERVICE COUPON

A hot new CB—
with something extra!

□ Every few years that famous testing organization given to rating "best buys" for teachers, intellectuals, etc., tackles equipment even the angels in heaven would give a wide berth. In their October 1977 issue the testers rated CB transceivers. Of the more than 1090 transceivers which had been FCC type-accepted by October, the testers rated a grand total of twenty 40-channel models.

I don't mind that the testers provided absolutely no specification for their *selectivity* rating—was it 40, 50, or 60 dB adjacent channel rejection they rated as excellent? Nor am I concerned that their image rejection standards concern frequencies which practically never cause CB interference because they are rarely used.

What I do object to is that two of their rated models had power output in excess of 4.0 watts, a clear violation of the FCC's 4.0 watt output limitation. What is the next item for ratings, CB linears?

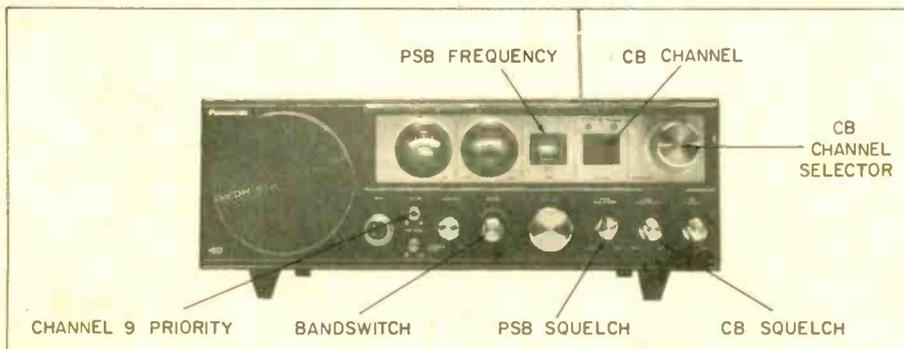
As far as I'm concerned I like to make my own judgments from hard facts: I want to know how much adjacent channel rejection in *dB attenuation*; how much microphone sensitivity for 85% modulation (I don't want every noise for five miles picked up by a mobile with a microphone sensitivity of -50 dB). In short, I want detailed performance information so I can select a particular transceiver for a particular job. I don't need a \$299.95 SSB rig for communications out in the boondocks when I'm two miles from camp, just as

I don't want a rig with 40 dB adjacent channel rejection for use in the center of New York, Chicago, or L.A.

Best Buys or not, the place to get hard facts is the *CB YEARBOOK* and its sister publication the *CB BUYERS GUIDE*. Both provide actual measurements, made in our own lab, on close to 150 rigs (that's right, *one hundred and fifty*). There are no fancy write ups on styling, nor performance judgments made by someone who never turned the power switch on. All you get are the measurements that directly affect communications, and possibly a few comments on theft-proof mobile mounts. Then *you* decide which transceiver has the features and performance that meet your own particular needs and budget.

CB and PSB. One of the really new ideas to come along in CB is Panasonic's RJ-3660 combination CB transceiver and VHF PSB (Public Service Broadcast) receiver. In what is essentially a base station measuring 5³/₁₆-in. high x 13¹/₄-in. wide x 9⁵/₁₆-in. deep with a user option for 13.8 VDC operation. Panasonic has combined two separate types of receivers (AM for CB, FM for PSB) with full CB override and priority selection of CB channel 9.

The PCB receiver has its own squelch control and covers the range of 136 to 174 MHz, with the tuning dial specially calibrated to indicate the weather service frequencies. No crystal control is provided for PSB; you must locate the desired services through manual tuning and careful monitoring. The antenna for the PSB is a telescopic whip, permanently affixed to the back of the trans-



Though the Panasonic RJ-3660 combines an FM PSB receiver and an AM CB transceiver in the same cabinet, the front panel isn't cluttered or complicated. Major differences is a PSB tuning dial in addition to the digital CB channel indicator, and separate squelch controls for each receiver. You'll be sure to find the PSB receiver a useful addition, especially in time of emergency when your CB is most important. For more information circle No. 67 on the Reader Service Coupon.

e/e KATHI'S CB CAROUSEL

ceiver, that can be pivoted into a horizontal storage clip.

The RJ-3660 can be set for only PSB reception, or PSB with CB override, called *CB Monitor*. When set for *CB Monitor* both the PSB and CB receivers feed the speaker, each receiver being squelched by its own squelch control. If a CB signal comes on while you're listening to PSB the CB squelch releases and you hear the CB signal in the speaker. To answer the call you must switch to CB (only) because you cannot transmit in the *CB Monitor* mode. A typical use of the override feature would be a REACT team monitoring the VHF marine channel and the local CB "boaters" channel. A distress call on either frequency would be heard. Alternately, a REACT team might chose to monitor the VHF marine channel and CB channel 9.

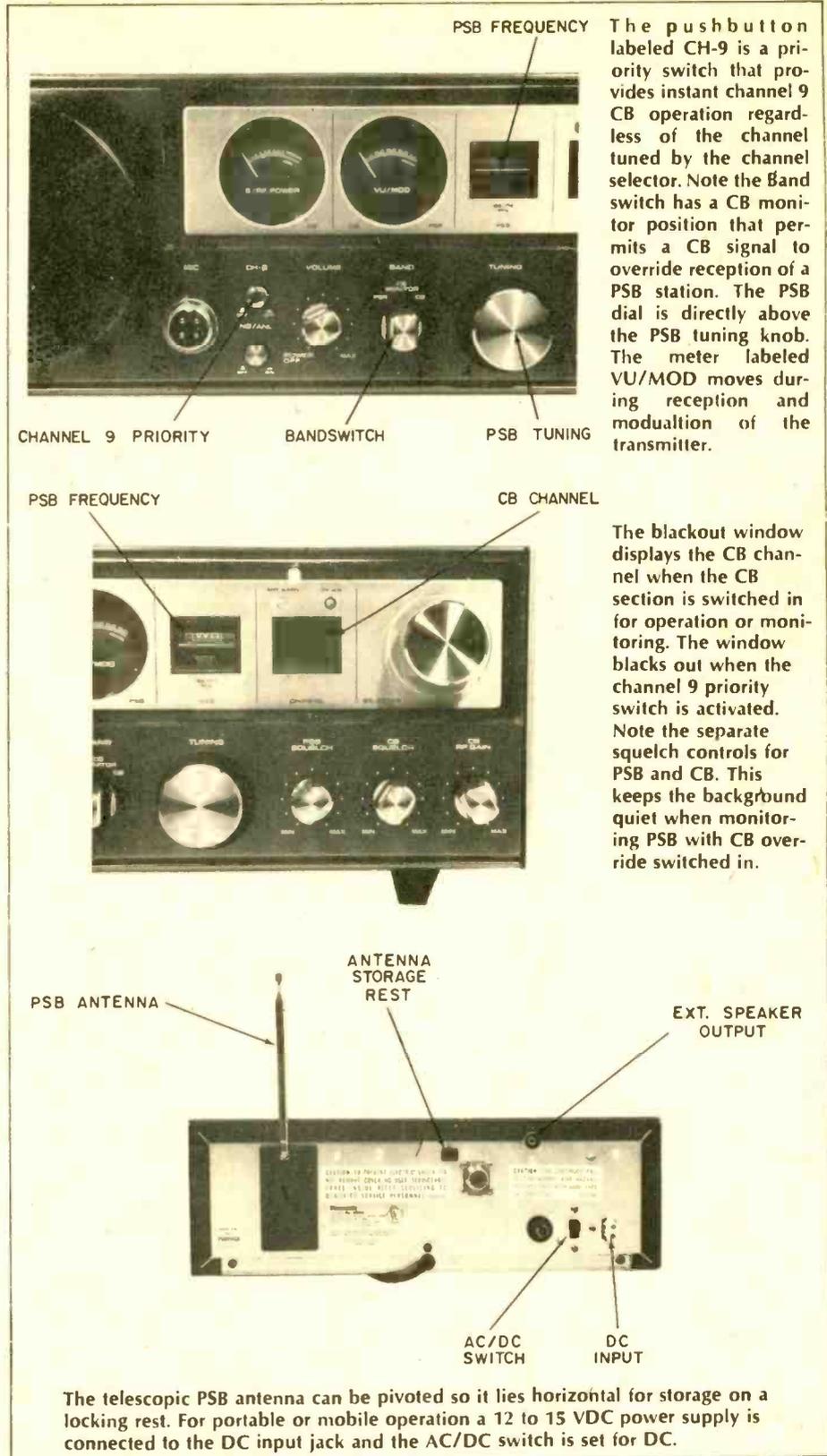
A special priority switch provides instant access to channel 9. Regardless of the channel selected by the main CB channel selector pressing the channel 9 pushbutton instantly switches the CB transceiver to channel 9 (even when monitoring PSB).

The CB transceiver has many of the common high-performance features: digital channel indicator, switched ANL and noise blanker, RF gain control, combination S/RF-output meter, and an antenna warning light. The antenna warning light is really a *safe SWR* indicator; it goes on only if the antenna system's SWR rises above a safe value (2.5:1 in the unit I tested). If the light goes on it means your antenna system is defective.

A somewhat rare feature is a VU/Modulation meter that provides a reading when receiving (speaker output) and transmitting (modulation). According to the manual the meter has some relationship to the modulation level, but this rig has a sensitive mike and lots of compression. You would almost have to whisper in the next room before the modulation level dropped. The meter therefore serves as dress-up, and I can't see it has any real operating function.

The overall CB performance is strictly first rate. Power output (when 120 VAC powered) measured 3.8 watts into 50 ohms. The microphone sensitivity was -38 dB (+18 above average voice level) and modulation was limited to 100%.

Receiver sensitivity measured 0.4 μ V.



The pushbutton labeled CH-9 is a priority switch that provides instant channel 9 CB operation regardless of the channel tuned by the channel selector. Note the Band switch has a CB monitor position that permits a CB signal to override reception of a PSB station. The PSB dial is directly above the PSB tuning knob. The meter labeled VU/MOD moves during reception and modulation of the transmitter.

The blackout window displays the CB channel when the CB section is switched in for operation or monitoring. The window blacks out when the channel 9 priority switch is activated. Note the separate squelch controls for PSB and CB. This keeps the background quiet when monitoring PSB with CB override switched in.

The telescopic PSB antenna can be pivoted so it lies horizontal for storage on a locking rest. For portable or mobile operation a 12 to 15 VDC power supply is connected to the DC input jack and the AC/DC switch is set for DC.

Adjacent channel rejection was 63 dB. The AGC action compressed an 80 dB dynamic input range to an ear pleasing 9 dB variation from the speaker. The S-meter was calibrated so a 35 μ V input produced an S9 meter reading. The remainder of the S-meter calibrations

indicated relative signal strength.

Overall, the Panasonic RJ-3660 is an unusual and attractive transceiver. Priced at \$279.95 it comes with AC and DC power cables. For additional information circle No. 67 on the reader's service coupon.



2 Meter Method

Get in on Ham Radio's network of fun!

By Morrie S. Goldman

and a written exam covering laws, operating procedures and electronics theory. Unlike some CB operating practices; call sign identification and other legalities are taken quite seriously in the amateur radio service. Most hams pride themselves on good operating procedures and respect for regulations.

The American Radio Relay League can supply you with information about publications designed to help you earn a ham license. You can write to the ARRL at 225 Main Street, Newington, CT 06111, or look for their publications at local book stores or ham radio stores.

Before the current popularity of FM communications, the two-meter band was populated by a relatively few number of stations, operating with AM mode equipment. As surplus commercial FM equipment designed for the high business band (148-174 MHz) became available, enterprising hams converted these transceivers to operate on the two-meter band. Before long, two-meter FM activity was starting to spread. Surplus equipment was often large and quite hard to convert to multi-channel operation, so the introduction of moderately priced commercial solid-

state two-meter transceivers soon followed.

Two-Meter FM lives! Two-meter FM activity is buzzing 24 hours a day, all across the U.S. For many reasons, two-meters is probably the most convenient amateur band to operate, and it's ideally suited to local communications. A 1/4-wave antenna is only 17" long; a 5/8-wave antenna is only 40" long. Transceivers are efficient and compact as most are about the size of a mobile CB transceiver, but have power outputs of from two to twenty-five watts.

FM communication is very quiet. If you've noticed how much quieter an FM broadcast radio is than an AM radio, you have a feel for how much quieter it is in the two-meter FM band than on CB. There are no heterodynes and amplitude modulated noise, such as static and ignition crackling, is greatly reduced. Most two-meter FM transceivers have neither a noise limiter or blander!

Repeaters boost range. Another outgrowth of the similarity between two-meter FM operation and business band radio is repeater operation (termed *duplex*). The repeater may be thought of as a sort of satellite station located at a high point. The repeater's sensitive receiver picks up a transmitted signal and retransmits it through a transmitter (usually at least 100 watts) having an antenna atop a high building, tower or hill and, in this way, increases the reliable range of low-power stations. Even with a low-power hand-held transceiver, reliable range through the repeater may be fifty to sixty miles. Without the repeater (*simplex* operation), reliable range of a hand-held may be only two or three miles.

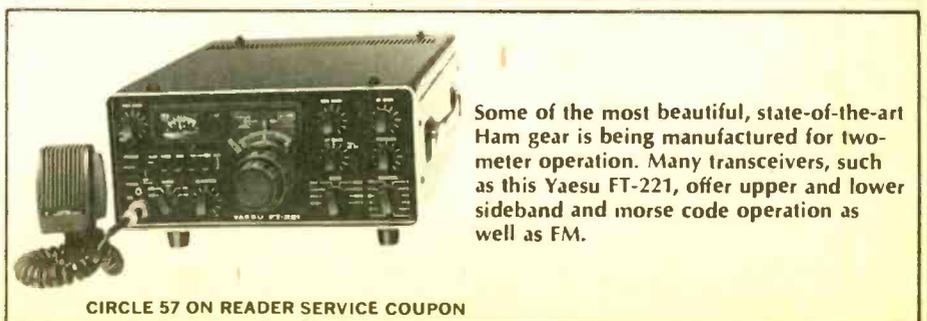
□ CHANCES ARE, you've been hearing all sorts of predictions about the future of personal communications. But, right now, there is already a personal radio service that offers even more convenience than a telephone! The service is VHF amateur radio, and we'll center this discussion on the two-meter amateur band. You can carry a portable two-meter rig with you anywhere and, unlike operations on the citizens band, your efforts won't be cramped by overwhelming interference or sunspot predictions. The two-meter amateur band covers 144 to 148MHz, well into the VHF range and above most interference problems.

To operate a two-meter transceiver in the United States, you'll need a Technician class or higher amateur radio license. Earning an amateur radio license is a good deal more difficult than obtaining a CB license, but it's well worth the extra time and effort. For a Technician class license, you'll need to pass a five word per minute Morse code test



Heath's popular HW-2036 is a synthesized two-meter rig which offers hundreds of channels. Available accessories include a PL encoder built into a microphone, and an AC power supply for use in the home.

CIRCLE 31 ON READER SERVICE COUPON



Some of the most beautiful, state-of-the-art Ham gear is being manufactured for two-meter operation. Many transceivers, such as this Yaesu FT-221, offer upper and lower sideband and morse code operation as well as FM.

CIRCLE 57 ON READER SERVICE COUPON

e/e TWO METER METHODS

When working through a repeater, a two-meter transceiver must transmit and receive on different frequencies, for when a repeater is receiving on one frequency, it is transmitting the received signal on a second frequency (usually 600 kHz higher). Most repeaters operate on somewhat standardized repeater frequencies, called "common pairs." Examples of these are 146.34 (repeater input)/146.94 (repeater output), 146.16/146.76, and 146.28/146.88. You'll commonly hear these pairs called 34/94, 16/76 and 28/88. Repeater directories that detail what repeater frequencies are used in each region are available from many ham radio stores.

Most repeaters are owned and maintained by local amateur radio clubs. Club dues pay the expenses of the repeater, but you don't have to be a member of a club to operate a repeater, though some clubs do frown on the practice.

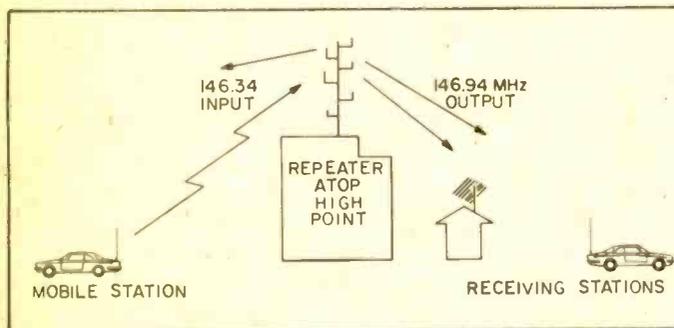
Sometimes, in an effort to deter non-members from operating, but mostly to reduce occasional interference from distant stations using other repeater, a club will design their repeater to "turn-on" only when a proper encoding signal is received. These are called "closed repeaters." Unlike the more common "carrier access" or "open repeater" which turns on when any carrier is received, closed repeaters will retransmit your signal only if it contains the

proper audio encoding signal. The encoding signal is usually a continuous sub-audible tone (commonly called "PL" or "private line") or a short audible tone burst at the beginning of each transmission. PL is most common. Accessory units are available to add these encoding features to most transceivers. Once installed, the encoder must be tuned to the PL or burst frequency used by your local repeater. This frequency can be learned by consulting a repeater directory or your local club.

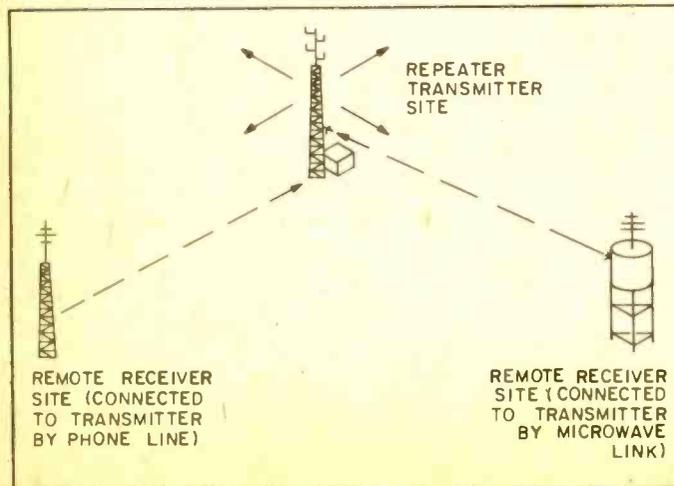
A Portable Telephone. As a service to their members, some clubs offer a repeater feature known as autopatch. Autopatch allows you to patch into a phone line (rented by the club) and use your rig to make short, local phone calls. By punching up the correct numbers on a touch-tone pad, you can gain access to the patch. From there, you need only punch up the phone number you're calling. In most all cases, autopatch is a service for members only. The access codes are changed frequently to maintain the member only operation. A few, very few, clubs do have open autopatch. In such repeaters, keying the * and # opens the patch.

Many transceivers are now available with optional factory installed tone pads, and similar tone pads are available as add-on accessories. Several companies have packaged their tone pad in a microphone case for easy installation.

Equipment Available. Two meter FM
(Continued on page 94)



Basic repeater operation is very simple. Here we have a repeater operating 34/94. A mobile station may transmit on the input of 146.34 MHz and the repeater will retransmit on 146.94 MHz with a higher powered signal.



More complicated repeater arrangements may involve more than one repeater site. The repeaters may be twenty or more miles apart. All the remote receivers transmit their signals simultaneously to the main repeater (via the phone line or microwave). A switching device at the main site chooses, and then rebroadcasts the best signal from the remote stations.



CIRCLE 55 ON READER SERVICE COUPON
Nothing could be handier than a two-meter handie-talkie. A Ham operator is never without communications if he has one of these and is anywhere near hundreds of different repeaters.

Manufacturers of Two-Meter Transceivers and Accessories

Amcomm, 730 West McNab Road, Fort Lauderdale, Florida 33309

Clegg Communications Corp., 208 Centerville Rd., Lancaster, PA 17603

Genave, 4141 Kingman Drive, Indianapolis, Indiana 46226

Hy-Gain Electronics Corp., 8601 N.E. Highway Six, Lincoln, NE 68505

Icom West, Suite 3, 13256 Northrup Way, Bellevue, WA 98005

Midland International, Box 1903, Kansas City, Missouri 64141

KLM Electronics Inc., 17025 Laurel Road, Hill, CA 95037

Regency Electronics Inc., 7707 Records St., Indianapolis, IN 46226

R. L. Drake & Co., 540 Richard St., Miamisburg, Ohio 45342

Standard Communications, PO Box 92151, Los Angeles, CA 90009

Tempo, Henry Radio, 11240 W. Olympic Blvd., Los Angeles, CA 90064

Tri-Kenwood, 1111 West Walnut, Compton, California 90220

Wilson Electronics, 4288 S. Polaris, Las Vegas, Nevada 89103

Yaesu Electronics Corp., 15954 Downey Ave., Paramount, CA 90723

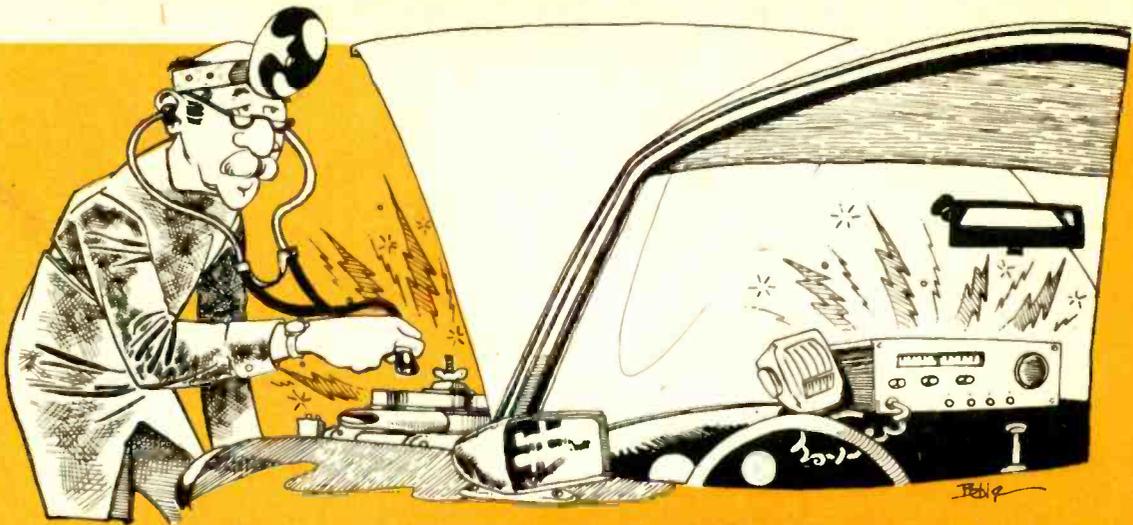
Antenna Manufacturers

Antenna Specialists, 12435 Euclid Avenue, Cleveland, OH 95037

Hy-Gain Electronics (address above)

New-Tronics Corp., 15800 Commerce Park Dr., Brookpark, OH 44142

Larson Antennas, 11611 NE 50th Ave., Vancouver, WA 98663



CURE THAT NOISE!

CB static got you stuck? Be your rigs mobile md

by David Kolman

VEHICULAR ELECTRICAL SYSTEMS have long been recognized as major sources of radio frequency interference (RFI). In recent years, the use of citizen band radios has undergone dynamic growth and is still expanding at a phenomenal rate. The vast number of CB radios, coupled with their low transmitting powers, their extremely high receiver sensitivities, and their proximity to interference sources, all combine to create a widespread and very severe RFI suppression problem.

Vehicles manufactured in the United States are suppressed at the factory to provide satisfactory reception on their installed AM and FM receivers, and to conform with suppression standards for external broadcast receivers. But for a CB radio additional and much more efficient suppression is required; even for CB radios that contain built-in noise limiters or noise blankers.

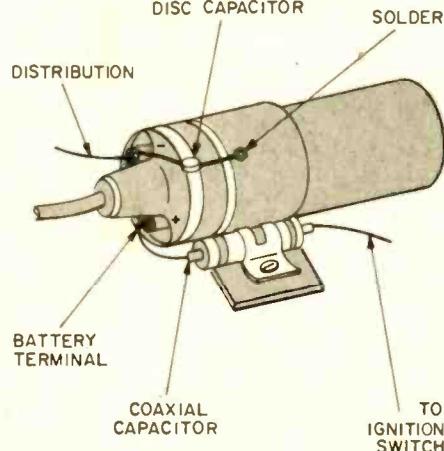
Fundamentals. The noise (RFI) you hear in your CB receiver is produced in two ways. Radiated interference comes from sources that act as miniature broadcasting stations and broadcast their interference. Most radiated noise originates in the engine compartment. Conducted interference, unlike radiated interference, is not transmitted through the air but rather travels along the wiring of the vehicle.

Three approaches may be used to suppress CB radio frequency interference. Limit the interference by turning the squelch up on your CB set. However, by "squenching out," you limit your range to only the stronger signals and "tune-out" all weaker signals.

You can reduce the strength of the interference at its source. Finally, you can try to confine the interference to its source.

Preliminary Procedures. Before attempting to identify a particular source of noise, it is best to suppress some minor sources of noise and thus make it easier to identify the major sources. Make sure the antenna, transceiver, battery and hood are properly grounded. Then check to see that all connections are clean and tight. Be certain all suppression devices installed by your vehicle's manufacturer are still in place and are in good condition. Broken components will not help to suppress radio interference, but can even make it worse.

0.005 mfd. 1,000
VOLT CERAMIC
DISC CAPACITOR



Those annoying popping sounds, which can be traced to the ignition system, can be readily cured. Install a coaxial capacitor at the coil's battery terminal and a .005- μ F, 1,000 VDC, disc capacitor to distributor.

If your engine has not been tuned recently, have it done. Include new spark plugs, breaker points, and condenser. In order to guarantee optimum radio performance, your engine must be in top operating condition.

You might consider having resistor spark plugs, resistor suppression ignition cable, and ignition suppression resistors installed if they are not already. All of these devices serve to check ignition noise and thereby reduce interference.

Connect your CB radio directly to the battery if not already done. Tapping into the accessory-ignition switch or another of your vehicle's electrical systems can cause interference.

After completing the preliminary procedures, you will probably find that the noise in your CB receiver has been somewhat reduced but not eliminated. A step-by-step search will be necessary to locate and identify the remaining sources of interference, since this interference may be due to a single source or a combination of effects. Every type of noise that you hear on your receiver will give you a clue to the culprit's identity by a characteristic sound.

Alternator and Generator? Most modern vehicles employ an alternator that generates alternating current, while older cars are equipped with a direct current generator to keep the battery charged. Both will produce a *high pitched whine or whistle* which varies with engine speed. It will be louder immediately after starting your engine or after turning on your headlights. The whine will not stop instantly when

the ignition is shut off at a fast idle, but will rather decrease gradually.

Ignition System? The interference caused by the ignition system is produced by the distributor (at the points) and by the spark plugs, each time a plug fires. This interference makes a *popping sound* in the CB receiver that increases with engine speed. The noise will stop instantly when the ignition is shut off at a fast idle.

Starting with 1975 models, all domestic and most import cars feature electronic ignitions as standard equipment. Electronic ignitions tend to produce more ignition noise because the major components of the system are generally widely separated, causing the wiring for the ignition system to be interconnected with the other engine compartment wiring.

Voltage Regulator? The voltage regulator causes a *rasping sound* that occurs

at an irregular rate. This irregular rate is because of changes in the generated voltage; caused by things such as an increase in engine speed or turning on the air conditioner. The rasping sound will usually be heard in conjunction with the alternator and generator whine. The interference produced by the voltage regulator will not stop instantly when the ignition is shut off at a fast idle.

Voltage Limiter? The interference produced by the voltage limiter is a loud *erratic scraping sound* that occurs when the ignition is switched to "start" but the engine remains off. It is caused by the movement of fuel and temperature gauges and will lessen after the gauges settle down.

Electrical Accessories? Electrical accessories such as electric windshield wipers, heater and air conditioner blowers, electric window openers, and turn signals can cause interference to CB reception, most often in the form of *various-pitched whines*. To determine the offending accessory, turn each accessory on one at a time and listen for

increased interference.

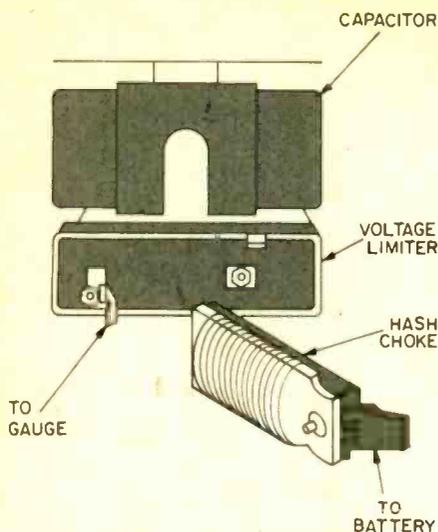
Instruments and Gauges? Instruments and gauges tend to produce *hissing, cracking, or clicking sounds* at irregular intervals. The noise they produce usually worsens on rough roads. To identify this source of interference; park the car and leave the engine running, hit the dash to simulate road conditions, and listen for a sudden change in hissing, cracking, or clicking.

Wheels? A less common source of CB radio interference is the front wheel axle. As the wheels rotate, a static charge is built up between the axle and the wheel bearing. This produces an irregular *popping and rushing noise* in the CB receiver. It occurs most often in dry weather at high vehicle speeds.

To identify this source of interference, accelerate to highway speed, then coast in neutral with your engine off. Apply the brakes gently. If the popping and rushing noise disappears you have wheel static.

Tires? In the case of tires, a static charge, similar to the noise generated by the wheels, can be generated by the

| The Disease | The Symptom | The Cure |
|--|--|---|
| Alternator or Generator High Whine or Whistle | Pitch of the whining or whistle varies with engine speed. The noise is louder after starting vehicle and decreases gradually after the ignition is finally shut off. | <ol style="list-style-type: none"> 1. Install a coaxial capacitor or a commercial noise filter. 2. Check the alternator for dirty slip rings or for worn brushes. 3. Check generator for worn commutator or worn brushes. |
| Ignition system Popping sound | Popping increases with engine speed, but the noise stops at once after the engine is switched off. | <ol style="list-style-type: none"> 1. Get a major tuneup; replace worn plugs, points and condenser. 2. Resistance ignition cable should be installed (or may have been factory-installed) from the distributor to plugs and ignition coil. 3. See that ignition coil and bracket are making a good connection. 4. Make certain that your CB antenna is properly, electrically grounded. 5. Install a noise filter (coax capacitor) near coil battery terminal. 6. Install a .005-uF, 1000 VDC, ceramic disc capacitor to distributor. |
| Voltage regulator Irregular Rasping | Heard in conjunction with the alternator or generator noise. The rasping will not stop instantly when the ignition is switched off. | <ol style="list-style-type: none"> 1. Install coaxial capacitors at the terminals of the regulator. |
| Voltage limiter Erratic Scraping | This noise occurs when the ignition is switched to start, but the engine is still left off. | <ol style="list-style-type: none"> 1. Install a coaxial or pigtail capacitor at the terminal. (or) 2. Install a hash choke in series with the battery terminal of limiter. |
| Electrical Accessories Various Whinings | Operate each of the vehicle's accessories one at a time. As you do this, listen for a whining sound. | <ol style="list-style-type: none"> 1. Install coaxial capacitors or commercial filters at terminals. 2. Avoid putting your CB on the same circuit as vehicle's accessories. |
| Instruments/Gauges Hissing, Clicking | Park the vehicle and, with engine running, bang the dash and listen for any occurrence of noise/static. | <ol style="list-style-type: none"> 1. Install a coaxial capacitor in series with each accessory. |
| Wheels Irregular Popping | On a dry day, coast at highway speed with engine off. Apply brakes very lightly. Popping should stop. | <ol style="list-style-type: none"> 1. Install static-collector rings against the tip of front axle. 2. Check the vehicle springs for wear and repack the wheel bearings. |
| Tires Regular Popping | Use same coasting test as for wheels. The popping will continue even if you apply brakes as before. | <ol style="list-style-type: none"> 1. Inject anti-static powder through the valves of each tire. |



An erratic scraping noise may point to your vehicle's noise limiter. Try installing a hash filter in series with the limiter and battery; also install either a pigtail or a coaxial capacitor at the terminal.

inner tube and tire. This static produces a more regular popping noise in the CB receiver.

Once you have identified and located the interference, there are many methods to help remedy the problem.

Alternator and Generator! The high pitched whine or whistle caused by the alternator can be eliminated by simply installing a noise filter or coaxial capacitor at the alternator output terminal. Care should be taken to make sure the filter or capacitor is rated to handle the maximum alternator output, and that the device is connected to the output terminal, and not the alternator field terminal. Cleaning the alternator slip rings and replacing worn brushes also helps to reduce alternator interference.

As is the case for the alternator, the high pitched whine or whistle caused by the generator can also be limited by installing a coaxial capacitor or noise filter. The generator will already have a factory installed capacitor attached to the armature terminal. If this capacitor is not already a coaxial capacitor, it should be replaced by one. The capacitor or filter is installed by connecting it to the generator output or armature terminal. Once again care should be taken to insure that the capacitor or filter can handle the maximum generator current, and the devices are connected to the output terminal and not the generator field terminal. In addition, check the generator for worn brushes and commutator.

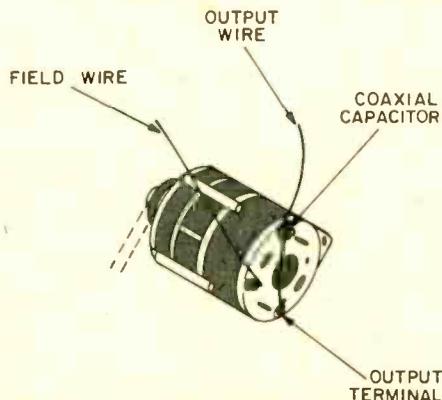
Ignition System! While most late model vehicles are factory equipped with resistance ignition cables and a minimum of radio noise suppressors, this usually will only reduce interference

sufficiently for satisfactory auto radio reception. To further reduce the amount of interference and thereby increase the operating range of your CB, you should get a major tune-up and replace worn spark plugs, points, and condenser. Then make sure resistance ignition cable is installed from the plugs to the distributor and from the distributor to the ignition coil. (This is very important if your vehicle is an older model). Also make sure the ignition coil and its mounting bracket are making a good connection with the engine block and install an ignition type filter or coaxial capacitor as close to the coil battery terminal as possible. Make sure the antenna is properly grounded. Try mounting a 0.005 mfd. 1,000 volt ceramic disc capacitor at the coil distributor terminal.

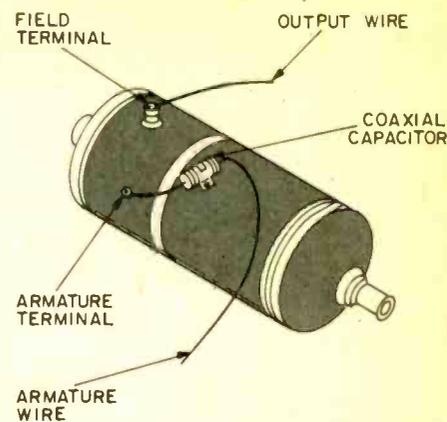
To supplement these steps in limiting ignition noise, you might consider the use of one or more of the following: resistor spark plugs; ignition noise suppressors; and ignition system shielding kits.

Voltage Regulator/Limiter! The rasping sound caused by the voltage regulator can be reduced by connecting a coaxial capacitor or noise filter as close as possible to the "armature" and battery" terminals. Some voltage regulators, particularly in late model vehicles, are solid state and thus have no contacts. Others have single or double contacts. In the case of a single contact, attach a coaxial capacitor or noise filter to the "ignition" terminal. For a double contact, a second capacitor or filter should be attached to the "battery" terminal. Make sure the capacitor or filter is rated to handle the maximum generator or alternator current.

The radio interference from the voltage limiter, in the form of a scraping sound, can be suppressed by connecting a capacitor at the "battery" terminal of the voltage limiter, or by attaching a radio-type pigtail capacitor directly



An alternator can often be stopped from whining by the installation of a coaxial capacitor at the alternator's output wire.



A generator's high whine can often be silenced by installing a coaxial capacitor at the armature terminal of the generator.

across from the voltage limiter terminals. If the interference still persists after taking these measures, install a hash choke (a small wire coil) in series with the voltage limiter battery terminal.

Accessories, Instruments! Once the accessory that is causing the interference is identified, its interference can be silenced by installing capacitors or noise filters at the accessory's terminals. The size of the capacitor or filter will be dictated by the accessory's maximum output. However, out of all the electrical accessories, it is really only worth suppressing the noise from the wipers and blowers since they get continuous use when turned on.

A similar source of interference can be attributed to the audible and visible safety and warning devices that have been installed in late model vehicles. Interference from these sources can be controlled by isolating the primary power circuits to your CB equipment, and avoiding circuit sharing with the buzzer and flasher systems.

The best approach to suppressing the cracking, hissing, and clicking interference produced by offending instruments and gauges is to connect a 0.5 mfd. coaxial capacitor in series with each

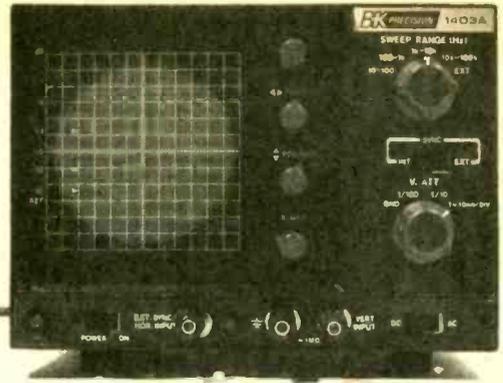
Wheels and Tires! Wheel static, which produces an irregular popping and rushing noise, can be cured by using a pair of static-collector rings. To install these devices, simply remove each front hub-cap and each axle dust-cover. Then, press the small end of the static-collector ring against the tip of the axle and replace the dustcover and hub-cap.

Additional measures to reduce the interference caused by the wheels include having your vehicle's springs checked for wear and having the wheel bearings repacked. gauge terminal.

Eliminating the popping noises gen-
(Continued on page 98)

e/e checks out the...

B&K 1403A Oscilloscope



This economical scope lets you see everything going on inside your equipment.

To judge by most advertisements in the electronic publications everyone should own one of the relatively expensive triggered sweep—or *lab type*—oscilloscopes. In actual fact, most hobbyists and many technicians can get along perfectly well with a rock-bottom priced "general purpose" 'scope such as the B&K 1403A which sells for \$219 complete with one alligator-clip test cable.

Not only do hobbyists and techs get

the advantage of low cost, the general purpose type of 'scope often has a feature virtually unheard of on triggered 'scopes; that of direct connection to the vertical CRT plates for direct observation of RF output from a transmitter. Yes, you could observe the output of a modulated 27 MHz CB signal on this general purpose 'scope by feeding the signal directly to the CRT plates.

But let's not get ahead of ourselves;

let's go back to the beginning and look at what the 1403A offers all hobbyists.

It is unusually small and light, even for a 3-in. 'scope; due entirely to a 100% solid state design except for the CRT itself. Overall dimensions are 7½-in. wide x 6-in. high x 11-27/32-in. deep. Weight is about 8.4 lbs. A carrying handle that folds flat is built into the top of the cabinet.

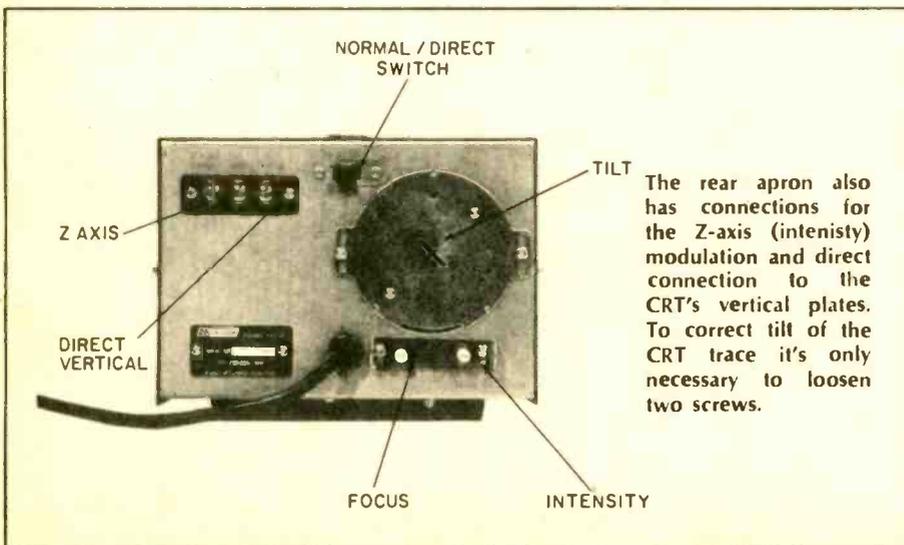
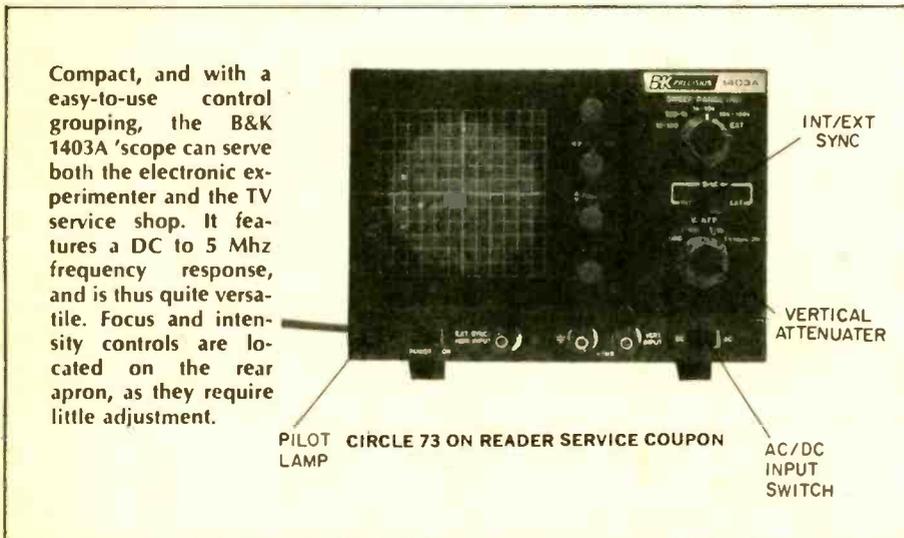
The frequency response is from DC to 5 MHz (−3 dB) or 2 Hz to 5 MHz (−3 dB) so the 'scope can be used for TV servicing. A five position *sweep range* selector switch provides coverage from 10 to 100 kHz or external horizontal input. A separate control serves as the variable sweep vernier or external horizontal gain.

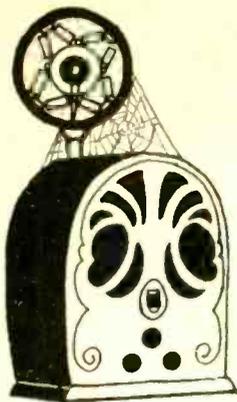
The vertical input is through standard ¼-in. spaced, banana jack 5-way binding posts and a DC/AC switch (that installs a DC blocking capacitor in series with the input for AC-only measurements). A four position rotary selector switch provides vertical sensitivity ranges of 1 (maximum sensitivity, equal to 10 mV/div), 1/10, 1/100 and GND. The GND position grounds the input to permit balancing of the vertical amplifier so that adjusting the sensitivity does not cause the trace to shift position. A "fine" vertical gain control is also provided to permit virtually any desired attenuation between the switch-selected values.

Other front panel features include a 5-way binding post for the external horizontal sync input, a selector switch for internal or external sync, a power switch and pilot lamp, and vertical and horizontal positioning controls.

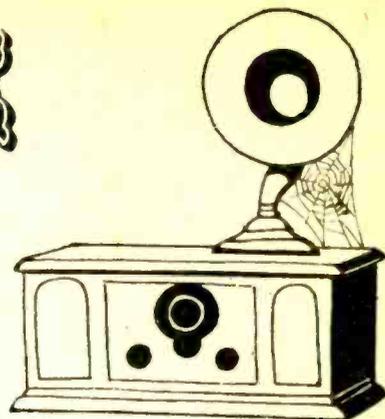
The CRT graticule isn't illuminated, but it does have a *db calibration* that permits you to "read" with some degree of accuracy from a user-selected 0-dB reference level to −20 dB. The graticule has 12 vertical and horizontal major divisions.

The *focus* and *intensity* controls which usually add two additional rarely
(Continued on page 92)





ANTIQUE RADIO CORNER



by James A. Fred

Resuscitate your old electronics with these foolproof operating room techniques.

□ Those of you who restore your radios and want them to look and operate as they did when new know that it is difficult to find suitable replacement filter capacitors. I am thinking especially about the aluminum can type with the threaded neck mounting stud. If you go to your local radio parts store they will not have them in stock. I will attempt to give you sufficient information here to enable you to replace the filter capacitors in your old radio.

The Old Paper Dielectrics. First let us discuss the two types of capacitors found in the old AC operated radios. The first type used was the solid dielectric capacitor with paper insulation. This type was manufactured by laying down alternate layers of metal foil and insulating paper. A layer of foil was placed on a layer of paper with the foil extending beyond the edge of the paper on one side a fraction of an inch, another layer of paper was placed on this foil-paper layer, and then a second layer of foil extending beyond the paper in the opposite direction. The sandwich of alternate layers of paper and foil was then rolled up into a cylinder. End wires or leads were soldered to the extended foil ends. The whole thing was placed into a plastic or cardboard tube and hot wax was poured into the ends of the tube to insulate the capacitor. Larger capacitors were made by increasing the width or length of the foil (increasing the area) or by making the paper thinner. The voltage breakdown of the capacitor is determined by the thickness and type of insulating paper. In order to do a good job of filtering the high "B" voltages generated in the early AC radios the paper capacitors became quite large physically. This is one of the reasons Majestic, Atwater Kent and other radio manufacturers had their paper capacitors sealed in pitch filled cans. You could put several capacitors in one can more cheaply than you could put them into individual cans. Filling

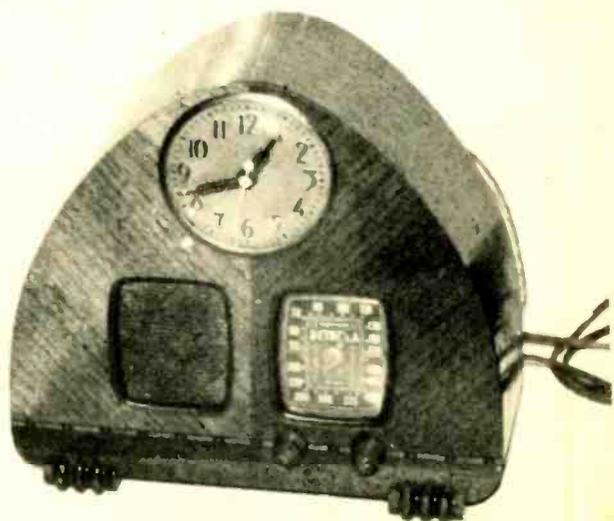
the cans with pitch sealed out the moisture which was fatal to paper capacitors. This type of capacitor is extremely difficult for the present day collector to replace in his restored radio. In another story we will tell you how to replace paper dielectric filter capacitors that were mounted in cans and sealed with pitch.

Early Electrolytics. The second type of capacitor is the electrolytic capacitor and is the one we will discuss in this story. The electrolytic was designed to obtain a large capacity in a small amount of space. Originally the electrolytic was a "wet" type usually housed in a copper can. Aluminum was used as the positive plate, the negative connection was the copper can, and a saturated solution of borax was used as the electrolyte. These capacitors were prone to leak, especially when the chassis was turned upside down for trouble shooting and repair. This was unsatisfactory so a "dry" electrolytic was developed. This type consisted of two metal electrodes separated by a layer of gauze

saturated with an electrolyte. By connecting the electrodes to a source of direct current one became positive and the other negative. An oxide film about one atom thick forms on the positive plate, and it is this thin film that forms the dielectric or insulation between the positive and negative plates. It is because the oxide film is so thin that the capacity of the electrolytic capacitor is large per unit area, and any desired capacity may be obtained by rolling up a suitable length of aluminum foil. The electrolyte is really the negative side of the capacitor, the negative foil is used merely to make contact with the electrolyte. There are more modern ways to construct electrolytic capacitors that provide more capacity in even smaller cans. These are the "etched foil" and "fabricated plate" methods. We won't go into those types of constructions now since we are more interested in replacing defective capacitors than we are in making new ones.

Causes For Failure. Since the dielectric of an electrolytic capacitor is very

This is one of the earliest clock radios, made by Detrola. The cabinet restoration shows that the unit had especially good woodworking, and you can see how careful the design of the case was.

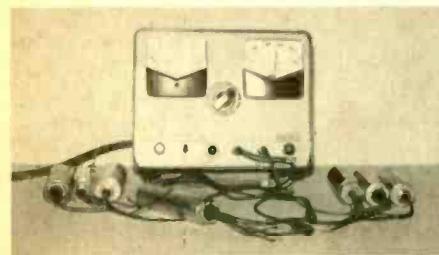


thin, about an atom deep in some capacitors, more than the rated working voltage should not be applied. If the voltage applied to the capacitor in a radio circuit exceeds its safe voltage, the dielectric breaks down, the film of aluminum oxide disappears and the capacitor conducts current in both directions. This means that a high leakage current or a direct short circuit will appear making the capacitor worthless.

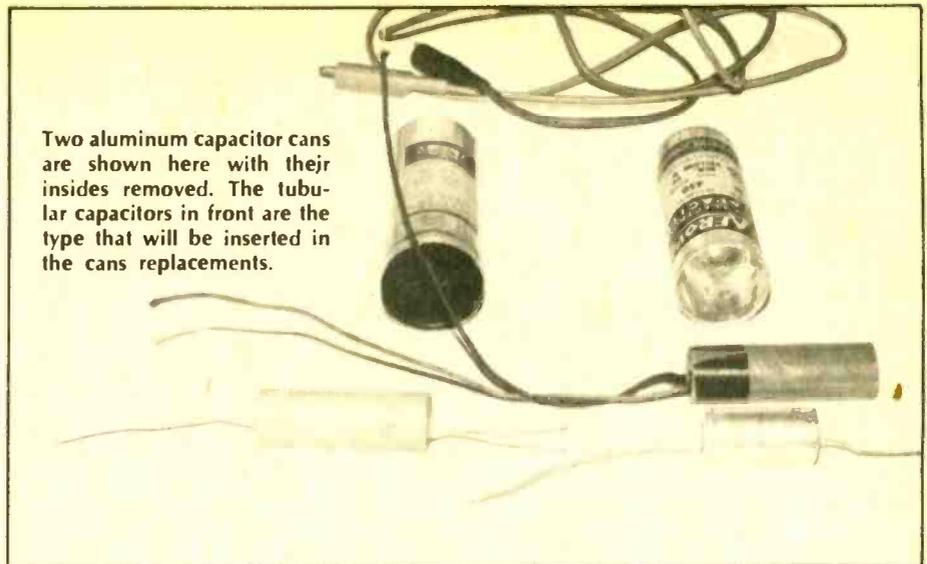
Drying up of the electrolyte is another cause for failure of an electrolytic capacitor. If a unit is subjected to too high a temperature, the electrolyte dries out, and the leakage current goes up. The increased flow of current through the internal resistance of the capacitor produces still more heat etc. If the capacitor is operated in this condition very long it may get so hot it will generate enough steam pressure to blow out the pressure relief seal or blow a hole in the can.

Unlike paper dielectric capacitors electrolytics have a certain amount of DC leakage, and for this reason will produce an indication on an ohmmeter even if the capacitor is good. Since electrolytics are polarized, it is possible to secure a misleading reading when checking with an ohmmeter, unless the polarity of the test leads is observed. You can check for the polarity of the test leads by connecting them to a DV voltmeter and observing which is positive and which is negative. For this reason an ohmmeter is not a satisfactory method for checking an electrolytic capacitor.

There are several types of capacitor testers available. I prefer to use a home built variable voltage power supply with a voltmeter and a milliammeter. The circuit is an old one and very easily built. You can pick up an old TV receiver for free and salvage the power transformer, rectifier tube, filter choke, and capacitors from it. You will need to buy a small variable voltage transformer and two meters plus several wirewound re-



The power supply which is used to measure leakage in filter capacitors. Shown with it are some of the rebuilt capacitors.



Two aluminum capacitor cans are shown here with their insides removed. The tubular capacitors in front are the type that will be inserted in the cans replacements.

sistors. The circuit diagram shown is simple to follow and you can choose your own favorite method of construction. Be sure to use a separate filament transformer for the rectifier tube.

To measure leakage with a power supply such as this one connect your filter capacitor in series with the power supply and a resistor of 5000 ohms at 25 watts shunted by a SPST switch as shown in the test circuit. Using the variable voltage transformer increase the voltage from zero to the working voltage of the capacitor while watching the milliammeter and if the meter reads over 20 mA pause and let the voltage rest at that point. If the current doesn't decrease within five minutes, the capacitor will start to get warm, (feel the capacitor for a temperature rise) this indicates excessive leakage and the capacitor cannot be used in a radio. If the current stays under 5 mA increase the voltage until you reach the working voltage of the capacitor. let it charge for 5 minutes and then close the switch which shorts out the resistor and observe the reading on the milliammeter. A new 8-mfd, 450-VDC capacitor should have a leakage current of about 2 mA. As the capacitor increases in age the leakage current will increase. A leakage current of 5 mA would be the maximum you could tolerate in a filter capacitor of this value. A good rule of thumb is to allow .5 mA of leakage current per mfd for a usable capacitor.

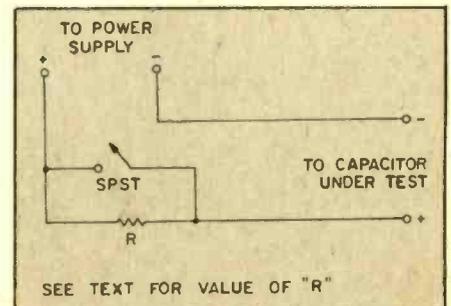
You will find electrolytic bypass capacitors from 10 to 50-mfds, rated at 10 to 50-VDC in many old radios. You can use the same setup just described except use a series resistor of 500-ohms in the test circuit. Apply the rated voltage to the capacitor for 5 minutes then close the switch and read the current. There should be no more than .2 mA leakage through the capacitor.

Take Some Caution. Always decrease the voltage to zero before connecting the capacitor. If you don't, the charging current surge of a good capacitor or the excess current drawn by a shorted capacitor may blow the fuse or the milliammeter.

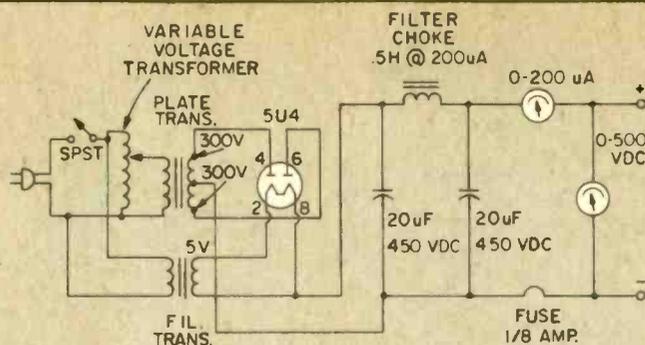
Making Do With New. Now that you know how to detect leaky and bad filter capacitors what do you do about replacing the bad ones in your old radios? At this point you have two choices. If you don't care about appearances you can simply cut the wires loose from the defective capacitors and wire tubular electrolytics in place under the chassis. Only you will know that you took the easy way out.

If you are quite particular you will open up the old aluminum capacitor can, clean out the pitch and old capacitor and insert new electrolytics, with the old lead wires attached into the can. Close up the end again and the set will be restored to its original condition. Sometimes you may have to do this because some of the old midget radios simply didn't have room underneath for any additional capacitors.

Be a Pitchman. At an auction sale of a radio-TV repair shop I picked up 15 aluminum can capacitors with the threaded neck mounting. When I mea-



The resistor value R in this test circuit to find leakage is explained in the text.



PARTS LIST FOR OLD ELECTROLYTIC RESUSCITATOR CIRCUIT

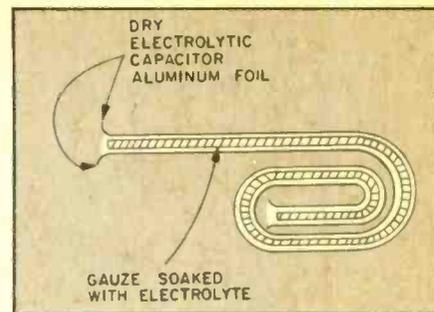
- | | |
|---|---|
| T1—5-volt, 3-A filament transformer (Allied 705-0049 or equiv.) | (Allied Radio 854-9101 or equiv.) |
| T2—380-volt, 20mA Rx plate transformer (Allied 928-3013 or equiv.) | Ch 1—70-Henry, 600 mA filter choke (Allied 705-1135 or equiv.) |
| T3—5-A variable transformer (Allied 927R5501 or equiv.) | F1— $\frac{1}{8}$ -A fast-acting fuse (Allied 603R0126 or equiv.) |
| V1—5U4G Rectifier Tube (Allied 610-0136 or equiv.) | M1—0-200-uA DC microammeter (Allied 701-0015 or equiv.) |
| Misc. Fuse holder (Allied Radio 740R0905 or equiv.), Octal tube socket (Allied Radio 713-2914 or equiv.), chassis, wire, hardware, etc. | M2—0-500-VDC voltmeter (Radio Shack 22-027 or equiv.) See note below. |
| C1, 2—20-uF, 450-VDC electrolytic capacitor | S1—SPST Toggle Switch (Radio Shack 275-602 or equiv.) |

In this parts list we have given values for components that are good replacements for the oldies listed in the schematic. There is one part that you might find hard to get, however. For the 0-500-VDC panel meter we have suggested you use an inexpensive VOM, such as the Radio Shack model listed above, which will give you the proper scale of measurement, plus a whole lot more. All the new parts will work, though, and you can use any necessary if you're not lucky enough to have a good used parts bin.

sured the leakage as described earlier I found that only 1 out of 15 was usable. All the ones I took apart had pitch poured inside to hold the capacitor in place and to seal out moisture. To remove the insides, lay the capacitor on its side on an electric hotplate. Be sure the electrical resistance wire doesn't touch the capacitor can. If your hot plate has exposed wires lay a piece of sheet metal on top where it won't contact the wire. Turn the hotplate on and if it has a heat control set it to medium. As the pitch softens the capacitor will gradually move out through the open end of the can. When the capacitor protrudes half way out of the can put on a

pair of insulated gloves and pull the capacitor all the way out. Cut off the wire leads close to the capacitor and save them for future use. You can continue to melt the rest of the pitch out of the can or you can dissolve it with a suitable solvent.

Making the New Capacitor. You are now ready to put new capacitors into the can. If you want to duplicate the size capacitors the can originally held buy the smallest capacitor of that rating you can find. Remember electrolytics have tolerances as great as $-50\% + 100\%$ in capacity. Always use a replacement the same or larger in capacity than the original, never go lower



Cross section showing the internal construction of a "dry" electrolytic capacitor. Two sheets of aluminum foil are rolled up with a strip of electrolyte-saturated gauze between.

in capacity or working voltage. Connecting equal microfarad capacitors in parallel keeps the working voltage the same as one, but makes the total capacity equal to the sum of the individual capacitors. If you need a higher working voltage capacitor you can connect two equal size capacitors in series, eg. the negative wire of one connected to the positive wire of the other. The working voltage will now be double but the total capacity will be one-half of either one. Use the leads you saved and solder them securely to the replacement capacitor. Use an adequate amount of vinyl electrical tape to insulate the capacitor and wire leads. If you can find cardboard tubes that you can slip the replacement capacitors into you can insert these into the cans. Put the threaded stud cover in place, with wires pulled through the hole, and with a small hammer carefully tap the aluminum can down around the edge of the cover. When the can is mounted in the chassis this end won't show.

Other types of capacitors can be reworked in a similar fashion. We do not have enough space here to go into details on each type. A little common sense will go a long way when replacing capacitors in old radios. If you have problems finding replacement capacitors or in knowing how to proceed with your particular problem write to me and I will try to cover it in a future issue.

There is a very interesting book now available telling about the life of Reginald Fessenden who broadcast the first music over radio before 1900. The book called "Radios First Voice," will be reviewed in this column next time. In the mean time there is a limited number available at \$2.00 each postpaid from Antique Radio Press, P.O. Box 42, Rossville, IN 46065. You will find it full of historical facts about the early days of radio broadcasting.

So long for now. I will be telling you how to replace other had-to-get radio components such as resistors, coils, speakers, etc. in future issues. ■



This beautifully restored Tuska Superdyne type 228 receiver is one of the highpoints of the fine collection of George Hausske, who lives in Wheaton, Illinois.



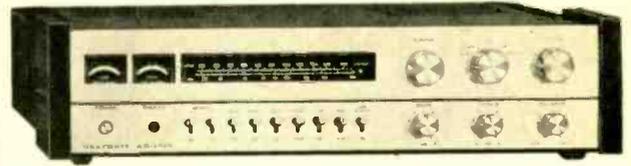
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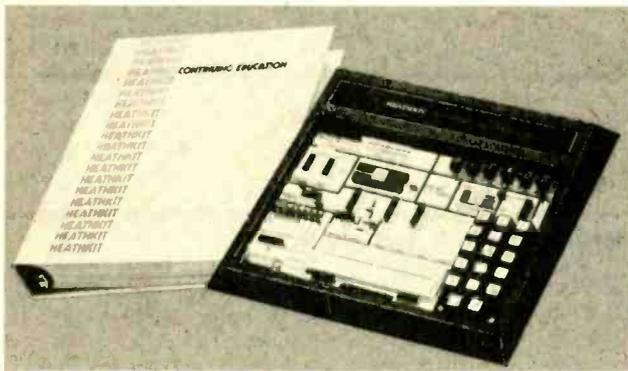
Read more about these and nearly 400 other unique and exciting kit products—all in the big, new 104-page Heathkit Catalog.

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A perfect kit for the first time kitbuilder. This super-accurate timepiece has an attractive blue four-digit display that dims automatically according to ambient light. It also has the features you need in a clock; 24-hour "smart" alarm, snooze switch, alarm-on indicator and power failure indicator. Only \$27.95



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- 2 H11 LSI-11 16-Bit Digital Computer Kit
- 3 H9 Video Terminal Kit
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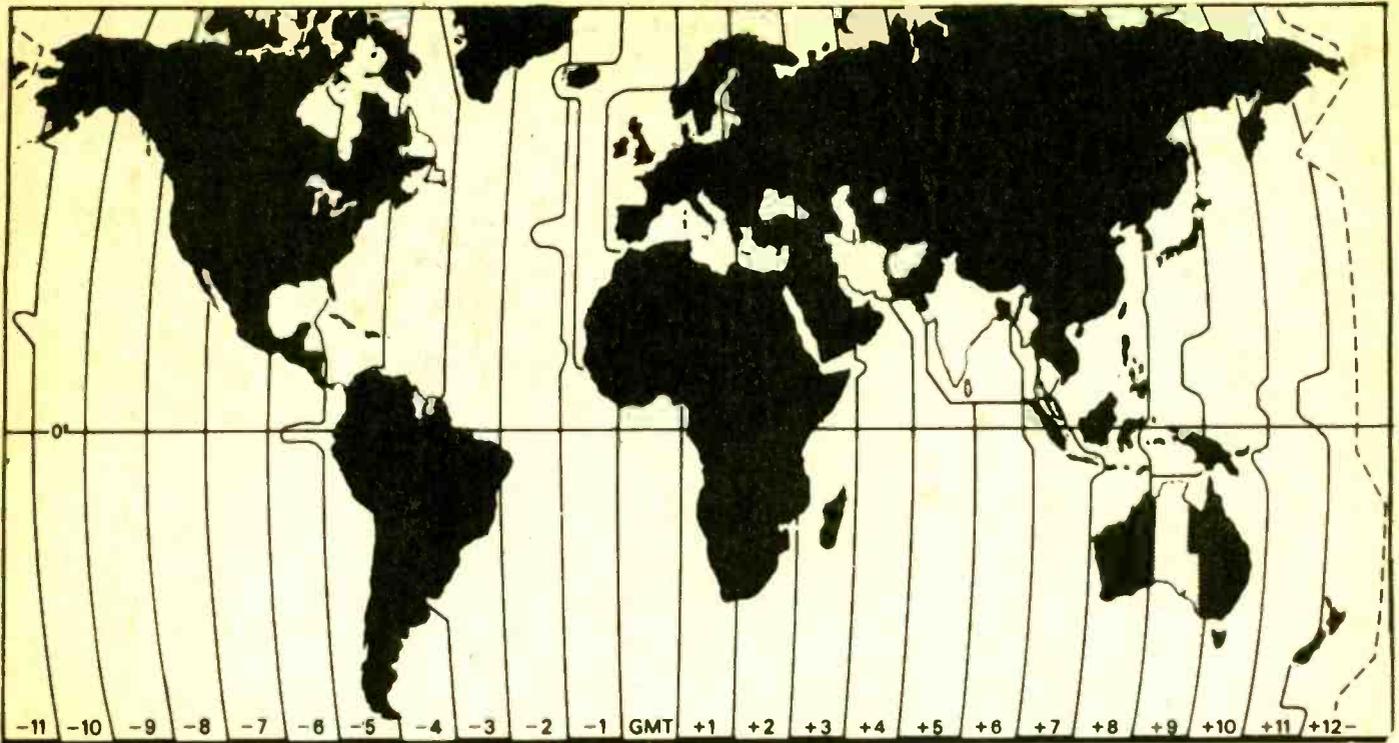
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CIRCLE 1 ON READER SERVICE COUPON



GOOD TIME

by Harry L. Helms, Jr.

DX

Check your LED watch, get QSLs, from worldwide time stations.

Once upon a time, an old story goes, a young shortwave listener (SWL) was visiting the listening post of an experienced SWL. The novice viewed the verifications collected by the old pro with all due awe, and made it clear that he was suitably impressed with the oldtimer's tales of his DXing feats. "Tell me," said the novice DXer, "what was the best time you ever had on shortwave?"

"I guess," the old-timer said with a grin, "the best time I ever had was the time I heard on WWV!"

Whatever the old-timer's faults as a humorist, he was right on the money in his answer to the novice DXer. WWV transmits around the clock from Fort Collins, Colorado, on 2500, 5000, 10000, and 15000 kHz, providing the time every minute, from super-accurate atomic clocks. The transmitted frequencies are equally accurate, and can be used for calibrating receivers and oscillators. Even non-SWLs are frequent users of the services of WWV and its sister station, WWVH, in Kekaha, Hawaii, transmitting on the same frequencies.

"Tell me, young man, have you verified many of the time and frequency stations other than WWV and WWVH?" said our old pro.

"Gee, I didn't even know that WWV and WWVH would verify reception reports," said our surprised novice.

The kindly experienced DXer informed his young friend that much good DX can be found among the various standard time and frequency stations. Such stations are often good verifiers as well. The old-timer's advice allowed the novice to hear some new stations and get several flashy new QSLs for his collection. You can do the same, regardless of your experience or receiver.

"*Easy Time*" DXing. Is there anyone who owns a shortwave receiver who has not at some time or another tuned in WWV or its sister station WWVH? But have you verified WWV and WWVH? Both are eager verifiers, and both are the easiest way to hear the states of Colorado and Hawaii, especially from the East Coast.

The time signals from WWV and WWVH are so well synchronized that one could be receiving both stations simultaneously without being aware of it. The key is to listen for the identification announcements and time, which is given every minute. WWV uses a male announcer, while WWVH has a female. The identification and time announcement is given by WWVH just prior to the one on WWV, and can

often be heard under the second ticks transmitted by WWV prior to its announcement. WWVH can often be heard all day under WWV in the West. Listeners in the East find best reception of WWVH to be from 0300 GMT to shortly after local sunrise on both 5000 and 10000 kHz. Another good period is after local sunset to approximately 0400 GMT, on 15000 kHz. WWV often fades out on this frequency but the propagation is still favorable to Hawaii and WWVH.

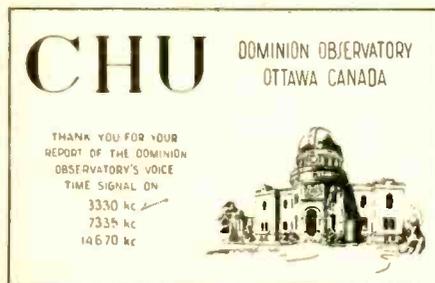
Both stations are ready verifiers and require no return postage. To prove your reception, copy the identification and time announcements word-for-word. WWV is located at 2000 East Country Road 58, Fort Collins, Colorado, 80521. WWVH's address is Box 417, Kekaha, Kauai, Hawaii, 96752.

The U.S. Naval Observatory is also in the time-signal business. Unfortunately, Naval Observatory time signal stations only identify in Morse code and their frequencies may be difficult to find on poorly calibrated receivers. But they do verify reports readily. Listeners in the West who have not logged and verified Maryland should try for the broadcasts from NSS in Annapolis on 8090 and 12135 kHz. Transmissions start five minutes before the hour and end on the hour with an identification

in Morse code. Transmissions start at 0455, 1055, 1655, and 2255 GMT. Similar time signals are broadcast from NPG, San Francisco, on 3268, 6428.5, 9277.5, and 12966 kHz. Like NSS, transmissions begin five minutes before the hour and end on the hour, and are scheduled for 2355, 0555, 1155, and 1755 GMT. Reports for both can be sent to the U.S. Naval Observatory, Navy Department, Washington, D.C. 20390.

Canadian Time Station. Ranking right after WWV and WWVH in ease of reception is CHU, transmitting from Ottawa, Ontario, Canada. CHU's frequencies are not standardized like those of WWV/WWVH. But CHU's frequencies of 3330, 7335, and 14670 kHz are easy to spot even on poorly calibrated receivers. Like WWV/WWVH, CHU features one-second pulses, and has announcements of the time every minute, in English and French, by a male announcer. 7335 kHz is heard well throughout the day in the East, and throughout North America at night. 3330 kHz is best at night, with 14670 kHz being the best bet for daytime reception in the West. Reports are welcome and can be addressed to National Research Council, Ottawa, Ontario, Canada, K1A 0S1.

More Challenging Times. The United States and Canada have no monopoly on standard time stations. VNG broadcasts from Lyndhurst, Victoria, Australia on 4500, 7500, and 12000 kHz. Operated by the Australian Post Office, VNG broadcasts time pulses and has identification announcements in voice on the hour, 15 minutes after the hour, on the half hour, and 15 minutes before the hour. Best times to listen include from 0600 to 0930 GMT on 12000 kHz, and from 0600 GMT to your local sunrise on 7500 kHz. Listeners in the West may also be able to hear VNG on 4500 kHz from its 0945



Verification card from CHU, the Canadian Time Station. CHU broadcasts time signals continuously, making its voice announcements each minute in English and in French. The station is operated by the Dominion Observatory, Department of Mines and Technical Surveys, Ottawa.

GMT sign-on to local sunrise. VNG is a quick QSLer, and reports can be sent to VNG, Telecom Australia, 172 William St., Melbourne, Victoria, 3000, Australia.

Southern Hemisphere. Venezuela is home to another well-heard time station, YVTO, operated by the Observatorio Naval Cagigal in Caracas. YVTO transmits on 6100 kHz on a 24 hour schedule. Programming is second pulses with an identification every minute. The identification is in Spanish, but is easy to pick out even if one doesn't speak Spanish. The best time to try for YVTO is from 0600-1100 GMT, when the frequency is clear of higher-powered international broadcasters. Reports, in Spanish if possible, should be sent to Apartado 6745, La Planicie, Caracas, Venezuela.

South America is also represented by LOL, in Buenos Aires, Argentina. Like YVTO, LOL transmits second pulses and Spanish identifications. Transmissions are not continuous, however. Best times to try include 2300-0000 GMT in the East and 1100-1200 GMT in the West on 10000 kHz. Listeners throughout the country can also try at 1700-1800, 2000-2100, and 2300-2400 GMT on 15000 kHz. Some interference is supplied by WWV/WWVH, but LOL often makes it through under the QRM (noise). Reports go to Servicio de Hidrografia Naval, Observatorio Naval, Avenida Costanera Sur 2099, Buenos

Aires, Argentina. Spanish reports are an advantage here as well.

"Hard Times." All the proceeding stations can be heard throughout North America with a little patience. There are more time stations, but often listeners in certain areas of the country will have an advantage over listeners in other areas. Logging these stations will take more skill and plain luck. Put simply, these stations are good DX!

Listeners in the East can shoot for IBF in Turin, Italy. Transmissions start 15 minutes before the hour and last until the hour. Identifications are given in English, French, and Italian. Try at 0645 and 0845 GMT on 5000 kHz, particularly if reception of WWV is poorer than usual. Report to Instituto Elettrotecnico Nazionale, Corso Massimo d'Azeglio 42, 10125-Torino, Italy.

France's *Bureau International de l'Heure* broadcasts time signals that are often heard in the East and occasionally in the West. Transmissions last for five minutes and identifications are in Morse code. The schedule calls for broadcasts at 0855 and 2055 GMT on 7428 kHz, 0755 and 1955 GMT on 10775 kHz, and 0925, 1255, and 2225 GMT on 13873 kHz. Reports go to 61 Avenue de l'Observatoire, 75014-Paris, France.

A real toughie is OLB5 in Podebrady, Czechoslovakia, operating 24 hours a day on 3170 kHz. It's a possible from local sunset to approximately 0600

STANDARD TIME AND FREQUENCY STATIONS

| kHz | Station and Location | California |
|--------|---|--|
| 2500 | WWV, Fort Collins, Colorado | 9368 BPV, Shanghai, People's Republic of China |
| 3170 | OLB5, Podebrady, Czechoslovakia | 9996 RTA, Novosibirsk, USSR |
| 3268 | NPG, San Francisco, California | 10000 WWV, Fort Collins, Colorado |
| 3330 | CHU, Ottawa, Ontario, Canada | 10000 WWVH, Kekaha, Hawaii |
| 4500 | VNG, Lyndhurst, Victoria, Australia | 10000 LOL, Buenos Aires, Argentina |
| 5000 | WWV, Fort Collins, Colorado | 10000 JYJ, Tokyo, Japan |
| 5000 | WWVH, Kekaha, Hawaii | 10000 RWM, Moscow, USSR |
| 5000 | IBF, Turin, Italy | 10000 RIM, Tashkent, USSR |
| 5000 | RAT, Moscow, USSR | 10004 RID, Irkutsk, USSR |
| 5000 | RIM, Tashkent, USSR | 10004 RKM, Irkutsk, USSR |
| 5000 | RCH, Tashkent, USSR | 10775 FTK77, Pontoise, France |
| 5004 | RID, Irkutsk, USSR | 12000 VNG, Lyndhurst, Australia |
| 5430 | BPV, Shanghai, People's Republic of China | 12135 NSS, Annapolis, Maryland |
| 6100 | YVTO, Caracas, Venezuela | 12966 NPG, San Francisco, California |
| 6428.5 | NPG, San Francisco, California | 13873 FTN87, Pontoise, France |
| 7335 | CHU, Ottawa, Ontario, Canada | 14670 CHU, Ottawa, Ontario, Canada |
| 7428 | FTH42, Pontoise, France | 14996 RTA, Novosibirsk, USSR |
| 7500 | VNG, Lyndhurst, Victoria, Australia | 15000 WWV, Fort Collins, Colorado |
| 9277.5 | NPG, San Francisco, | 15000 WWVH, Kekaha, Hawaii |
| | | 15000 LOL, Buenos Aires, Argentina |
| | | 15000 JYJ, Tokyo, Japan |
| | | 15000 RWM, Moscow, USSR |
| | | 15004 RID, Irkutsk, USSR |

e/e assembles the...

HEATH HW-2036 2 METER FM TRANSCEIVER



High range, high-fi, and high technology from this ham transceiver.

□ With 2-meter FM bursting at the seams it appears the only way to keep up with all the repeater and simplex activity is a week's salary worth of crystals—or better yet, a frequency synthesized transceiver capable of operation on any of the frequencies used for FM operation.

Problem is, a synthesized transceiver costs several week's salary unless you take the kit route with a Heathkit HW-2036. Priced at \$269.95, or \$299.95 with optional auto patch encoder, in kit form (mail order only), the HW-2036 offers much more than just frequency synthesis—but the "extras" are getting ahead of ourselves, so let's start at the beginning.

The HW-2036 is a mobile FM transceiver that covers any 2 MHz segment from 143.5 to 148.5 MHz. It is housed in a cabinet 2¾-in. high x 8¼-in. wide x 9¾-in. deep and weighs in at only 2¼-lbs. It is thoughtfully supplied with a quick release gimbal bracket and a gimbal support plate (that locks to the bracket) which is installed either underdash, on the transmission hump, or wherever you'd prefer. Because of the bracket-plate arrangement the bracket can be removed with the transceiver.

leaving unencumbered passenger leg-room when needed.

The transceiver requires 13.8 VDC (12.6 to 16 VDC actual) and a separate 117 VAC/13.8 VDC power supply kit is available for fixed operation.

In addition to the frequency synthesizer, features include simplex, -600 kHz and +600 kHz transmitter offset, and an optional user offset labeled AUX on the selector switch. The user can install a crystal for any desired transmitter offset from the receive frequency. Also, there is a subaudible tone oscillator with user selected frequencies for use with repeaters that require an access tone be transmitted with the modulation.

In addition to the frequency selectors, offset switch and subaudible tone selector the front panel has a volume/power switch and squelch control, an indicator lamp that shows when the frequency synthesizer is not locked, and an indicator lamp that shows the presence of a received signal. The received signal indicator is provided because the transceiver's output can be switched to an external speaker. If the connection to the external speaker should fail, or if the volume should be inadvertently

turned down the received signal indicator shows the receiver isn't defective simply because the user hears nothing. Any signal strong enough to "break the squelch" will light the lamp. (The signal lamp also indicates the frequency or channel is in use before you press the PTT switch.)

A front panel meter with a relative scale calibration serves as an RF output indicator, a received signal level indicator, and as an alignment indicator during adjustment and tune-up.

The rear apron has phono jacks for the antenna and remote speaker connections, and a selector switch for internal and external speakers.

Use Any Frequency. The frequency synthesizer uses three digital switches and one toggle switch to set the received frequency. The transmit frequency is determined by the simplex/offset selector. If the receiver frequency is set to 146.25 MHz and the selector is set to simplex the transmit frequency is similarly 146.25 MHz. If the selector is set to +600 offset the transmit frequency is 146.85 MHz.

The synthesizer provides coverage in a 2 MHz segment from 143.5 to 148.5 MHz with automatic lock-out if out of band operation is attempted. If specific out of band operation is required, say for MARS or CAP, the lockout can be defeated.

The three position digital selector provides the last three significant digits, such as 6.26 added to 140 MHz. The toggle switch provides a "0" or "5" (kHz) as the fourth digit, so the selected frequency would be either 146.250 MHz or 146.255 MHz.

Though it is possible to get synthesizer lock for receiving over more than 3 MHz, the 2 MHz range applies to transmitting. If the transmitter lock is out of range the synthesizer lock panel lamp illuminates to indicate an out-of-lock condition, and there is no RF output indicated by the signal strength/RF output meter.



CIRCLE 31 ON READER SERVICE COUPON

The Heathkit HW-2036 with the optional Micoder. The Micoder combines its microphone with a touchtone pad for accessing an auto-patch. The pad can only be used when the PTT switch is held down. A small LED directly above the "2" glows to indicate a numeral has been keyed into the transmitter, producing a tone.

e/e HEATH HW-2036

Solid Circuitry. Other than the frequency synthesizer the HW-2036 is more or less conventional, using proven circuitry. The receiver is double conversion with 10.7 MHz and 455 kHz IF frequencies. Selectivity is provided almost entirely by a 10.7 MHz crystal filter. The receiver's input RF amplifier is a dual gate FET; since there are no "protective" diodes ahead of the device the receiver is particularly immune to intermod by strong signals on nearby frequencies. Heathkit rates the receiver sensitivity at 0.5 uV for 15 dB quieting, a figure we certainly can support.

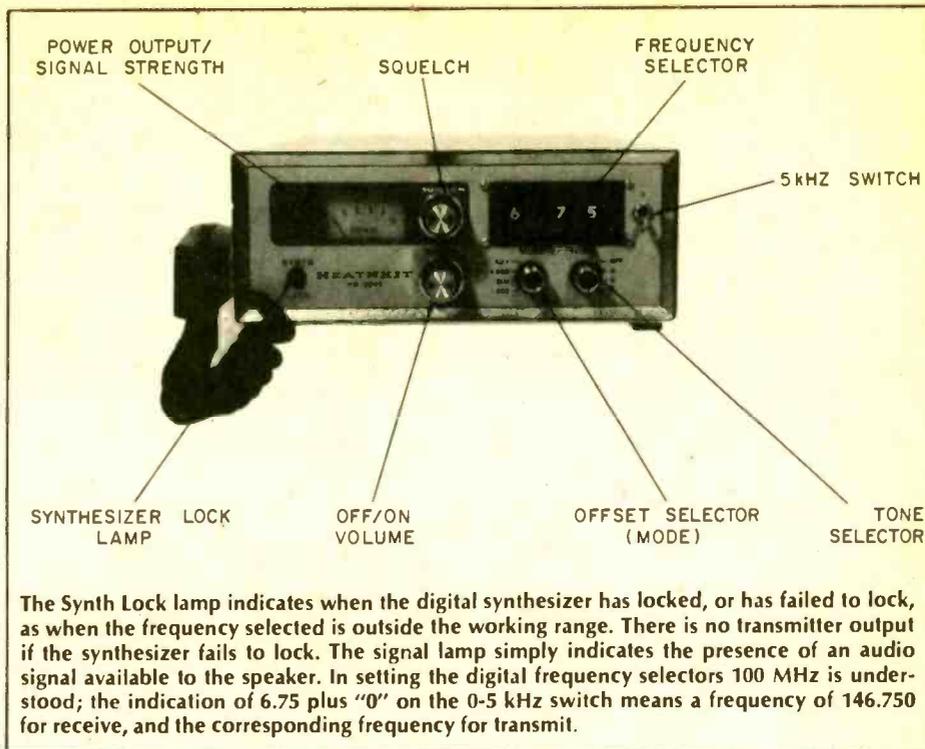
One place where the receiver is clearly outstanding is the sound quality from the internal speaker. It is excellent. The signal is crisp and clean even when the transceiver is on top of its optional AC power pack with the speaker (on the bottom) radiating its sound into the power pack.

The transmitter circuitry is also tried and true. The audio clipping level is symmetrical and drives a roll-off network which attenuates the general harmonics. The tone generator feeds in after the microphone's deviation adjustment to avoid interaction between the two signal sources.

The transmitter is normally supplied with a push to talk microphone. An optional Micoder kit, HD-1982, is available. This is a combination touch-tone pad and an electret microphone. The touch-tone output level has its own adjustment so it can be set to match the microphone level. Since we built the transceiver, power supply and Micoder at the same time we have no knowledge of the sound quality of the "standard" microphone; we do know that the Micoder's mike is notably clean and crisp when the deviation has been properly adjusted.

Building the Kit. This is not a beginner's project. No way. There is some very tight-quarter wiring, some mechanical assembly requiring an extra degree of dexterity, and a somewhat complex non-instrument alignment procedure. If you have access to the equipment, an instrument alignment wouldn't be a bad idea, although it's not necessary.

Overall, the transceiver's performance is excellent. Some of you might have heard of the spurious emissions in an earlier model that was recalled. As far as we can determine this model, the HW-2036, is as clean as a hound's tooth. The 'scope pix from our spec-

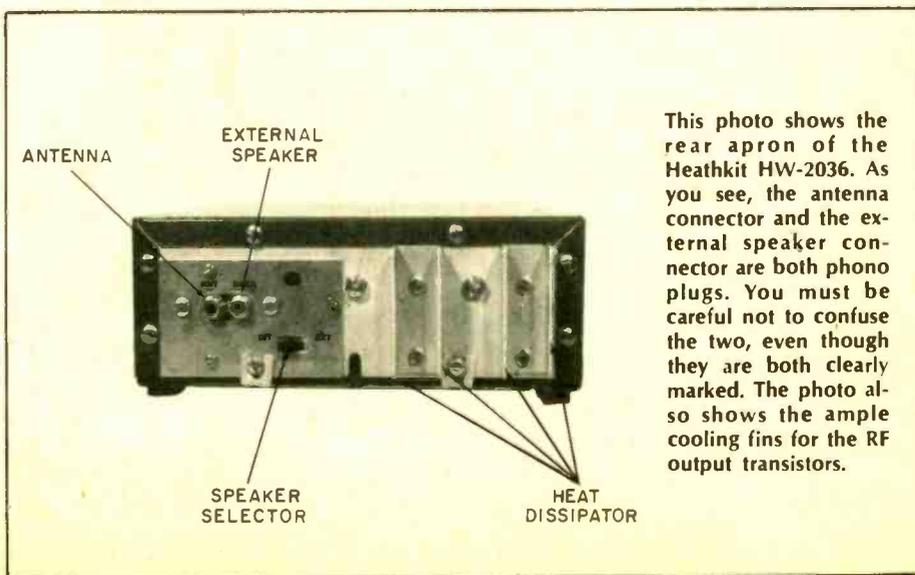


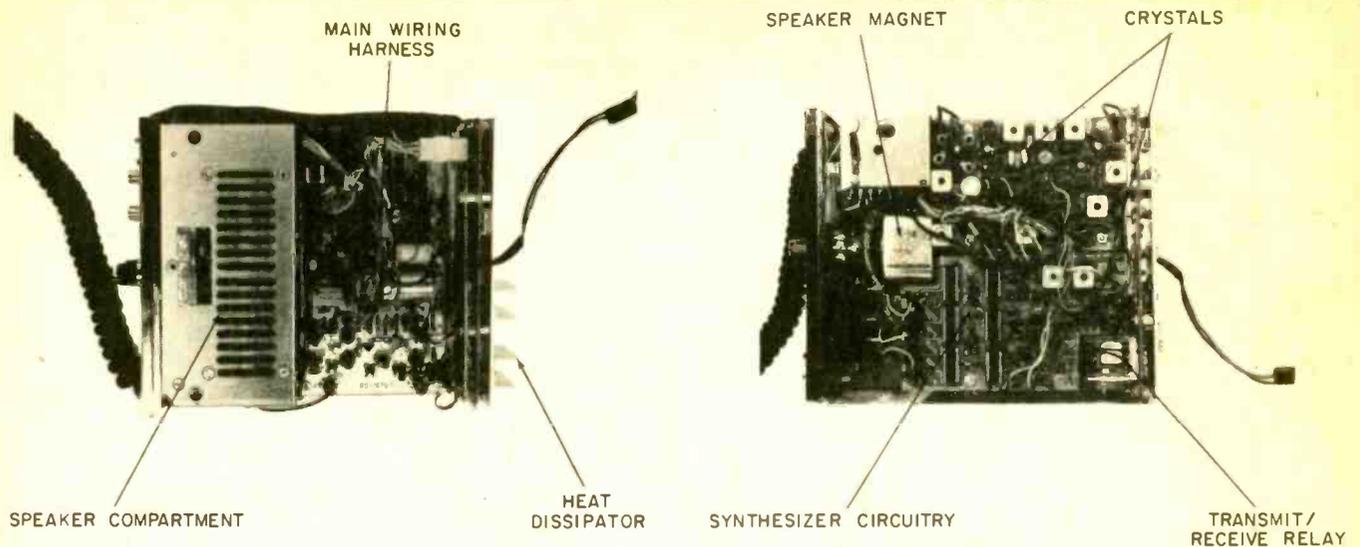
trum analyzer show nothing but the main frequency and "grass," internal analyzer noise. Each vertical division is 5 dB for a screen total of 40 dB. We have driven the trace 15 dB off the top of the screen so the grass represents -55 dB to -60 dB. Each horizontal division is 5 MHz, for a screen total of 50 MHz. As you can see, there are just *no spurs* to be seen down to the -60 dB range. We checked the second harmonic and could discern nothing in the grass. The rig, therefore, has neither spurious or harmonic output greater than -60 dB, which is even better than Heathkit's specs.

Final Punch. As for power output,

Heathkit specs the transmitter at not less than 10 watts. Using a lab power output meter we found the power output ranged from 9 to 11 watts depending on the specific frequency.

A Touch of Class. Two meters has changed a lot in the last few years, as those of you know who have been on the band when lots of people used war surplus SCR-522 transceivers, and the most popular rig was Heath's old Two'er, which many called the "Benton Harbor lunch box." They were good old days, but when you were lucky enough to find someone on the band to QSO with, they usually were within twenty miles of you. Now the band is





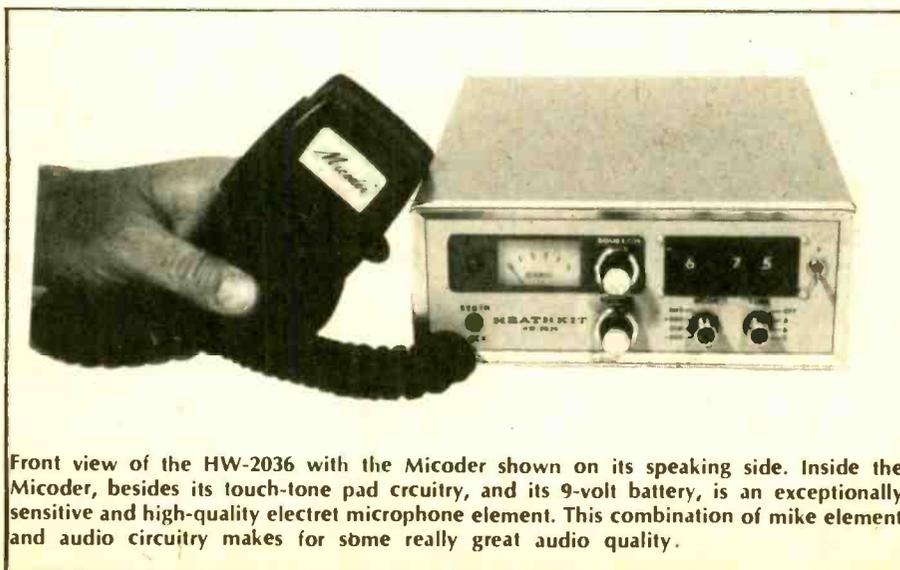
The HW-2036 chassis seen from above and below. As you see, it's a very complicated unit, and particular care must be exercised in building it. It's well laid out though, and as usual Heath's instruction manual is clear and detailed, and especially helpful for the builder. Most of the wiring between boards is cabled. The slotted metal box on the underside is the compartment for the large speaker, from which comes some excellent audio. From the top view you can see the speaker's magnet structure, as well as some of the many IC's and vast number of other components used in the circuitry. This is one triumph of design.

really populated, with hundreds of stations active in even rural areas, and the distances you can count on working normally would make an old time DXer's heart glad.

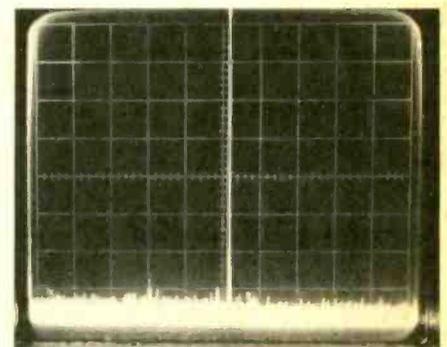
All this new activity depends upon two things however: the use of automatic repeaters, and the switch from AM to FM transmission mode. Each of these developments makes fantastic demands upon modern equipment, both in sophistication of circuitry, and in quality of components. In each of these ways the Heath HW-2036 definitely excels, a fact you'll realize for yourself if you build one. The payoff of all the quality is quickly apparent when

you get on the air, for the rig will cut through the interference coming from other stations on adjacent channels. Even under the most adverse conditions of QRM and high nearby RF the receiver will continue to perform superbly, bringing through signals that many other receivers would give up on. It's excellent sensitivity helps immensely, too. And, as has been mentioned, the audio quality and full RF output of the transmitter will carry your signal through where lesser transmitters would sound garbled. After months of on the air use, we have never gotten less than a terrific signal report, with many of our contacts complimenting us.

Summing Up. All in all, the crew at Benton Harbor has come up with a real winner, with a two meter transceiver that combines quality, state of the art design, and an unusually pleasing visual appearance—its styling is terrific, as you'll see from the photographs. While building this rig will take you a while, the work will pay off in extra range and the edge you'll have in signal reports, once you get on the air. This is a fine transceiver with which to enter the bright new world of two meters. If you want more information about this new Heath product, the HW-2036, circle Number 31 on the Readers Service Coupon. ■



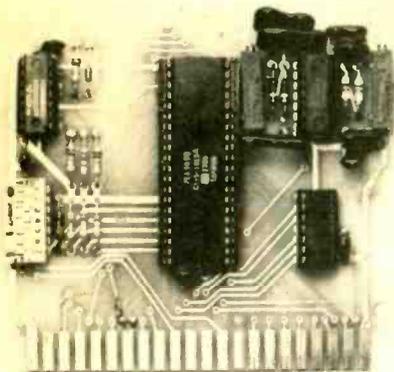
Front view of the HW-2036 with the Micoder shown on its speaking side. Inside the Micoder, besides its touch-tone pad circuitry, and its 9-volt battery, is an exceptionally sensitive and high-quality electret microphone element. This combination of mike element and audio circuitry makes for some really great audio quality.



Is it clean? This 'scope trace off our spectrum analyzer shows only the signal, and the analyzer's noise as "grass" some 55 to 60 dB down. Each horizontal division is 5 MHz, so you're looking at 25 MHz either side of the carrier. We couldn't find any trace of a second harmonic in the "grass" so we're not showing a photo because there's nothing to show.

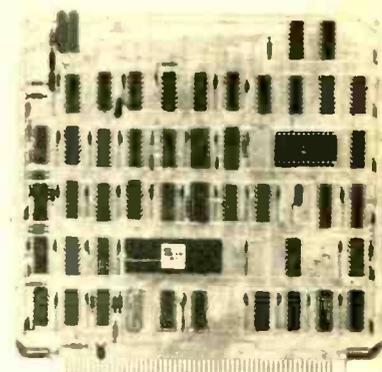
COMPUTER NEW PRODUCTS

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



Low Cost Computer Hardware—Electronic Systems offers inexpensive computer accessories that include the following: universal synchronous receiver/transmitter (UART) for both parallel-serial and serial-parallel conversion; a full-duplex, 300-baud modem; a TTL-compatible RS232C interface; Kansas City standard tape interface; 32- or 64-character per line television typewriter board; RF modulator board with power supply. Also available: an 8K static RAM board for S-100 bus, and a mother board, 8K memory board, and serial I/O board for Apple I computers. Each device is contained on a single

circuit board which comes with complete instructions and parts list. All circuits are designed to use inexpensive, easy-to-find parts. No crystals are required, and only one unit needs a coil the user can wind for himself. The devices are also available fully assembled and tested. Prices, for the circuit boards only, range from \$5 to less than \$40. Circle 64 on Reader Service Coupon for more information about this product or others by this company.



Video Display Board—Zilog's Z80-VDB Video Display Board interfaces the company's standard Z80-MCB directly to TTL horizontal, vertical and video drives of a standard TV monitor. The unit contains 256 bytes of dynamic RAM for line buffering to the MCB, and accommodates 64 upper case ASCII characters and display size of 24 lines, 80 characters per line. Price of the Z80-VDB is \$475. Circle 61 on Reader Service Coupon for more information about this product or others by this manufacturer.

Microprocessing Timer/Counter—Dana Laboratories' Model 9000 Microprocessing Timer/Counter is now available with four new options: selective gate control; synchronous window/selective gate control; pulse parameter; remotely programmed synchronous window/selective gate control. These features permit the measurement of the time between any selected number of pulses, or the measurement of any single pulse selected out of a train. It's also possible to measure rise time, fall time and pulse width by pushing a button rather than going through a lengthy process. The remote programming feature allows measurements to be carried out under control of a computer or other controller. The Model 9000 has an 11-digit display, utilizes 43 yellow LEDs, and has a calculator-type keyboard. Four system interfaces are available, including GPIB, Parallel BCD, Serial ASCII (RS-232C), and an extra high speed interface for special requirements. Prices of the Model 9000 range from: \$2095 to \$3495. Circle 48 on Reader Service Coupon for more information on this unit or other products by this manufacturer.



Two Full Feature Terminals—EECO (Electronic Engineering Co. of California) offers two terminals having all the features you'd expect in a "smart" terminal. Model D300, a Full-Feature Edit Terminal offers the following: 16-32 special function keys; program mode; edit insert mode; 56 remote (CPU controlled) operations; detached keyboard; roll/page; full video presentations (12-inch diagonal screen); protected format; tab, back-tab, columnar tabbing; screen-edge mode display; lower case alpha with true descenders; remote cursor read/address; extensive application-oriented switch selective operations. Model D400, a Polling Terminal, offers all the features found on the D300 plus: field-alterable address character; Burroughs specific polling; specific select; broadcast select; fast select; multi-point contention mode. An optional Burroughs Group Poll-Group Select package, which includes an additional terminal ID character, provides two additional field-alter-

(Continued on page 95)



Radio Shack System—Radio Shack's TRS-80 microcomputer system consists of a 53-key professional type keyboard and microcomputer plus regulated power supply, a computer-controlled data cassette recorder and a 12-inch video display monitor. The complete system is priced at \$599.95 but the microcomputer alone is available for \$399.95. The microprocessor is an advanced Z-80 8-bit processor. The video display is memory mapped, all graphics and alphanumeric controlled by BASIC

commands. There's cursor control and automatic scrolling. Text consists of 16 lines of 64 characters, also software selectable to 32 characters per line. Graphics: 128 horizontal by 48 vertical. Graphics and text can be interspersed in any manner by software. Memory includes 4K ROM, 4K dynamic RAM. Internally expandable to 12K ROM and 16K RAM. The total memory capability is 62K. The input/output is a computer-controlled cassette interface, and there's an expansion port for additional memory and peripherals. When purchased separately, options include a CRT display with 12-inch diagonal screen and a CTR-41 data cassette. Circle 32 on Reader Service Coupon for more information about this product direct from the manufacturer.



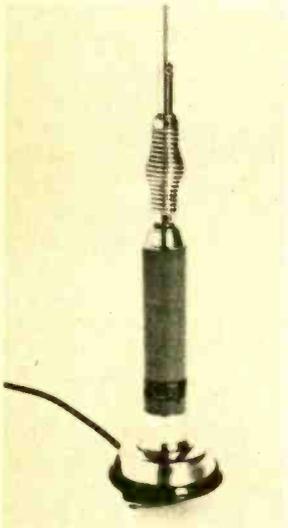
CB NEW PRODUCTS



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

Improved 40-Channel Mobile Antenna

An improved 40-channel CB antenna that mounts on a trunk lip roof or rear deck without drilling holes has been introduced by the Antenna Specialists Co. The new model, MR176, provides a new lower profile mounting cup with a bevelled edge for better rear window clearance when used on trunk lip applications. Exclusive waterproof mount provides protection when whip is



CIRCLE 53 ON READER SERVICE COUPON

removed for car washing. Stainless steel shock spring and 17-7PH stainless steel whip provide maximum flexibility, strength and antenna protection. For permanent mounting, a 3/8-inch hole is required. All mounting hardware, complete instructions and a 17-foot coaxial cable with attached radio connector are included. MR176 is complete and ready for "no holes" trunk lip mounting as well. The manufacturer's suggested list price is \$26.95. For further specifications, contact The Antenna Specialists Co., 12435 Euclid Avenue, Cleveland, OH 44106.

Frequency Counter Kit

Now every Cber and electronic hobbyist can have the accurate digital readout he always



CIRCLE 60 ON READER SERVICE COUPON

needed but could not afford. Designed primarily for mobile CB applications the EICO 700 operates automatically on CB transmit. It indicates frequencies in a range from 5

Hz to 27 MHz (all 40 CB channels) on five large bright LED displays. At the flick of a switch, a kHz or MHz reading is obtained. Mobile/Base switch permits automatic operation when you transmit. In standby, only the decimal point of the readout is lit and a current of less than 70 mA. is drawn. Electronics hobbyists will find the 700's accurate (± 10 ppm) readout invaluable on the test bench for frequency measurements from audio all the way up to the radio frequency range. The 700 can be driven directly with five volt TTL signals. Sells for \$69.95 in kit form; \$99.95 assembled. Get all the facts by writing to EICO, 283 Malta Street, Brooklyn, NY 11207.

Low Pass TVI Interference Filter

The proliferation of CB transceivers in use has caused a growing number of complaints of interference with television reception. One possible cause is the CB radio radiating harmonics on the same frequency assigned to one or more of the local TV channels. The Avanti AV-800 Low Pass Filter will overcome



CIRCLE 49 ON READER SERVICE COUPON

this problem and is especially useful on channels 2 and 5. Installed in the coaxial line from the CB transceiver, it has an impedance of 50 ohms, VSWR of 1.1:1, negligible line loss, and 3 dB cutoff frequency of 43 MHz. Attenuation on channel 2 (54 MHz) is 80 decibels. The unit has a capacity of 1000 watts. Sells for \$24.95. For further information, write to Avanti Research & Development, Inc., 340 Stewart Avenue, Addison IL 60101.

Indoor Car Battery

The new Regulated 3 Amp Power Supply by GC Electronics converts any mobile CB Radio into a base station radio. It maintains a strict regulation of $\pm 2\%$ or better for superior and reliable performance, whether it's handling an SSB radio, tape player,



CIRCLE 68 ON READER SERVICE COUPON

scanner or any other mobile accessory. The power supply operates from standard 110 V, 60-cycle AC house current and converts to a full 13.8 VDC output. Both primary and secondary circuits are fused to prevent overloading. An on-off pilot lamp and push type binding posts for easy connections are additional features. The compact unit measures 7-inch x 4 1/2-inch x 3-inch and weighs 6 1/2 lbs. Sells for \$24.72. For more information on the power supply and other GC products, write to GC Electronics, 400 South Wyman, Rockford, IL 61101.

For Hi-Fi on the Move

A major advance in automotive sound systems which provides "in concert" tonal performance, has been developed by Sparkomatic Corporation of Milford, Pennsylvania, it was announced by Jim Pedranti, Marketing Vice-President. The model LC-100 Sparkomatic Wide Spectrum Amplified System has been engineered to amplify the total sound spectrum uniformly. This is achieved by uti-



CIRCLE 50 ON READER SERVICE COUPON

lizing the latest integrated circuits. These ICs allow for high amplifier gain along with an increase in power. The high gain makes possible separate bass and treble controls which "mix" the sound for individual preference. Special high-performance, high-fidelity coaxial speakers are matched to the systems power potential to insure totally balanced reproduction along the entire frequency range. The LC-100 will retail for approximately \$79.95. For all the details, write to Sparkomatic Corp., Milford, PA 18337.

Magnet Mount Antenna

One of the fastest moving antenna items in CB outlets and stores is the magnet mount CB antenna, and Midland's magnet mount CB antenna is no exception. With a heavy-duty 5 oz. magnetic base, the Model 18-288 holds securely at highway speeds, yet is easily removable for security. This popular Midland antenna delivers peak performance on all 40 CB channels, and it's pre-wired for easy assembly. It features a tapered stain-

(Continued from page 95)

A PROGRAM TO SOLVE FOR REACTANCE

```

0100 REM PROGRAM **REACT**
0110 REM BY LARRY FRIEDMAN 7/1/77
0120 REM C = CAPACITANCE IN FARADS
0130 REM L = INDUCTANCE IN HENRIES
0140 REM F = FREQUENCY IN HZ (HERTZ)
0150 REM X(C) = CAPACITIVE REACTANCE IN OHMS
0160 REM X(L) = INDUCTIVE REACTANCE IN OHMS
0170 REM X(3) AND X(4) ONLY APPLY TO THE PROGRAM
0180 REM TO END THE PROGRAM PRESS CNTRL/-C- OR WHATEVER IS
0190 REM THE INTERRUPT FOR YOUR COMPUTER SYSTEM.
0200 DIGITS= 3
0210 REM PROGRAM STARTS HERE
0220 PRINT
0230 PRINT "WHAT DO YOU WANT TO SOLVE FOR?"
0240 INPUT JS
0250 IF JS="L" GOTO 390
0260 IF JS="X(L)" GOTO 430
0270 IF JS="F USING L" GOTO 470
0280 IF JS="C" GOTO 510
0290 IF JS="X(C)" GOTO 550
0300 IF JS="F USING C" GOTO 590
0310 PRINT "THIS PROGRAM WILL SOLVE FOR:"
0320 PRINT "L (MEANING INDUCTANCE)"
0330 PRINT "C (MEANING CAPACITANCE)"
0340 PRINT "X(L) (MEANING INDUCTIVE REACTANCE)"
0350 PRINT "X(C) (MEANING CAPACITIVE REACTANCE)"
0360 PRINT "F USING L (FREQUENCY USING INFO. ON INDUCTANCE)"
0370 PRINT "F USING C (FREQUENCY USING INFO. ON CAPACITANCE)"
0380 GOTO 220
0390 PRINT "ENTER X(L) AND F."
0400 INPUT X(4),F
0405 REM -M IS THE SOLUTION TO THE PROBLEM.
0410 M=X(4)/(6.28 * F)
0420 GOTO 620
0430 PRINT "ENTER F AND L"
0440 INPUT F,L
0450 M=6.28 * F * L
0460 GOTO 620
0470 PRINT "ENTER X(L) AND L"
0480 INPUT X(4),L
0490 M=X(4)/(6.28 * L)
0500 GOTO 620
0510 PRINT "ENTER F AND X(C)"
0520 INPUT F, X(3)
0530 M=1/(6.28 * F * X(3))
0540 GOTO 620
0550 PRINT "ENTER F AND C"
0560 INPUT F,C
0570 M=1/(6.28 * F * C)
0580 GOTO 620
0590 PRINT "ENTER C AND X(C)"
0600 INPUT C, X(3)
0610 M=1/(6.28 * C * X(3))
0620 PRINT JS; " =";M;
0625 GOSUB 710
0630 PRINT
0640 IF JS="L" THEN P=1
0650 IF JS="X(L)" THEN P=2
0660 IF JS="F USING L" THEN P=3
0670 IF JS="C" THEN P=4
0680 IF JS="X(C)" THEN P=5
0690 IF JS="F USING C" THEN P=6
0700 ON P GOTO 390, 430, 470, 510, 550, 590
0710 DATA L,HENRIES,X(L),OHMS,F USING L,HZ
0720 DATA F USING C,HZ,C,FARADS,X(C),OHMS
0730 READ B$,A$
0740 IF B$=JS PRINT A$
0750 IF B$=JS GOTO 770
0760 GOTO 730
0770 RESTORE $
0780 PRINT
0790 RETURN

```

SAMPLE OF AUTO-PROMPTING WHEN USER KEYS INCORRECT INSTRUCTION.

RUN

```

WHAT DO YOU WANT TO SOLVE FOR?
? R
THIS PROGRAM WILL SOLVE FOR:
L (MEANING INDUCTANCE)
C (MEANING CAPACITANCE)
X(L) (MEANING INDUCTIVE REACTANCE)
X(C) (MEANING CAPACITIVE REACTANCE)
F USING L (FREQUENCY USING INFO. ON INDUCTANCE)
F USING C (FREQUENCY USING INFO. ON CAPACITANCE)

```

```

WHAT DO YOU WANT TO SOLVE FOR?
?

```

It's Simply BASIC

By Larry Friedman

Rig up your own Reactance Solutions with this month's program in computer Basic.

□ For the electronic hobbyist, a computer's primary advantage is that it can solve problems in seconds that would take you hours to work out using pencil and paper. As an example, there is no advantage in using a computer to solve one or two reactance problems, because an ordinary calculator would require less time and effort. However, if you had to solve a series of reactance problems, you couldn't ask for anything faster than a computer programmed for automatic recycling when solving for F, L, C, XL, or Xc.

This month's program, REACT, is an automatic recycling program for inductive and capacitance reactance problems. It is designed for high speed operation, and therefore eliminates unnecessary phrases and identification. Once the unknown is specified, it will recycle for the same unknown until the program is interrupted by "control C," or whatever your computer system uses for an interrupt.

The statements are arranged in groups for easy modification to your particular needs, rather than by convention. For example, data statements usually come at the beginning; in REACT, they are grouped at the end from 710 to 780, so you can follow the logic of the program.

Self-prompting is built in via statements 310 through 380. If you enter an unrecognizable unknown, the computer will print all the unknowns which can be solved for, and then recycle to ask for corrected input.

SAMPLE RUNS

```

READY
#RUN

```

```

WHAT DO YOU WANT TO SOLVE FOR?
? X(C)
ENTER F AND C
? 1000, .001E-6
X(C)=159235.668 OHMS

```

```

ENTER F AND C
? 1E6, .001E-6
X(C)=159.235 OHMS

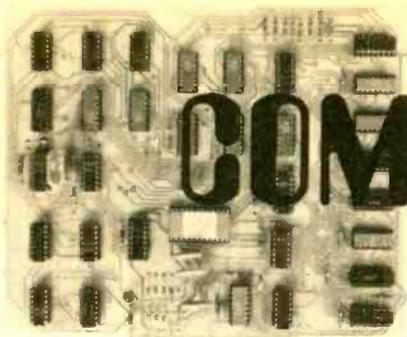
```

```

ENTER F AND C
?
READY
#RUN

```

(Continued on page 98)



COMPUTER READOUT

by Norman Myers, Computers Editor

All's fair when Norm attends a computer fair

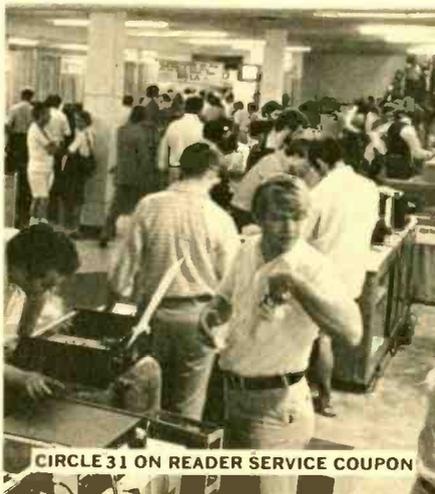
□ There is simply nothing like a computer fair, and the past Personal Computing Fair at Atlantic City, New Jersey, was a good example of how entertaining and educational a computer show can be. If you have never attended a computer show-and-tell affair where dozens and dozens of manufacturers arrange floor space in a large hotel or colosseum area and set up demonstrations of their products, then read on. You may want to find out what you are missing and plan to attend such a show in the near future. Even if you know what these micromania fairs are about, read on. We will talk about the new and interesting hardware, software, books, et cetera, that were at this year's Personal Computing Fair.

Computer fairs are growing by leaps and bounds. Some of the microcomputer outfits have even set up groups to travel from show to show explaining the product and demonstrating the most recent changes. A computer fair is something like an old-time country fair, in that they are usually held in the same place, at about the same month each year, and you get to see many of the same faces. So, the fairs are by no means impersonal. Most people find it very difficult to get away because they are experiencing so many new, exciting ideas and meeting so many people. Only fatigue makes many people leave, but they often return the next day. One example of how much people are turned on by computer shows can be seen in the door count at the Personal Computing Fair. Last year, which was the first time for the PC Fair, 2,500 people visited the 100 booths at the Atlantic City show. This year, 5,000 people attended and 140 computer-oriented companies showed their wares. Before reviewing some of the new things shown at the Atlantic City gig, let's take a closer look at what the Fair itself offered because it is typical of what you can expect of any large, well-run event



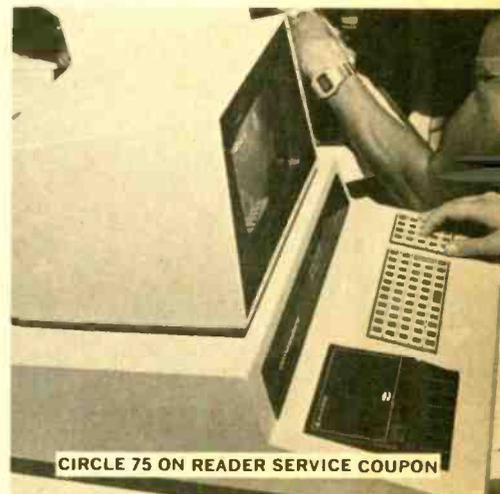
CIRCLE 66 ON READER SERVICE COUPON

Dayle Waite of PerSci, Inc. shows us a Model 227 Dual Diskette Drive which uses a voice coil to accurately position the access arm. Pretty girls are an added feature of computer fairs—just one more reason to attend the next one!



CIRCLE 31 ON READER SERVICE COUPON

The Heathkit computers were a very popular item at the fair. All models were on display, including samples of PC boards, internal wiring and CRT construction.



CIRCLE 75 ON READER SERVICE COUPON

The PET computer from Commodore was unveiled with a built-in video display, cassette tape drive, 4K of user RAM and 13K of ROM to hold the BASIC language.

e/e COMPUTER READOUT

in any of the major metropolitan areas.

The fair lasted two days and it took two days to do all that was available. Three large rooms in a hotel housed the 140 demonstration booths, and several conference rooms were used for seminars and technical talks by leading manufacturers. Ideas flowed like water at the seminars and they were truly brain-storming, question-and-answer sessions. Both software and hardware were discussed, with a clear indication from most speakers that the trend is toward less expensive, more powerful microprocessors which, in some cases, will have memory storage on the same chip. This means the days of a complete computer on a chip are not far away. In the exhibit halls one could see the startling change in computer technology just over a one-year period. The days



Games Galore Gave Gathering Groups Great Glee! Here a TV screen simulates a maze-like battlefield wherein two tanks fight it out to the bitter, fun-filled, end.



CIRCLE 69 ON READER SERVICE COUPON

The basic timeshare system from MITS interacted with users on four different consoles to land rockets and fight huge wars between fleets of starships.

of the simple computer on a card will soon be left, I predict, to a handful of manufacturers. The readouts are turning from simple LED character strings that are integral to the computer-on-a-card to video outputs. While the micro-computer brains get smaller and more powerful, the input/output devices are becoming larger so they can be more flexible and easier to use. Video displays were everywhere and few computers were without one. The power of a video display is clearly many times that of a simple character-string readout, although the cost can be another couple hundred dollars.

So what do you do at a fair? Stand looking at these video screens with their black-and-white or color games on display? No! You wait your turn in the circle of friends and get your hands on the console. You land that space ship, lift that rocket, win that chess game, and make that graph.

Literature explaining the products is at each booth, coffee and doughnuts are in each exhibit hall, and sample computer magazines are available. Your hands are forever holding something or working a keyboard. A computer fair is a real hands-on experience.

Heaps of Hardware. Let's take a look at some of the new hardware products available. Remember the RCA Microtutor that we covered in some detail in this column (Nov./Dec. 1976)? Well, RCA has upgraded the Microtutor to a real fun machine called the VIP. The earlier computer had an LED readout, toggle switches for an input, and a separate plug-in card for special output control. The VIP displays output on your TV screen, has a hexadecimal keyboard input (0 through 9, and A through F), and can control relays, and the like, directly. But the VIP is really much more than a cosmetic change to earlier computer designs. It is a computer system designed to provide operating fun from the moment you plug it in, even if you don't know how to program, yet it is also designed to be a strong system for the program lover. How is this possible? Simple (in today's technology). Twenty programs are provided with the VIP; you load in any one of them and immediately have yourself a video game the whole family can enjoy. These games are presently entered manually via the keyboard, but your ordinary cassette recorder can connect directly to the VIP and let you store programs on tape for easy entry later. To write your own programs, there is an IPL (interpretive programming language) which is similar to BASIC (see our course on BASIC continuing in this issue) because it contains

thirty-one instructions each of which is a complete command. One instruction will cause, for example, an output signal to a controlled device, and another will display a certain pattern on the video screen. The VIP is available only as a kit and sells for \$275. I will plan on covering this gem of a computer in a future Computer Readout column.

And speaking of computer companies making big advances in their computer line—remember that super computer-on-a-board made by MOS Technology? Right, the KIM-1 which we reviewed here in the March/April 1977 issue. Well, MOS Technology is now part of a company called Commodore International which, in the last year, has moved forward on some drawing-board type ideas that MOS generated awhile ago. The result is an assembled computer complete with keyboard and built-in video display for \$595 called the PET. It contains 4K (four thousand) loca-

(Continued on page 89)

Addresses of Manufacturers

Southwest-Technical Products Corp.
219 West Rhapsody
San Antonio, Texas 78216

RCA VIP Computer
New Holland Pike
Lancaster, Pa. 17604

Commodore
901 California Ave.
Palo Alto, Cal. 94304

Heath Company
Dept. 793-261
Benton Harbor, Mich. 49022

DATA
Box 406
Southampton, Pa. 18966

MIT
2450 Alamo S. E.
Albuquerque, N. M. 87106

COMPUTALKER
Box 1951
Santa Monica, Cal. 90406

Camelot Publishing Co.
Box 1357
Ormond Beach, Fla. 32074

Hayden Book Co.
50 Essex St.
Rochele Park, N. J. 07662

BITS Publications
70 Main St.
Peterborough, N. H. 03458

PerSci, Inc.
12210 Nebraska Avenue
West Los Angeles, Cal. 90025

E/E

BEGINNING PROGRAMMING WITH BASIC



BASIC is the most popular hobby computer language, and **ELEMENTARY ELECTRONICS** is going to make it easy for you to learn. This three part series will have you planning and understanding simple computer programs, and leave you with the foundation necessary to set out on your own after greater complexity. The world of computer programming awaits you—speak **BASIC** and enter.

Reprinted, by permission, from pp. 19-41 in BASIC by R. L. Albrecht, L. Finkel and J. R. Brown. Copyright © 1973 by John Wiley and Sons, Inc. One of a series of self-teaching guides.

WHAT you will learn. This is the second in a series of articles which will introduce you to BASIC, one of the most popular computer languages. After studying this second installment, you'll be able to use both commas and semicolons in a PRINT statement. You will also be able to write BASIC expressions using arithmetical and exponential functions. You'll be able to figure the LISTING of a program to accomplish the combination of arithmetic, exponentiation and scientific notation. We have also presented you with a Self-Test covering what you will have studied in both this and the preceding chapter. After this month's installment you should be well on your way to a BASIC understanding of computers.

On most computers using BASIC, there are 5 standard *print positions* across a teletypewriter line. A comma in a PRINT statement causes the teletypewriter to move to the next available print position. For example,

```

10 PRINT 1, 2, 3, 4, 5
99 END

RUN

  1      2      3      4      5
  ↑      ↑      ↑      ↑      ↑
Position 1 Position 2 Position 3 Position 4 Position 5
  
```

Did you notice that the little arrows in the above example seem to be pointing to the space to the left of the number? This is where the print position actually begins. When the computer prints a positive number or zero, it prints a space first, then prints the digits of the number. Watch what happens when *negative* numbers are printed below positive numbers.

```

10 PRINT 1, 2, 3, 4, 5
20 PRINT -1, -2, -3, -4, -5
99 END

RUN

  1      2      3      4      5
  ↑      ↑      ↑      ↑      ↑
-1     -2     -3     -4     -5
  ↑      ↑      ↑      ↑      ↑
Position 1 Position 2 Position 3 Position 4 Position 5
  
```

Q18. Negative numbers are printed with a _____ followed by the digits of the number, while positive numbers are printed with a _____ followed by the digits of the number.

A18. minus sign (or negative sign, or "dash")
space

But what happens if there are *more than 5* things in a PRINT statement? Watch.

```

10 PRINT 1, 2, 3, 4, 5, 6, 7, 8
99 END

RUN

  1      2      3      4      5
  6      7      8
  
```

The computer prints the 8 numbers on 2 lines with 5 numbers on the first line and 3 numbers on the second line.

Q19. What will the computer print during the following RUN?

```

A19.
10 PRINT 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12
99 END

RUN

  1      2      3      4      5
  6      7      8      9      10
 11     12
  
```

Now check what happens when we use *semicolons* instead of commas to separate things in a PRINT statement.

```

10 PRINT 1, 2, 3, 4, 5
99 END

RUN

  1 2 3 4 5

10 PRINT 1; 2; 3; 4; 5; 6; 7; 8
99 END

RUN

  1 2 3 4 5 6 7 8
  
```

Semicolon spacing varies from computer to computer. The above RUNs show how our computer does it.

Q20. Things get printed closer together when we use a

_____ instead of a comma.

A20. semicolon

Now let's see what happens when commas are used to separate two or more strings in a PRINT statement.

```
10 PRINT "THIS", "IS", "COMPUTER", "PROGRAMMING?"
99 END

RUN

THIS      IS      COMPUTER  PROGRAMMING?
```

In this PRINT statement, there are 4 strings, separated by commas. Each string is printed in a standard printing position. Here is a similar program using semicolons instead of commas.

```
10 PRINT "THIS"; "IS"; "COMPUTER"; "PROGRAMMING?"
99 END

RUN

THISISCOMPUTERPROGRAMMING?
```

As you can see, with semicolon spacing, no spaces are printed between strings.

Q21. Using semicolons to separate two or more strings will:

1. Double space between strings
2. Insert no spaces between strings
3. Act the same as a comma

A21. (2) There will be no spaces inserted between strings. If you want spaces, include them in the strings.

```
10 PRINT "THIS "; "IS "; "COMPUTER "; "PROGRAMMING?"
99 END
```

Q22. If we RUN this latest program, what will be printed?

A22.

```
THIS IS COMPUTER PROGRAMMING?
```

(Yes, this really is computer programming, although somewhat rudimentary. But read on!)

You have probably noticed that the plus (+) symbol of arithmetic tells the computer to add. The minus (-) symbol tells it to subtract. (It also indicates negative numbers.) The symbol for multiplication in BASIC is the asterisk (*), and the slash (/) is the symbol for division.

```
TØ TELL THE CØMPUTER TØ ADD, USE      +
TØ TELL THE CØMPUTER TØ SUBTRACT, USE  -
TØ TELL THE CØMPUTER TØ MULTIPLY, USE  *
TØ TELL THE CØMPUTER TØ DIVIDE, USE    /
```

Remember, when you want the computer to squeeze the answers or output more closely together, use semicolons instead of commas in the PRINT statement.

Here is a sample program to do simple arithmetic, with

the results of a RUN of the program. Note the use of commas, and the widely spaced answers.

```
10 PRINT 7+5, 7-5, 7*5, 7/5
99 END

RUN

12          2          35          1.5
```

Q23. Write a short program to do the following simple arithmetic. Group all of the expressions in one PRINT statement, using commas to separate expressions. Show the results you would predict for a RUN of your program, then try it on the computer if one is available.

$10 + 6$ $15 - 9$ $23 \div 5$ 3×13

A23.

```
10 PRINT 10+6, 15-9, 23/5, 3*13
99 END

RUN

16          6          4.6          39
```

Here are some BASIC expressions in which two or more operations are used.

| Expression | Value Computed by Computer |
|------------|----------------------------|
| $2*3 - 4$ | 2 |
| $2 + 3*4$ | 14 |

Q24. Here are three more BASIC expressions. What would be the values as computed by the computer after it does the indicated arithmetic?

- (1) $2 * 3 + 4 * 5$
- (2) $2 + 3 * 4 - 5$
- (3) $2 * 3 - 4 * 5 + 6 * 7$

A24. (1) 26 (2) 9 (3) 28

Now here are some more examples and exercises using division. The computer recognizes to do division when you program a slash (/).

| Expression | Value Computed by Computer |
|-------------|----------------------------|
| $3/4 + 5$ | 5.75 |
| $2 - 3/4$ | 1.25 |
| $2*3 + 4/5$ | 6.8 |

Q25. Now give these division examples a try on your own.

- (1) $3/4 + 5 * 6$
- (2) $2 - 3/4 + 5$

A25. (1) 30.75; (2) 6.25

The computer does arithmetic in *left to right* order, with all multiplications (*) and/or divisions (/) performed *before* additions (+) and/or subtractions (-).

$\left. \begin{matrix} * \\ / \end{matrix} \right\}$ before $\left\{ \begin{matrix} + \\ - \end{matrix} \right.$

Q26. Now try these. (REMEMBER: Do arithmetic in

left to right order.)

| Expression | Value Computed by Computer |
|---------------|----------------------------|
| $2*3/4$ | _____ |
| $3/4*5$ | _____ |
| $3/4/5$ | _____ |
| $2*3/4+3/4*5$ | _____ |

- A26. 1.5 Multiply 2 by 3, then divide result by 4.
 3.75 Divide 3 by 4, then multiply result by 5.
 .15 Divide 3 by 4, then divide result by 5.
 5.25 First compute $2*3/4$, then compute $3/4*5$ then add the two results.

If you want to change the order: use parentheses.

$2*3 + 4 = 10$
 but $2*(3 + 4) = 14$
 $2 + 3*4 + 5 = 19$
 but $(2 + 3)*(4 + 5) = 45$

Compute $3 + 4$, then multiply result by 2.

Compute $2 + 3$, then compute $4 + 5$, then multiply those two results.

- Q27. Complete the following. (REMEMBER: Operations in parentheses are done first.)

| Expression | Value Computed by Computer |
|-----------------|----------------------------|
| $(2 + 3)/(4*5)$ | _____ |
| $2 + 3*(4 + 5)$ | _____ |
| $1/(3 + 5)$ | _____ |

- A27. .25
 .29
 .125

One last look at the order in which arithmetic is done. In the expression below, the arrows in the circles show the order in which the operations are carried out. Write the final value for each expression.

| Expression | Value Computed by Computer |
|-----------------------------|----------------------------|
| $2 + 3 * (4 - (5 + 6 * 7))$ | -127 |
| $(3 * 4 + 5 * 6 - 7) / 8$ | 4,375 |

- Q28. Your next task is to write a correct BASIC expression to solve a given problem. Do so for each of the following.

Remember to indicate all multiplication and division operations with the proper BASIC symbol.

| Problem | BASIC Expression |
|--------------------------|------------------|
| $2 \times 3 + 6 \div 7$ | _____ |
| $16(33 - 21)$ | _____ |
| $3.14 \times 2 \times 2$ | _____ |
| $88 - 52$ | _____ |
| $18 + 47$ | _____ |

- A28. $2*3 + 6/7$
 $16*(33 - 21)$
 $3.14*2*2$
 $(88 - 52)/(18 + 47)$

(Did you forget the asterisk?)

A BASIC program to compute and print the values of the expressions in the preceding question would produce the following RUN:

```

RUN
6.85714
192
12.56
.553846
    
```

- Q29. LIST the program which would produce the above RUN.

```

A29.
10 PRINT 2*3+6/7
20 PRINT 16*(33-21)
30 PRINT 3.14*2*2
40 PRINT (88-52)/(18+47)
99 END
    
```

There is a fifth arithmetic symbol in BASIC, which indicates raising a number to a power. This operation is called *exponentiation*.

↑ means raise to a power

For example,

Volume of a cube: $V = S^3$, where S is the length of a side.
 If $S = 5$ and $V = 5^3$, then
 $V = 5^3 = 5 \times 5 \times 5 = 125$.

Since a teletypewriter cannot print superscripts, you tell the computer to raise a number to a power by using the symbol ↑. On the teletypewriter, depress the SHIFT key and hold it while you press the (N) key.

```

10 PRINT 5↑3      (5↑3 means 53 or 5 x 5 x 5)
99 END

RUN

125
    
```

- Q30. What would be the RUN for the following program?

```

(2↑6 means 26 or 2 x 2 x 2 x 2 x 2 x 2)

10 PRINT 2↑6
99 END

RUN
    
```

- A30. 64

Here are the BASIC expressions for a couple more problems:

| Problem | BASIC Expression |
|---|--------------------------|
| (a) $2^5 + 4^4$ | $2↑5 + 3↑4$ |
| (b) $7 \times 7 \times 7 \times 7 \times 7 \times 7 \times 7$ | $7*7*7*7*7*7*7$ or $7↑7$ |

When evaluating a mixed expression of arithmetic operations, the computer computes powers (↑) before doing multiplication, division, addition, or subtraction.



The formula for computing the area of a circle is

$$A = \pi r^2$$

Let's use 3.14 as an approximate value of π and write a program to compute the area of a circle of radius 7.

```
10 PRINT "IF RADIUS IS 7, AREA OF CIRCLE IS"; 3.14*7^2
99 END

RUN

IF RADIUS IS 7, AREA OF CIRCLE IS 153.86
```

In computing 3.14×7^2 , the computer first computes 7^2 , then multiplies that result by 3.14.

Computers use a special form of notation to indicate extremely large numbers, or extremely small decimal fractions. This method of expressing numbers is called *scientific notation*. Consider, for instance, a large number like the population of the earth which is about 3.6 billion people:

$$3.6 \text{ billion} = 3\,600\,000\,000$$

We asked *our* computer to print the population of the earth:

```
10 PRINT 3600000000
99 END

RUN

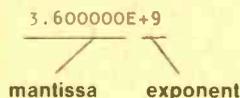
3.600000E+9
```

*Your computer may do it somewhat differently.

What's this?

Our computer printed the population of the earth in a form of *scientific notation*. (It really isn't especially scientific... it's just called that by some people.)

Scientific notation is simply a shorthand way of expressing very large or very small numbers. In scientific notation a number is represented by a *mantissa* and an *exponent*:



The mantissa and the exponent are separated by the letter E.

Here are some examples showing numbers written in good old every day notation and again in scientific notation (well, scientific notation according to our computer).

One trillion

ordinary notation: 1 000 000 000 000
scientific notation: 1.000000E+12

Volume of the earth in bushels

ordinary notation: 31 708 000 000 000 000 000
scientific notation: 3.170800E+22

Speed of a snail in miles per second

ordinary notation: .0000079
scientific notation: 7.900000E-6

Q31. In each of the numbers expressed above what is the exponent? Is the exponent positive or negative?

A31. +12 positive; +22 positive; -6 negative

Have you noticed? Our computer always prints the mantissa with 7 digits, one digit to the left of the point, 6 digits to the right.

Numbers printed in scientific notation can be converted to ordinary notation as follows.

CASE 1. Exponent is positive.

(1) Write the mantissa separately.

(2) Move the decimal point of the mantissa to the **RIGHT** the number of places specified by the exponent. If necessary, add zeros.

EXAMPLE: 6.123456E+4

4 places

(1) 6.123456 (2) 6.1234.56

Therefore, 6.123456E+4 = 61234.56.

EXAMPLE: 3.600000E+9

(1) 3.600000 (2) 3.600000000.

9 places (we had to add zeros)

Therefore, 3.900000E+9 = 3600000000.

Q32. Now you try it: 1.234567E+13

(1) _____ (2) _____

Therefore, 1.234567E+13 = _____

A32. 1.234567

1.2345670000000.

13 places (add 7 zeros)

12345670000000.

CASE 2. Exponent is negative.

(1) Write the mantissa separately.

(2) Move the decimal point of the mantissa to the **LEFT** the number of places specified by the exponent. If necessary, add zeros.

EXAMPLE: 7.900000E-6

(1) 7.900000 (2) .000007.900000

6 places (we added 5 zeros)

Therefore, 7.900000E-6 = .0000079

Q33. Now you try: 1.234567E-8

(1) _____ (2) _____

Therefore, 1.234567E-8 = _____

A33. 1.234567

.00001.234567

5 places (we added 4 zeros)

.00001234567

What You Have Learned

1. On most computers using BASIC there are five standard *print positions* across a teletypewriter line. A comma in a PRINT statement moves the teletypewriter to the next available print position.
2. When you use a semicolon instead of a comma in a PRINT statement, strings get printed closer together. Thus, you can vary the spacing in the RUN of a program.
3. You can program a computer, in BASIC, by using the symbols +, -, * and / to mean, respectively, add, subtract, multiply and divide. The computer will do all arithmetic in *right to left* order, with all multiplications and/or divisions performed *before* additions and/or subtractions.
4. There is a fifth operation in BASIC called *exponentiation*. This function raises a number to a power and its symbol is: \uparrow . For instance, 5 3 means 5^3 or $5 \times 5 \times 5$.
5. Computers use a special form of notation to indicate extremely large numbers, or extremely small decimal fractions—this is called *scientific notation*. A number in such notation is represented by a mantissa and exponent

separated by the letter E. The number 1,000,000,000,000 would be represented on our computer by 1.000000E+12 in scientific notation.

SELF-TEST

If you can answer these questions, based on this and last month's installment, you are a budding computer user and are ready to go on to next month's installment.

1. The device used to communicate programs to a computer is called a _____.
2. The individual lines of computer instructions in a program are called _____.
3. What is missing from this short program? _____

```
PRINT 2+2
END
```

4. Assume that you are at a computer terminal, typing a statement into the computer, and you notice that you have made a typing error. Describe a method of correcting your error (other than completely retyping the statement).
5. Describe a method for replacing a new statement for an old statement in a program without erasing the entire program and starting over.
6. Assume that there is a program in the computer. How do you erase that program from the computer's memory?
7. Assume that there is a program in the computer. How do you tell the computer to actually follow (or process) the program?
8. How do you cause the computer to type out a program stored in its memory?
9. Assume that this program is in the computer.

```
10 PRINT 3**5
20 PRINT 8 3
99 END
```

Describe how to delete (remove) the second statement without erasing the entire program.

10. Write the symbols used in BASIC for the following arithmetic operations.

| | |
|----------------|-------|
| addition | _____ |
| subtraction | _____ |
| multiplication | _____ |
| division | _____ |
| powers | _____ |

Refer to this program to answer questions 11 through 18.

```
10 PRINT "MY C#MPUTER IS A WHIZ AT ARITHMETIC."
20 PRINT 5+2**4 3
30 PRINT 8-16/32
40 PRINT (5+2)**(8-3)
50 PRINT "THAT'S ALL, F#LKS!"
```

11. Which statements contain strings? _____
12. A string begins and ends with _____
13. Describe the order in which the computer does the arithmetic in Line 20.
14. Describe the order in which the computer does the arithmetic in Line 30.
15. Describe the order in which the computer does the

arithmetic in Line 40.

16. In Line 40, why does the computer do the addition before the subtraction?
17. In general the computer does multiplication and division before addition and subtraction. Why is the order changed in Line 40?
18. Show what the computer will print when the program is RUN.
19. What symbol is used between several strings or expressions in a PRINT statement to cause the results to be printed close together when the program is RUN?
20. Look at this program.

```
10 PRINT 10, 20, 30, 40, 50, 60, 70
99 END
```

How many lines will the results of RUNNING the program occupy? _____

21. Convert the following numbers from scientific or "E" notation into standard notation.

| Scientific Notation | Ordinary Notation |
|---------------------|-------------------|
| 1.123456E+6 | _____ |
| 1.123456E+12 | _____ |
| 7.777777E-2 | _____ |
| 1.000000E-12 | _____ |

22. Write a computer program to do the following arithmetic and produce the results shown in the RUN below.

- (a) 10^3
- (b) 10^{12}
- (c) $18.56 - 9.35$
 $2.12 + 3.3^3$

```
RUN

TEN RAISED TO THE 3RD POWER = 1000
TEN RAISED TO THE 12TH POWER = 1.000000E+12
THE ANSWER TO PROBLEM (C) IS 1.689908
```

Answers to Self-Test

1. Computer terminal (e.g., teletypewriter).
2. Statements
3. Line numbers
4. Type a black arrow (\leftarrow) to erase each character (right to left) that you wish deleted until the mistake is erased. Then finish typing the statement, beginning at the point where the error was made.
5. Using the line number of the statement you wish replaced, type in the new statement.
6. Type SCR (for SCRatch), and press the RETURN key.
7. Type RUN and press the RETURN key.
8. Type LIST and press the RETURN key.
9. Type the line number of the line to be deleted (20) and press the RETURN key.
10. + addition
- subtraction
* multiplication
/ division
↑ powers
11. Lines 10 and 50.
12. Quotation marks
13. ↑, *, +. First the computer computes $4 \uparrow 3$, multiplies the result by 2, then adds 5.
14. /, -. First the computer divides 16 by 32, then subtracts the result from 8.

(Continued on page 87)

LITERATURE LIBRARY

301. Get acquainted with the new *EICO* products, designed for the professional technician and electronics hobbyist. Included in brochure are 7 IC project kits, *EICO's* "Fonealds," security products and many varied kits.

302. *International crystal* has illustrated folders containing product information on radio communications kits for experimenters (PC boards; crystals; transistor RF mixers & amplifiers; etc.).

303. *Regency* has a new low cost/high performance UHF/FM repeater. Also in the low price is their 10-channel monitor radio scanner that offers 5-band performance.

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

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

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

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

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

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

311. *Midland Communications'* line of base, mobile and hand-held CB equipment, marine transceivers, scanning monitors, plus a sampling of accessories are covered in a colorful 18-page brochure.

312. *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.

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

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

317. *Teaberry's* new brochure presents their complete lines of CB and marine transceivers and scanners for monitoring police, fire and other public service frequencies.

318. *GC Electronics* offers an "Electronic Chemical Handbook" for engineers and technicians. It is a "problem solver" with detailed descriptions, uses and applications of 160 chemicals compiled for electronic production and packaging. They are used for all types of electronic equipment.

319. *Browning's* mobiles and its famous Golden Eagle base station, are illustrated in detail in the new 1978 catalog. It has full-color photos and specification data on Golden Eagle, LTD and SST models, and on "Brownie," a dramatic new mini-mobile.

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

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

322. *Radio Shack's* 1978 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.

323. Get *Lafayette Radio's* "new look" 1978 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.

327. *Avanti's* new brochure compares the quality difference between an Avanti Racer 27 base loaded mobile antenna and a typical imported base loaded antenna.

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

329. Semiconductor Supermart is a new 1978 catalog listing project builders' parts, popular CB gear, and test equipment. It features semiconductors—all from *Circuit Specialists*.

330. There are nearly 400 electronics kits in *Heath's* new catalog. Virtually every do-it-yourself interest is included—TV, radios, stereo and 4-channel, hi-fi, etc.

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

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

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

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

335. The latest edition of the *TAB BOOKS* catalog describes over 450 books on CB, electronics, broadcasting, do-it-yourself, hobby, radio, TV, hi-fi, and CB and TV servicing.

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

338. "Break Break," a booklet which came into existence at the request of hundreds of CBers, contains real life stories of incidents taking place on America's highways and byways. Compiled by the *Shakespeare Company*, it is available on a first come, first serve basis.

342. *Royce Electronics* has a new 1978 full line product catalog. The 40-page, full-color catalog contains their entire new line of 40-channel AM and SSB CB transceivers, hand-helds, marine communications equipment, and antennas and accessories.

344. 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.

345. 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.

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

352. Send for the free descriptive bulletin from *Finney Co.* It tells all about their new auto FM radio signal booster (eliminates signal fading).

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

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

355. New for CBers from *Anixter-Mark* is a colorful 4-page brochure detailing their line of base station and mobile antennas, including 6 models of the famous Mark Helihwip.

356. Send for *Continental Specialties* new bread-boarding protostat devices. They vary in prices from a mini-budget kit at \$19.95. Featured is the new logic monitor, giving information on what it does, how it works, and how to use it.

358. *PixTronics* announces its new Model 200 Super Sensitive Electronic Darkroom Exposure Meter, used to determine the correct exposures of all black-and-white and color negatives. Useable with any enlarger.

359. *Electronics Book Club* has literature on how to get up to 3 electronics books (retailing at \$58.70) for only 99 cents each... plus a sample Club News package.

360. *Cornell-Dubilier* has a 4-color, 4-page, brochure on its Ham II, CD-44, and Big Talk rotor communication systems. Exploded half tones detail interior rotor construction, and tables list specs.

361. "Solving CB Noise Problems" is published by *Gold Line* and tells you how to reduce the noise and get a clearer signal. In discussion and diagram you can find out about the kinds of noise, their sources, and the remedies.

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Basic Course—Programming with BASIC

(Continued from page 85)

15. +, -, *. First the computer add 5 and 2, next it subtracts 3 from 8, and then it multiplies the two results.
 16. The computer does the operations contained in parentheses in left to right order.
 17. The computer does arithmetic contained in parentheses first.
 18.

```

RUN
MY CØMPUTER IS A WHIZ AT ARITHMETIC.
  133
   7.5
   35
THAT'S ALL, FØLKS!
    
```

19. Semicolon.
 20. Two lines, like this:

```

10          20          30          40          50
60          70
    
```

DX Central

(Continued from page 22)

the easily heard Albanian station, Radio Tirana on 6,200 kHz for a start.

To use your graph, first be sure to tune the band so your key reference station lines up precisely where it should according to your graph. Do this by setting the bandspread pointer to the proper log scale number and then adjusting the main tuning carefully and slowly until you find the key station's signal. Now you're set up to determine the frequency of any station in that band, by means of the chart.

When you run across a station whose SW frequency you want to determine, note the logging scale reading on your receiver. Check the appropriate graph. Move upward from the corresponding logging scale reading until you intersect the graph's curve, then read laterally to the left to find the frequency.

While not as exciting as reading those little red numerals, it works, it's cheap and you should, with care, be able to hit a frequency accuracy of about plus or minus five kilohertz.

Barbary Coast Pirate. A few centuries ago, the U.S. went to war against the Barbary pirates, the scourge of the North African coast. These pirates plundered merchant shipping, killing or enslaving the hapless crews.

About seven years ago, another sort of pirate popped up, but in different waters. It was a pirate broadcasting station called Radio Nordsee International.

It was one of a number of pirate broadcasters in the North Sea, in international waters off northern Europe and England. By locating aboard ships anchored in international waters, they skirted the licensing requirements of the various European governments, which held a tight rein on broadcasting. These stations featured pop music and commercials, two commodities rarely if ever heard on the staid, government-

controlled stations of northern Europe. Most pirate broadcasters operated on the medium waves. Radio Nordsee International (RNI) was different. It also used a 10-kilowatt shortwave transmitter. As a result, its signals could be readily heard on this side of the Atlantic.

RNI was owned by a company called Mebo Ltd., a name coined from the first letters in the surnames of its owners, Erwin Meister and Edwin Bollier. The company was headquartered in Zurich, Switzerland. A 20 year old, 570-ton coastal vessel was purchased and was renamed the Mebo II. It was outfitted with American-made transmitting equipment. Shortly the shipboard radio station was anchored off Holland in the North Sea, broadcasting commercial rock music programs, mostly to German-speaking audiences.

The story of RNI's activities is tangled and not without its drama. But suffice it to note here that eventually it, like most of the other unlicensed offshore radio pirates, was silenced. The ship, Mebo II lay for years, its radio gear unused, in a Dutch harbor.

Then, some months ago, there were rumbles that the Mebo II would sail. The word was that the radio pirate would head for the Mediterranean and the northern coast of Africa.

A new Barbary pirate? Not this time. The Mebo II's station was not to broadcast in defiance of the government off whose shores it was anchored. The station had been chartered by the government of Libya to augment that country's shore-based shortwave facilities.

Stateside DXers began hearing the station on its old frequency of 6,205 kHz, during the afternoon hours. But programming was odd, to say the least! There were reports of station announcements, in heavily accented English, for "the Socialist Libya Arab Broadcasting Corporation," with disco music and anti-Zionist propaganda coming back to back!

What's coming next? Who knows! Listen in and find out.

Bandsweep. (Times in GMT, frequencies in kHz): 3,285—Radio Belize broadcasts English programs from the Central American territory of the same name, formerly called British Honduras. Look for this one here around 0400 to 0430 or so. . . . 6,035—Nice signals have been reported lately from Radio Panamericana in La Paz, Bolivia. This is not a trip for the very beginner, but for the SWL with some listening under his belt who would like to try for some Spanish-speaking stations in South America, this could be a good target. Try around 1100. . . . 9,590—The newest relay station of West Germany's Deutsche Welle is located on the Caribbean island of Montserrat. You can find it carrying the regular DW program in English at 0130 on this frequency. . . . 15,105—Another voice from the West Indies is Radio Grenada, on the island of Grenada, which can be heard with English programming during the afternoons, for instance, around 2030. (Credits: Josephine Bryan, CA; Kevin Lyons, CT; Kenneth Earhart, PA; Roger Legge, VA; American SWL Club, 16182 Ballard Lane, Huntington Beach, CA 92649)

GLOSSARY OF DX TERMS

DW—Deutsche Welle, the West German shortwave station.

DXer—DX is a distant or otherwise hard to hear broadcast or other type of radio station. A DXer is one who listens for DX stations as a hobby.

GMT—Greenwich Mean Time, the universal time standard used by broadcasting stations and DXers. GMT is equivalent to EDT+4 hours, EST/CDT +5 hours, CST/MDT+6 hours, MST/PDT+7 hours or PST+8 hours.

kHz—Kilohertz, a frequency measuring unit; 1000 cycles per second.

SW—Shortwave

SWL—A shortwave listener, one type of DXer.

21.

```

1.123456E+6      1123456.
1.123456E+12    1123456000000.
7.777777E-2     .07777777
1.000000E-12    .000000000001
    
```

22.

```

10 PRINT "TEN RAISED TO THE 3RD POWER =";10 3
20 PRINT "TEN RAISED TO THE 12TH POWER =";10 12
30 PRINT "THE ANSWER TO PROBLEM (C) IS";(18.56-9.35)/(2.12+3.33)
99 END
    
```

SHOOTING AHEAD IN BASIC LANGUAGE PROGRAMMING

If you want to go further in your exploration of programming with Basic, you can order the book from which this article was excerpted, BASIC, by R. L. Albrecht, LeRoy Finkel and Jerald R. Brown. Write to Self-teaching Guides Department, John Wiley & Sons, Inc., Publishers, 605 Third Ave., New York, NY 10016. The price is \$6.45 postpaid. If you want more information about the popular John Wiley & Sons self-teaching guide series, just ask, and they'll send you some. Be sure to mention you saw it in ELEMENTARY ELECTRONICS.

Midget Digit

(Continued from page 52)

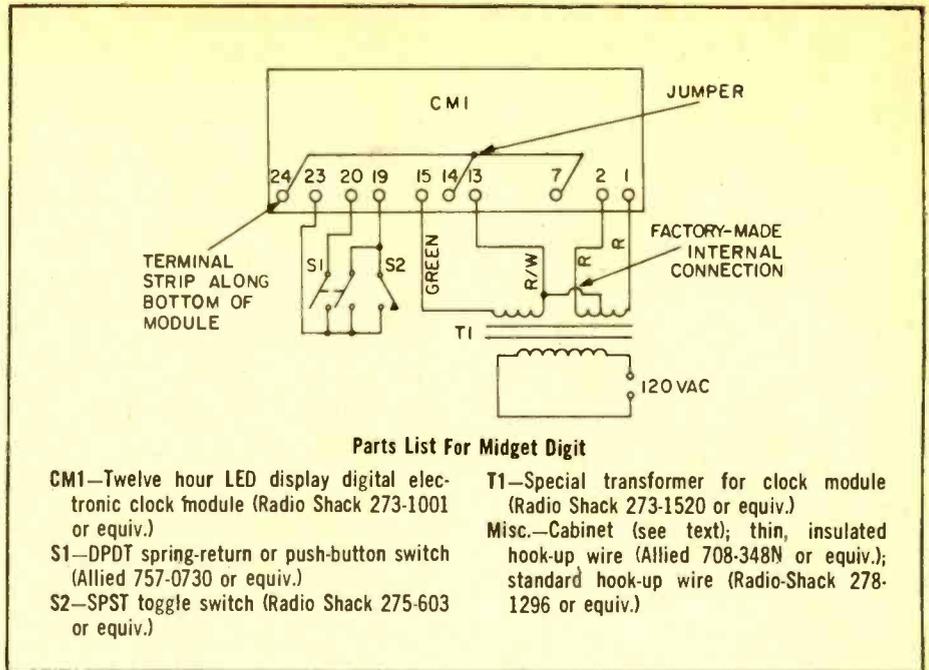
wires connect to terminals 1 and 2 (either way will do); the red wire with white tracer is the centertap for the red wires and connects to terminal 13; the green wire connects to terminal 15. Connect reset switch S1 and hold switch S2 as shown in the schematic. That's the whole construction.

Checkout Procedure. Apply power to Midget Digit (our model does not use a power switch). The display will be some random time that blinks on and off, incrementing seconds with each blink. If you don't get the incrementing effect you have made a wiring error or the module is defective.

Pressing the *reset* switch will stop the blink, the display will remain on and reset to zero, then start incrementing in one second intervals. Each time the reset switch is pressed the display should return to zero. If the *hold* switch is de-



Here is the complete chip for Midget Digit. Note the compactness and ease of handling.



pressed (remaining depressed) the timer should hold. Releasing the switch should cause the timer count to resume without a reset to zero.

If you don't get the proper reset and hold functions you most likely have a wiring error rather than a defective module. In particular, check the wiring on *reset* switch S1. The two wires

should be shorted only when the switch is closed. When the switch is open the wires from module terminals 19 and 20 should not be shorted.

A timer is a must for every photographer. Why pay five times as much for a commercial model when our Midget Digit is so easy to build and actually performs better in the bargain? ■

Mighty Met

(Continued from page 37)

in a square pattern. Flea clips could be used to support the wiring, but it is just as easy and less expensive to run the component leads through the board and connect them on the underside with fine wire, like the type used for wire-wrapping. Double check the orientation of the IC's and transistors, and the polarity of the electrolytic capacitors and battery. The prototype was assembled in a 2 x 6 x 4-inch cabinet, but another size or type could be used. The circuit board was mounted to the bottom of the cabinet with four 1/4-inch spacers. The speaker was mounted by means of two ground lugs soldered to its frame. For the sake of appearance, the two bolts holding the speaker and grille were epoxied to the inside of the cabinet.

Performance and Revision. After all wiring is complete, plug in the IC's, then connect the battery and adjust trimpot R7 to midrange. Turn the Mighty Met on and it should produce a continuous series of clicks whose rate can be varied by the *tempo* control. Adjust trimpot R7 for the desired difference in loudness between the initial

beat and the other beats, and check the function of the *meter* switch. Finally, calibrate the *tempo* control, using a watch or clock that indicates seconds. For the faster tempos, set *meter* to 5 or 10 and count the initial beats. If there are problems, try to determine which part of the circuit is faulty: If there are no clicks, first check that there is about +9 volts between the +V supply line and ground. If not, check for a wiring error or short. Next check for pulses at pin 3 of IC1; an oscilloscope is preferable, but an audio amplifier can also be used. If there are no pulses, the problem is in the multivibrator circuit. If everything is operating up to this point, check pin 4 of IC3 for pulses to see if the divider is working, then check pins 10 and 11 of IC4, and finally the output circuit.

Marking Time. Use of Mighty Met is straightforward. A word of caution is in order, however. When a metronome of this type is used for practicing on an instrument, there may be a tendency for the player to accent the first note of each measure, even when it is not appropriate for the particular piece of music being played. This tendency is more likely if the initial metronome beat is louder than the others. The Metered Metronome was designed to

allow the initial beat to be made softer than the others, by suitably adjusting trimpot R7, as a means of counteracting this tendency.

For darkroom use or other timing applications a natural concern is how much the timing changes as the battery voltage drops with use. Specifications for the 555 timer IC used in the circuit indicate only a fraction of a percent timing variation per volt; variation with temperature is also only a fraction of a percent over an ordinary range of temperatures. Tests of the prototype showed no significant change (less than one second in 5 minutes) for a battery voltage variation from 10 volts down to 7 volts. ■



Computer Readout

(Continued from page 80)

tions for random access, user-controlled memory, and 13K of read only memory which contains the programs necessary to let the user enter all his programs in BASIC. There was no doubt at the Atlantic City shindig that a lot of hobbyists are enthusiastic about the PET.

Southwest Technical Products was at the fair with a large and growing line of computer-oriented devices. Their Motorola 6800 microprocessor-based system is as strong and flexible as ever with its teletype, disc and tape, and video capabilities. The \$395 kit gives the user a starting point for a complete minicomputer system should he care to go that far. And the PR-40 printer is one of the smallest and best little chatter-boxes on the market. It sells for \$250 as a kit. The new calculator interface (\$46) for the Southwest Technical Products computer is a printed circuit board with ICs that do arithmetic calculations through hardware rather than software thereby saving memory and time.

The new Heathkit computers were introduced to e/e readers in our September/October 1977 issue, and the full line was on display at the Personal Computing Fair. The H8 computer at \$375 is a popular machine that allows a lot of expansion. It differs from the H11 (\$1295) in having a key-pad input, LED display output, and 8 bit words instead of the more sophisticated input/output capabilities of the H11 and 16 bit words. The H8 comes with BASIC to allow easy programming, a built-in power supply, and expansion capability for memory and I/O devices, such as a cassette interface. Heathkit also displayed the H9 video terminal and H10 paper tape reader/punch for use with either the H8 or H11. For those interested in reading up on the Heathkit line before diving into a major purchase, there are several books the company offers and a users group that publishes a newsletter. All this is nicely explained in the flyer called *Introducing Heathkit Computers*. Write to the company for a copy (address given separately in this article).

There were far too many computers on display at the Fair to mention them all, but I was impressed by the progress DATAC has made with their Tutorial Boards. The 1000E (\$345) board now has interface capability for cassette, teletype, and video. It can handle 64K of memory and allows expansion to a full system. A user's group has been started which you may like to join for

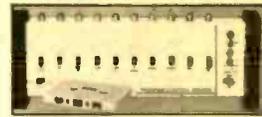
\$5 (covers six newsletters). And MITS had a real crowd-pleaser with its new Timeshare BASIC. Four video consoles were operating from Altair computers under the Timeshare BASIC system allowing real-time interaction with the computer programs almost as if a large IBM 360 were at the other end of the video control.

Speak to Me. But have you ever heard a computer talk? Well, a company called Computalker makes it happen for microcomputer buffs for \$395. A cassette tape demonstrating the sounds and the applications is available for \$2.95 and a users manual for the CT-1 Speech Synthesizer is available for \$10. How does it work? The sounds from a computer-controlled speaker are made in real-time under computer control. Nine sounds, called "acoustic-phonetic parameters," are selected by you on the keyboard of your computer. Your computer addresses the CT-1 Speech Synthesizer, which is a plug-in module, and the CT-1 in turn generates the sound corresponding to the letter you pushed on the keyboard. About 900 bytes of storage are needed for the computer to talk one second, so a fair amount of memory is required. But it is really fun to listen to the words. Computalker comes out as "KAAMP-YUWTAOLKER" with a stress on the "TAO" part because the user specified that stress in the input.

Finally, this Fair, like most, had dozens of new computer and calculator books on display and for sale. Camelot Publishing Company has some new books out by Donald Spencer who has written over thirty books on computers for hobbyists and the layman. Hayden Book Company is jumping on the BASIC bandwagon with books on game playing and on advanced computing using BASIC. Software-oriented books are a great aid to computer hobbyists because they show them how to use the systems they have bought and built. BITS Publications had some exciting, interestingly illustrated books that no curious person could put down. One was *What Do You Do After You Hit Return* (\$8.00), a large-size paperback with zany drawings and lots of computer games.

I will keep you informed of upcoming computer fairs as I learn of them. If you live in the West, or will head that way, mark March 3-5 and October 27-28, 1978 on your calendar. The first date is for a San Jose exhibit, and the second is for one in Los Angeles. Write to Computer Faire, Box 1579, Palo Alto, Cal. 93402. Keep those letters coming. Ideas, problems, stories—I love 'em.

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B&K 1827 Counter

(Continued from page 60)

needed functions to the front panel have been moved to the rear apron, joining the Z-axis CRT input, the direct plate connections, the switch that selects direct CRT plate connection and a somewhat unusual CRT tilt adjustment.

The focus and intensity adjustments are short-shaft controls also slotted for screwdriver adjustment. To prevent their being accidentally disturbed, or dam-

aged if the 'scope is pushed against a wall, the controls are protected on both sides by a "crash bar," very similar in function to the "crash handles" used to protect the front panel controls of laboratory equipments.

The Z-axis (intensity) and direct vertical inputs, and a common ground connection are on a screw-terminal strip. A slide switch selects normal or direct vertical plate connection. A small bracket secured by a single screw keeps the switch "locked" for normal connection until deliberately changed by the

user. As long as the bracket is in place the 'scope cannot be inadvertently changed to direct vertical plate connection.

CRT tilt is adjusted by simply loosening two screws and rotating the cover located behind the CRT on the rear. Normally, the CRT baseline (sweep) is exactly parallel to the graticule's vertical calibrations, but we all know that low priced 'scopes often are factory-assembled with some degree of tilt—when the baseline is aligned with the graticule on the left it's high or low on the right. Even if the adjustment is initially correct servicing the 'scope can cause tilt. On the 1403A you don't have to disassemble the cabinet and a half dozen interlocking adjustments to eliminate the tilt. You do it from the outside just by rotating the CRT cover. (The whole thing doesn't sound like much but it does eliminate an irritation common to many budget priced 'scopes.)

Summing up. Overall, the 1403A is an excellent value for its price. It works just the way it should: it's not spectacular, it just does what any other general purpose scope with a 5 MHz bandwidth will do. The direct vertical CRT plate input is a decided convenience when working on, or testing transmitters such as those found in CB transceivers and, of course, the instruction manual is excellent. B&K has come to be known for rather thorough manuals with many illustrations showing precisely what their instruments can do. The 1403A is no different; the manual is an excellent introduction to 'scope servicing for beginners and hobbyists. It also has a good section on using the 'scope for adjusting the keying characteristics of amateur CW transmitters.

Most important, for most hobbyists the 1403A has *all* the performance and features you'll need at a really rock-bottom price.

For additional information circle Number 73 on the Readers Service Coupon.

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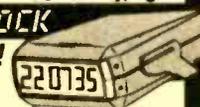
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(Continued from page 28)

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CB New Products

(Continued from page 77)

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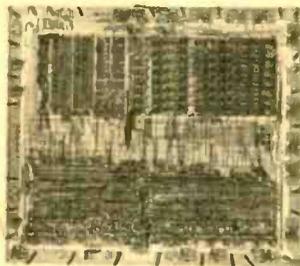
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Computer New Products

(Continued from page 74)

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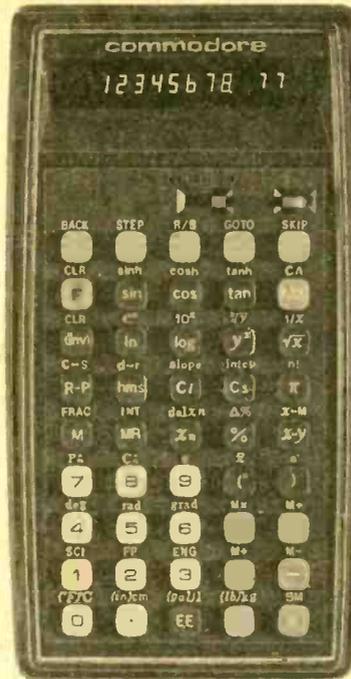
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Mobile MD

(Continued from page 59)

erated by the inner tube and tire is accomplished by injecting anti-static powder into each of the inner tubes through the tube valves. Kits for this contain the special tool and packets of powder necessary.

Last, Not Least! One final noise suppression measure warrants mentioning, and that is bonding. Bonding is a procedure whereby the interference generated by the ignition and charging systems are kept from traveling throughout

the vehicle by assuring a common ground. This is accomplished by connecting the metal parts of your vehicle together (usually by means of a braided ground strap) to form a shield.

All of the following are strategic bonding locations: Corners of the engine to the frame, air cleaner to the engine block, coil and distributor to the engine and firewall, exhaust pipe to the engine and frame, tail pipe to the frame, both bumpers to the frame, both sides of the trunk lid, both sides of the hood, battery ground to the frame, steering column and gauge and other lines where they pass through the firewall. ■

Simply Basic

(Continued from page 78)

WHAT DO YOU WANT TO SOLVE FOR?
? F USING L
ENTER X(L) AND L
? 1000, .1
F USING L=1592.356 HZ

ENTER X(L) AND L
? 10, 3.0
F USING L=0.530 HZ

ENTER X(L) AND L

?
READY
#RUN

WHAT DO YOU WANT TO SOLVE FOR?
? C
ENTER F AND X(C)
? 100, 10000
C=1.592E-07 FARADS

Programs are written in SWTP type 208K basic, and might require some modification for use with other BASIC interpreters. Programs for this column are checked and debugged using a SWTP 6800 computer with 12K memory, a Micro-Term ACT-1 CRT terminal, an ASR 33 TTY, and a National Multiplex CC8 recorder. Print-out will fit single line TTY or two lines on most CRT terminals.

Computer Supermarkets

(Continued from page 43)

an advanced hobbyist(s) who guides you into your first purchase, and it will be experimenters like yourself and perhaps advanced hobbyists who will give you fresh ideas on expanding your computer installation. Unless the store creates an atmosphere welcoming hobbyists like yourself, providing a place to get together to try new equipments and talk it out, you'll be floundering all alone in a sea of computer equipment—and it can get very expensive that way. You can wind up with a lot of hardware you don't need or can't use.

Summing Up. We have several computer systems in operation throughout the E/E staff and in all instances we were going nowhere until getting "professional" guidance: It's one thing to read that we must "initialize the computer", its quite a different thing to have someone tell us to simply "set the pointer to memory address 0100."

To be frank (with the exception of the preliminary instructions supplied with the first run of the Radio Shack computer), for the electronic hobbyist newly introduced to personal computing the quality of instruction manuals

supplied with the equipments we have handled is abysmal. You're going to need a lot of free assistance, particularly in the way of concise operating instructions, so be certain you pick a store capable of meeting your equipment needs while providing the atmosphere for meeting the hobbyists that can help you get your system up and running with the least amount of difficulty.

In short, many of you will need a lot of assistance at the beginning, so better select a computer store willing and capable of meeting your personal requirements.

Finally, and most important if you're a newcomer or beginner at personal computing, the store must want you. That might seem like a simple enough idea, but the truth of the matter is that many computer stores are gathering places for hobbyists, where strangers get together to swap ideas, programs, or just to learn "a little bit more." Well, people hanging around aren't welcome everywhere. We've been in computer stores with just two chairs, one for the salesman and one for the customer. In a gathering place, such as the Computer Mart of New York, you can hang around, try different systems, ask questions, and no one keeps asking "Can I help?" over and over until you get the idea it's either buy or leave. ■

NewsScan

(Continued from page 26)

to make certain on-board vehicle electronics do not create harmful fields to the surrounding environment. The FCC is getting very interested in RF noise generated by cars.

So you see, you'll soon need an EE degree to road test your family buggy.

Fiber Optic Telephone Link

The world's first high-capacity telephone link using laser beams over hair thin optical fibers was demonstrated in Harlow, England last year by four European companies of International Telephone and Telegraph Corporation (ITT).

The lightcarrying fibers run about six miles through normal underground cable ducts between telephone exchanges in two towns, Hitchin and Stevenage, about 26 miles north of London. The fibers are contained in a cable seven millimeters (about a quart-

er inch) in diameter and can carry nearly 2,000 simultaneous conversations.

STC, the major British telecommunications manufacturing company of ITT, supplied the special optical cable, electronics and the terminal PCM multiplex equipment for the system. BTM and FACE are supplying higher-speed multiplexing equipment for either end of the system. STL, the British research subsidiary of ITT, which originated the idea of wideband optical-fiber waveguide, is providing the technical backup to the project.

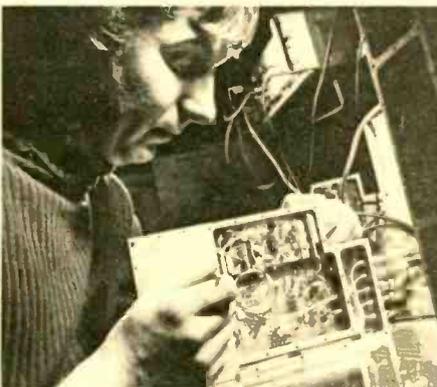
Widespread use of the new optical fiber links can be forecast because of these cables' outstanding advantages: greatly reduced bulk and weight compared with copper, far greater capacity, freedom from electrical interference, and enhanced security. The fibers are so clear that a slab of the same material one kilometer (about half a mile) thick would be as easy to see through as an ordinary window glass.

It was in 1966 that two scientists at STL proposed the ideas on which the whole new science of fiber-optic transmission is based.

Another ITT invention, called pulse code modulation or PCM, is used to transmit the telephone conversations. With PCM, the telephone conversations are coded into small electrical pulses, transmitted, and then reassembled at the other end into the original conversations.

The Hitchin to Stevenage 140 megabits per second digital optical transmission system is the world's first high-capacity repeater link, to be installed in the field to demonstrate its suitability for use in public telephone networks.

Its seven millimeter diameter optical cable runs through about six miles of normal telephone cable ducting between the two towns where post office exchange buildings house the multiplexing and optical terminal equipment. ■



One of the two repeaters that is used along six mile route to boost and reshape the infrared pulses that are transmitted along the optical fiber. An engineer is seen here making final adjustments to this repeater before installation in the optical link between Stevenage and Hitchin.

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

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

For completion by publishers mailing at the regular rates (Section 132.121, Postal Service Manual). 39 U.S.C. 3626 provides in pertinent part: "No person who would have been entitled to mail matter under former section 4359 of this title shall mail such matter at the rates provided under this subsection unless he files annually with the Postal Service a written request for permission to mail matter at such rates." In accordance with the provisions of this statute, I hereby request permission to mail the publication named in item 1 at the reduced postage rates presently authorized by 39 U.S.C. 3626.

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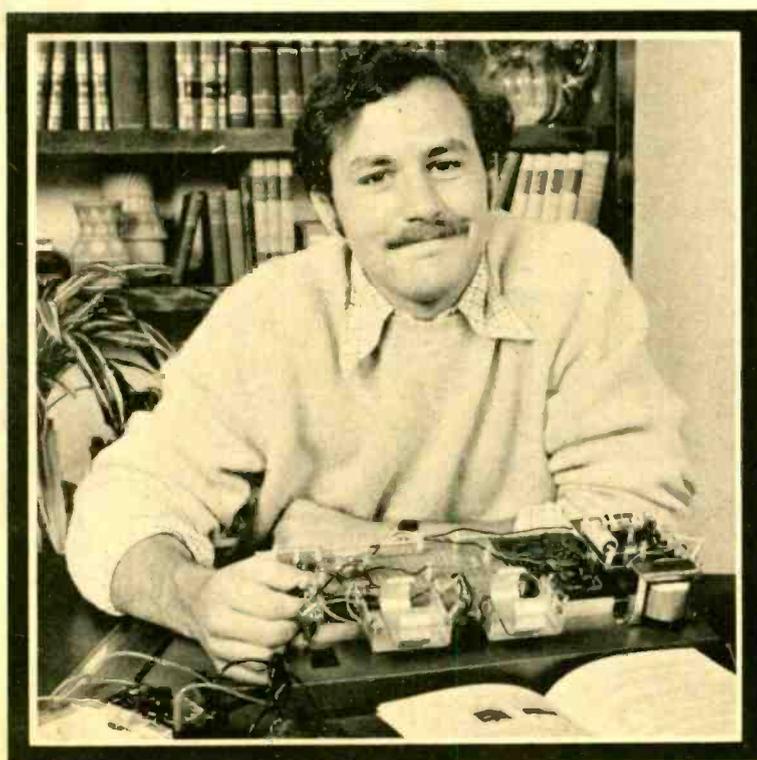
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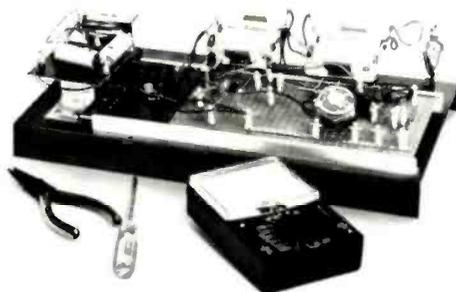
No question about it. Building new skills in electronics troubleshooting is an investment in your future. It's well worth the effort.

Why you should get CIE to help you do it.

Troubleshooting starts with *ideas* . . . principles. CIE's Auto-Programmed® Lessons help you get the idea — at your own most comfortable pace. Step by step at home, you explore each principle — each theory — until you understand it thoroughly and completely. Then you start to use it.

How CIE helps you turn ideas into reality.

If you're a beginner, you start with CIE's Experimental Electronics Laboratory. You actually perform over 200 experiments to help you grasp the basics. Plus you use a 3-in-1 Precision Multimeter to get your first taste of the testing, checking, analyzing steps you take in troubleshooting!



How 3 practical steps help you build troubleshooting skills.

You'll take your first practical step in professional troubleshooting when you build your own 5MHz triggered-sweep, solid-state oscilloscope.

As a trained troubleshooter, you'll use your oscilloscope the way a doctor uses his X-ray machine. As a student, you learn how to "read" waveform patterns on a big, 8cm. x 10cm. screen . . . how to "lock them in" for closer study . . . how to understand and interpret what they tell you.

Your second practical, skill-building step begins when you get your Zenith 19-inch diagonal, solid-state color TV — featuring nine removable modules! Now's your chance to apply the new skills you learned with your oscilloscope!

With CIE's guidance, you perform actual service operations — the kind you'd handle on the job as a trained troubleshooter! Using the TV, you learn to trace signal flow . . . detect and locate malfunctions . . . restore perfect operating standards . . . just as you would with any sophisticated electronics equipment.



Finally, step three rounds out your experience as you work with a completely solid-state color bar generator — actually a TV signal transmitter that produces ten different display patterns on your TV screen!

You study a gated color bar rainbow . . . crosshatch lines . . . dot patterns.

You explore digital logic circuits . . . observe the action of a crystal-controlled oscillator!

This practical, "hands on" training takes concentration and effort. But it's enjoyable and rewarding. And it's a great way to prepare for a troubleshooting career!

Why it's important to get your FCC License.

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

Almost 4 out of 5 CIE graduates who take the exam get their Licenses. More than half of CIE's courses can prepare you for it . . . and the broadest range of career opportunities!

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