

COMPUTER BASIC LANGUAGE TAUGHT HERE - See page 81

Elementary
Electronics



02342

Elementary Electronics

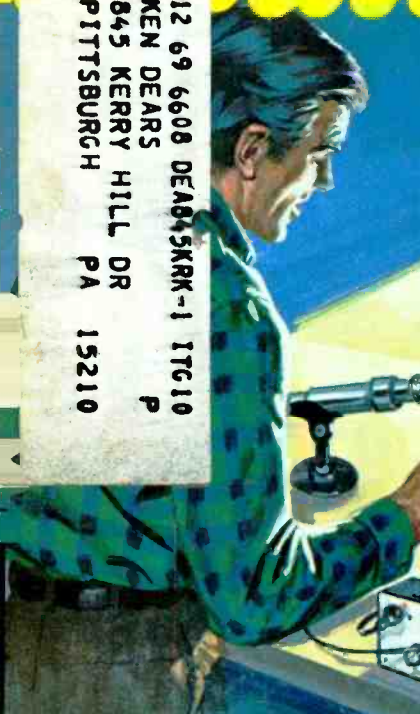
NOVEMBER-
DECEMBER
1977
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decibels from voltage
and power readings!

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KEN DEARS
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Thunderbolt lets sound stop the motion
for freeze action strobe pics!
(See page 50)

Pro-Timer takes the guesswork out of
the darkroom for better enlargements
(See page 33)

PLUS more projects—

Clobber burglars with BAM—you can be trickier than the Cat Man

Lissy gets your surplus TV out of the cellar and into your music

Let Frag, the Friendly Audio Generator, keep your Hi-Fi happy

TEST REPORTS

- ✓ Texas Instruments 58 Programmable Calculator for the desk top
- ✓ RCA Studio II Programmable TV Game for the playroom
- ✓ B&K 1827 Frequency Counter for the basement workbench



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HAVE TO WORK 2 JOBS
JUST TO MAKE
ENDS MEET.**



What would a second job mean to you? A few grubby dollars and a life that's an endless grind.

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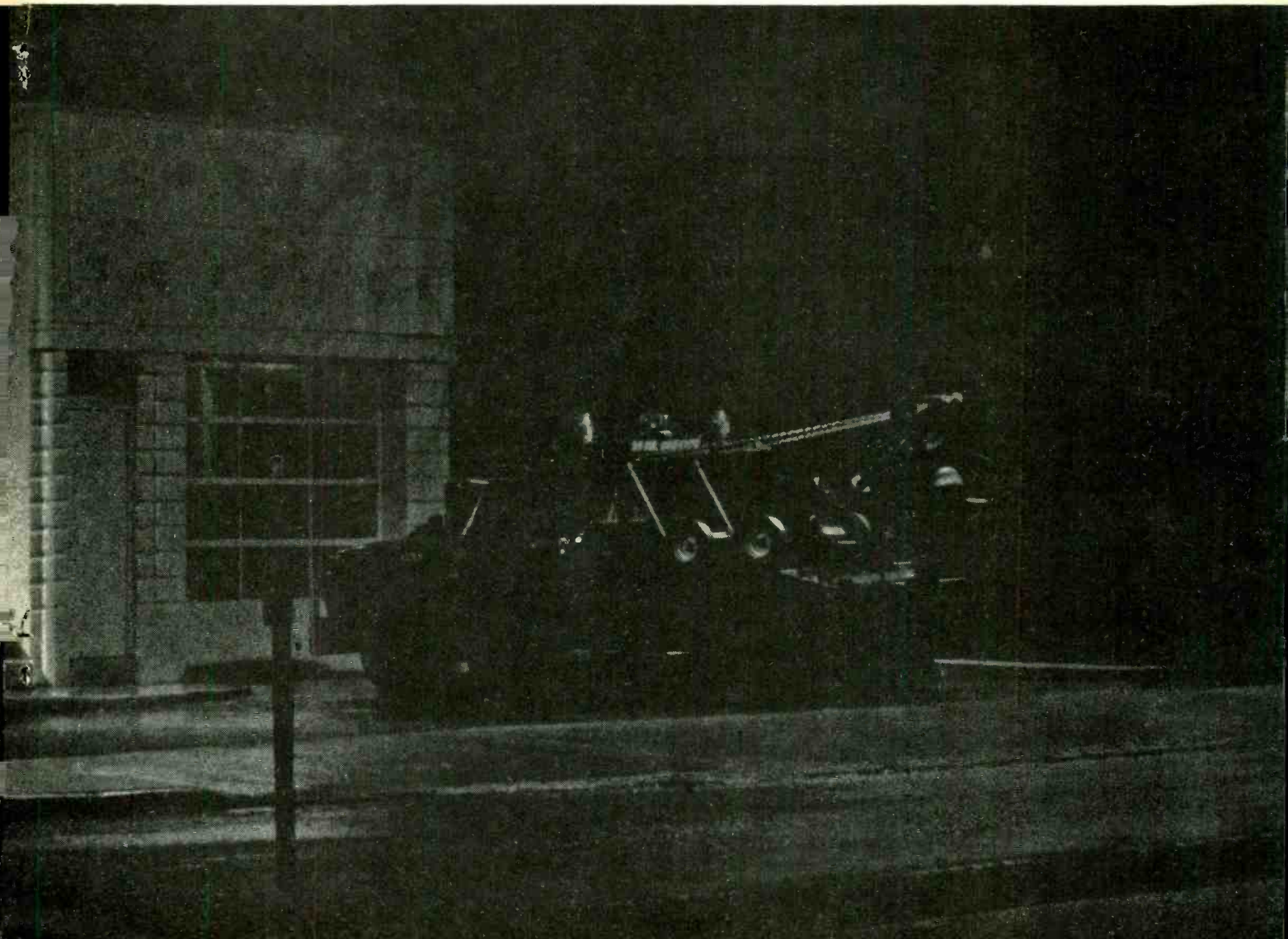
No one can promise success, but if you *want* more—more money, more security, more day-to-day satisfaction and more future—our free Career Booklet and free Demonstration Lesson can help you get started in the right direction. Just check the box next to the field that interests you most and mail the postpaid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

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Scranton, Pa. 18515

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elementary electronics

November/December 1977
Volume 17, No. 6

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THIS ANTENNA WILL NOT KILL!!

HUSTLER'S NEW HOMING PIGEON™ THE FIRST ALL-INDOOR CB BASE ANTENNA IS A TIMESAVER, WORKSAVER, .. AND LIFESAVER!



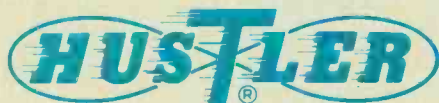
Patent Pending for Homing Pigeon™. Other Hustler antennas are protected by one or more New-Tronics patents: 3287732, 3513472, 3327311, 3419869, 3599214, 3873985, 3582951.

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.

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Model HP-27



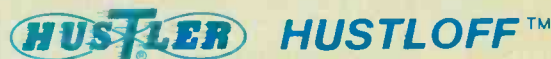
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It won't dart off like magnetic mounts can so it can't hit a passing car or pedestrian, leading to lawsuits — spin the knob to remove!



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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.



Hey, look me over

Showcase of New Products

Pockette Scanning Monitor

RCA Pockette Scanning Monitor, Model 16S150, operates on the two most used bands; VHF-Hi at 150-174 MHz, and UHF at 450-470 MHz. This FM scanning monitor is a crystal controlled receiver with an automatic scan circuit that, sequentially, monitors selected fre-

CIRCLE
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SERVICE COUPON

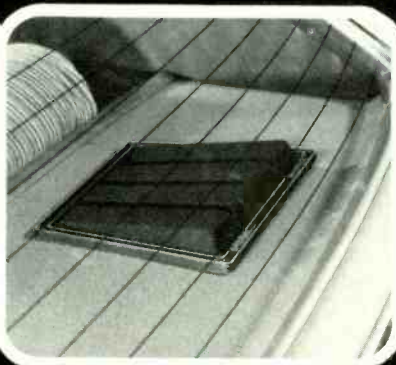


quencies on the Public Service band. It locks onto an active frequency and keeps the receiver tuned in so long as the signal remains on the air. The RCA Scan-Aire, model 16S150, is solid state using integrated circuits. It has separate lock-out switches for each of its four channels, squelch control, volume control, automatic/manual scan control, built-in speaker, telescoping antenna, and LED channel indicators. This unit operates on four AA size batteries (not included) — standard or rechargeable — and can also be used on optional RCA 120 Volt adapter for charging or AC operation. It has a built-in battery charging selector switch that keeps the unit from being inadvertently damaged when AC operated with nonchargeable batteries. It weighs 14 ounces. Suggested retail price is \$142.95. For further information, contact your local RCA Scan-Aire Distributor or write to RCA Distributor & Special Products Division, Deptford, NJ 08096, attention: Sales Promotion Services.

SERIES 6000™ car stereo speakers, the only air-sealed convertible mounts on the market today



Surface mount



Flush mount

We know that sometimes you can't cut a hole and mount a speaker where you want it in your sports car, truck, van, hatchback, station wagon, RV, etc., etc., etc. That's what makes the **KRIKET® SERIES 6000™** car stereo speaker unique. You can mount it on any surface. And its patented **WORKING WALL®** sound baffle insures sound reproduction unmatched in performance, quality and value.

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The result is sound so clear, clean and brilliant, you'll think you're listening to a home stereo speaker system valued at hundreds of dollars. Yet **KRIKET®** speakers are sold at a fraction of that cost.

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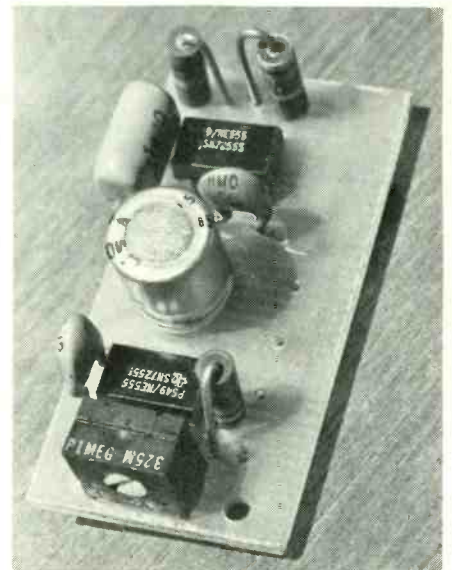
afs Kriket

Acoustic Fiber Sound Systems, Inc.
Indianapolis, Indiana 1977

CIRCLE 5 ON READER SERVICE COUPON

Time Repeater Use

Timekit's integrated circuit time-out timer, Model TG-970, was designed for users of 2-meter amateur repeaters. All circuitry is on a 1-in. x 2-in. printed circuit board, which fits nicely in most transceivers. Connections to the TG-970



CIRCLE 57 ON READER SERVICE COUPON

are 13VDC, P.T.T., ground and output. When the microphone button is depressed, a timing cycle is initiated (continuously variable from 10 seconds to 3 minutes). At timeout, the TG 970 provides a 2 Hz, 13 V pulse train. The output can be used to flash a LED, a beeper, or can be used to excite the Timekit Model TG-3 Oscillator, which will pulse an external or transceiver speaker at 2 Hz with a 1000 Hz note. The TG-3 is designed to attach to the TG 970 board. Reset is immediate with no false triggering. The TG-970 is priced at \$7.95 wired and tested and in kit form at \$6.50. The TG-3 at \$4.50 or as a kit at \$4.00. Other Timekit products include Touch Tone

Shakespeare's Big StickTM Antenna. World famous performance. And right in your own backyard

Punch out the big signal from 60 feet up with Shakespeare's Big Stick. The omnidirectional fiberglass base station antenna that outperforms anything on the 40 channel band. Illuminating 12 times more capture area. And sending the signal energy out to the horizon in a unique, low angle radiation pattern.

This half-wave coaxial sleeve antenna incorporates exclusive Shakespeare engineering in fiberglass to outrange taller, heavier metal antennas under all conditions. Withstanding ice and winds up to 125 MPH with no damage to reception. And pretuned to a low SWR over the 40 channel band.

Move up for the big gain with Shakespeare's Big Stick. Pretested. No ground radials. Works anywhere with any length of cable. Also available in a low cost, 2-piece model, Big Stick II.

Shakespeare



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CIRCLE 24 ON READER SERVICE COUPON

Big Stick, Style 176
Used as part of this country's DEW
line defense system. Less than \$45.

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Group, P.O. Box 246,
Columbia, S.C. 29202
In Canada:
Len Finkler, Ltd.,
Ontario.

HEY, LOOK ME OVER

Interfaces and an integrated circuit Burglar Alarm. Get more facts from Timekit, 23715 Mercantile Road, Cleveland, OH 44122.

Storm Alarm

Developed in support of the new National Weather Service weather reporting and warning system, the Storm Alarm, Model TA-3, provides 24-hour protection against hazardous weather such as tor-



CIRCLE 59 ON READER SERVICE COUPON

nadoes, floods, hurricanes, severe thunderstorms, damaging winds or marine weather emergencies. The local N.W.S. office transmits a code signal over a special radio station; it is received by the Storm Alarm and the unit triggers a

siren signalling the presence of hazardous weather. A spoken description of the danger, the area affected and survival instructions may be heard immediately following the siren. TA-3 sells for \$29.95. Get all the facts direct from Weather-alert, 639 So. Dearborn, Chicago, IL 60605.

Scanner for Aero

Aero band listeners will be interested in a new scanner designed specifically to receive aircraft channels. The new



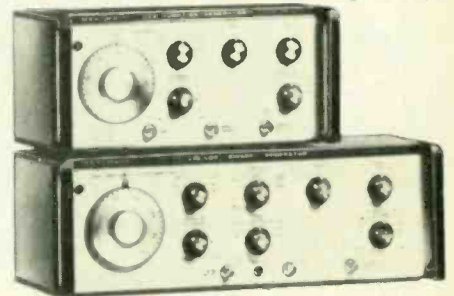
CIRCLE 73 ON READER SERVICE COUPON

Regency Flight Scan AM monitor radio features 8 normal channels plus one additional priority channel that will override calls coming in on other frequencies. The priority function can be switched in or out by the user. Long life LED channel lights will detail the new AC or DC unit's search for aircraft calls. AC and DC power cords, antenna, built-in speaker and mobile mounting bracket come with the new scanner for only \$149.95. For all the facts, write

to Regency Electronics, Inc., 7707 Records Street, Indianapolis, IN 46226.

Two Function Generators

Two new function generators, the IG-1275 and the IG-1273 by Heath can be said to be lab grade instruments. The two are identical except that the IG-1275 has sweep-function capability and the IG-1273 does not. Both provide sine, square and triangle waveforms from 3 Hz to 3 MHz in 6 ranges. Operational modes include continuous output (CW); gated CW; a burst mode that completes a variable number of output cycles and, on the IG-1275, linear and log sweeps



CIRCLE 31 ON READER SERVICE COUPON

for a 1000:1 sweep range. The units have pen lift and chart control signals for use with chart recorders; a 50 db attenuator variable between ranges; adjustable symmetry from 5% to 95%; variable offset; and VCG input for ex-
(Continued on page 87)

Special Bonus Offer!



A P Terminal and Distribution Strips for Faster and Easier solderless circuit building and testing. No special patch cords are required, and any solid wire up to No. 20 AWG can be used for connection. Strips accept all components with leads up to .032" diameter, and hardware and mounting templates are provided with every strip. Terminals are non-corrosive nickel/silver.

For the name of the distributor nearest you call Toll-Free 800-321-9668.

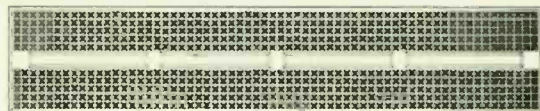
Send for our complete A P catalog The Faster and Easier Book.

Faster and Easier is what we're all about.

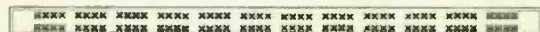


A P PRODUCTS INCORPORATED

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Buy this Model 264L **TERMINAL STRIP**, with 128 five-tie-point terminals, #923261 for only **\$12.50**.



And get this Model 212R **DISTRIBUTION STRIP**, with 24 four-tie-point terminals, #923277 **FREE** of added cost.

Free offer also applies to other sizes.

Look for the Special Bonus Offer Display at your A P distributor.

*Special bonus offer expires 12/31/77

CIRCLE 6 ON READER SERVICE COUPON

ELEMENTARY ELECTRONICS/November-December 1977

The Touch by Regency is the first fully synthesized, 16 channel scanner to put over 15,000 action radio frequencies at the command of a fingertip.

There's no complicated programming to do. No crystals to buy.

Simply tap out the frequency number you want on the pressure sensitive touch pads, and you're there.

Touch SC, and scan your 16 possible stored frequencies.

Or search for the unknown by pressing SS. The Touch seeks out frequencies you may never

know existed. When you find new action, The Touch tells you what you've found with the exact frequency number in LED display.

If you think that's the ultimate in scanning, wait. There's more.

One. You're never more than 1.2 seconds away from your favorite channel. The Touch lets you set up Channel 1 as a priority receiver; and it samples that frequency every 1.2 seconds. So you never miss a call.

Two. You'll also never miss a severe weather warning. Just set Channel 16 to the National

Weather Service emergency frequency, if available in your area. The Touch automatically alerts you to any severe weather broadcast.

Three. Our mobile filter screens out code noises from car telephones. Completely. Automatically. So all you hear is full, clear action.

See your Regency dealer for a demonstration. It's an experience you'll want to take home with you.

**The Touch by Regency.
The Ultimate Scanner.**



Introducing the Ultimate Scanner.

CIRCLE 21 ON READER SERVICE COUPON



The President Mobile.
You'll value its performance long after you've forgotten its price.

Even the least expensive President costs considerably more than the squawk box bargains you see splashed in the newspapers.

But even the most expensive President is an excellent value for the money.

Because it's not how little you pay that counts. It's how much you get.

President's modulation circuitry sets a new standard of talkpower. The microphone feeds directly into a variable pre-amp which connects to one of the most sophisticated compression circuits in CB. The result is consistent 100% modulation.

And every President Mobile incorporates new power output circuitry to give you full power—consistently—over all 40 channels. Some older sets don't.

You can buy a 23-channel CB for much less than a President. Which would be like buying a mono record player when stereo was introduced. A President not only gives you 17 uncrowded new channels to talk on—it gives you state-of-the-art electronics to talk with.

And one first class radio to talk about.



PRESIDENT

Engineered to be the very best.

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

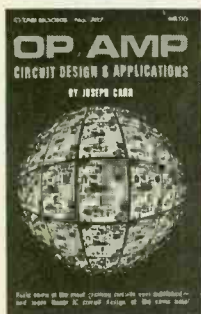
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www.americanradiohistory.com



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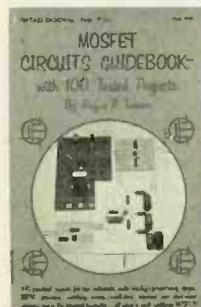
For Project Lovers. *Op Amp Circuit Design & Applications* by Joseph Carr is an easy-to-read, easy-to-understand, no-frills book with all the information needed to put op amps right to work. All that's needed to design functional circuits, as well as adapting the author's designs to personal requirements, is a basic electronics background. Early chapters carefully explain the operation of op amps, the inverting and non-inverting characteristics,



Soft cover
280 pages
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and the fundamentals of establishing the overall gain of the device. These basics are then applied in following chapters in computational circuits, including summation, logarithms, multipliers, trig functions, integration and differentiation, comparators, etc. For those who've considered designing their own measuring instruments, a full chapter tells how to design a variety of useful instruments, both for special purpose and general utility. Published by Tab Books, Blue Ridge Summit, PA 17214.

Project Book. Here are practical circuits for test instruments, audio amplifying/processing stages, RF/AF generators, oscillators, broadcast and shortwave receivers, a flea-powered transmitter, switching devices—all within one title: *MOSFET Circuits Guidebook* by Rufus P. Turner. This well-written volume introduces the reader to the metal-oxide-semiconductor field-effect transistor, with an even hundred useful and instructive electronic pro-



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196 pages
\$4.95

jects. A compact theory section tells how the MOSFET offers the best of both electronic worlds—vacuum tube and solid state—and shows how to avoid damage from voltage surges, prevent stray pickup, etc.

The circuit section contains 100 of the most varied, useful, foolproof, easy-to-build, and satisfying projects one can possibly imagine. In a matter of minutes—using the inexpensive MOSFET device specified, and a handful of everyday parts—the reader can thrill to the high performance of an amplifying, switching, or oscillating circuit with all the advantages of the FET and the beautiful simplicity of the bipolar transistor. As for the circuits themselves, the emphasis is on practicality: all the plans are in the book—all worked out, checked out, spelled out, and drawn out for fast, sure results. Published by Tab Books, Blue Ridge Summit, PA 17214.

Test Gear. Perhaps the most comprehensive "how-to-do-it" book on precision test equipment construction and use ever published, *Build-It Book of Miniature Test & Measurement Instruments* by Robert Haviland is complete with circuits, photos, and full-size PC-board layouts. The most complex instrument that can be built from the diagrams and PC layouts of this book will cost less than \$50 even though more than 50 precision measurement functions are possible with the instruments built. Every instrument diagram is accompanied by complete instructions on the operation of the equipment and how to combine the instruments in various ways to perform even more practical functions than any of the circuits could do individually. The



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238 pages
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author has built every circuit himself, and he includes panel layouts (with photos and templates), special suggestions on knob and meter placement, and plenty of tips and notes relating to any special "problem areas" that could be encountered in construction. The individual data on each test equipment item, coupled with the completeness of data, makes construction as easy as building a professional kit! Published by Tab Books, Blue Ridge Summit, PA 17214.

A Real Blast! You're the captain of a crusading starship against the logic of your "6800" or "8080." Your mission: search-and-destroy a random number of alien ships, without running out of time, out of fuel, out of ammunition or out of the galaxy. Your galaxy consists of 64 quadrants, in which there are 64 sectors. You must plan your mission to destroy all aliens. But, every time you move you lose a star-date and precious fuel. Don't run into a roaming star that could damage your ship! And, don't forget how much fuel your warp factor uses! Suddenly, Condition RED! Alien in sight! But, you don't know
(Continued on page 91)

Limited time
offer on

B&K-PRECISION guide to CB servicing

The highly detailed sixty-page manual for B&K-PRECISION's popular Model 1040 CB Servicemaster is now available as a reference guide. The CB Servicemaster manual is far more than just an instruction book—it contains detailed information on virtually all aspects of CB transceiver servicing. Individual chapters include: CB Performance Testing, CB Receiver Adjustments and Troubleshooting CB Transceivers.

In "CB Performance Testing," twenty-two different test procedures are detailed and the importance of each specification is explained. Troubleshooting information describes how to locate a CB transceiver fault in the shortest time possible for most efficient servicing.

The price of the B&K-PRECISION CB Servicemaster manual is \$5 (postpaid) and includes a \$10 discount certificate toward the purchase of B&K-PRECISION Model 1040 CB Servicemaster. The \$10 discount certificate is being offered for a limited time only. Send your check or money order directly to B&K-PRECISION, Sales Department, Dynascan Corporation 6460 W. Cortland, Chicago, IL 60635.

B&K PRECISION
DYNASCAN
CORPORATION

Enclosed is \$5.00, please send me the B&K-PRECISION Guide to CB Servicing and \$10.00 CB Servicemaster discount certificate.

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Address _____
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Armchair Copy



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CIRCLE 41 ON READER SERVICE COUPON

newscan

Electronics in the News!

Laser Writes on Liquid Crystal

Scientists at the San Jose Research Laboratory of IBM have built an experimental terminal to demonstrate a new information display technology. It uses a deflectable laser beam to write alphabetic and numeric characters in a cell containing a specially formulated liquid crystal material. The laser-written characters are projected onto the rear of a translucent display screen for viewing at 25 times their original size.

With further development, the new technology may be useful as an alternative to television-like cathode-ray tube displays in certain computer applications. The characters are more sharply defined than in cathode-ray tube displays and appear black on a white background, giving the display the easy-to-read look of a typewritten page.

A key element of the new technology is a small but powerful solid-state laser which operates at room temperature, producing a beam up to 25 micrometers



One of the experimental terminal's developers, Dr. Anthony G. Dewey, holds the laser in a pair of tweezers. It can produce up to 25 milliwatts of power in its continuous-wave output beam. In addition to the laser itself, the housing on the right contains devices to control the laser temperature and the electronics needed to operate it.

wide by 400 micrometers long. (200 micrometers is about 8 thousandths of an inch, or twice the diameter of a human hair).

Gallium arsenide laser systems are being developed for this display and other applications by a group led by Eric G. Lean at the IBM Thomas J. Watson Research Center in Yorktown Heights, N.Y.

ok wire wrapping center ok

NEW HOBBY WRAP MODEL BW 630



Battery wire wrapping tool

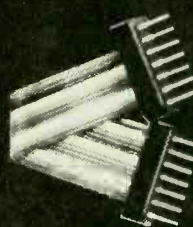
\$34.95
ONLY COMPLETE WITH BIT AND SLEEVE

STRIP/WRAP/UNWRAP TOOL MODEL WSU-30

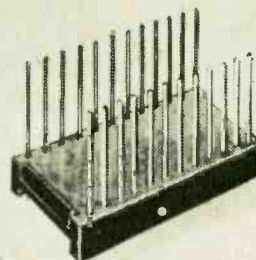


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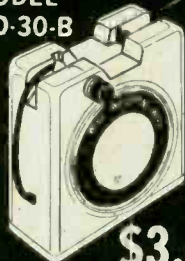
DIP IC INSERTION TOOL WITH PIN STRAIGHTENER

MODEL INS-1416



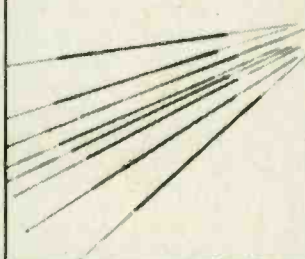
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WIRE DISPENSER MODEL WD-30-B

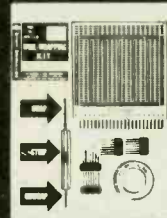


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CIRCLE 16 ON READER SERVICE COUPON

ELEMENTARY ELECTRONICS/November-December 1977

www.americanradiohistory.com

NOW, SCANNING OVER 6000 FREQUENCIES IS AS EASY AS USING A PUSHBUTTON PHONE.



Introducing the incredible, new Bearcat 210.

The exciting, new Scanner Radio with the space-age, computer control center that brings in every available public service frequency with pushbutton ease.

Bearcat's new 210 is as easy to program as a pushbutton phone. You can select any of the public service bands (all the available local frequencies) simply by pushing buttons.

Simply punch in the frequency numbers on the computer control center keyboard. Hit the Enter button. And you're programmed.

A large, flashing, digital readout panel shows you each frequency you've selected.

The Bearcat 210 patented search capacity lets you explore the endless world of every available public frequency out there, too.

Best of all, you're no longer limited to a given band or set of frequencies. The new Bearcat 210 is synthesized. Space-age circuitry lets you forget crystals forever.

Let's look at some Bearcat 210 features. And facts.

5 BAND COVERAGE—Includes Low, High, UHF and UHF "T" public service bands, the 2-meter amateur (Ham) band, plus other UHF frequencies.

SCANS 20 CHANNELS PER SECOND—In half a second, the Bearcat 210 scans all 10 channels.

CRYSTAL-LESS—Space-age circuitry with 5 custom designed chips. You never have to buy a crystal.

TRACK-TUNING—Patented track tuning provides full-band coverage on every band.

AUTOMATIC LOCK-OUT—Locks out channels and "skips" frequencies not of current interest.

AC/DC—Mobile mounting bracket included.

SELECTIVE SCAN DELAY—Adds a two-second delay to prevent missing transmissions when "calls" and "answers" are on the same frequency.

AUTOMATIC SEARCH—New, patented feature searches out any active local public service frequency automatically. For more police, fire, marine, emergency calls. And much more.

THE NEW BEARCAT 210

THE MOST EXCITING THING THAT'S HAPPENED
TO SCANNING SINCE SCANNERS.

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CIRCLE 9 ON READER SERVICE COUPON

NEWSCAN

To write characters, the laser beam is focused onto a transparent liquid crystal material sealed in a flat glass cell about the size of a photographic slide. Two computer-controlled oscillating mirrors deflect the beam across a portion of the cell, producing a scanning motion in the horizontal and vertical directions. The beam is turned on and off at the right times to form characters from patterns of overlapping spots in a grid 9 spots high by 7 spots wide.

The display terminal contains lenses,

mirrors, and a projection bulb that project reflected images of the characters being formed in the liquid crystal onto the rear of a viewing screen. The magnified character images—originally 90 micrometers high—appear on the screen about 2.25 millimeters high. This is nearly one-tenth of an inch, or just about the size of characters printed by a pica typewriter.

Spots formed in the liquid crystal are caused by heat from the laser beam. This heat destroys the alignment of molecules in a small region of the material, and the misaligned molecules scatter the projection light, producing a

dark spot in the magnified image on the screen. The display can be erased faster than the eye can perceive by applying an audio-frequency voltage across the plates that confine the liquid crystal.

Writing of characters is done only when the laser beam is scanning from left to right and from top to bottom within one character location. With this method of scanning, it takes the laser 50 milliseconds to form a character—a rate of 20 characters per second.

1977 Queen of the Road

Cassandra R. "Sandi" Purdum, 26, of Walkersville, Maryland, has been named Queen of the Road for 1977 in the annual competition sponsored by Open Road magazine, Radio Shack, Fram/Autolite, Ford Heavy Trucks and Justin Boot Company.

Only professional women truck drivers with two or more years of truck-driving experience are eligible in this annual competition. Ms. Purdum holds a Maryland Class A license, is a member of Teamsters Local 992 and has seven years of truck driving experience.

She has been employed by Mitchell



Cassandra R. "Sandi" Purdum, 1977 Queen of the Road, receives one of her prizes, a Realistic TRC-425 40-channel CB radio, from Radio Shack district manager Paul Pullen.

Transport, Inc. for the past two-and-a-half years and is presently hauling aggregate in Maryland, Virginia, West Virginia, Pennsylvania and the District of Columbia. Her record as a woman truck driver in the difficult field of dumptruck operations has attracted wide attention.

Ms. Purdum lives with her six-year-old son, Eddie, in a 100-year old log cabin home which she has restored and decorated. A recognized artist, she has done a number of commissioned oil paintings, including one of her own truck.

Among the prizes awarded to the new Queen were a 40-channel Realistic CB radio and a personal appearance contract with Radio Shack.

(Continued on page 90)

Less Bread, More Box.



New, complete Breadboarding/Interfacing Station.
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We took our economy Breadbox IV kit and did a complete design number on it . . . to add accessories and give you far more hardware for the buck.

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CIRCLE 11 ON READER SERVICE COUPON

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- ★ AMPLIFIER
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- ★ 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.

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

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

THE "EDU-KIT" IS COMPLETE

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

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

FREE EXTRAS

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- PLIERS-CUTTERS
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- TESTER INSTRUCTION MANUAL
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- PRINTED CIRCUITRY

SERVICING LESSONS

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

FROM OUR MAIL BAG

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

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

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

PRINTED CIRCUITRY

At no increase in price, the "Edu-Kit" now includes Printed Circuitry. You build a Printed Circuit Signal Injector, a unique servicing instrument that can detect many Radio and TV troubles. This revolutionary new technique of radio construction is now becoming popular in commercial radio and TV sets.

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

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

Progressive "Edu-Kits" Inc., 1189 Broadway, Dept. 587DJ Hewlett, N.Y. 11557

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

NAME

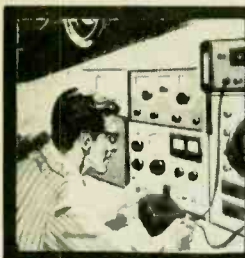
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1189 Broadway, Dept. 587DJ Hewlett, N.Y. 11557

CIRCLE 20 ON READER SERVICE COUPON



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**

No-fill Batteries

How good are those new sealed auto batteries that need no water replacement?
—C.O., Minneapolis, MN

I have one and, knock on lead-calcium, it works good so far. The battery I'm using is eight months old and going strong. I'll let you know when it fails, if it fails before I get rid of the car.

Operate When Hot

I measured the filament resistance of a 100-watt light bulb and found it to be very small. In fact, the needle barely moved on my ohmmeter. Hank, the wattage of this bulb has to be several thousands of watts. How come?

—C.C., Cumberland, IN

When the filament of an incandescent lamp is cold, its resistance is very, very low; but the tungsten material has a positive temperature coefficient. What that means is that as the temperature of the filament rises, the resistance increases. Thus, for a millisecond or two, large cur-

rents flow through the filament and heat it up, this raises the filament's resistance, which in turn reduces the current. The filament wire thickness is selected by the bulb manufacturer so that, at a certain filament temperature, as much power is spent overcoming the filament resistance as the amount radiated—a balance is achieved. With 100-watt bulbs, this occurs at the input of 100 watts of power. The best method of testing the power used by a light bulb or electrical appliance is to hook up a series ammeter and a parallel voltmeter. Multiply amps by volts for the watts of power consumed.

Play Safe!

I wanted to connect a three prong outlet to the three wires coming out of the wall box. I don't know the color code, but I went ahead and the outlet works fine. Now I am worried. Did I do right?

—L.K., Grand Junction, CO

No! If you don't know what you are doing with home electrical wiring, don't do anything—call an electrician. Actually,

it's very simple. I'm assuming the original wiring was done by a licensed electrician and the wall receptacle went bad with use. Connect the new receptacle to the wires in this way: black wire to the brass screw, white wire to the chrome screw, and green or center wire to the green screw. If the wire colors are not as described, call an electrician. He will do the job and tell you how to do it yourself the next time. It's money well spent.

Auto Volts

I installed a voltmeter in my car. Now, what should I look for to know everything is okay?

—J.R., Bensenville, IL

Under no load and with ignition off, the battery should read between 12.0 to 12.6 volts DC. When cranking the car to start, the voltage may drop to 10 volts but no lower. Under driving conditions, the battery should be charging anywhere between 13.8 to 16.0 VDC. With the battery low, the voltage during charge should be higher than near the end of a long drive. Check your meter frequently; when starting, first few minutes after starting, every 15 minutes on a long drive, just before you slow down to park, and when you park. You will find your car will give a repeatable voltage indication trip after trip. When this indication changes, look for trouble. Also, because you have a voltmeter, do not think your normal battery preventative maintenance procedures are not necessary. Always check battery waterlevel—once a week in hot weather. Keep post terminals clean, and keep it under 55.

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Remotely measure rainfall in the comfort of your home in tenths of inches (up to 999.9"). Gives total rainfall count for hr., day, wk., etc. Push reset button on indoor counter for new period and to empty outside collector. Outdoor collector mounts easily on fence, roof, etc. Incl. 30 ft. of waterproof wire. Runs on 9-V trans. radio batt. (not incl.).

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Descriptive set compiled by noted astronomer Dr. J. Allen Hynek, professor at Northwestern U. Discusses UFO sightings occurring very close to witnesses. Describes three aspects of UFO phenomena. No. P-42,594

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Top-quality Spy Scope, a \$30 value, now \$16.95! Special purchase saves you 40%. 100% coated optics; 393 ft. field of view. Only 2 oz.—stores in pocket, purse, glove box. No. 1568



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TRI Strikes Again

My neighbor down the block and I have been trying to eliminate TRI (Tape Recorder Interference) on his unit caused by my base CB transceiver. We've tried all sorts of filters and nothing works. What can we do?

—B.H., Kenner, LA

Sounds like it is your fault, but check first. Have a friend pull up in front of your house with his mobile unit and transmit. If the tape recorder does not pick it up, then the tape deck is functioning normally. Next, replace your current antenna with a borrowed unit, even if it is a mobile job. Transmit on your base rig. If all is OK, your antenna system is defective. If you suspect your rig, especially the older 23 channel-SSB types, borrow one from a friend and see what happens. Chances are your rig is clipping (are you using a power mike incorrectly?). Have the unit checked out by a 2-way radio specialist.

Elcaset Elusive

I have heard so much about the Elcaset tape deck last year and nothing this year. What gives?

—C.S., Stamford, CN

The hi-fi press hops on new innovations as they occur without considering the availability and marketability of the product. After all, they want to be first with the most words. Unfortunately, products are scarce because sales in test areas are low. Maybe in 1978 you'll see a rebirth. ■

IF YOU'RE NOT DESIGNING WITH A CSC PROTO-BOARD, LOOK AT ALL YOU'RE MISSING.

Utility—Models are available with or without built-in regulated power supplies (fixed or adjustable).

Economy—Eliminate heat and mechanical damage to expensive parts. Save money by re-using components.

Versatility—Use with virtually all types of parts, including resistors, capacitors, transistors, DIP's, TO-5's, LED's, transformers, relays, pots, etc. Most plug in directly, in seconds.

Durability—All Proto-Board models are carefully constructed of premium materials, designed and tested for long, trouble-free service.

Expendability—Proto-Board units can be instantly interconnected for greater capacity.

Visibility—All parts are instantly and easily visible, for quick circuit analysis and diagramming.

Speed—Assemble, test and modify circuits as fast as you can push in or pull out a lead. Save hours on every project.

Adaptability—Use in design, packaging, inspection, QC, etc. Works with most types of circuits, in many, many applications.

Flexibility—Use independently, or in conjunction with other accessories, such as scopes, counters, CSC Proto-Clip™ connectors, Design Mate™ test equipment, etc. One Proto-Board unit can serve a thousand applications.

Accessibility—All parts are instantly and easily accessible, for quick signal tracing, circuit modifications, etc.

Variety—A wide variety of models are available with capacities ranging from 630 to 3060 solderless tie-points (6 to 32 14-pin DIP's), to fit every technical and budget requirement.



Whatever type of electronic circuits you work with, you can do more in less time with CSC's solderless Proto-Board systems. As fast and easy as pushing in or pulling out a lead, you can design, test and modify circuits at will. Components plug into rugged 5-point terminals, and jumpers, where needed, are lengths of #22 AWG solid wire. In the same time you took to read this ad, you could be well on your way to assembling a new circuit. For more information, pick up your phone and call your dealer—or order direct.

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See your CSC dealer or call 203-624-3103 (East Coast) or 415-421-8872 (West Coast) 9 AM to 5 PM local time. Major credit cards accepted. Add \$2.50 for shipping and handling in the U.S. and Canada on direct orders of \$50.00 or less; \$3.00 for orders over \$50.00. On all foreign orders add 15% to cover shipping and handling.

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PB-101	940	10	29.95	8 distribution buses, higher capacity
PB-102	1240	12	39.95	Large capacity, moderate price
PB-103	2250	24	59.95	Even larger capacity, only 2.7¢ per tie-point
PB-104	3060	32	79.95	Largest capacity, lowest price per tie-point
PB-203	2250	24	80.00	Built-in 1% regulated 5V, 1A low ripple power supply
PB-203A	2250	24	129.95	As above plus separate 1.0 amp +15V and -15V internally adjustable regulated power supplies

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CIRCLE 31 ON READER SERVICE COUPON

Learn to service Communications /CB equipment at home...with NRI'S COMPLETE COMMUNICATIONS COURSE

Learn design, installation and maintenance of commercial, amateur, or CB communications equipment.

The field of communications is bursting out all over. In Citizens Band alone, class D licenses grew from 1 to over 2.6 million in 1975, and the FCC projects about 15 million CB'ers in the U.S. by 1979. That means a lot of service and maintenance jobs . . . and NRI can train you at home to fill one of those openings. NRI's Complete Communications Course covers all types of two-way radio equipment (including CB), AM and FM



special instruction so you can go on the air.

The complete course includes 48 lessons, 9 special reference texts, and 10 training kits. Included are: your own electronics Discovery Lab, Antenna Applications Lab, CMOS Frequency Counter, and an Optical Transmission System. You'll learn at home, progressing at your own speed, to your FCC license and into the communications field of your choice.



Transmission and Reception, Television Broadcasting, Microwave Systems, Radar Principles, Marine Electronics, Mobile Communications, and Aircraft Electronics. The course will also qualify you for a First Class Radio Telephone Commercial FCC License or you get your tuition back.

Learn on your own 400-channel digitally-synthesized VHF transceiver.

You will learn to service all types of communication equipment, with the one unit that is designed mechanically and electronically to train you for CB, Commercial and Amateur communications: a digitally-synthesized 400-channel VHF transceiver and AC power supply. This 2-meter unit gives you "Power-On" training. Then we help you get your FCC Amateur License with

NEW CB SPECIALIST COURSE NOW OFFERED



NRI now offers a special course in CB Servicing. You get 37 lessons, 8 reference texts, your own CB Transceiver, AC power supply and multi-meter . . . for hands-on training. Also included are 14 coaching units to make it easy to get your commercial radio telephone FCC license—enabling you to test, install, and service communications equipment.

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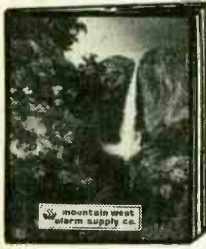
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DX CENTRAL

night that high frequency is replaced with 2,889 kHz. Shannon's schedule is from H+00 to H+25 and again from H+30 to H+55 minutes.

Those are the most commonly heard VOLMET operations. Here are some others that you might have some luck with:

European Area VOLMET network—Tel Aviv, Prague and Paris on 2,980, 5,575 and 11,391 kHz.

African Area VOLMET network—Algiers, Algeria; Las Palmas, Canary Islands; Dakar, Senegal; and Tananarive, Malagasy Republic, on 6,575, 8,896 and 11,279 kHz for the first three stations; 6,617 and 10,073 kHz for Tananarive.

Southeast Asia Area VOLMET network—Sydney, Australia; Calcutta, India; Bangkok, Thailand; Karachi, Pakistan; Singapore; and Bombay, India, on 3,432, 6,680 and 10,017 kHz.

Middle Eastern Area VOLMET network—Baghdad, Iraq; Bahrain; Beirut, Lebanon; Cairo, Egypt and Istanbul, Turkey, on 3,001, 5,561, 8,819 and 8,828 kHz.

Utility DXing fans may find the newly published SPEEDX UTILITY GUIDE, with 230 pages of information on all types of ute stations, useful. It is available for \$6.95 postpaid from SPEEDX, P.O. Box E, Elsinore, CA 92330.

Handler Enterprises Inc., P.O. Drawer CC, Northfield, IL 60093, has a useful publication, AVIATION AND AERONAUTICAL STATIONS (AV-600), priced at \$1.05. The firm also has a number of other utility DXing publications available.

Whither WARC? In just two years, the nations of the world will be gathering

in Geneva, Switzerland for the World Administrative Radio Conference, dubbed WARC-79. The conference, under the auspices of the International Telecommunications Union, will establish the worldwide use of the radio frequencies for the next 20 years.

What will come out of WARC-79? As with any international conference, no one can predict with any certainty. There are many nations and several major blocks of nations that will be vying for their own pet notions of just how the radio frequency pie will be divided up. Of equal concern, of course, will be the matter of enforcing the decisions made at WARC after the conference is over. Today, under past frequency agreements, there are some countries which carefully follow the letter of the pacts and others which ride roughshod over the rest of the "competition" when it comes to radio "space." How much cooperation will there be in the use of radio frequencies after WARC-79? That remains to be seen. In recent years we've seen a power race among the major international broadcasters. Once 50,000 watt transmitters were considered "big." Then came the 100 kilowatt, 200 kilowatt and 300 kilowatt giants. And they're still growing in lungpower around the globe. Unless useful agreements that will be followed emerge from WARC-79, it seems certain that the crowded bands and the ever-more-powerful shortwave transmitter race will continue.

For over a year the United States, through the FCC, has been trying to come up with the official position it will take at WARC-79. There are many sides to be heard, many services competing domestically to be heard on the frequency allocations. Shortwave listeners are represented on a subcommittee known as the International Broadcasting Service Group.

In May, the FCC issued a "Fifth Notice of Inquiry," a working document that gives at least a tentative idea of the thrust of the United States' position at the Geneva conference two years hence.

The tentative proposals include some power limitations on international broadcasting, the elimination of the mutual interference between radio amateurs and international broadcasters in the 7 megahertz band and some additional band space for shortwave broadcasters.

Don't look for any reductions in power of the really powerful shortwave broadcasting stations. At best all we can hope for is an end to the upward spiral which is, after all, just a case of everyone trying to "yell louder" to drown out the next guy. If adopted, a more useful limit would be a proposi-

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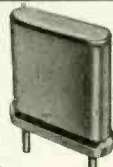
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DX central reporting

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BY DON JENSEN

Usually, in DX CENTRAL REPORTING, I deal with shortwave broadcasting stations; sometimes with the broadcasting

outlets on the AM medium wave band. It isn't too often that we talk about the so-called utility stations.

The utility operations—usually termed the “utes” by DX listeners—are more easily defined by what they are not.

A ute is not a broadcasting station. That is, it does not broadcast programs, music, news, entertainment, propaganda or whathaveyou. A ute does not direct its transmissions to a general audience.

Utility stations are not found just in the shortwave frequencies, but use channels all the way from the very low frequency longwaves up to UHF.

Broadly speaking there are four types of utility stations, categorized by their mission. There are fixed or point-to-point utes; maritime and coastal stations; time and frequency standard stations; and aeronautical stations.

Point-to-pointers, whether commercial, governmental or military operate specifically to get messages of one sort or another from point A to point B—simple as that. Most listeners are familiar with the time and frequency stations of the U.S. and Canada, WWV and CHU respectively. And there are numerous others in the world. Stations in the maritime and aeronautical services are involved in obvious communications services.

From time to time, in future columns, we'll get involved with some of the specific types of ute stations you can hear on shortwave and other frequency ranges. This month, we focus on one type of aeronautical operation that many SWLs have come upon while dialing across the shortwaves—the VOLMET stations.

VOLMET's air regular transmissions of aviation weather information for pilots on international and overseas flights. Typically, the VOLMET stations transmit five minutes of aeronautical weather data twice each hour. Usually three to five, even six, VOLMET stations share the same set of shortwave frequencies at different times during the hour.

There is the Pacific Area VOLMET network, which operates on 2,980, 5,519, 8,903 and 13,344 kHz., on frequencies shared by stations at Oakland, CA; Tokyo; Hong Kong; Honolulu, Hawaii; and Anchorage, Alaska. If conditions are right you may be able to sit on one of those frequencies for a half hour and hear all five stations in sequence.

Oakland uses the frequencies from five to ten minutes past each hour and again from 35 to 40 minutes after the hour. Tokyo uses the channels at 10-15 and 40-45 minutes after the hour. Hong Kong's schedule is 15-20 and 45-50 minutes. The rest of the net is as follows: Honolulu, 20-25 and 50-55 minutes; Anchorage 25-30 and 55-60 minutes.

Equally well heard throughout North America are the stations of the Atlantic Area VOLMET network. New York Radio and Gander (Newfoundland, Canada) share 3,001, 5,652, 8,868 and 13,272 kHz. New York operates from the hour until 20 minutes past, and again from H+30 to H+50 minutes. Gander fills in the “blanks” with transmissions at H+20 to H+30 and from H+50 to H+60 minutes.

Shannon Aeradio in Ireland uses 5,533 and 8,833 kHz full time. During the GMT “day” it adds 13,312 kHz. At

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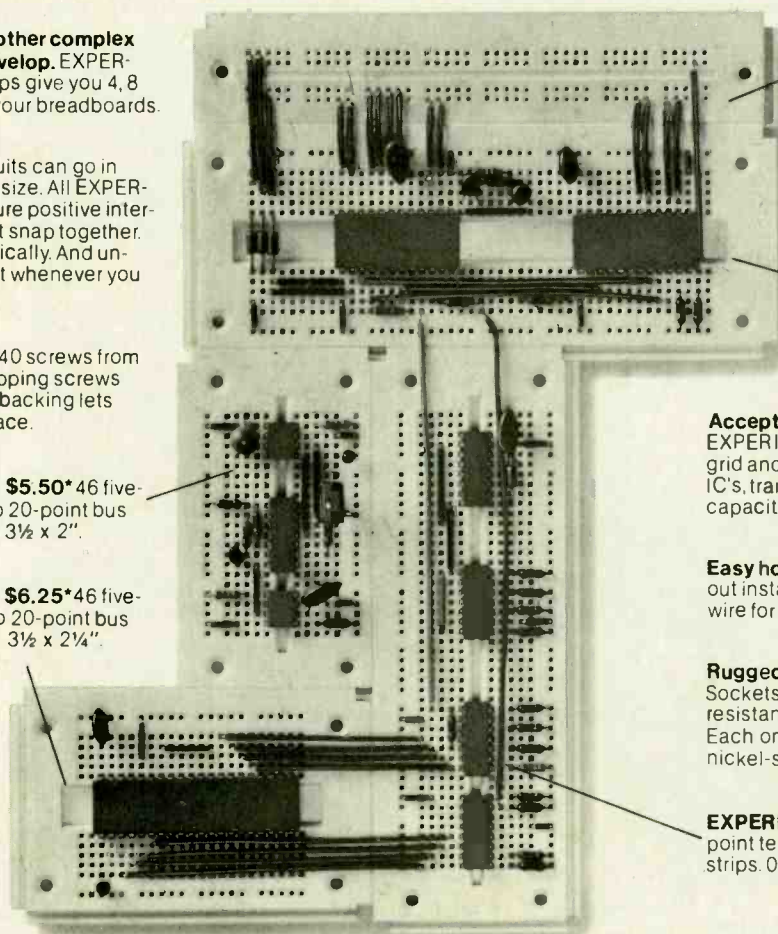
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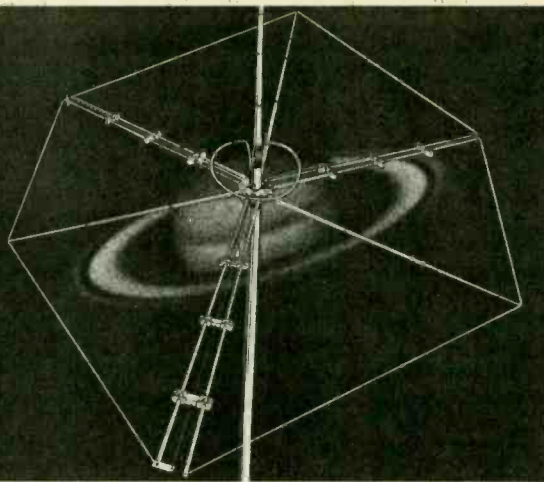


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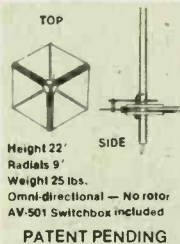
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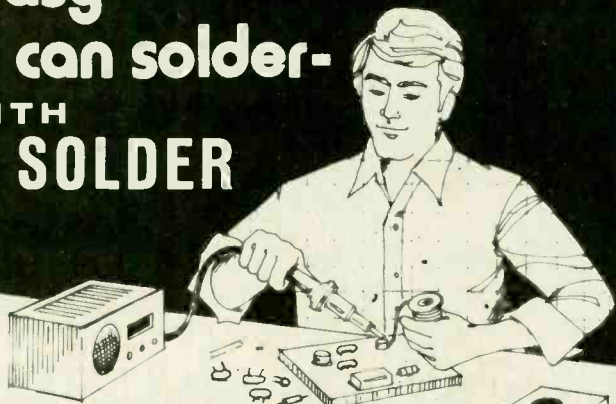
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DX CENTRAL

tion that each broadcasting agency around the world use no more than one frequency in each SW band with programs to the same or adjacent zones. This would mean, if finally adopted, that a station such as Radio Moscow could only use one frequency in each band at any given time for programs beamed to the east coast of North America.

There are proposals that would alter the present frequency bands. According to the tentative U.S. proposal, the regular AM medium wave band would expand its upper limit from 1605 kHz to 1800 kHz. The "Fifth Notice" of the FCC proposes a new International Broadcast band, 5,005 to 5,060 kHz.

The proposal would allot 6,950 to 7,250 kHz to amateur radio exclusively, with broadcasting stations operating between 7,250 and 7,500 kHz. The proposal would create a new broadcasting band between 13,700 and 13,800 kHz, and provide modest increases in the sizes of the 25, 19 and 16 meter bands.

The FCC notice also tentatively put forth the idea that all "Internal" shortwave broadcasting be limited to frequencies below 7,500 kHz. This would mean a departure of many Latin American stations, especially the Brazilians, from the higher frequencies. Finally, a stricter limitation on the power of these "Internal" SW broadcasters is proposed.

Bandsweep. (Frequencies in kHz, times in GMT)—4,985—One of the strongest Brazilian stations on the lower shortwave frequencies is Radio Brasil Central, which can be heard on this frequency most evenings in North America. . . . 6,120—This one is simply Super. Well, anyway that's the station's name, Radio Super and the location is the city of Cali in Colombia. Try this one around 0900 GMT, if you're willing to miss a little sleep. . . . 6,200—No difficulty should be experienced in logging the English language service of Radio Tirana, Albania. Programming, however, is strictly for yawns! Listen around 0130. . . . 9,595—Ads in English for Honda and Japan Airlines? You can hear these on NSB, Japan's "other" shortwave voice. You can find this station at 1530. . . . 11,755—FEBA, the Far East Broadcasting Associates, a missionary outlet on the island nation of Seychelles in the Indian Ocean, was shut down briefly during political unrest in the tropical isles during the summer. It's back on again, of course. A good time to tune this one is 0300. (CREDITS: Mark Godfrey, CO; Garry Spaoznikow, Winnipeg, MAN, Canada; Daniel Luce, TX; Glenn Thompson, NM; Bob Zilmer, WI; North American SW Association, Box 13, Liberty, IN 47353)

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- IC Troubleshooting Test Clip. Test up to 14 pins with probes or clips. Reg 4.99. 276-1950 Sale 2.99
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- Experimenter Socket. 2x47 rows of 5 connected tie points. 276-172 9.95
- Bus Strip. 2x40 connected tie points. Clips to socket above. 276-173 1.99
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Selected Diodes

Type	Cat. No.	Last Year	Now Only
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1N4003	276-1102	2/59c	2/49c
1N4004	276-1103	2/69c	2/59c
1N4005	276-1104	2/79c	2/69c
1N4735	276-561		2/89c
1N4739	276-562		2/89c
1N4742	276-563		2/89c
1N4744	276-564		2/89c
Trigger Diode	276-1050	\$ 49	39c
1N5401	276-1141		2/69c
1N5402	276-1142		2/89c
1N5403	276-1143		2/99c
1N5404	276-1144	2/51	19 2/99c
PTC205	276-1114		3/1.39c

SCR's and Triacs

Device	Rating	Cat No	Last Year	Now Only
LASC R	200V, 1.6A	276-1095	\$1.59	99c
SCR	200V, 6A	276-1067	\$1.39	89c
SCR	400V, 6A	276-1020	\$1.49	99c
Triac	200V, 6A	276-1001	\$1.39	89c
Triac	400V, 6A	276-1000	\$1.49	99c
BR	50PIV, 1.4A	276-1151		79c
BR	100PIV, 1.4A	276-1152		99c
BR	100V, 4A	276-1171		1.49
BR	200V, 4A	276-1172		1.69
BR	400V, 4A	276-1173		1.89
BR	50PIV, 6A	276-1180		1.99

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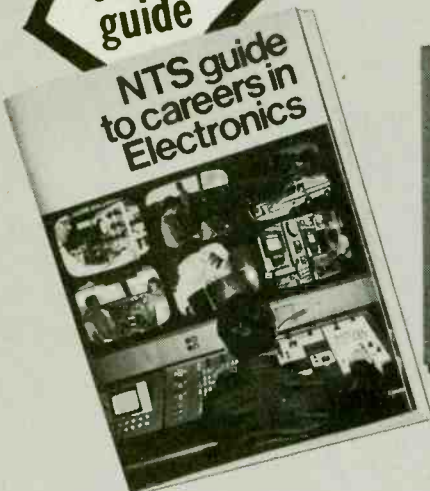
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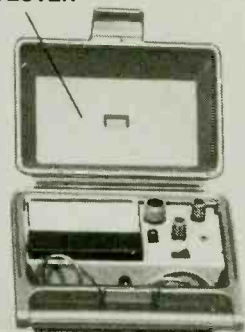
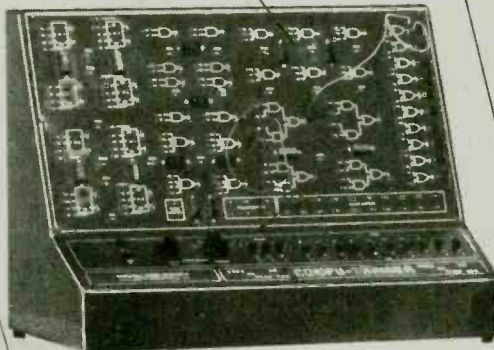
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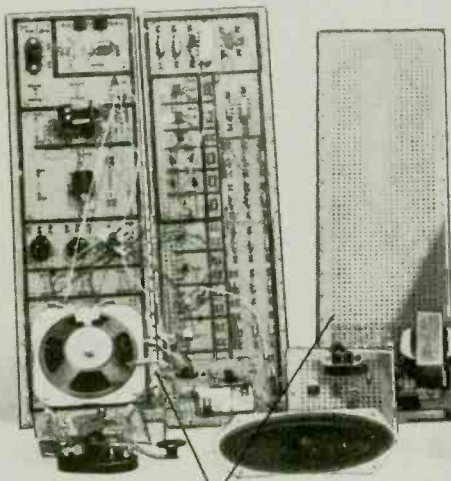
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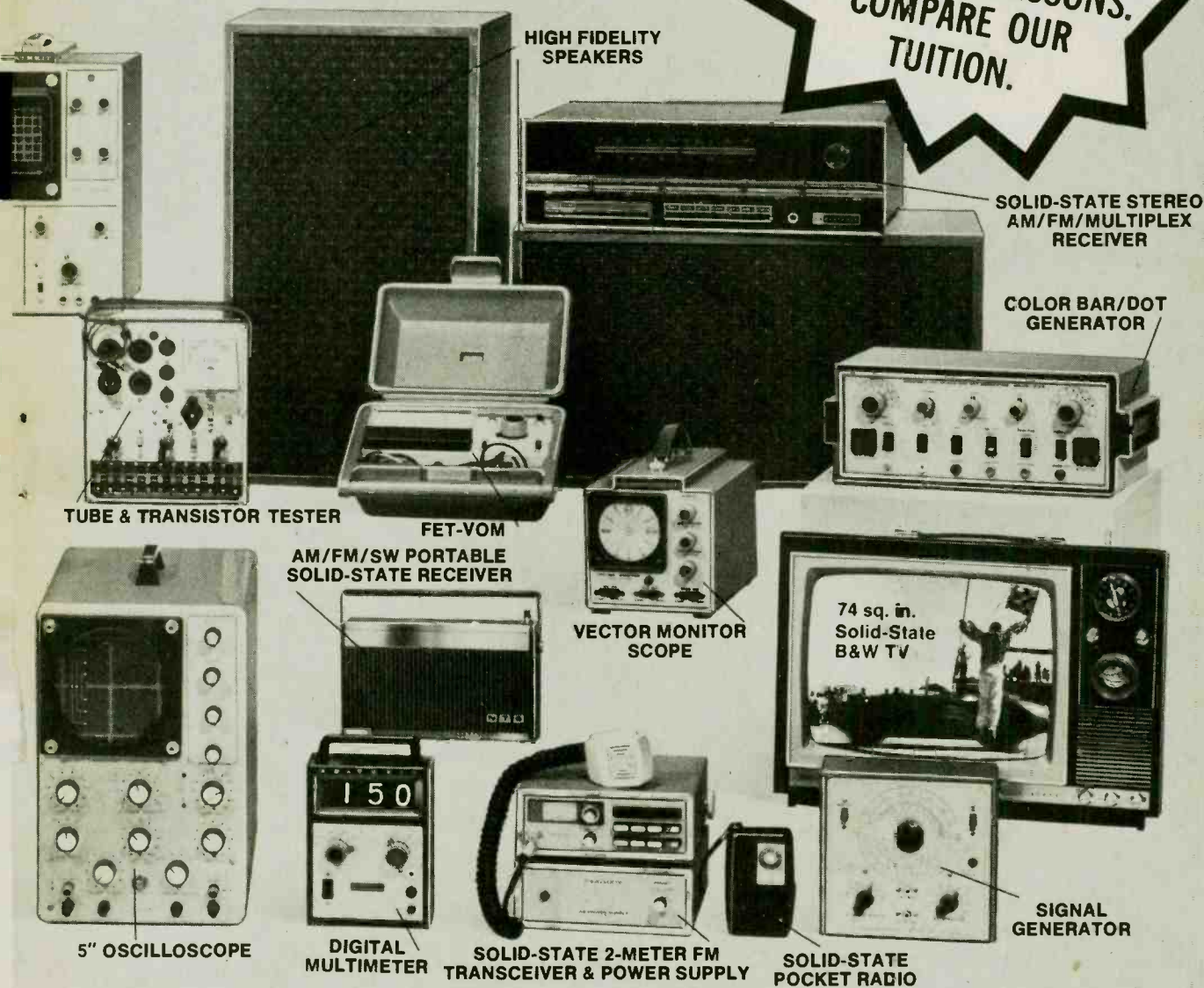
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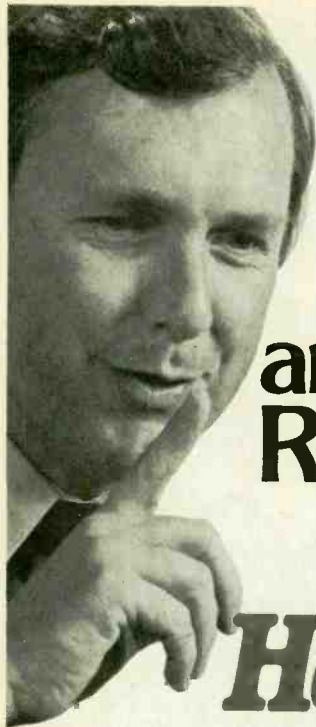
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PRO-TIMER

elementary Nov./Dec. 1977
Electronics

Get split-second accuracy for your darkroom prints with this IC timer.

by Walter Sikonowiz



IF YOU WORK IN THE DARKROOM or have a chemical process or other program which can use an adjustable interval timer you can use PRO-TIMER. Particularly if you need to time a program which runs on electricity, or which requires an alarm to be sounded at the end of the prescribed interval, *Pro-timer* is for you. You can adjust it to measure intervals as brief as 10 seconds, or as long as nearly six minutes (5:50). With a simple modification you can set it up for much longer periods, too.

While Pro-timer is busy keeping track of the amount of time left before it sounds the alarm, and cuts off the electricity to the device (or process or program) you want, a meter on its front panel shows what percentage of the timed interval has gone by, and how much is left.

Most electronic timer projects share a common fault: the lack of any indication of elapsed time. Suppose, for instance, that a process needs to be timed for two minutes. Further suppose that when one-half of the total time has elapsed, some subordinate task, such as the addition of a chemical, has to be performed. If your timer provides no indication of the elapsed

time, how do you tell when the first minute is up? It's simple, however, if you build Pro-timer because its panel meter shows the fraction of the total timed interval that has already elapsed.

For example, suppose that you've selected an interval of four minutes and thirty seconds by means of the two front-panel switches. When the meter needle shows .5, one-half the total time, two minutes and fifteen seconds, has gone by. The timed interval can be adjusted from 5 minutes and 50 seconds down to ten seconds in ten-second increments. For the duration of the timed interval, the timer will supply power to an electrical device. When the time is up, power to the load is cut off, and an audible alarm sounds. This feature permits you to use the timer on tasks under manual control as well as those under electrical control.

How The Circuit Works. To see how Pro-timer works, refer to the schematic diagram on the next page. IC1, a 555 integrated circuit (which is widely used in timing circuits) operates here as a monostable multivibrator.

Applying power to the timer triggers IC1 due to the action of D9 and R5 on the IC's trigger input, pin 2. In

order for IC1 to be triggered, pin 2 must be held at ground potential momentarily. When the unit is turned *On*, the supply voltage rises gradually, taking about .01 second to reach full potential. However, D9 and R5 hold pin 2 at ground potential until the supply voltage exceeds D9's rating: 9.1 volts. This causes IC1 to trigger. Consequently, its output (pin 3) goes high, K1 gets energized, and power is supplied to whatever is plugged into the AC socket, J1. Furthermore, the fact that IC1's output is high causes Q2 to conduct, thus shorting out C6 and keeping the alarm signal from sounding.

Transistor Q1 is connected as a constant-current source, which acts to charge up capacitor C7. The actual charging current is determined by the net resistance selected by S2 and S3. Selecting a smaller emitter resistance for Q1 results in a larger charging current, and C7 thus gets charged up at a correspondingly accelerated rate. Because the capacitor is being charged by a constant current, the voltage on C7 rises linearly with time. When the voltage on the capacitor reaches a threshold level, determined here by adjustment of R8, IC1 will reset itself and

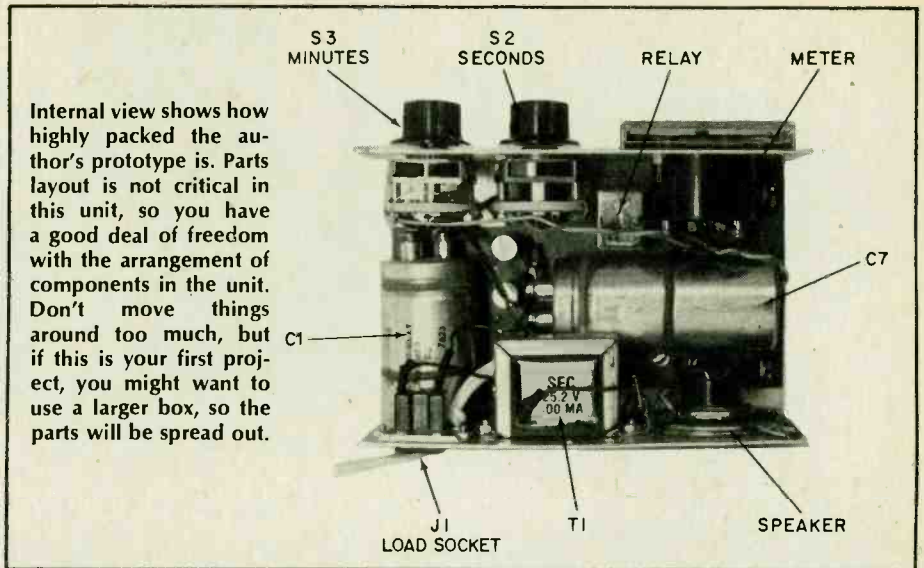
e/e PRO TIMER

discharge C7 through pin 7. This means that the timed interval is up, and pin 3 of IC1 drops to a low potential. Consequently, K1 becomes de-energized, cutting off power to the load. At the same time, Q2 stops conducting and, in the process, turns on the relaxation oscillator formed by R3, R4, C6, and Q3. During operation of the relaxation oscillator, C6 alternately charges through R3 and discharges through Q3's emitter. Since the speaker is in series with Q3's emitter, an audible warning signal is produced at the end of the timed interval.

Let's go back now to capacitor C7. The meter reads the voltage on C7 through unity-gain buffer IC2. If we calibrate the meter, by adjustment of R9, so that it reaches full-scale when the voltage on C7 reaches its maximum level, then any reading on M1 may be interpreted as relative elapsed time because the voltage on C7 is a linear function of time. When we select the required time interval, by means of S2 and S3, we change only the rate at which C7 charges—the threshold voltage level to which the capacitor eventually charges remains fixed. Therefore, the meter readout is valid for all timed intervals.

More On How It Works. Fuse F1 limits the load current to 1 ampere, which is about the maximum that the relay's contacts can handle. Use a slow-blow fuse since loads such as a lamp

Internal view shows how highly packed the author's prototype is. Parts layout is not critical in this unit, so you have a good deal of freedom with the arrangement of components in the unit. Don't move things around too much, but if this is your first project, you might want to use a larger box, so the parts will be spread out.



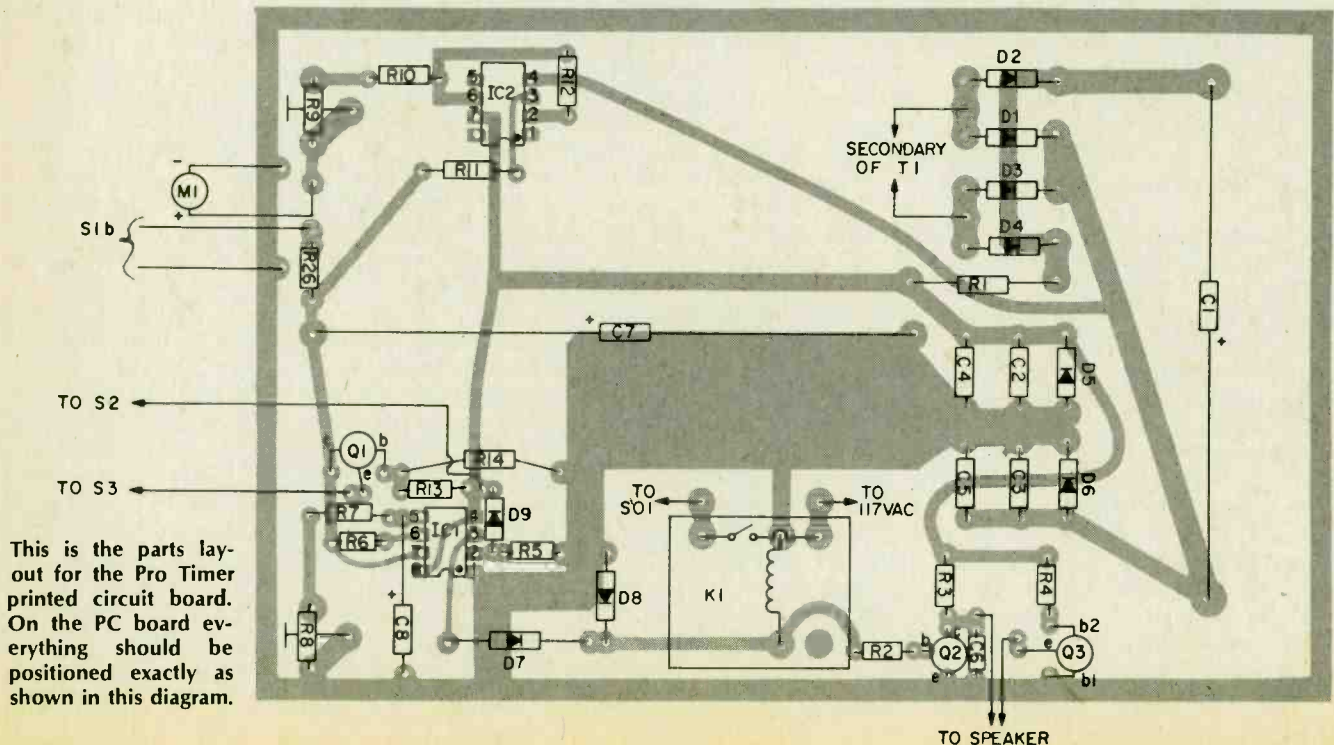
will draw initial current much higher than the normal operating current. If you were to use a heftier relay, then larger loads could be accommodated, and F1's rating could be increased accordingly. However, different relays will require different coil currents, which would require re-design of the power supply. So unless you know what you're doing, stick with the relay specified.

T1 supplies power to a conventional full-wave bridge rectifier system, whose output is regulated and split into two voltages, +15 volts and -6 volts, by zeners D5 and D6. Note that the negative supply connects to only one point in the circuit: pin 4 of IC2. Power for all the rest of the circuit comes from the positive supply.

Diodes D7 and D8 protect IC1 from

the inductive kickback generated by relay K1. Resistor R15 limits the maximum current through Q1 to a safe level in case both S2 and S3 should be turned to their "0" positions. Finally, note that power switch S1 is a double-pole affair. In the *Off* position, the AC power is disconnected, and C7 is discharged through R26. This provides a rapid discharge of the capacitor should the timer be turned off before completion of a timed interval.

Construction. Parts layout of Pro-timer is entirely uncritical, so you may use any method you like: a printed circuit, perfboard, or whatever else. The prototype shown here is housed, rather tightly, in a 3 x 6 x 4-inch aluminum mini-box. Use a larger case if you like lots of room in which to work. The



This is the parts layout for the Pro Timer printed circuit board. On the PC board everything should be positioned exactly as shown in this diagram.

meter and switches mount on the front panel of the cabinet, while J1 and the speaker go on the back. Don't worry that the alarm's volume will be reduced by a back-mounted speaker. Since the alarm signal operates at about 300 Hz, it gets reflected well enough to be audible in all directions. Switches S2 and

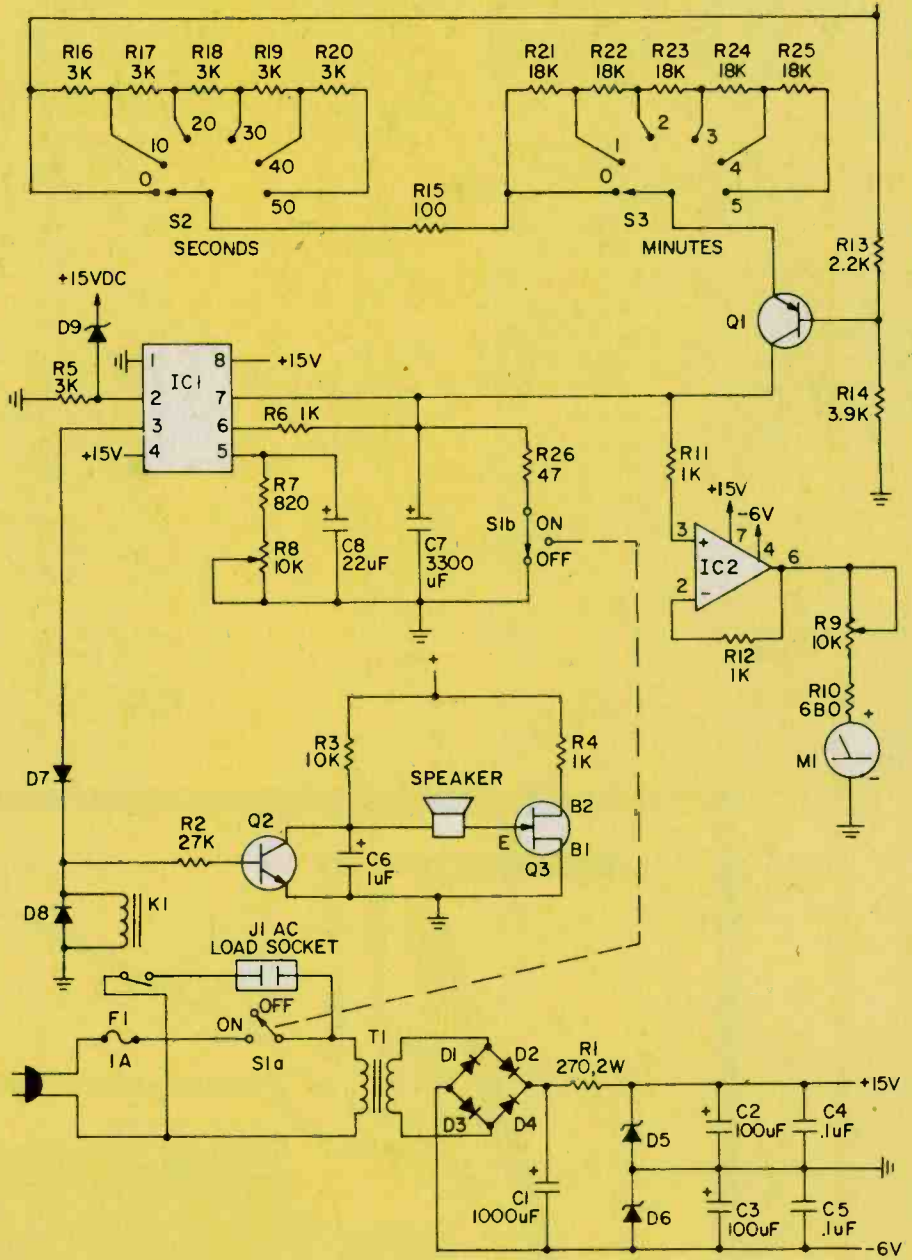
S3 are single-pole, six-position rotary devices, whereas the Radio Shack units specified are double-pole units. Just ignore one section on each switch.

Timing resistors R16 through R25 can be mounted point-to-point on the lugs of the two rotary switches. Be sure to use a good-quality, low-leakage ca-

pacitor for C7. The capacitor you see in the photographs has screw terminals, while the Radio Shack unit specified has wire leads. Electrically, the units are identical. Since C7 and C1 are physically rather large, strap them securely to the board with wire. Don't rely solely on the capacitor's leads to

PARTS LIST FOR PRO-TIMER

- C1—1000- μ F, 50-Volt electrolytic capacitor (Radio Shack 272-1047 or equiv.)
- C2, 3—100- μ F, 35-volt electrolytic capacitor (Radio Shack 272-1028 or equiv.)
- C4, 5—1- μ F capacitor (Radio Shack 272-135 or equiv.)
- C6—1- μ F tantalum capacitor (Radio Shack 272-1406 or equiv.)
- C7—3300- μ F, 35-volt electrolytic capacitor (Radio Shack 272-1021 or equiv.)
- C8—22- μ F tantalum capacitor (Radio Shack 272-1412 or equiv.)
- D1,2,3,4,7,8—1-ampere rectifier (Radio Shack 276-1102 or equiv.)
- D5—15-V, 1-watt zener diode (Radio Shack 276-564 or equiv.)
- D6—6.2-V, 1-watt zener diode (Radio Shack 276-561 or equiv.)
- D9—9.1-V, 1-watt zener diode (Radio Shack 276-562 or equiv.)
- IC1—555 integrated circuit timer module (Radio Shack 276-1723 or equiv.)
- IC2—741 integrated circuit operational amplifier (Radio Shack 276-010 or equiv.)
- K1—12-V, 1200-ohm single-pole, single-throw relay (Radio Shack 275-003 or equiv.)
- M1—0-1 mA, DC panel meter (Radio Shack 22-052 or equiv.)
- Q1—General-purpose PNP silicon transistor 2N3906 (Radio Shack 276-2023 or equiv.)
- Q2—General-purpose NPN silicon transistor 2N3904 (Radio Shack 276-2030 or equiv.)
- Q3—Unijunction transistor (Radio Shack 276-2029 or equiv.)
- R1—270 to 300-ohm, 2-watt (Allied Electronics 823-270 or equiv.)
- R2—27,000-ohm, 1/4-watt resistor (Radio Shack 271-1300 or equiv.)
- R3—10,000-ohm, 1/4-watt resistor (Radio Shack 271-1300 or equiv.)
- R4,6,11,12—1000-ohm, 1/4-watt resistor (Radio Shack 271-1300 or equiv.)
- R7—820-ohm, 1/4-watt resistor (Radio Shack 271-1300 or equiv.)
- R8,9—10,000-ohm potentiometer, circuit-board mounting (Radio Shack 271-218 or equiv.)
- R10—680-ohm, 1/4-watt resistor (Radio Shack 271-1300 or equiv.)
- R13—2200-ohm, 5%-tolerance, any wattage resistor (Allied Electronics 824-405 or equiv.)
- R14—3900-ohm, 5%-tolerance, any wattage resistor (Allied Electronics 824-202 or equiv.)
- R15—100-ohm, 1/4-watt resistor (Radio Shack 271-1300 or equiv.)
- R16,17,18,19,20—3000-ohm, 5%-tolerance, any wattage resistor (Allied Electronics 824-427 or equiv.)
- R21,22,23,24,25—18,000-ohm, 5%-tolerance, any wattage resistor (Allied Electronics 824-565 or equiv.)
- R26—47-ohm, 1/4-watt resistor (Radio Shack



271-1300 or equiv.)
 Note: Any of the 1/4-watt resistors above may be replaced with 1/2-watt resistors. And if 5% resistors are not available, 10% resistors (Radio Shack 271-000 or 1300 series) will do, but accuracy of the timer will be slightly lower.
 S1—DPDT toggle switch (Radio Shack 275-1546 or equiv.)
 S2,3—DP, six-position rotary switch (Radio

Shack 275-1386 or equiv.)
 T1—power transformer, 115-VAC primary, 24-V, 300 mA secondary (Radio Shack 273-1386 or equiv.)
 Misc.—1-ampere fuse (Radio Shack 270-1238); fuse holder; small loudspeaker—any 3.2, 4, or 8-ohm speaker which will fit in your cabinet is OK (Radio Shack 40-245 was used in prototype); IC sockets; solder, wire, etc.

e/e PRO TIMER

hold them in place.

Also make sure that C7 is formed before wiring it into the circuit. To do this, connect the capacitor, in series with a resistor of about a thousand ohms, across a 9-volt battery or power supply with capacitor (+) connected to positive. Leave it there for half an hour, then disconnect everything, and discharge the capacitor through the resistor.

For best accuracy, it is desirable to use 5-percent tolerance resistors for R13, R14, and R16 through R25. Alternatively, for R16 through R25, you might try hand-selecting and matching resistors, using an accurate ohmmeter or bridge, but this is a tedious process. The object is to get the closest possible match among the elements of either set of resistors (R16-R20, or R21-R25), and at the same time to have the mean resistance of the second set equal to six times the mean resistance of the first. Precision resistors could be used, but excellent results were obtained in the prototype using commonly-available 5% resistors.

Be certain to observe proper polarities with C1, C2, C3, C6, C7, C8, the meter, and all the semiconductors. Incidentally, leads for all the semiconductors are properly identified on the packages in which they are sold.

Q3 is a UJT, and its lead terminology may be unfamiliar; B2 connects to R4, while E goes to the speaker, and B1 goes to ground. As always, use rosin-core solder and a low-heat (25-watt or less) soldering iron when making the connections. Finally, you'll note that no connection is made to pins 1, 5, or 8 of IC2. These may be clipped off before mounting.

Operation and Calibration. Operation of the Pro-timer is literally a snap. Dial in the desired time via S2 and S3, and flip S1 to *On*. At the end of the timed interval, the speaker will alert you with a raucous tone. To re-initiate another timed interval, switch S1 to *Off*, and wait a few seconds. Then switch it back *On* again. Before you can use Pro-timer, it must be calibrated. Begin by adjusting R9 so that its resistance is at maximum. Set R8 to the midpoint of its range of rotation. Dial in a time of 1 minute on S2 and S3. Flip S1 to *On* and, using a clock with a sweep-second hand as a reference, time how long it takes for the tone to sound after turn-on. Adjust R8 in small steps until the timed interval is exactly one minute. When that is done, start up Pro-timer, again set at one minute, and adjust R9 so that M1 just reaches full-scale at the end of the timed interval. You should use your clock as a reference here, too. As one minute approaches, adjust R9 so that full-scale deflection occurs at the one-minute mark. Your Pro-timer is now cali-

brated. Now you should check its accuracy at other time settings. When I checked my prototype, the following results were obtained:

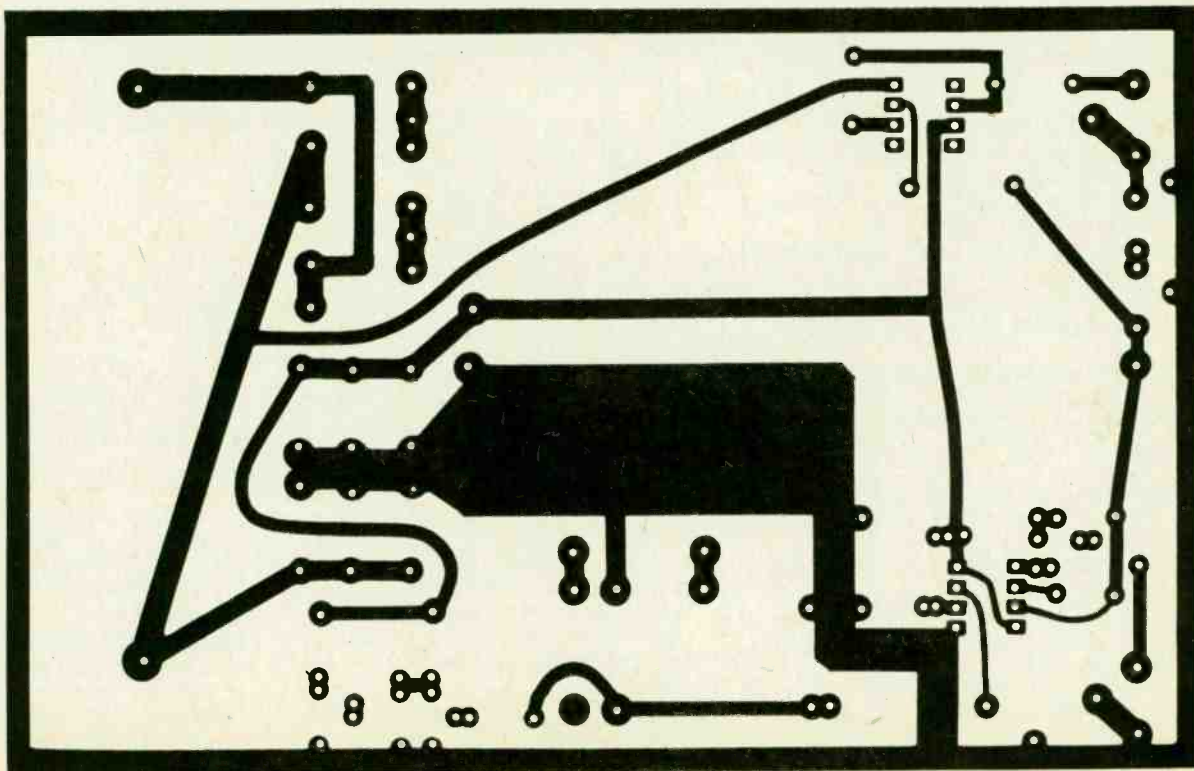
SWITCH SETTING	ACTUAL TIME
10 sec.	11 sec.
20 sec.	21 sec.
30 sec.	32 sec.
40 sec.	42 sec.
50 sec.	52 sec.
1 min.	1:00
2 min.	2:00
3 min.	3:01
4 min.	4:03
5 min.	5:03

Note that percentage-wise the accuracy is excellent on times over one minute, and only fair at times less than a minute. Since accuracy is a chance affair, your results will be different. Should you desire better accuracy, hand-select the timing resistors as described earlier. For most readers, however, results similar to those of the prototype will be more than adequate.

The Components Board. In this project the parts layout is entirely un-critical so the parts may be mounted on a printed circuit board, using the board pattern shown, or a similarly-sized piece of perf board, with flea clips inserted into holes at roughly the same locations as are indicated in the components location diagram. If you're

(Continued on page 93)

This is the printed circuit board layout for Pro Timer. It is shown in the exact size corresponding to the actual PC board you will need for the unit. If this is your first time making a PC board, be sure to exercise great care so that no hair-thin bridges short between conductive paths.

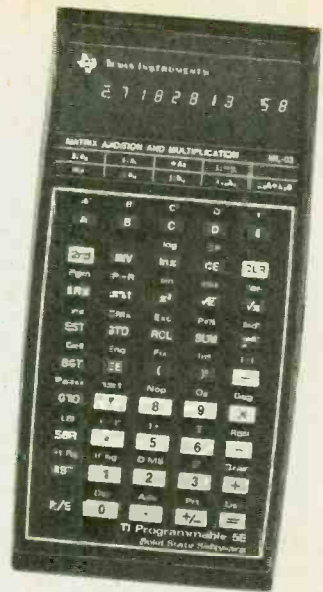


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IMAGINE A COMPUTER SO SMALL it can fit the back pocket of your jeans, or the inside pocket of a jacket. Not possible? Wrong! Though Texas Instruments, Inc.—or TI as they are more commonly known—has decided to call their model TI-58 a *programmable calculator* it is in fact a *computer*, with a lot more capability than some of the devices presently sold as “full scale computers.”

The TI-58 resembles many other scientific type calculators such as TI's own models 50, 51, 56, etc. It has a twelve character LED display that shows 10-digits with sign in standard format, or 8-digit mantissa with 2-digit exponentiation and 2-signs in scientific notation. The keyboard has the usual

work mathematical relationships.

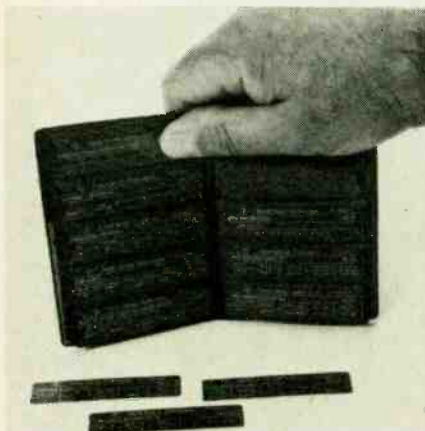
In addition to common scientific features the TI-58 can be programmed just like a computer for up to 480 steps. Actually, the number of steps is determined by the amount of memories needed as the overall capacity is shared between program steps and memories. If you need complete memory, and no steps, up to 60 memories are available. User partitioning allows the memory and program steps to be split as needed. You can partition the TI-58 for 320 steps and 20 memories, or 480 steps and no memory, and every choice in between.

It's true there are other programmable

calculators that approach the TI-58's steps and features, so you're entitled to ask “Why call it a *pocket computer*?”

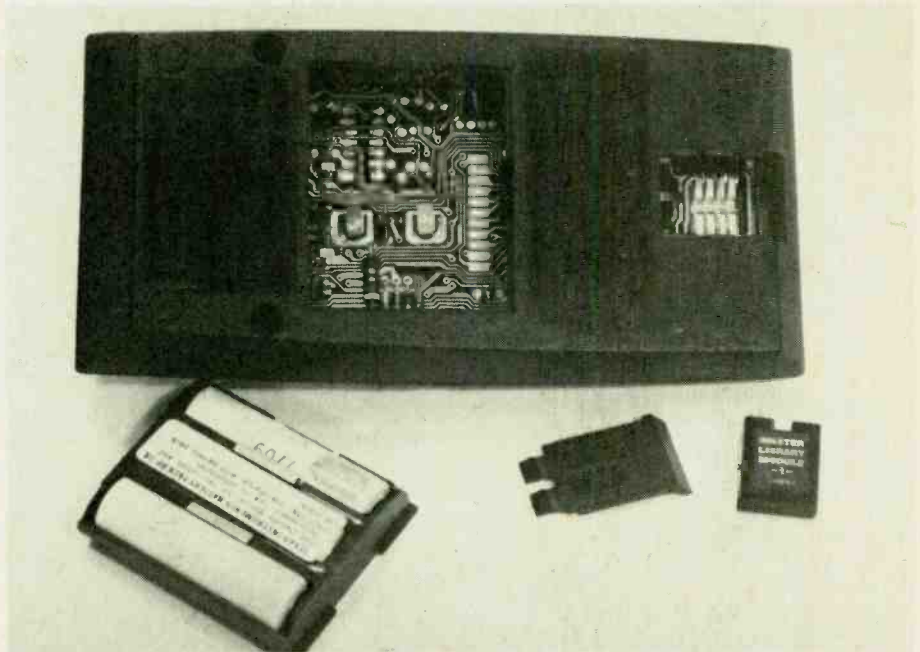
The Big Plus. Well, it's the extra features in the TI-58 that make it a pocket computer. Among these extras are: full editing capability; data memories; test registers available for looping, increment and decrement; and most important, solid state software (programs) available on thumbnail size ROMs (read only memories) that plug directly into the TI-58, and which can be utilized as independent programs or as part of a larger user-written program.

Using these extra features is ably taught in the instruction manual, *Per-*



A complete set of label cards for each module fits into a compartmented wallet (supplied) which, in turn, fits inside a compartment in the calculator's soft-case.

assortment of transcendental functions, storage (memory), parenthesis, etc., etc. The calculator uses an Algebraic Operating System (termed *AOS*) which means you enter the problem just as its written—usually from left to right—as you did (or do) in school. You don't have to learn a new way to express or



The module, which is no larger than the tip of your thumb simply drops into a polarized opening in the rear and is secured by the sliding door. To change modules you lift out the one that's installed and drop in the desired one. You cannot install a module incorrectly. When the battery pack is removed, internal contacts connect the TI-58 to the matching printer/plotter by simply securing the calculator to the printer. Because there are no connecting wires the calculator is restored to non-printer use by simply removing it from the printer and snapping the battery pack into place.

e/e TI-58 CALCULATOR

sonal Programming, which is packaged with each calculator. Much more than just an instructive pamphlet, the book runs to more than two hundred over-size pages and is—in itself—a fine entry into the world of programming. With this manual, coupled with the features of the calculator, the user will find himself able to program for sophisticated, complex problems within a very short time.

PROGRAM STEPS		480
	400	10
	320	20
	240*	30*
160	40	
80	50	
60	MEMORIES	

*Calculator in this configuration when turned on. May be changed from the keyboard or in a program.

With the TI-58, program steps and memory registers can be varied by the user. The 58 has a 240-program step and 30-memory configuration when turned on. This can be varied at the keyboard or in a program.

Firstly, *full editing*. Assume you have written a program and then discover that in entering the program you have left out a step, or you want to change one or more steps. With the TI-58 you

don't have to re-enter the program. Using the editing feature you can make changes, insertions, and even move the program forward, just as you might do with a computer.

The whole business of editing has been reduced to a series of easy, keyboarded steps. Four keys control the entire process. The calculator is first placed in the Learn mode; at this point, the LED display gives a numerical indication of the program step along with a label as to what that step is about.

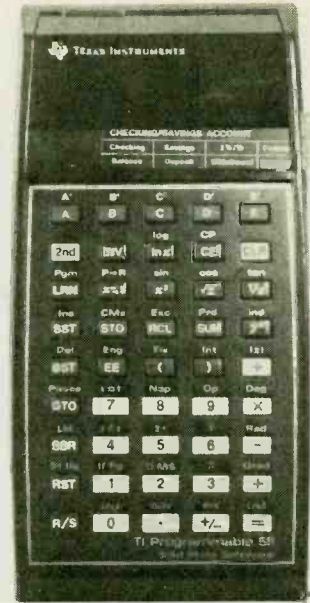
For instance: 000 76 on the LED display reveals that at the beginning of your program (000) you hit the Label (LBL) key. (76 is the position of the LBL key on the keyboard.) Likewise, 017 01 means that as the seventeenth step of your program you have entered the number 1.

You can single-step right through the program, and you can backstep and return to any point. Once you have found where you want to make the change you have only to key it in.

The *test register* actually permits you to test for *less than*, *greater than*, *equal to*, and *not equal to*, and then loop or shift to a function or subroutine depending on the test. Again, this is a computer-type function.

One of the most useful keys in making your program is the DSZ key, which stands for 'Decrement and Skip On Zero.' This is the key which allows you full control as to how many circuits of a 'loop' a program should make.

Instead of having to run the same



The Texas Instruments Programmable 58 calculator with an instruction card being inserted. Every subroutine contained in the calculator's Library Module has a separate card. The cards tell the user how to call up and use each individual program, so that there is no need to refer to a book.

program a few times over by manually pressing the Run/Stop key and keeping track how often its pressed, you just have to sit back and allow the DSZ to do it all for you. The convenience and sheer powerfulness of it all is bound to lead you deeper—and more rewardingly—into programming than you had ever thought you might go.

An Elephant's Memory. Every TI 58 has the capability of over 5,000 extra steps stored on a ROM (Read Only Memory) chip which plugs into the back of the calculator. TI calls this ROM a module, and they have an entire library of such modules.

The master module, which is supplied with the calculator, consists of twenty-five preprogrammed functions. The listing of programs (or subroutines) is truly astonishing; Matrix Inversion, Zeros of Functions, Polynomial Functions, Simpson's Approximation Continuous or Discrete, Compound Interest, Annuities and Moving Averages to name but a random sampling.

The great thing about this, is that each of the on-ROM subroutines is just that—a *subroutine*. You can call them up as part of your own program, use them in a loop, have them operate within whatever parameters you choose.

If you need even more versatility, TI has five other ROM modules programmed for specialized areas. These optional modules contain subroutines

(Continued on page 94)



The PC-100A printer adds alphanumeric printout to either the TI-58 or the 59. With this capability the distinction between calculator and computer becomes a very fine line. Installing one of TI's calculators on the printer is quite simple. The battery compartment is removed and the calculator then fits right onto the PC-100A.

Hearing Again Through Microprocessors

Electronics converts sound into feeling for the totally deaf.

□ The Teletactor is a new device which promises a limited sort of "hearing" to the deaf. A deaf patient wears a belt around his waist, a special belt which causes a tickling sensation on the skin when sounds are produced.

"Patients really can't converse with our belt," said Dr. Frank Saunders, one of the belt's developers, "but they are able to recognize a number of situations." The totally deaf, according to Saunders and others at the San Franciscan Smith-Kettlewell Institute of Vis-

ual Sciences, can be taught a new, limited kind of "language."

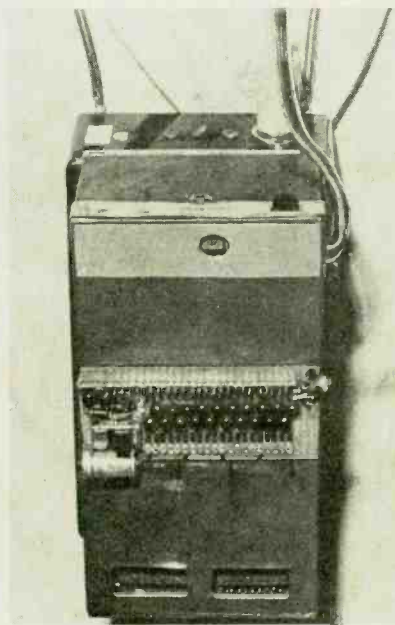
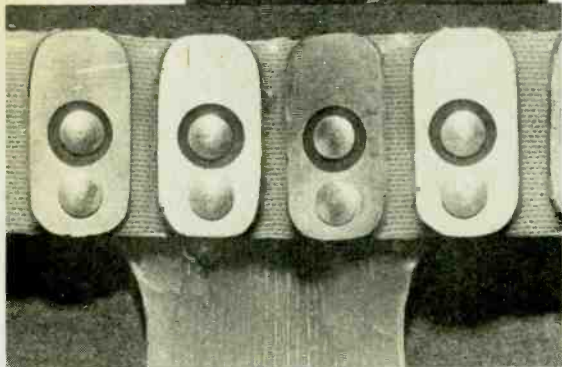
A deaf patient would be able to "hear" (actually, to feel) the tea kettle boiling or the doorbell chiming, or even the ringing of a telephone. Saunders maintains such informational input would be of great use to the deaf, though at first glance it might seem that it is of little use to a deaf individual to know the phone is ringing as they cannot hear the caller.

"This is so only up to a point," Saunders said. "If the caller wants to know how the patient is and is informed about the belt, he can use a word like 'allright' the sound of which will be instantly translated to a tickle and the patient will get the message. The patient could also inform emergency services in case of fire and say, 'There's a fire here. If you are getting my message, say yes. If he hears a response, the patient could then leave his address.'"

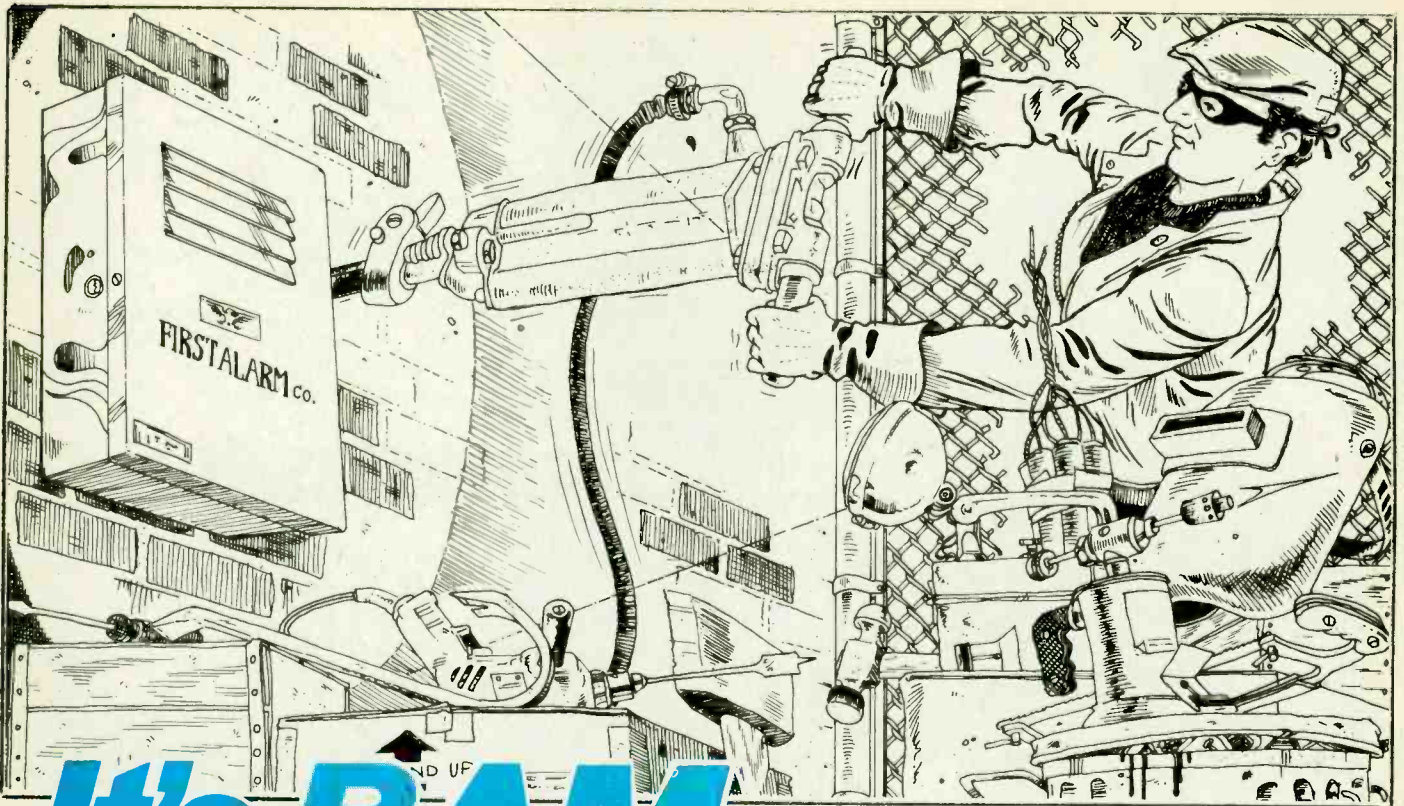
Actually, with the newest model of the Teletactor, patients have learned to distinguish many different words such as: I, you, we, he, want, like, see, and other simple one-syllable or evenly accented words. Once the deaf person becomes used to the device, his "vocabulary" will increase proportionally.

The device is lightweight, and simple to operate. The belt about the waist is connected to a battery-powered microphone worn outside the clothing. All manner of sounds, from speech to loud noises are converted into electrical impulses of varying strengths. The inner side of the belt is dotted with twenty 'stimulators.' These vibrate against the patient's skin.

Right now, the Teletactor is an expensive aid, priced at approximately \$400. It is expected, however, that the price will drop significantly in the near future. More information on the tickling belt can be had by writing to Dr. Frank Saunders, c/o the Smith-Kettlewell Institute of Visual Sciences, San Francisco, Calif. 94115. ■



The closeup on the upper left shows the reverse side of the Teletactor's belt, with its tiny stimulators that vibrate against the wearer's skin. As they vibrate in different patterns corresponding to varying sounds, even separate words can be distinguished with some practice. On the lower left, a deaf person models the "tickle belt" while holding the microphone in his hands. Under normal use the belt would be hidden by the individual's clothes. The battery-powered microphone and electronic processor is shown above. This unit receives sound impulses, converts them to electrical pulses, and passes them to the belt, which separates them into individual vibrations. The Teletactor allows its users much greater daily freedom.



It's BAM... Burglar Alarm Modification

Simple changes to make your alarm burglar-proof.

by Jorma Hyppia

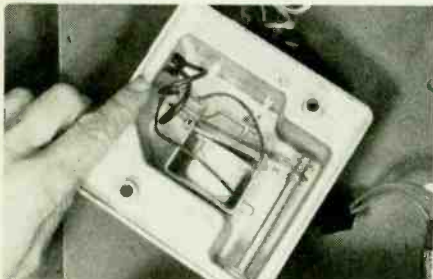
□ One of the slickest ways to fool a burglar, even a professional who thinks he knows all about alarm systems and how to silence them is to alter a seemingly-standard system into something quite different. An economy-minded homeowner can start with a basic system such as the Radio Shack alarm shown here and upgrade it at a cost of less than five dollars into an even more convenient and effective system

that will provide as much security as custom installations costing hundreds of dollars.

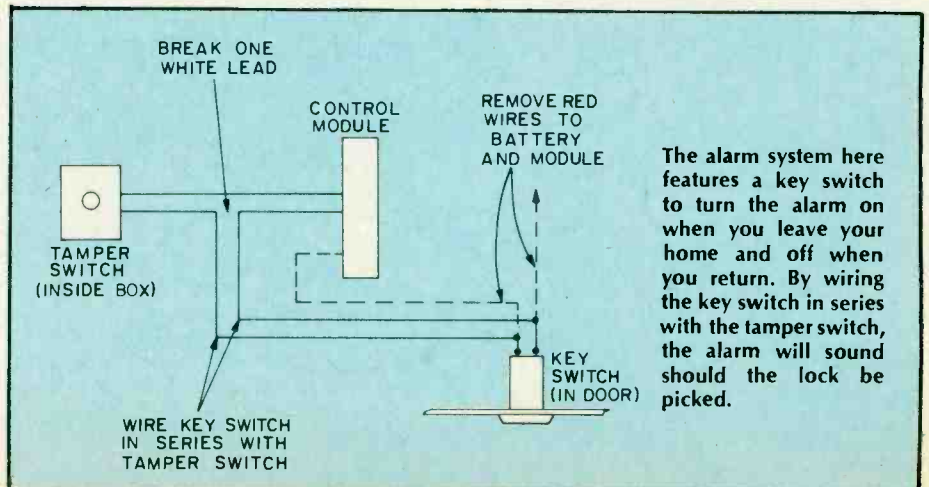
This intruder alarm system is popular with do-it-yourself home owners for several reasons. It is easy to install; it provides complete perimeter protection for all doors and windows; the conspicuous heavy-gauge steel box mounted outside the house or garage door serves clear notice that the prem-

ises are protected. In addition, there's no need for you to race against a built-in time delay when going in or out of the house because this system is activated and de-activated with an outside key switch. Finally, the loud eight-inch gong will alert the entire neighborhood if it is triggered by an intruder.

You Can Make It Better. Installed in the normal way, this system will provide good protection against most



The two black wires under the bell mount, which lead to the clapper mechanism, may be cut to permit wiring-in the circuit test box. Even more professionally, the leads may be unsoldered from where they connect with the vibrator terminals and a new two-conductor wire may be run from the terminals to the test box



The alarm system here features a key switch to turn the alarm on when you leave your home and off when you return. By wiring the key switch in series with the tamper switch, the alarm will sound should the lock be picked.



This low-cost perimeter alarm system includes a heavy gauge steel box, a loud 8-inch gong, more than 100 feet of wire, key lock switch, a separate indoor switch and a panic button. Enough magnetic switches are provided to protect six doors and/or windows. You can add more switches, window foil or other sensors.

would-be burglars. However, it can be defeated by a truly determined, knowledgeable burglar who knows how it is constructed. You can frustrate even such experienced crooks with easy-to-make alterations that require no extra parts. And for less than five dollars you can add a silent testing device so you can check the readiness of your system as often as you like without annoying your neighbors with the loud noise made by the eight inch gong. Silent testing provides another important ad-



This simple and effective test unit consists of a small box containing a DPDT toggle switch, part of the original equipment, is for the alarm bell. The white switch part of the original equipment, is used to arm and disarm the detection system from inside the house. Use lamp cord or 12-volt bell wire to connect these units.

vantage; if the gong should be triggered by an intruder, your neighbors will not mistakenly think that you are just testing your system, for the hundredth time!

The Testing System. You'll need three readily-available parts that cost a total of under five dollars. You'll need a small box to house the double-pole, double-throw (DPDT) toggle switch, and a 12-volt panel lamp. If your alarm system works on some voltage other than 12, substitute a pilot lamp with the proper voltage rating.

Drill a couple of holes in the box lid and mount the switch and lamp, then solder the two lamp wires to either pair of *end* terminals on the switch. Locate the box in a convenient place inside the house, as close to the outside alarm box as is possible (try to keep the connecting wires less than six feet long).

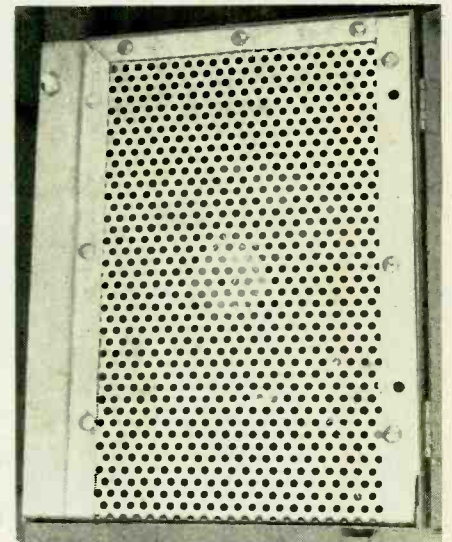
How To Rewire System. Remove the gong from the outside alarm box to reveal the metal mounting block that houses the activating mechanism for the bell clapper. Cut the two black wires that go from this housing to the plastic electronics module that is also hidden under the gong. Extend both cut pairs of wires so that they reach to the switch box inside the house (mark the wires for identification) and solder the pair connecting with the module to the *center* terminals of the switch, and the pair going to the gong mechanism to the remaining pair of end terminals on the switch. By flicking the toggle switch you can now cut off the gong and substitute the panel lamp; when-

ever the lamp lights during routine testing you know that the bell would have sounded had it been switched into the circuit.

To use the test circuit, close all doors and windows that are fitted with sensor switches. Turn off the main switch which should be located next to the test unit. Put the toggle switch into the *Test* position (the lamp position), then turn on the main power switch. The lamp should *not* light. If it does, you know that there is a break in the perimeter circuit or you have forgotten to close a door or window. If the lamp does not light, open any nearby window or door that is fitted with a sensor. The lamp should now go *On* to indicate that the bell would have sounded had it been in the circuit. When all units test properly, turn off the power switch, put the test switch back into the *Bell* position, and switch *On* the main power, when you want to arm the perimeter sensors.

Outwitting a Smart Burglar. This begins by moving the 12-volt lantern battery from its normal location inside the alarm box to a new place inside the house, again keeping the connecting wires as short as possible. If you keep the wires inside the box under the gong, a burglar can no longer deactivate the system by ripping the battery wires loose with a wire poked into the box through the cover vent holes.

There are several other advantages to moving the battery indoors; it's easier to check periodically and replace when necessary; it is subjected to less deterioration because of weathering; it will provide power much more reliably during winter months if it is inside a warm house. *(Please turn page)*

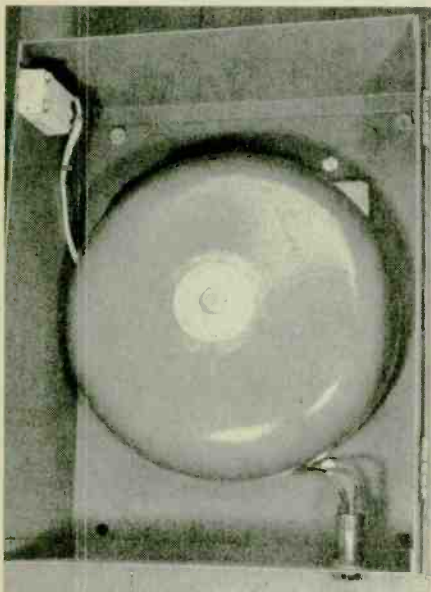


Mount some scrapped metal grill underneath the regular cover to serve as an additional foil to any burglar who attempts to defeat the alarm system by either opening the cover or working a wire through the cover vents.

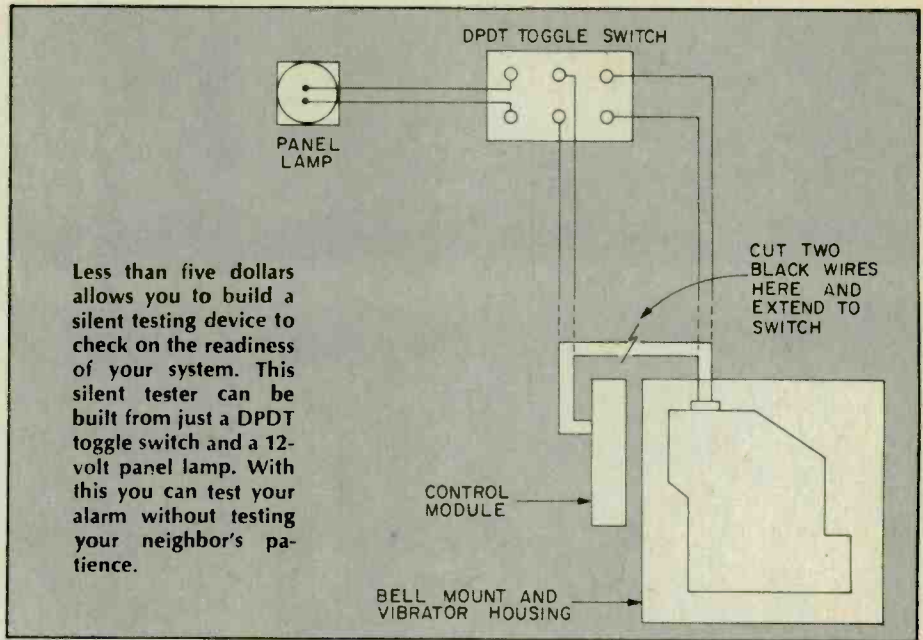
A really knowledgeable burglar knows where the gong clapper is located and could possibly jam it to silence the gong. But not if you drill a couple of new mounting holes in the rear of the box and turn the entire gong assembly so that the clapper is no longer where the burglar thinks it should be.

Some More Tricks. The alarm box has a tamper switch which turns the alarm *On* if any attempt is made to open the cover. Although difficult to do, it is possible to defeat this tamper switch. You can frustrate a determined burglar just by moving the switch to a different location along the same side of the box. Better yet, add another tamper switch and wire it in parallel with the first. Thus if the burglar defeats the first switch, he will be caught by the second switch which he doesn't know is there.

The alarm system shown here, and many others like it, features a key switch that is used to turn the alarm on when you leave your home and to turn the system off when you wish to re-enter. This lock, like most door locks, is vulnerable to an experienced lock-picker. The easiest way to overcome this weakness is to cut the wires leading to the key switch and lead them to another hidden switch that only you know about. Even if a lockpicker manages to turn the box switch, he does not succeed in disarming the alarm system, as he will discover when he at-



Interior of the box with the battery and the most vulnerable wiring removed. Read the text to learn how to improve the tamper switch and alter the key lock.



tempts to break through a window or door. But there's an even better way to outwit the crook. Wire the box key switch *in series* with the regular tamper switch and turn the lock into the *On* position. If a burglar picks the lock, the alarm will sound immediately, just as if a door or window had been opened.

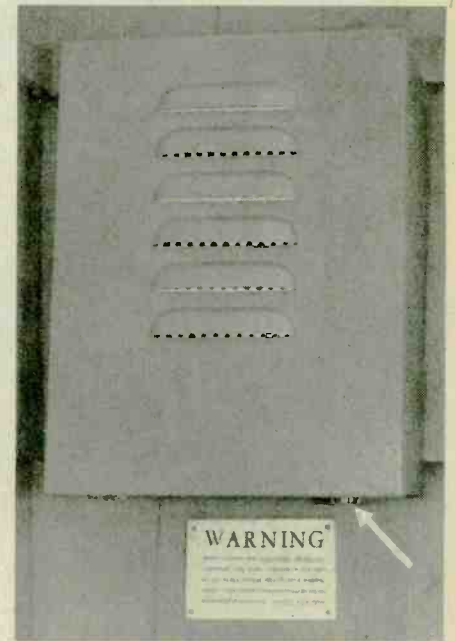
There's one more thing you can do whether or not you elect to follow the suggestions made so far. Add a perforated mesh or screen, of rugged steel (rather than soft aluminum), inside the box just behind the door. Bolt it in place using angle irons to hold it in

tempt to defeat it if you were a knowledgeable burglar. Then figure out ways to mislead the burglar by making the system different from what he thinks it is. If you are really clever about it, you can make the burglar turn the alarm *On*, when he confidently thinks he is deactivating it. These design modifications provide you with a basis for

- PARTS LIST FOR IMPROVED BURGLAR ALARM**
- Basic burglar alarm (Radio Shack 275-484 or equiv.)
 - DPDT switch, toggle (Radio Shack 275-666 or equiv.)
 - 12-volt indicator lamp (Radio Shack 372-322 or equiv.)
 - Case for above (Radio Shack 270-230 or equiv.)

position. Even if you leave the battery inside the box, a burglar will not be able to get at the wires. And if the intruder manages to get the lid open, figuring that he can silence the alarm before it attracts much attention, he will be frustrated by the *second* barrier that he unexpectedly finds inside the box. He isn't likely to stick around to figure out how to get past it. You can probably find a suitable screen or grill in a local junk yard. Don't worry about how it looks, so long as it is of tough metal and difficult to break through.

If you already have an alarm system that is different from the one discussed here, think about how you might at-



A warning label advertises the fact that BAM is ready to help foil any burglary. The arrow indicates the key lock which can now be used normally to turn the system on or off, or that can trick a burglar into setting off the alarm himself.

understanding both the workings of a standard burglar alarm system, and the workings of a burglar's mind. When you put the two together you can easily outwit intruders. ■

Ham Radio is Easier Than Ever

You can have kilowatts, and 5000 mile contacts. e/e tells you how.

by Charles J. Harris WB2CH0



The well-equipped amateur station of William C. Edler, WN6DLI. His transceiver is a Yaesu FT-101, with a matching VFO. A standing Wave Ratio Meter, a frequency counter, and an electronic key complete Bill's setup.

□ Working skip, legally! Interference-free mobile communications! 1000 watts of power! Unlimited numbers of channels! Do-it-yourself transmitters! Talking to hundreds of foreign countries! All these and more are yours with an amateur radio license. And recent rules changes from the FCC make the ham license more valuable and simpler to get than at any time in the history of ham radio.

A reduced code requirement and modern educational methods have opened the door of amateur radio for thousands of new hams this year. Every day hundreds of newly-licensed amateurs join the one million hams worldwide: talking through amateur satellites, relaying emergency messages from earthquake-struck disaster areas, building and experimenting with homebrew transmitters and receivers and communicating with their fellow amateurs throughout the world.

These new hams come from every age bracket and occupation, from grandmothers to grade school students, housewives to hardhats. Most have little or no knowledge of electronics; few have formal training in radio. But the hundreds of amateur radio classes in every city and new study guides written for the non-engineer have put the amateur radio license within the reach of anyone with the desire to get one and a few hours of study time each week.

First, the Novice. Almost every amateur today starts his ham career with

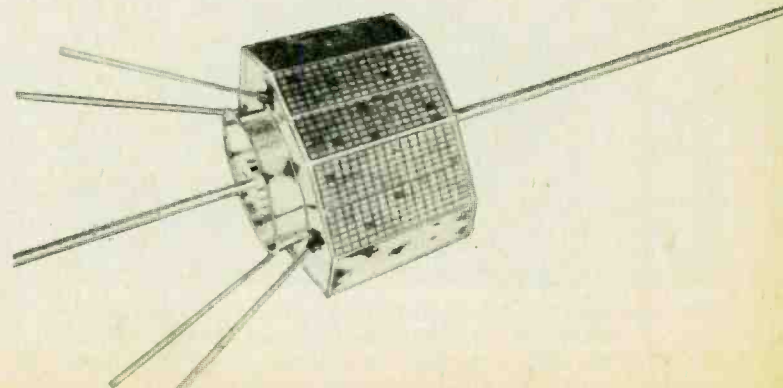
the simplest of all ham licenses: the Novice. Designed to help you get your feet wet in ham radio while you master the more complex theory and regulations for the higher licenses, the Novice is the student permit of amateur radio. It carries a license term of two years, more than enough time to move up to a permanent license. And if you need more time, you can apply for another two year term immediately. This recent change in the FCC amateur rules means you can hold a Novice license as long as you want, simply by taking the test every two years.

The Novice license is designed to be easy to obtain. As a Novice you are introduced to the many facets of this space-age activity as you continue your studies for the Technician or General class license. Neil Rapp, WB9VPG, of Vincennes, IN can attest that the Nov-

ice is the way to get started in ham radio. Neil got his first ham ticket last year, and is now making contacts with fellow amateurs throughout the US and other countries while he bones up for the next test. He hopes to have that next license before his Novice expires, a few months before his eighth birthday! Not everyone can get a ham license at the age of five, but Neil is a good example that the new study techniques really work.

One of the satellites that can be used for amateur radio communications. It works as a relay station in space, allowing hams to span the globe without having to rely on ionospheric reflection, which sometimes can be noisy.

The Novice offers you a taste of ham radio, but not the whole cake. Novices may only operate in certain restricted frequency bands, but these include most of the popular ham frequencies, and offer everything from local contacts to worldwide communication. Most important, the Novice is limited to code only. The Morse code remains a requirement of every amateur license in the US,



and is not likely to be eliminated as a requirement for several more years. Meanwhile, the FCC has lowered the code requirement.

The Comprehension Code Test. For years the FCC has required perfect copy on its amateur and commercial code examinations. The examiner sent about five minutes of code at the required speed and the applicant had to get at least one minute solid down on paper: no mistakes. The butterflies or even a moment's loss of concentration and you failed the test. But early in 1976 the FCC quietly changed the amateur rules to permit the use of a comprehension style code test, where you are asked questions about the message sent. No longer do you have to get every single letter. You can pass the new code test with only half the message down on paper. At the higher speeds, the failure rate of the code test dropped from 50% to less than 20%! Or to look at it another way, you need to copy only about 2 or 3 words per minute of Morse code perfectly, (about one letter sent every 5 seconds) to pass the 5 words per minute test for the Novice license.

The most commonly used comprehensive code test has been designed by the Club and Training Department of the American Radio Relay League, Newington, CT. This test is an ordinary amateur contact, with signal report, location, name, equipment used, weather and other information. At the end of the message, the examiner gives you ten multiple choice questions. Get eight or

CONDITIONS AND QUALIFICATIONS FOR AMATEUR LICENSES					
Type	Required Experience	Code Speed	Written Examination	Operating Privileges	Period
Novice	None	5 wpm	Elementary theory and regulations	Code in 3700-3750, 7100-7150, 21,100-21,200, and 28,100-28,200 kHz.	Two years, not renewable.
Technician	None	5 wpm	General theory and regulations.	All amateur privileges in 50.1-54.0 MHz, 145-148 MHz, above 220 MHz and Novice privileges.	Five years, renewable.
General	None	13 wpm	General theory and regulations.	All amateur privileges except those reserved for Advanced and Extra Class.	Five years, renewable.
Advanced	None	13 wpm	General theory and regulations, plus intermediate theory.	All amateur privileges except those reserved to Extra Class.	Five years, renewable.
Amateur Extra	None	20 wpm	General theory and regulations, intermediate theory, advanced techniques.	All amateur privileges.	Five years, renewable.

more right and you're most of the way toward your Novice license. Students are unanimous in their praise for this new testing procedure, and the increased passing rate shows that the test is indeed much simpler to pass than the now-outdated perfect copy method.

And That's Not All. In recent months the FCC has made many other changes to the amateur rules which make the Novice license more attractive than ever before. For example, the maximum input power limit has been raised from the former 75 watts to 250 watts. The difference in increased signal strength is not great, but this change does mean

that modern transceivers can be used without modification in the Novice bands. The Yaesu, Swans, Kenwoods and other commercially available transceivers operate at top efficiency around this power level. At the same time, the FCC limited the input power of other stations operating in the Novice frequencies. The Novice no longer must compete with kilowatt stations from higher class operators; everyone is running about the same power level.

Some other changes of interest to the beginner are the end of special call-signs for Novices, the deletion of the portable identification rule, and Novice CW privileges for Technicians. The first change means you keep your call-sign through every license class; you don't have to get new QSL cards when you upgrade. And you are no longer in-



The black object at the right which looks like a can of paint, is really a dummy load. It is filled with oil, and during testing it dissipates the radio frequency output of the transmitter instead of allowing it to clutter the bands unnecessarily.



This high-quality station uses separate transmitter and receiver. The key used for code transmission in this setup is automatic, but works on a mechanical principle instead of an electronic one.

stantly identified as a beginner. If you can operate well enough to convince an old timer, no one will look down at your Novice status.

The removal of the portable identification rule makes operation away from your licensed station simpler. You are no longer required to sign "portable 1" or "mobile 6" as you operate from other than your home, nor do you have to keep the FCC informed of your every move. As long as the FCC can send you mail through your station address, you can move around the country using your same callsign.

Finally, the Novice CW privileges for Technician class licenses allows you to upgrade to phone operations without losing your CW frequencies for code practice. It also means that there are more stations than ever to work in the Novice bands, as many Technicians are working on their code to upgrade their licenses.

Study Guides. The FCC is not the only organization working to make ham radio easier and more interesting. Amateur radio clubs, organizations and publishers are making a concerned effort to attract and assist thousands of new amateurs every month. New amateur radio courses, training aids and study guides aimed at the non-engineer help to explain the theory of radio in simple, everyday terms.

Gone are the out-dated Question-and-Answer format amateur radio texts, which required a firm understanding of the basic principles of electronics before you started your studies. Many applicants for the ham licenses tried to memorize the answers to the questions to pass the FCC exams. When they saw a new question, or one phrased in a different way, on the test, they were stumped. No wonder the failure rate on FCC exams was more than 50%.

The new training materials do not assume a technical background. In fact,

most of the recent texts and guides assume a lack of previous knowledge of radio communications. These books and courses use common examples and analogies to explain the basics of radio and electronics, and stress understanding of the simple concepts rather than memorizations. With this approach, the passing rate for the Novice written exam soared to 98%!

Tune in the World with Ham Radio, from the ARRL, is the first, and still most popular, of these new amateur radio texts. Written by professional educators for the non-technical beginner, *Tune in the World* compares the flow of electricity to the flow of water in a pipe, and demonstrates how Ohm's Law works. The radiation of electromagnetic waves is compared to the spreading ripples across a pond. Only after the student grasps the fundamentals of the topic is the mathematics and electronics introduced.

Tune in the World also initiated a new method of learning the Morse code, which has revolutionized this aspect of amateur radio study. Using a cassette tape with two instructors, the student is introduced to a couple of letters at a time, with frequent reviews and self-checks. It's just like having a personal teacher right in the room with you! And thousands of new hams can attest to the

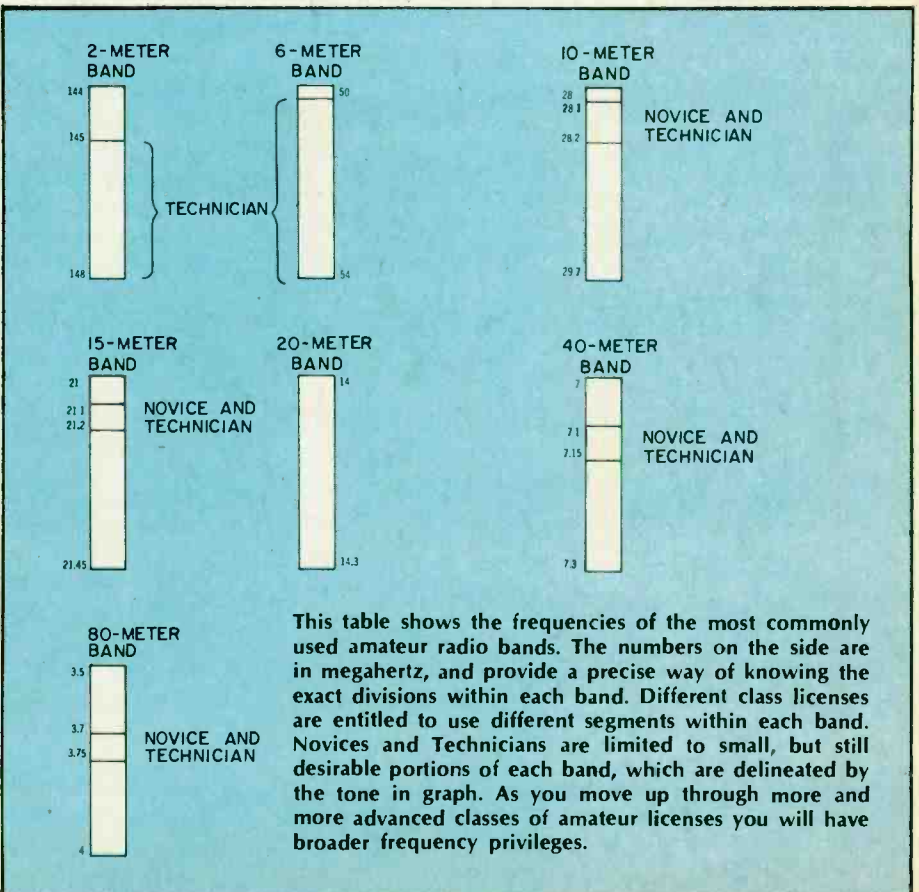
value of the system. Many would-be amateurs had tried other code learning systems without success, but they were all copying code within minutes of listening to the *Tune in the World* tape cassette. More about this in the future.

There's Plenty of Help Available. Learning amateur radio on your own can be a frustrating experience, and many potential amateurs have shied away from the Amateur Service for this reason. Thanks mostly to the demands of CBers looking to move up to ham radio, and the leadership of the training experts at the ARRL, thousands of present amateurs are running courses and providing personal assistance for new hams. There are more than 2000 amateur radio courses in every state in the Union, with more starting every day. If you can't find one in your area, drop a note to the ARRL, 225 Main St., Newington, CT 06111 and they'll tell you of one in your backyard.

Lower code requirements, increased privileges, easy-to-understand study guides, improved code learning techniques, and an amateur radio class in every city have put the world of amateur radio within your reach. Why not join the thousands of new hams getting their Novice tickets and getting on the air every month? It's easier than ever before. ■



This happy YL (young lady) is operating a neatly set up temporary station, which uses a simple key for code transmission.



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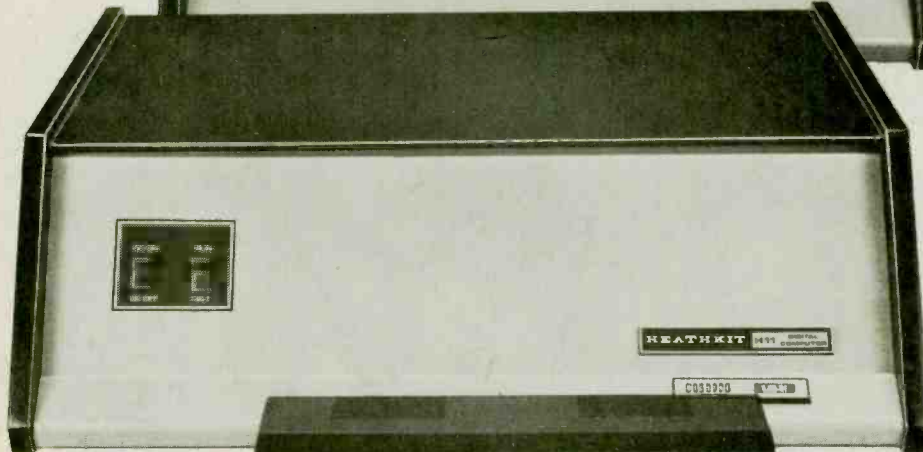
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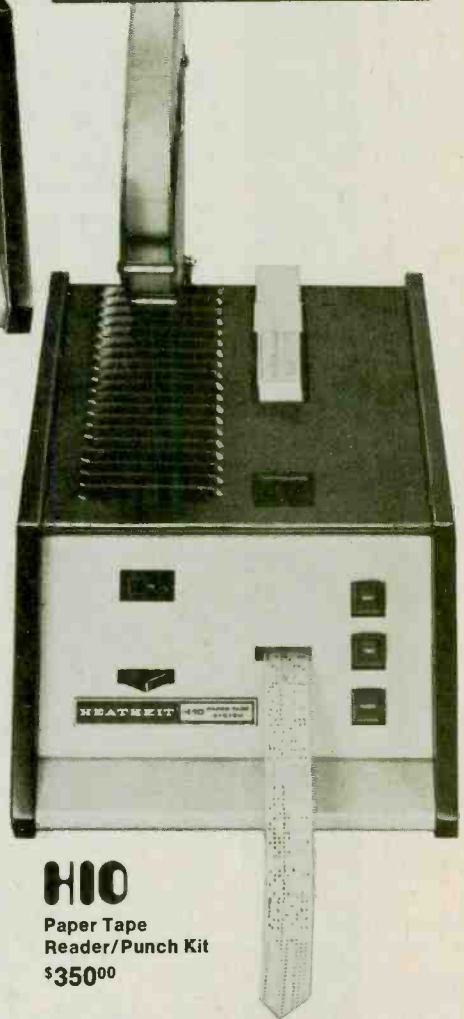
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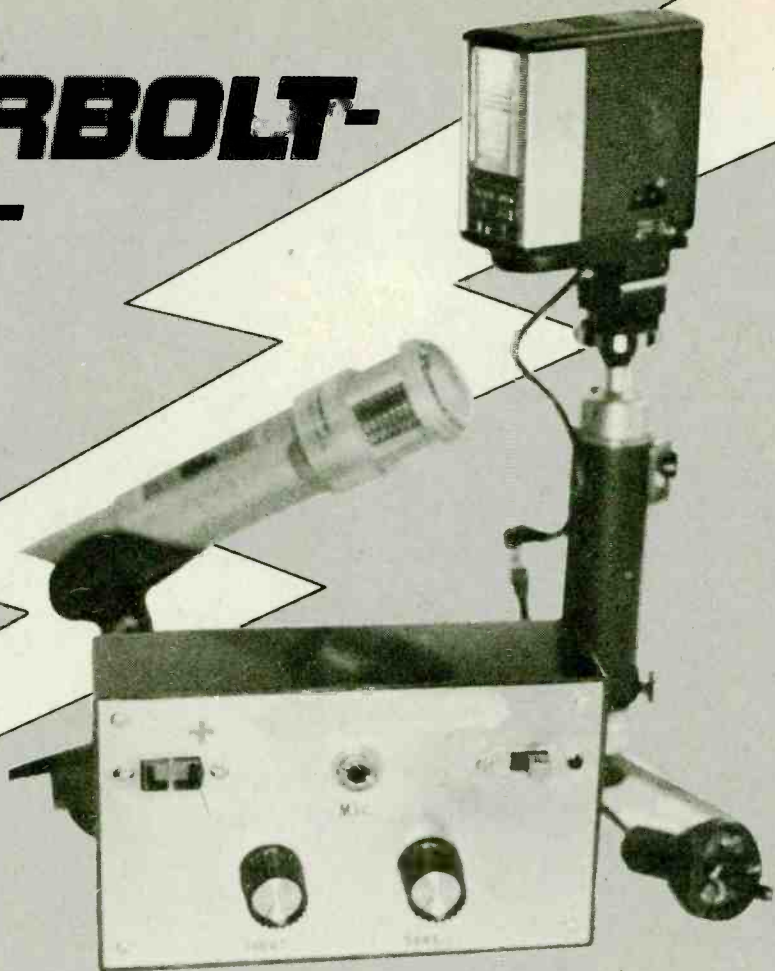
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CIRCLE 1 ON READER SERVICE COUPON

THUNDERBOLT- For Stop- Action Photos

Quick as lightning, this sound-activated flash switch responds to get your picture.

by Frank I. Gilpin



HOW WOULD YOU LIKE TO CAPTURE the sphere-capped minaret of a drop of water at the precise moment it strikes the surface of a pool, or a bursting balloon with the piercing dart still in mid-air? All you need is this easily-constructed, sound-activated, electronic flash—Thunderbolt.

Sound-activated switches have been around a long time. The first one I built 18 years ago weighed 25 pounds and would have cost nearly \$100 if I hadn't cannibalized some old radios for the parts and tubes . . . remember tubes? When I built Thunderbolt a few months ago it cost five dollars and weighed in at about eight ounces. What made the difference? Solid-state components, including a silicon-controlled rectifier, make it lighter and cheaper—and it works much better and faster.

How It Works. Sound picked up by a microphone is boosted by an amplifier which feeds the signal in the form of a rectified pulse (via R3 and D1) to the gate and cathode of the SCR. The SCR is internally like three diodes connected (alternately) in series—positive-negative-positive—so it acts like a conventional rectifier in the reverse direction. Thus, the SCR's forward conduction is controlled by operating the "switch," or gate. Since the sound we are picking up

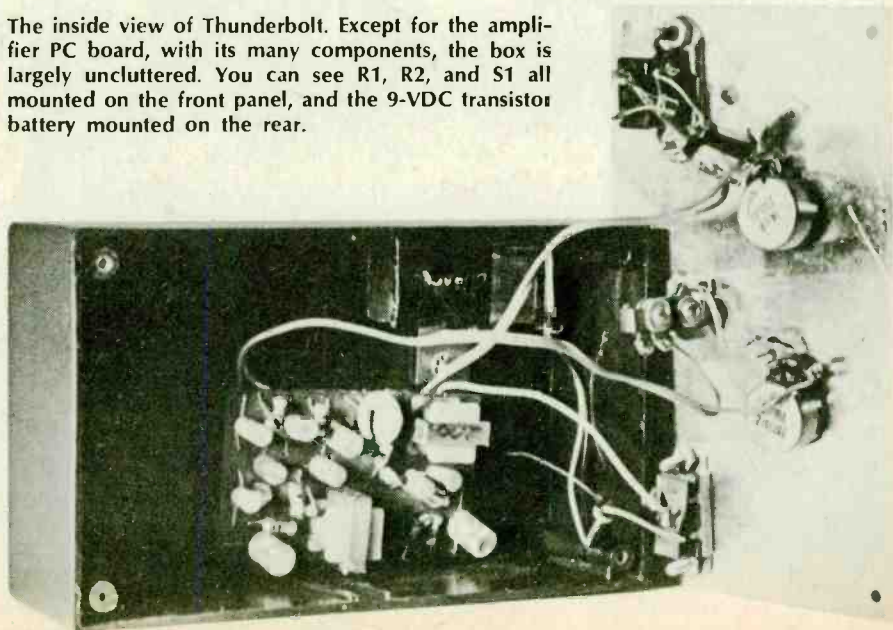
is a single, sudden sound of short duration, it acts like a pulse, when magnified by the amplifier, and it causes the SCR to conduct. An electronic flash unit connected across its anode and cathode "sees" this conduction as a direct short so it flashes.

In practice, you will find a wide latitude of application techniques possible. You can control the microphone's sensi-

tivity so it will respond only to certain higher level sounds, if the ambient noise level is high. Additionally, you can select the time at which an event is photographed by varying the distance between the event and the mike.

Various Applications. Let's say, for example, the event to be photographed is a coin dropping into water. By placing the mike very close to the container of

The inside view of Thunderbolt. Except for the amplifier PC board, with its many components, the box is largely uncluttered. You can see R1, R2, and S1 all mounted on the front panel, and the 9-VDC transistor battery mounted on the rear.



water, and by turning up Thunderbolt's sensitivity control, you can freeze the coin as it first touches the water. On the next shot, repeat the event, but place the mike farther away from the point of impact. The sound must now travel farther to reach the mike and the flash will go off at a later stage in the splash sequence.

By repeating this process, you can get a series of shots to cover the entire sequence from the coin first touching the water, to the final catapulted droplet falling back into the water. It could be a club flattening a golf ball, a dart bursting a balloon, a hammer shattering a light bulb, or a (patient) athlete diving into a swimming pool. Any event which produces a sound, faint or deafening, can be recorded on film at the decisive moment chosen by you.

The great advantage of Thunderbolt is that it is totally electronic, as opposed to the electromechanical heavy-weights of a few years ago. The older devices depended on mechanical relays and electromagnets to close a switch. This mechanical energy transfer added milliseconds to reaction time. Even that is a significant interval when you are planning to break up into sequences such events as bursting firecrackers and shattering lightbulbs. Once the sound gets to Thunderbolt's mike the reaction time approaches the speed of light. That's about as fast as you're going to get—in *this* world.

Putting Thunderbolt together is easy, because the most complicated part—the amplifier—is a module, ready to wire into a circuit with just a few simple connections and a handful of other parts.

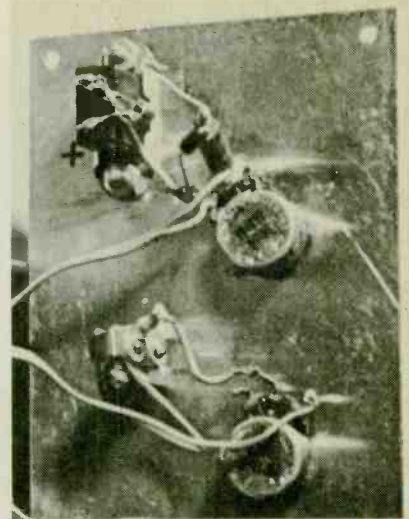
Building It. Begin by selecting an amplifier. Almost any inexpensive module will do as long as it has an output transformer. Note that most modern transistor amps don't have an output transformer. Radio Shack and Lafayette Electronics sell suitable amp modules for less than six dollars apiece. Any amp capable of delivering a couple hundred milliwatts is sufficient. I scavenged the amp for my Thunderbolt from an old, discarded portable tape player. You can find many of these old reel-to-reel relics in second-hand stores for a dollar or two. Goodwill and Salvation Army Thrift Shops are a good hunting ground. All you need do with these old units is carefully trace and identify the input and output leads and the battery supply leads. If you get a unit that's fairly intact, it may even have volume and tone control pots which are of the correct value for your Thunderbolt.

The cabinet I show in the parts list

will accommodate almost any transistor amp you select. You could even get ambitious and build a simple transistor amp. Most any old tube amp will also work fine, though it'll be quite bulky.

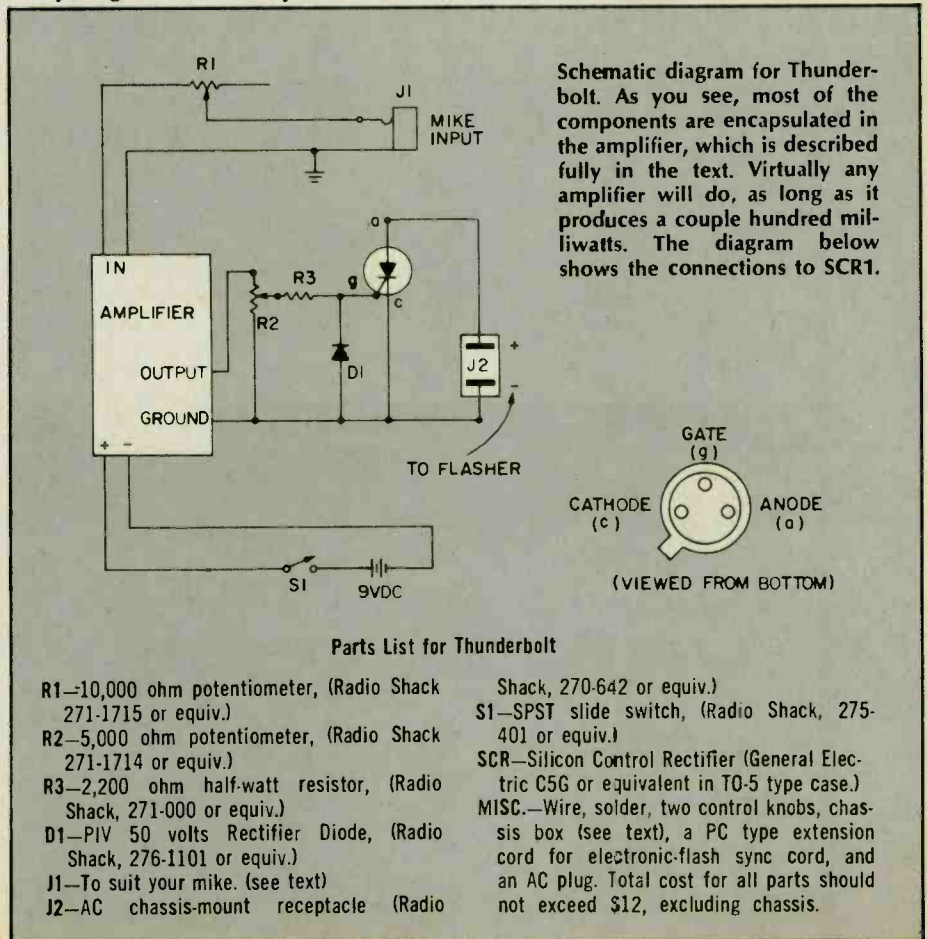
Just which mike jack, you use will depend on the plug on the microphone you use. It may be a standard phone jack, or the miniature type—whatever, as long as it matches your mike plug. When you have all the parts in hand, arrange them on the cabinet's front panel and mark the panel for the mounting holes to be drilled. Parts placement is not critical, but the leads to R1 and R2 should be kept short. If you locate S1 close to the sensitivity control, R2, then you can use point-to-point wiring for the SCR, D1 and R3. They are rigid enough to be self-supporting if the leads are kept short; otherwise a tie-point terminal can be used. Follow the schematic and wiring illustrations carefully and you'll have no trouble. You must use shielded (co-ax audio cable) for the input connections from R1 to your amp.

Hookup To Flashgun. After making all the connections, double check your work. Be sure you have connected the SCR's three leads correctly and check the polarity of D1. When you are sure everything is in order, you'll need to



Closeup of the front panel, showing the way SCR1 is mounted directly on S1, and D1 and R3 attached to R2.

make a connector cord for your flash unit. Insert the PC plug of your flash extension cord into the flash unit's sync cord. Both ends of some brands of extension cords look almost alike and you don't want to cut off the wrong end. With one end plugged into your flash unit to make sure, cut off the other end close to the plug. Strip off the insulation and carefully separate the braided



e/e THUNDERBOLT

shielding from the inner conductor of the co-ax cord. There is little or no standardization in the photo industry, so you can't be sure that the inner conductor of any given sync cord is connected to a positive voltage when plugged into a flash unit. Some units have a positive ground and some have a negative ground. In order to make sure your Thunderbolt will work with any flash unit, you need a plug which can be reversed for any polarity match. You may have more than one flash unit and they may not be the same, hence the adaptor cord.

Plug one end of your modified cord into Thunderbolt and the other into the flash unit's sync cord. Set the *sensitivity* control, R2, at the center of its rotation and *input* control, R1, fully counter-clockwise. Plug in a microphone and apply power to both the switch unit and the flash unit. The flash may fire once or twice by itself before it settles down. If the flash unit keeps firing as fast as it recycles, reverse the plug in J2 to get the correct polarity match.

With the polarity established, whistle or hum into the mike as you slowly turn R1 clockwise. The flash should go off. From this point, it's a matter of see-sawing controls R1 and R2 back and forth until you get the hang of your mike's sensitivity. The best way to discover what your Thunderbolt can do is to use it in a closely controlled test set-up. This procedure is easier



This is one of the things you can do with Thunderbolt. You can use it to capture any sound-producing motion instantaneously, as long as the object to be photographed is within the range of your electronic flash gun.

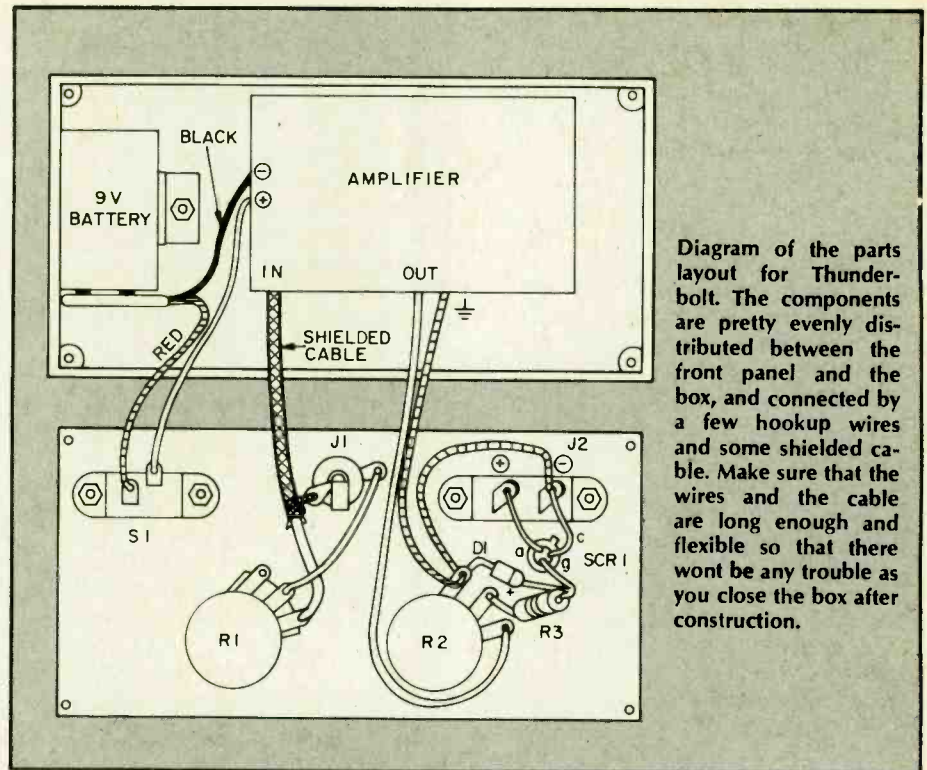


Diagram of the parts layout for Thunderbolt. The components are pretty evenly distributed between the front panel and the box, and connected by a few hookup wires and some shielded cable. Make sure that the wires and the cable are long enough and flexible so that there won't be any trouble as you close the box after construction.

with an assistant, so recruit a friend.

Against a dark background, set up a clear glass, or bowl, of water. Place the mike as near to the bowl as possible without it getting into the picture area. Position the flash on a tripod and aim it at the bowl. The camera, also tripod mounted, should be aimed at the bowl at a 45 degree angle to the flash. Focus on the surface of the water and compute your f-stop as you normally would for a flash shot using the flash's guide number divided by its distance to the subject. (For instance, if the manufacturer's recommended guide number for your flash is 45 when used with ASA 25 film and your flash is placed five feet from the subject, divide 45 by five. Since the answer is nine, choose the f-stop closest which is f-8).

Set the camera's speed control on "B" as you would for a time exposure. Attach a locking type shutter release cable to the camera and position your assistant close to the bowl, but out of the camera's field of view.

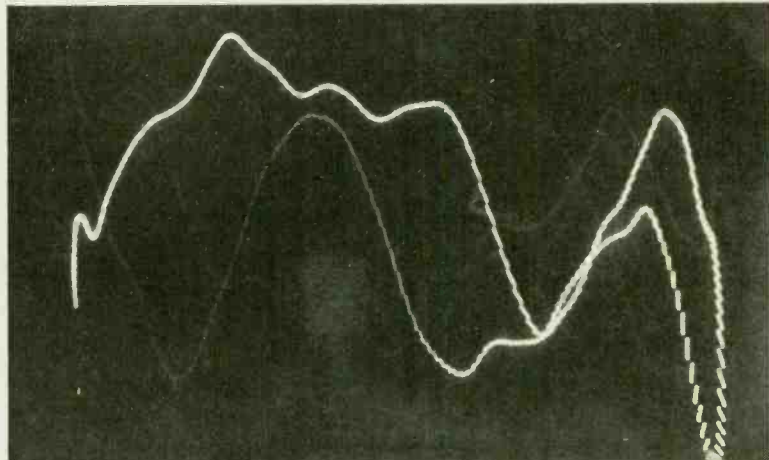
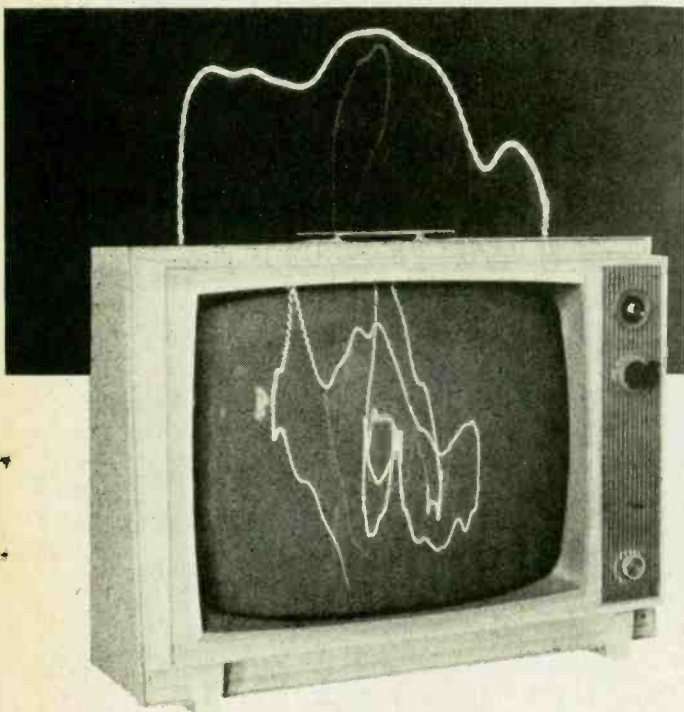
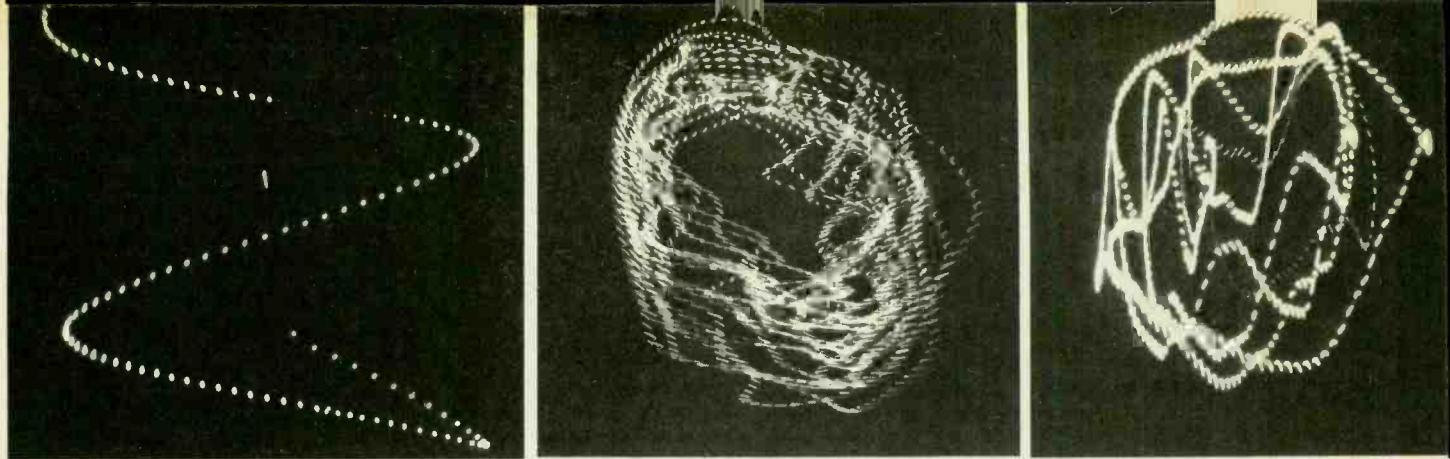
Turn off all the lights in the room and open the lens with the shutter release cable, but *do not* remove the lens cap yet. With your assistant poised over the bowl, ready to drop a coin into the water, turn on the flash unit and the switch unit. The flash may go off, triggered by the sound of its own switch, which is why you've left the lens cap on. Wait for the flash to recycle, then snap your fingers. It should go off again. When it recycles, remove the lens cap and give your assistant a visual signal

to drop the coin. As the coin hits the water, the flash will go off and you can close the shutter and replace the lens cap.

On the next shot, move the mike a foot or two farther away and repeat the process. On successive shots, move the mike exactly the same distance farther away. You should have a complete sequence after about six to eight shots.

The film should be a very slow film, that is one with a very low ASA number, such as Plus-X by Kodak, which has an ASA of 125. If you have a set-up which requires you to have more room illumination in which to work, use an Othro type film which is insensitive to red light. With this film, you can use a fairly bright red light in the room without affecting the film image while the lens is open.

Once you've done a series such as the water bowl and coin, you will know what Thunderbolt can do for you and how to predetermine its sensitivity to a given sound. When you have all its parameters for operation understood and set up, you can start thinking of things to do with Thunderbolt. Its applications are virtually limitless, since the principle of stopping sound-producing motion is an especially fascinating one. You can use it indoors in ordinary ways, such as the coin and bowl technique, or you could even use it for crime detection, by fixing it at night on a window or door you expect an intruder to come through. Any sound he makes will take his picture. Good luck! ■



LISSY, THE TV LIGHT PEN

Lissajous patterns on your old TV
add excitement to stereo.

by Dean Hock

□ Are you an avid stereo enthusiast looking for a new way to experience your favorite music? Have you tried conventional "color organs" and found them fun for a few minutes, but dull as dishwasher thereafter? Have you perhaps seen an oscilloscope hooked up with a microphone on its input and watched in fascination as the sound waves dance on the screen in perfect synchronism with your voice?

If you'd like something new to stretch your visual sense and expand the aural connection with your eyes, look no further. *Lissy*, the adapter which turns any beat-up old TV set into an oscilloscope for stereo sound, displays myriad sound patterns on the receiver screen. Its *Lissajous* patterns respond to both right and left-hand stereo signals—although it can also work with just one channel—providing an infinitely-variable light/sound display for your friend's pleasure and amazement.

What's a Lissajous? Let's go back to basics for just a minute, and review what a Lissajous figure is. Those of you who read our Basic Course in the

March/April issue (*Using the Oscilloscope*, pages 83-88) will recall that Lissajous figures are 'scope displays of two signal inputs to the display screen—not just the usual vertical input signal which we use when we want to measure the amplitude of a voltage or watch how its amplitude changes with respect to time (the most common use of the oscilloscope).

With signals going to both the vertical and the horizontal inputs of an oscilloscope we can measure the relationship with respect to time (it's called *phase*) between the two signals.

For example, if a known signal is applied to the horizontal input and an unknown signal is applied to the vertical input, the resulting Lissajous pattern shows the phase relationship of the two signals.

Lissajous patterns can also be used to measure frequency. A known frequency is applied to the horizontal amplifier and an unknown frequency is applied to the vertical. By counting the number of tangency points at the top and at one side, a ratio of unknown-to-

known frequency can be obtained. By multiplying the ratio times the known frequency, you can determine the frequency of the unknown.

A Simple Pattern. The drawing shows a Lissajous pattern for two sine waves. Numbers have been assigned to corresponding voltage points on the two signals. Extensions of these points are brought to the screen. The intersection of corresponding numbered lines is the position of the electron beam at that instant of time. In this case the two sine waves are in phase.

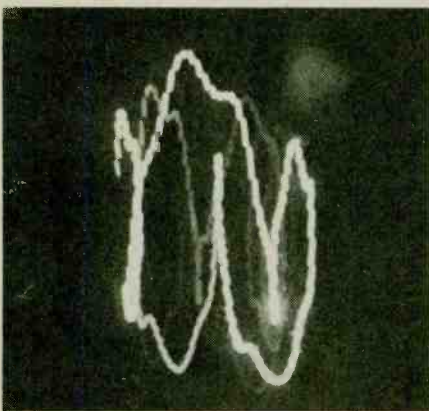
In the figure below, voltage/time relationships are different; corresponding voltage points are 45° apart. Therefore the waveforms are 45° out of phase.

Lissy's Pictures. A continually shifting Lissajous pattern results when the phase relationship between the two input signals is constantly changing. The more complex the pattern (resulting from a frequency ratio having large numbers, such as $17/13$) the harder it is to interpret. But since we were not trying to *analyze* Lissy's pictures, we can just lean back and enjoy. (*Please turn page*)

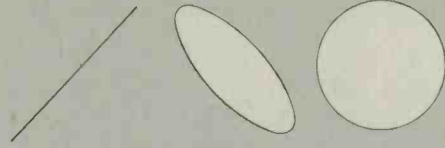
How Lissy Does It. By connecting the parts of an old TV set so that the output from one channel of a stereo set (for example, the left) drives the electron beam of TV tube vertically, and the output of the stereo set's right channel drives the beam horizontally, we can use the TV set to display Lissajous figures created by the signals from the two stereo channels. What we do is make the old TV set/stereo amplifier combination into an uncalibrated oscilloscope. Then we feed it the two signals without worrying what they mean.

Putting It Together. Begin with an old television set. You can use one in which the tuner, IF, and sound sections do not work since they will not be used. You'll also need an extra deflection yoke from another old set. Most of the older tube-type black and white sets have yokes the same size. As long as the extra yoke will fit over the neck of the set's picture tube it can be used. A junked TV is the best place to look. You must also have a stereo set with amplifiers capable of producing 12-15 watts of output power per channel. Even better is a spare (second) stereo set. This will insure better results and will also allow you to adjust the tone, volume and balance controls to the TV set without upsetting your listening pleasure, by changing the volume setting while you listen.

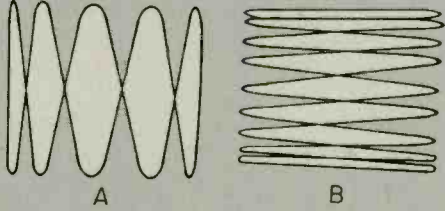
Begin by removing the back from the old TV set. Disconnect the socket from the rear of the picture tube. Loosen the clamps holding the deflection yoke and slide it off the neck of the tube. Do not disconnect any of the wires from the



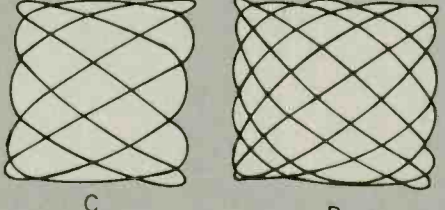
These patterns appear from moment to moment on the TV screen when it's being driven by signals from music. To see what they really look like you'd have to have motion pictures.



Simple Lissajous figures like these result from putting the same (or almost same) signal voltages on horizontal input and vertical input of oscilloscope (or TV picture tube).



A B



C D

SINE WAVE ON HORIZONTAL DEFLECTION PLATE

SINE WAVES ON VERTICAL DEFLECTION PLATE

IN PHASE OR 360° OUT OF PHASE

45° OR 315° OUT OF PHASE

90° OR 270° OUT OF PHASE

135° OR 225° OUT OF PHASE

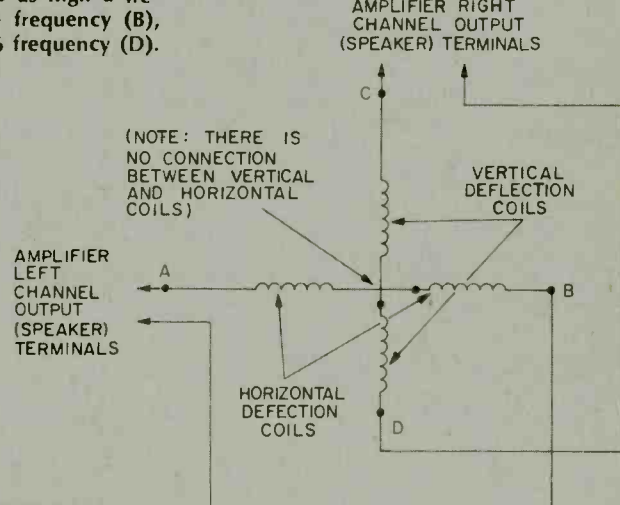
180° OUT OF PHASE

If your two stereo channels put out exactly the same signals (or you put a mono signal into both) you should get a straight (diagonal) line on the screen. If not, adjust gain of one channel. Other Lissajous patterns like these will result from out-of-phase signals. Music waveforms are extremely complex compared to the signals used to derive simple patterns shown here.

These more-complex Lissajous patterns are created by feeding a simple sine wave to the horizontal input of a scope and sine waves of exactly five times as high a frequency (A), one-ninth the frequency (B), 3/5 frequency (C), and 5/6 frequency (D).

The added deflection yoke from second TV set is connected as shown above to the two stereo channels of an amplifier or receiver. Using a separate amp (from the one you listen to) is recommended, but not essential.

(NOTE: THERE IS NO CONNECTION BETWEEN VERTICAL AND HORIZONTAL COILS)

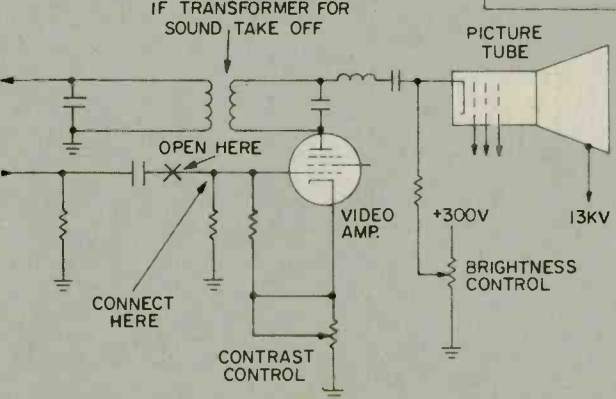


AMPLIFIER LEFT CHANNEL OUTPUT (SPEAKER) TERMINALS

AMPLIFIER RIGHT CHANNEL OUTPUT (SPEAKER) TERMINALS

HORIZONTAL DEFLECTION COILS

VERTICAL DEFLECTION COILS



IF TRANSFORMER FOR SOUND TAKE OFF

OPEN HERE

CONNECT HERE

VIDEO AMP.

+300V

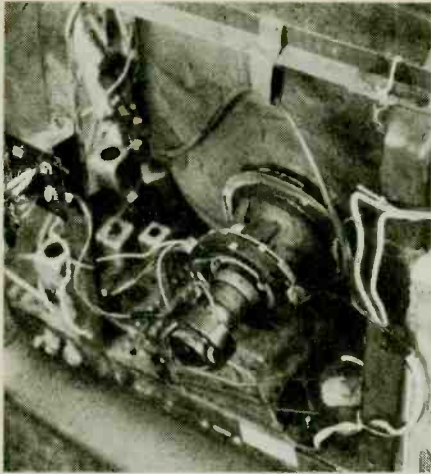
BRIGHTNESS CONTROL

PICTURE TUBE

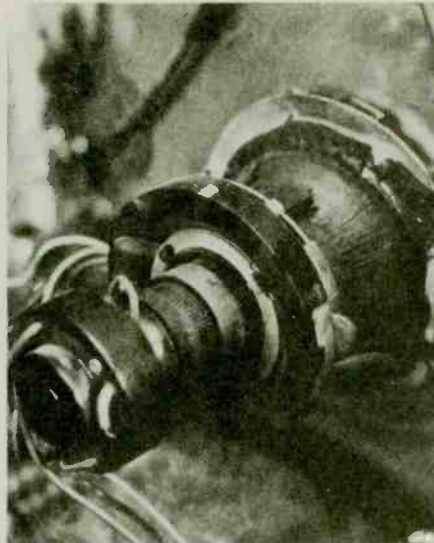
13KV

CONTRAST CONTROL

This schematic shows a typical video amplifier tube for TV sets six to 15 years old. Disconnect the video input signal on the grid side of the grid-coupling capacitor and connect your Lissy oscillator at the same point to make Lissy do extra tricks.



Here's how the back of author's set looks with the new picture tube yoke (deflection coils) on neck of picture tube. Original deflection yoke is removed from tube but kept hooked up because it's also used in the circuit which generates high voltage for picture tube. It's tied out of way at upper right, atop high voltage cage.



Closeup of picture tube neck shows large circular positioning magnet which some sets have behind yoke. Be sure to replace any magnets your set had into their original position after you replace the yoke.

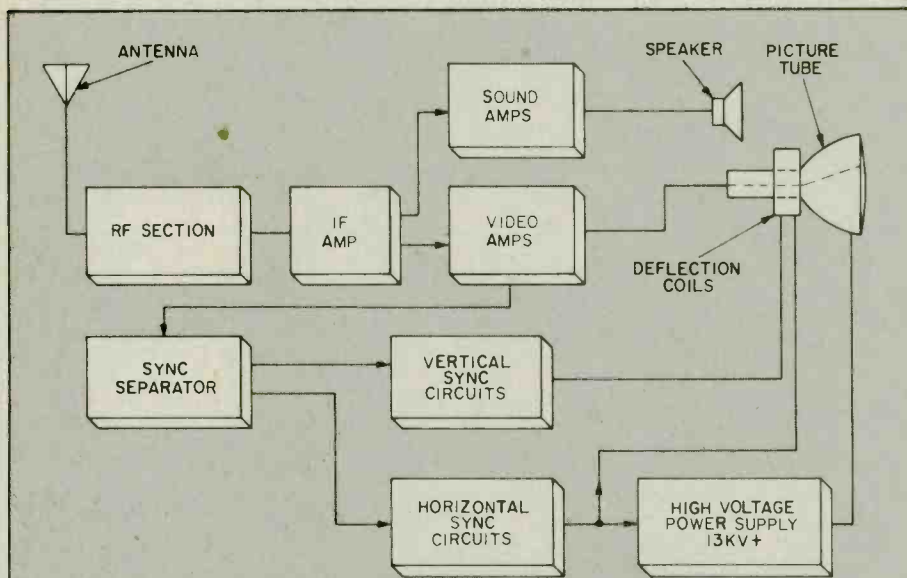
yoke since it is part of the circuit for putting the beam on the screen. Secure the old yoke to the chassis of the TV somewhere out of the way, taking care in seeing that it does not short circuit.

Preparing the Deflection Yoke. There are two coils in the deflection yoke of a TV set. One is called the horizontal and one the vertical.

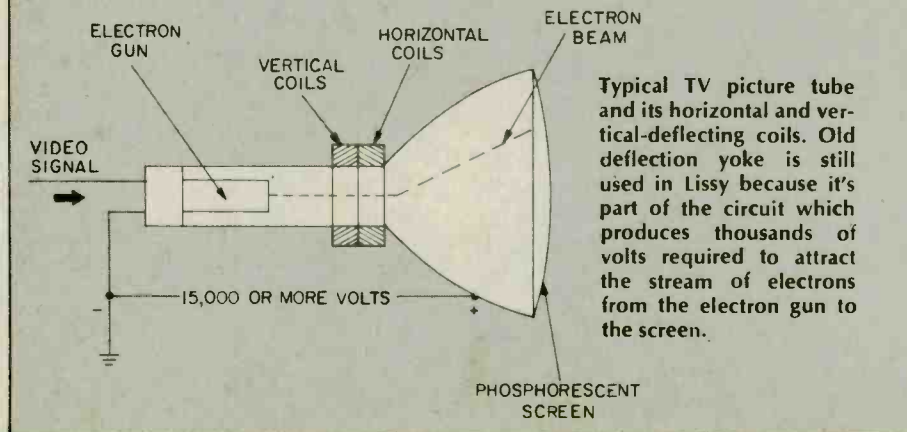
Each of these two coils is divided into two sections, and we must eliminate any extra parts such as a small resistor or capacitor which are often connected to one or both of the yokes. They are usually connected to the mid-point of the horizontal coil or vertical coil. Simply remove any resistor or capacitor connected to any parts of the yoke, and if this separates the two sectional parts of either the horizontal or vertical coil, put a jumper between the two sections. Check with a voltmeter to be sure which terminals are connected (through the two coils) together. Mark them in some way so that you'll know which two leads of each coil are connected together (through each coil). Solder 2 three-foot lengths of speaker wire to the terminals of the vertical and horizontal coils.

Putting It Together. Take the yoke and slide it on to the neck of the picture tube securing it with a clamp. Return the socket to the back of the tube along with any magnets that may have been removed. Put the magnets back exactly where they were. (Adjust to center beam, later.) Route the speaker wire out the back of the TV set as you put the cover back on. Run wires from the speaker outputs on your stereo to the TV set and connect the two sets of wires together using a terminal strip.

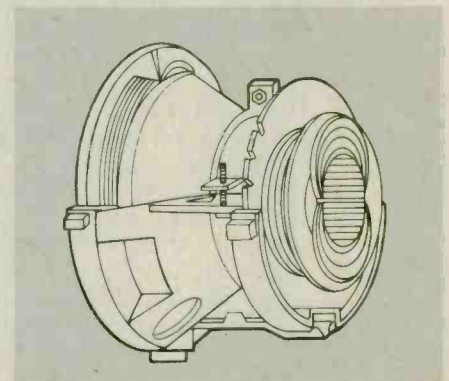
You are now ready to test out Lissy. Leave your stereo off and turn on the TV set. After warmup a small dot should be visible in the middle of the screen. Adjust the magnets, if any, to



Simplified block diagram of TV set shows how vertical and horizontal sweep currents are derived from the synchronizing signals sent from the transmitter. Vertical and horizontal sweeps feed vertical and horizontal deflection coils.



Typical TV picture tube and its horizontal and vertical-deflecting coils. Old deflection yoke is still used in Lissy because it's part of the circuit which produces thousands of volts required to attract the stream of electrons from the electron gun to the screen.



Most old TV sets have deflection yokes which look like this. Large end (left here) goes snug up against the flare of the picture tube. May require loosening of screw which secures clamp around coils.

center the beam. If necessary turn the brightness control up or down. Now turn on the stereo set and turn up the volume slowly until you start to notice the dot moving. By adjusting the balance control you should be able to make the dot move about an equal amount horizontally and vertically. It may be necessary to disconnect the speakers in order to move the beam enough. Adjust the brightness for a pleasing light level without burning the screen phosphor. Low bass notes will show up as rotating circles. Each tone has its own pattern which intensifies with the volume.

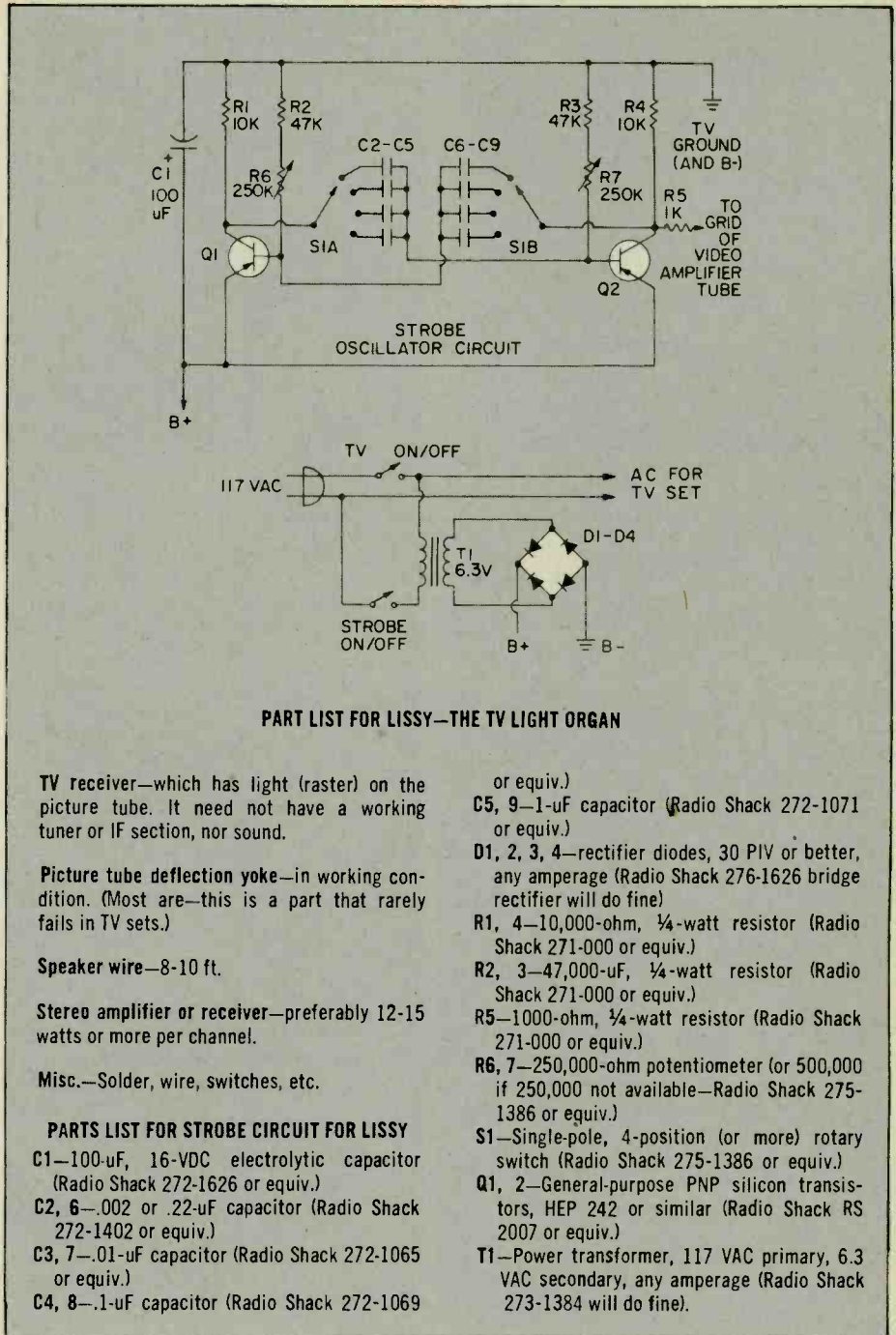
Now that you are finished sit back and enjoy the added dimension of the music TV in a dark room. It will provide you with many hours of listening and viewing pleasure.

More Fun With Lissy. Once your Lissy is working you may want to add an extra circuit which will strobe the moving pattern on and off, making a more unusual and interesting light display. By connecting the output of an oscillator to the grid of the TV set's video amplifier tube you can turn on and off the electron beam in the picture tube. This will produce dots and dashes as the beam is moved around on the screen. The effect is quite pleasing. A stop-action type of display (called "strobe") is only one interesting improvement you'll see.

The added circuit is a simple two-transistor oscillator. The switches and potentiometers allow you to select different dot line lengths and frequencies. By connecting the output of the oscillator to the grid of the video amplifier you force the tube alternately into conduction and cutoff.

The oscillator and power supply are not critical and can be constructed any way that is convenient, as long as safe construction practices are used. The circuit in the prototype was built on a terminal strip using point-to-point wiring and then mounted inside the TV. Almost any general purpose PNP transistors can be used for Q1 and Q2.

If you can't get a schematic of the TV set you are using the best way to locate the video amplifier tube is to look at the tube placement chart (usually on the side or back of the TV) and find the tube which is labeled *Video Amp*. If the video amp tube also contains other elements in the glass envelope you will have to trace down that part of the tube which has its plate connected to the sound trap transformer



PART LIST FOR LISSY—THE TV LIGHT ORGAN

TV receiver—which has light (raster) on the picture tube. It need not have a working tuner or IF section, nor sound.

Picture tube deflection yoke—in working condition. (Most are—this is a part that rarely fails in TV sets.)

Speaker wire—8-10 ft.

Stereo amplifier or receiver—preferably 12-15 watts or more per channel.

Misc.—Solder, wire, switches, etc.

PARTS LIST FOR STROBE CIRCUIT FOR LISSY

- C1—100-uF, 16-VDC electrolytic capacitor (Radio Shack 272-1626 or equiv.)
- C2, 6—.002 or .22-uF capacitor (Radio Shack 272-1402 or equiv.)
- C3, 7—.01-uF capacitor (Radio Shack 272-1065 or equiv.)
- C4, 8—.1-uF capacitor (Radio Shack 272-1069

or equiv.)

C5, 9—1-uF capacitor (Radio Shack 272-1071 or equiv.)

D1, 2, 3, 4—rectifier diodes, 30 PIV or better, any amperage (Radio Shack 276-1626 bridge rectifier will do fine)

R1, 4—10,000-ohm, 1/4-watt resistor (Radio Shack 271-000 or equiv.)

R2, 3—47,000-uF, 1/4-watt resistor (Radio Shack 271-000 or equiv.)

R5—1000-ohm, 1/4-watt resistor (Radio Shack 271-000 or equiv.)

R6, 7—250,000-ohm potentiometer (or 500,000 if 250,000 not available—Radio Shack 275-1386 or equiv.)

S1—Single-pole, 4-position (or more) rotary switch (Radio Shack 275-1386 or equiv.)

Q1, 2—General-purpose PNP silicon transistors, HEP 242 or similar (Radio Shack RS 2007 or equiv.)

T1—Power transformer, 117 VAC primary, 6.3 VAC secondary, any amperage (Radio Shack 273-1384 will do fine).

(usually a metal can type) and its cathode connected to the contrast control. This may vary slightly in your set.

Once you have found the video amplifier cut one of the leads of the capacitor going to the grid and replace it by connecting the oscillator output to the tube in its place, (see the schematic). Connect the negative lead on the oscillator's power supply to the TV common ground.

Fire Her Up. Now you are ready to test the circuit. Look it over for any wiring errors. Set the potentiometers to maximum resistance and set the rotary switches at the .01 uF capacitors. Turn

on the TV set and allow it to warm up. Get a music display on the screen. Turn down the brightness control until you can no longer see the raster (white lines). Turn on the strobe oscillator and adjust the brightness control as needed. The display should be chopped up into little line segments. By adjusting the controls you can get different line lengths and frequencies—anything from star-like dots to a pulsating array of stopped action traces.

Now you can lean back and enjoy your Lissy—the TV light organ which will amuse and amaze your friends for many evenings ahead. ■



by Kathi Martin, KGK3916

Kathi's CB Carousel

Kathi tests two accessories to make your CB and your home, family and neighbors get along a lot better.

□ Many gadgets brought to my attention either as a sample sent to ELEMENTARY ELECTRONICS or the test lab are rejected because they just don't work. In fact, a lot of the equipment I review is specifically requested by the editors or myself *after we have seen the device actually work* in a CB show-room, or a typical CB installation.

Therefore, I feel some surprise and pleasure that I can report on two highly successful CB accessories we first saw as samples, though it is true we requested the samples because they were

not yet available in the local CB shops. (Yes, much of the equipment reviewed is obtained locally, the same way you get your equipment.)

This month's winners as far as CB accessories are concerned are the Vitek "Super Trap" CB TVI Filter Cable, and the Hustler HP-27 "Homing Pigeon" Indoor CB Base Station Antenna.

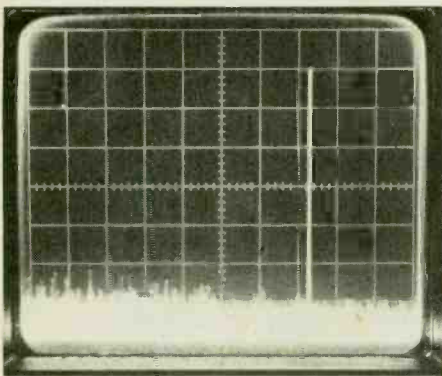
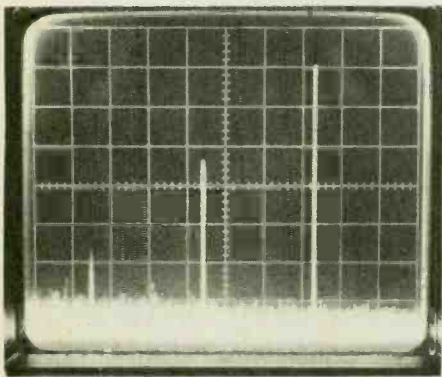
The "Super Trap." I'm certain you all have seen some form of "black box" TVI filter that serves to attenuate the harmonic frequencies generated by a CB transmitter. The Vitek "Super Trap" is no "black box" but is a little over 6-feet of what appears to be slightly thicker than usual coaxial cable with male and female UHF connectors pre-attached. All you do is connect it in series with your present transmission line. As shown by the photos taken off my spectrum analyzer, the harmonic frequencies that cause TVI to channels 2, 5 and 6 are heavily squashed. The top photo shows the transmitter output without the "Super Trap." (Each horizontal division is 10 MHz starting at zero at the extreme right. Each vertical

division is 5 dB.) The main carrier is at approximately the middle of the Citizens Band (2.7 divisions from the right—representing 27 MHz), the second harmonic at about 55 MHz is 16 dB down; the third harmonic at about 82 MHz is 23 dB down.

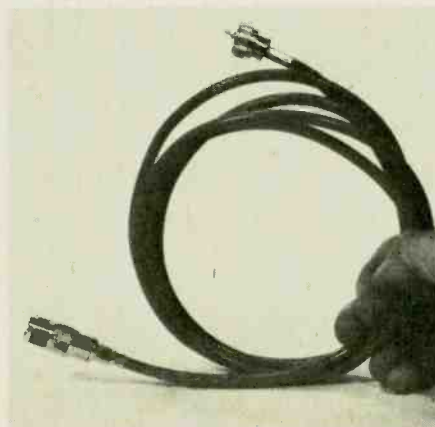
Another photo compares the same transmitter with the Vitek "Super Trap" connected between the transmitter and the load. There is no trace of 2nd or 3rd harmonic output; whatever exists is down into the residual noise of the test equipment.

The secret behind the "Super Trap" is a coax center conductor with three wires, only one of which connects to the input and output. The remaining two wires are trimmed and soldered to the main conductor to form a series of resonant traps that are tuned to the harmonic frequencies of a CB transmitter; and few filters are as effective as tuned traps.

Even though the Vitek "Super Trap" looks like nothing more than a length of coax with a red jacket, take it from Kathi that it really works. →



These two photos graphically illustrate the result of installing the Vitek "Super Trap" on your CB. The top photo, the before photo, shows the CB carrier and the second and third harmonics. The bottom photo, once "Super Trap" has been installed, shows that both harmonics have been reduced to ultra-low levels.



The "Super Trap" is a little over six feet long and appears to be slightly thicker than usual coax cable with male and female UHF connectors installed on both ends.

CIRCLE 71 ON
READER SERVICE
COUPON



Not trick photography—there really are three center conductors in the "Super Trap" coax. The middle one goes from the input to the output and the other two are cut to harmonic wavelengths. Then they are soldered to the center conductor. This forms a series of wavetraps at CB harmonics.

e/e KATHI'S CB CAROUSEL

The Homing Pigeon. Here's an indoor antenna specifically for the folks stuck in an apartment where the landlord allows nothing on the roof or out the window, or where the slightest inking of a CB antenna brings out fifty neighbors blaming every form of TVI on the CBER.

The "Homing Pigeon," from Hustler, is an electrical half-wavelength end-fed antenna concealed in what appears to be a telescopic pole-cat, the type of device that clamps between the floor and ceiling and is usually used to support several lamps. The transmission comes out the bottom to a plug. A 17-foot length of coax cable plugs into the transmission line; matching connectors are supplied factory-installed.

Decorative metal sleeves that slide up and down on the pole serve as capacitive tuning devices (you must use an SWR meter). A supplied gauge allows you to position the sleeves well inside the ballpark, and you can get quite good results with the gauge settings, though a "peak trim" with an SWR meter gives optimum results.

The "Homing Pigeon" works best



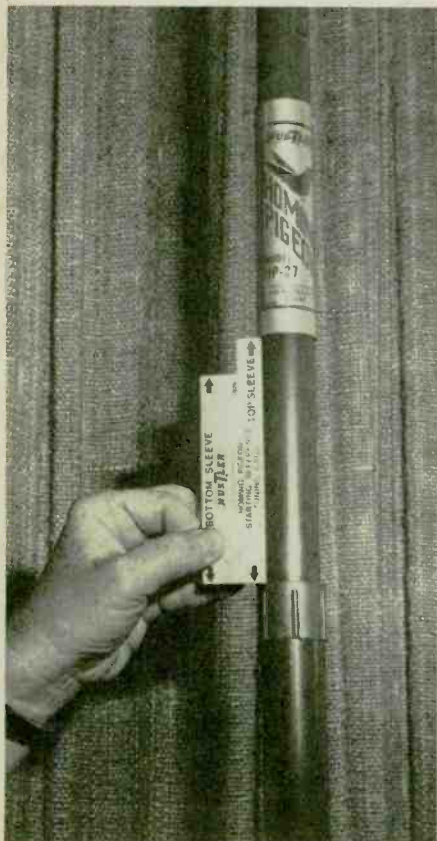
CIRCLE 45 ON READER SERVICE COUPON

This is one "Homing Pigeon" that looks more like a pole-cat, which is used to suspend lights between ceiling and floor. The half-wavelength antenna is inside the pole. Transmission line comes out the bottom.



KATHI, THE NEW TV STAR

Last issue, we showed a picture of Kathy, the new TV star, and promised to let you know when you can see her CB program in your area. If you've gotten your copy of *ELEMENTARY ELECTRONICS* early, and you live around Cleveland, Ohio, you can catch her on WKYC, Channel 3, on October 26th, at 5:50 am. If you live around New York city, you can see her on WNBC, Channel 4, at 6:30 am. Tune in—it's well worth while!



The gauge supplied is accurate enough to set SWR in nearly all home-use situations.

when not in close proximity to metal screens, or large metal objects such as a filing cabinet. Even in a frame (wood) house Hustler suggests the "Homing Pigeon" be positioned at least 1.5-feet from the nearest wall. As for aluminum siding: I trucked the antenna to a friend's house which recently was covered with aluminum siding and the results were total failure; the signal barely got out a couple of blocks. On the other hand, I used the "Homing Pigeon" ten stories up in a modern concrete building and my signal ranged up to ten miles, the actual distance depending on how much building was between the antenna and the rest of the world. Opposite to the direction my signal ranged up to 10 miles it barely made two miles. But this is a lot better than no CB at all.

In fact, if you're stuck with a no-compromise landlord, or you're looking for an efficient indoor antenna you can pack in the trunk while on vacation, the Hustler HP-27 is the best indoor antenna I've used.

Well, those are my first choices in CB accessories in a long, long time. Both the Vitek "Super Trap" and Hustler "Homing Pigeon" really work, and do exactly what the manufacturer claims they will do. ■



The antenna is tuned by decorative metal sleeves, adjusted for the best SWR reading.

e/e checks out the...

RCA STUDIO II HOME TV PROGRAMMER



Get games and computer potential too with this neat package.

CIRCLE 46 ON READER SERVICE COUPON

BECAUSE OF DELIBERATE and accidental computer-style rip-offs of consumers by utilities, phone companies, banks, and department stores the modern computer has replaced Jesse James as the legendary public enemy number one. Actually, it's not the computers ripping you off but the people who run them. The computer is nothing but a collection of electrical circuits you can program to do as you please. Last Christmas, computers were programmed into TV games, and many a child (and adult) spent many pleasurable hours playing tennis, handball and hockey on their TV sets. The TV games of 1976 were really what is termed *microprocessors*; the real or full-scale home microcomputer was yet to come, but it has finally arrived in the form of the RCA Studio II Home TV Programmer.

Though the studio II resembles the older TV games in that your B&W or color TV receiver is used for display, the RCA console goes way beyond the

three to six pre-programmed games usually found in department and variety stores. The big difference is the Studio II can be programmed for a wide variety of functions simply by plugging in a pre-programmed *cartridge*. Fact is, if any alphanumeric keyboard was added, the Studio II could be a full-scale "home computer," and we really expect this is the next step up for RCA. But let's not go too far afield and predict the future; let's stick to the Studio II.

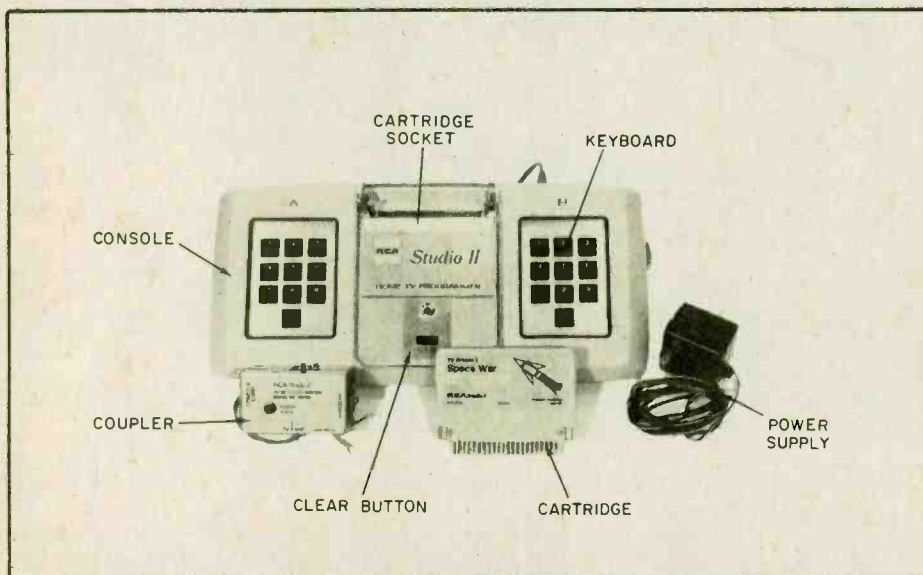
As shown in the photographs, the Studio II is a package consisting of a console, a power supply unit, and a coupler that installs on the back of the TV that connects either the antenna or the Studio II to the TV. The connecting cord that plugs into the coupler is 18-foot long and permanently attached to the console. (The power supply unit plugs into the coupler, in this way several couplers and power supplies can be used for several TVs with only one console unit. The console cannot be

battery powered.)

On the Keyboard. Unlike the usual TV game that has two adjustable controls the Studio II has two 10-key keyboards and a clear button. The keyboards serve to both call up a program (or game) and to provide directional control of the display. At the top rear of the console is a recessed multi-pin socket.

The console, actually a microprocessor or minicomputer depending on how one looks at it, is preprogrammed by a ROM (Read Only Memory) for five activities: *Doodle*; *Patterns*; *Bowling*; *Freeway*; *Addition*. The programs are selected by depressing a numbered key. *Doodle* allows pictures and patterns to be drawn or partially erased by moving a spot on the TV screen. *Patterns* allows the player (artist) to draw endless full-screen patterns. *Bowling* actually displays ten pins, can be played by one or two players, and allows a ball to be thrown with a hook. *Freeway* is the arcade game where you must drive and steer around an oncoming car. *Addition* is essentially a pre-school game or mathematics drill. Three numbers are flashed on a screen. The first player to key in the correct answer scores points—or pre-schoolers can practice addition by themselves.

The five built-in programs are just to whet your appetite; you can go further through optional cartridges that plug into the socket on top of the console. At the time this article is being prepared three cartridges are available: *Space War*; *Fun with Numbers*; and *TV Schoolhouse* (TV Schoolhouse is actually a series of cartridges). *Space War* is two arcade type "shoot 'em down" games. *Fun With Numbers* are puzzle games (many on the cartridge). *TV Schoolhouse* is a series of tests in math, social sciences, literature, etc. The early programs we saw were excellent study guides to be programmed for early and late education, just as there will be a series of cartridges for arcade type games and puzzles.



The RCA Studio II Home TV Programmer consists of the console which is pre-programmed for five activities, the power supply, and the TV/antenna/console coupler. Cartridges with additional programs are optional. Note the console has two sets of numbered keys as operating controls. The keys select the desired game, quiz or other activity, and function as the operating controls and selectors for each activity.

e/e RCA STUDIO II

It's obvious that the advantage of the RCA Studio II is its non-obsolescence; by simply plugging in a cartridge it can be programmed or reprogrammed.

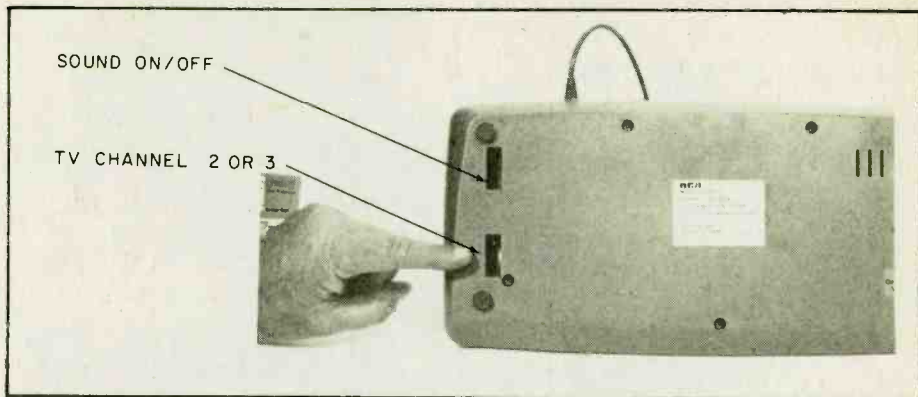
Though the cartridges are rather large, their size is determined primarily by handling ease rather than intent—they are goof-proof even when used by young children. As our photograph shows, the "guts" of the *Space War* cartridge is a single ROM—the entire program is in the ROM. Since the ROM is a CMOS chip, sensitive to static electric charges, a special set of *shorting fingers* provides a discharge path around the chip. When the cartridge is inserted in the console the fingers are automatically lifted clear of the printed circuit board wiring. (Like we said: It's goof-proof.)

Ponnnng!!!! The TV games industry long ago learned that people need a positive reaction to what they do, so almost from the inception of TV games a *beep*, or *pong* has been built into all TV games. The RCA Studio II is no exception. It has a beep-bong sound that goes off whenever there is a screen action, whether playing a game or taking a "test" through *TV Schoolhouse*. Provision is made for turning off the sound, but it's sort of eerie watching events take place on the TV while the room echoes nothing but silence.

The control switch for the sound is recessed on the bottom of the console, as is the channel selector that programs the console's output for TV channel 2 or 3. You use the channel which isn't normally used for TV broadcasting in your area.

Accessories. RCA has allowed for the fact their Studio II might be used at several locations in the home. From experience, just about everyone has learned that connecting and disconnecting the coupler in order to move the "game" eventually results in damage to the coupler. So RCA makes available optional couplers and power supplies; you can leave the coupler "permanently" connected to a TV when you move the Studio II's console to another TV. (Actually, since the power supply plugs in you can also move the supply without damage to the coupler. There's really no reason to purchase an optional power supply.)

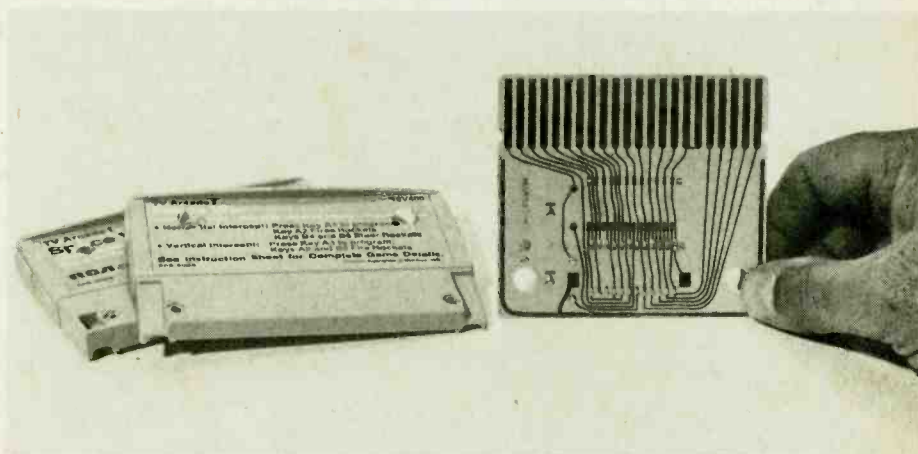
The Final Score. Unlike the conventional TV game, which is limited in application and which cannot be reprogrammed, the RCA Studio II can be continuously updated with program cartridges. In addition, because the con-



Two deep recesses on the bottom of the console conceal the sound on-off and TV channel switches. Switches are changed with a pencil or ball-point pen passed into the recess.



Our laboratory technician shows how easy it is to insert the cartridges into the Studio II receptacle. You can see the positioning studs on either side of the socket.



The flip side of the PC board holding the ROM has the printed circuit wiring and the "fingers" that connect the ROM to the console's socket. A unique shorting bar system within the cartridge connects the ROM's leads together when the cartridge is withdrawn to prevent high static voltages from damaging the MOS ROM. The short is automatically removed when the cartridge is inserted into the console.

sole is basically a computer with a built in numerical keyboard it is conceivable that future cartridges will be programmed so the Studio II can serve as a small "personal computer." But just imagine what the Studio II could do if equipped with an alphanumeric keyboard?

The RCA Studio II comes complete with console, power supply and TV coupler, and has built in programming for the five activities previously described. The kit retails for \$149.95. Optional cartridges, \$14.95 to \$19.95. For additional information circle No. 46 on the Readers Service Coupon. ■

Electronic Eccentricities...

Voltswagen Bike

The "Volkswagen" is the answer for the bicyclist who wants to rest awhile without slowing down. The unit can either power a bicycle for a short length of time, or lend power assists in climbing steep hills.

A heavy-duty, 12-volt, U-1 size aircraft battery which weighs in at twenty pounds is fastened in a sling arrangement to the crossbar of the bike. Two motors attach to the axle of whichever wheel drives the bike, one motor on each side of the tire. Controls are accessibly mounted on the handlebars.

The battery-driven motor can move the bike along at speeds in the range of 15 to 20 miles per hour. One overnight charging provides an electrical reserve good for about thirty miles under most conditions. Besides full-power function, a touch to a special button provides the cyclist with a power-assist which continues until the button is released.

Price class of the Volkswagen is around \$150 and it's manufactured by Sunward Corporation of Canoga Park, California. It may not be the greatest invention since the pedal-pusher, but it can take the exhaustion out of a hard day's cycling. ■



Here's a bike that's really ready to go. The "Volkswagen" battery rides in a sling on the crossbar and the two motors are visible on either side of the rear tire.

Recorded Boots

Patients who suffer from diseases of the hip-joint can now be better diagnosed and helped via electronics. Doctors can now have patients wear specially-designed shoes which determine elaborate data regarding the loads and stresses put on the various bones of the leg and foot. Such information can spell the difference between a successful course of treatment and a long, drawn-out and fruitless series of hospital visits and operations.

Shoes, with telemetry equipment in the soles, have become the newest diagnostic aids. The signals from the shoes are relayed to two separate display and recording units. From the data, a qualified podiatrist can determine all sorts of things relating to the patient's physical well-being.

Normal gait curves are, for instance, characterized by a series of double-peak curves with the nature of the curves varying according to the disability and the severity of it.

The sole of each shoe contains a pressure-sensitive capacitor consisting of metal filigree sheets between layers of spongy rubber. When the patient walks, the rubber is compressed and this alters the electrical capacitance. Currents are then amplified and inductively coupled to a pick-up wire, going from the heel to the measuring instruments.

The shoes are expected to be marketed for hospital use. ■



These specially-designed shoes, along with the instruments shown, can be instrumental in combating diseases of the hip-joint. Using variable capacitance effects, electrical impulses are telemetered to the displays where a doctor can interpret them.

Driverless Bus

If the idea of stepping foot into a driverless bus, and then having the vehicle tear madly off down the road to the next stop seems somewhat less than appealing—try to have a little more faith in modern day electronics. Such a scene is commonplace at England's Road Research Establishment.

The first step in the automatic bus-route is to lay a cable about four inches beneath the road surface the bus will travel along. A monitor which is slung beneath the bus' chassis will keep the vehicle electronically guided along the cable length.

The driverless bus is equipped with a form of "radar." If, during its travels, the vehicle is blocked by an unprogrammed hazard, the "radar" unit at the front of the bus senses this, puts on the brakes and will only release them once the route is clear again. The Harrison-Fraba Optical Detector unit emits an infra-red, modulated beam which, when interrupted by a blockage on the road ahead, reflects back to a photocell detector which activates the braking and gear-changing system. So, while not radar in the true meaning of the term, it functions in much the same way. The Optical Detector is sensitive from approximately 1.75 to 30 meters in front of the bus.

Right now the bus is only in use at the Road Laboratory, but eighty miles of cable have already been laid along a roadway in Berkshire. Soon all of Merrie England may be riding on automatic buses, and the rest of the world may not be far behind. ■



Passengers riding in this bus have a completely unobstructed view out the front windshield, there being no driver to get in the way. The driverless bus has been in operation for some time now at England's governmental testing labs and may soon be a familiar sight along many superhighways.

TUNE IN THE INCA EMPIRE And Hunt For Modern DX Gold

by Ralph W. Perry



This Cathedral known simply as The Cathedral of Lima, occupies the Plaza de Armas in that Peruvian city. Francisco Pizarro, Conquistadore, is interred in the cathedral.



This monument to Jose de San Martin stands in the Plaza San Martin in Lima, Peru. The Argentine general played a key role in the Peruvian fight for freedom.



Radio Tawantinsuyu has a small, capable staff manning the transmission facilities. Stations in the Andes and other South American locales are often small, but deliver powerful signals.

□ A half-century ago, the amazing Incas carved out an empire across the spine of the Andes Mountains in South America. Their sturdy little towns, built by stacking up precisely-sliced boulder chunks, peppered the mountain valleys.

Today, the shortwave spectrum is peppered by radio stations run by descendants of the Incas who, in fact, still speak the native tongue of the empire. Luckily for the radio freak, the signals from these stations sometimes "slice" through the noise and band interference as sharply as an Inca mason could slice through stone.

Stations broadcasting from the area of the old Inca Empire (modern-day Peru, Ecuador and Bolivia) have a style and feel all their own—and that's one reason for the "Land of the Llama" being a hot DX target. At its height, the empire required not one but two capital cities, the present-day Ecuadorian capital city of Quito; and the Peruvian town

of Cusco, in the Andean highlands. These are good starting points for a shortwave, Incan tour.

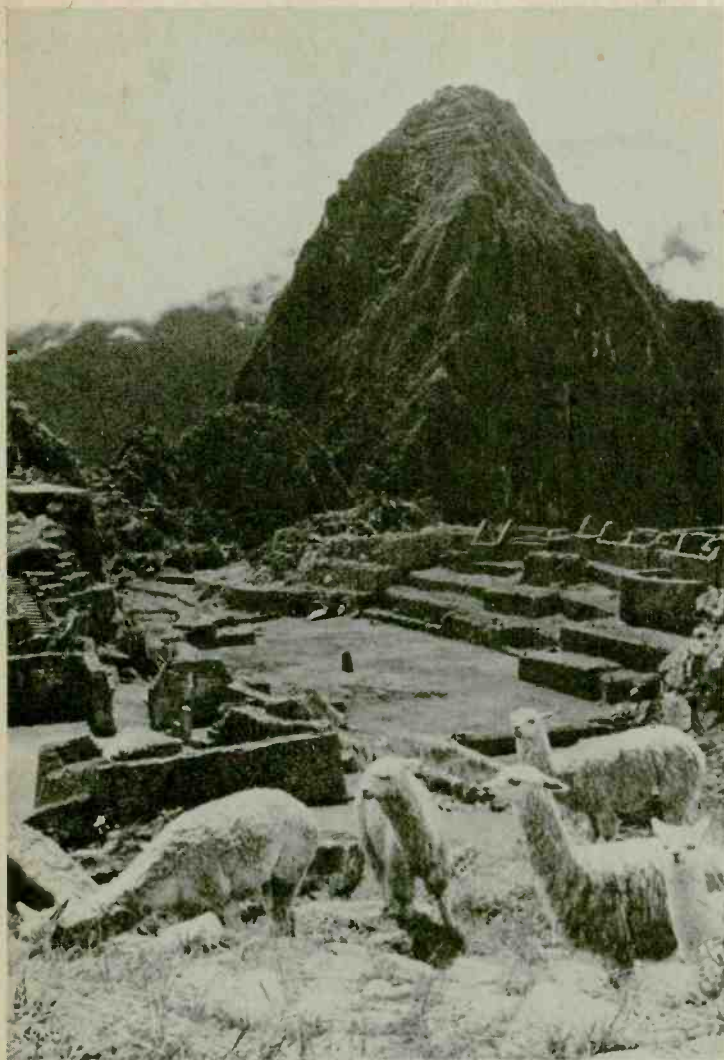
Training the Ears. You don't have to understand Spanish, or Quechua—the area's Indian tongue—to enjoy Andes DX. All that's usually required is initial exposure to the region's haunting music, which features raspy flutes, plucking of high-pitched, acoustic guitars and an instrument made of (believe it or not) armadillo skin, called a charango. If most Andes area musical tunes sound to you like the pop song "El Condor Pasa" by Simon and Garfunkel, it's because S&G "borrowed" the melody from an age-old Peruvian folk song called, surprisingly enough, "El Condor Pasa." New sounds, indeed!

To start out our Top 20 of the Inca empire, we'll pick a couple easy ones which feature typical regional music; HCJB in Quito, Ecuador, and Radio Nacional del Peru, transmitting from

Lima. HCJB offers fine "musica del campo" (rural folk songs), around 1200 Greenwich Mean Time (GMT) daily on 9715 and 6075 kHz. Radio Nacional del Peru is a frequent catch in the early evenings, around 0100 and later, on the in-betweenish frequency of 6082 kHz.

Now, let's buzz down to the other Inca capital, Cusco, in Peru. From there we will meander up the old "Inca Trail" retracing by radio the footpath which linked the north and south of the empire. Imperial runners once used the Trail to keep their empire in constant communication—the Incas depended on their runners much as we depend on radio today. These "chaquis" were able to hustle fresh fish from the ocean to the Emperor's table in Cusco (a mere 250 miles) without a bit of spoilage to dampen the royal appetite.

Listen to History. Cusco is a bustling town which, viewed from the heights of



Machu Picchu, the Lost City of the Incas, was recently discovered near Cuzco. Incan Virgins of the Sun hid there from the Spanish.



Radio Onda Imperial QSLs with a unique card that pictures an old Incan wall that is still standing near the station in Cuzco, Peru. Hear "Radio Waves of the Empire," 1100 GMT on 5055 KHz.



This bounteous, Bolivian lass stands amidst the tumbled minaret shaped ruins of Bolivia's beautiful Moon Valley.

the surrounding mountains, appears like a sea of red-tiled roofs. Cuzco was the prime city of the Incas, but the Spaniards sacked it in the mid-1530s and build the modern city upon the ruins. However, Cuscenos know their "roots." Broadcasting from a studio up a side street from a still-standing Incan wall is Radio Onda Imperial, 5055 kHz, which is a difficult catch at best! Its genial owner, Senor Alberto Barrioneuvo, and his mother run the whole show, with six deejays. Try to catch this prime DX target around 1100 GMT. Alberto says the station's tag means "Radio Waves of the Empire." Not bad, eh?

Equally caught up in the glorious past is another Cuzco station, Radio Tawantinsuyu, which broadcasts from a tangerine and cream-colored one-story studio. Their multisyllabic name, director Raul Montesinos explains, means "four divisions" of the empire . . . and the Incas liked the term so much, that

that's what they called their land: Tawantinsuyu. If you're lucky, you can hear the electronic version signing on at 1000 GMT on 6175 kHz. in the 49 meter band.

Historians have discovered the astonishing fact that the Incans had no written language and were still able to administer a far-flung empire. Their secret? A lot of knots! The Incas invented an ingenious rope-tying system, based on numbers, by which they stored much information. The wise men who could decipher a knotted rope were titled "Amautas." This leads us to another Peruvian station—Radio Cultural Amauta in Huanta. This station has been spotted with some regularity in early spring and late fall on 4955 kHz., signing on at 1100 GMT (six a.m. in Peru).

Even in the swank, cosmopolitan, up-to-date Peruvian capital of Lima, you can find Incan descendants gazing

back at their glorious past. Try Radio Inca del Peru on 4762 kHz. at about 1030 GMT. or, if you need your sleep, tune in at about 0330 GMT.

Rounding out the Peruvian selection are two more stations. Radio America is often known to change frequency within the range of 9505 to 9510 kHz, but look for it for its different sound. Radio Libertad de Junin (Radio Liberty of Junin) is on-again, off-again on 5040 kHz., but when they're in business they broadcast a *magnifico* signal around 1030 GMT.

Heading North—Ecuador. Up at the north end of Incaland, right on the earth's waistline, is Ecuador, a favorite for many due to the tangy brand of music offered. Ecuadorian music, while an obvious cousin to the fare offered in Peru, is a little more modern with, perhaps, a catchier beat and more melodic variation. If you don't know a pasacalle from a bombo, move right

over to the rig and tune in a few of these:

The easiest Ecu-DX has to be Radio Nacional Progreso (R. National Progress), which transmits from the Ecuadorian city of Loja. This one is a snap for two reasons: their power will knock the shingles off your shack; and they have a beautiful frequency, 5660 kHz., just about the last station you tune as you cruise up the top end of the 60 meter band. Just keep listening for that catchy sound, anytime after dark at your location, until about 0400 GMT.

Radio Nacional del Ecuador (Radio National of Ecuador) is back on the air nowadays and they're packing quite a punch! 4939 kHz. is the frequency and 0200 GMT the time for an evening of pleasant melodies and no-strain reception.

If you want something more of a challenge—then Radio Zaracay, in Santo Domingo de los Colorados, Ecuador, is the answer. The city of Santo Do-

mingo borrows part of its name from the Colorado Indians who live in the surrounding hills and, presumably, tune Radio Zaracay. Make like a Colorado and tune 3390 kHz. (just about the top of the rough 90 meter band) at 0230 GMT or later. Recognize that music? And don't you love it?!

To round out the Ecuadorian picks, try these: Radio Splendit (for a splendid time) on 5025 kHz. around 1000 GMT and again at 0300 GMT; Emisora Gran Colombia, 4910 kHz., broadcasting daily from Quito at 1100 GMT sign-on with consistently good strength; Radio Paz Y Bien (Peace and Goodness), a religious station in Ambato, which requires an early check of its 4820 kHz. frequency, at about 0930 GMT, when they often first take the air; and finally, my favorite: Escuelas Radiofonicas Populares, which translates as "Popular Radio Schools." Located in the town of Riobamba, perched high atop the Andean chain which runs the length of Ecuador, north to south, this school will indeed teach you something: patience! Although it is sometimes well heard at 0200 GMT, the

frequency of 3985 kHz. plops it right in the high-end of the 75-meter ham radio band. The hams, rightfully enough as the frequency is theirs under international agreements, tend to make it hard to copy their Latin competition.

But of Course, Bolivia! Mention "Bolivia" and you're spouting fightin' words for many an Andes-DX enthusiast. While Bolivian stations and programming are choice DX, they've been hard to log.

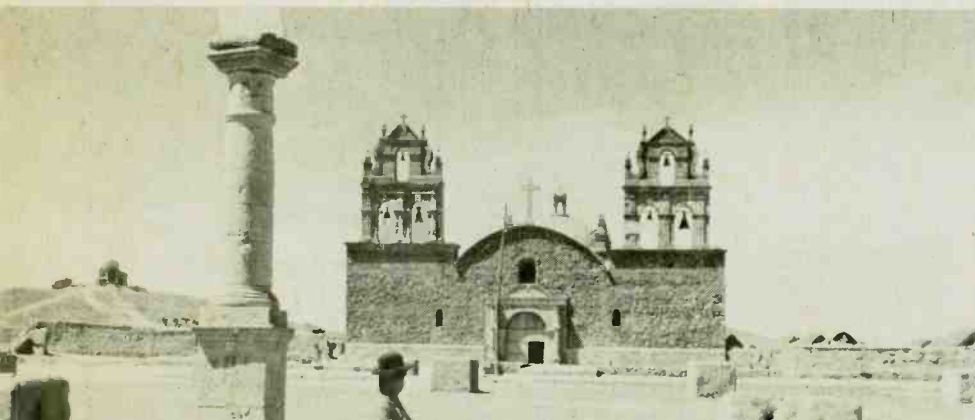
Your best bet for the land of the high, windswept "Altiplano" (a bleak, treeless plain populated by Indians and llamas, and also the location of the astonishingly blue and beautiful Lake Titicaca) is probably the La Paz station, Radio Panamericana, on 6034 kHz. around 1030 GMT. Prepare yourself for a surprise when tuning this one—the signal quality is A-1 all the way. Although La Paz is a highly "with-it" city, get it on Radio Panamericana during its first hour or so and you'll be listening to their equivalent of an early morning "farm show," with music of a highly rustic nature for the Indians in the countryside.

Next we have to swing down to 60 meters for the rest of our Bolivian visitors. A big favorite is Radio Nueva America, 4797 kHz. (officially 4795 kHz.), also a La Paz station, which also signs on at about 1030 GMT. Nice thing about these Bolivians is that if one isn't in, you didn't crawl out of the sack for nothing, just try another! Radio "New America," as the English version goes, is heavy on the flute/guitar/drum fare and, as such, is just fine with us!

In Oruro, Bolivia, an interesting station is Radioemisoras Bolivia, which flits about within the frequency range 4753-4756 kHz. Not a very easy one, they are most often noted during the wee, wee hours—about 0900 or shortly after, for by 1000 GMT, interference in the form of a potent Colombian station arrives on the scene!

Lest anyone get the impression that Bolivia is all mountain, we'd better throw in Radio Mamore (which, while it looks like it should rhyme with "amor," it is actually mah-moe-RAY. Amor or no, you'll still love it!), transmitting from Guayaramerin, Bolivia, on the bank of the River Mamore, which separates Bolivia from Brazil. Listen to the rather tropical sounds of this station, operated by the very genial Carlos Hurtado Romana, and remember that in this neck of the woods it's indeed just that. Woods! In fact, it's jungle.

And that's probably why our Inca friends chose to remain up in the nice, cool reaches of the Andes. Why not join them electronically speaking? ■



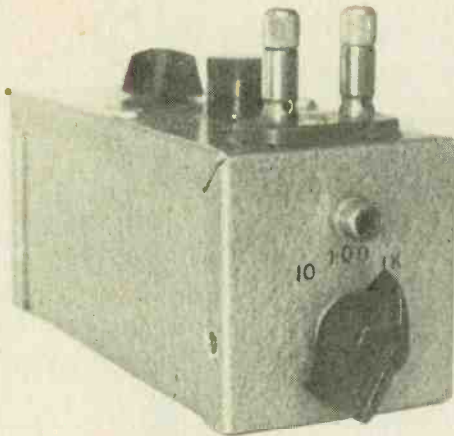
The architecture found in the Bolivian highlands is rare and altogether unique. Many ancient villages lie close to such beautiful and dramatic structures out of the nation's past.



This Indian woman and child seem like visions from the Empire's past at the Tambochay Ruins just outside of Cuzco.



The Presidential Guard at the palace in Plaza de Armas, in Lima, Peru, wears a costume that comes from centuries of tradition.



FRAG

your friendly audio generator

By Frederick W. Chesson

IF YOU NEED AN INEXPENSIVE and highly portable audio test set, this Full Range Audio Generator (FRAG) is for you! Our friendly FRAG delivers variable and fixed outputs of sinusoidal waveform from 10 Hz to over 15 kHz and up to five volts peak-to-peak.

The Circuit. There are several circuit networks which can produce a sinusoidal waveform, including the Phase-Shift and the Twin-T. It is the latter which will be examined here, as it proved in application to be the most suitable for the FRAG.

As shown in the Twin-T Oscillator diagram, we have a Low-Pass network of R1, R2, and C1 in parallel with a High-Pass network formed by C2, C3, and R3. The combined network is connected between the inverting input and output of a gain device, such as the familiar 741 integrated circuit op-amp. Typically, R1 = R2, while R3 is one-half to one-tenth of R1, and C1 = C2, and C3 = 2C1.

Since the phase shifts for the two networks are opposite, there exists, in theory, only one frequency where the total phase-shift from input to output will reach 180°, at which point sinusoidal oscillations will occur, provided sufficient gain is available. The approximate frequency will be

$$F = \frac{1}{2 \pi R_1 C_1}$$

Varying any or all of the network elements will cause the nominal frequency to change, accompanied by a drop in output, until oscillation can no longer be sustained. Over a certain range, varying the resistive elements simultaneously, as by a ganged potentiometer, will yield a useful frequency span, provided the gain can be raised appropriately, but without causing over-driven distortion.

Shunting the Twin-T network with a

fixed resistance RF yielded fair results, in experiments conducted to obtain a wide operating range consistent with simplicity. It was then found that addition of a diode back-to-back pair, forming an active feedback element, gave a considerably greater range, as shown. Further experimentation finally showed that even greater improvement could be obtained by connecting the feedback elements between output and the *offset-null* terminal associated with the inverting-input. Three switch positions give ranges of 10-100 Hz, 100-1000 Hz, and 1kHz - 10kHz. A fixed output of about 5 VPP and a variable output of 0-1.0 VPP were added to provide a choice of useful signal levels.

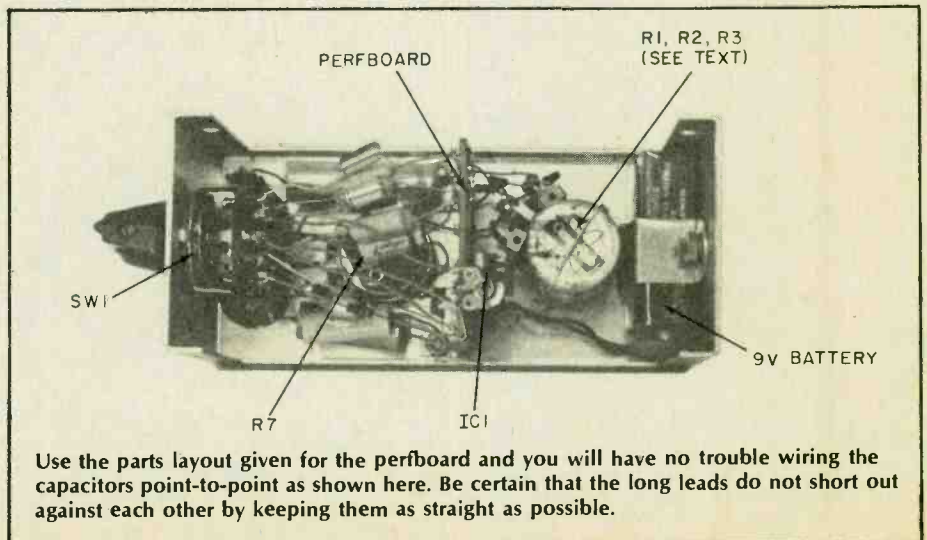
Put It All Together. For convenience in portability, a utility box having a five inch length by two and one-quarter inch height and width was selected (Either Bud CU-2104A or Premier 12P3886 types are suitable).

A photo shows the parts placement of the prototype, with the range-capacitors being strung between the range switch and a perf-board mounting the

integrated circuit and other components. Check the drawing to see how these components may be placed on a two inch square section of perf-board having 0.1 inch spaced holes. A pair of No. Six ground lugs are bent at right angles to serve as miniature mounting brackets. There is sufficient room for a 14-pin DIP IC socket for the 741 op-amp, should replaceability be desired. Although a mini-dip 8-pin 741 was used in this circuit, the standard 14-pin unit will do as well, paying attention to the pin connections. The nine-volt transistor battery (Eveready type 222, or equivalent) is secured in place by an S-shaped half-inch wide aluminum bracket.

The only component difficult to find is a three-gang 250K, 250K, 25K potentiometer, used for variable frequency settings. If a ready-made assembly (preferably log-taper) cannot be obtained, use a built-up unit, like Centralab *Fastach* components.

Optional resistors R4, R5, and R6 are included so that the variable frequency dial may be rotated to maxi-



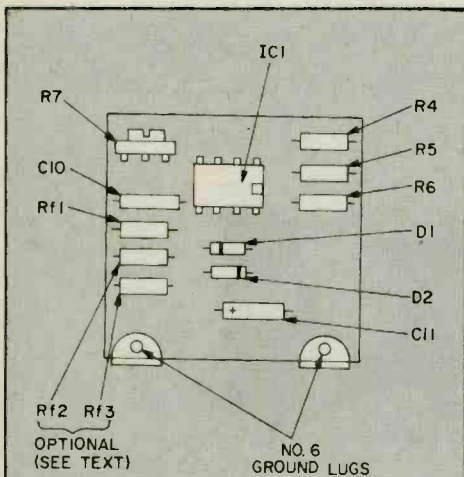
Use the parts layout given for the perfboard and you will have no trouble wiring the capacitors point-to-point as shown here. Be certain that the long leads do not short out against each other by keeping them as straight as possible.

imum frequency without having the circuit drop out of oscillation, as it would should R1, R2, and R3 fall too low. Temporarily omit the feedback resistor(s) RF for later adjustment. If a four pole-three position switch (such as Calctro E2-168) is available, then each range may have its own individually selected feedback resistor for maximum efficiency.

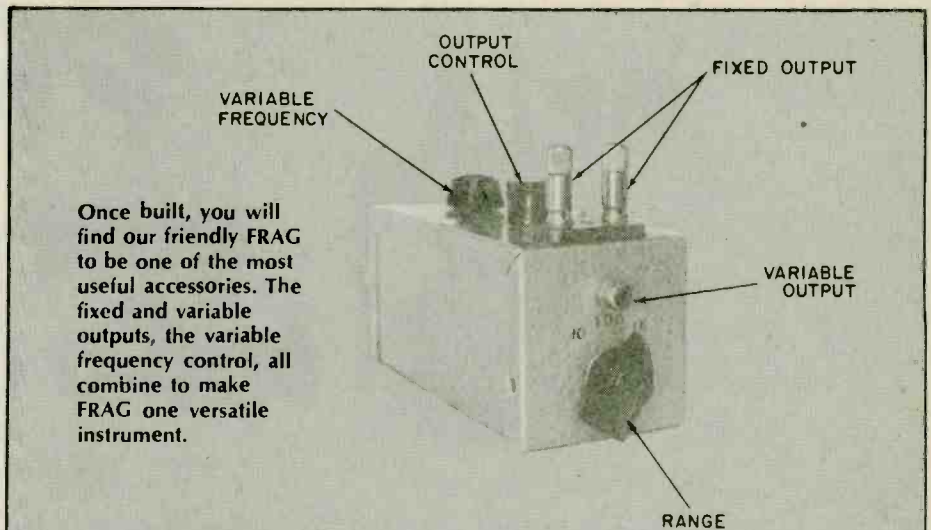
Adjustment and Operation. An oscilloscope is essential for adjustment of the friendly FRAG to determine optimum waveform and amplitude and for rough frequency determinations. A frequency-counter is also useful, although the FRAG is not intended to be a precision audio generator.

Before applying power, set the input bias potentiometer R7 for approximate midrange position and connect a decade resistance box, set at about 33K ohms, in place of RF. Set the Range Switch to its middle (X100) position and the variable frequency control to its mid position. Connect the scope (and frequency counter, if available) to the fixed output terminals.

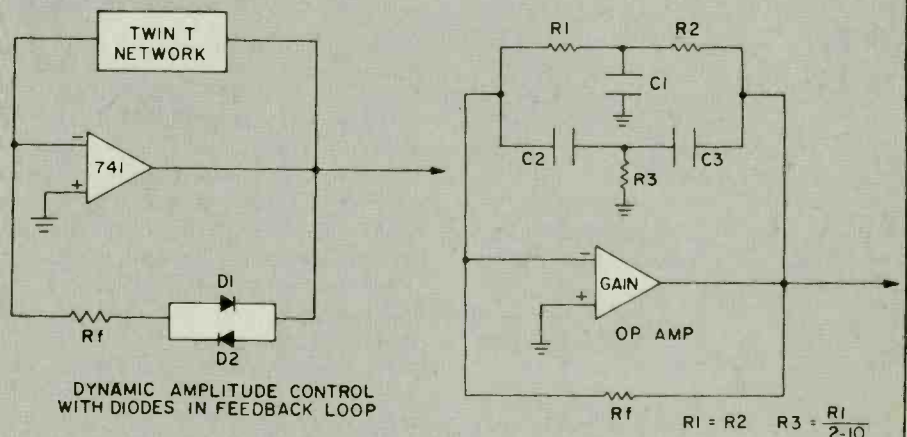
Switch on the power by turning the Output control to mid-position. The scope should display a more or less square wave of about 200 Hz. Adjust the decade box, or individual fixed resistor, for a sinusoidal waveform of maximum amplitude, consistent with low distortion. If the wave is flattened at top or bottom, try adjusting R7 while rechecking RF. Rotate the variable frequency control from one end to the other, rechecking RF and R7



Use this parts layout for your perfboard. Rf2 and Rf3 are optional, as mentioned in the text. Also, use a socket for IC1.



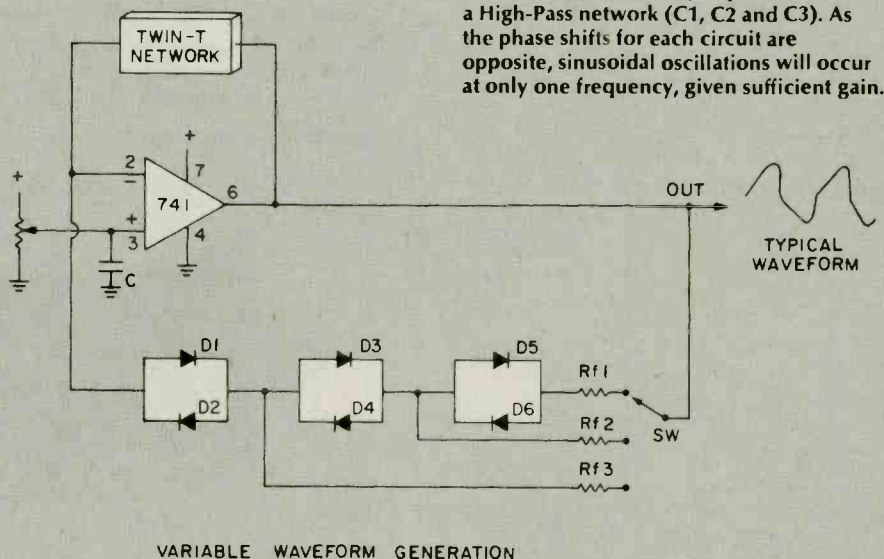
Once built, you will find our friendly FRAG to be one of the most useful accessories. The fixed and variable outputs, the variable frequency control, all combine to make FRAG one versatile instrument.



Shunting a Twin-T network with feedback resistance (Rf) yielded fair results. The addition of a back-to-back diode pair as an active feedback element greatly tended to increase the FRAG's operating range.

BASIC TWIN-T OSCILLATOR

This basic Twin-T circuit uses a Low-Pass network (R1, R2 and R3) in parallel with a High-Pass network (C1, C2 and C3). As the phase shifts for each circuit are opposite, sinusoidal oscillations will occur at only one frequency, given sufficient gain.



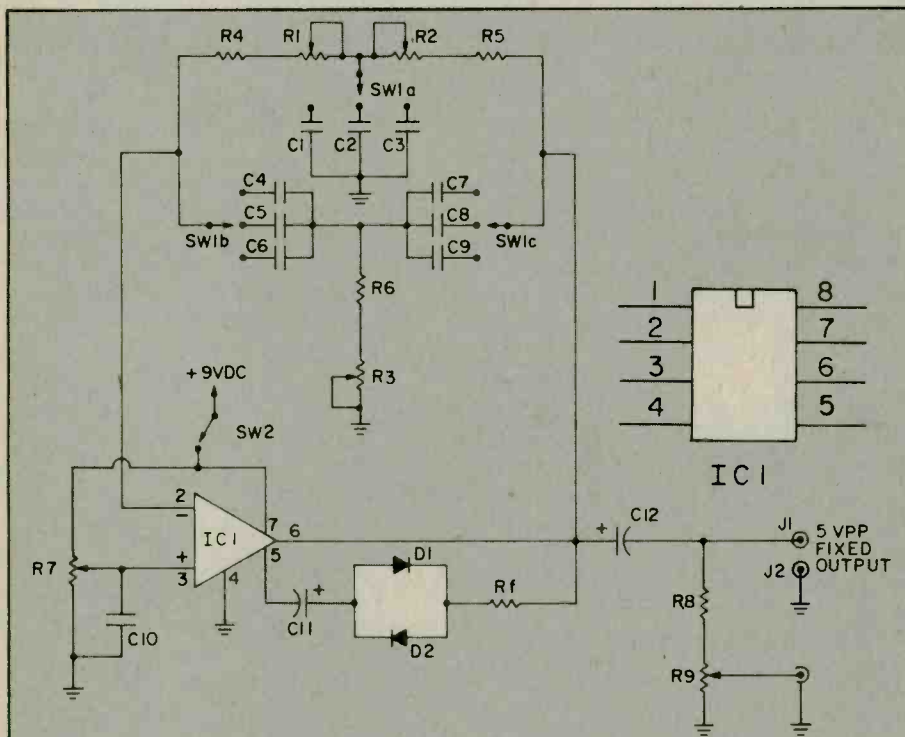
During development of the FRAG, additional diode pairs were added to see if they would further increase the variable frequency range. They did—but at the cost of adding some distortion. This, however, results in some interesting tones—music!

should distortion occur. Amplitude will be less at each end of the dial, and will drop out entirely at the upper end, unless the optional resistors R4, R5 and R6 have been included. A maximum output of 5 VPP should be obtainable at the fixed output terminals and up to 1 VPP at the variable output jack. If separate feedback resistors are used

(with a four-pole Range Switch) re-check the other two range positions and select the correct individual resistors and mount them on the perf-board. Otherwise, a single feedback resistor will have to be a compromise for best operation over the entire span of all three ranges.

The variable frequency dial may be

calibrated simply on a 1 to 10 basis, which should hold good for the three ranges. If a linear potentiometer is used (all that was available in the Fastach components at time of construction) the dial will necessarily be non-linear, which is why a log-taper pot is more desirable. Also, due to mechanical backlash in the stacked sections, it is best



Parts List For The Friendly FRAG

- IC1—Type 741C (Radio Shack 276-010 or equiv.)
- C1—22 μ F capacitor (Radio Shack 272-1402 or equiv.)
- C2—.02 μ F capacitor (Allied 710R1136 or equiv.)
- C3—.002 μ F capacitor (Allied 710R1093 or equiv.)
- C4, C7—.1 μ F capacitors (Radio Shack 272-1069 or equiv.)
- C5, C8—.01 μ F capacitors (Radio Shack 272-131 or equiv.)
- C6, C9—.001 μ F capacitors (Radio Shack 272-126 or equiv.)
- C10—.1 μ F capacitor (Radio Shack 272-135 or equiv.)
- C11—10 μ F electrolytic capacitor (Radio Shack 272-1002 or equiv.)
- C12—220 μ F electrolytic capacitor (Radio Shack 272-1006 or equiv.)
- D1, D2—1N914 silicon diodes (Radio Shack 276-1122 or equiv.)
- R1, R2, R3—250,000-ohm, 250,000-ohm, 25,000-ohm, ganged potentiometer (Centralab "Fastach")
- R4, R5—10,000-ohm, 1/4-watt resistor (Radio Shack 271-1335 or equiv.)
- R6—1,000-ohm, 1/4-watt resistor (Radio Shack 271-1321 or equiv.)

- R7—5,000-ohm trimmer potentiometer (Radio Shack 271-217 or equiv.)
 - R8—4,700-ohm, 1/4-watt resistor (Radio Shack 271-1330 or equiv.)
 - R9—1,000-ohm potentiometer (Allied 854-5800 or equiv.)
 - SW1—3-position, 3 or 4-pole miniature rotary switch (Calectro E2-168 or equiv.)
 - SW2—potentiometer switch (mount on back of R9) (Radio Shack 271-1740 or equiv.)
 - Rf—feedback resistors (see text)
 - J1—Pair of five-way binding posts (Radio Shack 274-661 or equiv.)
 - J2—RCA type phono jack (Radio Shack 272-346 or equiv.)
 - Misc.—9-V battery, battery clip, perf. board with .1-in. spacing (Radio Shack 276-1395 or equiv.), perf. board terminals (Radio Shack 270-1392 or equiv.), DIP socket (Radio Shack 276-027 or equiv.), a 5 x 2.25 x 2.25-inch chassis (such as the Bud CU 2104A), wire, solder, etc.
- Allied Electronics' address is:
401 East 8th St., Ft. Worth, Texas 76102
Calectro Electronics' address is:
400 S. Wyman St., Rockford, Ill. 61101
Centralab Electronics' address is:
P.O. Box 858, Fort Dodge, Iowa 50501



Looking at FRAG from the front shows the frequency range selector, as well as the output terminals and level controls on top.

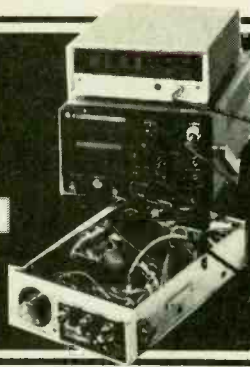
to move well past an over-shot frequency point before reversing to zero back in. The 0-1 VPP shielded jack is best for low-level output applications involving audio amplifiers and other high-input impedance gear. The 5 VPP fixed-output terminals are useful for general purposes, or where it may be desired to construct fixed voltage-divider networks.

Although the battery drain is quite modest, make sure to turn off the test set when not in use.

Range Switch Positions			
X	FREQ.	SW1a	SW1b/c
10	10-100	C1	C4/C7
100	100-1000	C2	C5/C8
1K	1K-10K	C3	C6/C9

Other Applications. During development of the circuitry, additional diode pairs were tried to see how far their "dynamic feedback" operation could extend the variable frequency range. Although two pairs gave some increase, this was at the expense of waveform purity. This distortion, however, can be put to use in the area of electronic music. The last diagram shows how a chain of diodes, with individually selected feedback resistors may be switched in to provide for the generation of interesting synthetic tones . . . another benefit of this original FRAG! ■

CB XCVR CHECKOUT



- COMMUNICATION POWER CP 4000
- MIDLAND 77-849
- SHARP CB-5470
- TRAM/DIAMOND D-12

ELEMENTARY ELECTRONICS has been able to obtain more of the new 40-channel CB transceivers for review, and presents the test reports here. These units are not prototypes, but are "stock standard," the same as the transceivers that you can buy over the counter. If you don't find the particular unit you are interested in reported on here, check for the 1978 edition of CB YEARBOOK, soon to be on the newsstands.

● COMMUNICATION POWER CP 400

\$599.00 (Communication Power, Inc.)

General Description: A 40-channel AM/SSB transceiver for mobile, P.A., operation. Fine tuning ± 1 kHz is provided. Power supply is 12 to 13.8 VDC with negative ground and 120 VAC. (Can be modified for positive ground.) Overall dimensions are 2¼-in. H x 9-in. W x 11¾-in. D. There are front panel controls for channel selection, volume, squelch, clarifier, and AM/USB/LSB switches for power, speaker 1/2, PA/CB, and noise blanker. Standard accessories include a DC power cable, mobile bracket with key-lock, and power microphone.



CIRCLE 63 ON READER SERVICE COUPON

Receiver Section Test:

Input Sensitivity	1.0 uV
Adjacent Channel Rejection	73 dB
AGC Action	9 dB
SSB Opposite Sideband Rejection	45 dB
Input Level for S9 Meter	
Indication	28 uV

Transmitter Section Test:

AM RF Output	3.8 watts
--------------------	-----------

SSB RF Output	14.0 watts P.E.P.
Modulation to 85%	yes
Relative sensitivity for	
85% Modulation	-52 dB max.
Modulation Limited to 100%	yes

Editorial Remarks: Has connections on power plug for external and P.A. speakers. Power mike has sensitivity control. Also an S/RF-output meter. The S-meter has a relative S-unit scale calibration. ■

● MIDLAND 77-849

\$269.95 (Midland International Corp.)

General Description: A 40-channel AM transceiver for mobile, P.A. operation. Power supply is 12 to 13.8 VDC with negative or positive ground. Microphone has sub-master volume control and channel selectors.



CIRCLE 65 ON READER SERVICE COUPON

Overall dimensions are 2½-in. H x 7-in. W x 8¼-in. D. There are front panel controls for volume, squelch/P.A., SWR calibrate and channel indicator dimmer. Switches for channel selection, meter function, ANL, noise blanker, CB to P.A. speaker, and local/distance sensitivity. Standard accessories include a microphone, mobile mount, DC power cable.

Receiver Section Test:

Input Sensitivity	0.4 uV
Adjacent Channel Rejection	68 dB

AGC Action	7 dB
Input Level for S9 Meter	
Indication	50 uV

Transmitter Section Test:

AM RF Output	3.5 watts
Modulation to 85%	yes
Relative Sensitivity for	
85% Modulation	-35 dB
Modulation Limited to 100%	yes

Editorial Remarks: A double conversion receiver with jacks for external and P.A. speakers, and a microphone with auxiliary channel selectors and volume control. L.E.D. digital channel indicator. Also an S/RF-output/SWR meter. The S-meter has a relative S-unit scale calibration. ■

● SHARP CB-5470

\$249.95 (Sharp Electronics Corp.)

General Description: A 40-channel AM/SSB transceiver for mobile, P.A., operation. Fine tuning ± 800 Hz is provided. Power supply is 12



CIRCLE 50 ON READER SERVICE COUPON

to 13.8 VDC with negative or positive ground. Overall dimensions are 2¾-in. H x 7½-in. W x 9⅝-in. D. There are front panel controls for channel selection, volume, squelch/PA, RF gain, clarifier. Switches for AM/USB/LSB, noise blanker. Standard accessories include a microphone, mobile mount, DC power cable.

Receiver Section Test:

Input Sensitivity	0.7 uV AM
Adjacent Channel Rejection	64 dB
AGC Action	16 dB
SSB Opposite Sideband	
Rejection	50+ dB

(Continued on page 92)

e/e checks out the...

B&K 1827 Frequency Counter

This high quality unit keeps your CB on the beam.



CIRCLE 61 ON READER SERVICE COUPON

Just a few short years ago even the simplest frequency counter was priced well beyond the budget of a service shop, let alone a hobbyist, but technical advances have come so fast it's now possible to turn out an autoranging frequency meter for \$120.

The device that features all this operating and price convenience is B & K's Model 1827 Autoranging Frequency Counter, actually the basic unit of a complete optional-accessory system we'll look at later. The model 1827 is small enough to fit inside a tool box, or even an oversize jacket pocket, although the display consists of six oversize LEDs approximately 0.3-inches high, which is a larger display than you'll find on many "laboratory grade" counters.

The 1827 has only two operating controls. The first is a function switch that provides for *Off*, *Auto Time Base*, and *1-second time base*. The second

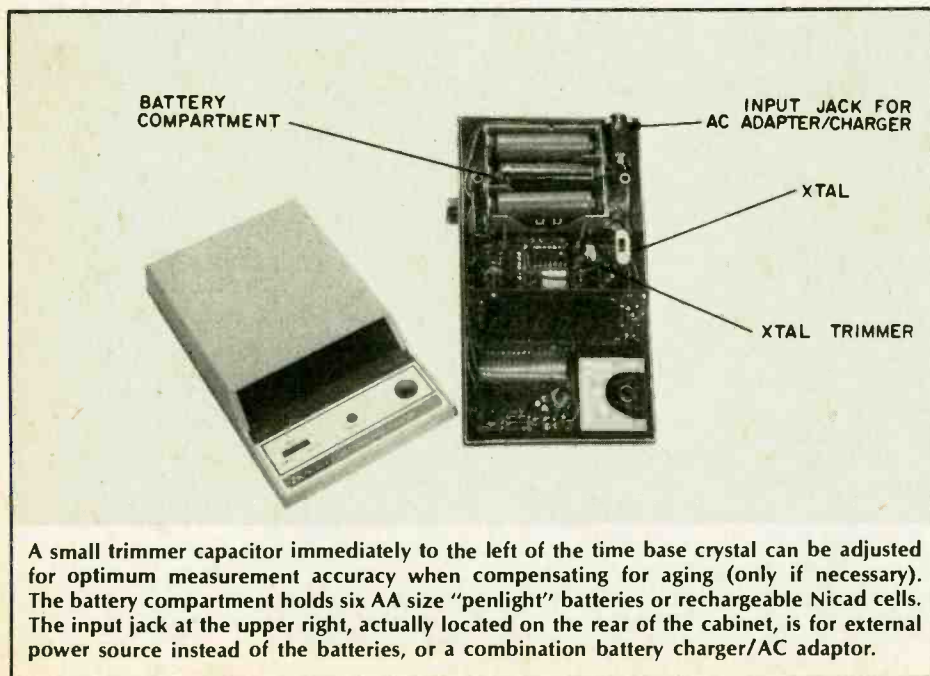
control is a pushbutton switch for *Display*. To conserve battery power the display is blanked *Off* because LEDs of any type consume a relatively large amount of power. To indicate that power is *On*, both a decimal point and the kHz or MHz LED are illuminated even with the digits blanked *Off*. To take a frequency reading the user presses the display switch which turns on the frequency display for approximately 10-seconds, at which time the display is again turned off to conserve battery power. Each time the *Display* switch is pressed the display is turned on for about 10-seconds. When the frequency counter is powered by the optional AC adaptor, or an external power source, the display remains *On* at all times.

The 1827's guaranteed frequency range is 100 Hz to 30 MHz, and this requires some explanation. The high end of our model went to about 35 MHz, but this might not be possible on

all units so B & K guarantees an upper limit of 30 MHz. 100 Hz is the lower limit when autoranging from a frequency that requires six digits for a megahertz display; for example, 29,161,165 MHz, the display can only indicate 29.1611 MHz. If the function switch is moved to the 1-second time base position the least significant digits will be given; the display will indicate 161.165, and an *overrange* indicator lamp will illuminate to show there are more significant digits. This is standard display technique for any counter whose total frequency range exceeds the available number of display digits. Use the autorange function to obtain the most significant digits, than a slower 1-second time base for the least significant digits. In this manner the counter has an effective frequency range from 1 Hz to the upper frequency limit ± 1 count \pm the time base accuracy. (It's ± 1 count at the instant the count is taken because of inherent design: in the usual frequency counter the total count is usually off by one. 1 Hz on any typical counter might be displayed as 0, 1 or 2.)

Autoranging is a function that simply eliminates using a switch to hunt for, or to set the correct time base. In the model 1827 the correct time base is automatically selected and kHz or MHz is indicated by LED lamps. Also, the decimal point is correctly positioned by the autoranging circuit.

Here's how it works in actual practice: You feed the unknown frequency into the meter and the meter selects the correct time base. Assume the input is 213.989 kHz. The meter displays 213.989 and the kHz LED indicator illuminates to show the frequency is 213.989 kHz. If the frequency is 21.3989 MHz, the display shows 21.3989 and the MHz LED indicator lights, indicating a frequency of 21.3989 MHz. If the meter is set to the 1-second time base to observe least significant digits the *Overrange LED* indicator previous-

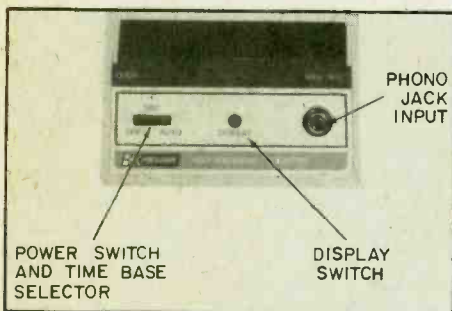


e/e B&K 1827 COUNTER

ly mentioned would light if there is overflow of a most significant digit.

Phono In. The input to the meter is a phono type jack, and a matching shielded test lead terminated in alligator clips is supplied. The input sensitivity ranges from 100 to 200 mV depending on the frequency. The maximum input voltage (AC +DC) ranges from a high of 200 V up to 500 Hz, to a linearly derated low of 25 volts at MHz. (Most service and lower cost lab-grade counters derate as the frequency increases; on the 1827 the maximum derated voltage at the CB frequencies is still sufficiently high to allow testing of CB transmitters).

The 1827's sensitivity is normally sufficient to receive signals within 6-foot of a CB antenna—a direct connection to the transmitter's output isn't required



Operation couldn't be easier. The left hand switch controls the power and automatic selection of the correct time base, or a 1-second time base

Accurate. The overall accuracy of the B & K 1827 is similar to most other counters that don't use a TXO—a *temperature compensated crystal oscillator* which requires a "permanent" power connection for the crystal oven. The internal 4 MHz reference crystal provides a temperature stability of $\pm 0.001\%$ (i.e. ± 10 PPM) from 0-50°C, with a maximum aging rate of 1 PPM/month, 10/PPM/year.

Summing Up. The B & K 1827 Autorange Frequency Counter is ideal for general radio and TV service and CB measurements. Used in conjunction with any of the X10 prescalers it allows measurements to be made up to 300 MHz or the upper limit of the prescaler—whichever is less. Naturally, this extended range covers the 50, 144, and 220 MHz amateur bands as well as the low and high public service bands.

For additional information on the B & K 1827 Frequency Counter circle No. 61 on the reader's service coupon. ■

IT'S SIMPLY BASIC

Attack the Decibel problem with this Basic computer program from ELEMENTARY ELECTRONICS

by Larry Friedman, WB2AHN

□ You don't have to be an electronic genius to build a personal computer, any more than you have to be a math wizard to program one. Using what is considered "the student's language," called BASIC, even the newcomer to computers can quickly learn to program using simplified statements in the English language.

While there is a never ending supply of books containing BASIC programs, many of them are filled with games of which you easily tire, or the programs are too specialized, such as computing real estate depreciation or navigation.

In this column you will find simplified BASIC programs specifically oriented to the electronic hobbyist who is also a beginner in computer programming. The programs here will have extra detail and more steps than is usual

so you can follow the reasoning and make your own modification. Where necessary, we will also show you a RUN of the program, or rather, a printout of what it should look like when you use the program. For example, in this issue you will see the LISTING and RUN of a program that solves power and voltage ratios. To aid you in your understanding of the program, positive and negative values are used in the program RUN. You'll also find in the program a REM statement at the end showing how you can modify the program to recycle automatically when you have to make many calculations with different voltage or power ratios.

To help you get a better understanding of BASIC programming, we recommend that you obtain a copy of "Basic BASIC" by James Coan (Hayden Book

DECIBL

```

0010 REM - BY LARRY FRIEDMAN
0020 PRINT
0030 REM - LINE 40 SETS DECIMAL TO 2 PLACES.
0040 DIGITS= 2 ! MAY NEED MODIFICATION ON YOUR SYSTEM.
0045 REM - PROGRAM STARTS HERE
0050 PRINT "DECIBELS FOR VOLTAGE AND POWER RATIOS"
0060 PRINT "ENTER MODE (VOLTAGE OR POWER)";
0070 INPUT X$
0080 IF X$="VOLTAGE" GOTO 200
0090 I=10
0100 PRINT "ENTER P1 IN WATTS";
0110 INPUT P1
0120 PRINT "ENTER P2 IN WATTS";
0130 INPUT P2
0140 A=P1
0150 B=P2
0155 PRINT
0160 GOTO 500
0200 PRINT "ENTER E1 IN VOLTS";
0210 INPUT E1
0220 PRINT "ENTER E2 IN VOLTS";
0230 INPUT E2
0240 A=E1
0250 B=E2
0270 I=20
0280 PRINT
0475 REM - LINE 500 CONVERTS LOG NATURAL TO LOG BASE 10
0500 X= I * LOG (A/B)/LOG (10)
0530 PRINT "THE ";X$;" RATIO REPRESENTS A CHANGE OF ";X;" DECIBELS."
0540 PRINT
0541 PRINT
0548 PRINT
0550 STOP
0560 REM - IF YOU WANT THE PROGRAM TO AUTOMATICALLY RECYCLE
0570 REM - CHANGE LINE 550 TO 550 GOTO 50
0580 END

```




Just fourteen years old, Larry Friedman, who set up this program, is an old hand with computers. He has built his own computer system using an SWTP 6800 as the base. The computer gets such diverse uses as processing complex electronic equipment test reports and keeping the statistics for Larry's baseball and bowling teams. Larry is also a consultant on programs for electronics experimenters, an amateur radio operator (his call is WB2AHN).

Company) as most of the programs we'll be using follow the techniques illustrated in this book.

If you have any specific electronic hobbyist programs you'd like to see just drop a note to "It's Simply BASIC." If your idea has general interest we'll work up the program for a future column.

Our program this month is DECIBL, which calculates the dB values for volt-

age and power ratios. Statements which follow REM (meaning *remarks*) are simply notes to assist you in your understanding of the program. They are not part of the program itself.

For an even better understanding of BASIC, take a look at the beginning of our first course in BASIC right here in this month's ELEMENTARY ELECTRONICS. You can't say we are not trying to help you talk to your computer.

Programs are written in SWTP type 1.0 8K basic, and might require some modification for use with other BASIC interpreters. Programs for this column are checked and debugged using a SWTP 6800 computer with 12K memory, a Micro-Term ACT-1 CRT terminal, an ASR 33 TTY, and a National Multiplex CC8 recorder. Print-out will fit single line TTY or two lines on most CRT terminals.

SAMPLE RUN OF DECIBL

RUN

```
DECIBELS FOR VOLTAGE AND POWER RATIOS
ENTER MODE (VOLTAGE OR POWER)? VOLTAGE
ENTER E1 IN VOLTS? 40
ENTER E2 IN VOLTS? 20
```

THE VOLTAGE RATIO REPRESENTS A CHANGE OF 6.02 DECIBELS.

```
STOP 0550
READY
#RUN
```

```
DECIBELS FOR VOLTAGE AND POWER RATIOS
ENTER MODE (VOLTAGE OR POWER)? POWER
ENTER P1 IN WATTS? 4
ENTER P2 IN WATTS? 2
```

THE POWER RATIO REPRESENTS A CHANGE OF 3.01 DECIBELS.

```
STOP 0550
READY
#RUN
```

```
DECIBELS FOR VOLTAGE AND POWER RATIOS
ENTER MODE (VOLTAGE OR POWER)? VOLTAGE
ENTER E1 IN VOLTS? 437
ENTER E2 IN VOLTS? 876
```

THE VOLTAGE RATIO REPRESENTS A CHANGE OF -6.04 DECIBELS.

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STOP 0550
READY
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KRAZY KEYBOARD

It could be the shape of things to come.



□ While computers and terminals keep on getting more and more state-of-the-art, advancing generation by generation toward some humanly unknowable, cybernetic perfection—one device still remains trapped within the stasis of an electronic Stone Age. That keyboard you type your Input on just isn't as advanced as the rest of your computer. A British electronic firm has recently developed what they term "a fully ergonomic keyboard." That is the Queen's English for a keyboard made to fit the human hand's anatomical design. The new keyboard has been revamped into a three-dimensional wonder of efficiency. Fingers no longer have to make unnaturally long stretches to reach the keys. Middle finger keys are set deeper into the keyboard than little-finger keys, and keys for the index and ring fingers are at different heights.

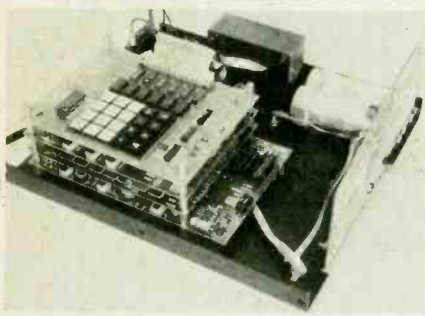
Even the thumbs, underused on even the most modern I/O, haven't been forgotten—they can control up to eight different keys apiece. The design thus equalizes the effort of typing amongst all the hand's muscles and also makes it almost impossible for fingers to stray to the wrong row of keys.

The letter layout has also been completely redone. 73% of the letters in the hundred most used English words are on the home row, compared with only 44% for the old-style system.

Right now, the keyboard's quite expensive. However, it's manufacturer, P.C.D. Limited of Farnborough, Hants, England assures us all that increased production will lower costs. So, it may be some time before you have your ergonomic keyboard but as you sit straining your fingers just think of the glad days that lie ahead.

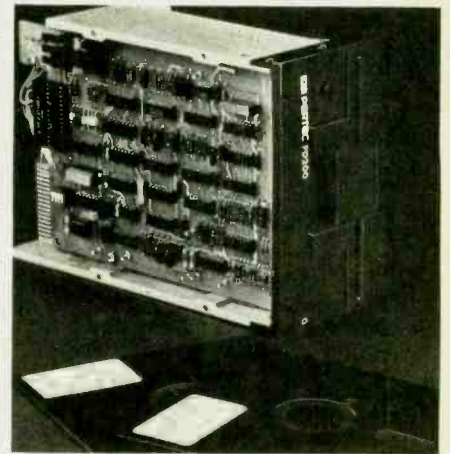
COMPUTER NEW PRODUCTS

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



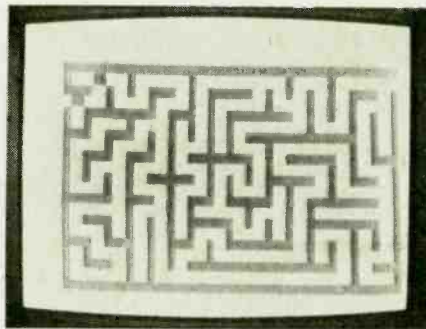
Z80-Based Microcomputer System—Martin Research offers the Mike 8, a Z80-based system that is the newest entry in the firm's Modular Micro series of compact (5½-inch x 7-inch) micro-computer boards. The Model 882 system comes with 4K of RAM, a 1K Monitor program in a PROM, the CPU board, and a console board which has a calculator-type keyboard and six LED digits. The Monitor allows the user to enter and execute programs via the console, and offers advanced debug

features, including RAM test, single-stepping, and setting traps. The system includes a PROM programmer, so the user can permanently store his programs in a blank 2708 PROM (included). An ultraviolet lamp is supplied for erasing PROMs. Model 882 is mounted on a base with its own switching-regulated power supply. The \$895 price, says Martin, brings features comparable with those of small development systems costing as much as \$1,495. An extra bonus is said to be the Z80's extended instruction set which includes the 78 Intel 8080 opcodes, plus 80 more. Smaller Z80 systems are offered by Martin Research at prices starting at \$495. Circle 58 on Reader Service Coupon for information.



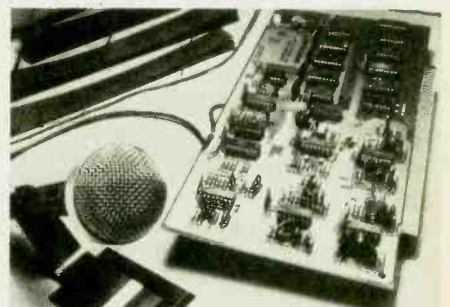
Double Density Disk Drive—Pertec Computer offers the first flexible disk drive for 5¼-inch diskettes capable of providing double density recording of 250,000 bytes on each side of a diskette. The Pertec Model FD200 Microfloppy allows recording on both sides of a diskette. Besides providing added capacity and two-sided data recording, the FD200 reduces interface electronics to a single circuit board using IC components. Up to four FD200 drives can be daisy-chained on a single 34-line ribbon cable. The Microfloppy drive employs an IBM-compatible read/write head with tunnel erase. Head life is estimated at 20,000 hours. A special design feature prevents the head from disengaging from the positioning cam mechanism. LEDs on the faceplate indicate the drive selected. Formatted capacity is 102,400 bytes per side; data transfer rate of the diskette drive is 125,000 bits per second; average access time is 463 milliseconds; and recording density at the inside track is 2581 bits per inch. The FD200 operates with standard 5- and 12-volt DC power supplies, and power dissipation is 15 watts continuous. Unit price of the FD200 is \$405. Circle 53 on Reader Service Coupon.

Four New Game Cartridges—Fairchild Camera and Instrument is offering four new plug-in cartridges for its programmable, computer-based video game system. Videocart 8/Magic Numbers pits the player's brains against the computer in two games of logic and deduction. In Mind Reader the player tries to guess an unknown, randomly selected number through a process of elimination. Nim involves the removal of numbers from number groups, the object being to win by removing the last number from the screen. Videocart 9/Drag Strip reproduces the drama of a professional car race, according to Fairchild. Videocart 10/Maze incorporates 52 game variations based on the idea of getting two mice out of a maze. Videocart 12/Baseball is a video game version of the classic sport. Videocart cartridges incorporate programmed semiconductor memory that functions with the system console's microcomputer to increase versatility. They have a suggested retail price of \$19.95. Circle 55 on Reader Service Coupon for more information about this product and others by Fairchild Camera



Computer That Thinks in BASIC—Ohio Scientific's new model 500 computer has full mini-computer BASIC in ROM and a minimum of 4K RAM for user programs. The Model 500 can be used for short or medium-sized programs in BASIC while its immediate mode is an "ultra-powerful" scientific calculator according to OS.

It can be used as a stand-alone computer or as the CPU in a larger system. The board accepts 8K of ROM, 4K of RAM, 750 bytes of PROM, an ACIA based serial port, a 6502 processor, and full buffering for expansion. Model 500 is available completely assembled with 8K BASIC in ROM for \$298. By simply adding a terminal and power supply, the user has a complete system which will accept up to 200 lines of BASIC program without expansion. The board requires +5 volts at 2 amps, -9 volts at 500 ma, an external reset switch, and an ASCII serial terminal for operation. Model 500-1 (\$429) is a fully enclosed 500 board with power supply, reset switch, and two 25-pin EIA standard terminal connectors for loop through operation. Model 500-8 (\$629) is a 500 board in an 8-slot Challenger case allowing seven slots for expansion; the unit has a heavy-duty power supply. Circle 60 on Reader Service Coupon for more information about this product and others from Ohio Scientific.



Vocal Input for Computers—Heuristics, Inc., offers a new voice input and control system that is compatible with all S-100 bus computers and that replaces

(Continued on page 92)



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!

CB Battery Pack

All the safety and convenience of a mobile CB is now available for camping, fishing, skiing, boating and other outdoor activities which require leaving the car behind. CB Power-Mate is a battery pack utilizing 9 standard "C" cells or nicad batteries. It is built of tough, high impact plastic, weighs less than a pound, has a built-in voltage test meter, a 63-in. long antenna system



CIRCLE 49 ON READER SERVICE COUPON

tuned to 27 MHz, a wide carrying strap and universal hardware that allows fast hookup to almost all 23 or 40 channel CB transceivers. Sells for \$34.95. Get all the information from Kendon Manufacturing Co., Division of Univex International, 3636 S. Jason St., P.O. Box 1977, Englewood, CO 80150.

Squelches TVI

To kill TVI from your CB rig, install Telco's 40 channel antenna tuner and adjustable low pass TVI filter—Channel Guard XL-1000. FCC amended rule #95.58 states that any CBER causing interference on TV channels 2, 5 or 6 because of spurious emission from his rig, will be required to install a low pass filter between the transmitter output and the transmission line that is feeding the antenna. Using the XL-1000 below 30

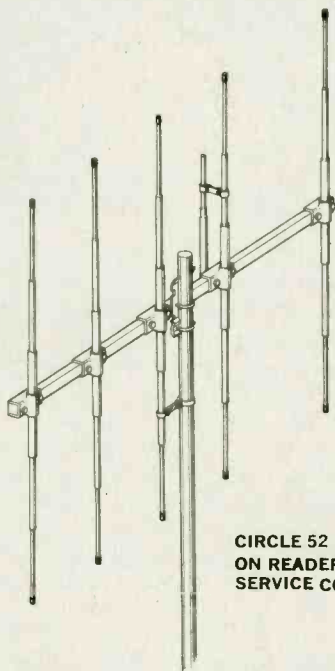


CIRCLE 56 ON READER SERVICE COUPON

MHz, the CBER or Amateur can selectively eliminate all unwanted harmonic radiation at the source. Utilizing a five section tunable in-line, low-pass filter designed for negligible insertion loss; the XL-1000 is rated up to 1000-watt PEP power, and spec'd to attenuate all frequencies above 40 MHz by 100 dB. User net is \$34.95. For additional information, contact Telco Products Corporation at 44 Seaclyff Ave., Glen Cove, NY 11542.

Beam It Out

For best transmitting and receiving range at base stations, a directional antenna is a must. FINCO has developed beam-type directional base antennas. Designed for use with all 40 CB channels, the three element Stinger 340 \$56.95, four element Stinger 440 \$68.35, and five element Stinger 540 \$86.60, utilize a square aluminum boom. A square



CIRCLE 52 ON READER SERVICE COUPON

boom is said to be considerably stronger than its round counter part; it is also claimed that through the use of the square element and mast brackets, self-alignment is maintained even in the highest winds. For more information, write The Finney Company, 34 West Interstate Street, Bedford, OH 44146.

Variable Audio Filter

Hearing better signals on your CB is possible with Prime Electronics' PR-1000 Variable Audio Filter. For use between any CB transceiver and external speaker, the PR-1000 will provide a receive signal improvement of up to ten times by allowing the operator to tune out unwanted interference plus sharpen the receiver selectivity to exactly match the desired signal. Based on an electronic circuit first used in the space



CIRCLE 62 ON READER SERVICE COUPON

program to improve signal quality of weak signals from deep space, electronic variable audio filters have become very popular for use by commercial AM and SSB point to point stations and by ham radio operators. Easily connected in less than a minute to any CB, SWL or ham receiver or CB transceiver, the unit is packaged in an attractive low profile eggshell white cabinet with walnut sides. Suggested list price of \$59.95. For information on the complete Prime line, write to Prime Electronics, Inc., 8605 Quivira Road, Lenexa, Kansas 66215.

CB Working Indicator

No guessing anymore! Here's a constant CB performance indicator that features light emitting diodes for easy monitoring of SWR and transmitter output. CiBco's unique CPI II in-line indicator is designed for the growing



CIRCLE 68 ON READER SERVICE COUPON

number of CB owners who want constant assurance that their transceiver-antenna system is performing properly. A green LED indicates transmission output of 3.5 watts or more. A red LED is energized when reflected power exceeds a SWR of 1.8 to 1. This red LED doubles as a speech modulation indicator. Readings are produced automatically by pressing the microphone switch. In case of trouble, the red LED flashes an immediate

(Continued on page 90)

WOMBLES RAMBLE ON

This talking toy is teaching English children.



□ In England, a child's best friend is often his "womble." An ordinary womble is nothing more—or less—than a soft, cuddly, furry toy shaped something like a bear, a bit like a person, and a whole lot like nothing else in the world. Wombles are by now a firmly entrenched part of English culture; so it is only natural that the world was recently presented with the first *electronic* womble.

Though it was hard to improve upon the original model, Barrie Chapman, who designed the electro-womble, set out to turn the furry playmate into a lovable teacher. Barrie succeeded by teaching the womble to talk. Children might have a hard time listening to adults, might avoid teachers all together, but what kid anywhere could resist learning from a womble?

Womble Value. "Kids with speech difficulties, blind children, all kinds of

handicapped tykes can be taught many things nowadays," Barrie explained. "The womble means something to them, that's the great advantage."

Barrie put electronic play-back equipment into a large womble; equipment which contains a large number of pre-recorded replies. The womble has a microphone hidden in its protrusive snout and, when a child speaks or makes a sound, a VOX circuit activates the hidden recorder play-back. Of course, a child may say something to which there is no pre-recorded reply or which is out of order for the wombles' inner tapes. However, this drawback does not seem to matter very much to the children who have played with the valuable womble. Barrie maintains that a child's interest can be easily changed over from one matter to another.

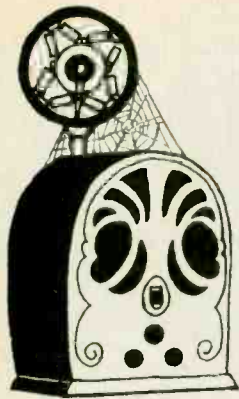
"When the wombles talk," Barrie explained further, "they get an eager re-

sponse from children. They are far more effective than any amount of persuasion by grown-ups."

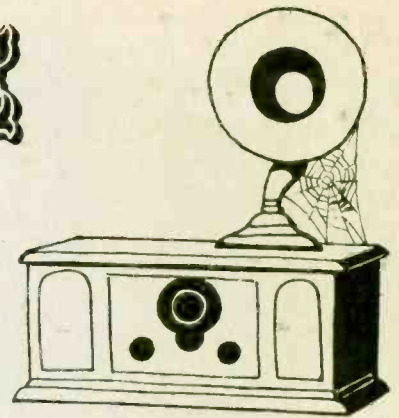
How To Womble. Barrie's womble is easily controlled by a teacher. The womble's voice can be varied in volume from a whisper to a shout; a child's voice may be recorded and played-back; or a message repeated over and over. The teacher should also be able to guide the student into asking specific questions which the womble can answer.

Though mass-production of these electrified wombles is still in the future, Barrie stated that should be the next step. For one thing, every school which teaches children with speech defects could, Barrie feels, benefit from one of his creations.

Stay alert—the next voice you hear could be that of your friendly, neighborhood womble! ■



ANTIQUE RADIO CORNER



by James A. Fred

□ Hello! out there in Radioland. Radio collecting must be on the upswing in Canada because I've received more mail from Canadians than ever before. Collectors from Canada are having a difficult time finding schematic drawings and service information for their antique radios. Many Canadian collectors have written to me for information on their sets, but usually I cannot supply their needs. I depend mostly on Riders Perpetual Trouble Shooters Manuals for schematic drawings, etc. 95% of the time I draw a blank when looking through a Riders Manual for Canadian radio information. If any reader from north of the border has a supply of service information on Canadian built radios, and would be willing to share it, I would like to hear from him.

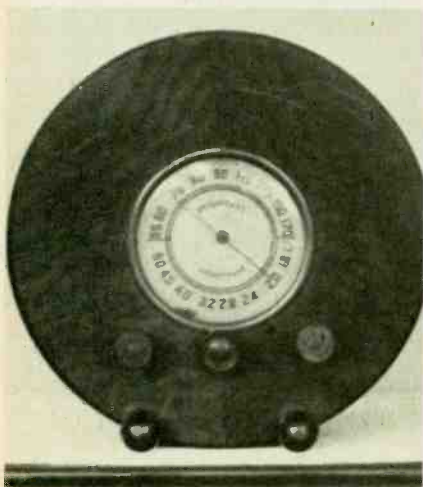
In the last Antique Radio Corner I told you how to convert the 864/VT24 to a WD-11 tube. Unfortunately, the WD-11 base I used for a sample did not have the proper spacing of the base pins. Several other WD-11 tubes I own have different spacing of the base pins. You may have a problem of tight fit in some tube sockets if you use the 864 base. I had a letter from one reader that

pointed out this defect. You may have to enlarge the socket holes slightly. The only other solution would be to manufacture new bases or plug the holes in the old bases and drill new holes. I will look into this problem for a future column.

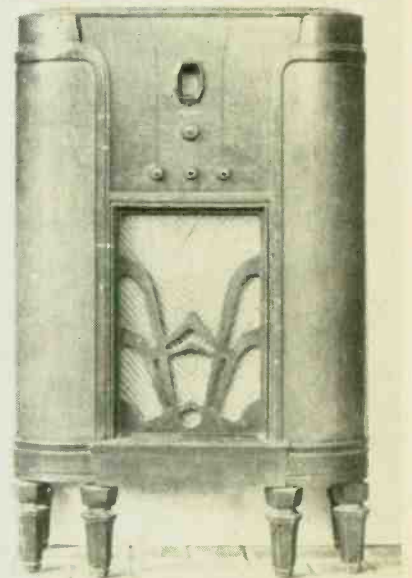
There is an increase in interest in collecting AC radios manufactured between 1928 and 1940. Several readers have written to me asking for help in locating radios of these years. I was surprised to find that collectors want console radios. Most collectors do not have room for console radios; and aren't looking for great numbers of common consoles, but want the different, unique, ornate consoles. In one of the photos you will see a Garod radio that looks like an old 1920's battery radio set on legs. I am assuming that this is a factory-built radio, although it is of a strange design. The radio has three-dial tuning with an additional tuning condenser turned by the small knob on the left side of the panel. Another view shows the back of the set, where the tube sockets and other parts are mounted on a board just like the old battery sets. The cabinet is hinged to a lower compartment that contains a boxed power supply about a foot square and four inches high. The rectifier tube, an 80, is in this box and connected to wires coming from this box is a large filter capacitor. It is difficult to tell if this capacitor is the original or a replacement. In the front of this part of the cabinet is a toggle switch and a pilot light jewel. Behind the jewel a large hole is punched in the side of the black metal box. I suppose the light from the rectifier tube would illuminate the jewel to indicate that the set is turned on. The tube complement consists of two type 24A's, two 27's, and a 45 audio output tube. With the type 80 mentioned previously there are 6 tubes. These tube types indicate the set was made around 1930. A large metal box covers the tuning coils, tuning condenser and a few other components.

I haven't yet had time to restore this set electrically. A separate free-standing, magnetic cone speaker was still attached to the set when I bought it. The speaker cone had been crumpled like a ball of old newspaper. A future article will show how to replace speaker cones of this type.

A unique little AC-DC radio is also shown in an accompanying photo. The set is completely round, about 10 inches in diameter. A round dial is mounted directly in the middle of the front along with three knobs. One knob is for tuning, one for volume, and the other is a wave-change switch to select short wave stations. Sets of this vintage have no built in antennas so you must attach an outdoor antenna to get optimum results. There is no name anywhere on the set, just part of a label on the inside that reads: "Made in Factory A, Chicago, Illinois." I would judge the date of manufacture to be 1932 to 1934. The speaker grill is on the side of the cabinet. The cabinet was in quite good con-



Here's a unique, round little radio which was made sometime in the early '30's. The only clue to its manufacture is a part of a label which reads: "Made by Factory A."



This Philco Model 34 farm-battery radio, made in the late 30's, has a number of short wave bands. A good outdoor antenna would be needed to receive such stations, however.

e/e ANTIQUE RADIO CORNER

dition, but the knobs were missing. The insulation on the line cord has hardened and will have to be replaced. I plan to completely restore this radio through the winter months ahead.

Another odd console radio I picked up this summer was a Philco model 34 farm battery radio. The cabinet is rather strange with two six-sided legs on each front corner. The console is small with a tiny dial escutcheon. It reminds me of the dials on the Philco cathedral radios. The set has several short wave bands, but no built-in antenna. A good outside antenna will be necessary to receive stations on this radio. The speaker is a permanent magnet type with a very large, flat magnet several inches wide. Naturally, after setting around in a barn several years the speaker doesn't work properly and the cabinet needs much work. The tube lineup includes: a 1C6, detector-oscillator; a pair of 34's as IF amplifiers; a 30 as a detector; a 32 first audio amplifier; a 30 as an audio driver; and a 19 dual triode as an audio output amplifier. The set was intended to be used with the Philco type 172-R 2 volt storage battery. A Philco type P968 battery supplied the B and C voltages. I have included a copy of the circuit diagram as a matter of interest to collectors of radios made in the 1930's.

In the mid 30's Chicago was the center of private brand radio manufacturing in the United States. A private brand radio was a radio made for a retail sales organization by a company whose name wasn't usually known to



The hinged top of the Garod's cabinet lifts to reveal a compact, boxed power supply.

the general public. The makers name never appeared on the radio, just a label listing the numbers of as many as 30 patents under which the radio was made. The label usually stated, "Made under the patents of RCA and the Hazeltine Corp." A royalty of a certain percent was paid to the above named companies for each radio sold. The factories were assigned letters of the alphabet as identification. The round radio I mentioned earlier was made by Factory A, Chicago, Illinois. I no longer have a list of these code letters so I don't actually know who made this radio.

Some of the better known private brand manufacturers were: Wells-Gardener (still in business under that name), Belmont Radio Corp. (now a part of the Admiral Corp.), Continental Radio and TV Corp. (now a part of the Admiral Corp.), and others. Of course, some of the major radio manufacturers made private brand radios too. Zenith made auto radios for Ford, Hudson, etc.; Hallicrafters made many of the McMurdo-Silver radios; and Motorola made auto radios for Chrysler and Ford as well as home radios for the automotive supply stores. There just isn't enough room here to list all the radios and who made them. That is another story in itself. Among the largest purchasers of private brand radios were: Montgomery-Ward, Sears Roebuck, Aldens, Walgreen Drug Stores, Spiegels, Gamble-Skogmo, Western Auto Supply, Goodyear stores, Lyon and Healy, Firestone, Goodrich and a host of others.

Of course there were other private brand radio manufacturers outside of Chicago. In Kokomo, IN the Kingston Radio Company made radios for Gambles, Western Auto, and Montgomery Ward. No doubt there were many more, but my memory fails to recall them.

If there is anyone out there in Radioland who has the list of radio factories in Chicago with their code letters I will be happy to publish it in this column. I think this list would be a big help to the many collectors of radios built in the 30's.

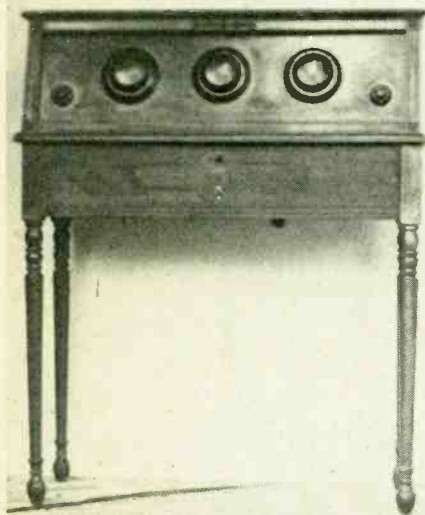
One thing our hobby needs is more books both on the Historical and tech-

nical side of radio. All of a sudden there are several new books available that I think you will be interested in. As I mentioned, some time ago, there was to be a book published on the history of the vacuum tube. This book *Saga of the Vacuum Tube* by Tyne was to have been available early in 1977. It wasn't, but the latest word is that the book is now at the printers; but that it will be some time before it is available. The AWA will publish an annual Journal devoted to historical material not found in any other publication. Even if you aren't a member you will still be able to purchase this Journal.

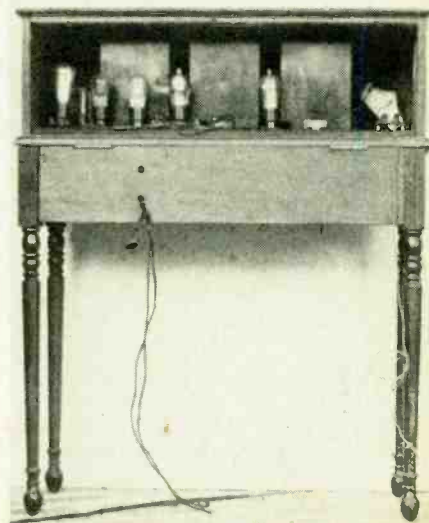
The General Electric Hall of History, a new museum to be erected in Schenectady, New York will publish a series of books on the history and development of General Electric and its products. The first is already in print and is titled *The Edison Years, 1876-1892*. It is soft cover, 56 pages and packed full of rare photographs of early light bulbs, generators, etc. If you would like a copy of this book send \$2.95 to: Hall of History, Room 3A15, R and D Center, K-1, General Electric Co., Schenectady, NY 12345.

David McKenzie of Indianola, Iowa reports a new book for collectors and restorers called *Collecting Old Radios and Crystal Sets* by Max Alth. It can be obtained at the Mid-America Book Co., Leon, Iowa 50144 for \$7.95. I plan to review all these books in this column.

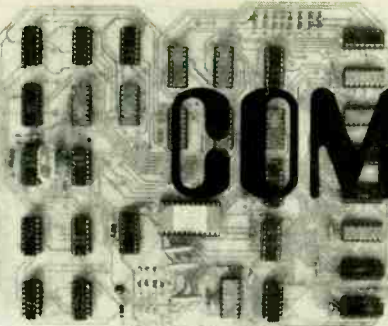
So long for now! I will bring you more interesting information on collecting antique radios in the next issue of ELEMENTARY ELECTRONICS magazine. ■



This Garod Radio from the Roaring Twenties looks like an old time, three-dial battery set—but, it isn't. A power supply is mounted in the chassis, and it uses AC tubes.



This back view of the Garod shows the AC cord hanging down. Note that the AC tubes are still mounted on a board which is very similar in design to the old battery sets.



COMPUTER READOUT

by Norman Myers, Computers Editor

This new Datac 1000T computer board instructs as well as computes for you and does it economically.

□ We have covered a wide spectrum of different microcomputers, calculators, and microcomputer books in past COMPUTER READOUT columns, and the horizon is filled with even more new and interesting micro-magic things—in this issue we will discuss two of them; a very basic microcomputer training device, and current work in the area of talking to computers.

DATAc. Datac Engineering is a rather new and growing company with an interest in designing and manufacturing microcomputers students and hobbyists can use and use quickly. The Datac 1000T is a tutorial (thus the "T") microcomputer on a 9 X 12 inch printed circuit board. It has no fancy keyboard or numerical readout, but is just a basic computer with the simplest possible input and output arrangements. The input is provided by the user one bit at a time just as a computer would operate internally. To provide these bit-at-a-time inputs, there are small metal touch pads along the bottom edge of the board that are touched one at a time by a probe. Each address word is 8 bits, and each data word to be stored in an address location is 8 bits. For each address bit there are two metal touch pads on the printed circuit board, one pad for "0" and one pad for "1". So by touching the appropriate pads one can write any binary address or data word. If you want to get to address location 0000 0100 (location 8) in memory, just hit the zero pad for the first binary digit, and so forth until all 8 bits are entered into the control unit. The readout that lets you see what digits have been entered into memory, and also shows the data that you are putting in or are getting out, is made up of small LEDs above the touch pads. When you probe the address memory touch pads with 0000 0100 the eight LEDs for the address will all be out but for one and this display indicates 0000 0100. This way you know the address location the microcomputer is using, and for data you know the values stored in memory. With some of the tutorial microcom-

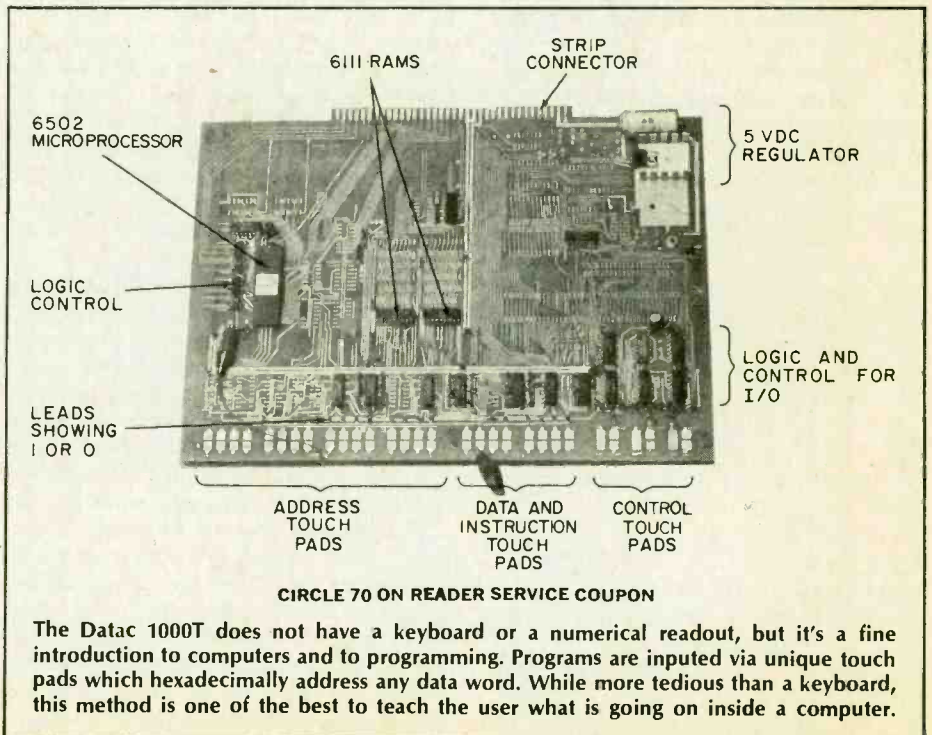
puters, like KIM-1, you have to read hexadecimal code on a numerical display; here you read hexadecimal code from individual lights. Remember that 0000 is zero, 0001 is one, 1001 is nine, 1010 is called "A", and so forth until 1111 which is "F".

While on the subject of the input and output, let's take a look at some other touch pads and corresponding LEDs on the Datac 1000T. In the lower right-hand corner are nine pads used to give commands to the microprocessor unit. When Reset is touched by the probe the processor finds the beginning of your program and awaits instruction to run through it. The Run pad executes the program while the Norm pad (touched after Run) causes a regular lightning speed computer run, and Single causes the computer to execute one instruction with each touch of the probe to the Step pad. There is an Examine pad for fetching contents out of memory, a Load pad for placing data into the

processor, and a Deposit pad for storing data into memory cells.

Hardware. The heart of the Datac 1000T is the popular MOS Technology 6502 microprocessor. This means you can use the MOS Technology Programming Manual to learn fine points on the instruction set of the computer. The storage is in 6111 random access memory (RAM) chips, each pair of which can handle 256 8-bit words. You can see that with an 8-bit address word, 256 memory locations (2 to the 8th. power) can be reached. This block of 256 locations is called a page of memory (like a page in a book).

The Datac 1000T has been designed with expansion in mind. More pages of memory can be added by slipping extra 6111 RAMs into the pre-drilled holes on the printed circuit board. In fact, the microcomputer is so basic it could have been built on a board one-half the size, but the present size allows a threefold increase in memory and control by



The Datac 1000T does not have a keyboard or a numerical readout, but it's a fine introduction to computers and to programming. Programs are inputted via unique touch pads which hexadecimally address any data word. While more tedious than a keyboard, this method is one of the best to teach the user what is going on inside a computer.

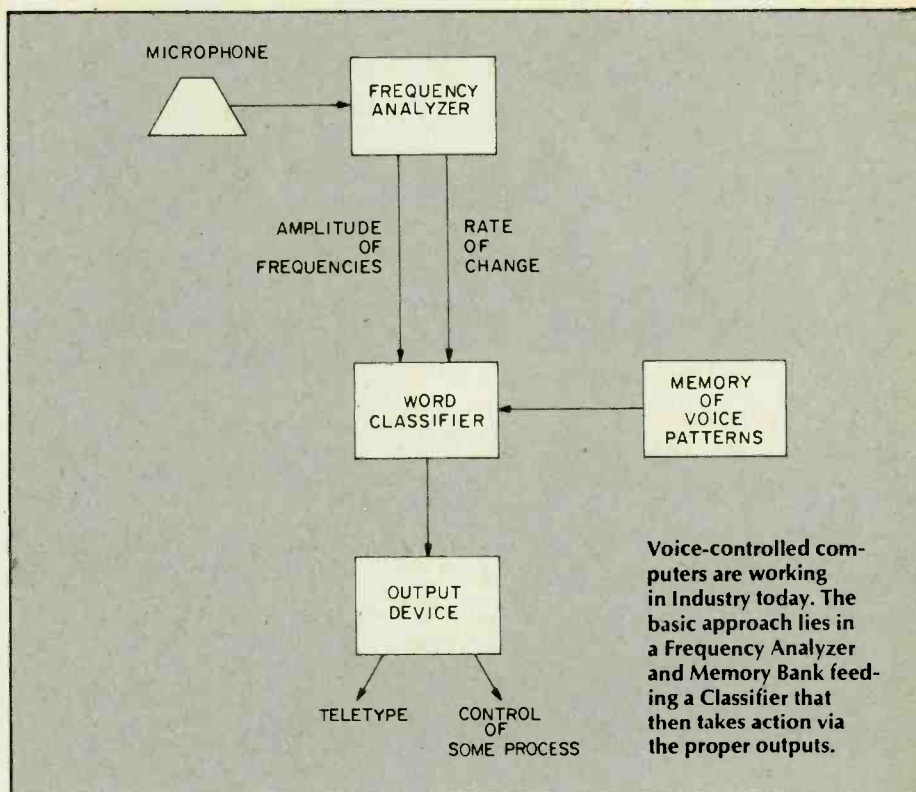
e/e COMPUTER READOUT

addition of the appropriate integrated circuits and memory chips. Power for the unit is supplied by a small wall plug unit. Finally, there is a connector strip at the back of the PC board for access to control functions in future Datac versions. Readers interested in more details of expansion capabilities and options should write directly to Datac Engineering at P.O. Box 406, Southampton, Pa. 18966.

Make It Work. Let's do a simple programming example with our Datac. We will write and enter into memory a program to add two numbers. Such a program is the beginning of many more complex and very useful programs for controlling railroad trains, playing computer games on TV screens, and the like.

We will begin at location ten in memory (there is only one page in the Datac 1000T so we do not have to specify pages here) by placing instruction "D8" there. This hexadecimal instruction has special meaning to the 6502 microprocessor as we shall see shortly. To write D8 at location ten simply touch the probe to the pads in such a way as to light the LEDs to read 0001 0000, 1101 1000 (10, D8). Now touching the Deposit pad will place instruction D8 at location ten. The program continues as shown in the box accompanying this article.

Examine the program. First, the D8 instruction tells the microprocessor to add numbers in binary form so we can read out the hexadecimal answers on our display. The next command ("18") sets a carry-flag register to zero just so the computer will not think something is left over from a previous addition that it has to add in here. Then the two selected numbers are read-in, added, and placed in memory slot 00 where the final answer will be found. The next two commands actually tie-up the computer doing busy work so that it will not by chance take noise bits from the memory as commands, operate on them and perhaps (really little chance) destroy the result in location 00. These two steps cause the computer to go back and forth between locations 18 and 19 so it can get out of the loop. When you hit Halt, the looping is stopped. That's all there is to it! The last line of code is used to tell the computer the starting point (memory cell ten) of the program when Reset is touched. This microcomputer can handle a wide range of interesting programs, especially games you can invent



Voice-controlled computers are working in industry today. The basic approach lies in a Frequency Analyzer and Memory Bank feeding a Classifier that then takes action via the proper outputs.

Programming the Datac 1000T

11	18	Clears the carry bit.
12	A9	Place number below into accumulator
13	12	First number to be added (any number)
14	69	Add number below to accumulator
15	24	Second number to be added (any number)
16	85	Place accumulator value into location 00
17	00	
18	4C	Jump to location 18 of memory
19	18	
7C	10	When Reset is touched, go to location 10

To run the program hit Reset, Run, Norm, Halt, then touch Examine and the address pads for location 00 (hex). The answer 36 (24+12) will appear on the LEDs. (See text for more explanation.)

yourself, because it is based on the powerful instruction set of the 6502 processor. The Datac 1000T unit costs \$185 and can be purchased by writing the address given above.

Number Please. We just talked about a very simple, basic computer; now let's go to the other extreme and learn about talking to computers, and computers talking back. Ten years ago developers began to think that the wild dreams of carrying on conversations with computers might just be possible someday. While dialogue with a machine may be decades away, there are over 150 special purpose electronic computers today that are in operation receiving voice commands. The first installations of these units were in the airline industry during the early 1970's. Voice-controlled machines would operate baggage sorting equipment by steering suitcases to appropriate locations

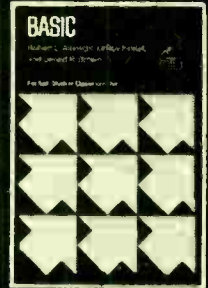
under selected voice commands. With microprocessor power and flexibility increasing at a rapid pace, voice-controlled units can be expected to blossom.

The advantage of a voice-controlled machine lies in the mobility given to the user; it allows hands and eyes to be focused on the task rather than on the computer keyboard. A basic speech-recognition system has a microphone feeding a Frequency Analyzer whose output gives both the amplitude of the various frequencies in the voice command and the rate of change of those amplitudes. Two persons saying the same word will have different frequency content and it is the job of a Word Classifier to recognize the word based on three inputs. It receives the two pieces of frequency content information from the Frequency Analyzer and it receives reference information from

(Continued on page 95)

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. 1-18 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 first of a series of articles will introduce you to BASIC which is one of the most popular computer languages. After studying this first installment, you'll be able to specify the correct format for entering a computer program. You'll also learn how to erase (SCRatch) an unwanted program from the computer's memory, how to LIST a program currently in the computer and how to RUN (process) a program. You'll be able to specify methods for correcting, editing and deleting individual statements within a particular computer program. Talking to your computer can be fun—if you know BASIC.

You will start off slowly and simply, to kind of ease your way into things. There are several devices that are commonly used for communication between a computer and computer user.

Q1 What characteristics do these devices have in common?

- (a) television screen
- (b) a typewriter-like keyboard
- (c) a steering wheel

A1 (b) a typewriter-like keyboard

A computer *terminal* provides the means for communicating with the computer. By means of a teletype or other terminal, a computer program and data may be communicated to a computer. When the program is *run* or processed, the computer sends signals to the terminal which provides *output*—that is, the results of processing the program. (Therefore, a terminal provides two-way communication between the computer and the user.)

Q2 A terminal provides _____-way communication between the computer and user.

A2 two

The *teletypewriter* is the most common device used for communication between the computer and its user, and it is the most common *computer terminal*. The teletype is used much as an electric typewriter. It prints the numerals 1, 2, 3, 4, 5, 6, 7, 8, 9, and 0; the letters of the alphabet; and some special symbols. Letters are printed in upper

case (capitals) only. You may not use the lower case L to stand for the numeral one.

Q3 To print numeral one, you depress

- (a) the key marked 1
- (b) lower case letter L

A3 (a) the key marked 1

So you want to know what computer programming is all about? Here's a computer program that will calculate a student's grade point average.

```

100 REMARK PROGRAM TO COMPUTE GRADE POINT AVERAGE
110 PRINT "HOW MANY UNITS OF A";
120 INPUT A
130 PRINT "HOW MANY UNITS OF B";
140 INPUT B
150 PRINT "HOW MANY UNITS OF C";
160 INPUT C
170 PRINT "HOW MANY UNITS OF D"; This is the program.
180 INPUT D
190 PRINT "HOW MANY UNITS OF F";
200 INPUT F
210 LET U=A+B+C+D+F
220 LET G=(4*A+3*B+2*C+1*D)/U
230 PRINT
240 PRINT "YOUR GRADE POINT AVERAGE IS";G
999 END

```

RUN

```

HOW MANY UNITS OF A?4
HOW MANY UNITS OF B?6
HOW MANY UNITS OF C?6
HOW MANY UNITS OF D?0
HOW MANY UNITS OF F?0

```

This is the output or result of running the program above.

YOUR GRADE POINT AVERAGE IS 2.875



The program consists of 16 statements, each one on a separate line numbered 100-999. Each line begins with a line number. Following each line number is a statement that contains instructions to the computer.

This program was typed a line at a time on the teletype (or other terminal) and was saved in the computer's memory. Then we told the computer to RUN the program; that is, to follow the instructions in the program. During the run the computer, following the instructions in the program, asked for information (called input) to be supplied by the computer user—how many units of A's, B's, C's, etc., were received? The program then directed the computer to do the computation and print the result. By the end of Chapter Two, you will be able to understand and use all the BASIC notation used in this program and more, so read on.

- Q4** The distinct lines in a computer program are called _____.
A4 statements

The computer stores a program in its "memory." Before the computer user attempts to enter a new program into the computer, he will want to remove any previous instructions that may be currently in the memory. To erase previous instructions in the computer, type the letters SCR, then press the key marked RETURN. SCR stands for SCRatch, and scratches out or erases (removes) any previous program in the computer.

- Q5** Before a new program is typed into the computer, any old instructions held in the computer memory should be erased. To erase an old program, type SCR and press the key marked _____.
A5 RETURN

NOTE: Although most of the words and symbols in BASIC are the same for all computer systems that use BASIC, there are some exceptions. This is because there has not been a completely standardized form of the language that is used by all computer manufacturers. Common variations will be noted throughout this text. However, the concepts involved are the same, even though a particular code word or symbol may be different from that used here. When you have a grasp of BASIC, you will find it easy to make the substitutions necessary to use the particu-

lar computer system at hand, and a quick review of the BASIC reference manual for your system will provide you with any variations you need to know. For example, words such as NEW or CLEAR or START are used in place of SCRatch on some computer systems, but fortunately such variety is the exception rather than the rule.

Sample program:

```
1 LET A=5
10 LET B=10
135 LET C=A+B
277 PRINT A,B
852 PRINT C
9999 END
```

This program, written in BASIC, consists of six statements. Note that each statement begins with a line number.

From this example you can see that line numbers may range from 1 to 9999.

NOTE: The upper limit for line numbers is different on some computers.

The line numbers indicate to the computer the order in which it is to follow the instructions in the program. It is not necessary for line numbers to follow each other successively (e.g., 1, 2, 3, 4, . . .) as you can see by looking at the line numbers in the program in the previous frame. However, it is more common to number by ten's as we have in the program below. Then, if we wish, more statements may be easily inserted in the program between existing statements.

```
10 LET A=5
20 LET B=10
30 LET C=A+B
40 PRINT A,B
50 PRINT C
99 END
```

This is a common way of numbering a program. Note that the line number for the END statement is 99. For convenience, we will use 99 or 999 or 9999 for the END statements, depending on the size of the other line numbers in the program.

Nine new statements could be added between Lines 20 and 30; they would be consecutively numbered Line 21, 22, 23, 24, 25, 26, 27, 28, and 29.

```
10 PRINT 12 + 33
99 END
```

This is a very short program that is composed of only two statements. Each statement begins with a line number.

```
10 PRINT 12 + 33
99 END
```

In this mini-program, Line 10 instructs the computer to evaluate the numerical expression $12 + 33$, (i.e., do the arithmetic) and to PRINT the result. When this program is run on the computer it will print the sum of 12 and 33.

The computer follows instructions in line number order. In the preceding program, Line 10 is done before Line 99.

```
10 PRINT 12 + 33
99 END
```

If you are seated at the computer terminal, and have erased any previous programs in the computer, you are ready to type in this program. To enter the program, type the first line, then press the RETURN key. Then type the second line and press the RETURN key.

```
10 PRINT 12 + 33
99 END
```

Assume you have typed this program into the computer. Now you wish the computer to process the program. Type RUN and press the RETURN key. If you have not made any typing errors in entering the program, the computer will evaluate $12 + 33$, print the result 45, and stop. Here is what you would see on the teletype printout.

```
10 PRINT 12 + 33
99 END The program
      RUN      you typed in..
      45
```

- Q6** What command, in any of the previous programs, tells the computer to begin to follow the instructions contained in the program?
A6 RUN

The program is not altered or erased from the computer's memory when you RUN it. Every time you type RUN and press RETURN the computer will RUN the program. Every time you RUN a program with the same information you will get the same result.

NOTE: There are some exceptions to the above rule.

- Q7** As a rule, every time you RUN a program with the same information you will get _____ result.
A7 the same

```
10 PRINT "12 + 33"
99 END
```


Look at this program. Do you see the difference from the ones we have already studied? That's right—the numerical expression is enclosed in quotation marks.

Note that the computer evaluated these two programs quite differently when it was told to RUN them.

```

10 PRINT "12 + 33"
99 END
RUN

12 + 33

10 PRINT 12 + 33
99 END
RUN

45

```

The statement `PRINT 12 + 33` without quote marks tells the computer to evaluate the *numerical expression* `12 + 33` (i.e., do the arithmetic) and print the result as a decimal numeral.

The statement `PRINT "12 + 33"` with quote marks tells the computer to print the *string* enclosed in quotation marks *exactly as it appears*. No arithmetic is performed.

Q8 In BASIC, a string is information in a PRINT statement that is enclosed by _____
A8 quotation marks

Q9 Fill in the blank as the computer would print it.

```

20 PRINT "186 - 58"
25 END
RUN _____

```

A9 186-58 (Note that the computer does not print the quotation marks.)

```

PRINT "MY HUMAN
UNDERSTANDS ME"

```

The underlined portion of the statement is a *string*. It is enclosed in quotation marks.

```

PRINT "12 + 33"
This is a string. It is enclosed
in quotation marks.

PRINT 12 + 33
This is not a string. It is a
numerical expression.

```

A *string* may include

- (a) numerals (0, 1, 2, . . .)
- (b) letters (A, B, C, . . .)
- (c) special characters (+, -, *, /, ↑, comma, period, semicolon, etc.)

Since quotation marks define the beginning and end of a string, they cannot be used as a character in the string.

Q10 True or False: The following could be printed out following a RUN command: ONLY USE NUMERALS "1, 2, 3."

A10 False: Quotation marks cannot be used as a character in the string.

If you wish to change one or more statements in a program currently in the computer, you may do so *without* SCRatching the program and starting over. You merely type in a new statement, using the *same line number* as the line you wish to replace. Look at the program below, and the change made in it by replacing one line.

```

SCR SCRatch the preceding program.

10 PRINT 7 + 5
99 END Enter the new program.

RUN RUN the new program.

12 Here is the result.

```

Next . . . *replace* Line 10 with a new Line 10. (*Replace*, means retype the line, beginning with the line number.)

```

10 PRINT 6*9

```

Now tell the computer to LIST the current program.

```

LIST

10 PRINT 6*9 Here is the new line 10,
99 END and the old Line 99.

RUN RUN the modified program.

54 Here is the new result.

```

Q11 You may change or replace any line in your program by retyping it, using the same line number as the line you wish changed. The new statement _____ the old one with the same line number.

A11 replaces (or changes)

While we're on the subject, suppose you wish to take a statement out of a program *without* replacing it with another statement. *Don't* SCRatch and start over. Merely type the line number of the statement you wish deleted or removed and press RETURN.

```

10 PRINT 5+5
20 PRINT 12+3
30 PRINT 6+4
99 END

This program is in the computer,
and we wish to delete (remove)
Lines 20 and 30.

20 Type the line numbers only, and
30 press RETURN after each.

LIST Now, LIST the program.

10 PRINT 5+5
99 END

Presto! Lines 20 and 30 are gone.

```

Here is another program and a RUN of the program:

```

10 PRINT "MY CØMPUTER
UNDERSTANDS ME"
20 PRINT "MY CØMPUTER
CØNFUSES ME"
99 END

RUN

MY CØMPUTER UNDERSTANDS ME
MY CØMPUTER CØNFUSES ME

This offends us, so we want to delete the
statement in the program that caused the
computer to print it, and we want a RUN
of the program to look like this:

RUN

MY CØMPUTER UNDERSTANDS ME

```

Q12 What would you do to remove the offending statement from the program? _____

A12 Type 20 and press RETURN.

Q13 Show a LISTing of the program with the offending statement removed.

A13

```

LIST

10 PRINT "MY CØMPUTER
UNDERSTANDS ME"
99 END

```

NOTE: The quotation marks are in-

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* "Foneaids," 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 monitorradio 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 1977 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* 1977 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" 1977 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 1977 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 1977 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 Heliwhip.

356. Send for *Continental Specialties* new bread-boarding prototest 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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cluded because this is a LISTing of the program itself, and not a RUN of the program.

When typing your programs into the computer, you may make a typing error or some other mistake. Look at this example.

```
10 PTINT 2*3+4
We misspell PRINT.

SYNTAX ERRØR
The computer tells us we made a mistake.
(Some computer systems do not inform
you of errors until you try to RUN the
program.)
```

The error message may be different on your computer. That's not the point. The point is, if you had noticed that you hit T when you meant to hit R, you could have immediately corrected your mistake by using the back arrow (←).

BEWARE! This method for correcting mistakes may not work on your computer.

The back arrow ← is on the same key as the letter O. To type a back arrow, hold the SHIFT key down and press the letter O.

This error correction information becomes quite obvious when operating a complete terminal. The Editors suggest you review use of the back arrow correction technique at the terminal.

Assume you just sat down at the computer terminal. You wish to know if there is a program currently in the computer's memory. Type LIST and then press the RETURN key. The computer will automatically type out the program (if there is one) that is in its memory. Here is an example.

```
LIST

10 PRINT "12 + 33"
99 END
The computer automatically typed all this.
```

Q14 The command which causes the computer to type out the program already in memory is

```
A14 LIST

10 PRINT "12 + 33"
99 END
```

Assume that this program is currently in the computer's memory. Now you wish to add a new statement to the program, that says PRINT 12 + 33. You want the new statement to be evaluated by the computer after PRINT

"12 + 33." The line number for the new statement must be greater than 10 and less than 99.

```
10 PRINT "12 + 33"
99 END
```

This program is stored in the computer. We type in the following statement:

```
20 PRINT 12 + 33
```

and then press the RETURN key. The new statement is then incorporated into the existing program. To verify this, type LIST, then press the RETURN key. The computer will type out the program with the new statement in line-number order. The computer will printout:

```
LIST

10 PRINT "12 + 33"
20 PRINT 12 + 33
99 END
```

If you type RUN with the preceding program in the computer, the computer would print:

```
RUN

12 + 33
45
```

Q15 When you type LIST, in what kind of order will the computer type out the program including the latest corrections?

A15 In line order (or numerically)

If you retype Line 10 and added a comma to the end of the statement, the program would look like this when LISTed:

```
LIST
10 PRINT "12 + 33",
20 PRINT 12 + 33
99 END

RUN

12 + 33      45

Note that the two results are printed on
one line.
```

Here is a variation of the program that

causes the computer to print the problem (i.e., the string enclosed by quotation marks) and the answer on the same line.

```
10 PRINT "12 + 33 =",
99 END      12 + 33

RUN

12 + 33 = 45
```

Q16 In this program, fill in the blank to show what the computer would print.

```
10 PRINT "TWELVE PLUS
THIRTY THREE EQUALS",
12 + 33

99 RUN
RUN
```

A16 TWELVE PLUS THIRTY
THREE EQUALS 45

In BASIC, the comma and semicolon permit several expressions and/or strings to be printed on the same line. Look at the results of these two programs.

```
PROGRAM A

10 PRINT "12+33=", 12+33
99 END

RUN

12+33=      45

PROGRAM B

10 PRINT "12+33="; 12+33
99 END

RUN

12+33= 45
```

Examine the first statement in each program. Program A has a comma separating the string and the numerical expression, Program B has a semicolon.

Q17 The computer prints the results of the two parts of the PRINT
(Continued on page 86)

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(Continued from page 85)

statement *closer together* if you use a _____ instead of a _____.

A17 semicolon, comma

What You Have Learned

1. A computer terminal, such as a teletypewriter, provides a means for communicating with a computer. When a program is RUN (processed), the computer sends signals to the terminal which provide a visual output of the program. In this way, the terminal provides two-way communication between the computer and the user.
2. A computer program is typed a line at a time into the computer. Each separate line is considered a *statement* and begins with a *line number*. The computer reads and processes each statement consecutively depending on its line number. New statements may be added later, providing they may be labeled with line numbers consecutive with the older statements.
3. The computer responds to *commands*, which are words in the BASIC language. RUN commands the computer to process a program. LIST commands the computer to print out each statement of a program in its memory. SCR (Scratch) will command the computer to erase its memory (if this command is verified by hitting RETURN).
4. Quote marks when entered into a program command the computer to print out whatever is enclosed in the quotations, exactly as it appears. The information to be printed-out is referred to as a *string*. A string may contain numerals, letters or even special characters but it *cannot* contain quotation marks which may only enclose a string.
5. Just one statement may be removed from a program without erasing the rest of the program. Simply type the line number of the statement to be removed, then hit RETURN.

SHOOTING AHEAD IN BASIC

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.

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Hey, Look Me Over

(Continued from page 8)

ternal control of main generator. The IG-1275 is mail-order priced at \$319.95 kit form, or \$475 factory-assembled and tested. For further information, send for a free catalog to: Heath Company, Dept. 350-17, Benton Harbor, MI 49022.

Programmable Calculator

Featuring plug-in, solid-state software libraries, the new TI Programmable 58 calculator brings significant additional program memory capability and programming flexibility to advanced students and professionals in business, engineering and science. Suggested retail price for the TI 58 is \$124.95. The unit can use interchangeable solid-state software modules with prerecorded program libraries containing up to 5,000 steps each. The libraries range from applied statistics and surveying to real estate/investment, aviation and marine navigation. Users can partition the TI 58 with

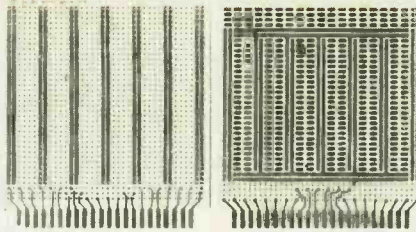


CIRCLE 47 ON READER SERVICE COUPON

up to 480 program steps or up to 60 memory registers. For every increase or decrease by 10 memories, 80 program steps are added or taken away in storage. Changing program steps affects the amount of memory in an opposite way. So that users can put their machines to work more quickly and obtain maximum benefits of programming, TI has developed new instructional material in a "Personal Programming" book form to replace the traditional owner's manual. This learning guide comes with the calculator. For more information on the TI 58, write to Texas Instruments Inc., IAS (Attn: TI Programmables, P.O. Box 53, Lubbock, TX 79408.

Universal PC Board

Model H-PCB-1 is the first in a new series of top quality PC Boards for the serious amateur. The 4 x 4.5 x 1/16-in. board is made of glass coated epoxy laminate and features solder coated 1 oz. copper pads. In addition, the board has a 22/22 two sided edge connector, with contacts on standard .156 spacing. The board contains a matrix of .040 in. diameter holes on .100 inch centers. The component side contains 76 two-hole pads that can accommodate any DIP size from 6-40 pins, as well as discrete components. Components may be sol-



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dered directly to the board, or intermediate sockets may be used for soldering or wire-wrapping. Two independent bus systems are provided for voltage and ground on both sides of the board. In addition, the component side contains 14 individual buses running the full length of the board for complete wiring flexibility. These buses enable direct access from edge contacts to distant components. These buses can also serve to augment the voltage or ground buses, and may be cut to length for particular applications. Sells for \$4.99. Available from O.K. Machine and Tool Corp., 3455 Conner Street, Bronx, NY 10475.

Deluxe Ham Antenna

A series of deluxe mobile antennas for frequencies between 3.5 and 30 MHz are available from Swan Electronics. Power rated at 1,000 watts PEP, the model 45 can be manually switched

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to any one of five bands: 10, 15, 20, 40 and 75 meters. Sells for \$119.95. Swan Electronics antenna accessories include the SWR-1A Relative Power Meter; the WM-1500 In-line Wattmeter; the HDS heavy duty spring for mobile antenna; the ABM mobile antenna ball mount and the stainless steel strap bumper antenna mount. Further information is available from the Cubic Corporation subsidiary at 305 Airport Road, Oceanside, CA 92054.



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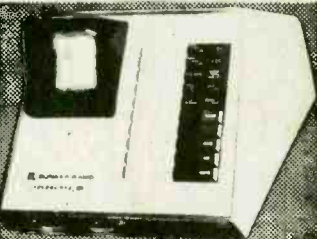
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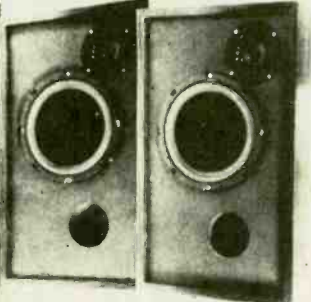
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From factory to you. Includes Fairchild FND-500 series. Hobby. Wt. 4 ozs. Cat. No. 11N3629

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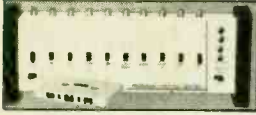
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CB New Products

(Continued on page 75)

warning. Also available is model CPI I, an indicator that monitors power output only. Both lightweight products feature solid state circuits and measure less than 6-in. wide by 1 5/8-in. deep and 1 1/4-in. high. Adhesive strips are supplied with the indicator for quick mounting either below or above the transceiver or the vehicle dashboard. The indicator comes with a PL259 connector for easy in-line installation between antenna and transceiver. Sells for \$19.95. For all the facts, write to CiBco Division, Southwest Factories, Inc., 3801 Willow Springs, Oklahoma City, OK 73112.

NewsScan

(Continued from page 14)

Fingerprints for Dynamite

Products now can be "fingerprinted" for positive identification, even when labels, logos, serial numbers and other conventional identifiers no longer exist. Identification can be made with 3M brand "Microtaggant" particles—tiny, multi-layered particles that can be incorporated in trace quantities into explosives, paints, plastics, animal and poultry feeds, or almost any other solid or semi-solid material. Microtaggants also can be used for protection against counterfeiting. Almost any items—proprietary compositions, electronic components, molded plastic products, etc.—can be coded with the 3M particles to authenticate the source of manufacture.

3M Microtaggants can be processed to provide more than 500,000 layer combinations, each representing a specific color code. Particles can be attracted to a magnet for easy isolation, and their top layers can be made fluorescent for identification in the dark with portable ultraviolet light (black light) equipment.

In addition, fast, on-site readout is possible without the use of special analytical equipment. Color codes can be read under a low-power (40X to 100X) microscope.



Greatly enlarged photo of 3M brand Microtaggants illustrates a sample multi-color coding arrangement. These tiny identifiers can be processed to provide more than 500,000 different combinations of color layers.

With a concentration of Microtaggants in dynamite of only 500 parts per million by weight (0.05 percent), a magnetic sweep of a blast area will yield enough of the identifiers to determine the kind of explosive used, the manufacturer, the specific plant which produced the explosive, the day it was produced and the shift that produced it. This means that dynamite could easily be traced from production to point of purchase or theft, providing a vital link in a chain of evidence.

Tests with explosives incorporating the 3M product currently are being conducted with U.S. agencies and the explosives industry.

**NEW LSI TECHNOLOGY
FREQUENCY COUNTER**

TAKE ADVANTAGE OF THIS NEW STATE-OF-THE-ART COUNTER FEATURING THE MANY BENEFITS OF CUSTOM LSI CIRCUITRY.

FEATURES AND SPECIFICATIONS:
DISPLAY: 4 RED LED DIGITS 4" CHARACTER HEIGHT
GATE TIMES: 1 SECOND AND 1/10 SECOND
PRESCALER WILL FIT INSIDE COUNTER CABINET
RESOLUTION: 1 HZ AT 1 SECOND; 10 HZ AT 1/10 SECOND
FREQUENCY RANGE: 10 HZ TO 60 MHZ (65 MHZ TYPICAL)
SENSITIVITY: 10 MV RMS TO 50 MHZ, 20 MV RMS TO 60 MHZ TYP.
INPUT IMPEDANCE: 1 MEG OHM AND 20 PF
[DIODE PROTECTED INPUT FOR OVER VOLTAGE PROTECTION]
ACCURACY: ± 1 PPM [± .0001%]; AFTER CALIBRATION TYPICAL
STABILITY: WITHIN 1 PPM PER HOUR AFTER WARM UP [±.001% XTAL]
IC PACKAGE COUNT: 8 (ALL SOCKETED)
INTERNAL POWER SUPPLY: 5 V DC REGULATED
INPUT POWER REQUIRED: 6-12 VDC OR 115 VAC AT 50/60 HZ.
POWER CONSUMPTION: 4 WATTS

KIT #FC-50C IS COMPLETE WITH PREDRILLED CHASSIS ALL HARDWARE AND STEP-BY-STEP INSTRUCTIONS. WIRED & TESTED UNITS ARE CALIBRATED AND GUARANTEED.

- KIT #FC-50C 60 MHZ COUNTER WITH CABINET & P.S. **\$119.95 COMPLETE!**
- KIT #PSL-650 650 MHZ PRESCALER [NOT SHOWN] 29.95
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KIT #ALR-1 \$9.95
#ALR-1WT WIRED & TESTED \$19.95

60 HZ.

XTAL TIME BASE

Will enable Digital Clock Kits or Clock-Calendar Kits to operate from 12V DC.
1"x2" PC Board
Power Req: 5-15V (2.5 MA. TYP.)
Easy 3 wire hookup
Accuracy: ± 2PPM
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Complete Kit **\$4.95** Wir & Cal **\$9.95**

PLEXIGLAS CABINETS

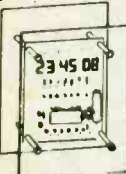
Great for Clocks or any LED Digital project. Clear-Red Chassis serves as Bezel to increase contrast of digital displays.

- CABINET I** 3"H, 6 1/4"W, 5 1/4"D Black, White or Clear Color
- CABINET II** 2 1/2"H, 5"W, 4"D \$6.50 ea.

RED OR GREY PLEXIGLAS FOR DIGITAL BEZELS
3"x6"x1/8" 95¢ ea 4/3

SEE THE WORKS Clock Kit Clear Plexiglas Stand

- 6 Big 4" digits
- 12 or 24 hr. time
- 3 set switches
- Plug transformer
- all parts included



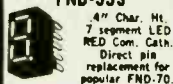
KIT \$23.50 ea.
Assembled \$29.95

Kit #850-4 CP
Size: 6"H, 4 1/2"W, 3"D

VARIABLE REGULATED 1 AMP POWER SUPPLY KIT

- VARIABLE FROM 4 TO 14V
 - SHORT CIRCUIT PROOF
 - 723 IC REGULATORY
 - 2N3055 PASS TRANSISTOR
 - CURRENT LIMITING AT 1 Amp
- KIT IS COMPLETE INCLUDING DRILLED & SOLDER PLATED FIBERGLASS PC BOARD AND ALL PARTS (Less TRANSFORMER) KIT #PS-01 \$8.95
TRANSFORMER 24V CT will provide 300MA at 12V and 1 Amp at 5V. \$3.50

Fairchild Super Digit FND-359



95¢ ea, 10/\$8.50

SET OF 6 FND-359 WITH MULTIPLEX PC BOARD \$6.95

MOBILE LED CLOCK

12/24 HR. 4" DIGITS!



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(Continued from page 11)



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7557N	69	74LS255	38	LM3517	4.50
7558N	69	74LS256	38	LM3518	4.50
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7570N	69	74LS268	38	LM3530	4.50
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7581N	69	74LS279	38	LM3541	4.50
7582N	69	74LS280	38	LM3542	

Computer New Products

(Continued from page 72)

keyboards in many instances. Speechlab sells for \$249 in kit form or \$299 assembled and tested. The unit digitizes and extracts data from a speech waveform and applies pattern-matching techniques to recognize the vocal input. Included in the price is a complete hardware/software system, a 275-page lab manual, 95-page hardware manual, hi-fi microphone, and three programs on paper tape. The lab manual, claimed to be the only introductory volume on speech recognition currently available, includes 35 graded experiments with over 100 tables and graphs. The system features 64 bytes of storage per spoken word and a vocabulary of up to 64 words in memory. Other features: real time response, 95% correct recognition, automatic hardware self-test capability and advanced CMOS design for low power drain and reliability. Software includes SpeechBasic Basic programming language, assembly language speech recognition program, SpeechBasic plot, correlation, recognition, advanced recognition and hardware self-test programs. Uses include computer input, games, research and vocal control. Separate power supply and connector can be used to couple the unit to computers other than S-100 bus computers for which it is basically designed. Circle 48 on Reader Service Coupon.

CB XCVR Checkout

(Continued from page 68)

Input Level for S9 Meter
Indication 140 μ V

Transmitter Section Test:
AM RF Output 3.8 watts
SSB RF Output 11 watts P.E.P.
Modulation to 85% yes
Relative sensitivity for
85% Modulation -24 dB
Modulation Limited to 100% yes

Editorial Remarks: A single conversion receiver with jacks for external and P.A. speakers. L.E.D. digital channel indicator. Also an S/RF-output meter. The S-meter has a relative S-unit scale calibration. ■

● TRAM/DIAMOND D12

\$169.95 (Tram/Diamond Corp.)

General Description: A 40-channel AM transceiver for mobile, P.A. Power supply is 12 to 13.8 VDC with negative or positive ground. Overall dimensions are 2 $\frac{3}{32}$ -in. H x 5 $\frac{3}{16}$ -in. W. x 7 $\frac{1}{16}$ -in. D. There are front panel controls for channel selection, volume, squelch, microphone gain, and ANL "depth." Switches for CB/PA,



CIRCLE 54 ON
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and local/distance sensitivity. Standard accessories include a microphone, DC power cable, and quick-release mobile mounting bracket.

Receiver Section Test:

Input Sensitivity 0.8 μ V
Adjacent Channel Rejection 52 dB
AGC Action 6 dB
Input Level for S9 Meter
Indication 32 μ V

Transmitter Section Test:

AM RF Output 3.8 watts
Modulation to 85% yes
Relative sensitivity for
85% Modulation -32 dB Maximum
Modulation Limited to 100% yes

Editorial Remarks: A double conversion receiver with jacks for external and P.A. speakers. ANL is user adjustable from the front panel (basically two limiting levels). Also an S/RF-output meter. The S-meter has a 5 dB per S-unit scale calibration. ■

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+/-15VDC @ 150 ma
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A fun EASY kit to assemble that emits an ear piercing 10 watt dual tone scream. Resembles European siren sound. Great for alarms or toys. Operates from 5-12VDC at up to 1 amp (using 12VDC 8 ohm speaker). Over five thousand have been sold. All parts including PC board, less speaker.

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PS-01B

Same as above but with +/-12 VDC instead of +/-15. Order PS-01B

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If you have trouble sleeping and you would like the rest of the neighborhood to share your misery then this little kit will be for you! There is no way to accurately describe the unearthly howls, screams and tones that come out of this kit. Four separate tone oscillators are mixed, cancelled and stepped at a varying rate. 10 Watts of crazy sounds. A great fun kit or a practical burglar alarm. Complete with PC board and all necessary components less speaker. For 6-12 VDC.

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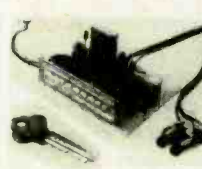
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Can be used as an elapsed timer
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Readout board: 2 3/8" x .75"

CAUTION: PC pads are small and require a small tipped low wattage iron & small diameter solder. Do not attempt this kit unless you can solder in small places!



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Pro Timer

(Continued from page 36)

projects, you'll find as you progress to more complex projects that making up a printed circuit board saves construction time and improves the project by making it neater and much more reliable (rigid mechanically) than other construction methods. However, you may, like many other beginners be hesitant about making such a board the first time. If so, making a fairly simple printed circuit board such as the one shown for this project is a god idea. Although not necessary for this project, it is good practice and training for much more complex projects, where use of a printed circuit components board is virtually mandatory.

You can get a good kit for making printed circuit components boards from your local Radio Shack store for \$6.95. It's the Archer Printed Circuit kit number 276-1576.

What Determines the Time Interval.

If math bothers you, you might be

$$T = \frac{B \times R_t \times C_7}{a - \frac{V_{be}(Q_1)}{V+}}$$

scared off by being thrown a formula like this:

However, if you take it slow, you'll find that there's nothing here any high school student who knows simple multiplication and division can't understand. Slowly now, here we go.

T is the Time, the interval we're setting up.

B is a constant—a fixed value which is determined by the size of R8 (R7, too, which is a small, limiting resistor).

R_t is the net resistance selected by the positions of the two switches.

C₇ is the capacitor which charges up. V_{be} (Q₁) is the voltage across the base and emitter of transistor Q₁.

And V₊ is the supply voltage, 15 volts in this case.

Finally, a is the ratio of R₁₃ to the sum of R₁₃ and R₁₄.

Put another way, the Time is equal to the Capacitance times Resistance (the familiar formula for time constants, remember?), multiplied by B, which depends on the size of R₈,—all this divided by whatever R₁₃/(R₁₃ + R₁₄) comes to, minus the ratio of Q₁'s base-to-emitter voltage (0.8V) divided by the supply voltage (15 VDC).

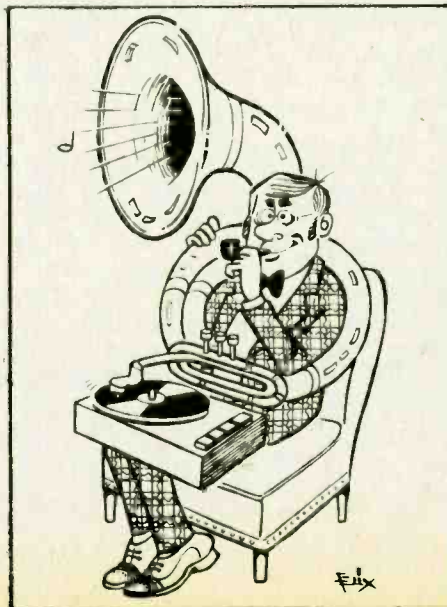
From this you can see that increasing either the size of the resistances selected by the switches, or increasing the size of charging capacitor C₇ will make the timed interval, T, longer. Decreasing either the resistances or the size of C₇ will naturally shorten the interval.

Now, in this particular instance, we leave capacitor C₇ fixed and change the timed interval T by changing the net resistance R_t. The B term which precedes R_t in the above equation is simply a scale factor which we choose by adjustment of R₈ (during calibration of the timer). Once the appropriate B factor has been found, we leave R₈ alone, and B is thereafter a constant factor in our equation. The only intended variable is R_t.

Let's assume we've constructed the timer-circuit using randomly selected, off-the-shelf components. Could we expect our prototype to behave precisely as predicted mathematically? The answer is NO because our equation is a simplification, and therefore incomplete. For one thing, it does not tell us that components like resistors and capacitors never have fixed, perfectly precise values. For instance, a 1000-ohm, 10%-tolerance resistor could have a resistance anywhere from 900 to 1100 ohms, and C₇'s capacity is a nominal 3300 mfd., +100% or -20%, which means that the capacitance of a randomly selected unit could be anything from 2600 mfd. to 6600 mfd. It is for this reason, non-ideal components, that the calibration, term B, is incorporated into the timing equation. By adjusting R₈ we change the B term's magnitude, and thus compensate for our inability to find components with precise values.

O.K., so we have a fudge-factor built-in, and the B factor minimizes the ill effects that component variations produce.

Additional Use. Once you've built Pro-timer you'll surely think of other uses for it outside the darkroom or the process laboratory. One good use is in timing TV games. Set the Pro-timer for a certain number of minutes, and see who can get the most points in that time interval.



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TI-58 Calculator (Continued from page 38)

covering such diverse specialties as aviation, marine navigation, real estate and investment.

Big Brother. The TI 58 is available in an even more elaborate version, the TI 59. The TI 59 has exactly twice the step/memory capability of the 58; it allows up to 960 program steps or 100 memories. To give you an idea of just how sophisticated this is, the TI 59 has 715 kilobytes of ROM, 1 kilobyte of RAM and a 70 usec. instruction time.

The TI 59 also offers a non-volatile memory, magnetic cards. The cards can be recorded on right from the keyboard after being fed into a slot on the side of the TI 59. Once recorded, a program can never be lost to you (unless you misplace the mag-card!). All you have to do is to plug the card back into the calculator and run the program.

Minding The P's and Q's. If all this weren't enough TI has carried their computer concept a step further and provided for direct printout so you can get a listing of a program, or a run. The TI-58 (and the TI-59) can be attached to a model PC-100A alphanumeric printer/plotter. No we haven't made a mistake, we mean alphanumeric. Though the basic calculator is only numeric, when attached to the PC-100A (not the PC-100) you can obtain a letter print by keying corresponding numerals on the calculator. This permits you to identify programs and steps in English, rather than a symbol code. The PC-100A also can plot results from a calculator program instead of simply printing a list of values. If this *still* doesn't make you think of these calculators as computers, consider that with the PC-100A user-prompting can be entered into the program. The printer can thus announce when it is time to enter a variable during a program's run; this allows untrained people to use a previously prompt-prepared program.

Add all these features together—they total *computer*. The printer attachment might be somewhat expensive, for many pockets, but even without it you get essentially all the computer features even in just the TI-58.

Both the TI-58 and TI-59 come complete with NiCad batteries, a charger, a *Master Library* module with 89-page contents guide, the calculator instruction manual which is a complete course in programming and a belt-loop soft-case. The 59 also comes with mag cards. Price for the TI-58 is \$124.95, and \$299.95 for the TI-59.

For additional information circle No. 47 on the reader's service coupon. ■

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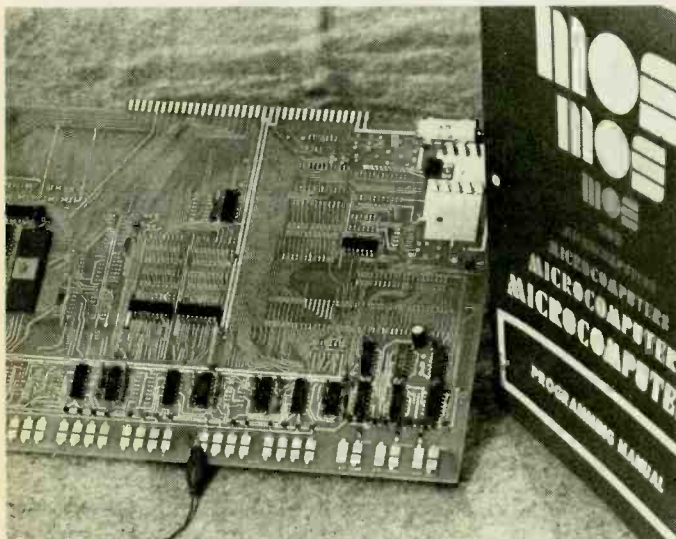
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Computer Readout

(Continued from page 80)

a Memory. The latter contains the frequency information for a selected set of words that the classifier is attempting to detect. Clearly the Analyzer, Classifier, and Memory must all be designed to function together since one depends on the other. Some classifiers have a training algorithm built into them that allows the user to repeat the word several times in order to home in on the right decision. The user, in this case, has a set of buttons to press to tell the computer the word he is trying to get across. So he presses the button for "stop baggage," for example, and then repeats the phrase "stop baggage" ten times so the Classifier is able to



The Datac 1000T with its instruction manual. As you see, the manual is a well-printed book with a complete set of directions for use, as well as suggestions dealing with the possible applications of the computer. The Datac is a basic computer board built around the MOS Technology 6502 microprocessor, and while it does not have a full-fledged keyboard or CRT readout, it is nevertheless a very flexible tool with considerable capability for expansion built in. For more information circle No. 70 on the Reader Service Coupon.

make a proper decision for that particular user's voice.

The future in this voice-controlled computer dreamland may bring us replacements for dictation services (just talk in the manuscript, the computer will do the typing job), voice-controlled security systems, or a television set that turns to the channel you whisper. Microprocessors can serve this dreamland as they become faster and more powerful. Tune in next time for more micro-mania and keep the ideas coming. And don't forget the Personal Computing Expo at the New York Coliseum, October 28-30. Write Bruno and Associates, 78 East 56th Street, New York, N.Y. 10022, for details, or call 212-753-4920.

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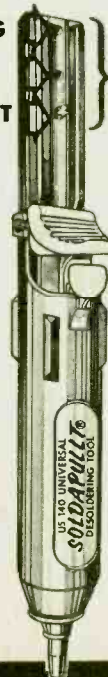
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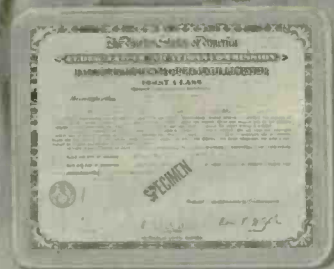
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A Government FCC License can help you qualify for an exciting, rewarding career in ELECTRONICS, the Science of the Seventies. Read how you can prepare at home in your spare time to pass the FCC Licensing examination.

If you're out to bag a better job in Electronics, a Government FCC License can give you a shot at job opportunities with *real* futures.

According to the U.S. Office of Education Bulletin (4th Edition): "The demand for people with technical skills is growing twice as fast as for any other group, while jobs for the untrained are rapidly disappearing." There are new openings every year in many different industries for electronics specialists. And you don't need a college education to qualify.

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

Importance of an FCC License and CIE's Warranty of Success

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

But even if you aren't planning a career which involves radio transmission of any kind, an FCC "ticket" is valuable to have as Government certification of certain technical skills. It's a job credential recognized by some employers as evidence that you really know your stuff.

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

It's not that simple. To get an FCC License, you must pass a Government licensing exam.

A good way to prepare for your FCC License exam is to take one of the CIE career courses which include FCC License preparation. We are confident you can successfully earn your license, if you're willing to put forth an effort, because the vast majority of CIE students have. In continuing surveys, nearly 4 out of 5 CIE graduates who take the FCC License exam get their licenses.

That's why we can offer this time-tested Warranty of Success: when you successfully complete any CIE career course which includes FCC License preparation, you will be able to pass the Government FCC Examination for the License for which the course prepared you or you will be entitled to a full refund of an amount equal to the cash price in effect on the date of your enrollment for CIE's "FCC License" Course, No. 3. This warranty is good from the date you enroll until the last date allowed for completion of your course.

CIE HAS CAREER COURSES THAT INCLUDE "HANDS ON" TRAINING

ELECTRONICS TECHNOLOGY with LABORATORY Courses . . . takes beginner from fundamentals to skills required of technician or engineering assistant. Includes Experimental Electronics Laboratory for "hands on" training.

ELECTRONICS TROUBLESHOOTING . . . several CIE courses combine electronics theory with the actual construction, testing and troubleshooting a big screen, solid state color TV.

With CIE you learn at home

With CIE, you learn in your spare time at home . . . or wherever else is convenient. No classroom time, ever. No one to make you go too fast . . . or too slow. With CIE's Auto-Programmed® Lessons you'll pick up facts, figures, and electronics theories you may have considered "complicated" . . . even if you've had trouble studying before.

You can have attractive job opportunities

There have already been many exciting developments and breakthroughs in Electronics and some people might assume there will be no new frontiers . . . no new worlds to conquer. Not so.

Electronics is still growing. In nearly every one of the new and exciting fields of the Seventies you find electronics skills and knowledge in demand. Computers and data processing. Air traffic control. Medical technology. Pollution control. Broadcasting and communications. Once you have the solid technical background you need, you can practically choose the career field you want . . . work for a big corporation, a small company or even go into business for yourself.

Yes, Electronics can be the door to a whole new world of career opportunities for you. And CIE training can be your key.

Send for FREE school catalog

Discover the opportunities open to people with electronics training. Learn how CIE career courses can help you build new skills and knowledge and prepare you for a meaningful, rewarding career. We have courses for the beginner, for the hobbyist, for the electronics technician, and for the electronics engineer. Whether you are just starting out in Electronics or are a college-trained engineer in need of updating (or anywhere in between), CIE has a course designed for *you*.

Send today for our FREE school catalog and complete package of career information. For your convenience, we will try to have a representative call to assist in course selection. Mail reply card or coupon to CIE . . . or write: Cleveland Institute of Electronics, Inc., 1776 East 17th Street, Cleveland, Ohio 44114. Do it TODAY.

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All CIE *career* courses are approved for educational benefits under the G.I. Bill. If you are a Veteran or in service now, check box for G.I. Bill information.

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