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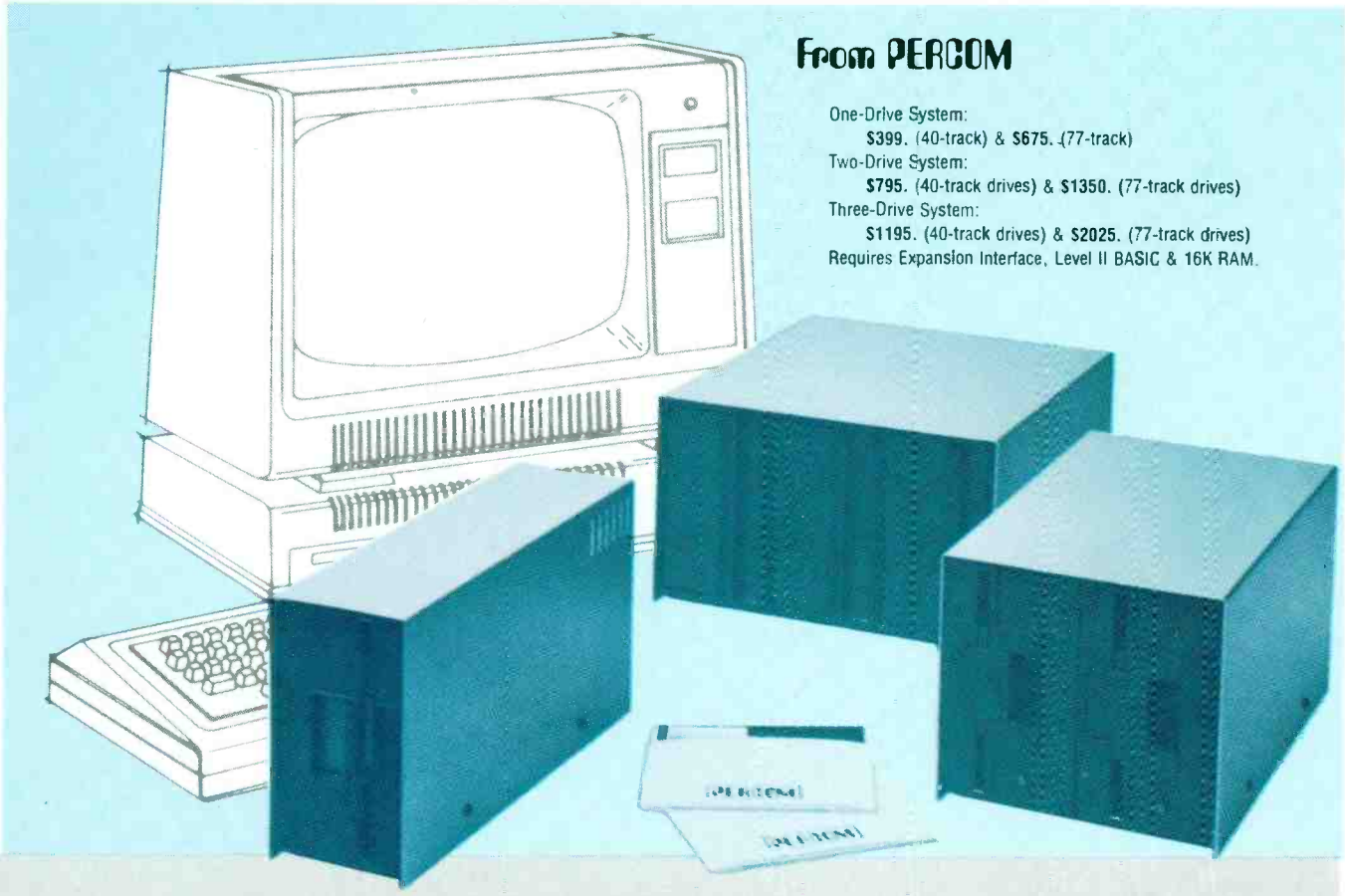

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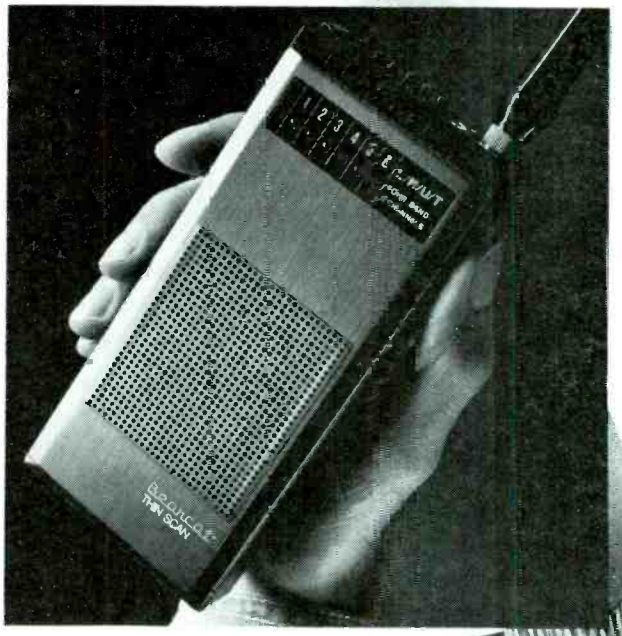

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March/April 1980 Volume 20, No. 2

AUTHORS IN THIS ISSUE

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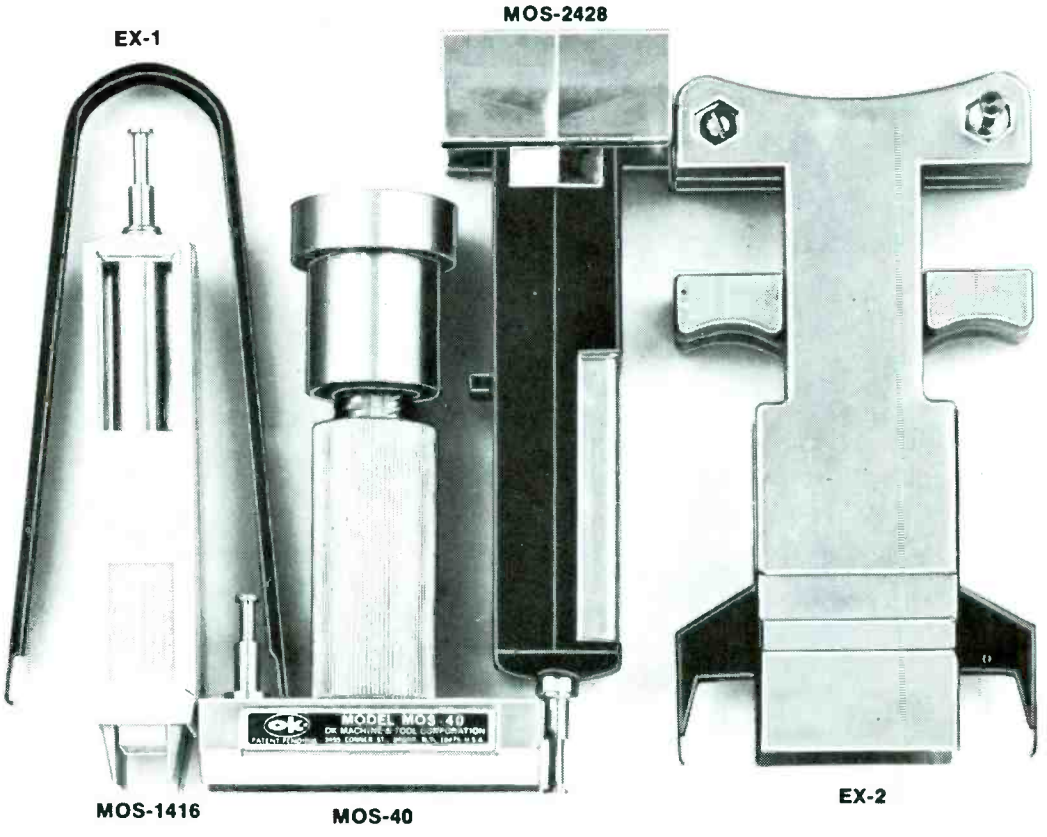

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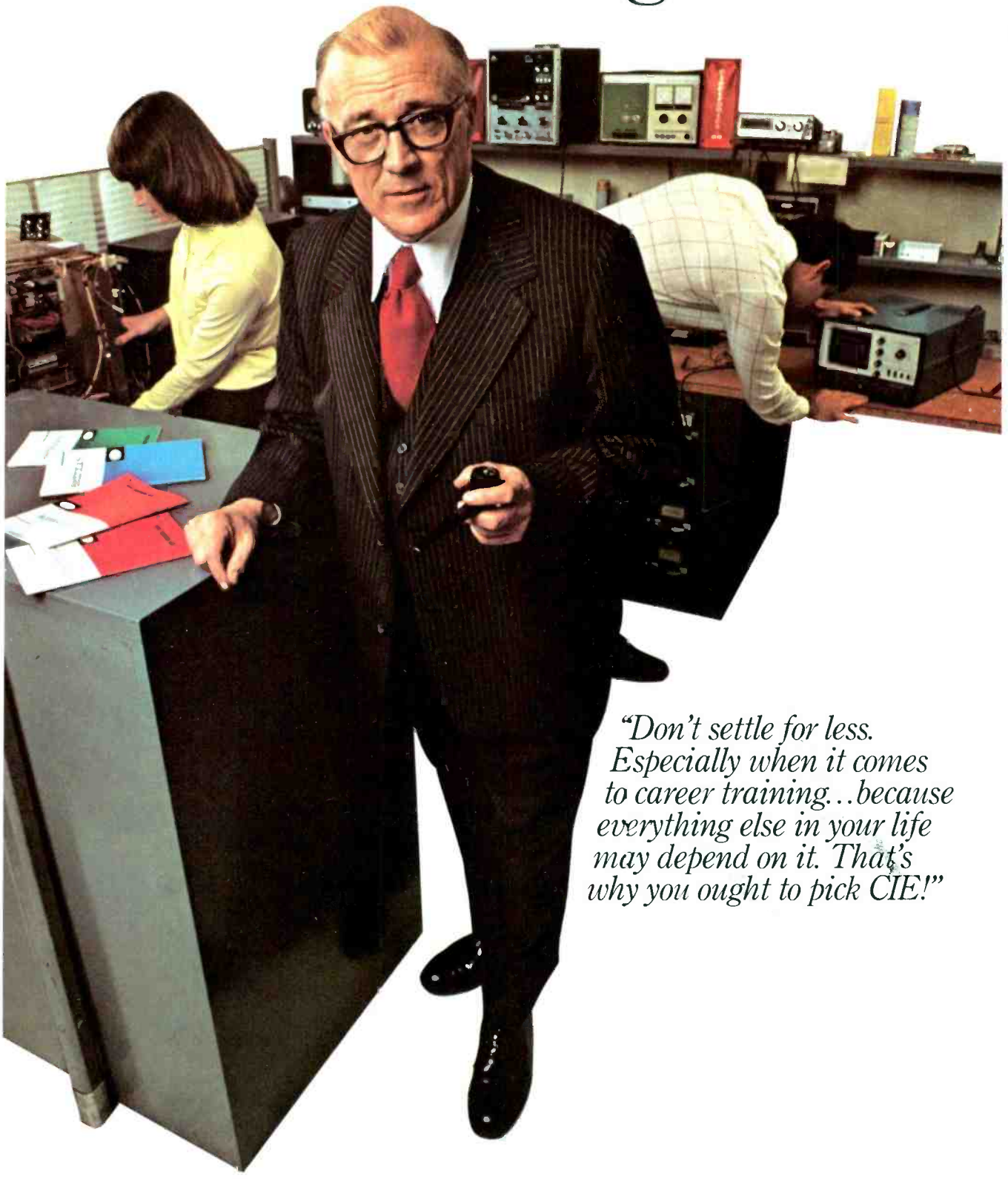

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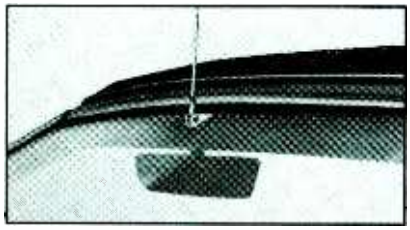
CB antennas

By Scott Larkin

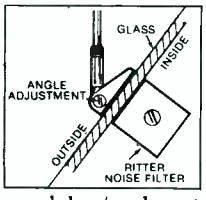
The Avanti Moonfantom

A new long range antenna called the Moonfantom has been recently developed by Avanti – one of the oldest and largest antenna companies in the world. The Moonfantom combines so many right things it's almost too good to be true.



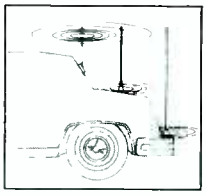
Amazing patent pending design puts coax and pick-up inside where it's safe from the elements.

Just take a look at the following:



Less Noise – A special "Ritter Noise Filter" used in the Moonfantom effectively reduces static noise by as much as 30%. You can actually use less squelch (and get greater range) when using the Moonfantom because your antenna picks up less noise.

More Efficient – The Moonfantom can be pushed to 400 Watts. The S.W.R. will run 1.1:1 at resonance so you make use of all the power your set puts out.



Uniform radiation pattern with no dead spots.

New On-Glass Unique Design – The Moonfantom functions and operates as a true 5/8 wave antenna, yet can be conveniently mounted on glass in a matter of minutes! There are no holes to drill. No car body patching at resale time. Space age epoxy holds antenna to glass window with the strength of a 3/8" bolt. Can be easily removed at resale time.

Mounts Anywhere – Because the Moonfantom requires no ground plane, it can be mounted on a fiberglass car, boat, truck, apartment window, or even a motorcycle. Plus easy installation and convenient 48" whip length.

If you're tired of changing from one CB antenna system to another, ask your CB dealer about the new long range Moonfantom or contact Avanti Research and Development, Inc., 340 Stewart Ave., Addison, IL 60101. 800-323-9429. Illinois Residents 312-628-9350.

HEY, LOOK ME OVER

SHOWCASE OF NEW PRODUCTS

Sound Shapers

The ADC Professional Products Group of BSR has introduced two new frequency equalizers, the Sound Shaper Two Mk II and the Sound Shaper One Ten. The Sound Shaper Two Mk II is priced at $329.95 and features 12 bands of equalization ranging from 30 Hz to 1600 Hz, each providing a range of 24 dB control (± 12 dB). The unit is an update of the Sound Shaper Two Mk I. It also features DUAL (7 segment per channel) LED solid-state quick response dB meters, accurate to within 1 dB. Also, for the first time, located on the rear panel of the unit are two

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Variable Frequency Spectrum Level Balancing Controls, used to adjust each channel so that the average output will be equal to the input signal level. This adjusts the equalizer for unity gain. Frequency response is 5 Hz to 100 kHz ± 1 dB with Harmonic Distortion not exceeding 0.02% at 1 Volt Output (20-20 kHz). The Sound Shaper One Ten is similar to the Sound Shaper Two Mk II except that it features 10 bands of equalization ranging from 31 Hz to 1600 Hz. The unit doesn't include LED dB meters, Level Balancing Controls or a Sound Level Meter input Jack. Retail price for the Sound Shaper One Ten is $229.95. Get all the facts direct from ADC, a Division of BSR, Route 303, Blauvelt, NY 10913.

Mobile Disguise Antenna

A new series of Chrysler disguise antennas for land mobile communications is now available from Antenna Incorporated. The antennas utilize parts identical to those used in existing Chrysler antennas. Available in either single band or combination AM/FM land mobile models, the Chrysler disguise antenna is factory-tuned to the exact frequency the customer specifies within the following ranges: 25-54 MHz (Models 41080 and 41081). 130-174 MHz (Models 42080 and 42081) and 406-512 MHz (Models 43080 and 43081). Maximum power is 150 watts for the single band model, or 100 watts for the combination AM/FM land mobile model. VSWR is 1.5:1 or less. The antenna's 32-inch whip is made of permanent set, impact resistant 17-7 PH stainless steel for true and total disguise. High quality 17-foot coaxial cables with matching transformers and PL-259 connectors are used to ensure dependable performance. In-line cable connectors are provided on AM/FM models for easier installation and routing through openings as small as ⅜-inch. The new Chrysler-style antennas augment the Antenna Incorporated disguise line, which also includes universal and Ford-style mounts. For further information, including prices on the new Mobile Disguise Antennas for land

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mobile applications, contact Antenna Incorporated, 26301 Richmond Road, Cleveland, OH 44146 or telephone at 216/464-7075.

Single-Play Turntable

The Radio Shack Realistic LAB-250 belt-drive, single-play turntable has a fully automatic arm return and

(Continued on page 10)

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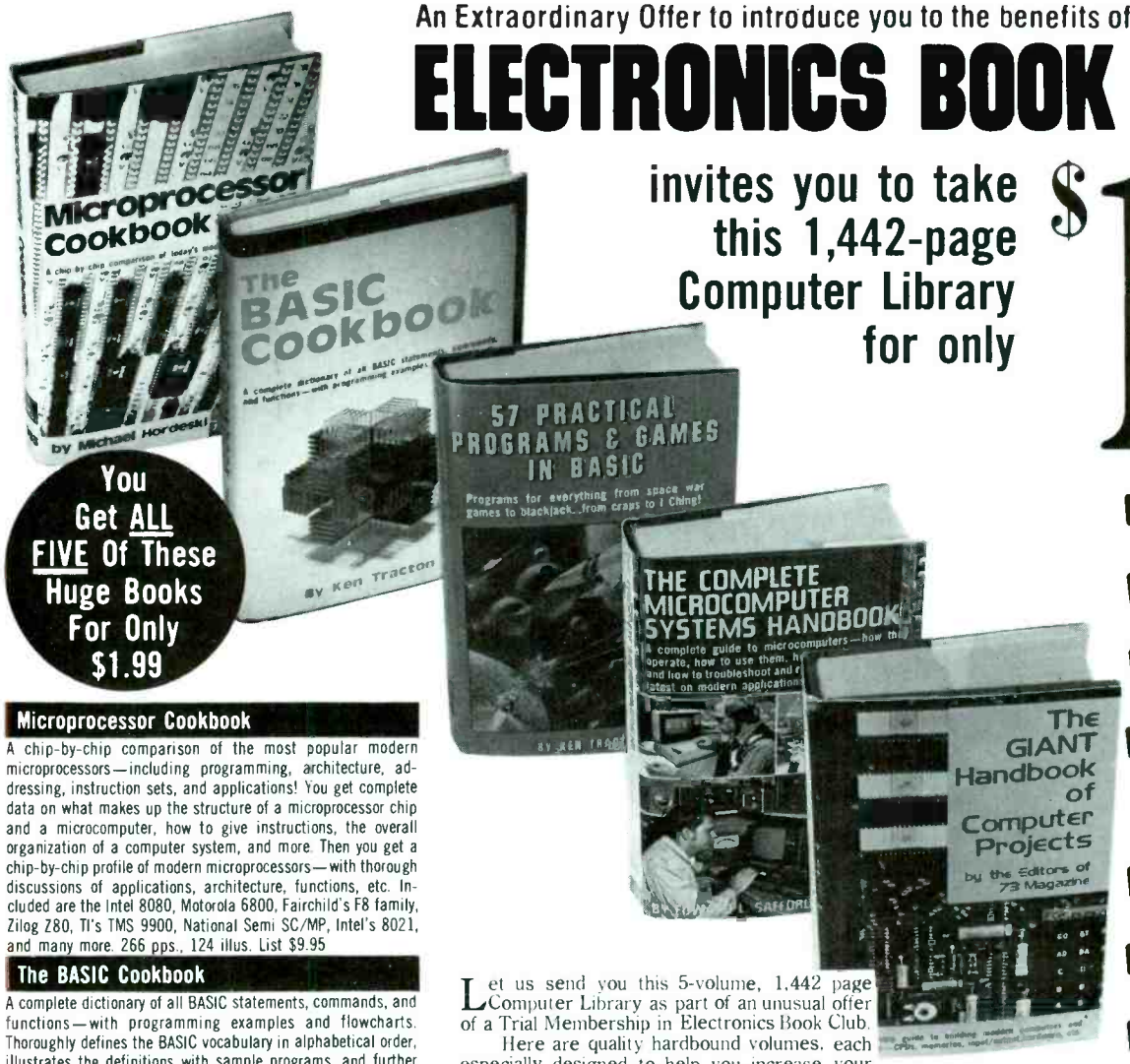

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HEY, LOOK ME OVER

shutoff. The belt drive system is said to absorb the slightest vibrations to give noise-free music. The S-shape tonearm has viscous-damped cue/pause lever that gently lowers the stylus onto the disc. A four-pole synchronous motor, adjustable anti-skate, and an acoustically isolated

CIRCLE 32 ON READER SERVICE COUPON

shock-mount suspension are the main features of the LAB-250. Speeds are 33⅓ and 45-rpm. Wow and flutter is less than 0.09%. The turntable has a walnut grained vinyl veneer base and hinged dust cover. Priced at $129.95, the Realistic LAB-250 belt-drive, single-plav turntable is sold exclusively by Radio Shack stores and dealers nationwide and in Canada.

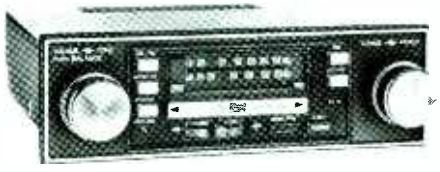
Sound System

Shure's new sound system, the new Pro Master, is designed to meet the needs of entertainers for a truly professional, portable system employing today's most modern sound control and enhancement techniques. It is also ideal as a permanent, professional quality sound system in intimate clubs, auditoriums, churches and school installations. The basic Pro Master system consists of a Model 700 Power Console and two Model 701 Speaker Systems. The three components individually weigh 58 pounds or less, and the system fits easily into today's most popular subcompact automobiles. The price of a basic Pro Master sound system consisting of Model 700 Power Console and two Model 701 Speaker Systems is $1,980.00. (Price of one 700 Power Console is $990.00; price of one 701 speaker is $495.00). Monitor speakers, electronic cross-over units, console cover, stand, and line matching transformers are available as optional accessories. The Pro Master Power Console and Model 701 Speaker are available individually for use with other components, or as part of house systems. For additional information, write: Shure Brothers Inc., 222 Hartrey Avenue, Evanston, Illinois 60204.

CIRCLE 40 ON READER SERVICE COUPON

Quality In-Dash-Fi

From their Pro series, Tenna offers a deluxe in-dash Auto Reverse Cassette AM/FM Stereo that offers the quality of home stereo. C-3039 AR comes with pre-amp output so that increased amplifier power can be achieved without distortion or complicated rewiring. Installation is also easy with fully adjustable shafts and a universal nose size, short (4½-inch) chassis that makes it easy to fit in most cars including foreign models. It features adjustable FM muting, separate front to rear fader and balance controls, as well as dial-in-the-door and selectable end-of-the-program eject or continuous play. Specs include: 10 Watts RMS stereo power; 3 Watts per channel minimum RMS at 4 ohms from 40-20 000 Hz with no more than 1% THD both channels driven. Sensitivity is 3 uV (max.), 5 uV at 30 dB S/N. Suggested retail price is $199.95. For more facts on the C-3039 AR, write to Tenna Corp., 19201 Cranwood Parkway, Cleveland, OH 44128.



CIRCLE 38 ON READER SERVICE COUPON

(Continued on page 12)

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The "Edu-Kit" offers you an outstanding PRACTICAL HOME RADIO COURSE at a rock-bottom price. Our Kit is designed to train Radio & Electronics Technicians, making use of the most modern methods of home training. You will learn radio theory, construction practice and servicing. THIS IS A COMPLETE RADIO COURSE IN EVERY DETAIL.

You will learn how to build radios, using regular schematics; how to wire and solder in a professional manner; how to service radios. You will work with the standard type of punched metal chassis as well as the latest development of Printed Circuit chassis.

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

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

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

THE KIT FOR EVERYONE

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

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

PROGRESSIVE TEACHING METHOD

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

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

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

THE "EDU-KIT" IS COMPLETE

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

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

FREE EXTRAS

• SET OF TOOLS

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

SERVICING LESSONS

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

FROM OUR MAIL BAG

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

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

SOLID STATE

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

PRINTED CIRCUITRY

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

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

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

Progressive "Edu-Kits" Inc., 1189 Broadway, Dept. 601-DJ Hewlett, N.Y. 11557

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

NAME .....

ADDRESS .....

CITY & STATE ..... ZIP .....

PROGRESSIVE "EDU-KITS" INC.

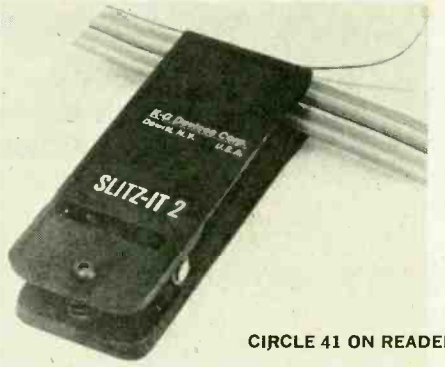
1189 Broadway, Dept. 601-DJ Hewlett, N.Y. 11557

CIRCLE 16 ON READER SERVICE COUPON

HEY, LOOK ME OVER

A Better Ribbon Slitter

K-G Devices has introduced the *Slitz-It 2*, a separator tool designed for the easy isolation of single conductors from computer-style ribbon cables. The *Slitz-It 2* ends the frustration of broken fingernails and inadvertant removal of adjacent insulation when preparing ribbon cable for end connector attachment. It can be used either hand-held or bench-mounted, and features easily replaceable blades, single-screw adjustment for cable thickness, and molded nylon construction. The *Slitz-It 2* comes with 10 extra blades. The *Slitz-It 2* retails for $12.00 postpaid from K-G Devices Corporation, P.O. Box 81, Dewitt, NY 13214.



CIRCLE 41 ON READER SERVICE COUPON

Super Scorpion Antenna

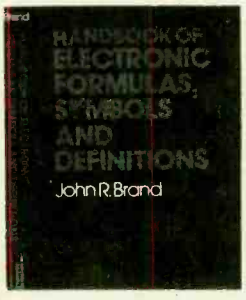
Antenna Specialists' new Super Scorpion base loaded CB mobile antenna provides substantial performance gain due to its full 60-inch tapered whip. The stainless steel professional grade whip bends full circle and snaps back perfectly, creates less surface to air resistance, and resists pitting and corrosion. The mobile antenna is factory tuned across all 40 channels and carries a 5-year limited warranty. The high impact Lexan base mounts on a trunk lip or roof using Antenna Specialists' Leverlok—an electrical/mechanical connection that instantly disconnects by twisting a lever. The Super Scorpion's coil is precision wound of 12 gauge enamel-coated copper wire for maximum efficiency and reserve power capability. To simplify installation, the 17-feet of coaxial cable is presoldered and has an in-line miniature connector. The suggested retail price of the Super Scorpion model is $39.95 Complete details are available from A/S antenna dealers or by writing directly to The Antenna Specialists Company, 12435 Euclid Ave., Cleveland, OH 44106. ■

CIRCLE 39 ON READER SERVICE COUPON

BOOKMARK

BY BOOKWORM

Look It Up! *Handbook of Electronic Formulas, Symbols and Definitions* by John R. Brand is an instant-access handbook providing thousands of electronic formulas, symbols, and definitions that relate to today's passive and active analog circuit technology. Its alphabetical format allows for instant location of information without searching through an index, saving the user hours of time and effort, the formulas are presented in linear form with sufficient parenthesis and brackets for direct use with

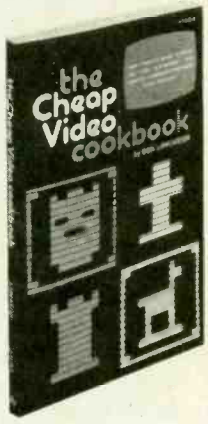


Hard cover
368 pages
$15.95

Instant
Electronics
Information.

any scientific calculator or computer program. Coverage of passive circuits extends from series circuit formulas to parallel and complex circuit formulas. Comprehensive information is presented on susceptance, bandwidth, capacitance, voltage, frequency, conductance, current inductance, power, Q factor, resistance, reactance, admittance, impedance, and much more. Greek letters that relate to electronics are defined, complete with sections on phase angles, wavelengths, ohms, and angular velocity. A handy appendix helps prevent laborious computations by listing ratios available from 5% component values. A virtual encyclopedia of useful data in a unique, "carry-around" volume, the Handbook will prove its value time and time again. Published by Van Nostrand Reinhold, 135 West 50th St., New York, NY 10020. Circle No. 60 on the Reader Service Card.

You Can Do It. *The Cheap Video Cookbook* by Don Lancaster presents a new "recipe" for saving time and money in hobby computer electronics. Here is a brand-new, low-cost way to get words, pictures, and op-code out of a computer and onto an ordinary TV set with minimum modifications to either. You will find complete do-it-yourself nuts and



Soft cover
288 pages
$5.95

A guide to
bargain
computer video
systems.

bolts construction details with thoroughly documented and debugged support software. The first chapter begins with the basics to determine what is really needed for alphanumeric and graphics video display systems. The second chapter shows you how to design cheap video software. Hardware is presented in Chapter 3. Here the interface circuitry you will need between your computer and TV set is introduced on a block-by-block basis. The nuts-and-bolts construction and debugging details of the TV terminal follow in Chapter 4, along with complete details of four modules that program your terminal for upper and lowercase alphanumerics and high-resolution and color graphics. Rounding out the book are complete details on transparency techniques that let you compute and display at the same time while keeping surprisingly high throughout. Published by Howard W. Sams & Co., Inc., 4300 West 62nd St., Indianapolis, IN 46206. Circle No. 61 on the Reader Service Card.

Digital Dash. *Digital Documentation No. 1 (Auto and Marine Applications),* by Frederick L. Young Jr. and Sr. shows the hobbyist/builder of moderate experience how to build

(Continued on page 84)

HI-FI REPORTS

LIVE RECORDING TECHNOLOGY

BY GORDON SELL

TWO YEARS AGO, Larry Johnson, a New Jerseyite, had no idea that his basement would become a recording studio. He was just your typical electronics hobbyist who liked to tinker with electronics projects and equipment, and he had developed an appreciation for hi-fi components. All this changed when a friend, who was starting a rock group, came to visit. The guitarist took one look at Larry's reel-to-reel tape deck and asked, "Hey, do you ever record live music?"

Two days later, Larry set up some microphones and hooked up the tape machine. The group sounded great live, but when the tape was played back—forget it. The lead guitar was too low, the bass too high and the singer, when you could hear her, sounded like she was in a shower stall. Repositioning the microphones helped, but the overall effect was purely "amateur."

Larry was hooked; he dug out an old electronics magazine and built a couple of rudimentary, four-into-one channel mixers. This enabled him to give each performer a mike line for vocals and one input for their instruments.

With a lot of trial and error, he was able to adjust the levels to get a balanced recording on the tape, but still the room's cement walls were upsetting the recordings.

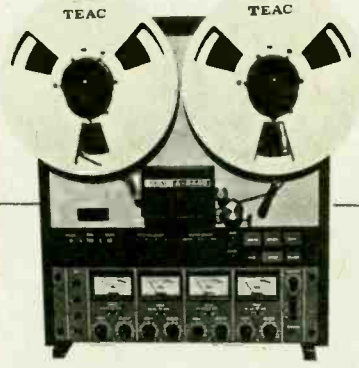
Room Acoustics. Larry did a bit of reading on the subject and realized that his first step was to deaden the reflections from the walls of the room. He hung old blankets and drop cloths so that they were about six inches out from the walls. This cut down on the singing-in-the-shower effect, but made the next problem more obvious.

The microphones were not only picking up music from one musician but from all of them. Larry now separated them a bit and hung double layers of blankets between them to deaden the crosstalk. This type of sound deadening wasn't too effective, but it enabled them to produce recordings that were far more professional than the first attempts.

By now, he was beginning to find shortcomings with his reel-to-reel; each time somebody goofed they had to go back and start from the beginning. He had no editing capability and all the mixer balancing had to be done before the music was recorded.

Multi-track. Larry decided to go out and buy a high-quality mixer and a multi-track recording machine with synchronized record/playback. On an audiophile tape recorder, the playback head is almost an inch away from the record head. If you tried to record on one track while monitoring the other, one music track would lag behind the other.

On a studio-type multi-track machine with synchronized heads, the record heads do double-duty so that all tracks are synchronized.



A four-track recorder is the key component in a home recording studio. This TEAC A-3440 features a three-motor drive, erase, record/synch and playback heads, and separate VU meters for each track. $1,600. Circle reader service number 46.

TEAC also makes an interesting, home recordist mixer, Model 2A. It's a six-input, four-output mixer with bass and treble controls plus fader for each channel. Unit shown has optional MB-20 meter bridge. Model 2A: $475. MB-20: $250. Circle 46.

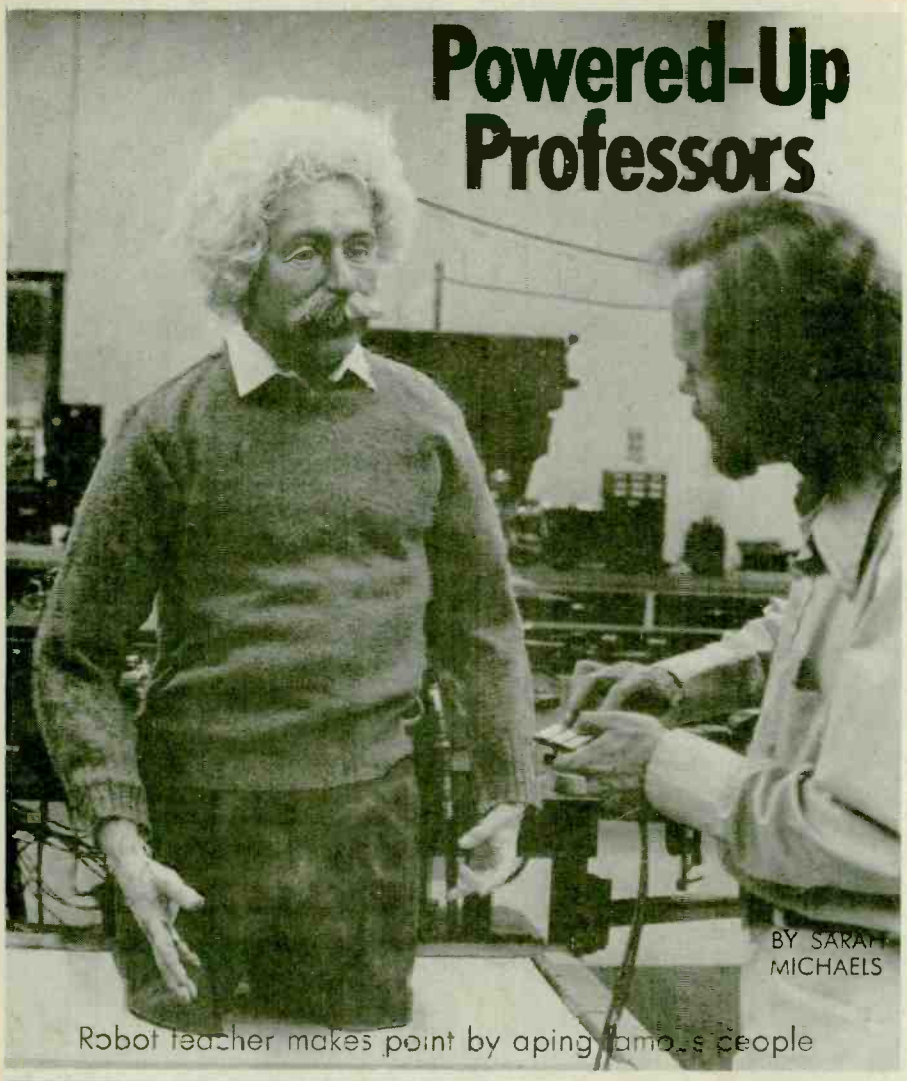
Now, if the lead guitar player goofs, Larry will rewind to that part of the tape and rerecord only the lead guitar's track. The musician is able to listen to the recordings of the other tracks and then play along.

The multi-track machine Larry uses is a four-track unit that is ideal for home studios. (Professionals use machines that can record 32 tracks on one-inch wide tape). He now records the musicians onto their own individual tracks. Once he has the basic recordings, he can mix them down so that they can be rerecorded on his original two track machine. Now he can manipulate the music for the most professional sound, and his recordings are almost up to par with some commercial offerings. ■

The Otari MX-5050-8 is an eight-track recorder that uses half-inch tape. The transport mechanism and electronics are in separate units. You can mount them in your own panel or buy the console shown for $350. $4,895. Circle number 48.

For someone willing to make a larger investment, the Sound Workshop produces a 12-input, eight-output mixer with bass, midrange and treble control, fader, 35 dB trim and more. $4,100. Circle 47.

Powered-Up Professors



BY SARAH MICHAELS

Robot teacher makes point by aping famous people

The pneumatic Albert Einstein robot prototype is shown here in various states-of-repair. To the left is the electro-pneumatic control box which fits under professor. In the lower left photo, Davies makes some minor adjustments to Einstein's arm. Note the framework of the hands. Davies also checks inside Doctor's head but the real brains of the outfit is the touchtone controller (right).

COMMUNICATIONS is an art requiring more than just an ability to speak and a knowledge of facts. Real communication crosses the line into theatrics—it is visual as well as verbal.

Los Angeles inventor and communications specialist John Davies has developed a mechanical, visual/verbal communicator that should have some rather interesting applications. His device is a lifelike recreation of a famous person that talks and moves its limbs, mouth and eyes.

Davies' robots simulate famous people such as Ben Franklin or, as is shown here, Albert Einstein, and he uses these famous people as his communicators. Imagine getting a lecture about the theory of relativity from Albert Einstein himself rather than some boring physicist; or hear "science in colonial America" by Ben Franklin.

Dr. Einstein is controlled by a touch-tone encoder which is connected to the circuitry in the base beginning at the Doctor's knees. All the robot's movements are actuated pneumatically. He can move his hands, arms, torso, head and, most importantly, his mouth. The motions and words are recorded on separate tapes and synchronized

According to Davies: "The animated man is a powerful communications tool. It's just short of telepathy. Looking at my animated persons, I have created a communications form rather than an appliance.

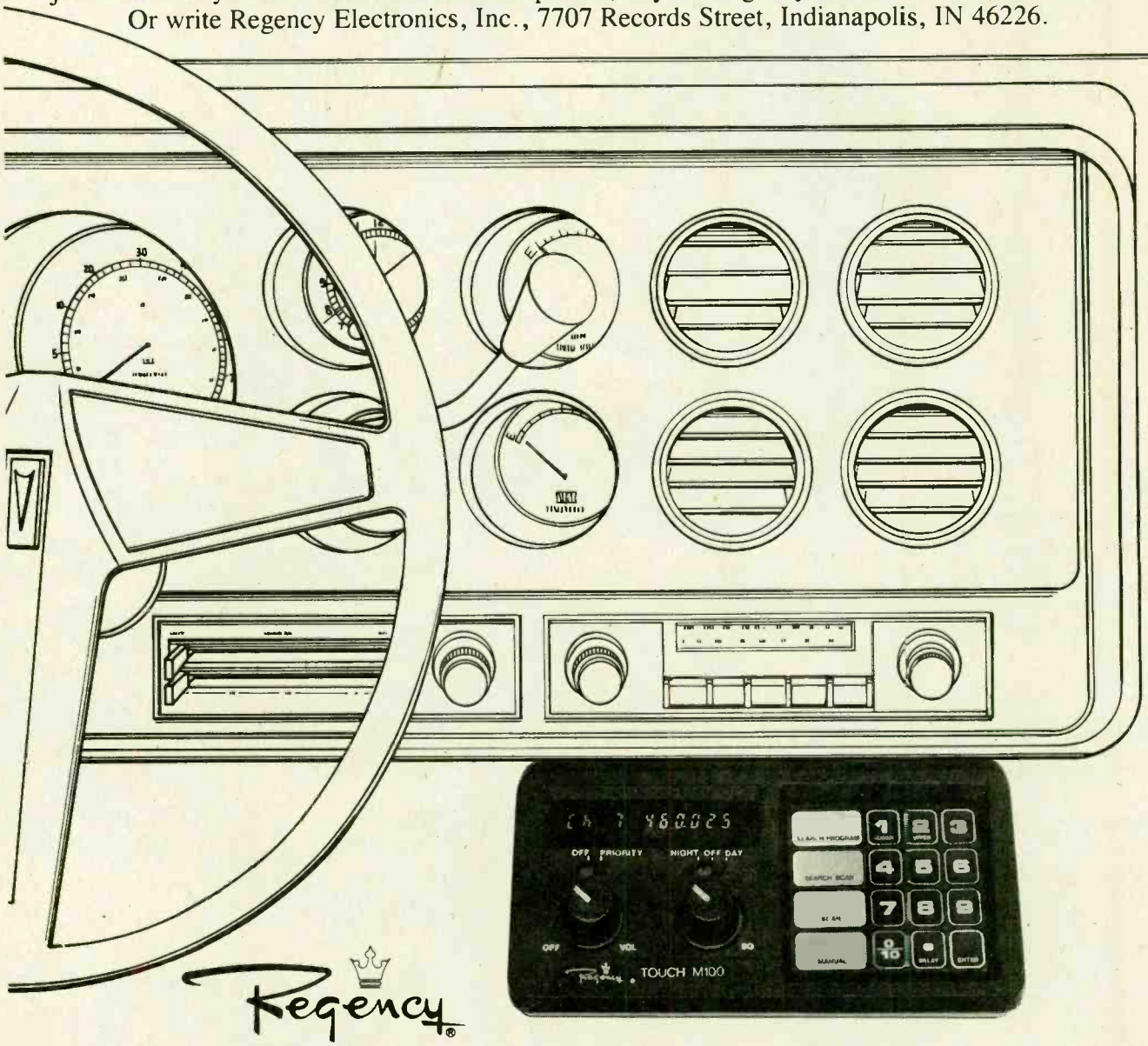
"We can make basically any pneumatically powered human but we have to know such a person. Otherwise one would get nothing at all, or just a robot that looks like Einstein. In the case of, for instance, Benjamin Franklin we did not have such a problem for all we had to do was study paintings of him. Nobody has ever seen him in person or heard him speak. As a result of which we could let our imagination get to work."

Davies points out that nobody alive has ever heard Benjamin Franklin's voice, but people have heard Einstein. Davies found a voice mimic who could make lectures that sounded like Einstein.

To do all this Davies had a lot of help from engineers Joe and Bill Munford, they are brothers, who saw to it that the robot's facial and other pneumatic movements are operating properly; and from Mark Wickham who handled the electronic controls. These four have started a partnership appropriately called: Creation=Multi-Dimensional Animated Systems. The company is now marketing the robots for advertising purposes, medical education, displays and for teaching purposes. ■

Introducing the only crystalless scanner designed for mobile use.

Introducing the totally new Regency Touch M100 Computerized Scanner to hear the action of police, fire, weather and emergency calls. It's the first digitally synthesized scanner that's perfect for mobile* or at home use. And it has a wealth of features to make programming simple. Like a full function digital readout, memory, search and scan delay, priority, fingertip sensitive, backlighted pressure pad and more. Plus you can choose from over 15,000 public service frequencies to monitor through 10 channels. All for under $300.00. If this sounds good, just wait until you hear the Touch M100 in person, at your Regency Scanner Authorized Dealer. Or write Regency Electronics, Inc., 7707 Records Street, Indianapolis, IN 46226.



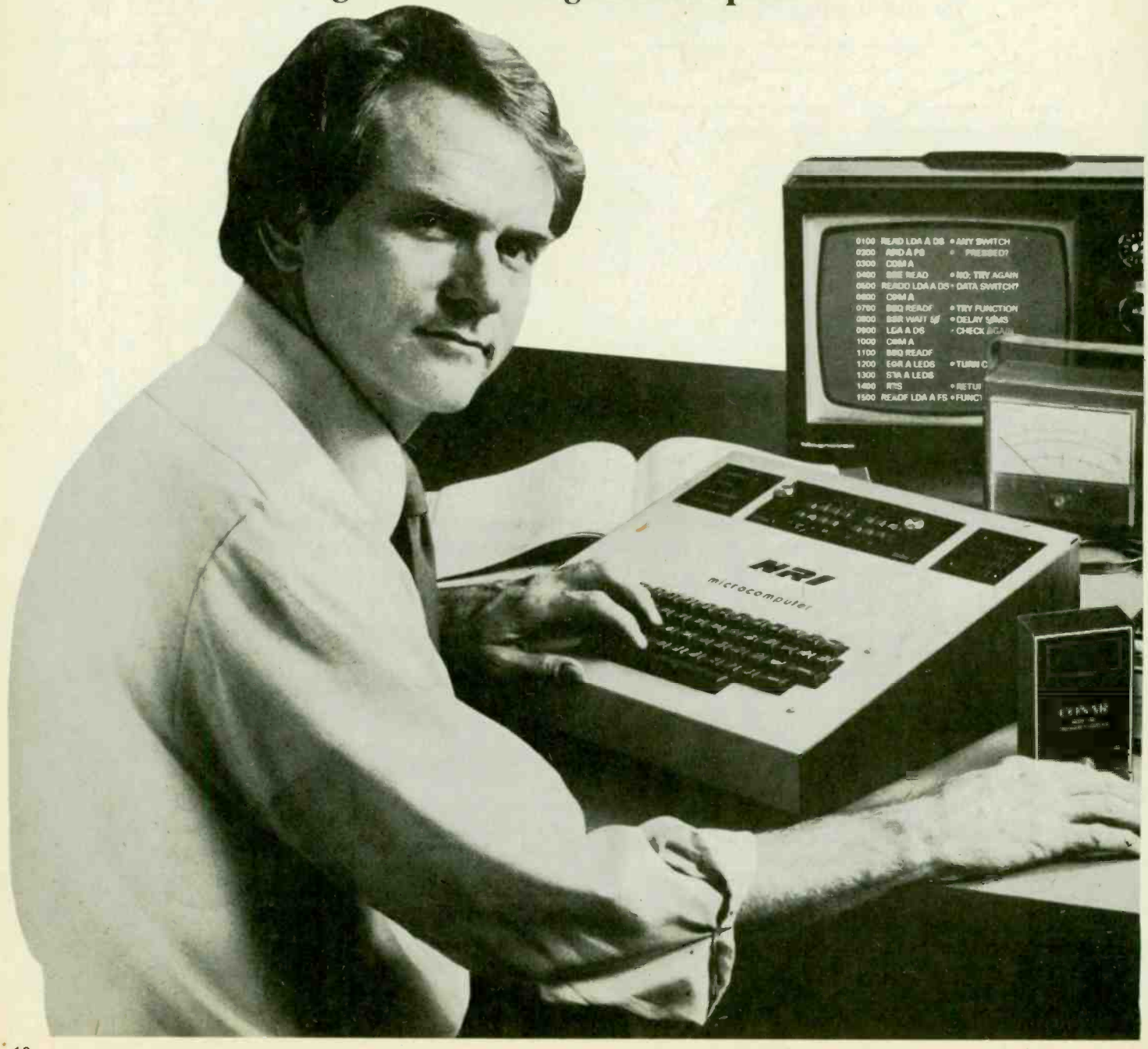
Regency Electronics, Inc.
7707 Records St.
Indianapolis, IN 46226

*Mobile use subject to restriction in certain localities

CIRCLE 20 ON READER SERVICE COUPON

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

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



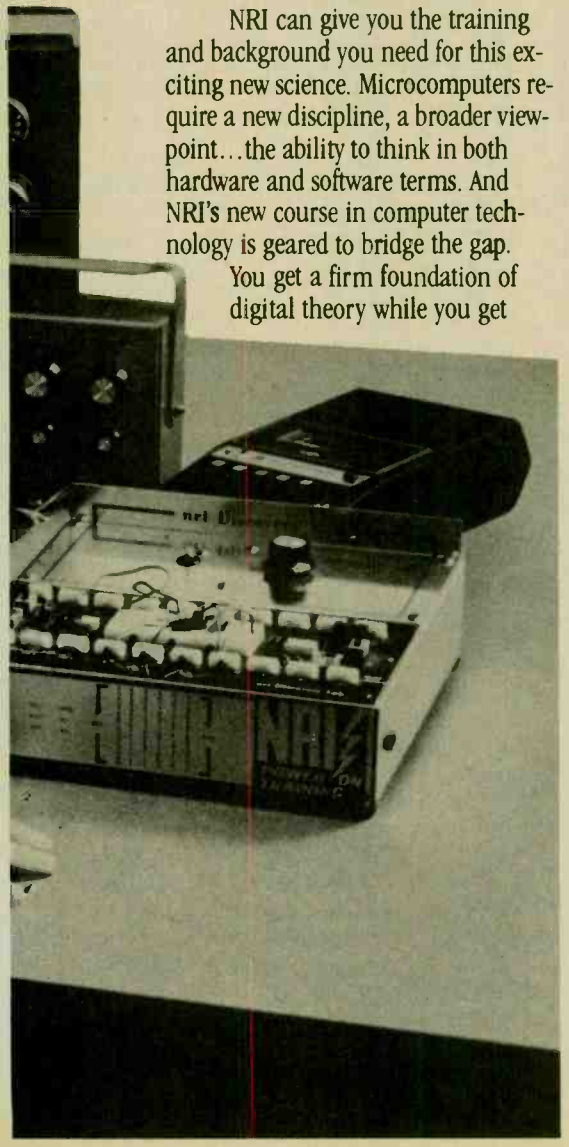
The microprocessor, that amazing little chip which shrinks electronic circuitry to microscopic size, has changed the world of the computer with dramatic speed. Now, big-performance computers are here in compact sizes...priced to make them practical for thousands of medium and small businesses, even homeowners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

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

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

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

You get a firm foundation of digital theory while you get



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

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

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

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

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

Other Courses in Today's Electronics

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

Free 100-Page Catalog No Salesman Will Call

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

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NRI Schools
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3939 Wisconsin Ave.
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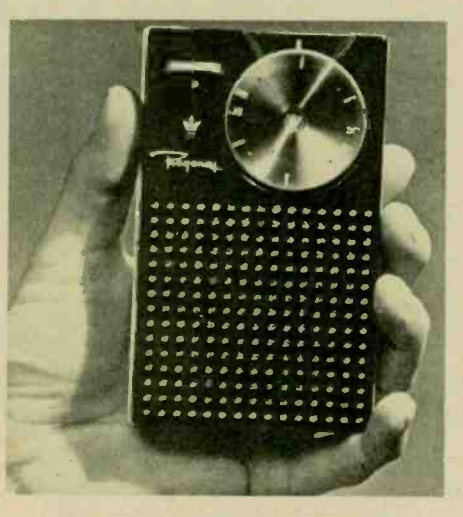
NEWSCAN

ELECTRONICS IN THE NEWS

Who Made the First Transistor Pocket Radio?

Recently Sony Corporation ran a series of advertisements claiming it manufactured the first pocket-size transistor radio in 1957. This was approximately three years after Regency Electronics, Inc. actually *did* make the first fully-transistorized radio in 1954. Transistors for this innovation in electronics were provided by Texas Instruments. The original circuitry was designed by Richard Koch, who is still with Regency engineering.



Here's Regency's entry into the pocket transistor radio sweepstakes. It first appeared in 1954 and was the first on the market.

Now, who is truly the company that made the *first* transistor pocket radio? Regency claims the title! If there is another will they please stand up and be counted!

56 Years and Still Alive

Solid-state is here to stay, and the vacuum tube is now a museum piece. Or so it would appear to be, except that nine new receiving tubes, used as replacement parts in entertainment products, have been added to the Sylvania electronic tube line. Imagine that!

Here's a run down on the new "valves." Sylvania type EY500A/6EC4, designed primarily for booster diode service in color television sets, is an indirectly heated half-wave diode rectifier. A companion tube, type PY500A/41EC4, is similar to it in all respects except for heater characteristics and configuration.

Also used in television receivers, type PCL805/18GV8 contains a medium amplification triode section which functions as a vertical oscillator, and a pentode for vertical oscillator and deflection applications.

Nine new receiving tubes, like the ones shown in this simulated chess game, have been added to the Sylvania line of electron tubes. The tubes are designed for replacement use in entertainment products.

Sylvania types PCL86/14GW8 and ECL86/6GW8 are alike except for heater characteristics. Both tubes contain high amplification triodes and pentodes and are used in audio power applications.

Used as horizontal deflection amplifiers in color television sets, types PL504/27GB5 and EL504/6GB5 are beamed power pentodes with Magnoval construction and a special anode for better dissipation.

Sylvania types PL519/40KG6A and EL519/6KG6A are used for horizontal deflection in color television receivers. These beam pentode tubes feature a special anode and Magnoval construction for improved heat distribution and increased reliability.

The Sylvania Electronic Tube Division has been manufacturing electron tubes for commercial, industrial and military applications since 1924. They are used in original equipment, and as replacement parts in both domestic and imported electronics products. So, if you think your 1972 tube manual is good enough, think again. You need to get a new 1980 one for the new tubes. ■

DX CENTRAL REPORTING

A WORLD OF SWL INFO

BY DON JENSEN

☐ How do you keep in touch with "over here" when you're "over there?"

For our military personnel abroad and on the high seas, that problem has been handled neatly by the American Forces Radio and Television Service (AFRTS) since World War II.

Of course, in those days when Willie and Joe were slogging through the mud in Normandy, it was the "Armed," not "American" Forces network and there was no "T" for television in the title.

AFRTS transmissions today are widely heard by shortwave listeners, but still the average SWL doesn't know too much about this extensive radio service for our military men and women and their families stationed abroad.

Some listeners, for instance, don't realize that AFRTS owns none of its own transmitters. All programs are aired over the shortwave facilities of the Voice of America, in the U.S. and at the Philippine relay station.

And most DX fans aren't aware of the fact that the shortwave AFRTS broadcasts they hear are primarily intended to provide programming for local military broadcasting stations overseas rather than to directly reach GI listeners via shortwave.

Local Outlets. The real heart of the AFRTS network is the system of more than 750 AM medium wave, FM and television outlets located in more than 20 foreign countries, as well as remote areas of Alaska, U.S. Trust Territories and Possessions, and aboard U.S. Navy ships at sea.

Some of these local service, land-based stations abroad are grouped into regional AFRTS networks to serve a specific geographic area, such as American Forces Network in Europe and the American Forces Korea Network.

Most of these localized AM and FM stations produce some of their own programs for their military audiences. But they also rely heavily on programs produced stateside to fill their daily schedules.

AFRTS has two program-producing centers in the United States, one in Los Angeles, CA, and the other in Washington, DC. AFRTS-LA and AFRTS-W are part of the American Forces Information Service, an activity under the Assistant Secretary of Defense for Public Affairs, which also is responsible for producing and distributing film and printed material.

Media Highlights. AFRTS-LA supplies the overseas and high seas AFRT local stations with radio and television entertainment programs, special video information programs for GIs and their dependents, and current pop records for the stations' music libraries. This material is mailed weekly to AFRTS stations.

(Continued on page 82)

COMMONLY HEARD SHORTWAVE STATIONS

Australia—Radio Australia, 1100 GMT, 9,580 kHz
Norway—Radio Norway, 1400 GMT Sundays, 15,175 kHz
Israel—Kol Israel, 2000 GMT, 11,655, 15,415 kHz
Turkey—Voice of Turkey, 2130 GMT, 9,515, 11,955 kHz
Sweden—Radio Sweden, 2300 GMT, 11,705, 15,275 kHz
USSR—Radio Moscow, 2300 GMT, 9,530, 9,720, 11,770 kHz
Japan—Radio Japan, 2345 GMT, 15,270 kHz
China—Radio Peking, 0000 GMT, 15,115, 17,680 kHz
Albania—Radio Tirana, 0000 GMT, 15,140 kHz
Bulgaria—Radio Sofia, 0000GMT, 15,330 kHz
Ecuador—HCJB, 0030 GMT, 9,745, 11,915 kHz
Vatican—Vatican Radio, 0100 GMT, 6,015, 9,605 kHz
Czechoslovakia—Radio Prague, 0100 GMT, 7,345, 9,540 kHz
W. Germany—Deutsche Welle, 0130 GMT, 6,085, 6,145, 9,565 kHz
Hungary—Radio Budapest, 0200 GMT, 9,833, 11,910 kHz
Egypt—Radio Cairo, 0200 GMT, 9,475, 12,050 kHz
Netherlands—Radio Nederland, 0230 GMT, 6,165, 9,590 kHz (relayed via Bonaire, Neth. Antilles)
Cuba—Radio Havana Cuba, 0330 GMT, 11,760 kHz

If you are worried about inflation, here's cheering news! By 1981 you will be able to start saving money by paying $10 for each light bulb you buy. Sure, you'll still be able to buy a three-way bulb for a few dollars, but why waste money on such cheapies when you can get a two-way bulb for about six times the cost?

No, we have not tried to recharge our pocket calculator by plugging into a high tension power line, nor has our son come home from school fired up by some new kind of New Math. Actually, it's all very simple and logical. That ten-buck bulb consumes only a third as much electrical power as the conventional bulb, and also lasts four times as long. The result: over the long run the ten-dollar bulb will save you twenty dollars in operating costs. That is, if you don't drop it.

elementary Electronics March/April 1980

New Developments In Electric Lighting

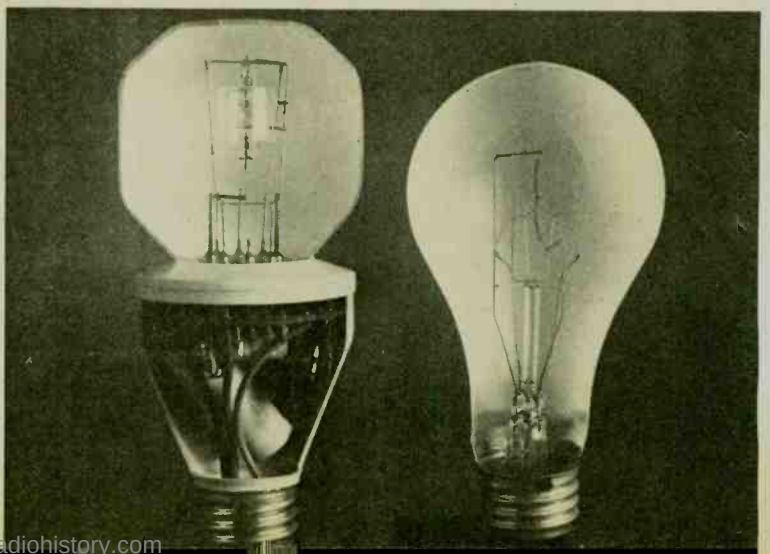
The ten dollar light bulb and other advances

BY JORMA HYYPIA

The first of General Electric Company's new generation of Electronic Halarc bulbs will feature high and low settings; they will give off as much light as a regular 50/100/150-watt 3-way bulb at its highest setting, and will have an average life of some 5,000 hours. In time, the Halarc family of bulbs will also include a replacement for the 100-watt general purpose bulb, as well as a variety of reflector lamps for recessed and track lighting applications.

The Ten Dollar Bulb. Will the American consumer be willing to shell out a sawbuck for a single light bulb? G.E. concedes that there may be considerable sales resistance at first, but the company is betting heavily that the buying public can be educated to appreciate and want the long-term benefits of the new bulbs. So far some $20 million has been invested in an accelerated lamp development program, and another $20 million will be spent on new production facilities for the Electronic Halarc. That's betting pretty heavily on success.

The potential payoff? If the company could put a new bulb into each of some 1.65 billion residential, business and industrial sockets in the U.S., sales volume would be in excess of $10.6 billion. To breach a significant part of this potential total market, G.E. hopes to enlist the support of



(below left) Sylvania's new 880-watt Unalux high-pressure sodium lamp, designed to replace 1000-watt mercury vapor lamps, can greatly reduce power consumption for users.

(above right) These Thrift/Mate fluorescents from Sylvania can cut electricity costs by one-third to one-half the amount required by standard fluorescents. A tremendous savings.

(below right) Cutaway view of General Electric's new "Electronic Halarc" bulb, shows sophisticated electronic controls in the base and an arc tube on top. A design for the future.

conservationists by poinnting out that the total energy savings could amount to 40-billion kilowatts of electricity—enough to power both the state of Maryland and the Disrict of Columbia for a full year!

The new Halarc bulb looks a little like two conventional bulbs that someone had tried to crowd into a too-small package. Suspended in the top section is a slender quartz arc tube which is the main, although not the sole, source of light in the bulb. The upper section also contains two incandescent filaments that provide light when the lamp is first turned on. This eliminates the turn-on delay which would occur if only the slower-starting arc source were used. The filaments also help the ballast circuitry, which is housed in the bulbous plastic lower section, to regulate power fed to the arc tube.

The quartz arc has been around for several years, although in the form of high-wattage, industrial-type multivapor lamps. The problem was redesigning the lamps for more general, private consumer use. G.E. says the successful redesign was a "major breakthrough in Electronic Ballast technology" because the circuitry must control the interaction of the arc tube and filaments, in order to start the lamp and precisely regulate power to it.

(above left) Huge cutaway model of GE's "Electronic Halarc" bulb, designed to fit standard sockets and be highly economical. The old incandescent bulb may become obsolete.

(lower left) 70- and 100-watt Sylvania Lumalux bulbs shown. These bulbs deliver the familiar gold tones and economy too.

(center) Tungsten-halogen lamps from Sylvania deliver more light and last longer than conventional globe incandescents.

(right) The Sylvania Energy Control Device is a remote control system to regulate fluorescent lighting levels and economize on usage in many industrial and commercial applications.

As in any arc tube, the light is created by the well-known electrical discharge phenomenon. In this case, a mixture of metal halide is used as the discharge media. The color of the emitted light and the efficiency of the arc tube is affected by the metal halide composition, the size and arrangement of the arc tube and the amount of power applied.

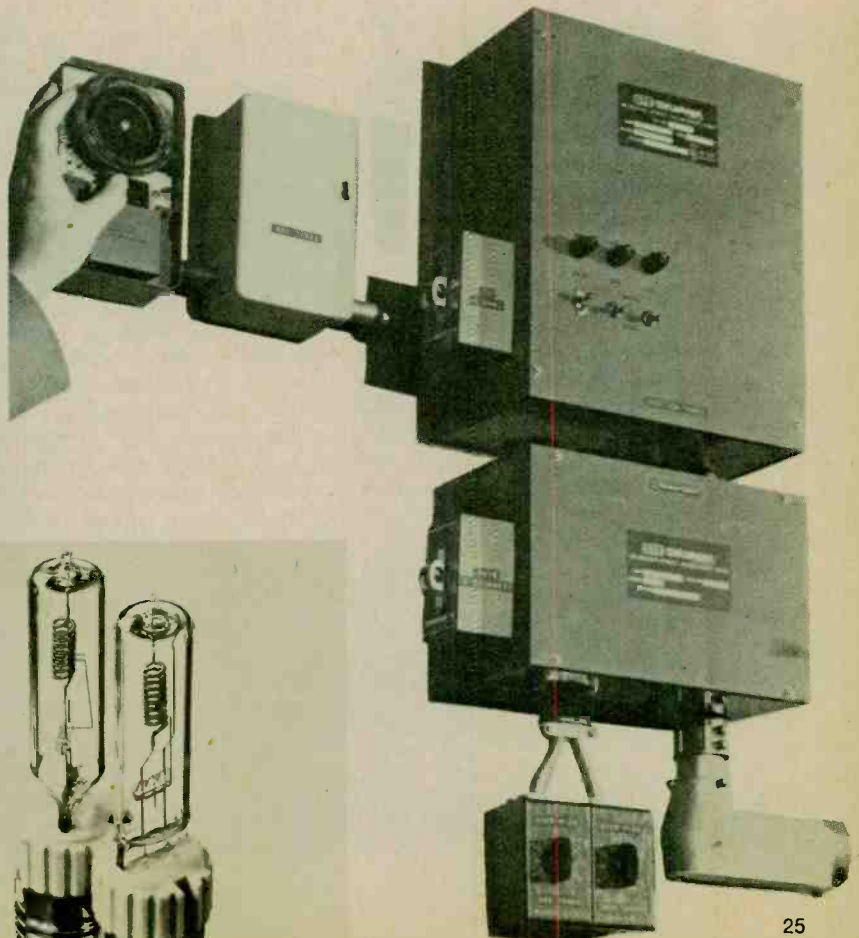
The two filaments are made of tungsten, just like those in conventional household lightbulbs. They are sequenced to provide high and low levels of light from the arc tube, but are always at low power level, except during start-up, so that they do not shorten bulb life by burning out prematurely and opening the circuit.

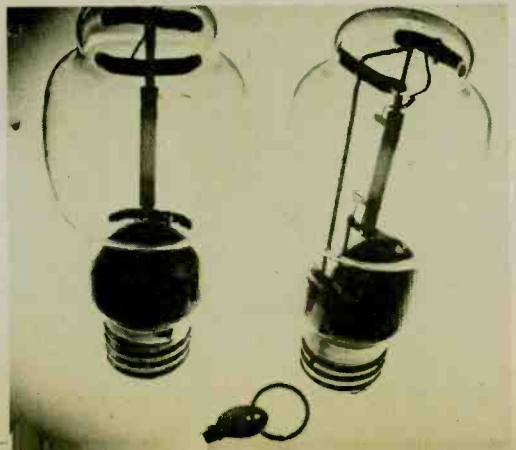
Three different approaches were used in the attempt to design a general-purpose replacement for the common household bulb. The Halarc proved to be the best method, although the two other programs may yet yield useful products sometime in the future.

There was an attempt to utilize an infrared reflection system (first investigated way back in 1912) to increase lamp efficiency. An infrared (IR) lamp has a specially-designed spherical bulb with an inside coating that reflects heat back to the filament while allowing light to pass through. This process increases bulb efficiency, but not enough to offset hard-to-solve drawbacks, notably the high cost of manufacturing such bulbs. However, many basic problems have been solved, so research on IR bulbs continues apace.

Another approach has concerned development of a new fluorescent technology called Solenoidal Electrodeless Fluorescent systems. SEF uses a special high-frequency ballast in conjunction with a unique ferrite ring to replace the electrodes that are found in traditional fluorescents.

(Continued on page 83)





CIRCLE 32 ON READER SERVICE COUPON

Voice of the Future

Computers are speaking a new language—English!

BY MICHAEL KAYE

IT LOOKS INNOCENT enough, in it's Radio Shack "computer" gray, and sits 4-inches high by 6-inches deep and a foot wide. Standard equipment includes a knob which, in knoblike fashion, rotates, and a red LED which knowingly winks at you when the grey box talks. It's the Radio Shack Speech Synthesizer. It has an accent that you can't quite trace, sort of like a railroad official at the Swiss border who impatiently waits while you fumble for your passport. It speaks recognizable if rather emotionlessly-intoned phrases, and it will decidely outlast your mother-in-law. But, unlike your mother-in-law, it only says what *you* want it to say, and it can be turned off.

Operation. I didn't quite know what to expect when I sprung this little goodie from the box. I found that it was simple enough to use—just plug in the power supply module and hang the 40-pin connector off the expansion interface port on your 16K level 2 machine and you're ready to talk. Radio Shack included a cassette of software of some kind, but no instructions about its use; so "CLOAD" was the next step and then "RUN." The little gray box proceeded to introduce itself and tell me a little about how it works. I listened to it over and over for 15 minutes, any more and I would have been hypnotized. Then I took a look at the program listing using the "LIST" command, and thought that the machine had decided to take the rest of the night off because of all of the strange characters that I saw in the program. Could it be that the programmer had gone mad as many of my fellow "hackers" do at three in the morning, mumbling BASIC statements under their breath as they shuffle bleary-eyed off to bed, knowing full well that IF the alarm clock is set at 6AM THEN they will have to arise and earn their daily bread? The IF THEN statement is one of the more powerful operations that BASIC performs in a computer. (A hacker, by the way, is slang for an operator of a personal computer). Anyway, here is an example of what I saw in the program:

"H38L80U H;U;R Y(UU"

Holmes and Watson would have a tough time with that one! It was the TRS-80's way of inquiring after my health—

"HELLO HOW ARE YOU?"

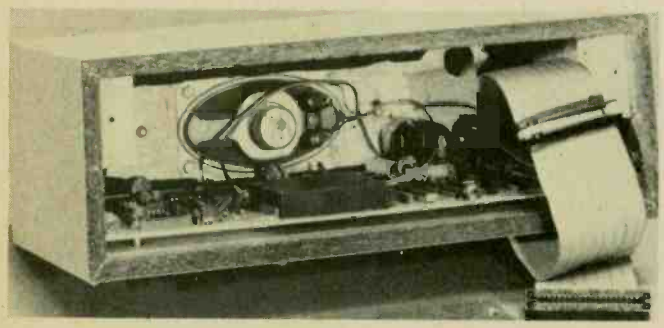
How it Works. So how does it do it? Well, you say, sit down at the keyboard and start typing in sweet nothings to woo your best lady with a TRS-80. Nope, it ain't that easy. It doesn't understand written English like you and I do. In order to explain how it operates, you have to look at each word as an assembly of different sounds that are glued together to form that *single* word; things like vowels and consonants. There are hundreds of these separate sounds that we use in everyday speech and are quite unaware that we are using them. We don't have to use all of them in order to generate recognizable speech in the Synthesizer; we can get away with using just 62 of them. The expensive word for these sounds is "Phoneme."

The business end of this talking machine is a black cube, mysteriously encapsulated, which is a small computer in itself. It has stored in its memory the electrical representations of the 62 sounds mentioned previously. One way to visualize how the system works is to compare it to a magnetic tape. You could record each of these sounds on an individual piece of tape and then edit them together to form a word. This would take a lot of tape and a lot of time. The Radio Shack Synthesizer stores each of these sounds in digital form and, when you tell it to, converts them from digital form into an audio signal and glues them together to form individual words.

The reason for all of the strange symbols in the BASIC program is that their aren't enough letters on the keyboard to represent the sounds, so you have to use numbers and punctuation marks to fill out the 62 sounds. The manual that Radio Shack supplies gives you all of the characters and what sounds they represent, and several software routines that explain how to put words together easily. You also have to allow for breathing between word. You can do this with timing loops—"FOR:NEXT" loops as they are known. The Synthesizer accepts 32 sounds at a time, which include the "breathing space," puts them together, and then goes and gets 32 more in an assembly line. fashion. There is no way to program inflections on this Synthesizer, but you can give it a bit of an accent if you play around, or maybe even a slight drawl.

Intriguing Possibilities. Some of the more interesting programs that use the synthesizer include computer-aided instruction for children, programs for

(Continued on page 82)



This interior view shows the mass of circuitry needed to encode and decode digital and analog signals used by the computer and the Voice Synthesizer respectively. Circle number 32 on the reader service card for more info.

BIG BOOST

This inline preamp puts more punch in your mike

BY HERB FRIEDMAN

WHEN THE VOCALIST can't make it over the bass player, or the lead guitar gets buried behind the rhythm section, or the audience can't tell the keyboard player is really tickling the ivories, that's the time you need a big boost in preamplification between the performers and the amplifiers. And that's just what you'll get from Big Boost, a self-contained mike/guitar/keyboard preamp you can plug directly into the amp, or into the mike or instrument itself.

Big Features. Though the Big Boost is a simple one-transistor project, it has several features specifically intended for rock or dance band use, or just for straight vocal amplification. First off, the Big Boost contains its own battery power supply, a standard 9-volt transistor radio battery operating at only 1 mA drain. Next, it is virtually overload immune; whether driven by a mike or the signal from an electric guitar pick-up (about 0.1-volt) the output signal is not driven into clipping. As for gain, it's a whopping 25 dB, almost "ruler flat" from 100 Hz to about 20kHz. If you need extra bass for a keyboard, simply change C1 to 0.1-μf. Finally, the whole device is assembled in a palm-sized metal cabinet, and using a Switchcraft phone plug-to-phone plug adaptor, you can plug the Big Boost directly into an amplifier input. Or, because it's also unusually light, you can plug the preamp into the guitar or keyboard so the volume control is directly at the instrument.

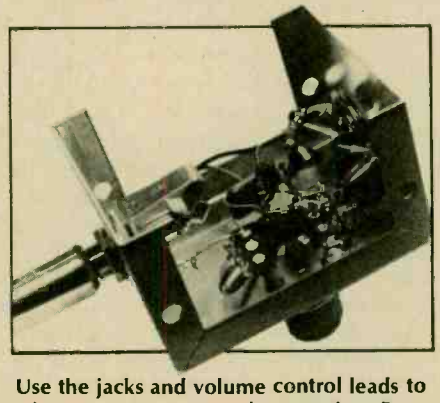
Assembly. The unit shown in the photographs was assembled inside of a 2¾ by 2⅛ by 1⅝-inch Mini-Box. Admittedly, it's a tight fit, but it can be done if input and output phone jacks J1 and J2 are installed ⅛-inch off-center on each end (make certain they are offset to the same side). This should leave just enough clearance for battery B1 on one side. Rotate J1 and J2, and bend their lugs if necessary, until you are certain the battery will fit with the Mini-Box's cover in place.

Potentiometer R5 is the volume control, and the miniature type specified in the parts list must be used if you want to get everything in a miniature cabinet. You must be certain R5 will not interfere with insertion of plugs into J1 and J2. It might appear that there's lots of room, but there really isn't. To avoid problems, it's best to insert a dummy plug into both J1 and J2 while marking R5's mounting spot.

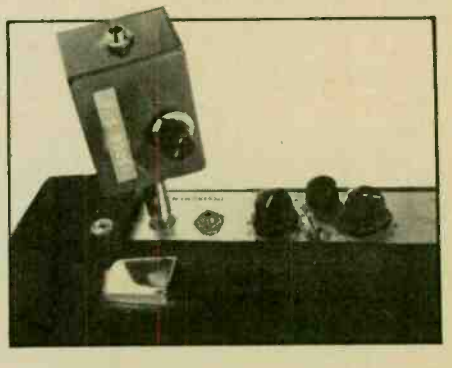
R1 is supplied with a DPDT switch, S1a and S1b. Take note that some types have only two wire lugs for each switch section, the third connection being a rivet through which the builder sticks the component lead before soldering. Don't think something is wrong with the potentiometer because each switch section has only two lugs. Remember, the third connection for each switch is a solder-rivet.

No terminal strip is needed for assembly. All components are self-supported by simply twisting them together and soldering. If you keep the connecting leads as short as possible, the assembly will be sufficiently rigid to take the most rugged handling without shorts or "sound dropouts." It will all squeeze in nicely if the resistors used are ¼-watt units, and the capacitors are the miniature mylar printed circuit type (both leads from the same end) available from Radio Shack.

As with the mounting of R5, double-check that inserting a plug into J1 or J2 does not touch any wire or compon-



Use the jacks and volume control leads to wire up your amp point-to-point. Parts layout is not critical with this project.



Use of the double male phone plug allows placement of the preamp at the amp's control head or right at mike stand.

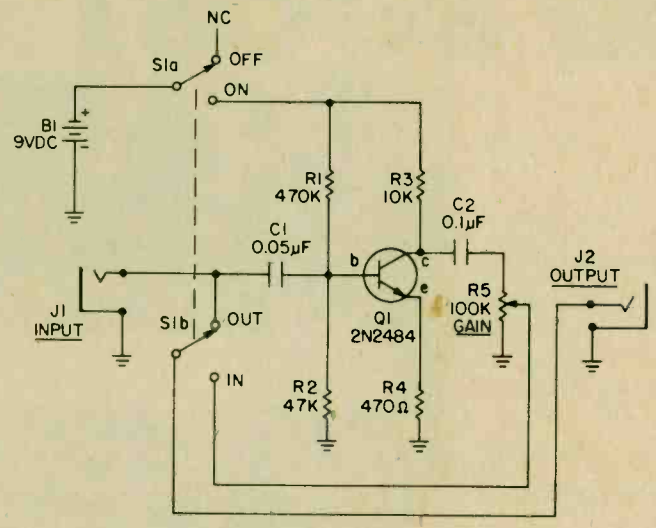
BIG BOOST

ent. Again, your best bet is to wire the project with dummy plugs installed.

Checkout. Install a battery, rotate R5's shaft until you hear the power switch click, and then check the voltage from Q1's collector to the cabinet. It should be about half the battery voltage (4 to 5-volts). If it's excessively high, around 8-9 volts, or excessively low, 1-2 volts, you have either made a wiring error or substituted an improper transistor for the specified Q1.

Connect a mike or an electric instrument's output to the Big Boost input and connect the preamp's output to your main amplifier's input. Advance R5 as you speak into the mike or play the instrument. The volume should increase as R5 is advanced. If it doesn't, you have wired S1a/S1b incorrectly. Note that when R5 is fully counterclockwise (off) the battery is disconnected and J1 is connected through S1a directly to J2. When R5 is advanced, closing S1, the battery is connected and S1a connects the preamp's output via R5's wiper to J2.

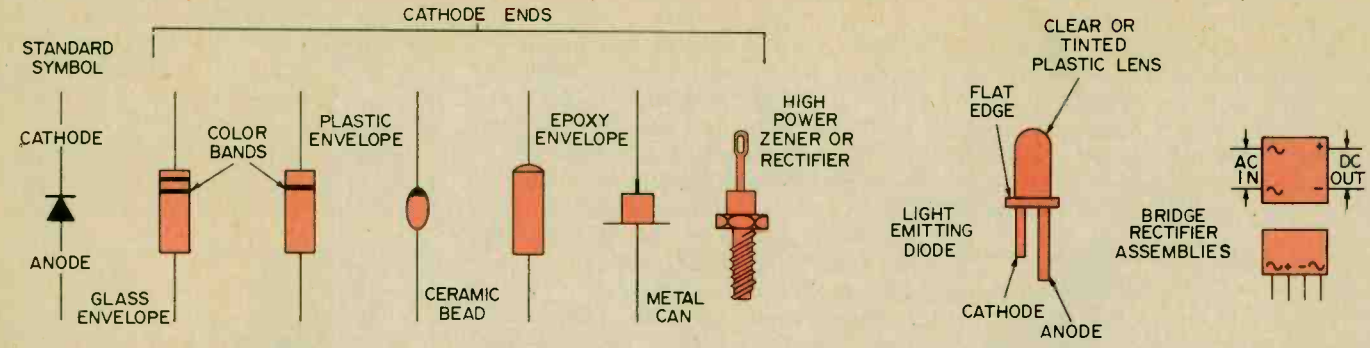
Plug to Plug. While you can use patch cords to connect the Big Boost to your equipment, it's usually a lot more convenient and less of a hazard if the Big Boost is right at the amplifier input. Professional musicians do this by using a special *phone plug-to-phone plug* adaptor sold at music instrument shops. You can use the adaptor for either the input or output. If desired, you can plug the Big Boost directly into an electric guitar or keyboard output jack, and then use a regular patch cord to the amplifier's input. ■



PARTS LIST FOR BIG BOOST

B1—9-volt transistor battery
C1—0.05-uF, 15 VDC mylar capacitor (see text)
C2—0.1-uF, 15 VDC mylar capacitor
J1, J2—¼-inch standard phone jack
Q1—PN2484 NPN transistor
R1—470,000-ohm, ¼-watt resistor, 10%
R2—47,000-ohm, ¼-watt resistor, 10%
R3—10,000-ohm, ¼-watt resistor, 10%
R4—470-ohm, ¼-watt resistor, 10%
R5—100,000-ohm audio taper potentiometer with built-in DPDT switch (Radio Shack part #271-216 or equiv.)
S1—DPDT switch (part of R5)
Misc.—cabinet, wire, battery clip, knob, phone plug (female-to-male) adaptor, etc.

DIODE DIGEST



IT MAY SOUND SILLY, but it seems that a lot of people still don't know which end of a diode is up. A letter we received recently from O.M.S. of Guilford, Connecticut illustrates this point. He writes:

"I have been trying for the last three months to purchase a power supply that I can use to power a walky-talky from house current. I've finally given up and decided to build my own. I have a transformer that converts 110 VAC to 12.6 VAC, some large filter capacitors salvaged from an old television, and some 'bargain bag' diodes I purchased from a discount store. The diodes are black, unmarked, and have one rounded end. Can I use them, or will I have to shell out for ones with known values?"

Of course, we couldn't be sure of just exactly what he had in hand, but from the description, and basing our guess on the chart, we were pretty sure that these were epoxy-encapsulated rectifiers, with probably about a 100 to 200-PIV rating. These would fill his needs if our guess was right. Although we haven't heard any more from that gentleman, we assume he didn't blow himself up. By tearing out the chart and pasting it up inside the cover of your spare parts box, you can have a handy reference guide for identifying the leads and types of whatever diodes happen to find their way into your hands. ■

Innovations

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CIRCLE 1 ON READER SERVICE COUPON

e/e checks out the...

K40 SPEECH PROCESSOR MIKE

Innovative circuit combines quality microphone with self-powered speech processor

CIRCLE 42 ON READER SERVICE COUPON

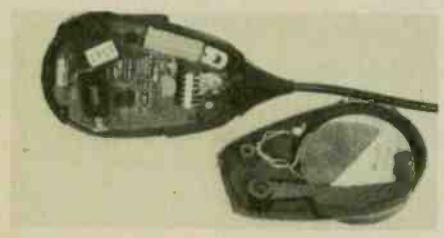
EVEN THOUGH ALL MODERN CB transceivers have modulation limiting to 100%, there are still instances when some additional form of speech (modulation) processing can increase transceiver effectiveness. Certainly many of the older transceivers, which were not limited to 100% modulation—which produced "splash" on adjacent channels if the voice level was loud—can benefit from speech processing.

While there are several types of powermikes and speech processors on the market, one of the most interesting from the CBer's viewpoint is American Antenna's Model K40 Speech Processor microphone.

How's it look? Housed in a rugged and attractive case, the K40 provides amplification, peak limiting, frequency shaping, adjustable output level and a clever power circuit that eliminates the need for a battery. As an extra plus, the K40 has a magnetic mounting; you simply place the mike against any steel surface and it stays there. For non-ferrous mounting surfaces, a steel disc is supplied that can be secured with adhesive or a screw.

The "heart" of the K40 is an integrated circuit operational amplifier (opAmp) configured as a limiter by diodes connected from the output to the inverting input. The limiter provides a maximum output voltage even if the user shouts into the microphone, so that there is a modulation limit regardless of the voice level.

The operational amplifier's output is fed through a screwdriver-adjustable potentiometer to the transceiver's mike input. The potentiometer is adjusted while the user is talking, for optimum "talk power" while transmitting.



Inside the rugged housing of the K40. The large power storage capacitor by the PTT switch holds "phantom" power.

An unusual feature of the K40's opAmp limiter is frequency shaping, which is controlled by a two-position switch built into the microphone. Voice frequencies are not equal in strength: the higher the frequency, the weaker the signal fed into the microphone. Fact is, the stronger lower frequencies usually determine the percent of modulation because they are hitting the 100% modulation limit while the information-carrying higher frequencies are below 100%—this is normal for all voice transmitters.

What it does. What the K40 does is to maximize the information carrying higher frequencies. When the frequency shaping switch is in the HI position, a resistor and capacitor network bypasses a broad range of frequencies around the limiting circuit so the opAmp maximizes amplification at the midrange and high end. This limits the lower frequencies, which do not carry information. The lower frequencies primarily carry the characteristics by which we can distinguish different voices.

When the switch is set to the LO position, high frequency feedback to the inverting input, around the limiter, reduces the high frequency output. This results in a "mellow" sound quality more suited to local contacts where your signal doesn't have to fight its way through interference.

No battery needed. The K40, in addition to providing speech processing, eliminates the No. 1 headache of powermikes: the battery—which often runs out of "juice" just when needed most.

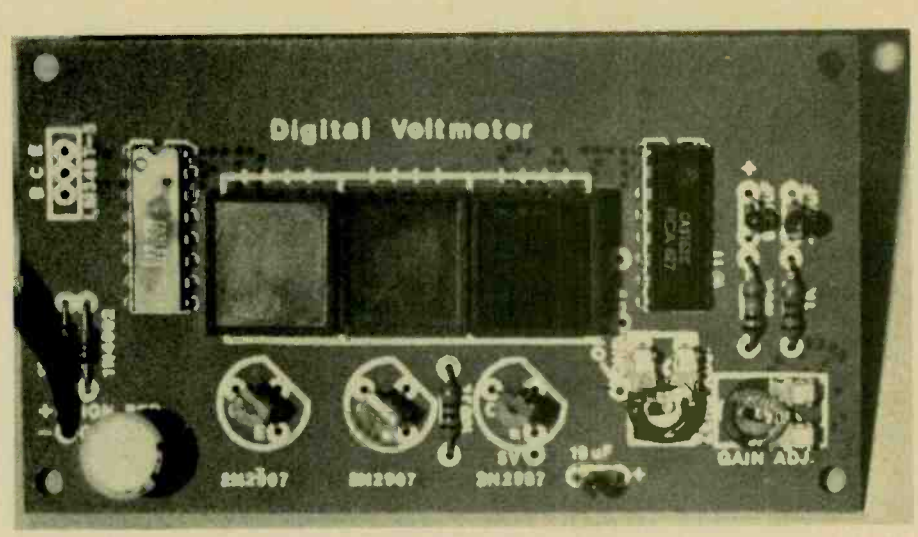
There is no battery in the K40, even though its descriptive literature implies some form of "charger"—hence, a battery. The K40 uses a clever and very effective power system. One of the wires in a CB mike is the transmit/receive control, which is connected either to a powered relay circuit, or to an electronic switch of some kind. If it's a relay transmit/receive switch, the line has voltage on it. If it's electronic switching, there is either sufficiently high voltage to power the opAmp; or DC voltage for the opAmp can be superimposed on the electronic switching circuit by using a diode and resistor. When the transceiver is in the receive mode, the switching wire voltage charges a capacitor in the microphone. A voltage/current regulator knocks down the voltage from the capacitor to 3.8-VDC and feeds it to the opAmp. When the mike's push-to-talk switch is depressed, keying the transmitter, the applied voltage to the capacitor is removed. Because the IC opAmp takes so little current, the charge on the capacitor can last through even a long-winded transmission without pooping out. When the push-to-talk switch is released for receiving, the capacitor is "recharged" for the next transmission.

American Antenna suggests that you let the dealer install the K40 microphone, and we agree, because some electronically-switched transceivers require a slight modification to provide "phantom power" through the switching wires. A wiring booklet included with the mike shows the microphone plug pin connections for almost all, brand-name transceivers of recent vintage. Special wiring instructions are provided for Motorola transceivers having the microphone preamplifier built into the microphone itself. Also provided is a modification kit containing the needed resistor, diode and instructions for adapting the mike connector of electronically-switched rigs for "phantom power" on the switching line.

From American Antenna, Elgin, Ill. 60120, the K40 microphone is priced at $44.50. For additional information circle No. 42 on the reader's service coupon. ■

Dashboard Digital Voltmeter

Keep an electronic eye on the voltage level of your vehicle's electrical system



BY FRED L. YOUNG SR. AND FRED L. YOUNG JR.

YOU'RE MAKING TIME down the interstate at three in the morning, and all of a sudden you become aware that the lights on the dash seem kind of dim, and that the headlights don't seem to be reaching out as far ahead to warn you of darkened semis parked on the shoulder. Are your eyes just playing tricks on you, or is there something the matter with your car's electrical system? A quick glance down at the three glowing LED numerals on the dash gives you the instant answer. Either you pull into a rest area and grab a few hours of shuteye, or you pull into a service area and have the battery, alternator and voltage regulator given a good scrutinizing by the mechanic.

In either case, your car's digital voltmeter has given you the information sought about the state of the electrical system, and maybe saved you either a headache, a smashup, or a king-sized repair and towing bill. Maybe all three.

Recent advances in the design and availability of industrial integrated circuits have opened up many doors to the electronics hobbyists. Analog-to-digital devices have become more complex internally, thus making the portions of the circuitry which have to be assembled by the hobbyist that much more simple. The Dashboard Digital Voltmeter takes advantage of these advances, utilizing three ICs and a small handful of discrete components to give you an instrument capable of better than ± 1% accuracy in reading the voltage level delivered by your car's (or boat's) electrical system.

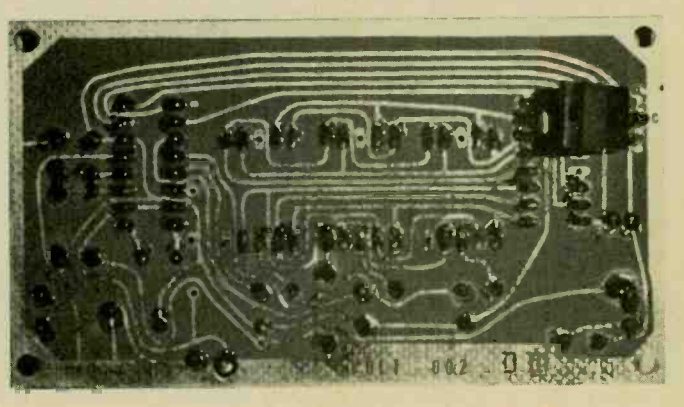
Two New ICs. The system is built about three ICs: the LM340T-5 (a 5-volt regulator now available for several years); a CA3162E; a CA3161E; and a support combination of diodes, resistors, and capacitors. It is the CA3161E and CA3162E that now open the door to new horizons in possible applications not only because of their unique capabilities, but also because they reduce substantially the numbers and types of formerly required support components. The heart of this system is the CA-3162E, a dual-slope, dual-speed, A/D converter industrial chip. Its almost equally important companion, the CA-3161E, is a BCD, 7-segment, decoder/driver chip. It is also unique in that it has a current-limiting feature. This eliminates the necessity of resistors in series with the 7-segment displays that were required in earlier designs.

The above feature not only reduces circuit board space requirements, but reduces the probability of component failure. Power required to operate this voltmeter is minimal (160 mA or less), a result of the multiplexing feature of the CA3162E. With that as a background, let's consider some of the more important operations of this simple, but very accurate digital instrument.

Circuit Function. Analog voltage from 000 mV to 999 mV can be applied between pins 11 (+) and 10 (−) of the CA3162E (U2). That IC converts the voltage into a Binary Coded Decimal (BCD) equivalent. The BCD leaves pins 2, 1, 15, and 16 (the group represents the 1's, 2's, 4's, and 8's) and enters pins 7, 1, 2, and 6 respectively of the CA3161E (U3). The latter IC takes the BCD code, converts the output, then uses it (in conjunction with the 7-segment display) to generate (form) the number that correlates to the BCD input of the CA3161E. The multiplexing driver pins 5, 3, and 4 (5 being the least significant and 4 the most significant) turn on that display by means of the PNP switching transistors. Concurrently, the CA3162E is providing the BCD information to the CA3161E driver/decoder.

As indicated earlier, the system includes a combination of diodes and capacitors. These are required to control or minimize the voltage spikes (positive and negative) that result from turning inductive devices on and off; e.g. windshield wiper, air conditioner, and electric windows, etc.

The maximum input differential between pins 11 and 10 of CA3162E is 999 mV. A resistor network (R1, R2) is used to attenuate the applied 13.8-volts to 138 mV. An Ohm's Law cal-



This view of the assembled PC board shows the voltage regulator, (U1) mounted on the underside of the PC board. This was done in order to accommodate a flush-mount installation in a smaller car. Let your space needs dictate placement of this component.

e/e DIGITAL VOLTMETER

culation would give a result of 136.6 mV. The gain-adjust potentiometer compensates for the slight drop. The FND 507s display this as 13.8-volts.

Note the point marked OPTION on the schematic. With Pin 6 of the CA-3162E grounded or disconnected, there are four conversions or comparisons made each second. Tying pin 6 to the 5-volt line will result in 96 conversions or comparisons per second. The 96/second rate moves with excessive rapidity, is not appealing to the eye, and usually results in the least significant digit appearing to be blurred. Of the two rates, the 4/second conversion (4 Hz) is by far the more pleasing to the eye, is easier for the eye to focus on quickly, and is the recommended rate. These rates could vary slightly because of capacitor difference and manufacturer variance from stated values.

Assembling the Voltmeter. The unit may be assembled quickly and relatively easily using a predrilled and etched circuit board. If a Digital World circuit board is being used, the four corner holes will have been drilled. If a blank board is being used, drill the corner holes *before* starting to "stuff" the board. It is easy at this point to scribe the plexiglass panel and mark the corner holes on it for later drilling and perfect alignment. Additionally, examine the recess or place where the completed unit will be mounted. Determine how it will be secured (bolted, clamped, or glued), doing any additional drilling that may be required.

Get the workbench ready for soldering. Use a low wattage, electrically-isolated, fine-tipped soldering tool and fine solder. A blunt-nosed tool could damage or destroy the ICs and create foil bridges between pins. This is both expensive and frustrating. If you have had limited experience in soldering in small areas, it may be wise to practice on something else before you start.

Now, locate all resistors and potentiometers on the circuit board placement diagram and install them in their respective holes. Next, do the same for all capacitors, observing polarity. Install the CA3161E and CA3162E. *Caution!* When inserting the ICs, be careful *not* to fold the pins under or bend them in any way.

IC *orientation* is critical. Be sure these chips (CA3162E and CA3161E) are aligned as shown on the diagram. Note the notch mark on the chips and the corresponding notch mark on the schematic, or the "1" on pin 1 on top of the plastic case. All manufacturers use one or both of these base reference directional indicators.

If you have doubts about your soldering ability or the type of solder tool you have (grounded or not grounded), place two 16-pin sockets in the chip holes. The ICs may then be placed (not soldered) in the sockets. Next, insert the three LEDs, noting the notch marks on the LEDs and the notch marks indicated on the diagram. For the final action on this side of the board, insert both diodes in their respective holes (observing cathode markings).

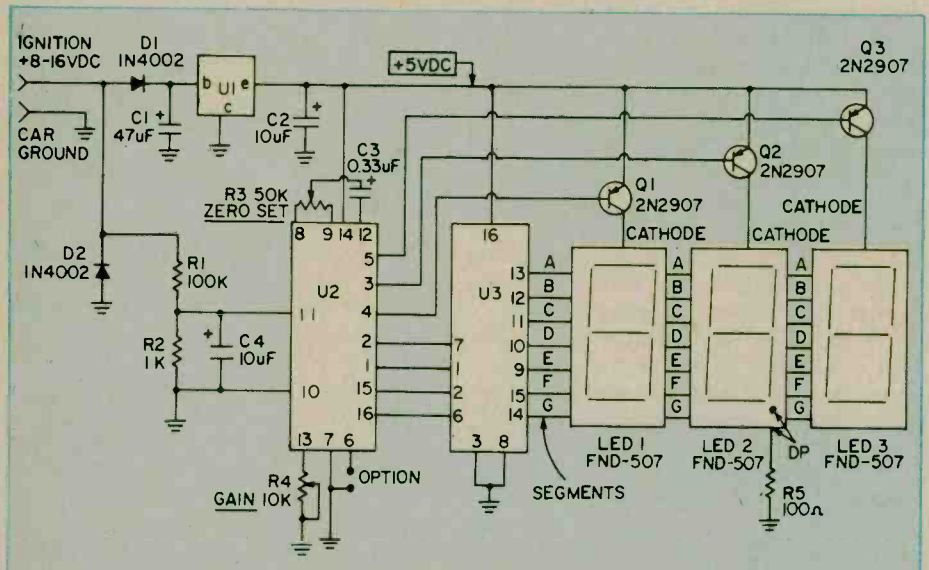
Reverse the circuit board and install the LM340T-5 regulator. *Caution!* This must be correctly placed or it will destroy your unit when power is applied. The *metal side* of the regulator must be facing the FND 507 pins. Recheck it to make sure.

Now, turn the board over again. Use a red wire for the ignition line and a black wire for the chassis ground. Determine the lengths required (usually three-feet is sufficient). Solder the red wire to the point marked IGNITION on the diagram and the black wire to the GROUND.

Calibration Procedure. Correct calibration determines the accuracy of your voltmeter. Follow these steps carefully and sequentially. Apply a *known* voltage source (above 10 and below 16-volts) to the IGNITION point. We recommend a 13.8-volt source. Next, for zero adjustment, ground pins 11 and 10 to the circuit board ground momentarily. Using a small screwdriver, slowly rotate the wiper arm on R3 until there is a reading of 000. Remove the ground from pins 10 and 11. Set the *gain control* (R4) by rotating the wiper arm until the displays are displaying the same voltage as is being applied.

Installation. One final action is necessary before your unit is ready to be mounted in the dash location of your choice. Secure the black wire to the metal chassis ground and the red wire to any accessory line that is active only when the motor is running. Secure and mount the voltmeter in the location of your choice.

A colored plexiglass facing (cover) is required and we recommend red for most display contrast. A location which is not usually exposed to the sunlight will make the displays easier to read during the brighter periods of the day. If the unit is going into an existing recess, the present glass cover may be



PARTS LIST FOR DIGITAL VOLTMETER

C1—47-uF electrolytic capacitor, 25 VDC
C2, C4—10-uF tantalum electrolytic capacitor, 16 VDC
C3—0.33-uF tantalum capacitor, 35 VDC
D1, D2—1N4002 diode
F1—1-amp fuse
LED1, 2, 3—FND-507 7-segment LED display
Q1, 2, 3—2N2907 PNP transistor
R1—100,000-ohm, ¼-watt resistor, 5%
R2—1,000-ohm, ¼-watt resistor, 5%
R3—50,000-ohm PC trimmer potentiometer
R4—10,000-ohm PC trimmer potentiometer
R5—100-ohm, ¼-watt resistor, 5%
U1—LM340T-5 5-volt voltage regulator
U2—CA3162E Analog-to-Digital converter
U3—CA3161E BCD display driver

Misc.—solder, hookup wire, red plexiglass (for display filter), IC sockets, transistor sockets, suitable enclosure, etc.

Note: An etched and drilled circuit board for the Digital Voltmeter is available for $6.50 (postpaid in U.S. and Canada), and a complete parts kit, including PC board but not including plexiglass, is available for $27.50 from: Digital World, P.O. Box 5508, Augusta, GA 30906. Please allow 4 to 6 weeks for delivery. No C.O.D.s or foreign orders, please.

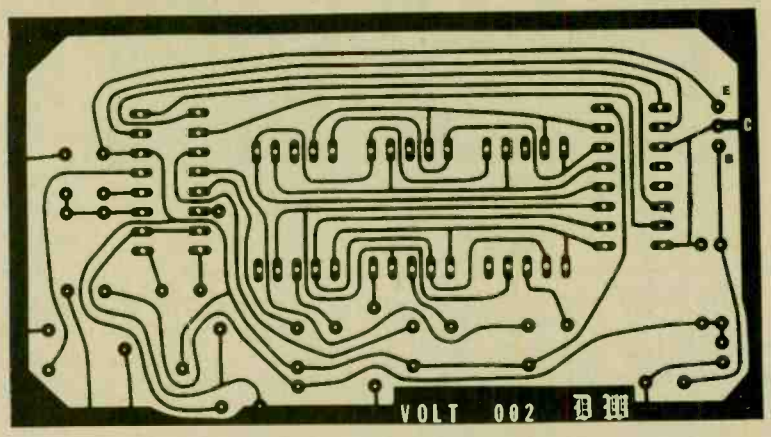
used as a template for the plexiglass cover dimensions. One-eighth or 1/16-inch thickness plexiglass works well and is relatively easy to cut using a roofer's shingle cutter knife. Place two clamps on a straight line along the template edge, then cut one side at a time. Scribe it deeply with a dozen or more strokes, then break off the excess with a pliers. When drilling screw holes, use a small starter bit first, then the larger bit. This should prevent the larger bit from wandering across the plexiglass.

The plexiglass must be "spaced" away from the board by approximately 5/8-inch, using either spacers or the bolt/nut method. The latter method is to insert a bolt through the plexiglass corner hole and put a nut on the reverse side. Put a second nut on the bolt, allowing a 1/2-inch inside space between the two nuts. Do this on all corners. Next, insert the bolts into the board corner holes and put on the final nuts. We recommend securing all four corners, rather than just two.

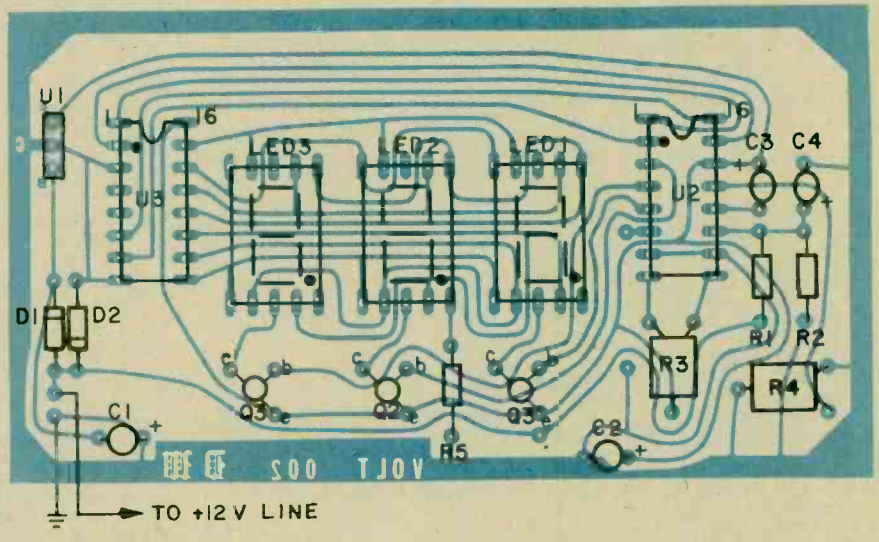
Troubleshooting. If the unit does not light up for the calibration procedure, first check that the wiper of R3 is centered. If it still does not light up, recheck your work. Carefully inspect for possible solder bridges and loose connections. If a solder bridge is discovered, remove it carefully. It is easy to destroy a chip during the removal process. If it still fails to light up, start a systematic test check to isolate possible faulty component(s).

If the unit does not function after installation, reheck for a good electrical connection on the line that supplies power from the car. Did you break or loosen the solder connections of the source wires during installation? If so, this will require removal and resoldering, plus a bit more care during installation the second time.

One Final Note. Some ICs, and quite possibly the ones used in this project, generate high frequency harmonics which might find their way into your car's radio. Try holding your LED readout pocket calculator next to the radio antenna with the radio tuned to a blank spot on the AM dial to see what we mean. If you experience any interference from the voltmeter circuit, try rerouting the antenna coax away from the voltmeter itself. A metal case around the voltmeter's PC board will also aid in the reduction of RFI. We suggest that you avoid using the radio's power lead as the voltage source for your voltmeter. The power lead to the horn (or horn relay) or the hot lead of the windshield wiper switch (find it at the fuse box) is probably the best place to attach the voltmeter. ■



This full-scale etching guide for the voltmeter's PC board is one of the trickiest we've offered. Unless you know your stuff, we suggest you use a Digital World board.



The component placement diagram for the PC board shows all IC and capacitor polarities. Take special care to observe them during assembly phases of project.

Even the best voltmeter in the world won't help you keep your car running if you don't take care of your battery. Check water level often and add only pure, distilled water.

IT'S SIMPLY BASIC

Program your own Kentucky Derby

BY LARRY FRIEDMAN WB2AHN

THIS MONTH'S PROGRAM, "Horse Race," is designed to let you simulate an actual horse race on the Radio Shack TRS-80 with Level II Basic. The program will randomly select odds for each of five horses, and the player bets on one of them. Using the Radio Shack graphics, the computer will print the horse race on the screen. The horses are represented by graphic blocks and will appear to "move" across the screen, at a speed relative to their odds.

"Horse Race" uses a random number generator (see line 460) to determine the odds for each horse. Horses are given odds between three-to-one and five-to-one, and the chances of their winning and the amount you will win depends on their odds. For example, a horse with the odds three-to-one has a 1/3 chance of winning (relative to the other horses), and the player would win three times what he bet. On the other hand, a horse with the odds five-to-one would have only a 1/5 chance of winning, but the player would receive 5 times what he bet if he wins.

Although the program can be used by as many people as desired, it is designed to keep track of the winnings for only one player. Line 970 determines if the player has won, while line 1000 determines how much he has won.

The program uses a data statement to store the names of the five horses. This data statement is at line 220, and you can change the names of the horses to your liking by simply typing in your own names instead of the ones used in this listing. Keep in mind that you also must correct lines 310-350 if you want to change the horses' names.

The program has been designed to run on all TRS-80 Level II systems; the memory allocations for subscripted variables and the amount of program memory used have been held to a minimum. If you want to add different features to this program (for example, have "win," "place," and "show" instead of simply having "win"), feel free to do so. However, we have kept extra features to a bare minimum to allow the users with less memory to fit this program. ■

```
100 REM           "HORSE RACE"
110 REM         BY LARRY FRIEDMAN
120 REM    FOR ELEMENTARY ELECTRONICS
130 REM
140 P(1)=P(2)=P(3)=P(4)=P(5)=0
150 DATA 10,16,22,28,34
160 FOR I=1 TO 5:READ D(I):NEXT I
170 T1=0
180 RANDOM
190 DIM A$(5)
200 R=0
210 REM LINE 170 CONTAINS THE NAMES OF THE FIVE HORSES
220 DATA SWIFT SAM,PIZZA SLICE,TELETYPE,APIES,CEASAR
230 FOR I=1 TO 5
240 READ A$(I)
250 NEXT I
260 INPUT "IS THIS FOR ONE PLAYER? (Y/N)";U$
270 INPUT "ENTER PAYOUT PERCENTAGE (FROM .01 TO 1.00)";P
280 CLS
290 PRINT@337,"WELCOME TO FRIEDMAN RACE TRACK"
300 PRINT@462,"TODAY'S COMPETITOPS APE (BY HOPSE):"
310 PRINT@595,"(A) SWIFT SAM"
320 PRINT@659,"(B) PIZZA SLICE"
330 PRINT@723,"(C) TELETYPE"
340 PRINT@787,"(D) APIES"
350 PRINT@851,"(E) CEASAR"
360 FOR I=1 TO 1300:NEXT I
370 FOR D=1 TO 1000:NEXT D:CLS
380 FOR I=1 TO 5:P(I)=0:NEXT I
390 IF U$="N" THEN 420
400 IF M<=0 THEN PRINT "YOU OWE THE COMPUTER ";-M
410 IF M>0 THEN PRINT "THE COMPUTER OWES YOU ";M
420 R=R+1
430 PRINT@212,"RACE NUMBER ";R
440 FOR I=1 TO 5
450 REM R(I) DETERMINES THE ODDS FOR EACH HORSE
460 R(I)=RND(3)+2
470 NEXT I
480 PRINT@320,"HORSE","ODDS"
490 FOR I=1 TO 5
500 PRINT A$(I),R(I);"-1"
510 NEXT I
520 PRINT@896,"ENTER HORSE'S NAME AND BET";
530 INPUT N$,B
540 R2=1
550 FOR I=1 TO 5
560 IF N$=A$(I) THEN 590
570 NEXT I
580 GOTO 520
590 FOR I=1 TO 500:NEXT I
600 CLS
610 Y1=1
620 A=1
630 FOR I=192 TO 704 STEP 128
640 PRINT@I,A$(A)
650 A=A+1
660 REM PRINT HORSE TRACK ON SCREEN
670 NEXT I
680 FOR X=36 TO 37
690 FOR Y=0 TO 127
700 SET (Y,X):NEXT Y:NEXT X
710 FOR Y=9 TO 36
720 FOR X=29 TO 30
730 SET (X,Y):NEXT:NEXT
740 FOR Y=9 TO 36
750 FOR X=125 TO 127
760 SET (X,Y):NEXT:NEXT
770 PRINT@116,"FINISH LINE"
780 FOR I=1 TO 5
790 R1(I)=RND(P(I))+1
800 NEXT I
810 FOR I=1 TO 5
820 REM P(I) DETERMINES HOW FARR THE HORSE WILL MOVE
830 P(I)=P(I)+(12/R1(I))
840 IF P(I)>100 THEN P(I)=100:F$(I)="WINNER"
850 NEXT I
860 FOR I=1 TO 5
870 IF R2=1 THEN P(I)=P(I)+3
880 SET (P(I)+27,D(I))
890 IF F$(I)="WINNER" THEN 950
900 RESET (K(I)+27,F(I))
910 K(I)=P(I):F(I)=D(I)
920 NEXT I
930 R2=0
940 GOTO 780
950 PRINT@916,"WINNER IS ";A$(I)"
960 F$(I)=""
970 IF N$<>A$(I) THEN 1040
980 PRINT@788," YOU WIN ";(P*B*R(I))
990 REM COMPUTE  WINNINGS
1000 M=M+P*B*R(I)
1010 PRINT@960,"HIT RETURN TO START NEW RACE";
1020 INPUT R$
1030 GOTO 370
1040 PRINT@788," YOU LOSE ";B
1050 M=M-B
1060 PRINT@960,"HIT RETURN TO START NEW RACE";
1070 INPUT R$
1080 GOTO 370
9999 END
```

Long Delay Timer

Whether you need delays of microseconds or months, this is the basic timer for all seasons.

BY ED NOLL W3FQJ

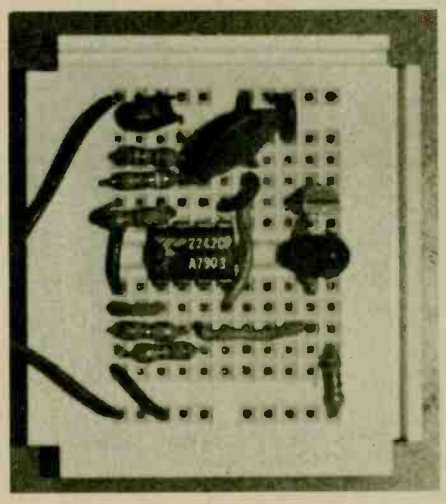
BY NOW, MOST ELECTRONICS hobbyists are quite familiar with timers, such as the 555. Projects built with these chips can serve a multitude of purposes, ranging from sirens to triggers for digital counters. However, in straight timing applications, the relatively high frequency at which these chips operate dictates the necessity for a lot of additional circuitry in the construction of long-range timer circuits.

This limitation has been solved with the introduction of the EXAR XR-2242 timer, which allows the user to set delays ranging from microseconds to (with the use of another 2242) virtually a year. So if you want to build a once-a-year alarm clock to nab Punxatawney Phil on Groundhog Day, or whether you need a repeating clock to trigger a light display every few seconds, try our Long Delay Timer.

Heart of the Matter. The Exar XR-2242 integrated circuit is a long-delay timer and very low frequency oscillator.

The functional plan of the 8-pin chip is shown in Fig. 1. It consists of a time base oscillator, the output of which is supplied to an 8-bit counter. There is a total count of 128. A control circuit is included to initiate and reset the time delay activity.

A simplified schematic of the timer IC, Fig. 2, shows the time-base circuit at the left. The external resistor and capacitor are connected among pins 1, 7 and 8. The time pulse generated



by the time-base oscillator has a period equal to 1RC. The output of the time-base oscillator is applied to a counter chain that provides a total count of 128. Therefore the delay time at the output is equal to 128RC.

$$Td = 128To = 128RC$$

This output is made available at pin 3. An output is also derived from the input counter and is in the form of a square wave with a period of 2RC. This output is derived at pin 2.

The recommended range of operation for the time constant circuit is between 1000-ohms and 10-megohms for the resistance R1 and between 0.01 and 1000-μF for capacitor C1.

The control logic provides a trigger input at pin 6. A positive edge initiates the delay interval. After the delay interval is initiated, it will continue for a time period of 128RC.

Circuit Function. A positive pulse applied to the trigger input, pin 6, will start the time-base oscillator. At the moment it is triggered, it generates a very short duration negative pulse. Capacitor C1 charges through resistor R1 forming a ramp voltage with a period equal to the RC product (time constant). At the conclusion of the charging period (ramp), a second sharp negative pulse is generated. This train of negative pulses at pin 8 is applied to the input of the counter chain. The trigger time-base output and output of the first binary counter are shown in Fig. 3. The output of the last counter is shown, but not in the same scale.

The output swings negative to logic 0 when the positive trigger pulse is applied. The output remains negative for a time interval equal to 128RC. After this interval of time, the output again returns to the logic 1 position and awaits the arrival of a trigger pulse at pin 6. Any trigger pulses that arrive during the time delay period (T) do not influence the operation of the circuit. However, the arrival of the first trigger after the delay period initiates a new time-delay interval. If the time-delay interval is to be stopped or reset it can be done by applying a positive pulse trigger to pin 5. This will reset the circuit, making it ready for the arrival of the very next trigger at pin 6.

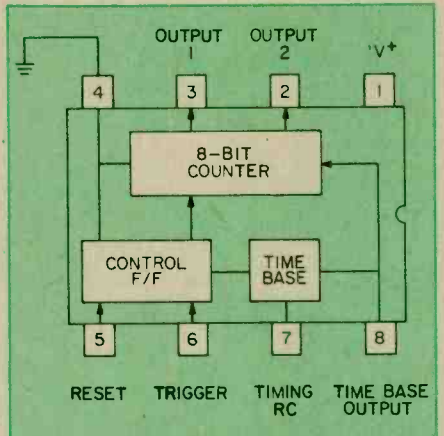


Fig. 1. This is a block diagram of the EXAR XR-2242, the heart of the timer.

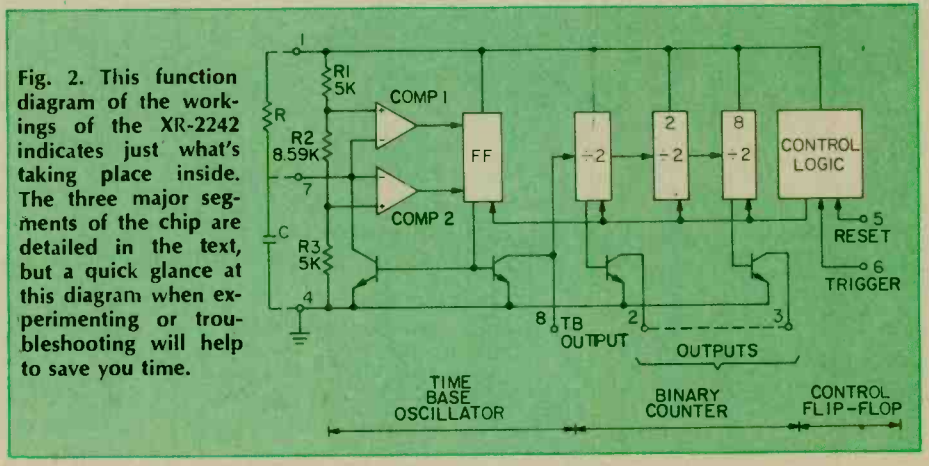


Fig. 2. This function diagram of the workings of the XR-2242 indicates just what's taking place inside. The three major segments of the chip are detailed in the text, but a quick glance at this diagram when experimenting or troubleshooting will help to save you time.

LONG DELAY TIMER

Operating Modes. The external circuit can be arranged for three basic modes of operation. These are: monostable, astable trigger and reset operation, or astable free-running self-triggered operation. In monostable operation, the timer awaits the arrival of a trigger pulse. When it does arrive, the circuit will go through one time-delay operation and stop. It will remain inoperable until the next trigger arrives.

In triggered astable operation, the arrival of the external trigger will start the circuit in operation. However, at the conclusion of the first delay interval, it will recycle itself and continue operation in this manner even though there is no arriving trigger pulse. The free-running circuit provides continuous operation. The circuit self-triggers as soon as power is supplied and there is no necessity for re-applying a pulse.

Experimental Circuit. The circuit of Fig. 4 shows the connection arrangement for using the timer for either monostable or triggered bistable operation. The time period equals the product of resistor R1 and capacitor C1:

$$Td = 39K \times 2 \times 10^{-6} = 0.078\text{-seconds}$$

This delay is multiplied by the counter chain to a value of:

$$Td = 128To = 128 \times 0.078 = 9.984\text{-seconds}$$

Thus the delay time at the output should be approximately 10-seconds.

The actual delay time depends very much on the true values of resistor R1 and capacitor C1. If you wish to adjust the circuit for some precise time interval, use a fixed resistor and a potentiometer for resistor R1 as shown in the optional circuit of Fig. 4. This arrangement permits you to adjust the time-base oscillator frequency precisely to obtain an exact 10-second delay interval. A stop-watch can be used to make the potentiometer adjustment.

Testing and Operation. Close switch S3 for monostable operation. Open switches S1 and S2. Connect the LED indicator circuit to the output and apply power. The LED indicator should light indicating that the output is high (logic 1). *Momentarily* close switch S1. Since S1 connects to the

(Continued on page 79)

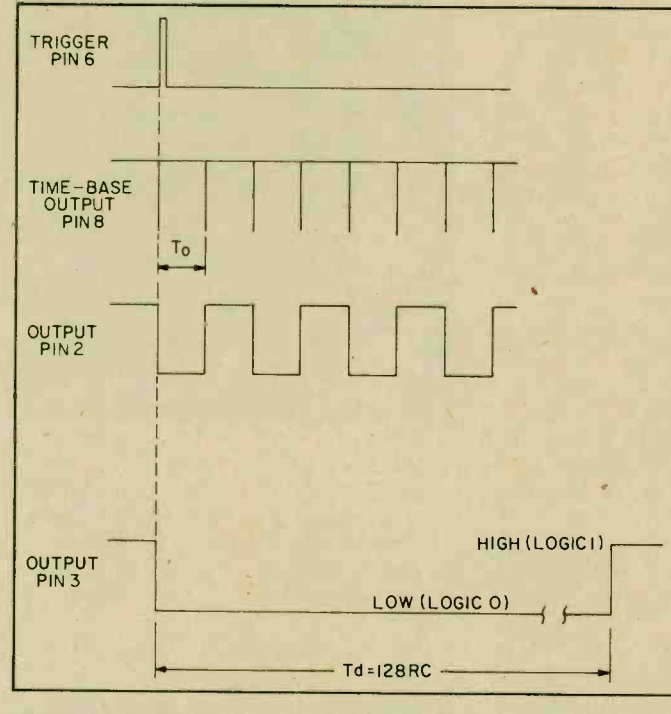
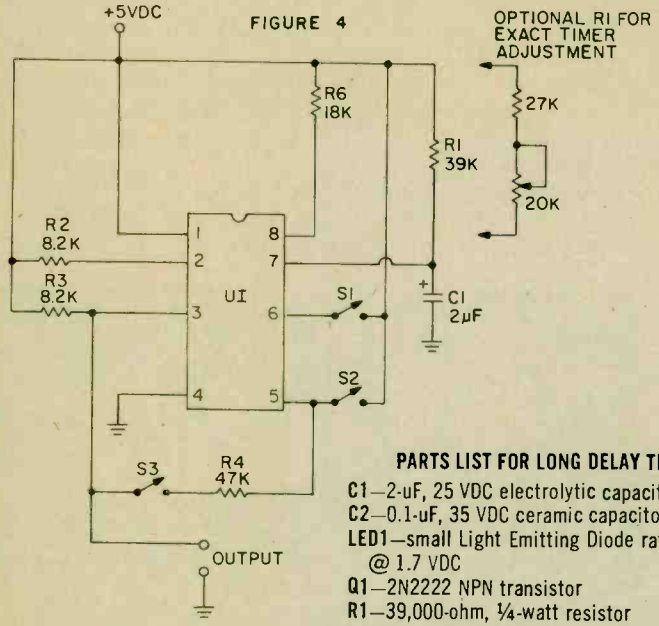


Fig. 3. This diagram depicts the output waveforms of the trigger, time base and of the first binary counter (pin 2). The second binary counter's output (at pin 3) is also shown for reference, but not in the same time scale as the other three. It's own scale is shown beneath it (Td=128RC).

FIGURE 4



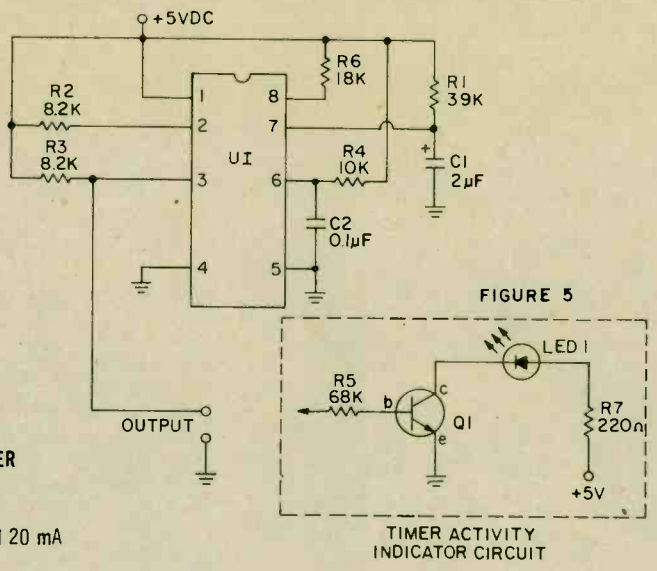


FIGURE 5

PARTS LIST FOR LONG DELAY TIMER

C1—2-uF, 25 VDC electrolytic capacitor
C2—0.1-uF, 35 VDC ceramic capacitor
LED1—small Light Emitting Diode rated 20 mA @ 1.7 VDC
Q1—2N2222 NPN transistor
R1—39,000-ohm, ¼-watt resistor
R1 (optional)—27,000-ohm, ¼-watt resistor, plus 20,000-ohm, linear taper potentiometer
R2, R3—8,200-ohm, ¼-watt resistor
R4—10,000-ohm, ¼-watt resistor
R5—68,000-ohm, ¼-watt resistor
R6—18,000-ohm, ¼-watt resistor
R7—220-ohm, ¼-watt resistor
S1, S2, S3—SPST toggle switch
U1—EXAR XR-2242 timer integrated circuit

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EXPANDING THE TRS-80 MICROCOMPUTER

BY HERB FRIEDMAN

CIRCLE 32 ON READER SERVICE COUPON

Handy computer add-on gives your TRS-80 room to grow

With its trap doors, secret compartments and access hatches making it look more like a magician's stage prop than a computer peripheral, the TRS-80 Expansion Interface is nevertheless the way a basic Radio Shack TRS-80 computer is expanded into a full-blown computer system. Except for a line printer, the interface is the only means whereby other peripherals are connected to the TRS-80. Without it, the TRS-80 can drive only the line printer. The disk system, RS232C serial interface, telephone modem, voice synthesizer-interface, a second cassette recorder, and probably all future accessories, as well as additional memory beyond the 16K that can be installed inside the basic TRS-80 computer, all require the Expansion Interface.

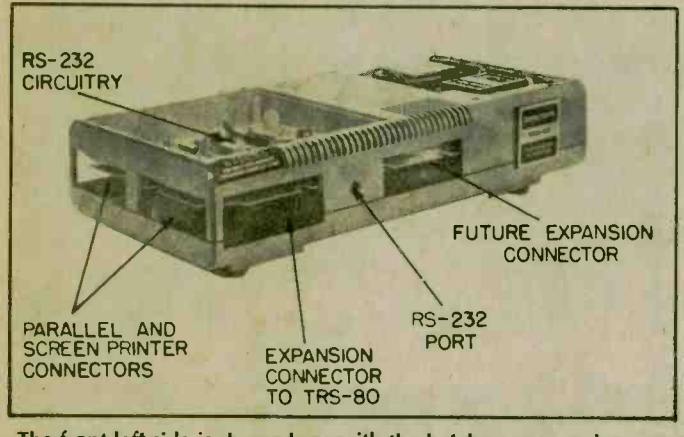
The Connection. The expansion interface is designed to serve as a base for the CRT video monitor. Indentations molded into the top of the interface match the position of the monitor's "feet" so the two fit together without the monitor sliding off the top of the interface. Priced at $299, the 26-1140 interface comes with no additional memory, its own plug-in power supply, a connecting cable for the TRS-80 computer, a special patch cord for a second cassette recorder, and a patch cord for bringing the TRS-80's cassette connection through the interface so it can be electronically divided to provide two cassette connections.

Models with factory installed additional memory (16K or 32K) are available at proportionally higher prices. Additional memory—up to 32K total—can be added to the basic or 16K models through a Radio Shack store.

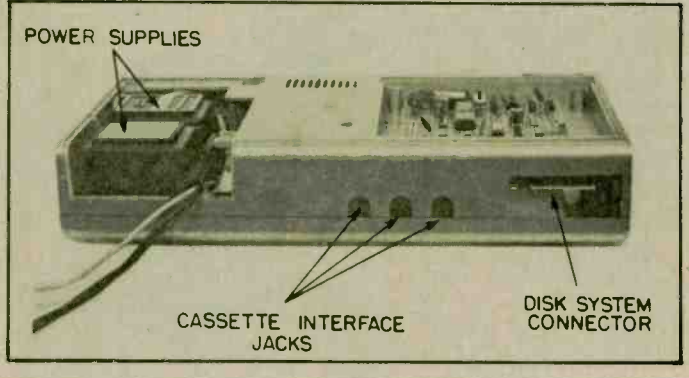
A logical question is: "Why does the basic interface cost $299?" The answer is a Disk Controller. Whether you presently need one or not, you get it. Each interface has the disk controller built in—you cannot purchase the interface without it. When the time comes to add a disk-system—from 1 to 4 drives—you don't have to modify the computer; you simply obtain the basic disk drive and plug it in to the interface yourself.

Trap Doors. The interface has all sorts of trap doors, jacks, storage wells, and connectors. First, by removing four screws you expose a storage well for two power supplies: the one for the interface and the one for the TRS-80 computer. Both get plugged into con-

(Continued on page 86)

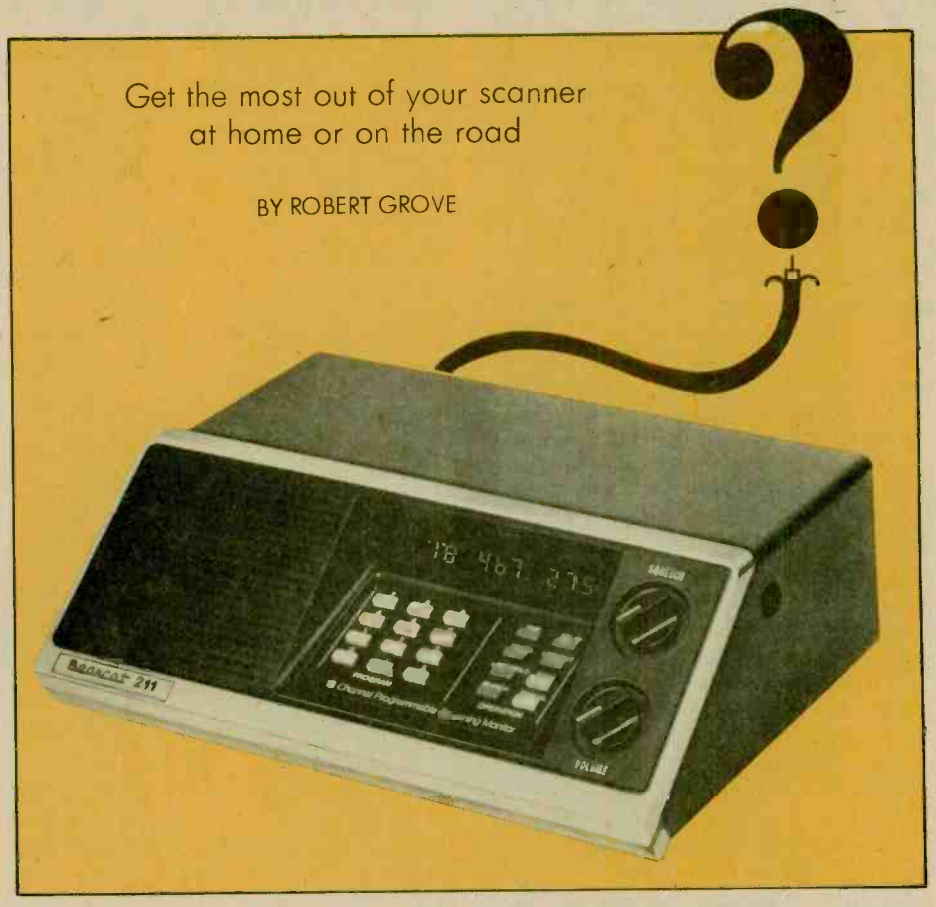


The front left side is shown here with the hatches open and covers off. Just about every bit of space is an I/O port or accessory storage well. In the top left well is the optional RS-232 adapter. Both that and the power supply well are covered by secured "plates."



The three tunnels in the center conceal DIN connectors for the main cassette connection from the computer, and the connections to the two cassette recorders. The edge connector on the right is the disk drive Input/Output port. On the top left is the storage well for the two power supplies: the one for the expansion interface and the one originally supplied with the TRS-80 computer system.

Scanner Antennas



NEXT TO YOUR RECEIVER, an antenna is the most important component in an effective monitoring/scanner station. The finest receiver in the world is worthless without signals to hear. After all, those signals must be captured by the antenna.

Inside or Outside? Your scanner receiver probably came equipped with a short plug-in antenna, useful for metropolitan reception. Many scanner manufacturers recommend the use of that antenna only in order to prevent overpowering signals from causing a variety of problems in reception. Strong signal overload is a serious shortcoming with most scanning receivers.

But when signals are weak, or when the reception of distant stations is the goal, or if mobile operation is chosen, that short plug-in antenna won't help.

Fortunately, a number of reputable firms manufacture antennas directed exclusively toward VHF/UHF scanner users. There is a wide array of choices available, custom-engineered to your own requirements. For the sake of convenience, we will classify these products into two main groups: base station (outside, normally rooftop) and mobile.

The choice of an antenna, whether mobile or base station, will depend largely on two considerations: Is performance required on several bands—VHF-low (30-50 MHz), VHF-high (144-174 MHz), and UHF (50-512 MHz)? Are optimum reception and rugged construction important enough to justify premium cost? Once these two questions are answered, the rest is simple enough to figure out.

Base Station Antennas. For top performance, there is no substitute for a good outside antenna. It should be mounted as high as possible. Keep it free and clear of nearby obstructions like trees, wiring, or metallic objects. Generally speaking, the higher the antenna, the more will you be able to hear distant stations. This is especially true in hilly or mountainous terrain; less so in flat country.

Most outside antennas are designed for rooftop mounting. They are omnidirectional, so you don't have to worry about "pointing" them in installation.

Commercial Antennas. Although it is certainly possible for the inveterate tinkerer to fabricate his own antenna, many manufacturers offer a variety of economical choices backed up by years of professional design experience. Why tamper with success?

When many hobbyists think of parts and equipment stores, they think of *Radio Shack* because there is hardly a town without one. To be sure, this super store chain has quite a selection of base antennas for scanners (as well as mobile antennas, which we will discuss shortly). A recent entry is their 20-014 all-band base antenna for $29.95. A VHF-high/UHF ground plane is also available (20-172; $9.95). A trap-loaded VHF-high/low ground plane (20-015; $24.95) is offered for applications where reception on all three bands is not required.

Lafayette Radio Electronics Corporation is another large retail outlet with stores located in major cities throughout the country plus an extensive mail order operation. While a growing portion of their catalog is shared by other manufacturers, Lafayette still offers a number of house brand items. Base station monitor antennas are among them. The 40A13363 is a VHF-high/low, UHF combination for $29.99. Lower cost antennas with less frequency coverage are also available.

Antenna Specialists is one of the largest manufacturers in the business. A brand new catalog carries a number of scanner antennas, among which the MON-3 ($17.50) & MON-8 ($32.95) are particularly worth mentioning. Both are dual-band, ground-planes.

A close contender in the race for widest product line is *Hy-Gain*, now a division of *Telex*. Their MR-8 (VHF-high/low), MR-3 (VHF-high), and MR-4 (low band) antennas are directed toward the serious scanner buff.

With the recent introduction of programmable aircraft band receivers, the *Finco* AMA-3 ground plane should be of interest; it receives 108-138 MHz without tuning and features rugged, large-diameter elements ($32.95). *Finco* also has a model SMA-1 VHF-high/low/UHF antenna for only $10.95! Several handy accessory kits are available at additional cost. One of these is a window mount for applications where a conspicous roof installation is out of the question.

Antenna Incorporated has been releasing new models at an incredible rate. Several of their new products are directed toward the scanner listener. The model 60501 covers VHF-low, high, and UHF bands—for only $21.09.

Probably no antenna ever designed has the wide frequency capability of the venerable "discone"—a 10:1 frequency range is typical! At this writing, and

e/e SCANNER ANTENNAS

for many years, only one company has offered a VHF/UHF discone: *Hustler*. Their DCX is designed for general purpose use in the 40-700 MHz range. For those experimenters who want to hear things both inside and outside of the normal scanner tuning ranges, the Hustler DCX is a good bet ($16.00).

Avanti has become a living legend in CB antennas, and now they are offering a unique base station scanner antenna: The AV-801 "Astro-Scan." It's a big one–over ten-feet in length with its low-band elements! It offers better gain than most simple ground plane designs.

One of the weirdest looking base antennas we've seen for a long time comes from *Channel Master*. If you want to draw comments, try the all-band "Monitenna" (model 5094). It features a dipole cluster, arranged to resonate automatically at their proper design frequencies. *Channel Master* has built an excellent reputation with its fine line of TV antennas; their Monitenna continues that tradition.

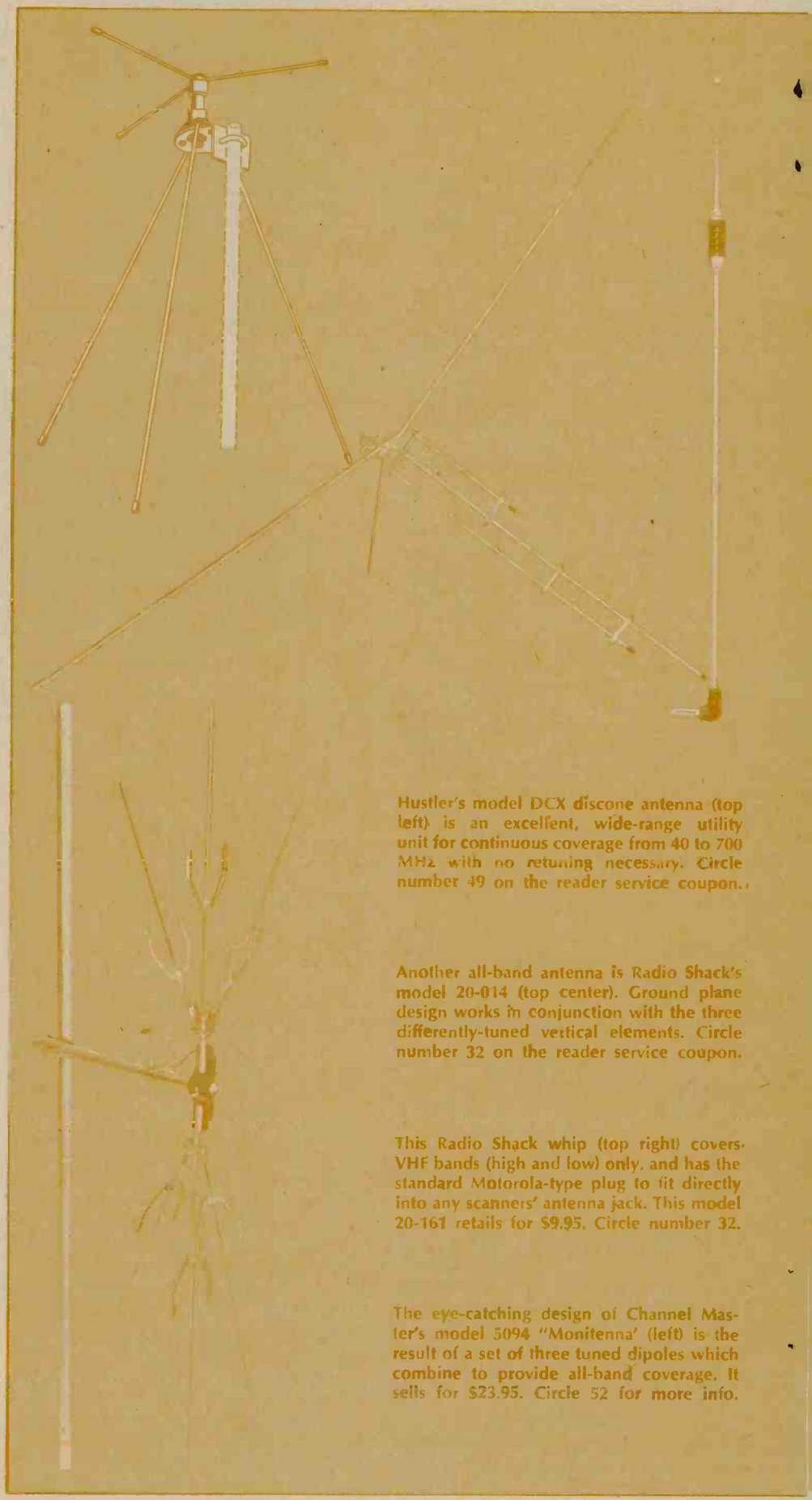
Mounting the Antenna. Erecting an outside monitor antenna is no more difficult than installing a TV antenna. In fact, it is easier. Standoff insulators are not needed for the coax cable down lead. and monitor antennas are always lightweight. They are not directional, so it is unnecessary to point them toward a specified location. A single section pipe mast is satisfactory for roof mounting. An inexpensive chimney mounting kit provides rigid support.

If it is necessary for the antenna to be free-standing, many TV retail outlets sell push-up masts. Most important, the antenna must be high enough to be free of surrounding obstructions.

Coax. Use a good grade of coaxial cable for the downlead, especially if runs are in excess of fifty feet. This is doubly important if UHF reception is a primary consideration!

Before you buy cable, peel back a half inch or so of the vinyl jacket to have a look at the braided shielding. If you can easily see the dielectric (insulation beneath the shielded braid, and covering the center conductor), reject the cable. VHF/UHF coaxial cable *must* be well shielded for acceptable performance and noise rejection.

Another hint is the composition of the dielectric insulation itself. If is is styrofoam-white in color, it is probably low-loss, and especially desirable for scanner use. Most name-brand cable conspicuously labelled "low-loss" is of

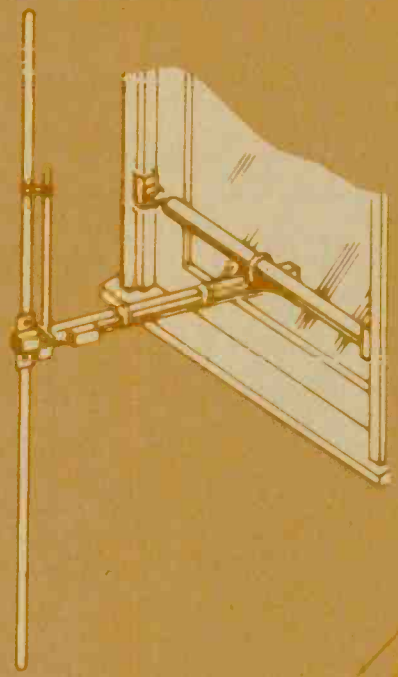


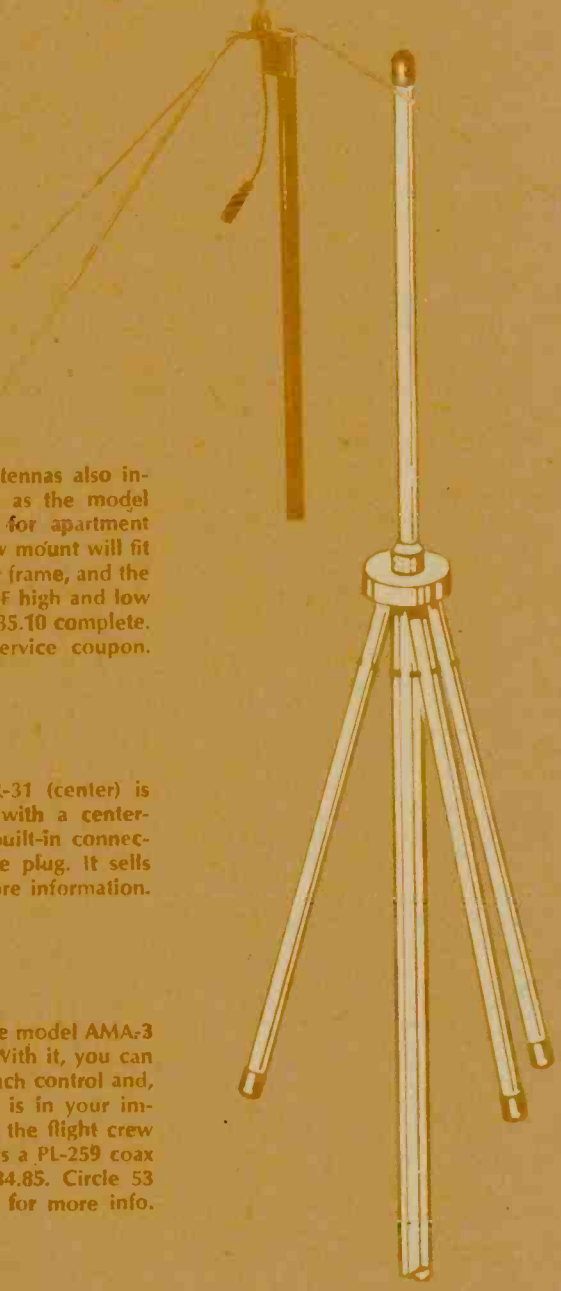
Hustler's model DCX discone antenna (top left) is an excellent, wide-range utility unit for continuous coverage from 40 to 700 MHz with no retuning necessary. Circle number 49 on the reader service coupon.

Another all-band antenna is Radio Shack's model 20-014 (top center). Ground plane design works in conjunction with the three differently-tuned vertical elements. Circle number 32 on the reader service coupon.

This Radio Shack whip (top right) covers VHF bands (high and low) only, and has the standard Motorola-type plug to fit directly into any scanners' antenna jack. This model 20-161 retails for $9.95. Circle number 32.

The eye-catching design of Channel Master's model 5094 "Monitenna' (left) is the result of a set of three tuned dipoles which combine to provide all-band coverage. It sells for $23.95. Circle 52 for more info.





Finco's "Stinger" line of antennas also includes monitor types, such as the model SMA-1WK (top). It's ideal for apartment dwellers. Adjustable window mount will fit virtually any type of window frame, and the antenna itself will cover VHF high and low as well as UHF. It sells for $35.10 complete. Circle 53 on the reader service coupon.

Antenna Specialists' MONR-31 (center) is an all-band ground plane with a center-loaded vertical whip. The built-in connector accepts a Motorola-type plug. It sells for $34.95. Circle 39 for more information.

Another Finco product is the model AMA-3 (bottom) aircraft monitor. With it, you can hear both tower and approach control and, in cases where the aircraft is in your immediate area, the voices of the flight crew as well. The antenna accepts a PL-259 coax connector, and sells for $34.85. Circle 53 on the reader service card for more info.

this type. Typical is the coax used in the cable TV industry. Often, substantial lengths of this excellent cable are discarded by cable TV installers, and hobbyists should not be hesitant to approach these sources for an adequate length for scanner-to-antenna lead-in. Don't splice! Use one length. If damage should ever require splicing coaxial cable, use only proper connectors designed for in-line cable splicing.

Small diameter RG-58 and RG-59 coax are useful on VHF for runs of less than 100-feet, especially if they are of the foam-dielectric type. On UHF, and for runs of 100-feet or more, use only large-diameter feedline such as RG-8 or RG-9. Cable TV coax is RG-6, and may require special adaptors for cable attachment, but the performance and low cost are worth the minor inconveniences involved.

Connectors. Years ago, manufacturers of automotive radios standardized on a plug-in antenna connector known as the "Motorola" type. All scanner manufacturers utilize that Motorola connector exclusively. Adaptors are available to interface with other fittings.

Mobile Antennas. Before installing a scanner in your car, check with your local police department. Some states and municipalities have laws and ordinances prohibiting the mobile operation of a receiver capable of intercepting police calls. Although these laws are being contested throughout the country, it is better to be safe than sorry.

Where Should I Mount It? In choosing the location for the installation of a mobile antenna, there are several considerations. First, the antenna should be mounted as high as possible; the center of the vehicle roof is ideal. Trunk lip and fender cowl mounting are next, and bumper mounting is last—and least!

The higher the antenna is, the more omnidirectional (non-directional) will be your reception. Directivity in a mobile antenna is not desirable; signal strength will fluctuate every time you change direction. Front cowl mounting exposes the antenna to a potential source of ignition interference, and mounting too low shields the antenna from arriving radio waves.

Mobile antennas are available in four basic mounting styles: magnetic, gutter clip, trunk lip, and permanent. In general, magnetic and permanent provide the most satisfactory reception. Gutter clip mounting tends to be quite directional. Trunk lip mounting is somewhat less directional, but not as good as in the center of the roof.

Because of the short length involved, the choice of coaxial cable is not important. Coax is nearly always supplied

by the manufacturer in any case.

How About Cost? In a mobile installation, the vehicle body acts as one component of the antenna system. Because radial elements are not necessary, one might expect that the average cost of mobile antennas is less than that of base station antennas. This is not the case. The special mobile mounting hardware is expensive to manufacture, and total antenna costs are about the same as those of comparable base station antenna installations.

Considerations in choosing the proper mobile antenna are similar to those in selecting a base station antenna. Are all three frequency ranges important? Does your budget allow for the highest quality of manufacture, or is economy a major consideration?

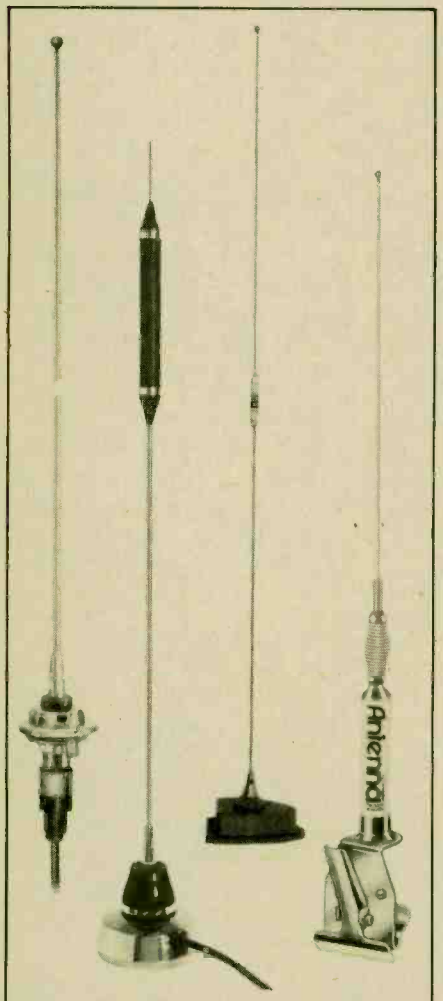
Original Antennae. There is a temptation to use the AM (or AM/FM) automotive antenna already on the car for monitor reception. For close range, strong-signal applications, this is O.K. Several manufacturers produce special signal splitters to allow for such combinations; thus, the AM/FM car radio is not defeated. In fact, it may be used simultaneously with the scanner.

Remember, however, that original equipment automotive antennas are mass-produced with a cost factor in mind. Often, the coax cable is of low quality. The serious scanner listener should use a separate monitor antenna designed for that purpose. Remember, if you want first class reception, go first class with your antenna selection.

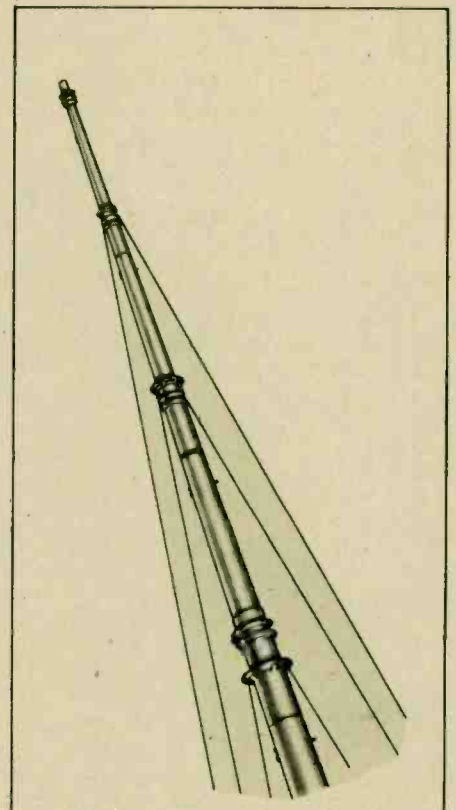
What Are The Choices? Not surprisingly, base station antenna manufacturers are also mobile antenna manufacturers. After the questions of frequency range and quality are resolved, there remains the task of choosing a manufacturer. Perhaps we can help. Since nearly all modern programmable scanners have three bands—VHF low, VHF high, and UHF—we will confine our sampling to those mobile antennas.

Avanti's AV-808 "Scan Fazer" is a convenient trunk-lip mount unit for $31.95. If you have a standard threaded base available, you can save three dollars by ordering the antenna element separately as the AV-804. *Antenna Specialists* has quite an assortment of

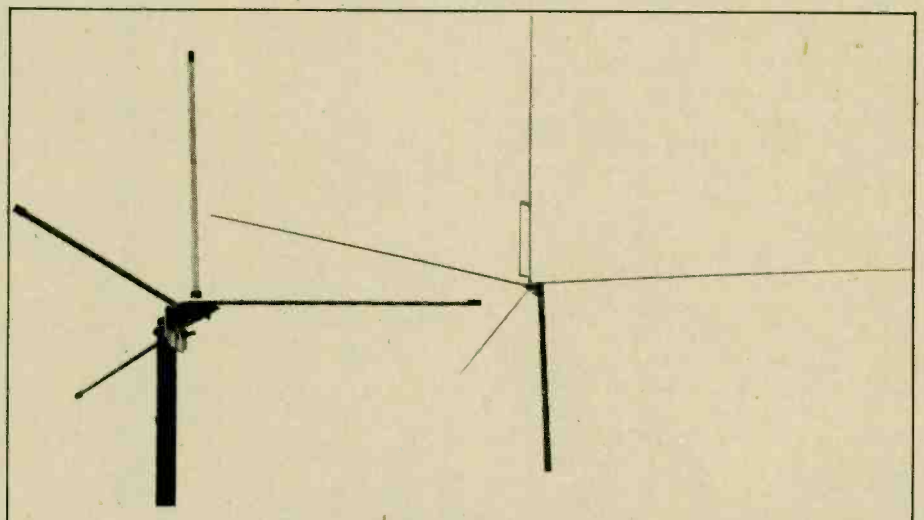
(Continued on page 82)



It probably will come as no surprise to you that the same people who manufacture quality base station scanner antennas also make mobile antennas as well. At left, Antenna Incorporated's disguise antenna (this one is for Chrysler cars) is just the thing for folks who don't like to advertise their mobile equipment. Circle number 34. Next, Antenna Specialists' MON-51 top-loaded magnet mount leaves no holes. Ideal for roof mounting. Circle number 39 on reader service card. Hustler's MOT center-loaded antenna covers all bands and uses a trunk-lip mounting. Circle number 49. At the far right, Antenna Incorporated's model 60003 has a convenient rain gutter clip mount for fast installation and removal. Circle number 34 on the reader service card for more information.



Radio Shack telescoping mast intended for a television antenna can serve as an ideal support for a scanner antenna. The coaxial cable can be run down either the inside or outside. Circle number 32.



Hy-Gain's MR-8 base monitor antenna is a ground plane design (left) with unity gain. It has provision for a PL-259 coax connector, and covers VHF high band. Hy-Gain's MR-18 handles VHF high and low as well as UHF. Circle 50 on reader service coupon.

IS SATELLITE TV IN YOUR FUTURE?

Direct satellite reception may replace many regular TV broadcasts

BY ROBERT GROVE

IN SLIGHTLY MORE THAN 20 years, the nations of the earth have launched over 11,000 orbiting satellites! Nearly all of them are either American or Russian. Fewer than 200 have been launched by all other nations combined. Of course, many of those satellites have decayed from orbit, spending their last few seconds of life as a flaming fireball. At present, nearly 4700 objects remain in orbit.

Why put those satelilte up there at all? Aren't they extremely expensive? And can't we perform adequate scientific experiments here on Earth without going into orbit?

Reliability of satellites is much better than that of shortwave radio. Normal radio communications links are highly dependent upon the sun, often suffering massive blackouts during solar storms. Satellites do not have this vulnerability.

Nations of the earth have decided that satellites do offer an advantage over earth-bound technology. So far as the cost, the use of satellites is shared by many supporters, justifying the high initial costs. That distributed cost will be decreased even further with the implementation of the Space Shuttle. The shuttlecraft will be able to place satellites in orbit and even extract them for repair and subsequent replacement.

Ears and Eyes Aloft. You have been enjoying the benefits of earth satellites for many years. Weather satellites have been providing closeups of storm centers and weather system movements. Military satellites constantly comb the earth for signs of possible aggression. Domestic communications satellites have relayed your long-distance telephone calls. But the most obvious of the present generation of earth satellites are the television relay satellites.

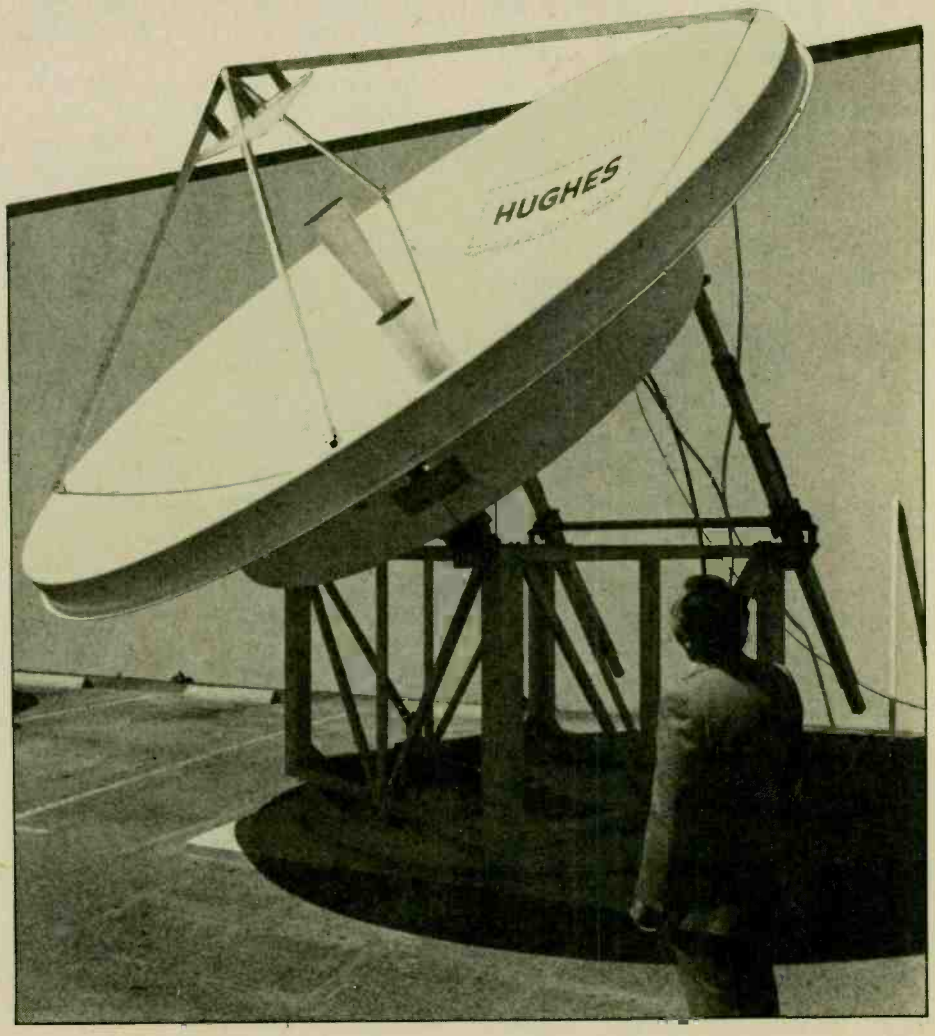
At this writing, five primary TV relay satellites are now positioned over the equator where they favor North American viewing. Four are American and one is Canadian. They are: RCA SATCOM I, 24 channels, programmed primarily for cable TV users; RCA SATCOM II, 12 channels, supplies special programming contracted by networks; WESTERN UNION WESTAR I, supplies Public Broadcasting Network; WESTERN UNION WESTAR II, Spanish Information Network and non-network "superstations;" CANADIAN ANIK III, Canadian Broadcasting Company and French TV programming.

Other satellites are nearby, on standby status for backup. The transmitters on board the domestic satellites are called transponders. They act as repeaters for incoming signals on the "uplink" from Earth.

Prime Time Fare? Assuming that you have your terminal, what is there to see? With the satellites presently providing 12 or 24 channels of programming, the variety is incredible! Home Box Office with its first-run movies, Warner Star Channel with movies for all tastes, sports specials, cultural programming, religion, news; an endless variety of choices.

Tuning In. It would be nice if we could point a conventional TV antenna at one of them and tune it in. Unfortunately, satisfactory satellite TV reception is incredibly complex, requiring sophisticated receiving equipment. These satellites are not compatible with our TV sets. Some of the differences between normal home TV reception and satellite reception include: frequency band, signal strength, and modulation.

In order to conserve spectrum space, many domestic satellites employ "frequency re-use;" that is, 12 channels are transmitted into a horizontally-polarized antenna, and then 12 more channels are transmitted on the same frequencies using a vertically-polarized antenna. Thus, the receiving user must match the antenna polarization to receive the signals he wants to see and hear.



e/e SATELLITE RECEIVERS

Our home TV sets operate on VHF (54-216 mHz) and UHF (470-890 mHz). American TV satellites transmit on the C-band (3700-4000 mHz). And to make matters worse, the orbiting transmitters are 22,300 miles away! Little wonder that there are only a few hundred operational, home-assembled satellite TV receiving terminals.

All of the domestic satellites are positioned in a straight line above the equator. Because they move around the earth at exactly the same rate as the earth rotates on its own axis, these satellites are called "geosynchronous." Thus, because they appear to remain permanently positioned overhead, they are called "geostationary." Once your antenna is pointed at a satellite, further tracking is unnecessary.

It is a ticklish business keeping them separated far enough to avoid interference on common channels (detected as "sidelobes" off the edges of directional antennas), while keeping them close enough for adequate signal strength for American users. The TV satellites are positioned above the equator from approximately 99° to 135° west longitude. Their signal radiation patterns (called "footprints") are established to favor the population densities of the north central United States.

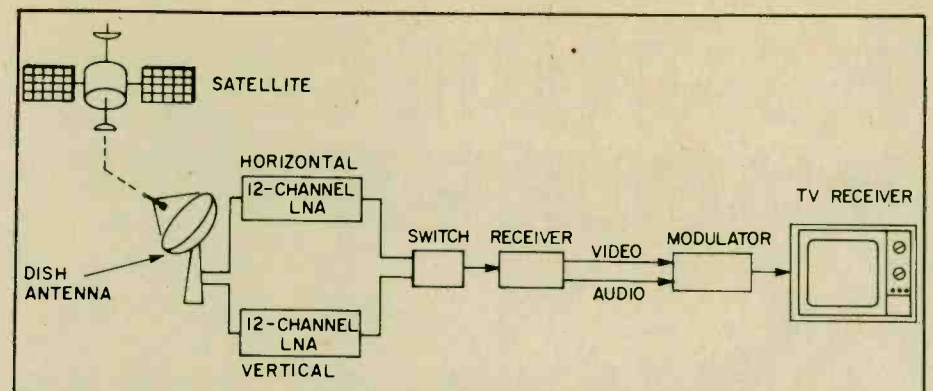
After the signal is located by the giant antenna (usually a parabolic dish of at least 10-feet in diameter), it must be amplified by a low-noise amplifier (LNA). Amplifiers like this are hard to come by, costing at this writing nearly $1000. The special low-noise transistors (and there are usually two in each LNA) may cost over $200 apiece! Because of their special internal composition of Gallium Arsenide, these field effect transistors are called "GASFETS" (GaAsFETs). The reason for such meticulous choice of parts is simple. Most amplifying devices work at low frequencies, and at reasonable signal levels. The weak signals from the TV satellites are nearly indistinguishable from cosmic background noise. Conventional amplifying devices become worse–generate their own internal noise –as their operating frequencies are raised. More noise we *don't* need! Consequently, acceptable transistors must be carefully manufactured and hand picked. Even the LNA circuitry itself is unconventional–stripline tuned circuits. Definitely not the sort of project for the average weekend tinkerer!

Even after the satellite signal has been amplified, there is need to process it further. A satellite receiver is used to provide video and sound to a TV monitor and speaker. Your own TV set cannot be used directly without a baseband demodulator–a device similar to that found in add-on TV games which may be connected directly to the antenna terminals of your TV set. Thus, the 4 gHz satellite signal is down-converted to channel 3 or 4 so that you may have the economical convenience of using your own TV set to watch the satellites directly.

Rolling One's Own. Can inveterate experimenters piecemeal together a working satellite terminal? Although some technical types have successfully converted surplus microwave receiving equipment into TV satellite receivers, the process is very difficult. It should not be considered by most hobbyists.

Unquestionably, prices will drop dramatically in the near future. But for now, consumer demand is not great enough to justify mass production techniques, so prices remain inordinately high. How high? Several thousand dollars for the least expensive terminal.

Buying In. As with any new technology, a large number of manufacturers are appearing on the market. It is still too early to tell which of these companies will grow to dominate the field of home TV terminals, but several companies were particularly helpful in providing information in the preparation of this article. We are pleased to mention the availability of their services.



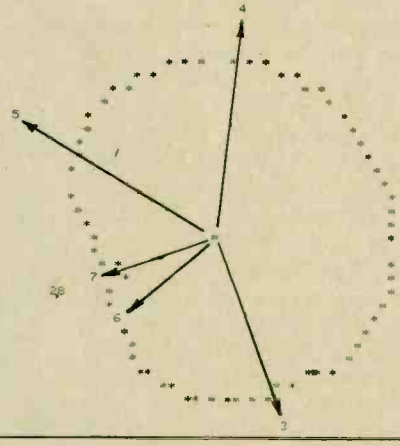
This is a simplified block diagram of what a typical home-use earth receiving station would look like. The 5-meter dish antenna in your yard feeds two signal amplifiers; one for the vertically polarized signals, and one for the horizontally polarized ones. A switch in the receiver selects either amplifier's output to be demodulated, and then fed to a special modulator which converts the signal to channel 3 or 4 on your TV.

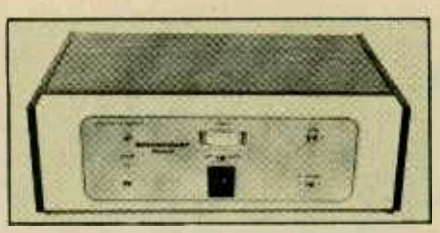
This is a sample of what the microwave survey provided by Channel One, Inc. looks like. For the sum of $200.00, a search is done of your immediate area to indicate local sources of microwave emissions that might preclude effective use of a home satellite receiver. If it's no-go, Channel One will refund your money. If conditions are right, your $200.00 is a down payment for the receiver system.

ES IDENTIFIER: LINCOLN MA
COORDINATES: 42 26 200 71 18 30
GND ELEV & ANT: 285. 9.

PATH	AZIMUTH DEGREES	DISTANCE KM	FS MARGIN DB.	OH LOSS DB	EST MARGIN DB	HORN MARGIN DB
1. BEAR HILL	158.1	7.2	0.	0.	0.	-19.
2. ASNEHUMSKIT	252.9	51.5	19.	6.	13.	4.
3. BEAR HILL	158.1	7.2	7.	0.	7.	-12.
4. CHESTER	6.5	54.0	13.	13.	0.	-15.
5. TROY	301.4	86.9	18.	18.	0.	-20.
6. NOBSCOT	230.5	16.2	1.	0.	1.	-15.
7. ASNEHUMSKIT	252.9	51.5	7.	5.	2.	-6.
8. ASNEHUMSKIT	252.9	51.5	16.	6.	10.	2.

PROBABILITY OF COORDINATION = 47.0% (PARABOLIC) FAIR
98.5% (HORN) EXCELLENT





Spacecoast Research's receiver includes the 2 LNA's, vertical/horizontal switch, signal strength meter, and the modulator needed to feed a TV. Retail $5,000.00.

Spacecoast Research (P.O. Box 442, Altamonte Springs, FL 32701) appears to have one of the lowest cost satellite terminals available for the consumer. At $5000, not including the parabolic dish antenna, it still seems expensive. When compared to similar systems available from competitors, it is downright cheap! Their comprehensive descriptive brochure is very informative.

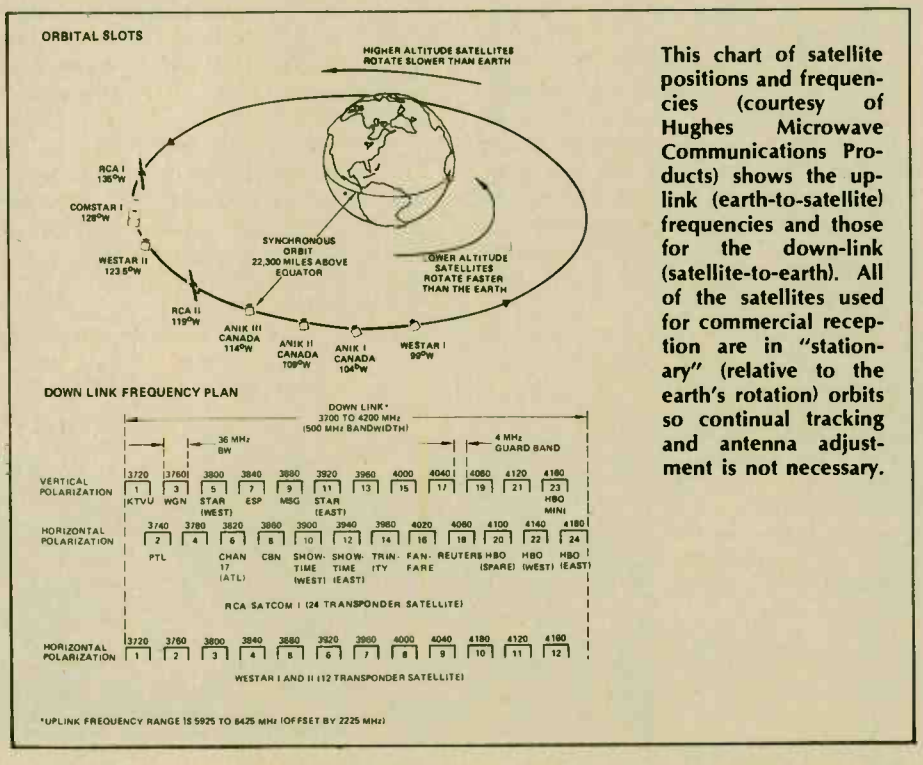
Hood's Lightworks (P.O. Box 1026, Beaverton, OR 97005) provides a complete satellite antenna-pointing chart custom-printed for your geographical location for only $4. Our sample provided 20 separate listings for present and prospective satellites.

Catalogs and literature from manufacturing giants like *Scientific Atlanta* (3845 Pleasantdale Road, Atlanta, GA 30340) and *American Satellite Corporation* (20301 Century Blvd., Germantown, MD 20767) provide technical insights into manufactured products designed for professional applications.

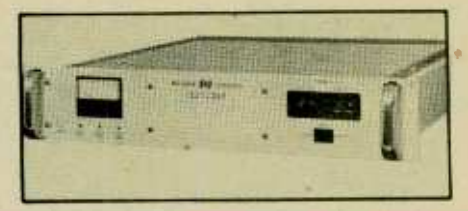
Some readers have undoubtedly heard of Japanese home TV terminals in the $500 range. It's true. But both the Japanese technology and geographical demands are much different from ours. Japanese TV satellites operate in the 12 gigaHertz (12,000 mHz) range, making signal-beaming sharper. Additionally, the Japanese mainland is hardly larger than the states of Florida and Georgia. Thus, while our satellite power is spread over much of the North American continent, the Japanese satellite may beam all of its energy on one concentrated spot, making signal levels there much higher. Under those circumstances, receiving terminals become much less demanding. Smaller antennas and less critical amplifiers are easily constructed at lower prices.

At the present time, a number of manufacturers are offering "turnkey" satellite receiving terminals. They will set up the equipment at your location, and you take it from there. New systems manufacturers are developing all the time, and prices will come down competitively. As more equipment becomes available at more attractive prices, consumer demand will increase. This will result in increased production driving prices down further. Clearly, home satellite TV reception is upon us.

On the Bandwagon. Just before press time, we received word that two other companies are now ready to market satellite receivers. Channel One, Inc., 68 Avalon Rd., Newton, MA is offering a complete (including dish antenna) system for $18,500. All you supply (aside from the bread, of course) is a suitable place for the antenna. For an initial fee



This chart of satellite positions and frequencies (courtesy of Hughes Microwave Communications Products) shows the up-link (earth-to-satellite) frequencies and those for the down-link (satellite-to-earth). All of the satellites used for commercial reception are in "stationary" (relative to the earth's rotation) orbits so continual tracking and antenna adjustment is not necessary.



Channel One's system includes the Microdyne model 1100-TVR 24-channel receiver as well as the dish antenna setup and costs $18,500.00 complete.

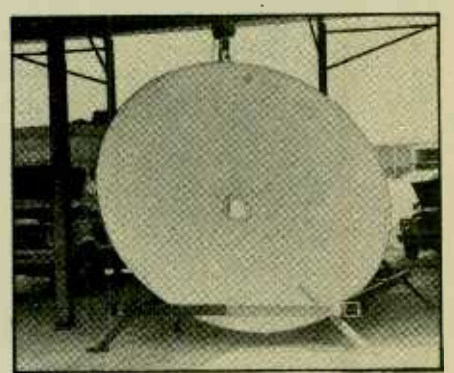
of $200, Channel One will perform a microwave survey for your location to determine whether there are existing microwave installations which would seriously interfere with reception. If there are, your money is refunded. If not, then the $200 goes toward the final purchase price.

International Crystal is preparing to market a receiver only (model TV 4200) with a rather agreeable price tag of $1,995. You will have to come up with the dish antenna yourself for the time being. This task, by the way, may not be as difficult as one might imagine, since there are many companies producing microwave equipment these days, and a little research might turn up a high-quality antenna for an affordable sum. For information on the International Crystal TV 4200 satellite receiver, write to them at 10 North Lee, Oklahoma City, OK 73102.

A Fly in the Ointment. There is still one discord in planning your own home TV terminal: FCC licensing. Yes, even though your prospective installation is for *receiving only*, and will never transmit, and even though that TV reception is for your own entertainment, not to be distributed with or without profit to others, you must be licensed.

Years ago, the Federal Communications Commission ruled that all microwave links must be licensed, both at the transmitting and receiving ends. This was done in order to register the

(Continued on page 83)



A dish antenna of the 5-meter variety is undergoing final preparations for installation in Florida. Center hole is for horn, which concentrates the received signals.

DXing Radio South Africa

TO MANY PEOPLE, South Africa is a fascinating country. It has lions and elephants, diamond and gold mines, miles of beautiful beaches along the Indian Ocean and, in Capetown, one of the world's most beautiful cities. Radio RSA, the external service of the South African Broadcasting Corporation, does an excellent job of bringing all these attractions to listeners of shortwave radio. In fact, it was by listening to RSA that got me interested in visiting South Africa to see for myself.

Thus, several months ago, I was being driven through the streets of Johannesburg, on my way to pay a visit to Radio RSA. The driver of the car was Pieter Martins, who some of you will know as the host of Radio RSA's DX Corner program. As we drove through this city that reminds one of Dallas, Texas, I recalled a visit that I had made to the BBC Studios at Bush House, London, a year ago. I wondered how Radio RSA's facilities would compare.

The "African BBC." A few minutes later, I was in for a shock! Instead of a simple office building, we were driving into a 40-acre complex of buildings that appeared to be a college campus. Pieter explained that all the operating facilities of the South African Broadcasting Corporation were housed at this site—TV studios, FM radio, Radio 5 and, of course, Radio RSA.

The most spectacular structure in this complex is a 55-story tower that houses the FM radio antenna. Pieter and I rode up to the top in a high-speed elevator and got a spectacular view of the city of Johannesburg as well as a good look at all the other buildings in the broadcasting complex. In addition to a tall 20-plus story office building, there are five two-story studio buildings and three garden apartment structures for employees who wish to live on the premises.

This is the 40-acre site of the Broadcasting Center in Johannesburg, home of RSA as well as television and FM radio stations.

Inside the building that houses Radio RSA, there are many studios, most with broadcasts going on at the time I visited (mid-morning). Radio RSA is on the air for some 20 hours a day and programs are broadcast in nine different languages. In addition to English, there are programs in German, French Dutch, Portuguese, Afrikaans, Swahili, Chichewa, Lozi and Tsonga. To handle this, the staff of Radio RSA is made up of people of all kinds of nationalities and races. It looks like the U.N. of broadcasting.

Programming. What do you hear on Radio RSA programs? First the news. Not just local news about events in South Africa but news about the world with emphasis on what is happening on the African continent. No other shortwave broadcaster covers Africa like Radio RSA; and this continent is where a good deal of the action is today.

Radio RSA sends out forty-two news broadcasts a day, of which seven are in English. In addition, they often have special background programs on some newsworthy event. A good example was the recent Rhodesian elections. Radio RSA not only reported on their progress each day, but had a half-hour program on the subject the evening before the elections began. Not even the mighty BBC gave this event such broad coverage.

News bulletins are written by Radio RSA News Department specialists and they utilize the full resources of the South African Broadcasting Corporation. These resources include the output of five international news agencies, regional news offices and a network of correspondents both inside and outside of the country.

A recent independent survey at the U.N. discovered that more than three-quarters of the delegates there from the African continent listened regularly to Radio RSA news broadcasts, a pretty good indication of how well they cover that part of the world.

News, however, is not the only thing

One of Radio South Africa's most popular programs is "Touring RSA." This radio travelogue takes you to such fascinating spots as Capetown and the Cape of Good Hope, as seen in the photo

you can hear on Radio RSA; they have some of the most interesting programs on the air today for general interest. One of the most popular is called *Good Morning Africa*. It is on every morning of the week at 0300 and 0400 (GMT), right after the morning news. This progam is not intended for North America but you can usually hear it easily here. It features short commentaries, live interviews and, of course, music.

Ever dream of traveling to South Africa yourself someday? Then you will want to tune in for *Touring RSA* on Saturdays at 2100 and Sundays at 0200 (GMT). This program takes you to the sightseeing spots. A recent one, for example, described a ride on the famous Blue Train—the world's most luxurious—that goes overnight between Johannesburg and Capetown.

Interested in soprts? Like the BBC Radio RSA has a *Saturday Special* from 1300 to 1500 (GMT). This can be a golf tournament with Gary Player and other international stars, or a track meet, rugby match, etc. Since, like Australia, their summer is our winter, don't be surprised to hear a ski meet from the Drakensberg mountains in July or a surfing contest from Durban, on the the Indian ocean, in January.

Interviews on a number of Radio RSA programs are, in this writer's opinion, the best you can hear on shortwave radio. Somehow, the staff at Radio RSA seems to come up with a continuous stream of very interesting people. These can be famous persons travelling in South Africa, movie stars making a film or doing an engagement in the theater there, or simply local residents who happen to have an interesting profession or hobby. You can hear some of the best on a program called *South African Panorama* heard at 2100 (GMT) on Mondays, Tuesdays, Thursdays and Fridays.

Just for DXers. Like many other shortwave broadcasters, Radio RSA has a DX program and it is one of the best. Pieter Martins, my host on this visit to the station, runs this program, (called *DX Corner*) and you can hear it on Saturdays at 2100 (GMT) and Sundays at 0200 (GMT). If you are into DXing the African countries, you can't afford to miss this program. If you're simply interested in shortwave radio listening, you will also enjoy DX Corner programming.

A good program to listen to is called *Wildlife*. This program often comes from the huge Kruger National Park where the lions, giraffes, zebras and other animals roam wild, but are protected from hunters. You can hear it on Thursdays at 2100 (GMT) and Fridays at 0200 (GMT).

Finally, tune in on Sunday mornings at 1300 (GMT) and hear a broadcast meant only for Southwest Africa and the South African Army stationed on the border of Angola but usually very well heard here in the U.S.A. They have letters to servicemen, music requests and Defense News. This program is interesting because it is put out in two languages; English and Afrikaans. Every announcement in English is immediately followed by one in Afrikaans.

Where to Tune. Radio RSA is easily heard here in the U.S. Actually, they only beam one program a day to the U.S. and this is in "prime time" at 0200 (GMT). Tune for it at 5980, 9585 or 9610 kHz. On the other hand, their English broadcasts to Europe and other parts of Africa are just as easily heard in North America as well. At 0300 (GMT), you can hear *Good Morning Africa* on 9585, 7270, 5980, 4990 or 3995 kHz.

When you get up the next morning tune to 25790 or 15125 kHz and pick up Radio RSA's broadcast to Europe at 1100 (GMT). Then at 1300 to 1550 (GMT), on 25790, 21535 or 15220 kHz, again hear broadcasts to Europe and Africa. The final English broadcast is at 2100 to 2150 (GMT) on 17780, 15155, 11900 or 9585 kHz. This is again being beamed to Europe but is usually very audible in North America. In most cases, it is the same programs you will hear later at 0200 (GMT) and often louder and clearer. ■

RSA's studio and equipment are among the most modern. Programs are broadcast in 9 languages throughout the world.

Kathi's CB Carousel

900 MHz and stay at home CBs

BY KATHI MARTIN KGK3916

I FORGET WHO MY teachers claimed first wrote the line, "The greatest embarrassment is to give a party and have no one show up.", but if ever there was proof of this it's the F.C.C. down in Disneyland-on-the-Potomac.

In recent years the F.C.C. has made two monumental goofs that cost us taxpayers millions of dollars. First, there was the case of licensing fees to which the F.C.C. was not entitled. They still haven't been able to return the millions they collected; meanwhile, the expense of returning these millions goes on and on, at considerable additional expense all the time.

Then there's CB. With one bold stroke the F.C.C destroyed the largest part of the consumer electronics market. Thousands are now unemployed because of this goof and those of us still employed are paying unemployment benefits to those who would otherwise be working if it weren't for Uncle Charlie and his good offices.

As if to recoup their losses, and rebuild the consumer electronics market, the F.C.C. came up with a 900 MHz CB band. Though the F.C.C. now denies 900 MHz was intended for CB, it takes just a fast skimming of the original proposal to realize it really was CB in every sense.

What happened is that no one cared —no one showed up at the party. The F.C.C. expected the manufacturers to whoop it up for the new band; they expected the CBers would gladly pay the development costs for 900 MHz in return for additional frequencies; most of all, they expected a strong response from "interested parties."

Well, at the time this column is being written, the whole proposal has fallen flat on its face, and the F.C.C. is backing off by claiming they only solicited opinions, and the proposal was not really CB, but a new form of communications band that would permit repeaters and direct access to the telephone system.

900 MHz a Fiasco. Repeaters and telephone access is called common carrier. The Bell System has a real fine radiotelephone network, so 900 MHz isn't new, different or an improvement. And if we eliminate repeaters and telephone interconnect, we're back to CB.

But no one is crying for new CB channels other than a handful of SSB operators who are illegally using 27-28 MHz for high power worldwide unlicensed amateur radio. The manufacturers whom the F.C.C. counted on? They were badly burned the first time around and their response to the F.C.C. has been underwhelming. They have no intention of getting involved and having the rug pulled out from under them again.

Regardless what you may read elsewhere about the new 900 MHz CB band, the fact of the matter is that the proposal has fallen flat, along with license fees and the 23/40 channel cut-off. No one trusts the F.C.C., and the only way we'll ever see 900 MHz CB is if it's literally forced down our throats by eliminating 27 MHz entirely. Unfortunately, I don't believe the elimination of 27 MHz will create a 900 MHz CB service. I think most CBers will just run their gear until the cut-off date for 11-meter CB and then call it quits for 2-way radio.

But all that's a long way off in the future. After getting next to no response from both users and industry concerning 900 MHz, the F.C.C. is waffling and claiming they really didn't mean 900 MHz was a substitute for CB, or an expansion, or whatever. Fact is, they are now even more confused by the lack of enthusiasm for their latest "inquiry" than we are, and it will be many years before Uncle Charlie ever tries to "upgrade" CB.

Where have all the mobiles gone? What with the stuff that the mailman no longer fights through—rain, wind, snow, sleet and cold—I haven't been able to get around the country too much, but I have noticed that out my way there's a sharp reduction in the number of vehicles with CB sky hooks; yet the band is just as crowded as ever, with the average channel six deep in signals from everywhere.

One explanation is that many mobile CB rigs have moved indoors. Anyone who monitors the band for just a few hours can tell that the majority of stations are *fixed*—base stations. The operator pulls the rig out from under the dash, connects one of those 120-VAC/13.8-VDC power convertors being sold almost everywhere at discount prices, and the mobile becomes a base station. All you need is a base antenna; and that can be a super-directional beam, or a mobile whip mounted on a window ledge.

Problem with having so many base stations is that they are used primarily as a hobby. While there's nothing wrong with hobby CB, for each mobile that becomes a base we lose another set of eyes and ears on the road. Perhaps the car, or next ten cars, that saw an accident or traffic jam had the capability to report the occurrence to the highway patrol when CB-equipped. But if the CB is back in the shack entertaining the kids, no one is going to get assistance quickly.

A recent incident really brought home to me how much we lose when trying to make a mobile rig do double duty by also serving as a base. I was coming back late at night on a road almost closed by snow when my headlights picked up a child's face in the window of a car that appeared abandoned at the side of the road. I threw

(Continued on page 86)

In snow or desert heat, when trouble strikes help is just a shout away—if your CB is in the car. Keep it mobile for safety!

e/e assembles the...

Factory aligned IF circuits make this old favorite an even hotter high frequency performer

CIRCLE 1 ON READER SERVICE COUPON

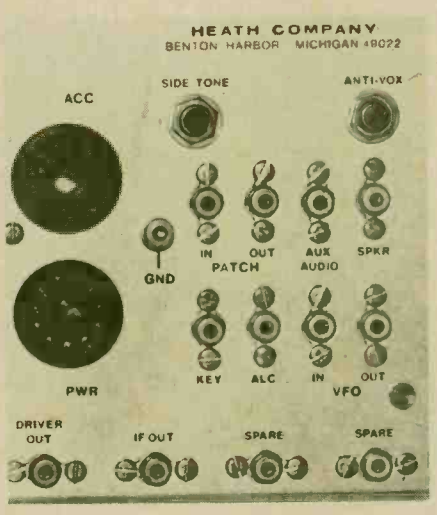
Heath SB-104A SSB Transceiver

SOME TIME AGO, ELEMENTARY ELECTRONICS looked at the Heathkit SB-104A single sideband Amateur radio transceiver. Since then, the Heath Company has incorporated a number of improvements into the rig, and because there has been so much reader interest in the unit, we have undertaken a new look at the SB-104A. While we intend to go very thoroughly into the design and operation of this transceiver, we can lead off by saying—in a nutshell—that the new SB-104A is a much-improved version of what was already a first-class ham transceiver.

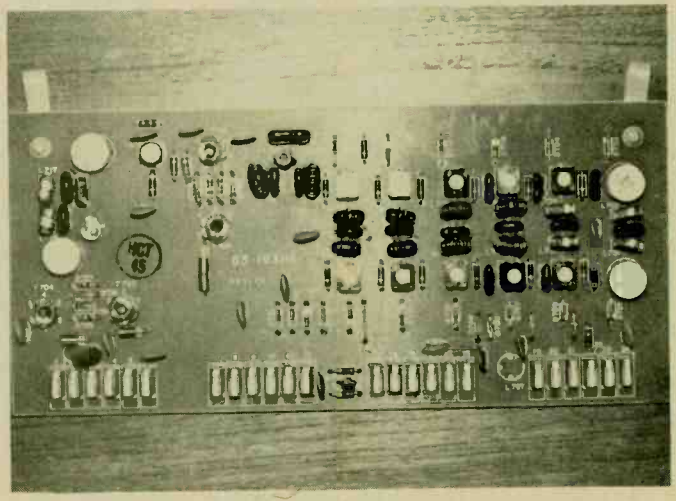
State-of-the-Art SSB. Since its introduction, Amateur radio operators have acknowledged that a properly built and aligned SB-104A is pretty close to the final word in current ham communications technology. The rig is completely solid state and broadbanded, meaning that during operation there is no need (in fact there isn't even the capability) to tune or peak any circuits. It employs digital readout of the frequency to which the transceiver is tuned. The frequency display is processed on two circuit boards, with a stable crystal oscillator acting as the time base, and calibrated against the US Government time and frequency standard station, WWV. The counter circuitry is arranged so that the entire premix frequency is counted, but only the signal frequency is displayed on the readout.

The transmitter circuit is of modern SSB design, employing a very stable VFO operating over a range of 500 kHz. The final amplifier actually consists of *two* push-pull amplifiers operated in parallel, producing 100-watts CW or 100-watts PEP SSB output power. The bias voltage is furnished by a diode mounted in the heat sink, so the bias voltage tracks with the heat sink temperature to prevent thermal runaway. A unique transmitter feature is a low power option. In low power mode, the driver's output is switched to bypass the final amplifier to furnish one-watt CW or PEP SSB direct to the filter/ALC board and the antenna. VOX (Voice-operated switching) is included for phone operation, and keyed-tone VOX is utilized for CW.

The receiver is, again, a modern circuit design employing a crystal filter for SSB, an effective fast/slow AGC action selection, and an RF Gain control (which in fact varies the IF gain). Of special interest in the receiver is the use of solid-state switching for mode selection and also for filter selection if the optional CW filter is installed. The IF selectivity on SSB is 2.1 kHz minimum at 6 dB down, 5 kHz maximum at 60 dB down for a 2:1 nominal shape factor. The accessory CW filter produces a sharp, 400 Hertz bandwidth. Audio output is a hefty 2.5-watts into 4-ohms.



The flexibility of the SB-104A can be seen on the back panel. Provisions have been made for many accessory operational aids.

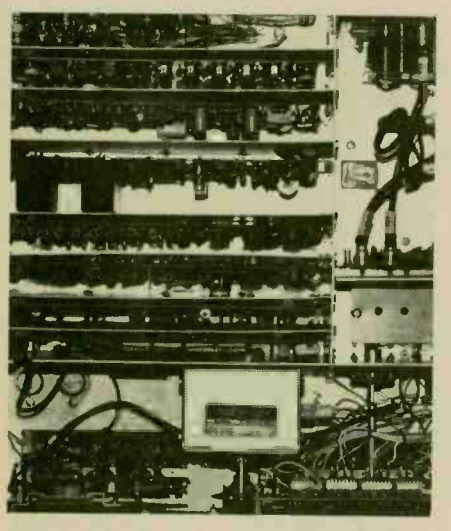


One of the ways in which Heath has made the kit builder's life easier is the inclusion of factory-assembled and aligned IF circuit boards. These take much of the headache out of final set-up and alignment of the transceiver.

e/e HEATH SB-104A

A Man-Sized Assembly Job. While there is nothing unusually difficult involved in putting this kit together, it is a job that requires a lot of time and patience. Heath employs a very logical sequence for the assembly, with the scrupulous attention to detail usually found in the Heath instruction manuals. The reader is taken step by step through the asembly of fourteen of the sixteen separate plug-in PC boards that make up the basic transceiver. (In addition, there are two optional accessory boards, the noise blanker and the CW filter, that come with their own assembly booklets.) The actual PC board assembly is very straightforward, and Heath furnishes everything needed, down to the simplest (or most esoteric) mechanical parts. Once the boards are assembled, the builder turns to the chasis. There's a great deal of interconnecting cabling, but almost all of it is in pre-assembled harnesess, so a great deal of time and confusion is saved. As far as assembly is concerned, the big plus in the new SB-104A kit is that Heath now furnishes both the receiver front end *and* the transmitter IF boards preassembled and prealigned. This is very important, since each of these boards is very critical in terms of adjustment and construction for attaining optimum performance.

We chose to build all the accessory kits that are designed to accompany the SB-104A—the noise blanker and the CW filter, as just mentioned, and the combination speaker and power supply. The power supply is very hefty—it supplies the 13.8-volts needed by the SB-104A with a maximum voltage variation of 2 percent between the 2 amps for receive and the 20 amps needed on transmit. We suggest building it first, so that when the transceiver is finished, you can go right into the testing and alignment procedure. In building the power supply, we encountered no hitches or rough spots whatever, and it worked right off. There's only one adjustment—a potentiometer on the regulator board which controls output voltage. Be sure you perform the test to see if the crowbar circuit is working properly, as Heath suggests. It's an important protection for your transceiver, if output voltage should surge.



A top view of the assembled transceiver reveals the clean, professionally finished layout. Even we couldn't clutter it up!

Get Out Your VOM. It's hard to believe, but a thorough and completely satisfactory job of aligning the SB-104A can be done using only a volt-ohm meter with a high ohms-per-volt rating, and a 50-ohm dummy load. Be prepared to take a while doing it though, for there are a lot of steps involved in getting this complicated transceiver really peaked up. Before alignment, Heath sends the builder through a number of voltage and resistance tests, to make sure that nothing goes up in smoke when alignment is attempted. Once it's acertained that there are no shorts, alignment progresses from High Frequency Oscillator, to VFO, to Counter, to Ten Meter IF/Predriver Filters, and on through the various circuits. We performed the complete alignment procedure using only a VOM, and later had our work checked by a top-quality technician at the excellent Fairlawn, New Jersey *Heathkit Electronics Center*. Naturally it turned out that uniformly we were right on the nose. In fact, there was only one very minor hitch in setting up our SB-104A—a wire had broken hidden inside an insulator, and we had a little troubleshooting to do to locate it. By the way, there are very extensive troubleshooting directions included in the manuals, and of course the *Health Hotline* technicians are extremely helpful.

Performance Results. After the time and effort involved in building and adjusting this complicated rig, was the result worth it? You bet it was. Every specification of the SB-104A met or exceeded Heath's claim. Receiver sensitivity measured better than 0.5-microvolt on all bands, on SSB selectivity was excellent, and with the CW filter in, bandpass was slightly sharper than the claimed 400 Hz. There were no detectable glitches such as spurious signals or dead spots, and audio quality using the accessory speaker was fine. Moreover, the receiver is very quiet.

Transmitter output power measured between 105 and 110-watts on all bands, unwanted sideband suppression was better than 55 dB down at 1000 Hz reference, and harmonic radiation was more than 40 dB down below a 100-watt output. Since this is a broadbanded output stage, the final is happiest when facing a 50-ohm load at less than a 2:1 Standing Wave Ratio. This is standard among the newer, solid-state rigs, and is something that you ex-CBers will recognize from your attempts to get maximum power from your solid-state CBs. In fact, the SB-104A really hums along when the SWR is 1.5:1 or less, so if you have a decent antenna, or use an antenna tuner, there won't be any trouble. As mentioned, there is protection against thermal runaway, and facing a high SWR, the output will shut down.

The figures in themeslves make clear what a fine rig the Heath SB-104A is, but it's really necessary to use one on the air to understand what care in contemporary circuit design and the use of high-quality materials can produce. The 100-watts, of course, is enough output to work plenty of DX, but it's in the absolutely clean quality of its signal—especially in the superb audio—that the SB-104A stands out. We have used the rig now very extensively, and have, without exception, received praise for its unusually readable audio. If you don't think DX stations appreciate a signal this clean, just try it. The receiver too is very smooth-operating, and the tuning vernier is silky with no detectable backlash. There's virtually every operating convenience (our one quibble is with the lack of receiver incremental tuning). Even the VOX works well, and the anti-VOX control on the back panel is extremely effective in cutting down on speaker-microphone interaction. The back panel has plug-in

(Continued on page 79)

This is the final amplifier circuitry. The RF power transistors are hidden from view. Circle number 1 on reader service card.

Antique Radio Corner

Wave trap cures interference in older sets

BY JAMES R. FRED

BACK IN THE EARLY 'Twenties radio listeners and experimenters were having problems with tube substitutions. Not that there was a shortage of tubes, but the 200's and 201's each consumed 1 ampere of filament current. This meant that the charge in a storage battery didn't last very long. Radio set owners living in town had electricity in their homes and could recharge their batteries over night by buying a simple battery charger, but listeners living in the country had a problem. If there was no electricity in the home, someone had to transport the battery to the nearest battery shop where it was recharged; then several days later they had to return and get the battery. Imagine driving a horse and buggy miles to the nearest town just to have a battery recharged. This also left the home without radio reception for several days. Tube manufacturers partly solved this problem by introducing the 200A and the 201A tubes, whose filaments only drew .25 amperes. This meant fewer trips to the battery shop.

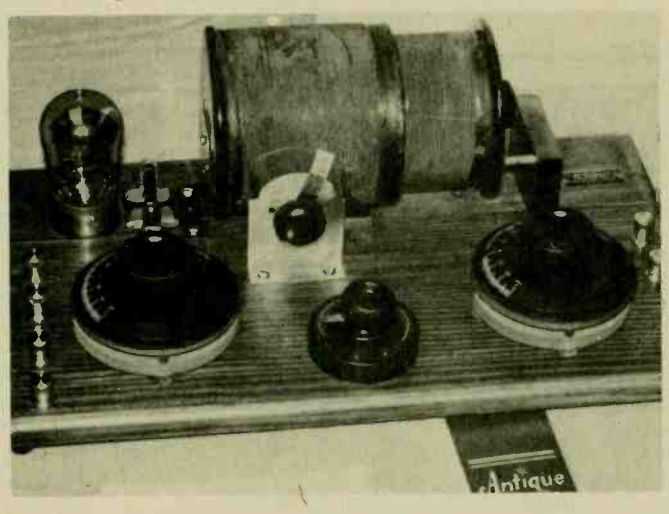
However, this wasn't entirely satisfactory to persons living in the more remote areas of the country. RCA brought out the Aeriola Senior and the Radiola III and IIIA which used the WD-11 tube, whose filaments operated on a Number Six dry cell. The Number Six 1.5-volt dry cell was well known since it was used in telephones and in the ignition systems of some gasoline engines. The WD-11 tube had some drawbacks, i.e., low gain, a fragile filament, a non-standard base, and they were microphonic. This led to the use of the 199 and the 120 tubes, which had a 3.3-volt filament. Since the WD-11 had a non-standard base, several companies made adapters that allowed the use of a 199 or 120 in a WD-11 socket. In some cases, i.e., the Radiola IIIA, it was possible to replace the WD-11 with a 199 as a detector tube, use a 120 as the audio amplifier tube, and have enough audio output to drive a horn speaker on local stations. Radiola (RCA) even went so far as to issue an 8-page bulletin on how to replace the WD-11 tubes in the Radiola III and in the balanced amplifier. The same instructions could be used with the IIIA.

Replacement for WD-11. Now collectors are replacing WD-11s in many early 1920's radio sets because they cannot find or buy WD-11 tubes. The logical replacement is the 864, whose characteristics, except base pin size and spacing, are the same as the WD-11. Another replacement is the Type 30 with a 2-VDC filament. Unfortunately, both tubes are out of production and the ones usually available are World War II surplus. In addition, you should have an adapter to go between the WD-11 socket and the 864 or 30 tube. These adapters are available from Antique Radio Parts, P.O. Box 42, Rossville, IN 46065. You will also need to use the proper filament voltage for your replacement tube.

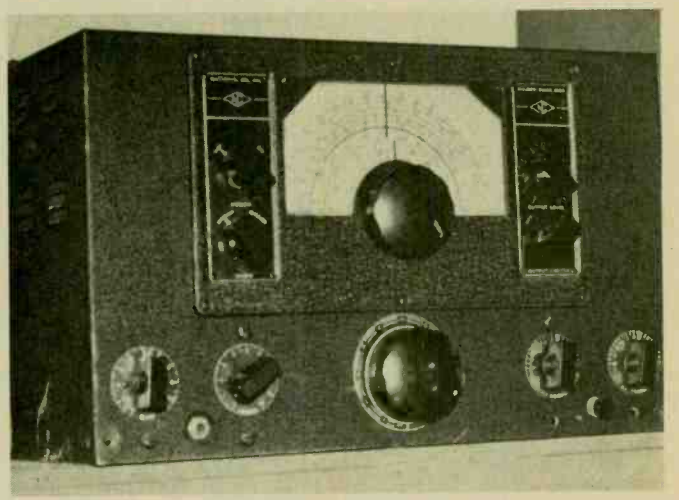
I am writing a portion of this column from Canandaigua, New York, where my wife and I are attending the Antique Wireless Association Annual Conference. With the price of gasoline expected to reach $2.00 per gallon, this may be the last year for such a meeting. In the future, regional meetings may be the only ones we can attend.

This year's conference had nearly 600 collectors in attendance, with over 300 at the awards banquet.

There was a tribute to Thomas Edison, whose invention of the electric lamp had its 100th anniversary in 1979. So much equipment was registered for the auction that even with 3½ hours allotted to it there were some unsold items still remaining at the end. A separate vacuum tube auction was held; among the items sold at it was a De-Forest spherical audion that would still operate. Other programs were: "Early Canadian Shore Stations," "Amateur Equipment of the 1930's," "A Pictorial History of Early Vacuum Tubes," a demonstration of early scanning disc TV, and a "show and tell"



This extremely rare A.C. Gilbert radio won first prize in its class at the Antique Wireless Association Annual Conference at Canandaigua, New York.



Once used aboard ships, this 1930's vintage National low-frequency receiver now forms part of a wireless telegraphy display at the South Street Seaport Museum.

seminar on how to restore and repair old radio-wireless equipment.

One very interesting program was "The Feminine Touch" by Lou Moreau, W3WRE. This illustrated talk traced the history of women in telegraphic and radio communication.

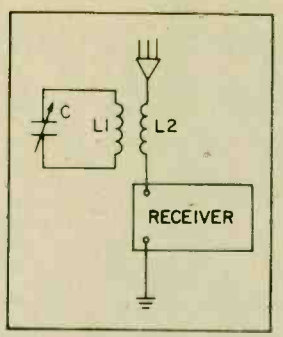
The old equipment contest had many outstanding entries. As usual, the parking lot flea market saw every kind of old radio-wireless gear change hands. I had the pleasure of meeting many of my "Antique Radio Corner" readers. Many collectors at the conference had started to collect radios after reading the column in this magazine.

It was another outstanding conference and I hope conditions will allow us to return in 1980.

Old Radio Literature. One of the best ways to learn about the early radios and other equipment is to study old magazines, literature, and catalogs. However, it is difficult to find publications from the 1920's. There are several collectors who recognize this fact and at their own expense have reprinted booklets and catalogs that provide much needed information. Many collectors are fortunate to have complete files of previously published magazines, and new discoveries of horded magazines are made quite often. I urge all collectors to seek out the oldest radio amateurs and radio repairmen in their communities. I am sure nearly every town, no matter how small, had a radio amateur or repairman during the 1920's. They are at an age now when most are thinking about disposing of their literature and equipment.

I recently visited one such gentleman who repaired radios, ran an electrical service shop; he is now retired and fixing TV sets in his home workshop. I stopped in Jim Thorpe, PA to see him as we were returning from the AWA conference. He was ready to sell his manuals and magazines, as well as some old radio tubes. I didn't have room to carry all he wanted to dispose of, but I plan on going back for the rest later this year.

Novelty Radios. In the 30's, as every home and automobile began to have radio, the manufacturers began to look for a way to expand the market for radios. One idea was to make novelty radios. By novelty radios I mean radios disguised to look like other objects, or radios made to commemorate some well-known movie star or cartoon character. One of the most valuable and sought after such radios is the Emerson Mickey Mouse Radio. It was just a small, brown plastic cabinet radio with Mickey Mouse molded into the speaker opening. Another sought after radio is a Jackson Bell cathedral radio with a Peter Pan figure cut-out in the speaker opening in front.



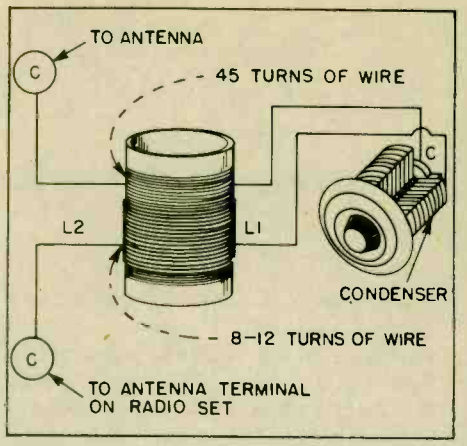
This diagram shows connections for the wave trap. For really serious interference, try two traps in series.

There were radios made to look like small red "Coke" coolers, others like globes, baseballs, wine bottles, small beer kegs, and microphones. Later, after WW II, came the Montgomery Ward "Rudolph the Rednose Reindeer" radio and the Arvin "Hopalong Cassidy" radio. You can probably remember many more that I haven't even seen or heard of.

These novelty radios are quite popular with collectors, and can be found in flea markets, antique stores, and auction sales. Repairing some of these sets can be a problem, since many parts were made especially to fit the specific cabinets.

Speaking of strange radios, have you ever seen the two and three-tube radios made by Arvin in the small steel cabinets? At one time Arvin made 4000 small radios per day, many of which were sold by Sears Roebuck. Naturally they did not use loop antennas because the steel cabinet would have blocked signals. Instead they were sold with a 30-foot hank of antenna wire. To put the radio into use, you had to unroll the antenna wire and lav it on the floor. The radios in steel cabinets had from two to five tubes. I can remember the two-tube model selling for as low as $5.95 in the middle of the 1930's. Besides Sears, you could find them in automotive parts stores, drug stores and variety stores. Remember, at that time there were no discount stores as we know them today.

A very interesting radio company of the early 1920's was the Adams-Morgan Company of Upper Montclair, NJ who manufactured the Paragon radios and component parts; they also manufactured a radiotelephone transmitter. A copy of the 1923 Paragon catalog is now available from Antique Radio Press, P.O. Box 42, Rossville, IN 46065. The reprint of the 1923 catalog has 20 pages and describes all the radios and parts made that year. The catalog is available for $3.00 postpaid. You will find it informative as well as interesting.

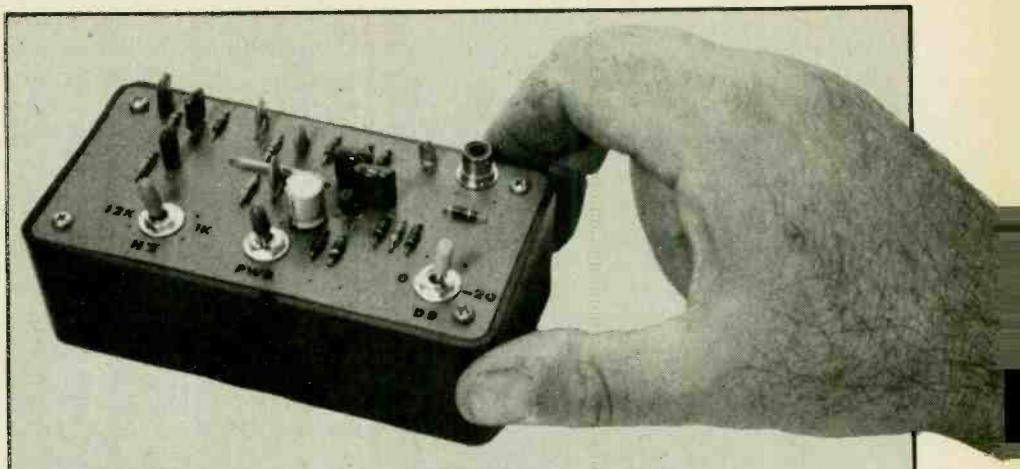


Cure the interference problems common to older, less sensitive receivers with this simple wave trap.

Technical Tip Of The Month. Many readers have asked us just what they can do to eliminate interference from strong local stations. This is especially a problem with the older, less selective battery receivers.

A wave trap can be built quite inexpensively that will reduce interference from strong local broadcasting stations. This simple wave trap can be constructed by connecting a variable capacitor and a coil of wire in parallel. The drawing shows one version that was used in the 1920's. The coil consists of a 4-inch diameter non-metallic tube, either cardboard or plastic, with two windings on it. Winding L-1 has 45 turns close wound, that is wound without any space between the wire, of number 28 enameled wire. Over the center of the 45-turn coil wrap several layers of waxed or gummed paper. Now wind in the same direction coil L-2, consisting of 10 turns of number 22 enameled wire. Connect the winding L-2 in series with the antenna and the antenna binding post of your receiver. Connect winding L-1 in parallel with a variable capacitor of 500-picofarads capacity (.0005-mfd.).

To use this wave trap, the first step is to tune in the interferring station to the loudest signal on your radio receiver. Now tune the wave trap until the signal is at its weakest. You might have to retune the set and wave trap several times to get rid of the offending signal. It must be remembered that the trap will absorb energy on only one frequency at a time. If you have more than one interfering station, you may want to try using two wave traps. ■



Tape Tester

A scientific method for determining the proper tape for your recorder

BY HERB FRIEDMAN

VIRTUALLY NO TWO BRANDS of recording tape, particularly the cassette tapes, deliver similar results at slow speeds. Even within the same price range, tape A might sound best on machine X, while tape B is the right one for machine Y. Fact is, because there is so much variation between tapes, many of the better cassette decks provide some means to optimize the bias for optimum frequency response from the tape playback.

The trouble is, not all machines have user-adjustable bias, and some models with the adjustment have no test system. The user must try for an adjustment that sounds right to the ear, a somewhat dubious method. Basically, most of us simply try a wide assortment of brands and types hoping to find the one that works best on our recorder.

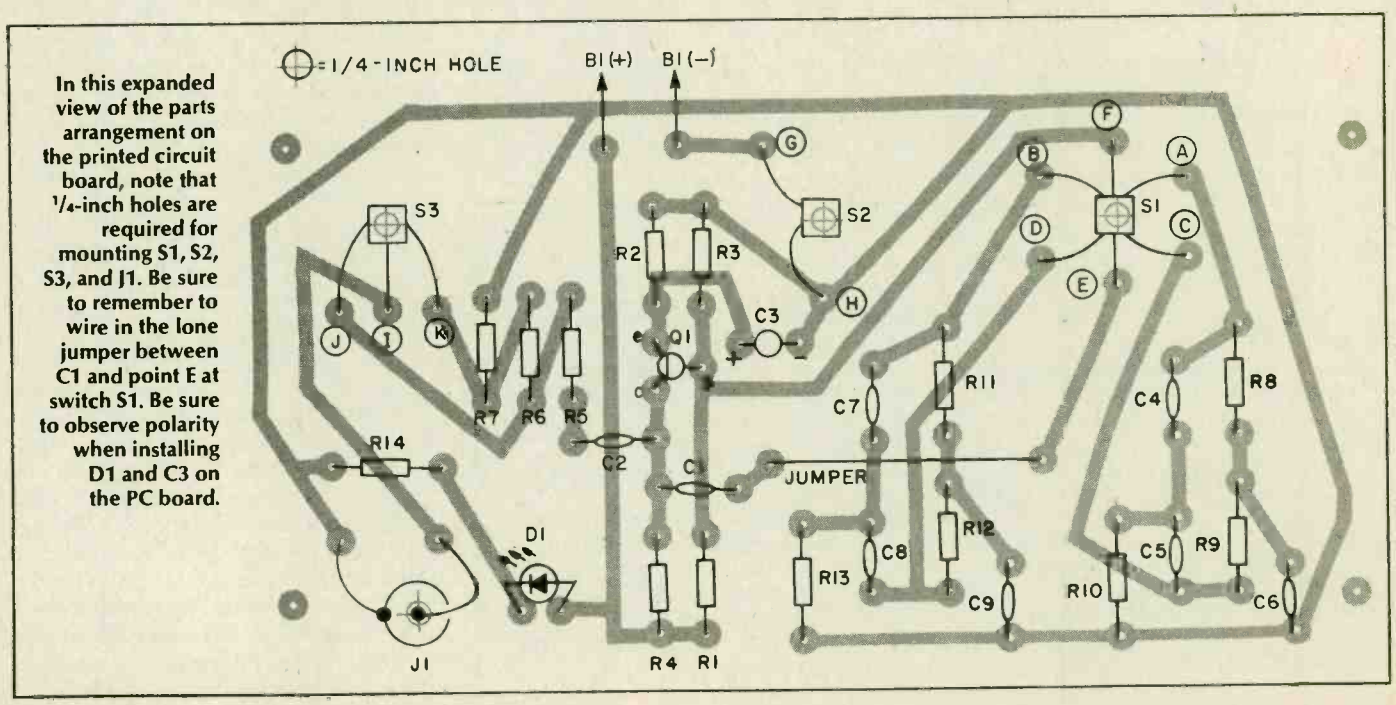
With our easy-to-build Tape Tester, however, you can check out tapes in seconds to find the one that gives the best response in your sound system. And the same thing goes if your deck has a bias adjustment; again, it takes just a few seconds to find the optimum adjustment for peak performance.

Easy to use. The tape tester provides two switch-selected test tones of approximately 1000 and 12,000 Hz at 0 dB reference output level—for adjustment of the recording level—and at approximately −20 dB, the standard cassette test level. (Of course, it can be used for reel-to-reel machines, though their test level is generally −10 dB.)

To determine whether you are using the best tape for your machine, or to make a bias adjustment, you simply record the −20 dB 1000 Hz signal for a few seconds, followed by 12,000 Hz. On playback, the 12,000 Hz tone should be within 3 dB of the 1000 Hz reference for "average" performance, and within 1 dB for optimum sound reproduction. If you're using metal tape and want to see how well the tape, or the machine itself, handles high-frequency high-level saturation, simply use the 0 dB output before running the standard −20 dB level test.

As an example, assume you've checked a tape and the 12,000 Hz playback is 7 dB below the 1000 Hz playback. Obviously, this isn't hi-fi, so try a tape with "hotter" highs. Alternately, if the 12,000 Hz output was 6 dB above 0 dB, you need a tape with less high frequency output—generally a less expensive tape. If your machine has a bias adjustment but no test system, simply adjust the bias until the 12,000 Hz playback level reads within 1 dB of the 1000 Hz playback level on your deck's VU record/playback meters.

Construction. The Tape Tester shown



In this expanded view of the parts arrangement on the printed circuit board, note that ¼-inch holes are required for mounting S1, S2, S3, and J1. Be sure to remember to wire in the lone jumper between C1 and point E at switch S1. Be sure to observe polarity when installing D1 and C3 on the PC board.

TAPE TESTER

in the photographs is assembled in a plastic cabinet sized approximately 2⅝ by 1⅝ by 5-inches, usually available from Radio Shack or Calectro. Some cabinets have square corners, some are round; it doesn't make any difference unless you contemplate problems in rounding the corners of a printed circuit board.

The cabinet cover (which replaces the supplied metal cover) is the printed circuit board itself. This arrangement eliminates the hassle of trying to mount the PC board inside the cabinet.

Before etching the printed circuit, make certain the board is cut to the exact size of the metal cover supplied with your particular cabinet. Not only is there the problem of round or square corners, but the overall dimensions and the location of the mounting holes vary from cabinet to cabinet. The holes for the switches and jack are ¼-inch diameter, and all other component holes are made with a #58, #59, or #60 drill.

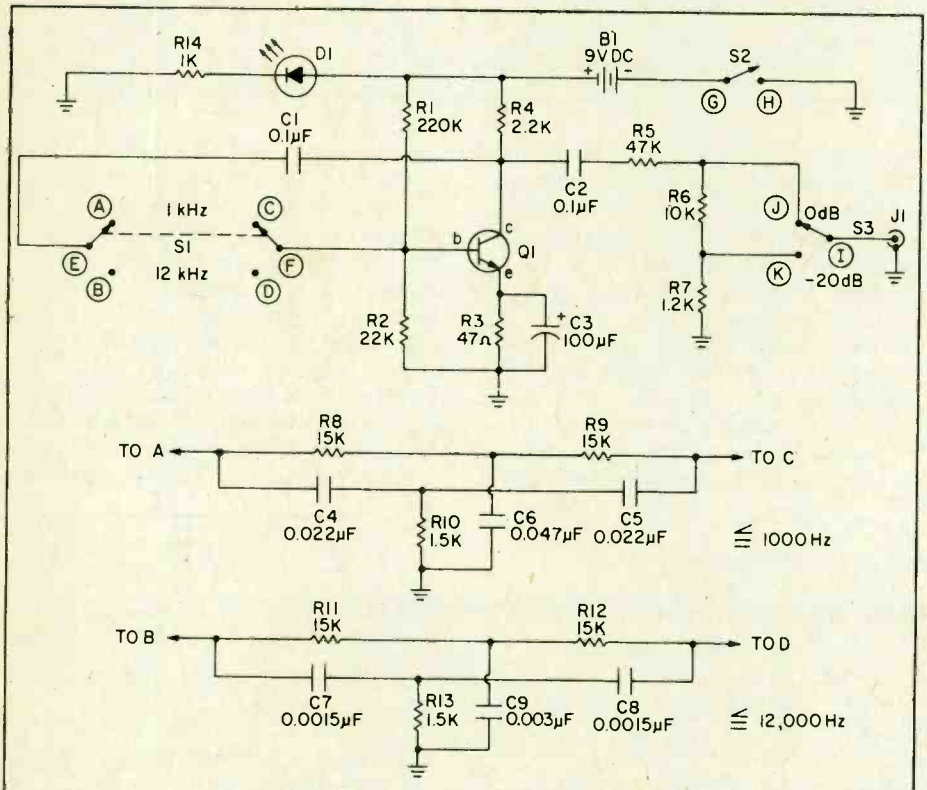
All oscillator values have been selected so the project will work with low-cost, normal tolerance components. There is no need to go through the extra expense of purchasing precision resistors and capacitors. However, take extra care that you do not change any specified value. For example, do not change R1 to 270K, or R13 to 1200-ohms.

If you cannot obtain the specified values, make them. For example, the 0.003-μF capacitor used for C9 can be a 0.002-μF and a 0.001-μF connected in parallel by simply twisting their leads together. Similarly, C7 and C8 can be a 0.001-μF in parallel with a 0.0005-μF (500 pF). The 0.022-μF capacitor is a standard value available just about anywhere. Similarly, all resistor values are "standard" in the sense that they are generally available types.

Since the switches are installed from the foil side of the board, take care that the connecting wires don't extend up *through* the board where they can act as a hazard to fingers working the switches. The photograph shows how to handle the switches and jack installations. Note that there is a small loop in the wire from the switch contact to the board. First, solder the wire to the switch contact (or jack). Before soldering to the board, trim the wire flush with the top (non foil side) of the PC board. Next, using long nose pliers or tweezers, back the wire very slightly towards the switch so the end is just below the top of the PC board—but still within the hole—then solder the wire to the foil. If done correctly, there will be no sharp edges sticking up through the PC board.

Check the LED polarity before you install it on the PC board, because some of the instructions supplied with "hobby grade" LEDS are incorrect. Temporarily tack-solder a 1000-ohm resistor to either LED wire. Clip one LED wire to either battery terminal. Touch the free end of the resistor to the other battery terminal. If the LED doesn't light, reverse the wires to the battery. When the LED lights, the LED wire attached to the resistor is the same polarity as the battery terminal to which the resistor connects. (If the resistor connects to the positive battery terminal, the LED wire on the opposite end of the resistor is the ANODE.) If the resistor is connected to the negative battery terminal, the LED wire on the opposite end is the CATHODE. If the LED doesn't light with either polarity, it is defective (not unusual in LED hobby assortments.)

Using the Tape Tester. The output of the calibrator at 0 dB is nominally 0.5-volts, and should be connected to a recorder's LINE/AUX input, not to the microphone input. Because of normal component tolerance, the oscillator might not "start" when power is first applied if the frequency switch is set for 12kHz. If this occurs with your model, rather than trying to "trim" resistor and capacitor values in the Twin-T feedband networks—R8 through R13 and C4 through C9—simply set frequency selector S1 to 1000 Hz before applying power. The oscillator will always "start" at the lower frequency. If the oscillator does not start at all, either you have made a wiring error, or



PARTS LIST FOR THE TAPE TESTER

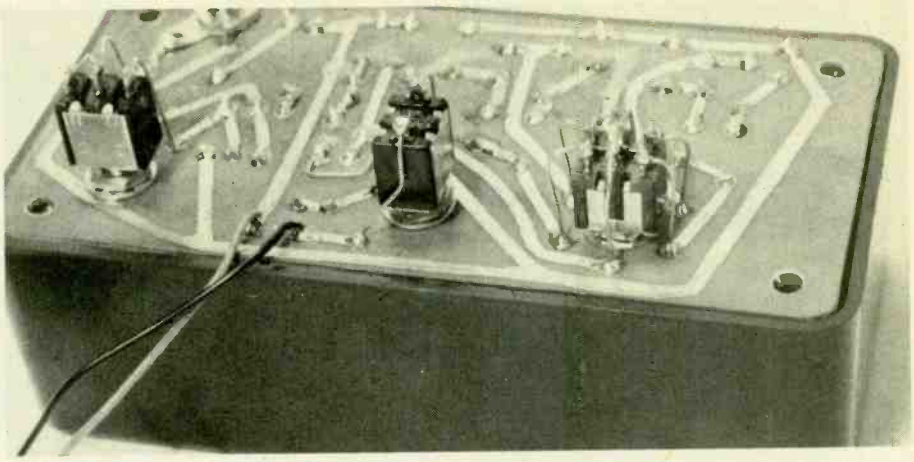
B1—9-volt transistor battery
C1, C2—0.1-uF, 10 VDC mylar capacitor
C3—100-uF, 25 VDC electrolytic capacitor
C4, C5—0.022-uF, 10 VDC ceramic or mylar capacitor
C6—0.047-uF, 10 VDC mylar capacitor
C7, C8—0.0015-uF, 10 VDC ceramic or mylar capacitor
C9—0.003-uF, 10 VDC mylar capacitor
D1—any type of LED (light-emitting diode)
J1—RCA-type phono jack
Q1—PN2484 NPN transistor (or equiv.)
R1—220,000-ohm ¼-watt resistor, 10%
R2—22,000-ohm, ¼-watt resistor, 10%
R3—47-ohm, ¼-watt resistor, 10%
R4—2,200-ohm, ¼-watt resistor, 10%
R5—47,000-ohm, ¼-watt resistor, 10%
R6—10,000-ohm, ¼-watt resistor, 10%
R7—1,200-ohm, ¼-watt resistor, 10%
R8, R9, R11, R12—15,000-ohm, ¼-watt resistor, 10%
R10, R13—1,500-ohm, ¼-watt resistor, 10%
R14—1,000-ohm, ¼-watt resistor, 10%
S1—DPDT miniature toggle switch
S2—SPST miniature toggle switch
S3—SPDT miniature toggle switch
Misc.—battery clip, cabinet, PC board material, wire, solder, etc.

the capacitors in each Twin-T network are not approximately equal to the specified values. Generally, the C4/C5 and C7/C8 combinations don't have to be the precise specified value, but each capacitor in a pair must be close in value to the other.

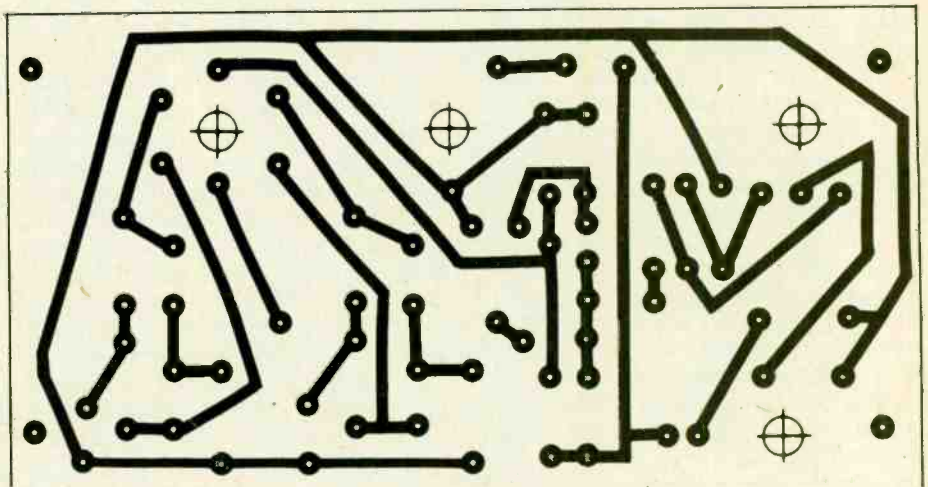
Set S3 for 0 dB output, S1 for 1000 Hz, and turn power switch S2 on. Adjust the record level for a 0 dB record level, or whatever is the maximum meter-indicated level for your recorder. Set switch S3 for a −20 dB output; you will see the recorder's meter drop 18 to 20 dB. (The exact amount depends on the components used in your project. It doesn't matter what the drop is, as long as it's near 20 dB.)

Start the recorder in the record mode and record a few seconds of 1000 Hz, followed by a few seconds of 12,000 Hz. On playback, the output of the two frequencies should be within 3 dB. Adjust the recorder's bias, or select a tape type that delivers this performance. Because of the 20 dB input attenuation, you will probably need an external level indicator because the usual −20 dB indication on a recorder's meter is not all that easy to "read" for precise value on playback. Use any external indicator, such as the meters on another recorder (feed the output of the recorder being tested to the input of a second recorder), the meters of a power amplifier, or an AC/audio meter. You can even use an oscilloscope if you have one.

To check for metal tape saturation at maximum recording level, set S3 for 0 dB and record at 0 dB record level, or whatever value is maximum for your recorder. ■

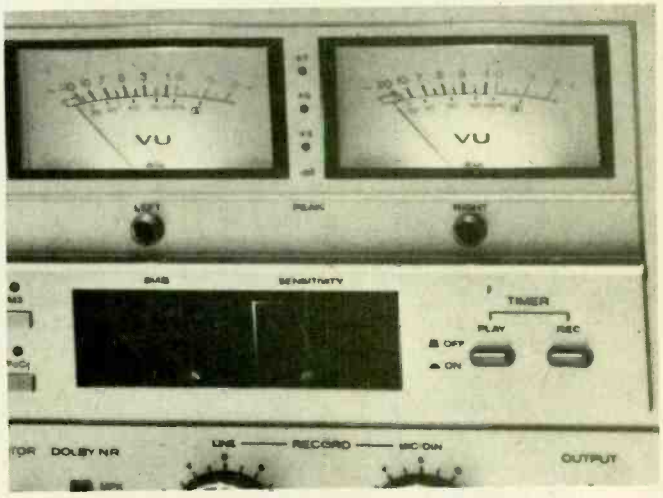


Here's the underside of the completed board with all three switches and J1 installed. The two wires leading away run to the 9-volt transistor battery which will fit in the cabinet.



This is the full scale etching guide for the Tape Tester's PC board. Note that the holes marked for the switches and J1 are not full-size. You will need a 1/4-inch drill bit.

There are so many types of tapes on the market today, that a device such as our Tape Tester is a virtual necessity for determining the correct type of tape to use with your machine. For instance, although both of the tapes at bottom have the same bias, AD type at left may exhibit different high-end characteristics than D type at right. Only the Tape Tester can tell you for sure which one will be right for your machine and your ears' tastes.



You'll have to depend upon the accuracy of your tape deck's meters for working with Tape Tester. If your meters aren't sensitive enough to record the 20 dB drop in calibration levels, feed monitor output of your deck into a good deck and use it's meters to complete the calibration procedure. You can do this because you only have to see a "relative" drop on the record level, and not necessarily a "calibrated" drop, in order to use the device.

A Basic Guide to Using Tune-Up Instruments

Learn how to use the basic tools of the automotive tune up

BY ANTHONY CARISTI

WHEN ONE HEARS THE WORDS "engine tune-up," they usually bring to mind an automotive service which can result in a bill approaching $100.00 or more. As a result, many of us are content to forget about this facet of automobile maintenance until we are forced to do something because the engine runs very poorly or not at all. The irony of this situation is that while the engine is in such bad condition, it's costing you money in excessive gasoline consumption. Automobile tune-ups are not complicated, and the investment in parts is so small that there really is no reason why anyone, especially anyone who has a serious interest in electronics, should drive a car that is badly in need of a tune-up. The purpose of this article is to discuss the elements which comprise an engine tune-up, and to discuss some of the various electronic instruments which are being used by both professional and amateur car mechanics alike.

If possible, you should refer to the automobile manufacturer's specifications and tune-up procedures as a supplement to the information provided by this article. At the very least, refer to the tune-up information which is contained on a decal and prominently displayed in the engine compartment of your car. This will give the proper specifications for ignition timing, spark plug gap, and idle speed adjustments.

Tachometer. The basic automobile tune-up instrument is a combination tachometer and dwell meter, which is commonly referred to as a "dwell/tach." This instrument is capable of measuring engine RPM, and in those cars which are not equipped with factory installed electronic ignition, point dwell. (More about dwell later). The more elaborate instruments also include additional functions, such as voltage measurements, resistance measurements, and current measurements. For a small additional cost, some instrument manufacturers have included an alternator test function which determines the condition of the alternator diodes by measuring the level of AC ripple voltage appearing on the alternator output terminal.

The tachometer section of the dwell tach measures engine RPM by responding to the pulses which appear at the distributor side of the ignition coil (negative terminal). This is the point where the sensing lead of the instrument is connected. Referring to Fig. 1, a typical schematic diagram of a conventional (non-electronic) automotive ignition system, note that each time the points open, the collapsing magnetic field of

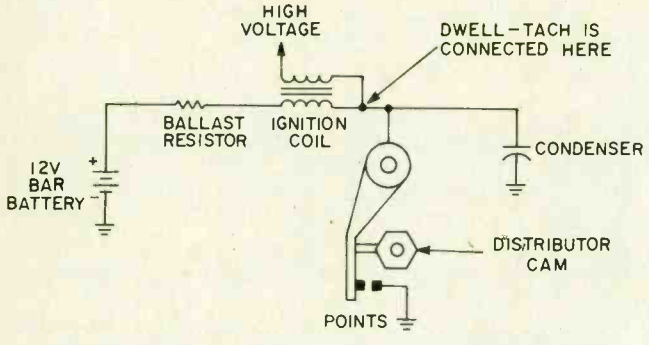


Fig. 1. A simplified schematic of an automotive ignition system using mechanical points (not electronic or "breakerless.")

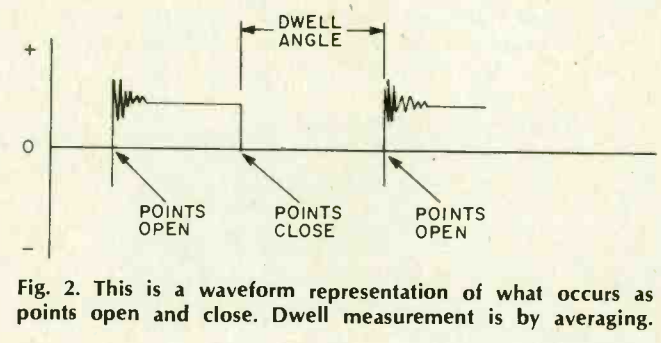


Fig. 2. This is a waveform representation of what occurs as points open and close. Dwell measurement is by averaging.

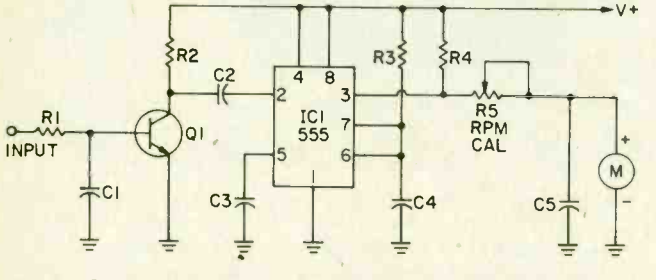


Fig. 3. This is a schematic of a simplified tachometer. It operates by counting pulses which appear at distributor side of coil.

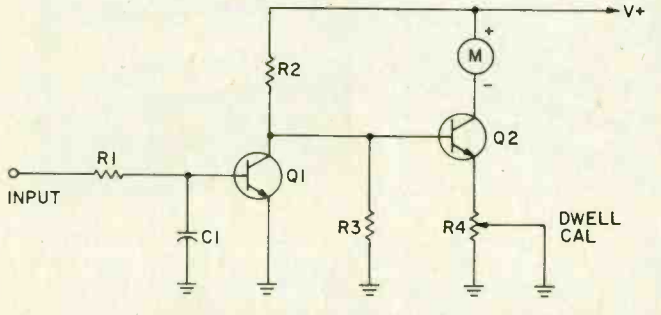


Fig. 4. This simplified dwell meter operates by reading voltage which is inversely proportional to that seen across the points.

the coil produces 20,000-volts or more at the secondary of the coil, and 100-volts or more at the primary. Fig. 2 illustrates the waveform appearing at the primary of the ignition coil, which is the voltage across the points. Since engine RPM is directly related to the number of pulses-per-second at the ignition coil, it can be seen that a simple frequency-to-voltage converter circuit can be used to measure engine RPM.

Fig. 3 is a typical schematic diagram of a tachometer circuit. Each time a pulse appears at the input to the circuit, Q1 conducts current and feeds a negative pulse to the trigger input of a one shot multivibrator, U1. The pulse duration of U1, about 4000 microseconds, is fixed. A resistor capacitor network, R5/C5, acts as a low pass filter to smooth the voltage pulses fed to the meter. The meter responds to the average of the voltage generated by U1, and is calibrated in RPM. Since the number of pulses-per-minute generated by 4, 6, and 8 cylinder engines is not the same, the meter circuit must incorporate a scale factor which automatically provides the correct RPM reading. This is the cylinder select switch which appears on tach's front panel.

Electronic ignition systems provide a special test point which produces pulses for use with standard automotive tachometers. Refer to the service manual for your car, or ask your dealer for the location of the tachometer connection.

Dwell Meter. Point dwell is a measurement of the number of degrees that the ignition points in non-electronic systems remain closed during the rotation of the rotor in the distributor. This measurement is directly related to the point gap, and is a more accurate method or of properly tuning an engine. This measurement is made at the same test point in the system as used for the tachometer connection. Factory installed electronic ignition systems have no points, and therefore no need for dwell measurement.

The number of degrees of point dwell depends on the number of cylinders in the engine. One full rotation of the distributor rotor is 360 degrees, and this is divided up in equal amounts for each cylinder. Thus, an eight cylinder engine can have a maximum point dwell of 45 degrees. 6 and 4 cylinder engines have maximum point dwell angles of 60 and 90 degrees respectively. Proper point dwell angle for these engines is usually slightly more than half the maximum. Typical dwell angles for 8, 6 and 4 cylinder engines would be 28, 36 and 56 degrees respectively.

The dwell meter measures dwell angle by producing a meter reading which is inversely proportional to the average voltage across the points. One such circuit that does this is shown in Fig. 4. The voltage appearing at the points is fed to the base of Q1, so that it is cut off when the points are closed, and saturated when the points are open. The collector of Q1 controls the base of Q2 which is connected as a constant current generator. Meter current is adjusted to full scale value (45, 60 or 90 degrees) by R4 when the sensing lead at the base of Q1 is shorted to ground, simulating closed points. As the points

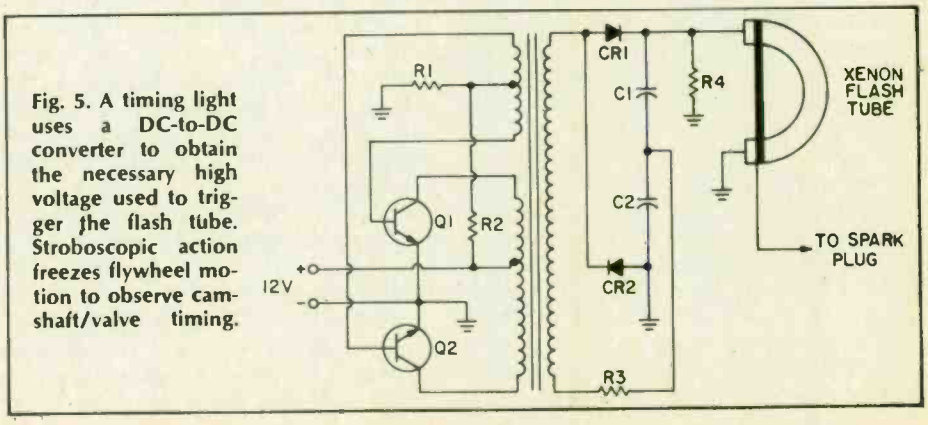


Fig. 5. A timing light uses a DC-to-DC converter to obtain the necessary high voltage used to trigger the flash tube. Stroboscopic action freezes flywheel motion to observe camshaft/valve timing.

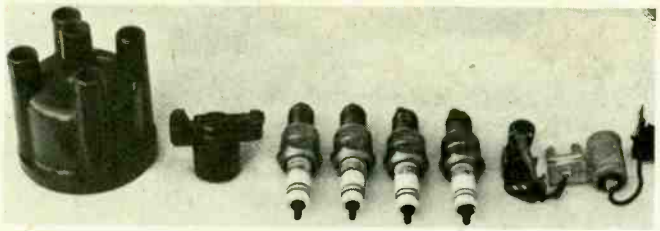
open and close at a rapid rate when the engine is in operation, the meter reading becomes the average of the two conditions and is the actual dwell angle of the points.

Timing Light. One final electronic instrument which is required for engine tune-up is the timing light. Quality timing lights are referred to as "power" timing lights, which means that the energy which fires the xenon flash tube is derived from a built-in power supply. Most units in use today use the car's 12-volt battery as the source of power. Refer to Fig. 5 which is a typical timing light schematic diagram. A DC to DC converter circuit charges two capacitors in a voltage doubler circuit to the high voltage (250 to 450-volts) necessary to fire the flash tube. The spark voltage generated by the car's ignition system provides the trigger which causes the flash tube to conduct, producing a burst of light perhaps 1/1000 second in duration. The car manufacturer has provided a timing mark on the flywheel of the engine, and a timing scale next to the flywheel. When spark plug number one fires, the stroboscopic action of the timing light enables the mechanic to visually determine if the flywheel is in the proper position. This shows engine timing.

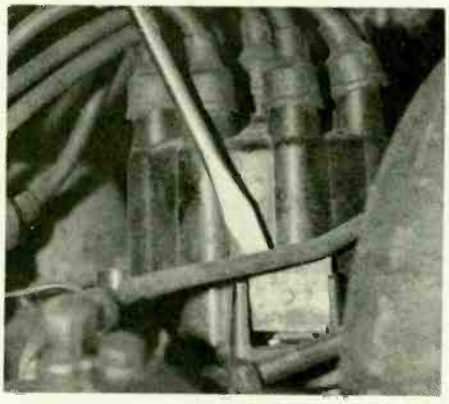
The best timing lights on the market provide inductive coupling to the spark plug wire so that it is not necessary to insert an adapter in series with the distributor wire and number one spark plug. Spark plug wires must never be pierced to make a timing check. To do so will render the wire defective.

The Engine Tune-Up. In addition to making the electrical measurements described above when tuning up an engine, there are certain mechanical procedures which must be performed to do a complete job. These procedures should be performed before making any electrical measurements or adjustments on the engine. It is not the purpose of this article to deal in depth with the mechanical procedures, and they will simply be mentioned briefly.

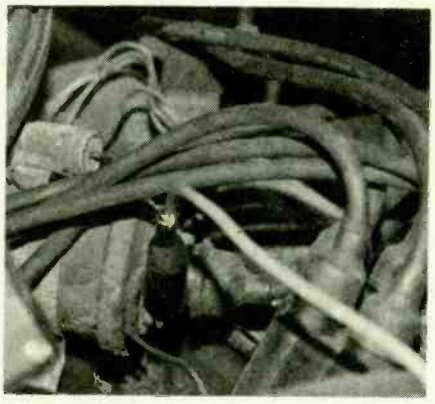
A complete and proper engine tune-up will include replacing spark plugs, ignition points, and condenser (if so equipped). In addition to these items, the distributor cap, rotor, fuel filter, and PCV valve should be either replaced or examined to make certain that they are still in serviceable condition. The air filter and crankcase ventilation filter should also be cleaned or replaced as necessary. The last item on this list are the carburetor and choke linkages, which should be cleaned with a carburetor spray product made for the purpose. Once these procedures have been completed, you are ready to perform the instrument checkout.



This is a typical ignition tune-up kit for a 4-cylinder car. From left to right: distributor cap, rotor, spark plugs, points, and condenser.



Almost all pre-1975 Delco (GM) distributors have a window through which point gap (dwell) can be adjusted while engine is running. This saves the time needed to remove cap and rotor to reset gap.



The input lead to the Dwell/Tachometer is connected to the distributor side of the coil. You can find this terminal by tracing back the wire from the condenser to the coil. Clip on the lead at the coil terminal.

The electrical checkout of the engine is made with the engine running and warm. On those cars which use ignition points, it will be necessary to set the point gap to the proper spacing so that the engine can be started. The only exception to this is on General Motors cars which use external adjustment Delco Remy distributors. Replacement points in these distributors usually are preset to such a gap that will permit the engine to be started without any prior adjustment.

A word of caution before making the instrument checkout of the engine: At no time should you permit your hands to come in contact with the metal portion of the test instrument's clip lead as you are connecting or removing it from the engine, if the engine is running. The test point may have sufficient high voltage to cause electrical shock. This may result in personal injury as you jerk your hand away. If in doubt, make your connections with the engine shut off.

Dwell Angle. The first measurement and adjustment to be made is dwell angle, which is necessary on all cars that have conventional (non-electronic) ignition systems. Attach the meter leads to the distributor side of the ignition coil and chassis, observing correct polarity. On negative ground automobile electrical systems (as in all American made cars), the positive lead of the meter is connected to the ignition coil. Follow the meter manufacturer's instructions for dwell measurement, and refer to the decal in the car engine compartment for the permissible range of dwell. If your measurement falls out of this range, the point gap will have to be decreased (for readings too low) or increased (for readings too high). On most General Motors cars, this is a simple adjustment which can be made with an Allen wrench while the engine is running. On other cars you will have to stop the engine, remove the distributor cap, and reset the point gap making it greater or smaller as necessary. Recheck dwell angle with the instrument after readjustment of the point gap.

Timing. After the proper dwell angle has been attained, the ignition timing can be checked and set if necessary. Ignition timing should always be checked after changing ignition points or point gap since any change in dwell angle will cause a corresponding change in timing. Improper timing will affect gas mileage, engine power, and exhaust emissions levels.

Before starting the engine, you can facilitate the timing measurement by cleaning the engine flywheel and locating the timing mark, which is usually a

narrow groove impressed in the flywheel. If possible, apply a small quantity of white paint or chalk to this groove to make it more visible. You must also locate the vacuum advance mechanism which is located at the bottom of the distributor housing, and remove the vacuum advance hose which is connected to the mechanism. Plug the open end of the hose with a pencil. This procedure is necessary if the timing of an engine is to be made with the automatic vacuum advance disabled. Check to see whether or not your car requires this procedure.

Connect the timing light to the number one spark plug according to the directions provided by the timing light manufacturer. Connect the timing light power leads to the car battery, observing correct polarity. Check to make sure that no wires will be caught by the fan or other moving parts. Start the engine and measure the timing. Refer to the tune-up decal in the engine compartment, which should have an illustration of the timing scale for your particular engine. If the timing is out of spec, adjustment is made by loosening a clamp at the bottom of the distributor housing and rotating the unit to the correct spot. Tighten the clamp, and recheck the timing to make sure it did not change. Stop the engine and replace the vacuum hose if it was removed earlier.

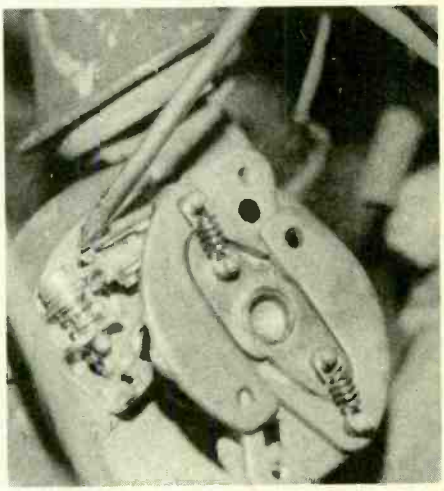
Carburetor Adjustments. All carburetors have some form of adjustment which controls engine idle speed. Single barrel carburetors have one adjustment for idle fuel mixture, and two and four barrel carburetors have two fuel mixture adjustment screws. These adjustments are performed with the aid of the tachometer, since engine RPM will vary as these adjustments are made. Since the order in which these adjustments are performed is important, the best practice would be to follow the vehicle manufacturer's sequence. Some tune-up decals in late model cars contain the proper adjustment sequence. The following procedure should prove satisfactory for most cars. Note: Some cars equipped with extensive emission control equipment have plastic caps covering the idle mixture screws, which limit the adjustment range of these screws. Under no circumstances should these caps be removed to set the mixture screws beyond the normal adjustment range. To do so may upset the engine exhaust emissions and/or affect driveability of the car.

Allow the engine to reach normal operating temperature before adjusting the carburetor. Connect the tachometer to the ignition system according to the manufacturer's instructions so that the meter reads engine RPM. Follow the information provided on the tune-up decal as to whether the transmission should be in neutral or drive, and if the air conditioning or lights should be turned on. (Be sure to set the parking brake securely before placing the transmission in Drive!)

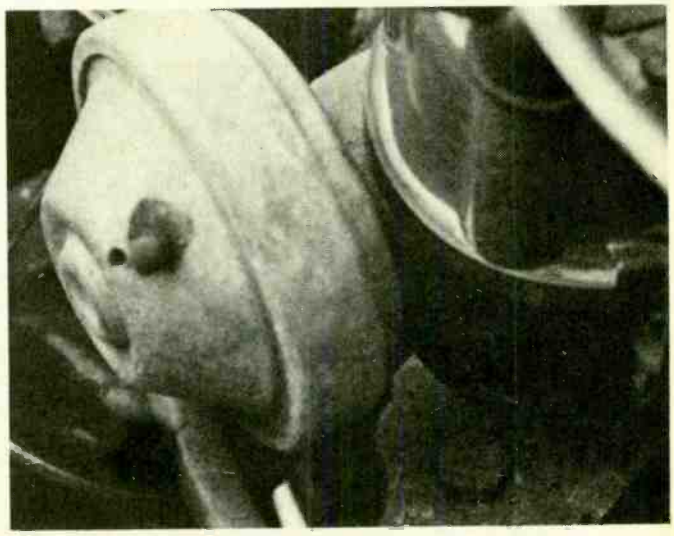
Adjust the idle mixture screw or screws for maximum engine RPM. Do this very carefully since only a small adjustment is usually necessary. Now adjust the engine idle speed adjustment to the engine RPM as specified on the tune-up decal. Very carefully turn the idle mixture screws clockwise to attain a 20 RPM drop in engine idle speed. Reset the idle speed adjustment for the recommended engine RPM.

The method just described is known as the "lean roll" method of setting the idle mixture. With this method, the vehicle exhaust emissions should be within specifications, and it avoids the necessity to use an exhaust gas analyzer for adjustment of the idle mixture.

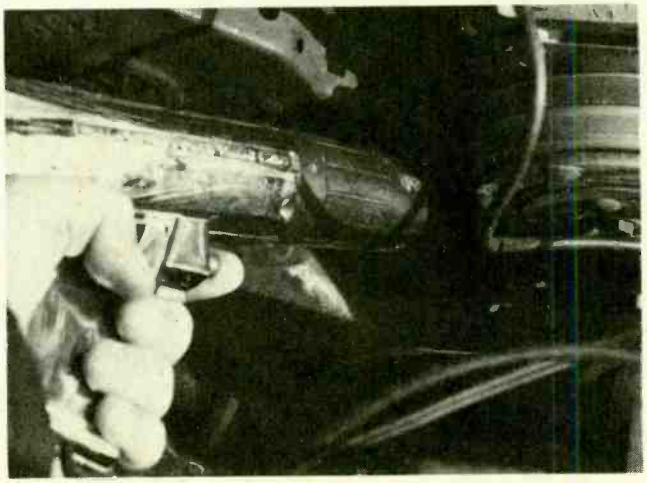
If you have performed the various engine adjustments as specified, you should have an automobile that performs as well as it was designed. Keep a record of the date and speedometer mileage, so that you will be ready to perform the next tune-up when due. ■



With cap and rotor removed on this Delco distributor, the point gap adjusting screw can be seen. Lift the window in the distributor cap and you can turn this screw to perform point gap (dwell) adjustment.



Release the distributor clamp bolt at the base of the distributor to adjust timing. Some engines need to have their timing adjusted with the vacuum advance (round object mounted on the side of the distributor) connected, and some need it disconnected. Check in your owner's manual or with your dealer.



Use of the timing light allows you to freeze the action of the flywheel and read the timing adjustment. A decal under the hood will list number of degrees (either in BTDC or ATDC) to which pointer on the flywheel must point to on scale next to the flywheel. Timing is adjusted by rotating the distributor body.

DWELL/TACHOMETER

Build a tool which can save you real money on tune-ups

BY ANTHONY CARISTI

OUTSIDE OF A GOOD SET of wrenches, the most commonly called for automotive tool is the dwell/tachometer. When tuning up an engine, there's no substitute for the kind of accuracy a dwell/tach can bring to your engine adjustments. A commercial version of this apparatus might run as high as $25.00. With some judicious parts buying, you should be able to do the job for roughly half of that figure. In addition, our dwell/tachometer gives you an additional feature not found on any but the most expensive commercial units: a DC voltmeter, which is highly useful in checking a car's electrical system and, in particular, the ignition.

Most of the parts used in the construction of this instrument will probably be found in the electronics hobbyist junk box. The meter is a common 1 mA DC movement. If desired, other meter movements may be used by simply changing circuit values to accommodate a more or less sensitive meter.

The Circuit. In order to best understand the operation of the dwell/tachometer circuit, it is necessary for the reader to be familiar with the voltage waveform appearing at the primary terminal of the ignition coil. This is shown in Fig. 1. The basic voltage waveform is a rectangular pulse with a considerable amount of ringing on the rising edge of the pulse. This ringing is caused by the sudden cut-off of current in the ignition coil, and results in the high voltage generation which fires the spark plugs. The duty cycle of the rectangular pulse is determined by the dwell angle of the ignition points (or solid state circuit in electronic systems), and must fall within specified limits for proper engine performance.

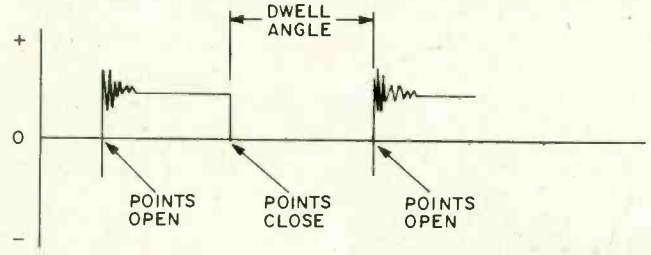


Fig. 1. A waveform diagram of the voltage across the ignition points illustrates exactly what happens during operation, and what it is that you're measuring when you use the instrument.

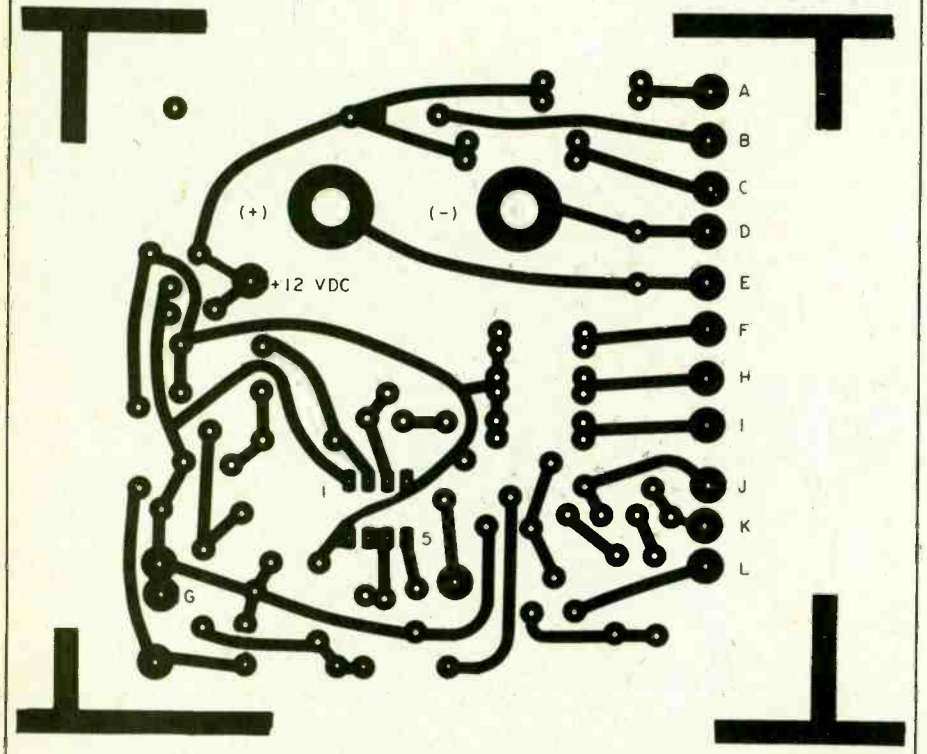


Fig. 2. This is the full-scale etching guide for the Dwell/Tachometer's printed circuit. Do not etch the board until you know the center-to-center distance of the studs.

The dwell meter section of the instrument is composed of Q2, Q3, and associated components, Q3 is connected as a constant current generator with eight-volts impressed upon the base and the meter placed in the collector circuit by the FUNCTION switch. The value of resistance placed in the emitter of Q3 determines the collector current of the transistor, and is adjusted so that the meter reads the full dwell angle (45 or 60 degress) when the sensing lead of the instrument is shorted to ground. Q2 acts as a switch which controls the base of Q3, and causes Q3 to either be on or off, depending upon the state of the ignition points. When the points close, Q2 is cut off and Q3 passes its calibrated constant current through the meter. When the points open, Q2 is forward biased and saturated by the voltage appearing across the points. This cuts off Q3 and the meter current is zero. Since this action takes place much faster than the meter needle can follow, the meter reading is the average of the two conditions, and is the actual dwell angle measurement.

The tachometer section of the instrument makes use of the fact that the meter of spark plug firings per second is directly related to the RPM of the engine. Q1 is used as a buffer transistor between the ignition system and the trigger input of a 555 timer IC which is connected as a one-shot multivibrator. Each time the ignition circuit produces a positive-gain pulse, U2 generates an 8-volt pulse of 2500 to 5000-microseconds duration, depending upon the number of cylinders of the engine under test. The output

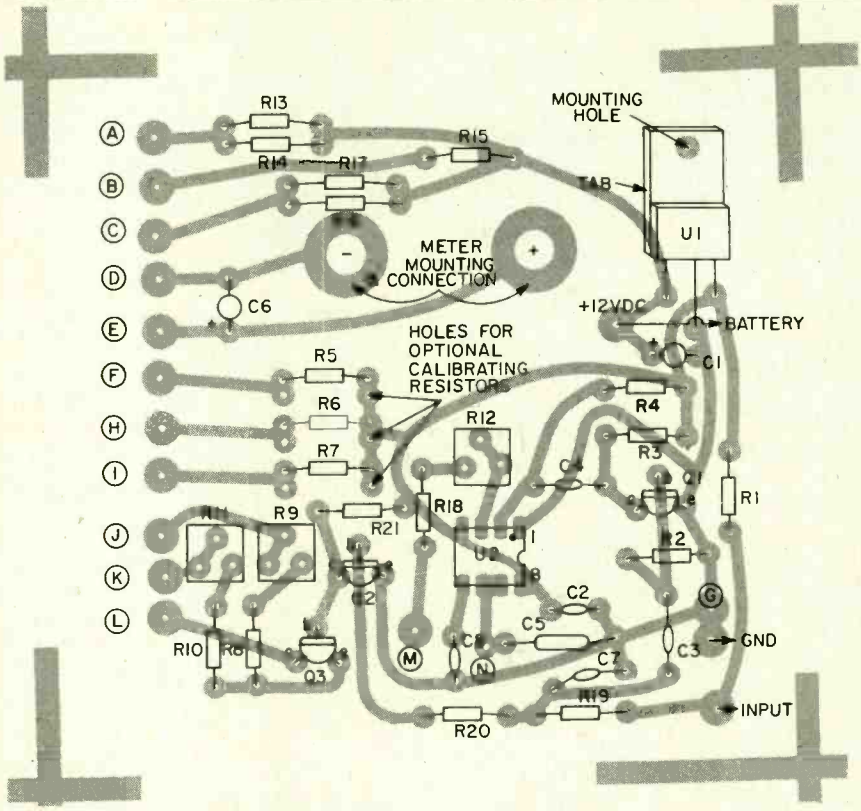


Fig. 3. The component layout diagram will guide you in assembly of board. Take care not to cover holes for calibrating resistors near R5, R6 and R7.

Compare this photo with the component layout guide at left for reference during assembly. In author's prototype, some calibrating resistors have been added. Don't be discouraged if your model needs them.

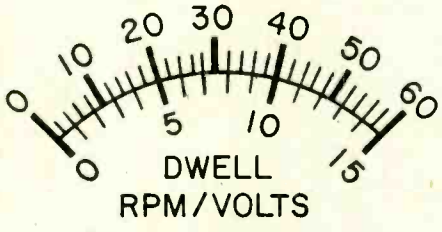
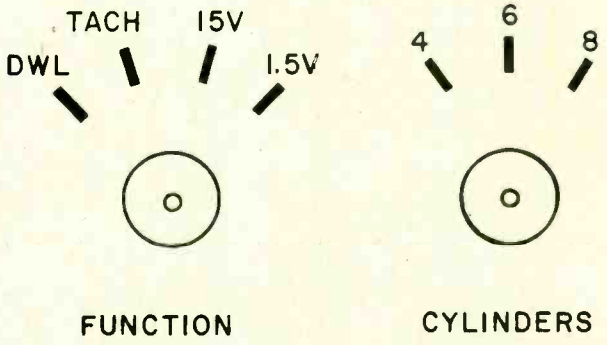


Fig. 4. This is a full-scale template for use on the meter face. It is designed to be used with the GC Electronics movement described in the parts list, but will likely fit other meter faces just as well.

Fig. 5. This template, also full-scale, can be used on the cabinet front to illustrate the switch positions. If your configuration differs from ours, a good method of illustrating the front panel is to use dry-transfer lettering stencils.



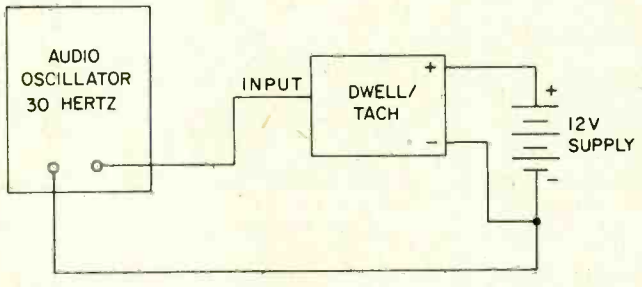


Fig. 6. This is the wiring setup utilized for final calibration. A well-regulated 12-volt power supply is a necessity here. Alternatively, you can use the car's battery if it is fully charged.

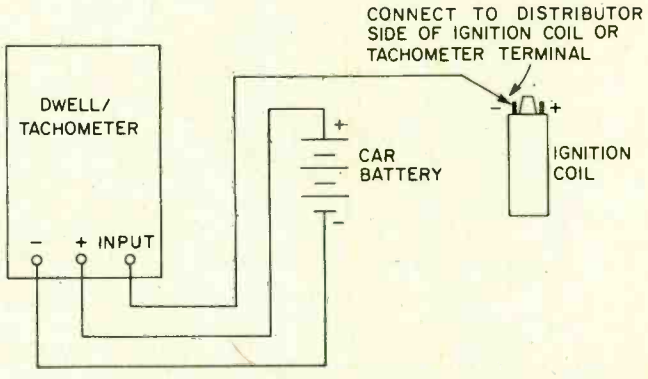


Fig. 7. This is a schematic representation of the manner in which Dwell/Tachometer is connected to car's ignition system. No other connections needed to use all of meter's functions.

e/e DWELL/TACHOMETER

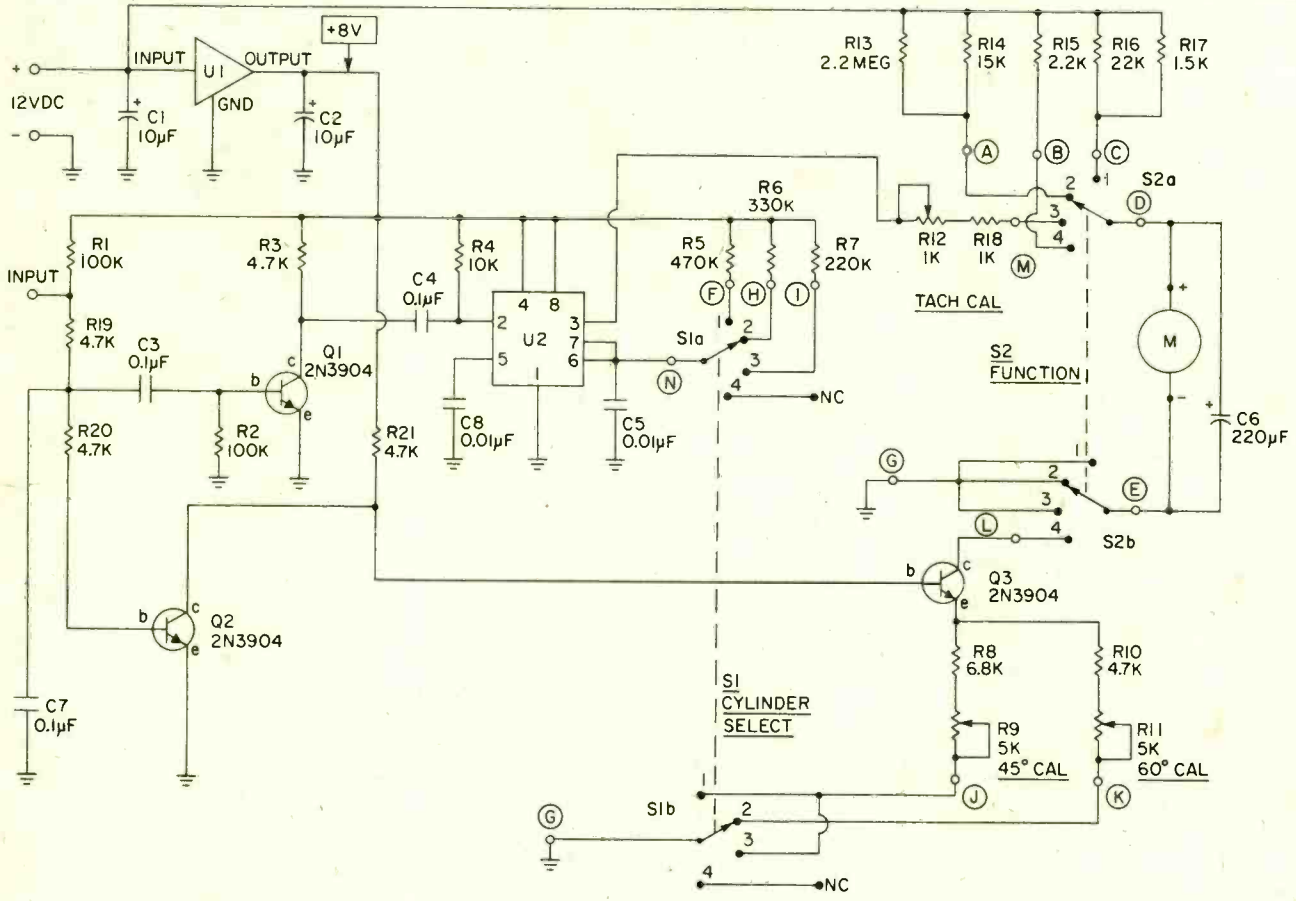
Here the Dwell/Tach's voltmeter function is being utilized to test a battery. If you look closely, you'll see that the meter is reading a nominal 12-volts.

of U2 is fed to the meter through a calibrating potentiometer. C6 acts as a filter to smooth out the pulses to nearly pure DC, and provides a steady meter reading which is engine RPM.

The voltmeter section of the unit consists of R13, R14, R16 and R17. These components are used as multiplier resistors so that full scale meter current is generated when either 15 or 1.5-volts is fed to the power leads of the instrument. The function switch of the unit connects the proper resistors into the circuit as necessary for a full scale voltmeter reading of either 15 or 1.5-volts.

U1 is a fixed, 8-volt regulator IC which provides the power to operate the dwell and tachometer sections of the unit. Since the circuit derives its power from the battery and alternator of the automobile under test, the 8-volt regulator ensures that the calibrated accuracy of the instrument is retained

(Continued on page 84)



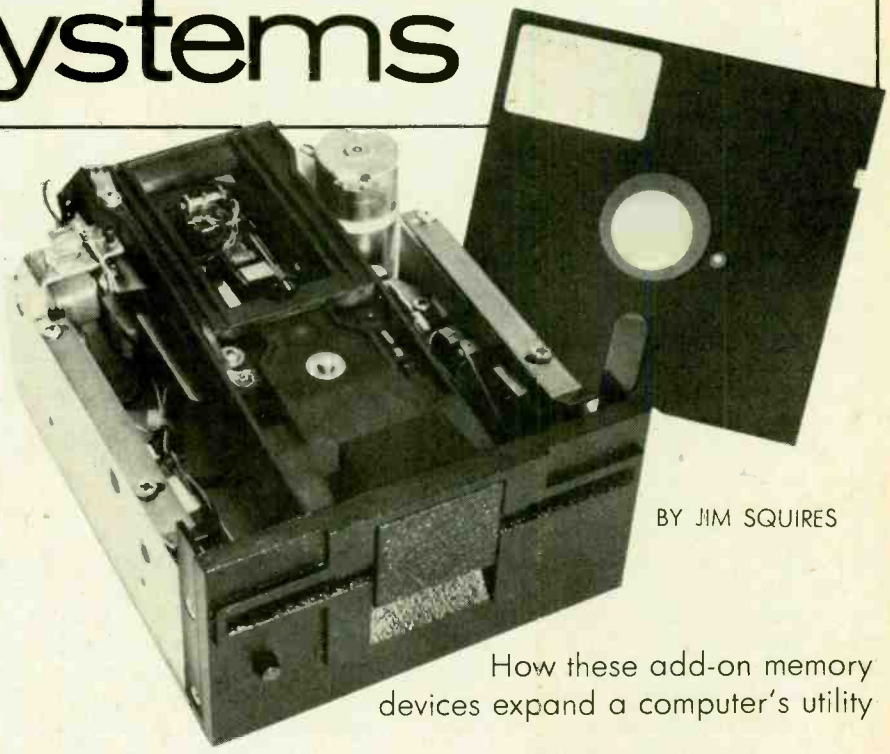
PARTS LIST FOR DWELL/TACH

C1, C2—10-uF, 25-VDC electrolytic capacitor
C3, C4, C7—0.1-uF, 25-VDC ceramic capacitor
C5—0.01-uF, 25-VDC tubular capacitor
C6—220-uF, 6-VDC tantalum capacitor
C8—0.01-uF, 50-VDC disc capacitor
Q1, Q2, Q3—2N3904 NPN silicon transistor (or equivalent)
R1, R2—100K, ¼-watt resistor, 10% (all resistors 10% tolerance unless otherwise noted.)
R3, R10, R19, R20—4.7K, ¼-watt resistor
R4—10,000-ohm, ¼watt resistor
R5—470,000-ohm, ¼-watt resistor
R6—330,000-ohm, ¼-watt resistor
R7—220,000-ohm, ¼-watt resistor
R8—6,800-ohm, ¼-watt resistor
R9, R11—5,000-ohm linear taper potentiometer (PC mount)
R12—1,000-ohm linear taper potentiometer (PC mount)
R13—2,200,000-ohm, ¼-watt resistor
R14—15,000-ohm, ¼-watt resistor
R15—2,200-ohm, ¼-watt resistor
R16—22,000-ohm, ¼-watt resistor
R17—1,500-ohm, ¼-watt resistor
R18—1,000-ohm, ¼-watt resistor
S1, S2—2-pole, 4-position rotary switch, GC Electronics #E2-166, or equivalent
U1—LM340T-8, 8-volt regulator integrated circuit
U2—555 timer integrated circuit

Misc.—0 to 1 mA DC ammeter movement, GC Electronics #D1-912, or equivalent, cabinet, solder, alligator clips, knobs, etc.

A pre-drilled and labeled printed circuit board, as well as a complete kit of parts for the Dwell/Tachometer, is available for $26.00 postpaid from: Niccum Electronics, Box 271B, Stroud, OK 74079. Please, no C.O.D.s or foreign orders. Allow 3-4 weeks for delivery.

All About Floppy Disk Systems



BY JIM SQUIRES

How these add-on memory devices expand a computer's utility

Sooner or later just about every computer hobbyist reaches their computer's memory limit. There are some applications that require too much I/O action to be practical with a cassette based system or require too much memory space to fit in a RAM. It's this need for high-volume storage and rapid access time that makes a hobbyist disk system desirable. These systems don't come close to commercial hard disk systems in terms of performance but they can easily fill the computer hobbyist's memory bill.

Floppies have become the missing link to a midrange of random access memory systems. The floppy offers higher performance at lower cost than cassette and similar types of Input/Output (I/O) devices.

Well Packaged. The present standard floppy is an 8-inch flexible disk of a plastic material coated with a magnetic oxide. Looking a little like a popular 45 RPM record, it is sealed inside a jacket and there are no grooves on the surface.

The disk cannot be removed from the jacket which is designed to protect the recording surface. The disk is visable at a slot, a spot, and a hole in the center of the jacket. Users are told by the instructions that we must not touch exposed areas of the disk or write on it with anything firmer than a Q tip. Finally the user is admonished to return the jacketed disk to its outer envelope after they have finished using it.

The natural skin oil of fingerprints can damage the quality of music in needle and groove recordings, and in the super-miniature world of floppies, a fingerprint can destroy an entire segment of data. A dust particle can waste a dozen sectors and a human hair can reduce the effectiveness of the *Read/Write/Erase* (*R/W/E*) heads. The chart illustrates these comparisons.

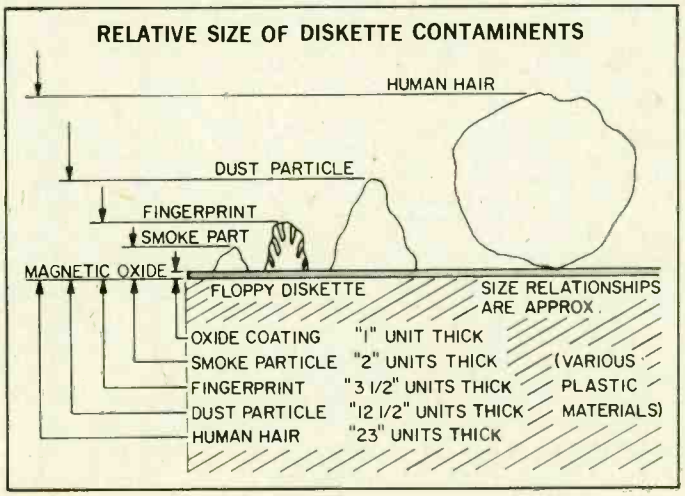
It is understandable why the media, as the flexible disk is sometimes called, is permanently sealed with all of those implicit instructions. There is, however, an internal jacket wiper that continually cleans the rotating disk and removes contaminents, and floppies are reasonably rugged.

Hardware. The disk-drive hardware is add-on equipment to the main frame of the computer. Inside the drive are motors, driving mechanisms, and interfacing electronics that enable the drive unit to "talk" with the controller.

The diskette is inserted into the drive unit through a small door in the front. Once the door is shut, it is locked by the drive unit logic until the door release button is pushed to disable the drive assembly. The drive spindle centers and grasps the center of the diskette firmly as the motor comes up to speed. During power-up the diskette reaches a speed of 360 RPM, and *R/W/E* heads are stepped out to track 00 and a mechanical index hole provides the first location pulse for disk timing. In the IBM format this is the only reference to a physical location on the disk.

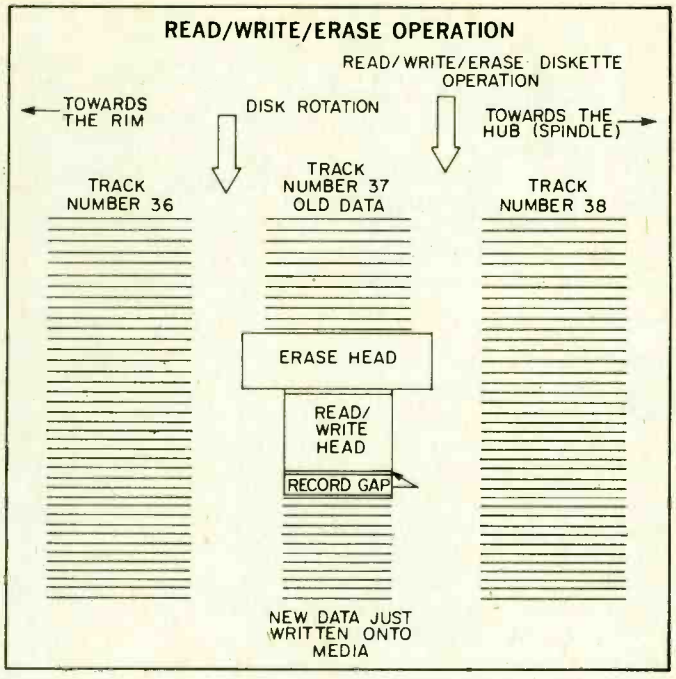
The floppy is firmly held against the recording surface, and the heads are positioned by a precise stepping motor. While the heads are positioned over the desired track, they ride above the spining diskette. Once the correct track

The metal oxide surface of a floppy disk is very sensitive to contamination. Each one of these contaminants (right) could cause a dropped bit. Since the disk is always kept in it's protective envelope, this is usually not too much of a problem in daily usage.



is located, in what is called a "seek operation," a head loading coil pulls the heads down onto the magnetic surface. This operation is called loading the heads and it is controlled by a computer program.

When the heads are to be moved again, in another seek operation, to a new track, they are first unloaded, stepped to a new track, and then reloaded to a new track. This requires about three milliseconds per track of movement. It will further require about 50 milliseconds, per track, to move the heads and about 15 milliseconds of settling time.



There is no physical track on the disk as with an LP record. The tracks are formed by the passage of the record (write) head over the surface of the disk. The disk itself appears to be a solid sheet of recording tape material.

Part of System. Floppies should always be thought of as a part of a sophisticated cluster of mechanical drives, computer electronics, and software called a computer. Fundamentally this computer consists of a central processor unit (CPU), some memory, some interfacing devices, called controllers here, and an entry device such as a keyboard CRT, and some software.

Computer operation is made possible by a written program entered into the computer's memory and operated on by the internal microprocessor. The programs are fed by any one of a number of techniques: a paper tape punch, keyboard, cassette tape, or teletype. All of these are slow and time consuming. New ways are continually being introduced to feed the voracious appetite of computer memories. Floppies are the most versatile of the program instruction loading techniques.

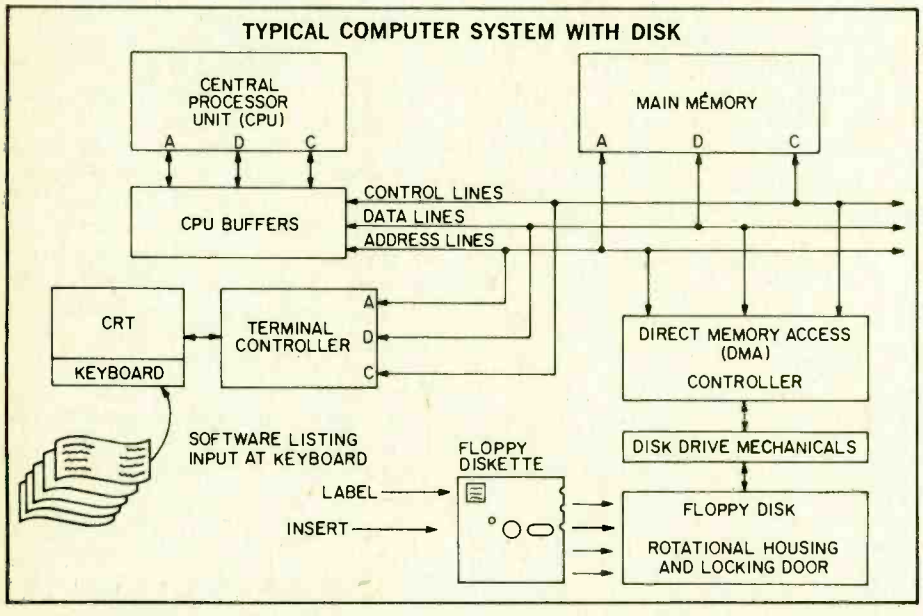
In a computer's time frame things go on a million times faster than in our brain's time frame. In such a whirlwind existence, telling computers what to do was a difficult problem. The answer was in the development of software which the computer could store in memory for reference each time it needed a new program instruction.

Software. The computer itself—the IC's, printed circuit boards, filter capacitors, chassis, and power supply—are all part of the hardware. All of this state-of-the-art electronics is just so much junk without a program, a way to make the computer compute. The instructions, written in computer languages, are called software.

We talk with the floppy (human to floppy) through a series of interpreters comprised of software and hardware. First we place our instructions, using perhaps, Fortran in a machine assembly language. Located within this language and acting as a general interpreter, is a section of software called a file manager. Its job is to take general instructions, count words to be put on the floppy, calculate the number of sectors, tracks, and floppies that will be needed to store your file. All we do is to tell the file manager how much and where; it will do the rest. It will even put the data on the floppy then check to see if it got there, and if not correct its own errors. The special language of the computer is based on the numbers zero and one.

These two values comprise one "bit" of information. At this level there are no grey areas, no informational maybes. Facts are either a zero or they are a one. In this language a word has only one length for the micro-computer. It is 16-bits long. That is 16-bits having two states or thirty two pieces of information. However most peripherial devices, such as the floppy controller, that hunk of electronics that interfaces (talks) between the floppy and the CPU, is designed to speak in half words. This half word is called a *Byte,* pronounced "bite." A byte has 8-bits so there are two bytes to a full 16-bit word computer.

The story doesn't stop there. A new



This block diagram of a typical computer system utilizing CRT readout and disk drive shows the parallel connections of the memory, drive controller and terminal controller.

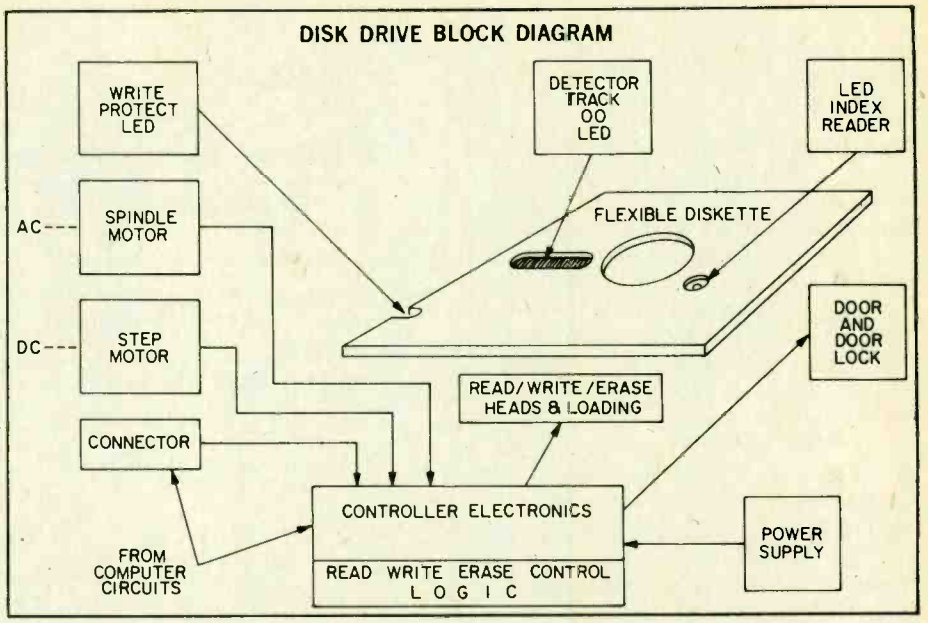
term is emerging in the industry as they learn to manipulate the byte. It is the half byte and is called a nibble.

Disk Mechanics. The R/W/E slot in the floppy jacket is two inches long by ½-inch wide. That little hole on the opposite side (8 inch diskette) is the mechanical index hole, which is a physical starting place (read by a LED sensor) for recording information on the oxide surface.

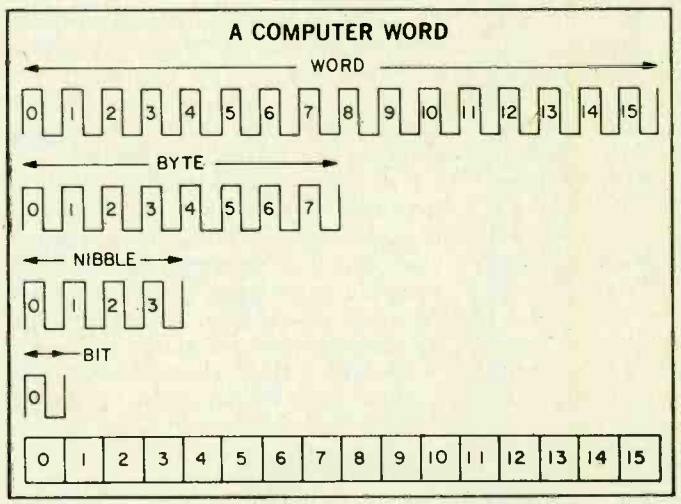
On a tape cassette you can break off a plastic tab thereby preventing further over recording on that cassette. An industry term for this is 'record protect.' Floppy disk jackets have this same feature, in a slightly different form. On some jackets there is a write protect slot cut in the paper of the jacket. When not needed the slot is covered over. This slot permits a photo-optical system to shut off the *write* electronics when the system detects a slot. In this way valuable programs already recorded are not destroyed by writing over the program. With some drive units there is a switch to override this system, with other drives we must tape over the write protect slot.

The erase head most widely used may be either a tunnel-erase or a straddle-erase head. The tunnel-erase head design minimizes the influence of noise from data in adjacent tracks. This more clearly defines the erase band and improves the signal to noise ratio. Present usage seems to favor the tunnel-erase head design.

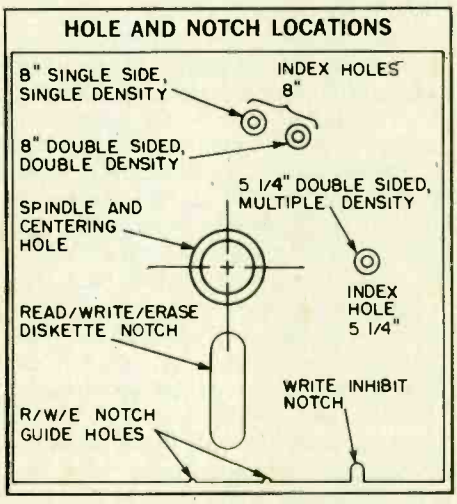
To place information on the diskette (to *Write*) and to retrieve information (to *Read*) a software plan called a *format* is employed to pre-organize diskette data fields. Where only a single reference is made to the mechanical index the resulting formatting is called



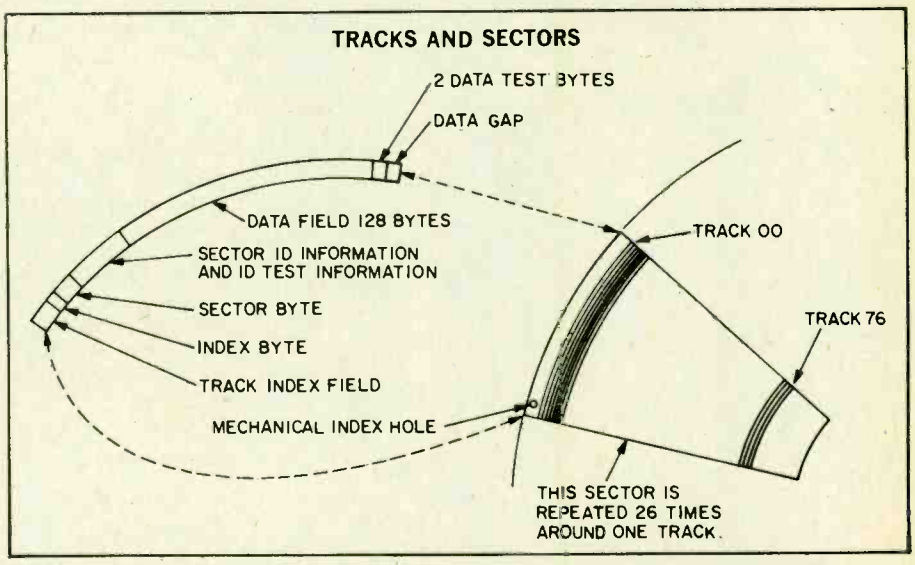
You can easily see from this diagram how the physical configuration of the disk is related to the various electronic systems needed to control information storage and retrieval.



Software is the artful manipulation of the WORDS, bytes, nibbles, and bits utilized in transferring something meaningful between humans and machines without resulting in the total disorientation of the two parties involved.



The disk's guide holes serve the same purpose as the arm on a record changer which positions the tonearm according to LP size.



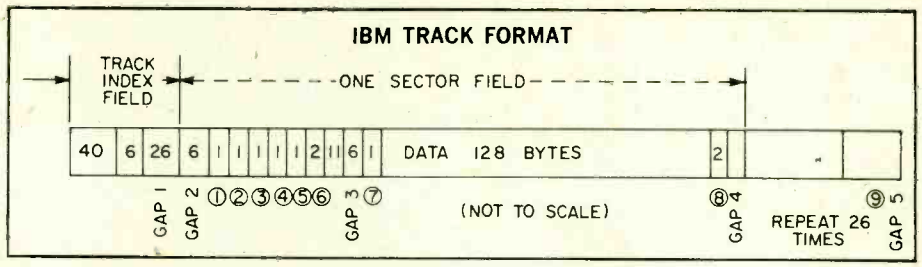
This diagram shows the relationship between track information and sector information as they are physically located upon the disk when utilizing the IBM-type disk formatting.

soft sectoring. Most of the information presented here is for a single density, soft-sectored, IBM formatted diskette. After receiving the pulse that represents the index hole, the rest of the floppy is formatted from the software, or computer program.

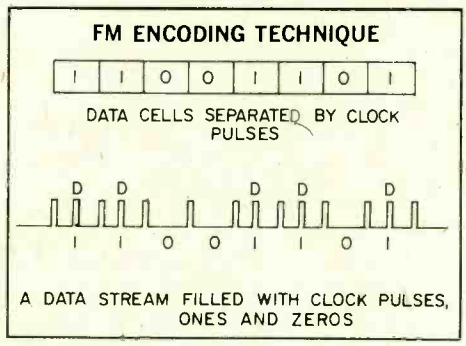
IBM Format. The IBM 3470 formatted diskette, one of the more popular industry standards, has 77 tracks, with 26 sectors, (data spaces) formatted per track. There are 128 bytes per sector, 256 nibbles, or 1024 bits. The total numbers of sectors per single density diskette is 2002. Of the tracks, 74 are for data storage, two are set aside as alternate "bad tracks reserves," and another track is reserved for maintenance purposes. A typical data transfer rate from floppy to controller is 250 kilobytes per second.

The tracks are numbered from the outside in with number 00 on the rim. Number 76 is the last track and is nearest the hub. Remember that there are no real tracks that you can see. They are the products of a software format, in this case IBM format 3470. These single sided, FM coded (more about that in a moment) disks can have a recording density of 3408 bits per inch.

A second type of sectoring is called hard-sectoring. Thirty two holes are cut in the diskette. These become the index marks for each sectored area. There is a 23% increase in data packing in hard-sectoring but the industry seems to prefer the soft-sectored format.



IBM definitions: byte 1—address mark; 2—track #; 3—side #; 4—sector #; 5—sector size; 6—ID test bytes; 7—data mark; 8—data test bytes; 9—trailing gap.



The binary data pulse stream (lower line) is translated into and stored in the data cells (top line). 1's and 0's are shown.

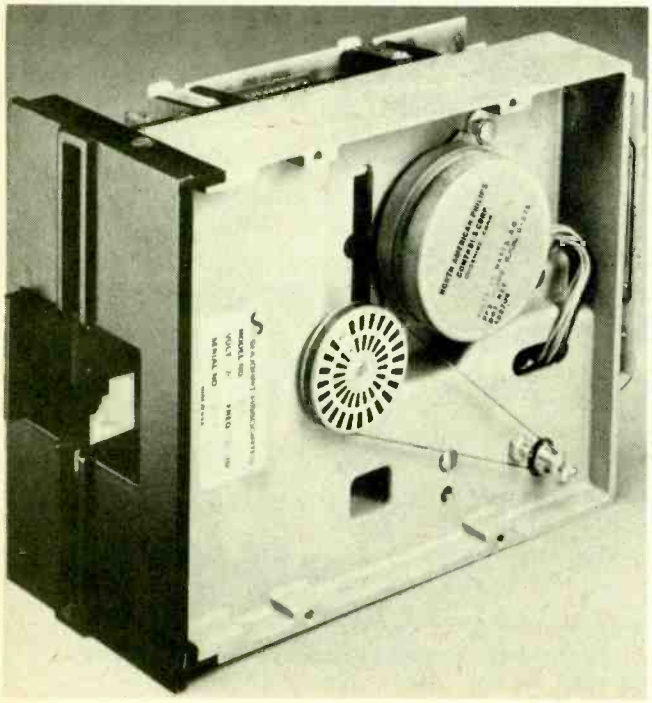
Frequency Mod. The technique used to place data on the diskette is called Frequency Modulation (FM). Clock Pulses, 4 micro-seconds apart, from a 250-KHz clock generator, are placed on the floppy sectors forming data cells. This is the time from one clock pulse to the next. A magnetic transition within a data cell is read from the data stream as a one; no transition as a zero. The data bit will fall into the center of the 4 microsecond data cell.

When the controller performs a read operation, the data stream going back to the drive electronics and on to the controller where the data is separated from the clock pulses, a known frequency, and also the index mark, sector data, and addressing information is removed before sending the data on to the Central processing unit.

As you might imagine there are sometimes errors in either a read or a write operation. A software test program is designed to search out these errors. They will be classed as either hard or soft errors. That is an error traceable to a piece of hardware such as a faulty motor is a hard error. An error traceable to a poorly formatted sector will be a soft error. One possible soft error would be a bad sector such that data could not be written into the sector. The controller would store the address of that sector in a *Bad-Sector* file in memory and search out another sector. Later if the computer addressed that bad-sector, the file manager would discover that it was bad and immediately go to the address of the new sector used in place of the damaged one. At some future date the user might want to replace the floppy if there are too many bad sectors.

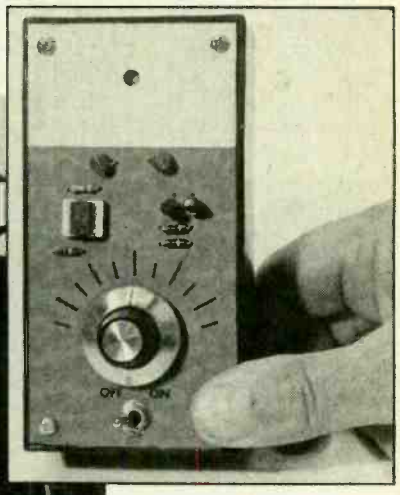
As the industry gets better at the techniques to pack and crunch data onto a small recording surface, floppy usage will increase. Shugart and Perteck, among others, are offering the double density floppy employing a recording code permitting double data packing using the MFM or Modified Frequency Modulation code. Two other codes now in use are the Modified MFM or the Group Code Recording (GCR) technique. Double sided re-

(Continued on page 83)



This bottom view of a Shugart 400 floppy drive unit shows the stepping motor, and the belt drive with strobe pattern pulley for calibration on both 50 Hz and 60 Hz (European and American) AC power mains.

DARKROOM PRINT PERFECTOR



End the guesswork in print developing

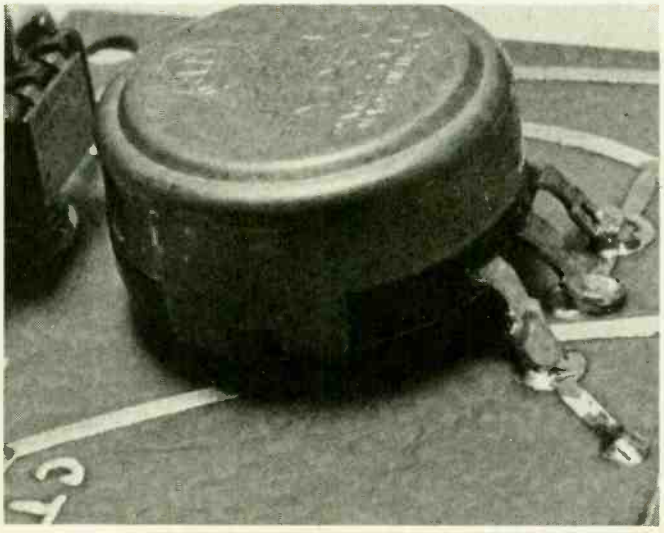
BY
HERB FRIEDMAN
AND
JOE CAPALUPI

A GOOD PRINT EVERY TIME is what you get using a printing meter. Whether every negative has a different density, or you continuously change magnification ratios, there'll be no need to waste paper or time making test strips or exposure guides. Just focus, slip the printing meter on the easel, close down the lens until two LED lamps on the meter turn *on*, place printing paper in the easel, and hit the timer's start switch. What you get after development will be prints that at the very least will be good, sometimes great. (*Great* prints are often made by dodging, using the basic time of a *good* print.)

If you're into color printing the printing meter can be used for the white-light exposure. After you've determined the correct color pack and time using the usual matrix guide, you can rack the magnification up and down without going through a complete series of matrix tests. Simply use the printing meter as you would for black and white printing—as we'll show you at the end of this article.

What you save in printing paper in one or two evenings' work will just about pay for this printing meter. What you save in time is immeasurable. You should be able to knock out 36 wallet-size exposures in less than one hour.

As for print quality, all the pictures used to illustrate this project were made with the meter, and they are all the very first try. Using a stabilization processor, from start to finish the prints were made in less than thirty minutes.



To prevent a shock hazard caused by the pins sticking up on the top side of the printed circuit board, R1's terminals are tack-soldered to the pads on the etched side of the board. A strong physical connection is assured by through-the-board mounting of R1's shaft.

Picking Your Parts. Since the purpose of a printing meter is to save considerable money on supplies as well as time, we have carried the premise through to construction of the printing meter, which should cost between $7 and $15 depending on what components you have around the shop.

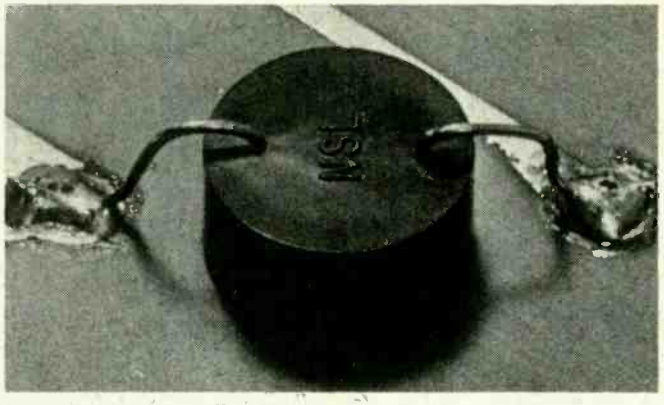
The entire meter is assembled on a printed circuit board, or solid phenolic board using point-to-point wiring, though the printed circuit construction is recommended. The board then becomes both the top of the meter's cabinet and the photocell "target," thereby saving the cost of a fancy cabinet, PC board mounting hardware, and a separate "target" assembly. Fact is, the few

components sticking out on top of the board make the device a "conversation piece" for visitors to your darkroom.

Other than the photocell, which must be the exact unit specified in the parts list because it's selected for light sensitivity, value, and rate of change, and the size of the "target hole" under which the photocell is mounted, nothing is critical. Feel free to substitute if it will save a few dollars. For example, Q1 and Q2 can be any NPN silicon transistor of the 2N3394 type with a gain of 50 to 150. Even general replacement types from Radio Shack can be used. Similarly, the LEDs can be any type capable of handling at least 20 mA. Just don't use the sub-mini models because they are too small to easily see. The unit shown uses Radio Shack LEDs with Fresnel lenses because the lens makes them extra bright in the dark, and also keeps the light from falling on the photocell. The so-called *diffused* LEDs are even easier to see, but they are not always in stock at Radio Shack stores. Resistors are ¼-watt size, 10% tolerance.

U1 is any type of half-minidip, (8 pins) 741 operational amplifier. A socket is suggested for the IC because you can get a defective IC, and you will literally destroy the PC board trying to get it off the board if you don't use a socket. This is the only place it's worthwhile to spend a few cents extra building the printing meter.

Switch S1 can be any miniature type DPST. Many of you might prefer a momentary contact type which stays on only as long as the handle, or button, is held down. Don't worry about leaving the meter on and running down the batteries; one of the LEDs is always on if S1 is on, so it's unlikely you'll pack up for the night with the meter left on.



After drilling a 3/16-inch hole in the PC board, center R6 in the hole, and tack-solder the leads to the solder pads in the same manner in which you attached R1.

Potentiometer R1, which serves as the sensitivity control, has a *linear taper;* it's value is 100K, 250K, or 500K depending on how you use the meter.

Generally, a good rule of thumb is: "A print looks good if there is some black in it." This is standard metering practice. You make the exposure for maximum black somewhere in the print, which is produced by maximum exposure illumination coming through a negative area of minimum density. If you prefer this method, R1 is 100k.

If you prefer to balance "flesh tones" (greyscale), taking the exposure off, say, a person's forehead—much as you would when making portraits—a 250k value for R1 will be somewhat easier to handle. This is also the correct value if you "integrate" the exposing light for a "neutral grey value" by placing a diffuser under the lens when using the printing meter; the same as you do when making the matrix test exposure for color printing.

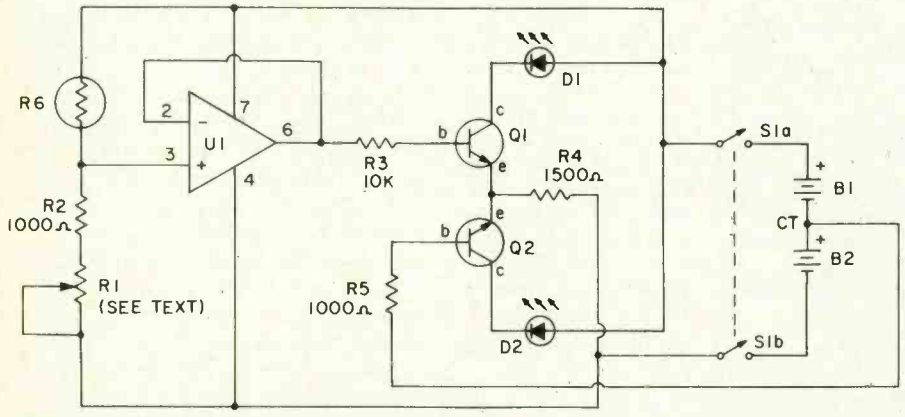
If you prefer "grey area" exposure metering, but have to deal with heavily overexposed or overdeveloped negatives, a 500K value for R1 is required. Increasing the value of R1 makes its calibration adjustment more delicate. Normally, 250K is a good "universal" value. The 500K value, however, lets you make a measurement that is often not even possible with rather expensive commercial printing meters.

Construction Notes. The "target hole" is precisely 3/16-inch. This is very critical. If you don't own the correct size drill, get one. Do not "approximate" its size. Photocell R6 is installed directly behind the hole.

No wires, such as those from the photocell, stick up through the PC board. They are soldered, as shown in the photographs, to PC foil "solder pads." These include the leads from R6, R1, S1, and the batteries.

Use battery terminals—don't solder wires directly to the batteries. Connect a red wire from one set of battery terminals to the black wire from the other battery terminal set, twist them together and tack solder them to the solder pad labled CT (for center-tap). The remaining red wire gets soldered to the "+" solder pad; the remaining black wire gets soldered to the "–" pad.

Final Checkout. Transistors come with an *ECB* or *EBC* lead arrangement; make certain you twist the transistors,



Note: The photoresistive cell is available for $4.00, and the PC board is available for $5.00 from Custom Components, Box 153, Malverne, NY 11565. Add $2.00 per order for postage, handling and insurance. Residents of New York must add 7% sales tax. Canadian orders must include an additional $2.00 for shipping. No foreign orders, please.

PARTS LIST FOR DARKROOM PRINT TIMER

B1, B2—9-volt transistor radio battery
D1, D2—red LED with diffusing lens, rated 20 mA
Q1, Q2—2N3394 NPN transistor or equivalent
R1—100K, 250K, or 500K linear-taper potentiometer (see text)
R2, R5—1,000-ohm, ¼-watt resistor
R3—10,000-ohm, ¼-watt resistor
R4—1,500-ohm, ¼-watt resistor
R6—type 4921 photoresistive cell—Do not substitute.
S1—DPST miniature toggle switch
U1—741 op amp (8-pin mini DIP)
MISC—cabinet, knob, PC board, IC socket, solder, battery clips, adhesive label, etc.

if necessary, so the *B* and *C* (base and collector) leads aren't interchanged. Next, make certain that the IC's pin #1, the one indicated with an indent molded into its case, is near R1, not R6.

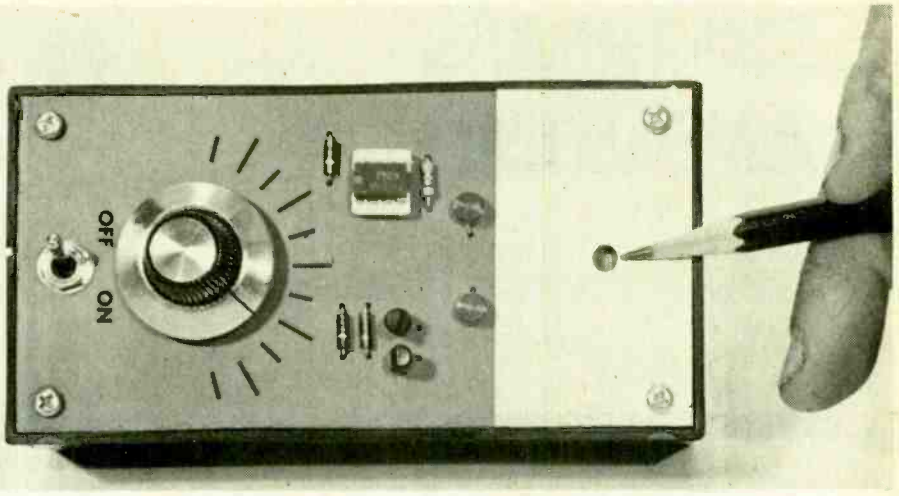
Install the batteries and turn S1 on. One or both LEDs will light. If neither light, either the LED polarity is reversed, or the Q1 and Q2 *B* and *C* leads are reversed. If all checks are okay, install a white target area cut from a piece of adhesive label (available at stationery stores). Punch a 3/16 or ¼-inch hole in the target, center it carefully over the 3/16-inch target hole, and then press the target down on the top of the PC board. Install a knob on R1's shaft, and install the PC board as the cover for a 5-1/16 by 2-5/8 by 1-5/8 inch Radio Shack Experimenter Box (#270-233).

Using the Meter. First, calibrate the meter. Make a good print from a good negative using an exposure time of approximately 20-seconds. When you're satisfied with the print, do not touch the enlarger controls. Slip the printing meter on the easel and center the target hole under "maximum black" for the print, which is some point that has the brightest light coming from the enlarger. Then adjust potentiometer R1 slowly until both LEDs are at equal brilliance. In normal operation, one LED will be lit, then both light as R1 is adjusted, then the original LED will go out as R1 is rotated past the calibration point. Proper calibration is when both are at equal brilliance. Don't worry if they aren't precisely equal. The difference from the left LED switching on, to equal brilliance, to the right LED switching on is less than ¼ f-stop. (The printing meter is very fast.)

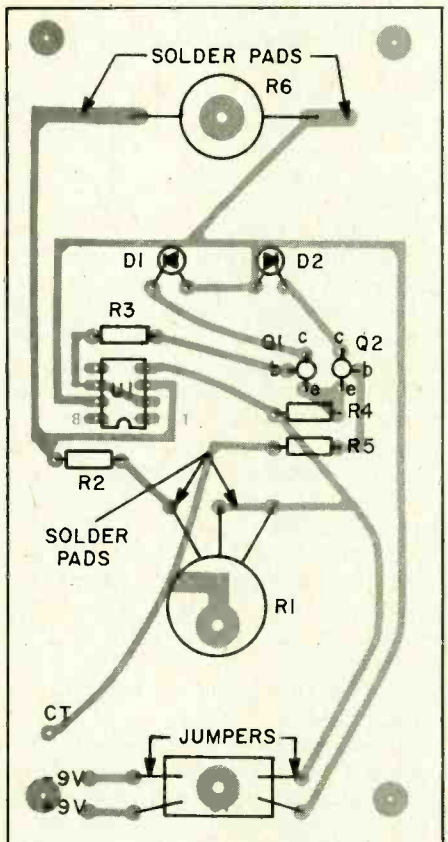
Once the meter is calibrated for your particular preference in print characteristics it's ready for use. Place the negative you want to print in the enlarger, rack for the desired size, and focus with the diaphragm wide open. Then pick the area of maximum light transmission, which will be black in the final print, place the meter's target hole in the brightest area and adjust the lens diaphragm until both LEDs turn on. The enlarger is now ready to expose, using your standard exposure time (20-seconds is recommended).

If you want a skin tone as the reference, simply make your initial meter calibration using a skin area, generally the forehead, as the reference light source. If you want an integrated calibration make the initial calibration with a diffuser under the lens, and make all subsequent adjustments through a diffuser. (Make certain you take the diffuser out of the way before you make the exposure.)

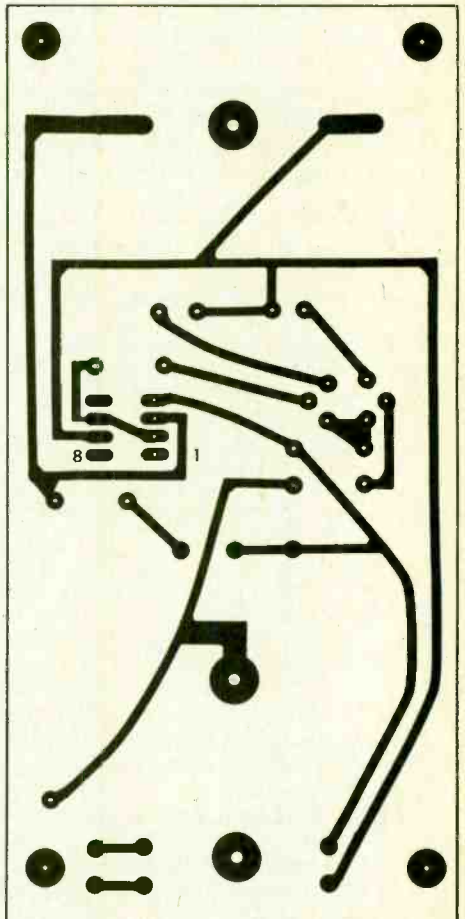
As a general rule of thumb, if you're making 4x5s or larger, or anything other than a portrait, exposing for some speck of black in the print is the best bet. For portraits, a meter reading off the skin is usually preferred—a portrait might not have any black in it to begin with. If you're grinding out what appear to be endless wallet-size "family" prints, an integrated, or "average grey" calibration will give you the easiest, and fastest way to grind out a stack of snapshots. For color print white-light exposure measurements, use the integrated method, using the diffuser that came with your color print kit. ■



To make the front panel anti-glare mask, make a 3/16-inch hole in a piece of stiff oaktag apply cement to one side, center over the hole and press into position.

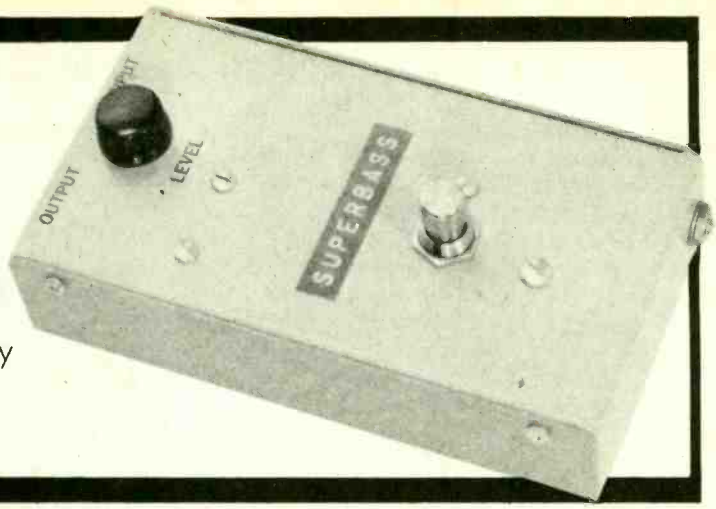


You'll note that parts layout diagram is viewed from foil side. This is done to aid in orienting the R1 and R6 connections.



This is a full-scale template for PC board. The points marked "solder pads" on parts layout need no holes etched or drilled.

SUPERBASS AMPLIFIER



For the hard-hitting superbass sound of today

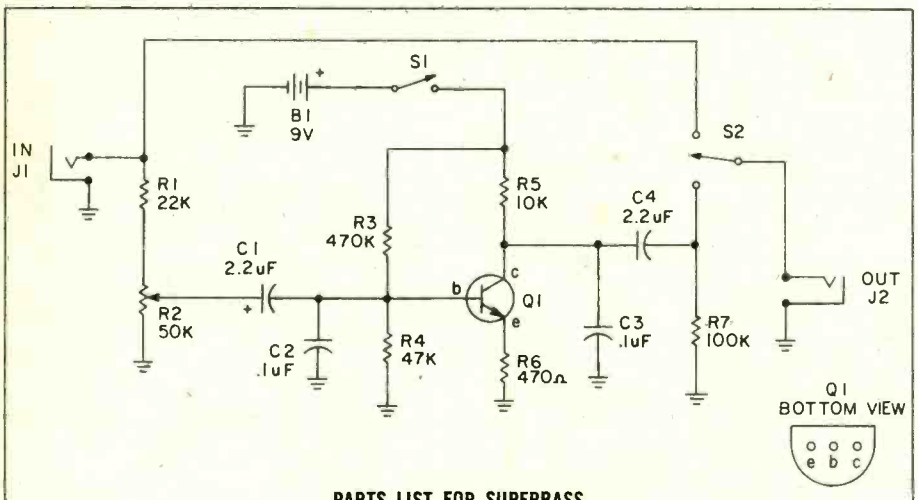
BY HERB FRIEDMAN

Superbass is today's sound . . . whether it's the driving, gut-vibrating pulsations of disco, or the solid bass line of soft, hard, or laid-back rock. One way to get the modern superbass sound without running out and buying an all-new expensive piece of equipment is to use a Superbass amplifier between your guitar, electronic organ or what-have-you, and the instrument amplifier.

A Superbass strips the highs from the instrument's output signal and amplifies low frequencies, feeding on "all-bass" sound to the instrument amplifier. Naturally, the bigger the speakers used with the amp, the more powerful the bass: use 15-inchers with a Superbass and you can rattle the windows.

The Superbass is powered by an ordinary 9-volt transistor radio battery. It is keyed in and out—switching from superbass to standard instrument output—by a foot operated switch. A level control allows you to equalize the superbass sound level with that of the musical instrument, so your volume level remains relatively constant as you key the superbas sound in and out. Of course, if you want the superbass to be louder or softer than the unequalized sound, you can adjust the level control accordingly.

The superbass connects between your instrument and its amplifier through two standard phone jacks—you can use your regular "patch cords".



PARTS LIST FOR SUPERBASS

B1—9-volt battery, Burgess 2U6 or equivalent
C1, C4—2.2-4.7-uF, 10-VDC electrolytic capacitor (see text)
C2, C3—0.1-uF Mylar capacitor, rated 10-VDC or higher
J1, J2—3-conductor, ¼-inch phone jack
Q1—NPN transistor (Radio Shack RS-2010, or equiv.)
All resistors 1/10 or 1/4-watt, 10%
R1—22,000-ohm resistor
R2—100,000-ohm audio taper potentionmeter (see text)
R3—470,000-ohm resistor
R4—47,000-ohm resistor
R5—10,000-ohm resistor
R6—470-ohm resistor
R7—100,000-ohm resistor
S1—SPST switch (see text)
S2—SPDT push On-push Off switch

Misc.—9-volt battery clip, aluminum cabinet, screws and other hardware.

Construction. Since you're going to stomp down on a footswitch to key the superbass in and out, the project should be assembled in a sturdy metal cabinet. We suggest one of the flat "instrument-type" cabinets which are available from time to time. The project fits nicely into a 1¼-inch x 3-inch x 5½-inch cabinet such as the one shown in the photographs. The "instrument" cabinets are not always available; as a substitute we suggest an aluminum "handy" or "Minibox." Do not use a plastic cabinet with a metal cover because it will probably fall apart after a few stomps.

Plug-in Circuitry. The amplifier itself can be assembled on a small printed circuit board, or on a perf-board using point-to-point wiring. Perhaps the easiest construction is the one used for the model shown: it uses a combination of printed circuit and perf-board. The board is an "Op-Amp IC Experimental Breadboard," available from Radio Shack stores. It has factory-etched copper strips, ground loops and buses that are pre-drilled in a perf-board pattern. You simply plug the parts into the board so the leads stick out on the foil side and solder. When finished, you have a printed circuit without the bother of making the PC board itself. (Use a 1½-inch x 1⅞-inch piece for this project.)

While the overall layout isn't critical, try to follow the layout shown because it keeps cables and the level control away from the footswitch. To conserve space, level control R2 can be any type of miniature audio taper potentiometer.

The battery is held in place by a small L-bracket. To prevent the battery from sliding around, two small strips of cork or rubber are cemented to the bracket. The bracket should be positioned so the battery must be lightly forced into position—in this way the

(Continued on page 85)

e/e BASIC COURSE IN ELECTRICITY & ELECTRONICS

The Silicon Controlled Rectifier is one of the basic circuit building blocks with which the experimenter and technician should become acquainted. This time, our Basic Course covers fundamentals of SCR design and operation, and how you can use them yourself.

SCR BASIC PRINCIPLES

A diode is a diode is a diode. While we're sure that Gertrude Stein was, in all probability, blithely unaware of the existence or purpose of the diode when she penned her deathless definition of a rose (which we've rather crudely paraphrased above), the bottom line remains the same: no matter in what configuration it's found; SCR, LASCR, DIAC, TRIAC, etc., the basic principles of diode operation are adhered to. Therefore, although this Basic Course will concern itself with providing an explanation of the SCR (Silicon Controlled Rectifier), we strongly suggest that you go back and review the Basic Course found in the March/April 1979 issue of e/e concerning simple diode function.

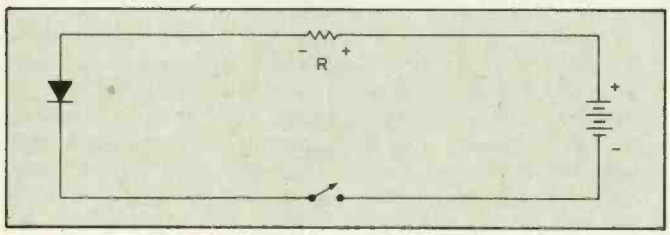
WHAT IS AN SCR?

An SCR, in practice, is basically a **standard rectifier** placed in series with a **switch.** When the switch is closed, the rectifier will conduct in one direction.

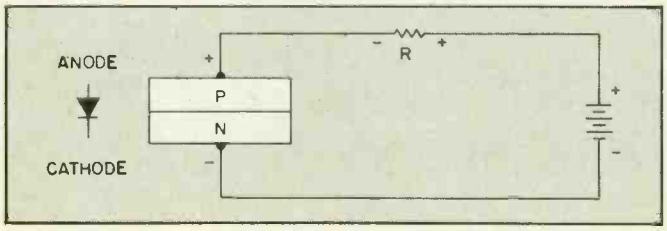
The difference between the diode/switch combination and the SCR is that the switch is built right into the SCR itself, and is commonly referred to as the **gate.** More about this later on.

A basic, four-layer silicon device has three junctions. With a battery connected as shown, the device **cannot** conduct because no current can flow through the reverse-biased junction in the middle. In this configuration, there are only three ways in which current flow can be induced: the current level can be increased to the point where the junction is simply overwhelmed, light can be directed at the junction until enough electron excitation is created to bridge the reverse-biased junction, or the device can be heated to the point where electron excitation occurs. Of course, these are all clumsy methods.

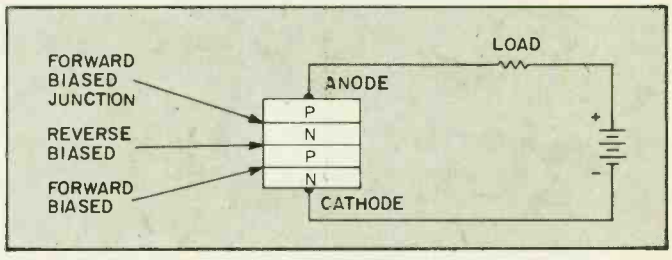
FUNCTIONAL SCR DIAGRAM



SIMPLE DIODE



FOUR-LAYER DEVICE



QUESTIONS

Q1. The basic component around which an SCR is built is the _____.

Q2. The SCR's gate functions as a _____.

ANSWERS

A1. diode

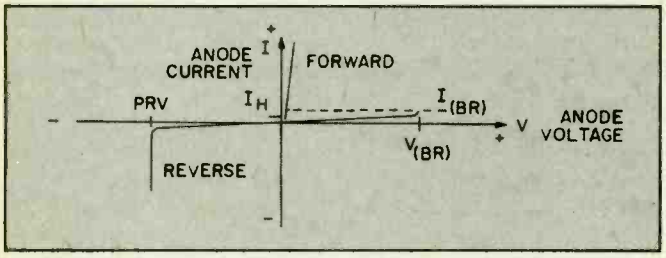
A2. switch

TRIGGERING

If we were to plot the voltage and current characteristics of this four-layer device, the result of the **forward voltage breakover** (VBR)—the point at which the SCR begins to conduct—can be observed. Initially, a small current (IBR) is required to trigger the device. In this application, it can be derived from any of the

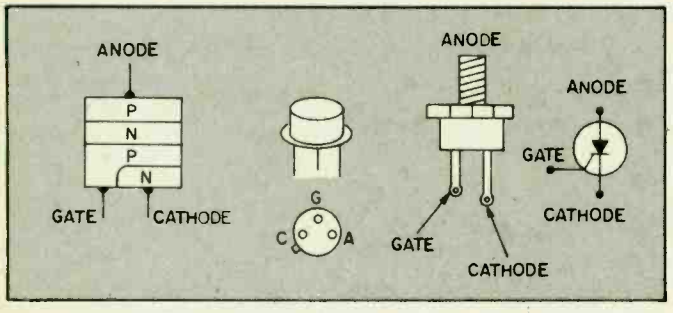
three sources mentioned above. In addition, a **minimum current** level (IH), or holding current, must be present in the external circuit in order to keep the device in a conducting state. Once the device has been triggered, and as long as the holding current is sufficient, no further triggering action is necessary.

CURRENT AND VOLTAGE BREAKOVER GRAPH



As noted earlier, the physical methods required to trigger the four-layer device are all clumsy and in fact may be destructive to the silicon wafer upon which the decive is constructed. The difference between the four-layer device and the SCR, is that the "P" region **nearest** the **cathode** has a lead attached to it (the **gate**) which, when current is directed into it (IBR), negates the normal reverse bias of the middle junction and allows the SCR to behave like a normal rectifier. Again, once the gate has allowed the cathode to trigger, only a small current level (IH) is required to keep the device

INTERNAL AND EXTERNAL SCR CONFIGURATION



in a conducting state. Even with gate current **removed**, the device will continue to operate until the holding current in the rest of the circuit falls below the minimum level.

QUESTIONS

Q3. The _____ is a measure of the point at at which an SCR will conduct.

Q4. It is necessary to apply the _____ to the gate in order for the SCR to conduct.

Q5. The SCR will cease to conduct only if _____.

ANSWERS

A3. forward voltage breakover
A4. breakover current (IBR)
A5. the holding current (IH) drops below the threshold level.

SCR OPERATIONAL PROBLEMS

One of the problems that engineers encounter when using the SCR in a switching capacity is **time.** As mentioned earlier, once the SCR has been triggered and current starts to flow from cathode to anode (typically this requires a time period of about 5-microseconds), it will continue to flow through the SCR until and unless the current level drops below the minimum required to hold the SCR open. Suppose, however, that we wish to use the SCR to switch a high-speed DC pulse current. Remember the center junction of the four-layer device that held the reverse (blocking) bias? Because all of the forward voltage flowing through the device must cross this junction, the "P" and "N" regions which comprise the junction actually act as the plates of a **capacitor,** charged to the voltage which is flowing through the SCR.

As a result of this phenomenon, an abrupt application of forward voltage to the junction (as may be supplied by a high-speed pulsed driver or other pulse source) may, through this capacitive effect, cause the SCR to trigger **before** a gate current is ever applied. Typically then, one must allow 50-microseconds to elapse before applying another pulse of forward voltage to the SCR to insure that it has reset itself.

This necessity limits the applications in which the SCR can be used, although newer types of switching transistors can operate at much higher speeds and have, in many cases, obsoleted the SCR in high-speed switching applications.

QUESTIONS

Q6. It takes _____ for an SCR to reach full conductance level.

Q7. An SCR can be falsely triggered because the middle junction has a _____ effect.

Q8. An SCR must be allowed a period of _____ to reset itself.

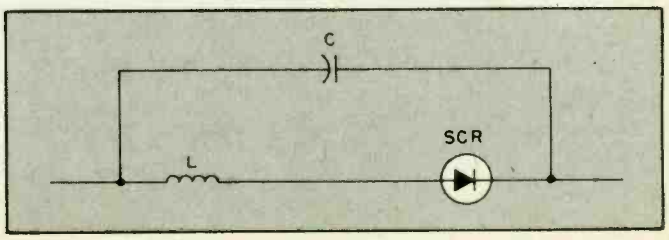
ANSWERS

A6. 5-microseconds
A7. capacitative
A8. 50-microseconds

RADIO FREQUENCY INTERFERENCE

Another problem encountered when incorporating the SCR into a circuit (especially one which operates at radio frequencies, such as digital clocks, ham receivers, and microcomputers) is that the relatively abrupt triggering and conductance process associated with the SCR, and the concurrently swift current level rise through the circuit, can cause RF frequencies to be spuriously generated. These RF signals can be

INDUCTIVE/CAPACITATIVE SHUNT



radiated directly into other parts of the circuit, or can be coupled into the power supply line and travel through it to other parts of the circuit just as easily.

Normal RF shielding precautions can be taken (good grounding, use of shielded cable, etc.), and in addition, an **inductive/capacitative shunt** may be employed to effectively slow down the current rise time across the SCR. Usually, a value of 0.1-uF for the capacitor, and 75-uH (microHenrys) for the inductor will suffice. Be sure, however, that both components are capable of handling the maximum voltage and current levels which will appear across the SCR normally as a result of the circuit's operation.

QUESTIONS

Q9. An SCR's switching action may create _____.
Q10. An _____ will help quiet an SCR.

ANSWERS

Q9. RF interference
Q10. inductive/capacitative shunt

SUMMARY

You have learned that the SCR is essentially a rectifier diode with an incorporated switch. The switch is comprised of two extra "P" and "N" layers which form a reverse-biased junction which effectively cuts off the forward flow of current and voltage. The **gate,** which is a lead attached to the "P" junction nearest the cathode, can, when a suitably large current (IBR) is passed along it, negate the reverse bias at the middle junction and allow current to flow. Once the current is fully flowing, removal of the breakover current **will not** open the gate, and the flow can only be stopped when current in the rest of the circuit drops below the level (IH) necessary to hold the junction open. In addition, you now know that it takes ap-approximately 50-microseconds for the capacitative charge on the "P" and "N" layers adjacent to the middle junction to drop to a level where the junction will not be closed by application of a forward voltage to the cathode. The swift rise of current associated with the closing of the middle junction (just as the closing of a light switch will cause a "pop" to come through an AM radio near it) can create RF interference, and suitable shielding and shunting may be necessary in certain circuit applications to avoid this. ■

Long Delay Timer

(Continued from page 38)

supply voltage, this is the same as applying a positive trigger. At the moment switch S1 is closed, the LED will be unlit indicating that the delay interval has been initiated. Output is low (logic 0). For the circuit of Fig. 4 it should remain unlit for approximately 10-seconds. After this interval the LED will again light and remain so until switch S1 is momentarily closed again.

Close switch S1 momentarily to initiate a new cycle. Then very quickly close S2 momentarily. Note that the LED will light immediately after the closing of switch S2. This activity is the same as applying a positive reset trigger pulse to pin 5.

Triggered astable operation is obtained by opening switch S3. Momentarily close switch S1 to initiate a delay interval. (The LED will be unlit.) After the delay interval, the output will switch to high and the LED will light. It will remain lit for approximately 10 seconds and then it will go out indicating the initiation of a new delay interval. This time, the new cycle was initiated even though switch S1 was not closed momentarily. This activity will repeat itself in an astable manner until the reset switch (S2) is momentarily closed during one of the time delay intervals. The circuit will not recycle itself again until the trigger switch S1 is again momentarily closed.

Free-Running Oscillator Operation. To operate the timer chip as a low-frequency oscillator, connect the circuit of Fig. 5. Note in this arrangement that pin 5 is grounded and that the trigger (pin 6) is connected permanently to the supply voltage through a resistor. This means that a fixed supply voltage is supplied to the trigger circuit which will insure self-triggering operation.

Rearrange the circuit for oscillator operation. Supply power to the circuit. Note that the LED will be lit for ten seconds and then off for ten seconds and so on. This indicates that a very low-frequency squarewave (one cycle each twenty seconds) is being generated at the output, the output swinging between high and low and back to high again during a single pulse period.

Connect the LED indicator to pin 2. The LED will flicker, indicating the much higher frequency square wave that is to be found in this initial stage of the counter chain. Return the LED indicator circuit to the pin 3 output.

If you wish, you can now experiment with other components for resistor R1 and capacitor C1. A 10-μF capacitor substituted for C1 will result in a delay of approximately 50-seconds. The LED will be off for 50-seconds and on for 50-seconds, etc. The use of a 1-megohm resistor and a 100-μF capacitor would result in a delay time in excess of 3 hours. A 3900-ohm resistor and a 2-μF capacitor would cut the delay time down to approximately 1-second.

You have learned how the XR-2242 operates as a long-delay timer and a very low-frequency oscillator. A more elaborate circuit could be added to the output, operating a mechanical or solid state relay, the activities of which could be regulated by the time-constant combination resistor R1 and capacitor C1. Other applications may come to mind for this versatile circuit as you continue to experiment. ■

SB-104A

(Continued from page 54)

provisions for just about any accessory you can think of—we'd be hard put to come up with a more flexible rig.

All in all, we can recommend the Heath SB-104A without reservation. The SB-104A kit sells for $729.95; the HP-1144A Fixed Station Power Supply is $94.95; the SB-604 Matching Speaker and Power Supply Cabinet is $39.95; the SBA-104-3 CW Crystal Filter is $42.95; and the SBA-104-1 Noise Blanker is $28.50. The Heath Company is located in Benton Harbor, Michigan 49022. For more info, circle number 1 on the reader service coupon. ■

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ELEMENTARY ELECTRONICS INDEX TO ADVERTISERS

DX Central

(Continued from page 23)

AFRTS-W, in Washington, is responsible for providing the affiliates with radio news, information and sports programming, which is transmitted 24 hours a day, seven days a week, via shortwave. This is the service familiar to SWLs.

At the various AFRTS stations around the world, these programs are picked up and either immediately rebroadcast locally, or taped for later rebroadcast. AFRTS-W also provides a radioteletype relay service to the stations from the Associated Press and United Press International.

Most of the programs on AFRTS shortwave transmissions are the same as those heard on local U.S. radio stations, since these broadcasts are made available to the military by the major commercial radio networks, NBC, CBS, ABC and the Mutual Broadcasting System, plus National Public Radio and the audio network news programs of Associated Press and United Press International.

Reports, and requests for the broadcast schedule should be sent to AFRTS-Washington, 1117 North 19th Street, Arlington, VA 22209.

If you don't hear the MW broadcasts—and post-0500 GMT might be a good time to check—you should have no difficulty hearing 4VEH on shortwave. Try 11,835 kHz at 1200 GMT, when the transmission is in English. Reports on this transmission should go to the regular 4VEH address, Box 1, Cap Haitien, Haiti.

ANARC 1980. In recent DX columns I've mentioned the annual conventions of the Association of North American Radio Clubs, the umbrella organization linking the various SWL and DXing clubs on the continent.

ANARC now has decided to hold its next convention July 18-20, 1980, on the campus of the University of California-Irving, 40 miles south of Los Angeles.

Listening hobbyists, whether members of ANARC affiliated clubs or not, are welcome to attend the three-day gathering.

For further information, send a stamped, self-addressed envelope to ANARC 1980, 16182 Ballad Lane, Huntington Beach, CA 92649.

Skywave Tests. Broadcast band medium wave DXers, those who tune the AM band between 540 and 1600 kHz, attention!

Radio 4VEH, Cap Haitien, Haiti, has announced that it will transmit tests on 1595 kHz until mid-1980, using an experimental "skywave" antenna and a one kilowatt transmitter. The station is anxious to receive reports of reception from North American listeners on this "split" frequency, which is between the regular U.S.-Canadian AM channels of 1590 and 1600 kHz. Correct reports will be verified with a special QSL card, according to the station. Reports should be sent to 4VEH, Radio Skywave, Box 1739, Port-au-Prince, Haiti. ■

DX GLOSSARY

DX, DXing = Distant broadcasting stations; the hobby of listening to distant or otherwise hard to hear stations as a hobby.

GMT = A universal time reference, Greenwich Mean Time, equivalent to EST+5 hours, CST+6 hours, MST+7 hours, and PST+8 hours.

kHz = kilohertz, a unit of frequency measurement equivalent to 1000 cycles per second; formerly expressed as kilocycles per second, or kc/s.

SW, SWL = shortwave; shortwave listener.

Scanner Antennas

(Continued from page 46)

mobile antennas. While a single band unit is only $19.95, all-band mobile antennas range from $21.95 to $28.95 depending upon the choice of mount. *Hustler* also offers their basic all-band antenna in a wide variety of mounts for mobile applications. Both trunk-lip and gutter-clip mounting configurations are available from *Antenna Incorporated* ($23.67 and $26.66). A series of *Hy-Gain* "MR" mobile antenna products provides something for everybody. Single, double, and three band antennas with every conceivable mounting style.

And, of course, *Radio Shack* and *Lafayette* supply mobile antennas which are certainly worthy of note. Pick up one of their new catalogs for more details on their lines.

Conclusion. As we pointed out, the choices of antennas for the scanner listener are many. It was not our intention to list all the products available from these and other fine manufacturers. But hopefully, this sampling will help provide some insight into scanner antenna considerations and applications. Scanner listening is fascinating. And with a little planning, it will provide hours of intriguing listening. ■

Voice of the Future

(Continued from page 26)

blind persons and, of course, computer games. It also gives some insight into how computers are much like ourselves. It is interesting to think of things like everyday speech as a series of software routines.

Programming for the synthesizer takes practice and patience. I recommend that you have a few months of Level II BASIC under your belt first. You're bound to have a lot of fun writing software for the synthesizer. I have a small program that is a voice identifier for a 2 meter "ham" repeater and another one that tells one-liners at parties. The synthesizer is a smooth talker, but it can't compete with yours truly! (And it's not nearly as modest.)

So, why are all the ladies hanging around the computer? Maybe they're just listening to the same old Subroutine . . .

For more information on the Radio Shack Speech Synthesizer, circle number 32 on the reader service card, or stop by one of the many Radio Shack dealers for a demonstration. ■

Floppy Disks

(Continued from page 72)

cording heads have also been introduced allowing recording on both sides of the floppy with transfer rates of 500 Kilobytes per second and 256 bytes per disk sector.

Mini-Floppy. Hardly had this double density, double sided floppy been introduced when the mini-floppy popped on the stage. Only 5¼ inches in diameter, it uses a coding scheme called the Modified MFM, with the index hole shifted 90 degrees to the right. The Radio Shack add-on TRS Mini-Disk System, uses a mini floppy. Cost is about $500 for the "first Disk-Drive." As with all disk systems, a certain number of sectors are devoted to housekeeping, sometimes called labeling. This usually consists of a directory, test programs, and other sector and track information so that it will talk smoothly with its computer system.

The flexible diskette is a very useful pheripherial device used with a I/O controller and can be used to store special diagnostics, (hardware test programs) and debug routines, (software test programs), invoices, end of month reports, special inventory, and more.

The low cost, ease of use, and reliability are rapidly ushering the floppy from the lofty realm of a convenience and a nice thing to have around, to a practical, hard working, near-necessity, in every microcomputer installation. ■

Electric Lighting

(Continued from page 25)

The SEF fits a standard household socket and provides about the same amount of light as a 150-watt incandescent lamp while consuming only one-third the power. The lamp also puts out the same pleasing light color as a normal household incandescent. Research problems still remain: the SEF's present high cost and large physical size are foremost among these.

Energy-Saving Flourescents are very much on the minds of lighting engineers at GTE Sylvania. The Thrift/Mate line of fluorescents offered by the company are said to substantially reduce electrical energy needs for factory, office, commercial or school lighting systems, where a high level of illumination is not needed. One version, the Thrift/Mate 33, can cut energy use by a third, while the Thrift/Mate 50 can slash power consumption to half that of a comparably-rated conventional fluorescent lamp.

High Intensity Lighting. There is, of course, continuing need to improve high-intensity lighting for such light-absorbing areas as streets, playgrounds and other indoor and outdoor locations. A few years ago Sylvania introduced Lumalux lamps in 70- and 100-watt versions. Both have the "distinctive golden-yellow overtones associated with high-pressure sodium light sources". The 100-watt lamp provides 9,500 lumens over a 12,000-hour average rated life, and it has a color temperature of 2100° Kelvin. This lamp restarts in one minute following energy interruption and stabilizes in three to four minutes after a cold start. The 70-watt version has the same color temperature and average life, but provides a lower (5,800 lumens) light output. These lamps are also made in 150-, 250-, 400- and 1000-watt versions.

The electric light has come a long way over the century since Thomas Edison perfected the first incandescent bulb. New technology and applications undreamed of just a few decades ago are now commonplace. These latest developments have come about in response to the needs of industry and the consuming public for energy-conserving, efficient electric lighting. ■

Satellite Receivers

(Continued from page 49)

locations of all antennas to avoid future transmitting installations which might interfere with prior licensees.

Needless to say, not all home TV users are licensed, but the law *is* specific—at least for now. Pressure is being brought to bear on the FCC to deregulate the satellite TV receive-only terminals, and many in the industry say it is only a matter of time. Even now, the licensing procedure is quite routine.

Today, most of us are watching a limited number of local channels, but tomorrow. . . . ■

Dwell/Tachometer

(Continued from page 68)

regardless of varying voltages being generated by different charging systems.

Construction. Most of the circuitry of the instrument is built on a printed circuit board, which mounts all components except the front panel switches and meter. The PC board is mounted to the rear of the meter by means of the two meter studs. This type of construction allows the entire circuit of the instrument to be contained in one module, and allows ease of assembly and service if ever necessary. The printed circuit layout as seen from the copper side of the board is shown in full size in Fig. 2, and the component layout as seen from the parts side of the board is shown in Fig. 3. If you are going to use a different meter than that specified in the parts list, be sure to take into account the center-to-center stud distance when laying out the printed circuit board.

Fig. 4 is an illustration of a meter scale which can be used for the instrument. This scale has two ranges; 0 to 1500 RPM, and 0 to 60 degrees dwell. To change the 0 to 1 milliampere scale on the meter, remove the plastic front of the meter and carefully remove the two small screws which hold the scale in place. You can then paste the scale of Fig. 4 over the back side of the meter scale and put it into place over the meter movement. Be careful not to disturb the meter needle during this operation, since it is very fragile. Fig. 5 can be used as a front panel label which provides the FUNCTION and CYLINDER lettering.

The instrument is connected to the automobile ignition system with three wires, as shown in Fig. 6. Be sure to use different colors to help prevent misconnections when the instrument is placed in use. Rubber covered test lead wire is ideal for the purpose, and comes in several colors besides red and black. Alligator clips and boots can be placed on the ends of the wires for the connections to the automobile.

Connections between the printed circuit board and front panel switches are indicated on the schematic diagram and printed circuit layout by a group of 14 letters, A through N. Three additional wires are used for the three operating leads of the instrument. These connections are clearly marked on the parts location guide diagram.

After the unit is completely wired, double check to make sure that the transistors, integrated circuits, and electrolytic capacitors are mounted to the printed circuit board in the correct direction. These components are polarized and will be damaged if they are placed into the circuit improperly.

Checkout and Calibration. To check and calibrate the unit, you will need a variable DC power source of 0 to 15-volts, an accurate DC voltmeter, and an audio oscillator which can deliver at least 15-volts RMS output. A Hewlett/Packard 200CD or equivalent is ideal.

Set the FUNCTION switch to 15-volts and connect the positive and negative leads of the instrument to the power supply. Connect the voltmeter across the output of the supply. Raise the voltage of the supply from zero to 15-volts while watching the instrument, which should agree with the DC voltmeter. If necessary, you can change the value of R14 to provide an accurate indication of 15-volts. Reduce the output of the supply to 1.5-volts and set the function switch to 1.5-volts. If necessary, the value of R17 can be changed to provide an accurate indication of 1.5-volts.

The next check to be made is upon the dwell meter circuit. Set the FUNCTION switch to DWELL, and the power supply to 14-volts. Connect the sensing lead of the instrument to the negative side of the power supply. This should result in some positive meter reading. Set the CYLINDER switch to 8, and adjust R9 for a meter reading of 45 degrees on the 0 to 60 dwell scale. Set the CYLINDER switch to 6 and adjust R11 for a meter reading of 60 degrees. Check the meter reading with the CYLINDER switch set to 4. It should read 45 degrees. (This reading will be doubled during operation of the instrument, and is actually 90 degrees for 4 cylinder engines). Remove the sensing lead from the negative side of the power supply. The meter should read zero for all settings of the CYLINDER switch. This completes the dwell calibration.

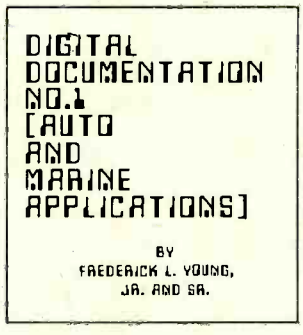
To calibrate the tachometer section of the unit, connect the instrument, power supply, and audio oscillator as shown in Fig. 6. Set the power supply to 14-volts output, and the audio oscillator to 30 Hertz at 15-volts output or more. Set the FUNCTION switch of the instrument to TACH and the CYLINDER switch to 8. Adjust R12 for a meter reading of 450 on the 0 to 1500 scale of the meter. Check the reading of the meter with the cylinder switch set to 6 and 4. These readings should be 600 and 900 respectively. If necessary, you can parallel R5, R6 or R7 with resistors as required to attain proper calibration for all positions of the CYLINDER switch. The printed circuit layout has additional pads and holes for any extra resistors that may be necessary.

Operation. The Dwell/Tach is connected to the automobile system as shown in Fig. 7. Note that cars with factory installed electronic ignition systems will have a special terminal for the connection of the sensing lead of the instrument. Refer to the service manual for your car, or ask your dealer where this terminal is located. Once the instrument is connected to the automobile, the function switch can be set to DWELL, TACH, or 15-volts as necessary. Keep in mind that when measuring dwell on 4 cylinder engines, you must double the meter reading. Be very careful not to switch the function to the 1.5-volt scale unless you have first checked the voltage of the circuit under test with the 15-volt scale to be sure that the voltage is less than 1.5 volts. This will avoid possible damage to your meter. ■

Bookmark

(Continued from page 13)

digital gauges for oil pressure, electrical system (voltmeter), and coolant temperature. The book provides step-by-step construction details, printed circuit templates, and a source for obtaining all of the parts necessary for the completed projects. Each chapter contains enough circuit theory to enable the builder to troubleshoot each circuit in the event that problems occur during construction. It's available for $3.50 postpaid in the U.S. and Canada from: Digital World, P.O. Box 5508, Augusta, GA, 30906. Circle number 51 on the reader service card.



Build a digital dashboard

Soft cover
39 pages
$3.50

Superbass

(Continued from page 76)

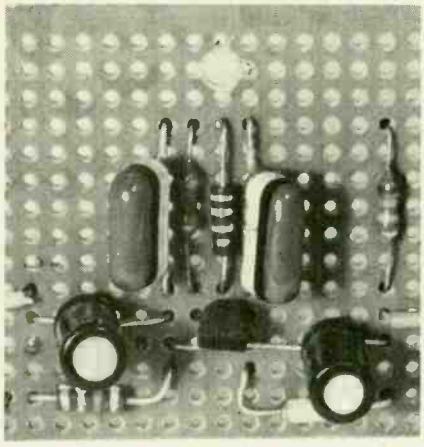
cork or rubber will retain the battery. You can use small cork "feet" such as sold in hardware stores for use on the bottom of bric-a-brac to prevent scratching of furniture. The cost is usually well under fifty cents and you can cut the "feet" to the needed size.

Take extra care to get S2's wiring right the first time. Note that S2 is SPDT, switching only the output connection. The input is permanently connected to the amplifier and switch S2.

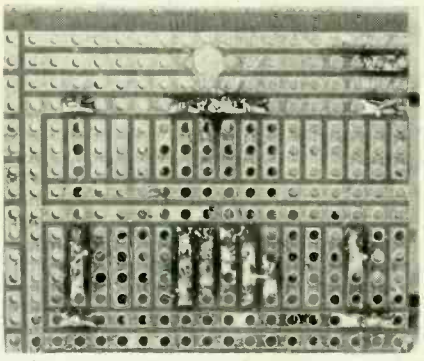
Nothing about the entire project is really critical other than the values of C2 and C3. Resistors need be no better than 10% tolerance—why spend money for better tolerance when the project won't work any better?—and electrolytic capacitors C1 and C4 can be any value from 2.2-uF to 4.7-uF. Use whatever you can get at lowest cost. The same "lowest cost" rule applies to C2 and C3; they don't have to be precision tolerance as long as their rated value is 0.1-uF.

Using Superbass. Connect your electric guitar or other electronic instrument to input jack J1; connect output jack J2 to your instrument amplifier's normally-used input. With power switch S1 *off*, key S2 so the instrument feeds directly to the instrument amplifier. With R2 set full counter-clockwise (Off), turn power switch S1 on, key S2 once, and advance R2 for the desired superbass sound level. To cut back to natural sound just stomp down on S2 and key the superbass out.

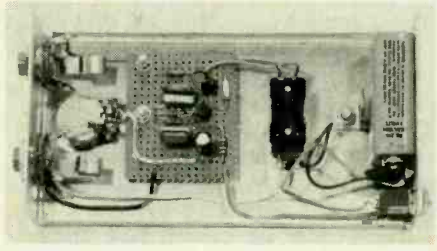
Don't worry about leaving power switch S1 on for the several hours of a gig. The circuit pulls less than 1-mA from the battery, so the battery will last many, many months. ■



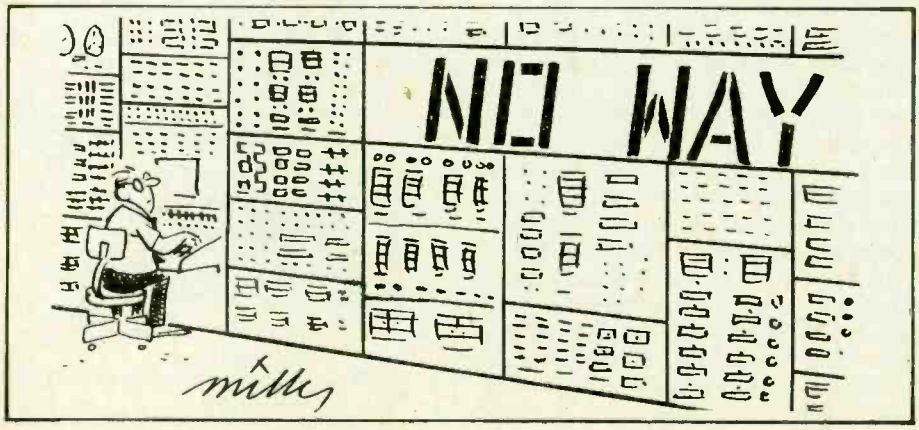
Bread board amplifier component mounting eliminates the need for etching your own PC board.



Mounting the printed circuit amplifier is quite simple. Just push the leads through the board and solder.



Inside the completed Superbass. Secure the amplifier board well to withstand the stress and pressure.



TRS-80 Interface

(Continued from page 42)

cealed jacks and are concealed when the trap door is replaced. Pop off a cover on the front left and you expose an edge connector, which just happens to line up with the TRS-80's expansion port. The connecting-ribbon-cable joins the two connectors. Next, you take the long cable with DIN connectors on each end and connect it between the computer's cassette jack and a cassette input jack on the back of the interface. Immediately adjacent to the cassette input jack are two cassette connecting jacks, which allows you to keep one cassette connected permanently for playback, the other permanently for recording. BASIC II allows software programming of cassette operation.

Still on the back, you'll find another trap door cover. This one conceals the connector for the disk system. When you're ready to upgrade to disk simply remove the cover, plug one end of a cable onto the edge connector, plug the other end of the cable into the back of the disk drive and you're up and running. (Couldn't be done any easier, or with less hassle.)

Coming around the left side are two trap doors: one exposes the connector for a parallel line printer (Centronics/Radio Shack type); the other port is for a screen printer (or some other device Radio Shack might come up with).

Back again to the front, in the center we find a trap door that exposes a Future Expansion connector. The future however, is really here, and there is a use for this connector. Up on top, next to the power supply storage well, is another well with a prewired connector beneath the cover. An RS232 serial interface fits in here. The interface permits the use of serial printers, terminals (such as a TTY or DECwriter), telephone modems, and other serial "what-have-yous." The output of the serial adapter is the Future Expansion connector on the front.

As far as we know, the only thing we left out is the interface's power switch, which is located on the front, facing the operator. It faces the front for good reason: it might be needed as a computer control switch.

Here's why: when the computer and interface are powered up simultaneously the interface looks for the disk system even if you don't presently have one. To avoid a "lock up" if you don't have the disk system, you must hold down the *Break* key when turning on the computer. The computer comes up in LEVEL II BASIC but the interface is still waiting for a disk. Everything works fine until the computer is caused to "hang up," say by using a port command without having an active peripheral at the port, or something in your program causes the computer to hang up. Normally, you simply press the Reset switch to get back to keyboard control. Not so with the interface. If it is powered up a Reset will cause your program to be "erased." The way to retain the program is to turn off the interface power switch, Reset, and then turn on the interface.

Time Clock. One big plus you might overlook at the beginning is a real time clock. It is user programmable and can be employed for screen display or within a program.

One thing to keep in mind when considering the interface and/or a line printer is future needs and cost. While you can connect a line printer directly to the computer through a special adaptor cable, the adapter is about 25% of the cost of the interface. If you later need the interface, which supports the printer, you won't need the adapter cable, and its cost is totally wasted. Your best bet is really to save up and get the interface, unless you are absolutely certain you won't ever need a disk, two cassettes, an RS232 serial I/O, or a modem, or additional memory. (Remember, you can configure the TRS-80 for 16K. For more memory you must have the interface; it can be configured for an additional 32K in 16K increments.)

Once you have the Expansion Interface it's easy to get your TRS-80 doing all those things you originally bought a computer to do. ■

Kathi's Carousel

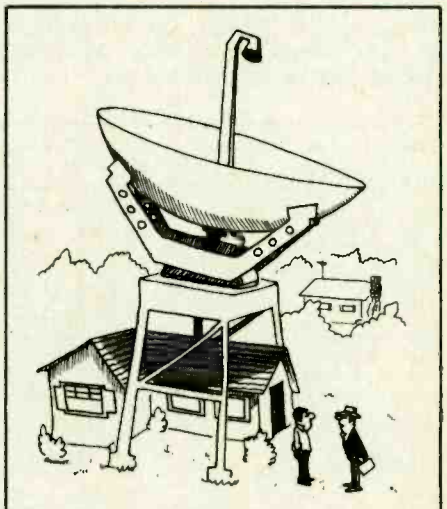
(Continued from page 52)

on the spotlight and edged up, one hand on my CB mike in case of trouble. Sure enough, it was a child; she was caring for an infant while mommy was off searching for help. Now three in the morning is no time to be looking for help out in the country, so I put my wheels into 4WD and inched through the snow using my P.A. speaker to call for mommy. I found mommy, got her back to the car and, with the help of a stout rope from my trunk and 4WD, I got their car back on the road pronto.

While unhitching the rope I noticed their car's rear deck had the mark of a trunk mount antenna. Right! You guessed it! They hadn't used the CB in months, so pop took it out and made it into a base station. I don't know what happened, but I'll make an odds-on bet pop put that CB back in the car the next day.

Keep it Mobile! The problem here was the family forgot that CB is primarily an emergency mobile service. The fact that it isn't used for days, or even months, doesn't mean it's not needed. In fact, CB is generally needed most when least expected. Even I no longer use my mobile every day; but one thing I do is test it weekly. I have a weekly routine: First time I step into the car on Saturdays I ask for an "air check." (I picked Saturday because out my way every channel is in use all day long on Saturday. I'm certain to raise someone out there.)

If you need or want a base station, the best thing to do is get a real base station; don't convert your mobile to base. This year's selection of base stations is limited, but almost every one is a winner in terms of features, performance, and price. Best of all, you almost always get SSB in addition to AM, and if you're looking for hobby activity, SSB can't be beat. There's a nice crowd of folks working base SSB, and most of them are always looking out for new friends. Best of all, there are some fantastic sales going on in base stations. Almost every day I see some model or other being sold for as little as half of last year's price. So you can't go wrong if you "buy base" to "go base." However you decide to "go base," don't pull the mobile rig from your vehicle, for that's the one you'll need when least expected. ■



"Who gave you permission to use our satellite?"

LITERATURE LIBRARY

398. *Hamtronics, Inc.* has announced a new 1980 catalog featuring many types of kits for the radio amateur. Products include a 435 MHz Transmitting Converter and a weather tone alert receiver module.

397. *Instant Software, Inc.* is offering a special holiday catalog for all kinds of year 'round software package gift-giving, as well as their regular microcomputer catalog.

396. *Creative Computing's* first software catalog of various education and recreation simulation programs as well as sophisticated technical application packages is available now.

395. *OK Machine and Tool Corporation* features the new PRB-1 Digital Logic Probe on the cover of its latest catalog of wire wrapping and other electronic assembly tools.

394. *KEF Electronics Ltd.* is offering two speaker systems in kit form at a significant cost-savings. The Model 104aB and the Cantata can be easily assembled and may be auditioned before purchasing.

389. You can't buy a bargain unless you know about it! *Fair Radio Sales'* latest electronics surplus catalog is packed with government and commercial buys.

388. SWLs need *Gilfer's* Shortwave Mail Order Catalog for economy one-stop armchair shopping. From top-notch rigs to reporting pads, Gilfer supplies all your hobby needs.

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

362. A new catalog crunched full of military, commercial and industrial surplus efectronics for every hobbyist is offered by *B&F Industries*. 44 pages of bargains you've got to see!

384. *B&K-Precision* has issued BK-10, a condensed catalog describing their oscilloscopes, semi-conductor testers as well as test instruments for CB, radio and TV repair.

310. *Compumart Corp.*, formerly NCE, has been selling computers by mail since '71, and is offering a 10-day return policy on many items featured in their latest catalog.

322. *Radio Shack's* latest full color catalog, "The Expanding World of TRS-80," is out now, packed with up to the date information on this microcomputer. Specifications for the new Model II as well as the Model I are included.

386. If you're lookng for books on computers, calculators, and games, then get *BITS, Inc* catalog. It includes novel items.

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

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

345. For CBers from *Hy-Gain Electronics Corp.* there is a 50-page, 4-color catalog (base, mobile and marine transceivers, antennas, and accessories).

393. A brand new 60-page catalog listing *Simpson Electric Company's* complete line of stock analog and digital panel meters, meter relays, controllers and test instruments has just come out.

385. Amateur Radio buffs and beginners will want the latest *Ham Radio Communications Bookstore* catalog. It's packed with items for the Ham.

373. 48-page "Electronic Things and Ideas Book" from *ETCO* has the gadgets and goodies not found in stores and elsewhere.

382. Buys by the dozens in *Long's Electronics* super "Ham Radio Buyer's Guide." Good reading if you're in the market for a complete station or spare fuses.

383. If you're a radio communicator, either ham, SWL, scanner buff or CBer, you'll want a copy of *Harrison Radio's* "Communications Catalog 1979." Just what the shack book shelf needs.

380. If your projects call for transistors and FETS, linear and digital ICs, or special solid-state parts, then look into *Adva Electronics'* mini-catalog for rock bottom prices.

301. Get into the swing of microcomputer and microprocessor technology with *CREI's* new Program 680. New 56 page catalog describes all programs of electronics advancement.

302. Giant savings are what *Burstein Applebee* has in store in their latest mail order catalog. Everything from CB test equipment to name brand audio wares are advertised.

305. A new 4-page directional beam CB antenna brochure is available from *Shakespeare*. Gives complete specs and polarization radiation patterns for their new fiberglass directional antennas.

371. Your computer system needn't cost a fortune. *Southwest Technical Products* offers their 6800 computer complete at $395 with features that cost you extra with many other systems.

306. *Antenna Specialists* has a new 32-page CB and monitor antenna catalog, a new amateur antenna catalog, and a complete accessory catalog.

307. *Atlas* calls their 210X and 215X the perfect amateur mobile rigs. Their 6-page, full-color detailed spec sheet tells all. Yours for the asking.

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

392. The opening of the new Software of the Month Club has been announced by *Creative Discount Software,* which is giving out membership enrollment applications now. The Club plans to have separate branches for users of the Apple II, TRS-80, Ohio Scientific, Exity, Pet and CP/M based systems.

390. *Whitehouse & Co.*, your "hard to find parts specialist," offers over a dozen parts and kits in their latest catalogue, featuring an entire section on gunnplexers for Amaeur Radio buffs.

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

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

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

328. If you are into audio, ham radio, project building, telephones, CB or any electronics hobby you'll want *McGee's* latest catalog of parts and gadgets.

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

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

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

391. A new software products catalog for the Apple II Computer has just been issued by *Charles Mann & Associates*. The booklet contains business accounting, accounts receivable, inventory, BASIC teaching and other special purpose business applications.

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

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

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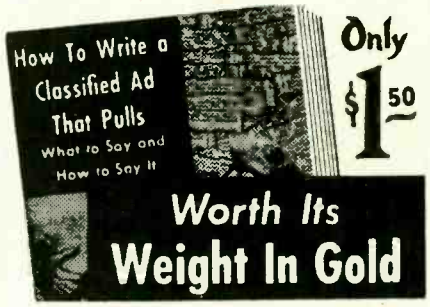

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BY HANK SCOTT

Letter on Letters

Hank, could you tell me where I could get black or white press-on lettering and supplies?

—D.R., Waupun, WI

Once upon a time almost all radio parts supply stores (now called electronic supply stores) carried press-on lettering and decals for the hobbyist. Not so anymore! Amateur equipment supply stores are now your best bet, and even there the distribution is mighty low. I suggest you visit a few local electronics parts stores first. If you strike out, then let your fingers do the walking in the "Yellow Pages." Look under Art Supplies. Press-on lettering is used widely in the commercial art industry, so you can be sure of getting the materials you need. One draw back—complete words like POWER, ON/OFF, AUDIO, ANTENNA, etc., are not available in art supply stores, making your panel callouts a bit more difficult to do.

Counting What?

I bought a cheap cassette deck as a back up for my high-priced job in my stereo system. It works okay, but I got ripped off because the tape counter is not standard like the expensive one. Should I write to the F.T.C.?

—L.N., Waretown, NJ

Spare the pen and hear this! Tape counters are not governed by any standard. It is true some decks use the counters to indicate minutes and seconds, but their accuracy is poor, considering that a rubberband-type belt drives the counter mechanism. The numbers on a counter are just an arbitrary reference point for that cassette deck only. Don't trouble the F.T.C. because the manufacturers make no claims as to accuracy between units.

Hook Up

I have to replace a wire between the bottom of a telescopic aerial and a transistor. It is a portable radio—AM/FM/HP/LP/VFM. What should the wire size be?

—R.H., Cleveland, OH

Use any conventional size hook-up wire. A gauge of 22 is fine. The size of the wire is not critical, but its length may be. Keep the lead reasonably short.

Bottoms Up

Will it do any harm to a portable TV receiver if I operate it upside down?

—R.A., Spencer, IN

During repair and alignment, sometimes that is the only way to do the job. I remember an old RCA with horizontal problems that drove me frantic until I fashioned a jig to hold it upside down during test. One tip—if your horizontal yoke coil is isolated from the vertical coil, then reverse the leads to the picture tube and the image will be right side up.

Weather Story

My home weather station is not always in agreement with the local weathercasts from the government on 162.55 MHz. What gives?

—S.F., West New York, NJ

I'm reminded of the old story of an ant that leaves a lush jungle, travels across a barren landscape in the hot sun for four hours and then enters a cool river plain. We could do it in a few minutes taking the same route across the parking lot as the ant did. You see, weather is where you are at the moment! In the metropolitan New York area, the three major airports have been known to have temperatures 10 degrees apart, sunshine at one, rain at another, and sleet at the third, all at the same time! If you listened to the New York weathercast that day, it may have said, "Cloudy with a threat of rain!" In the plain states the temperature may drop 50 miles away, and may be 20-30°F different anytime during the year, and it's quite a common occurance. So don't give up on your weather station, it is probably very accurate for your home. As for me, I like to look out the window each morning as a supplement to any weathercast. No matter where you are in the U.S., an NOAA Weather Radio should be in your receiver's reach. Tune in your scanner to 162.400 MHz, 162.475 MHz and 162.550 MHz, one of these frequencies should pull in NOAA Weather Radio.

Hold up the Head Stone

Hank, CB is dead! Why is ELEMENTARY ELECTRONICS *still covering the topic?*

—L.J., Niagara Falls, NY

Let's look at some facts, and then you decide whether or not CB is dead. Last year (1979) the FCC issued over 900,000 new CB licenses. This amount does not include the over 200,000 licenses for renewals and modifications. At year's end there were about 15 million CB licenses in effect. Now, don't confuse a dead hobby by what appears to be poor retail sales and depressed prices. I estimate CB sales to be about 3 million units in 1979. This figure is down from the boom years of the mid '70s, but it's still a large market. As the surplus disappears and new transceivers with improved circuitry and added features hit the dealer's shelves, prices will increase accordingly. Don't give up on CB as a hobby. It's had its rough years, and its golden years lie ahead.

A Lot of Zeroes

Whats' a giga?

—L.F., Kingston, TN

I believe you are referring to a prefix, for example: kilo-Hertz, megaHertz and gigaHertz. The term giga means you multiply by the amount of 1,000,000,000. In effect, a "gigabuck" will be one billion dollars. The abbreviation for giga is G.

Up on Ions

Hank, I can't find an ion generator kit anywhere. Where can I get one?

—B.C., Louisville, KY

An ion generator kit or wired product cannot be purchased simply because no one would buy one unless the manufacturer made some positive health claims. Manufacturer's won't make claims in fear of action from the Federal Trade Commission. After all, if you make a claim, you must back it up. I've checked several catalogs and can't find any.

Lend a Hand

Here are this issue's requests from some of our readers who need your help. If you can, please do so, and let old Hank know.

Δ Superior Instrument Model 82A Rapid Tube Tester; needs tube chart; Lyle Mahlberg, 11605 W. Highway 23, Duluth, MN 55808.

Δ Narco VAT4 Superhomer MK-IV Aircraft Radio; operator's manual and service information; J.M. Wood, 14305 Interurban Avenue South, Tukwila, WA 98168.

Δ Minerva 2-Band Tropic Master in steel cabinet; needs schematic diagram and service data; Tom Mooningham, 5807 MEMQ, Camp Lejeune, NC.

Δ Jackson 648-1T Tube Tester; needs info for roll chart after 1970; Danel Brown, 922-15th Street, Portsmouth, OH 45662.

Δ Surplus all-band amateur receiver and transmitter; urgently needed by a retired, semi-disabled senior citizen—if you can part with it, call (602) 272-4973; WB7WDI, 4122 W. Flower St., Phoenix, AZ.

Δ Burroughs CRT Terminal, Model B-9352, serial No. 60203; needs user and maintenance manuals; Larry Hoglen, 5624 Morgan Ave. So., Minneapolis, MN 55419.

Δ Hy-Gain 623A Utopia CB transceiver; owner's manual needed; Phillip D. Cassell, Box 31, Rt. 3, Inez, KY 41224.

Δ Allied Radio knight kit Model 620A; needs wiring diagram; David J. Hamm, 50C Hatchee Rd., Eglin A.F.B., FL 32542. ■

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:

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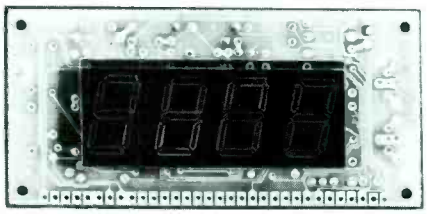

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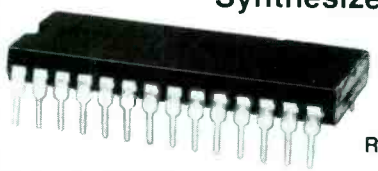

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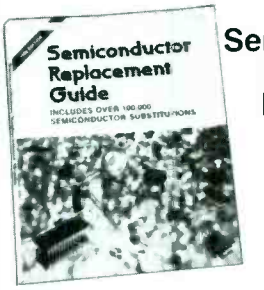

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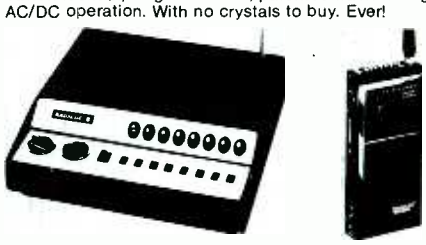

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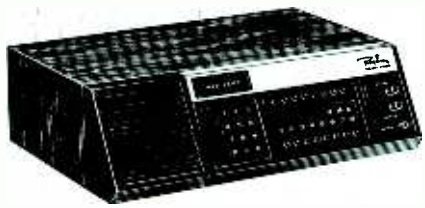

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