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JULY-AUGUST 1980  UK 95p

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Electronic
Lighting

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- ✓ USI Computer Intelli-Phone
- ✓ Realistic Direct Entry Scanner

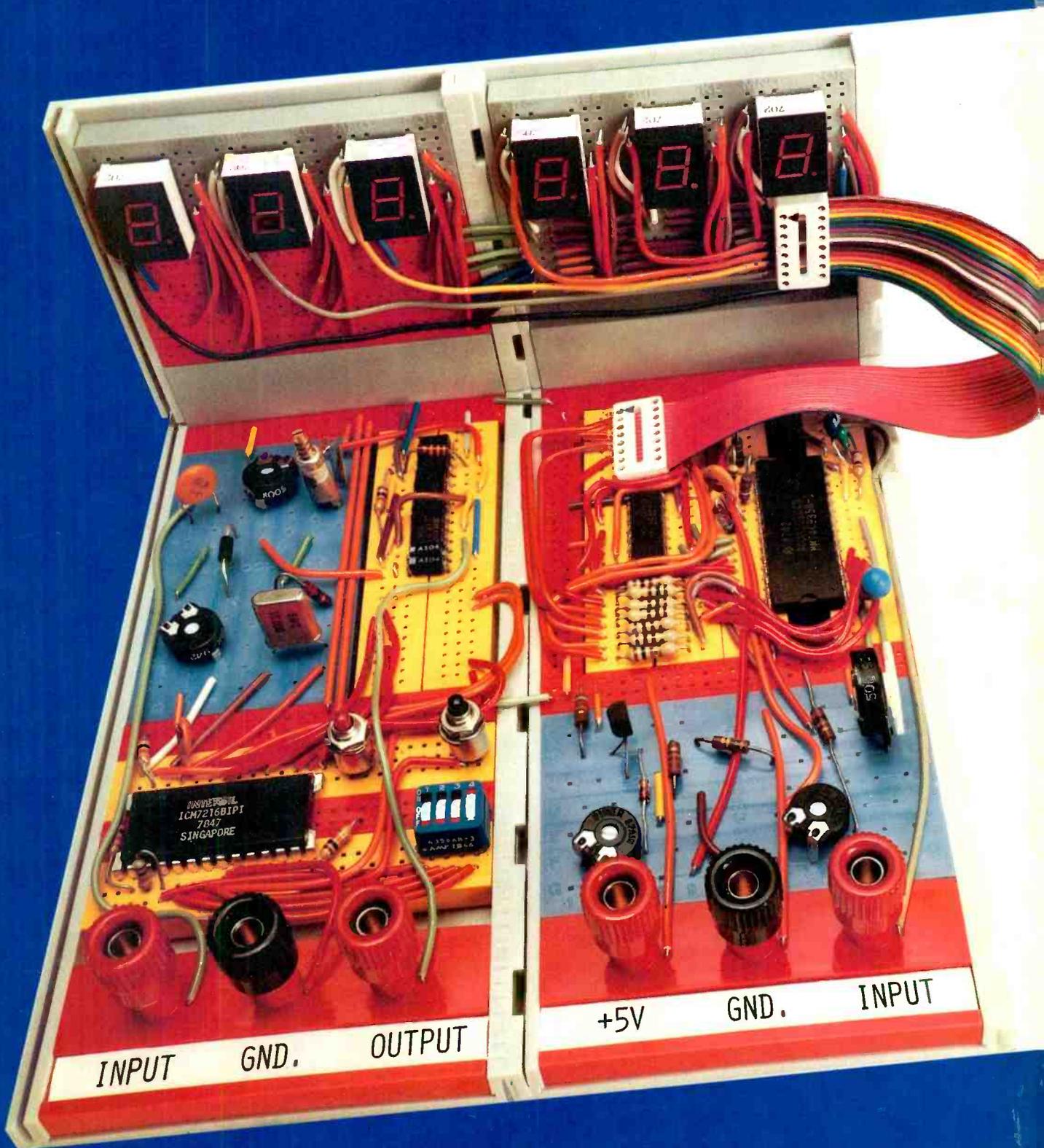
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D RADOMSKI
6613 BALBOA CIR
OCEAN SPRINGS MS 39564



A DAVIS PUBLICATION

A P's Hobby-Blox Preview

See Page 46



INPUT

GND.

OUTPUT

+5V

GND.

INPUT

ICM7216B1PI
7847
SINGAPORE

4350A1-2
AMP 18-6

7805

1000

20V

50

8

8

8

8

8

8

INTRODUCING THE NEW HOBBY-BLOX™ SYSTEM.

HOBBY-BLOX™. The new modular circuit building system designed especially for electronic hobbyists.

Until now, hobbyists had to buy "professional" solderless breadboards for their projects and pay "professional" prices. But now there's Hobby-Blox™, a brand new solderless breadboarding system that's not only economically priced but offers far more advantages to the hobbyist.

At the core of the system are two starter packs, one for discrete component projects, the other for integrated circuit projects. Each comes with a number of Hobby-Blox system modules that fit into a tray and an illustrated project booklet which shows you step-by-step how to build ten projects with the existing modules of each pack. Either starter pack is available for under \$7.00.

You can add modules at any time to build new projects or expand on existing ones. The Hobby-Blox system includes 14 separate module packs that can be purchased individually.

Modules include Tray, Terminal Strip Pack, Distribution Strips, Bus Strip, 2 x 16 Terminal Strip, Discrete Component Strip, L.E.D. Strip, Vertical Tray Pack, Speaker Panel Pack, Control Panel Pack, Blank Panel Pack, Battery Holder Pack, Binding

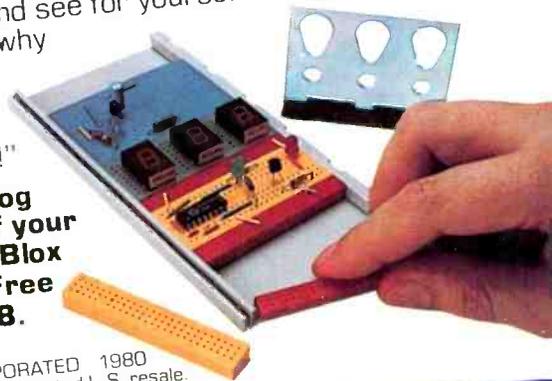
Post Strip, Tray Extender Clips. Modules are priced from \$1.29 to \$3.59. All modules are color-keyed and letter-number indexed to make circuit building even easier.

The Hobby-Blox system is compatible with DIPs of all sizes and a wide variety of discrete components. Simply plug in your components and interconnect with hookup wire. No soldering, and all components can be used again and again.

How far can you go with the Hobby-Blox system? Take a look at the example on the page to the left and see for yourself. Then you'll know why we say, "with Hobby-Blox, your only limit is your imagination!"

For a free catalog and the name of your nearest Hobby-Blox dealer call Toll Free (800) 321-9668.

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CIRCLE 15 ON READER SERVICE COUPON

elementary Electronics

July/August 1980

Volume 20, No. 4

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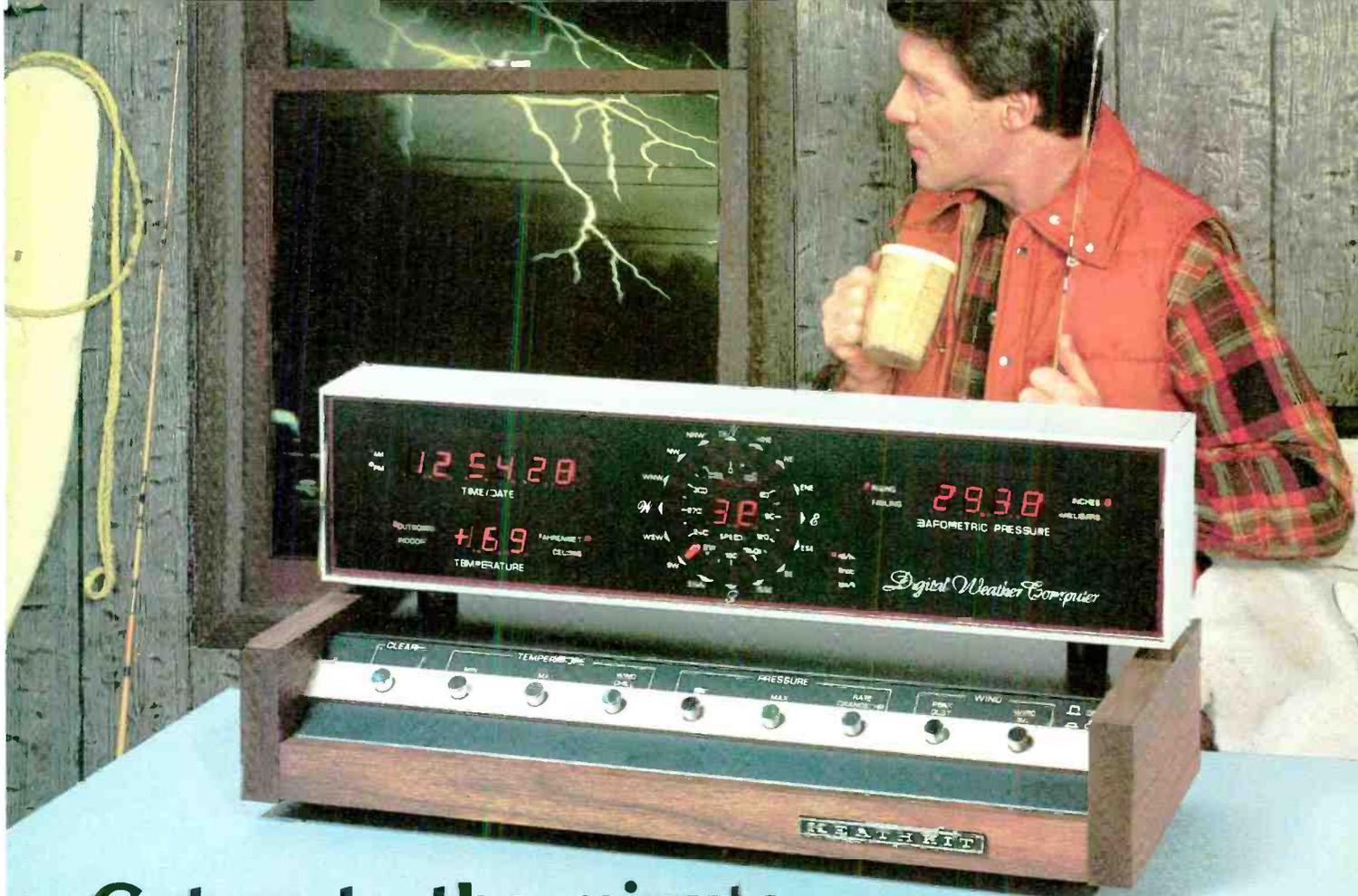
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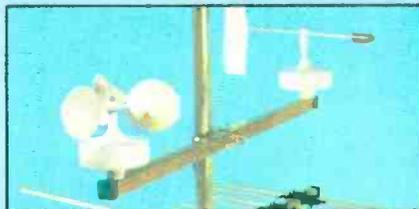
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NEW PRODUCTS PARADE

SHOWCASE OF NEW PRODUCTS

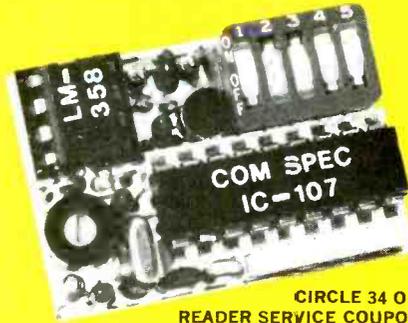
Time, Date, Alarm Calculator

Toshiba has added alarm and complete calendar and time functions to create an alpha-numeric pocket calculator "electronic diary." Featuring the month, day, date and time (AM/PM), the Memo Note II, may be used to record—for later recall, via alarm—important appointment schedules, special occasions (such as birthdays, anniversaries, board meetings), including date and time. On the designated date and hour, the stored data appears automatically in the unit's liquid crystal display, accompanied by an alarm sound. In addition to the "one-on-one" alarm-to-message capabilities (i.e., one message linked to one alarm for a total of 30 messages with 30 alarm functions), it is possible to link four alarm times to one message. The Memo Note II is an international timepiece, unaffected by time changes. Via its pre-programmed LSI circuit, the unit will display the exact equivalent time in 26 cities in different time zones around the world—including date, day and time (AM or PM). Each letter of the alphabet corresponds

Examples: A-Honolulu, B-Dawson, Alaska, C-Los Angeles, T-Bangkok, W-Tokyo, etc. A simple touch of the time zone/city designation key will display the time without the use of complex conversion scales and the like. Suggested retail price is \$99.95. For further information, contact Section H-H, Business Equipment Division, Toshiba America, Inc., 280 Park Avenue, New York, NY 10017.

Micro Encoder

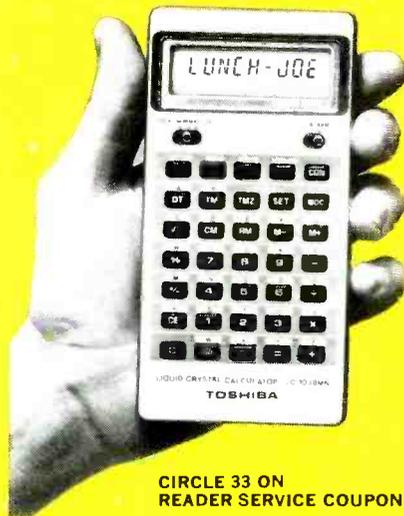
The Communications Specialists SS-32 Microminiature Tone Encoder utilizes a radically new



CIRCLE 34 ON READER SERVICE COUPON

concept for producing either sub-audible or burst-tone frequencies. This encoder adapts to mobile units and most portables. It operates on any DC voltage from 6 to 30-volts and may be ordered in either the audible or sub-audible configuration. The SS-32 is completely field-programmable using a DIP switch to produce any one of the 32 standard EIA sub-audible frequencies or any one of 32 audible frequencies which include touch-tones, burst-tones and test-tones such as 600, 1000, 1500, 2175 and 2805 Hz. No counter or other test equipment is required to set frequencies. The output is a low impedance, low distortion adjustable sine wave, 5 volts peak-to-peak. In the sub-audible version, the frequency accuracy is ± 0.1 Hz maximum from -40°C to $+85^{\circ}\text{C}$, and the accuracy of the

(Continued on page 6)

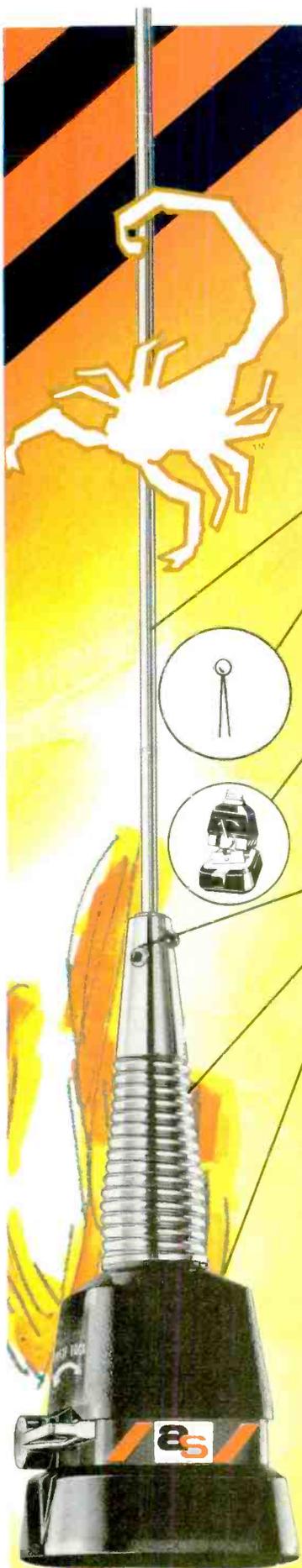


CIRCLE 33 ON READER SERVICE COUPON

to a city, identified on a handy reference card included with the Memo Note II's handsome wallet.

All the facts you should know about CB antenna reliability and performance...

"ours" vs. "theirs"



Precision machine ground tapered whip has less air resistance and less pattern distortion due to whip bending. Highest quality 17-7 PH stainless steel can be bent full circle and still snap back to perfect vertical!

True static ball tip for continuous dissipation of wind static build up and less noise! Also protects garage doors from nicks of unprotected whip tips. Safer, too.

Full 60-inch radiator surface for maximum range. Optimum length for non-critical tuning — use without fine tuning at 1.5 to 1 or better VSWR from channels 1 to 40!

Antenna Specialists' LEVERLOK™ quick release. Firm, positive electrical and mechanical connection, instant disconnect, with the twist of a lever.

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Guaranteed satisfaction with 5-year limited warranty PLUS lifetime coil burnout warranty.

\$39.95 suggested retail price for demonstratively superior quality and performance.

No whip taper.

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Quarter turn quick release.

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No shock spring.

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NEW PRODUCTS PARADE

(Continued from page 4)

audible tone output is ± 1 Hz. A remote-mounted rotary switch may be purchased to allow selection of any of the tones within either group. A full one year warranty is provided. Wired and tested, complete with instructions, the price is \$29.95. For complete details, write to Communications Specialists, 426 West Taft Avenue, Orange, CA 92667.

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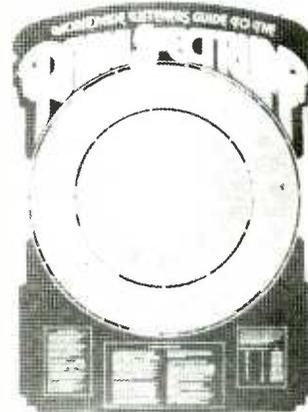
CIRCLE 35 ON READER SERVICE COUPON

ation and ultra-rugged construction with excellent overload characteristics for long term reliability. Other features of the new LX 304 include an automatic decimal point, a built-in low battery indicator, diode and transistor testing capability and 0.5% accuracy on DCV ranges. Designed for convenient and economical bench and field use, the Hickok LX 304 is self-contained, with test leads that store in the removeable, protective thermoplastic cover. For more information, write to Hickok Electrical Instrument Co., 10514 Dupont Ave., Cleveland, OH 44108.

Radio Chart

Worldwide listening is real fun. Let the Worldwide Listeners Guide

To The Radio Spectrum chart help you tune in and find some of those far away places. The chart covers the radio spectrum from 10 kHz to 30 GHz with specific sample listings of stations found on particular frequencies. Over 500 listings spreading across the spectrum



CIRCLE 42 ON READER SERVICE COUPON

appear on the chart. Laid out in an outer and inner circle, with the various frequency bands occupying their respective part of the circle, with their sample listings, it makes a quick and easy reference chart for hams, Short Wave Listeners, and scanner owners. The chart is printed in full color, resembling the rainbow spectrum and measures 35-inches by 25-inches and is printed on high quality paper. It makes an attractive and very durable wall chart. It sells for \$5.00 plus 65¢ for postage and handling. Send orders direct to C.B. City, P.O. Box 1030, Woodland Hills, CA 91365.

Glass Mounted AM/FM Antenna

A new, glass-mounted AM/FM antenna gives greater range and crystal clear sound to mobile audio systems. Called the AFM-1, this antenna has three unique features. First, it's a 3 dB gain-type antenna which greatly exceeds the performance of window wire or fender mounted and retractable antennas. The AFM-1 helps to eliminate poor reception caused by signal blocking which occurs in mountainous or rolling terrain, as well as in urban areas where large buildings interfere with FM radio signals. The AFM-1 showed up to a 30 dB increase over an imbedded, window-type antenna. The second main feature of the

(Continued on page 12)

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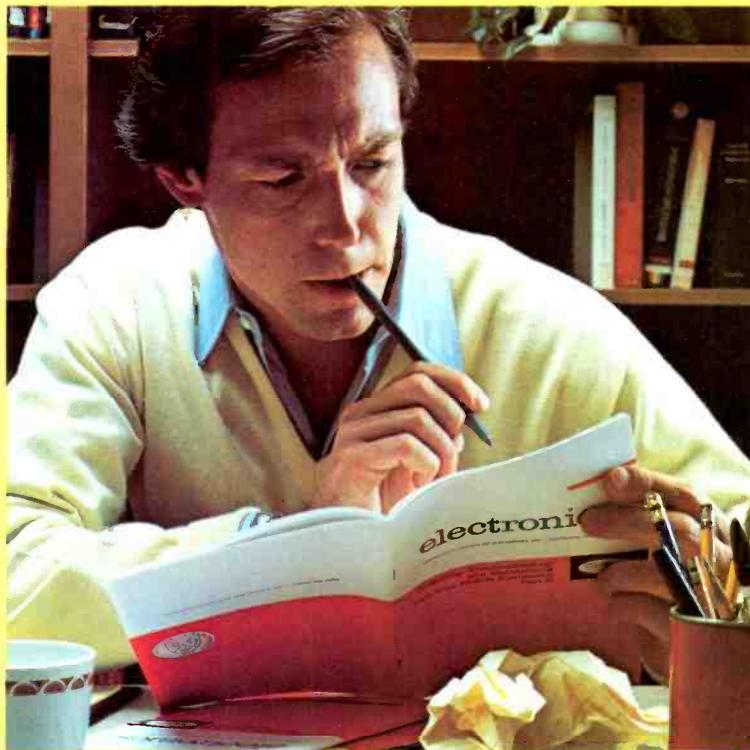
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CIRCLE 8 ON READER SERVICE COUPON

Learning electronics is no picnic.



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takes work and
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it's worth it.**

Whoever said, "The best things in life are free," was writing a song, not living a life. Life is not just a bowl of cherries, and we all know it.

You fight for what you get. You get what you fight for. If you want a thorough, practical, working knowledge of electronics, come to CIE.

You can learn electronics at home by spending just 12 hard-working hours a week, two hours a day. Or, would you rather go bowling? Your success is up to you.

At CIE, you *earn* your diploma. It is not handed to you simply for putting in hours. But the hours you do put in will be on your schedule, not ours. You don't have to go to a classroom. The classroom comes to you.

Why electronics training?

Today the world depends on technology. And the "brain" of technology is electronics. Every year, companies the world over are finding new ways to apply the wonders of electronics to control and program manufacturing, processing...even to create new leisure-time products and services. And the more electronics applications there are, the greater the need will be for trained technicians to keep sophisticated equipment finely tuned and operating efficiently. That means career opportunities in the eighties and beyond.

Which CIE training fits you?

Beginner? Intermediate? Advanced? CIE home study courses are designed for ambitious people at all entry levels. People who may have:

1. No previous electronics knowledge, but do have an interest in it;
2. Some basic knowledge or experience in electronics;
3. In-depth working experience or prior training in electronics.

You can start where you fit and fit where you start, then go on from there to your Diploma, FCC License and career.

Many people can be taught electronics.

There is no mystery to learning electronics. At CIE you simply start with what you know and build on it to develop the knowledge and techniques that make you a specialist. Thousands of CIE graduates have learned to master the simple principles of electronics and operate or maintain even the most sophisticated electronics equipment.

CIE specializes exclusively in electronics.

Why CIE? CIE is the largest independent home study school that specializes exclusively in electronics. Nothing else. CIE has the electronics course that's right for you.

Learning electronics is a lot more than memorizing a laundry list of

facts about circuits and transistors. Electronics is interesting! It is based on recent developments in the industry. It's built on ideas. So, look for a program that starts with ideas and builds on them. Look to CIE.

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That's exactly what happens with CIE's Auto-Programmed® Lessons. Each lesson uses famous "programmed learning" methods to teach you important principles. You explore them, master them completely, before you start to apply them. You thoroughly understand each step before you go on to the next. You learn at your own pace.

And, beyond theory, some courses come fully equipped with electronics gear (the things you see in technical magazines) to actually let you perform hundreds of checking, testing, and analyzing projects.

Experienced specialists work closely with you.

Even though you study at home, you are not alone! Each time you return a completed lesson, you can be sure it will be reviewed, graded and returned with appropriate instructional help. When you need additional individual help, you get it fast and in writing from the faculty technical specialist best qualified to

answer your question in terms you can understand.

CIE prepares you for your FCC License.

For some jobs in electronics, you must have a Federal Communications Commission (FCC) License. For others, some employers tend to consider your license a mark in your favor. Either way, your license is government-certified proof of your knowledge and skills. It sets you apart from the crowd.

More than half of CIE's courses prepare you to pass the government-administered exam. In continuing surveys, nearly 4 out of 5 graduates who take the exam get their licenses! You can be among the winners.

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Fill in and return the postage-free card attached. If some other ambitious person has removed it, cut out and mail the coupon. You'll get a FREE school catalog plus complete information on independent home study. For your convenience, we'll try to have a CIE representative contact you to answer any questions you may have.

Mail the card or the coupon or write CIE (mentioning name and date of this magazine) at: 1776 East 17th Street, Cleveland, Ohio 44114.



Pattern shown on oscilloscope screen is simulated.



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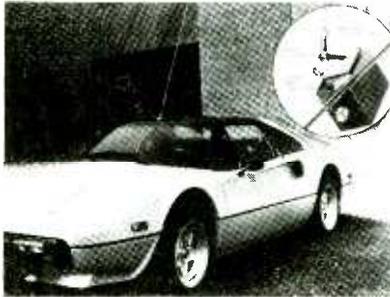
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MAIL TODAY!

NEW PRODUCTS PARADE

(Continued from page 6)

AFM-1 is the Ritter noise control circuitry contained in the black pick-up box. This advanced feature enables the AFM-1 to reduce noise and static before it ever



CIRCLE 45 ON READER SERVICE COUPON

gets to your mobile radio. Last, the AFM-1 can be mounted quickly and easily on a glass windshield or window without drilling holes in the vehicle, and it sells for \$34.95. For more information on the AFM-1 contact: Avanti Re-

search & Development, Inc., Audio Division, 340 Stewart Avenue, Addison, IL 60101.

Low-Cost 8-Channel Scanner

Electra Company has developed a low-cost, high-capability Bearcat™ crystal scanner to introduce the first-time user to the fun, and utility, of radio scanning. Called the Bearcat 5, the scanner has a suggested retail price of just \$129.95 (less crystals) yet will receive up to eight channels in any mix of four bands (high and low VHF, UHF, and UHF "T" Public Service Bands). In the Scan mode it scans all eight channels at the rate of 10 per second; each channel has a lockout control to permit bypassing when desired. In the Manual mode, the listener can manually select and hold any of the eight channels. Other plusses are a low-profile molded case, LED channel indicators, built-in speaker and telescoping antenna. It also has provisions for an external speaker and antenna. The unit operates on 117 VAC. Com-

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plete information on the new low-cost Bearcat 5 scanner is available from Bearcat scanner suppliers or directly from Electra Company, P.O. Box 29243, Cumberland, IN 46229.

Speaker System

Radio Shack's Optimus 25 speaker system has an acoustically sealed 12-inch woofer, a 4-inch midrange speaker, and a 2½-



CIRCLE 32 ON READER SERVICE COUPON

inch tweeter. Two switches let you adjust midrange and treble to suit acoustics. There are phono-type jacks and screw terminals for easy hookup. The Optimus 25 has a genuine walnut veneer cabinet with removable chocolate brown grille. The system's response range is 45-20,000 Hz, and the power handling capability is now up to 75-watts at 8-ohms. The catalog price is \$129.95 at Radio Shack stores and dealers nationwide and in Canada.

Super Car Radio

Alpine Electronics has introduced the 7308 in-dash FM/AM cassette radio that features digital phase-locked-loop frequency synthesizer, digital station readout and tape counter, a five-station preset memory with automatic scan and seek, and a music sen-

(ADVERTISEMENT)

NEW SCANNER MONITOR ANTENNA

By Scott Larkin

The Avanti Astro Scan Tri-Band Monitor Antenna

A new base station scanner antenna called the Astro Scan has been developed recently by Avanti - one of the oldest and largest antenna companies in the world.

As with a TV set, it's the antenna that helps make the system really work clearer and more effectively. That's why the Astro Scan is so much more than just a "built-in" antenna. It really pulls in the signal - and extends the receiving capabilities of your scanner.

With Astro Scan, you can monitor the entire range of HF, VHF and UHF signals, including the new "T" Band. It is also capable of transmitting on VHF and UHF and the Business Band portion of HF. You'll pick up more on the scene mobile reports, more long distance signals and hear a lot more action than with your "built-in" antenna.

The unique co-inductive design actually combines three antennas into one, with each antenna operating at peak potential. Astro Scan is compatible with all old or new base scanners.



Exclusive features of the Astro Scan:

Unique design eliminates troublesome coils. No burn out when lightning strikes.

Lightweight, compact design is engineered for ease of installation.

State-of-the-art design improves both gain and bandwidth. It gives you fewer dead spots and longer range, clearer reception.

Uses a DC ground construction. This electronic configuration cuts static and noise.

Compact aerospace construction is well balanced to reduce strain on the mast and rigging. The cryogenic aluminum used in the manufacture of the Astro Scan actually gains strength in colder weather, helping it to resist an antenna's worst enemy - ice storms.

So, if you're tired of not getting into all the action, discover what's really happening today with the Avanti Astro Scan. For more information, contact Avanti Research and Development, Inc., 340 Stewart Ave., Addison, IL 60101. 800-323-9429. Illinois Residents: 312-628-9350.

sor system that scans the tape for the start of a new song. The unit carries a suggested retail of \$699.95. The 7308 offers 6-watts-per-channel RMS for each of four channels, or a total of 24-watts RMS, Dolby noise reduction, separate bass and treble controls, four-way fader, chrome and ferrochrome tape switch, locking fast forward and rewind with automatic eject at the end of fast forward, and automatic replay at the



end of rewind. All controls are electronically activated for feather-touch softness and instant reaction. Alpine's unique cassette glide system gently pulls the tape into playing position and electro-mechanically locks the tape against the head to align the head precisely and to ensure fidelity to specifications. The electronic glide eject system lifts the cassette and gently presents it to the listener outside the cassette window to further protect the hard permalloy head. The 7308 fits most makes of American and foreign cars. The 7308 has built-in muting, balance control, noise eliminator switch, stereo indicators and FM/AM switch. For all the facts, write to Alpine Electronics of America, 3102 Kashiwa St., Torrance, CA 90505.

CIRCLE 40 ON READER SERVICE COUPON

5-way Speaker Switch

The Controller, a new stereo selector switch designed by Audiotex Laboratories Division of GC Electronics, allows hook up and in-



dependent control of up to five pairs of stereo speakers. Any one pair or up to all five pairs may be played at the same time! In addition, the Controller incorporates

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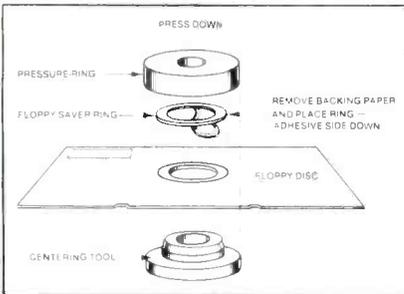
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NEW PRODUCTS PARADE

two stereo headphone jacks for private listening. The unit features built-in circuitry for amplifier protection, regardless of the number of speakers employed. The internal protection load may be switched out of circuit if desired when the speaker load is no less than 4-ohms. It's rated at 50-watts continuous per channel. Suggested retail price of the Controller (30-8710) is \$49.50, and it's available at electronics and audio dealers nationwide. Get all the facts directly from GC Electronics, 400 So. Wyman St., Rockford, IL 61101.

Ring a Floppy

The Floppy Saver is a reinforcing ring designed to lengthen the life of mini-disks by preventing damage to the center hole by the clamping hub and rotating spindle. Such damage can cause loss of the data on the disk. Floppy Saver is made of 7-mil (.007) my-



CIRCLE 39 ON READER SERVICE COUPON

lar with paper-protected super adhesive backing. The rings are punched on a special steel die with a tolerance not exceeding 0.0005-inches. The Floppy Saver is easily installed with the special tool provided and in many cases can resurrect damaged mini-disks. Price is \$14.95 for a kit with 25 rings and tool. Contact your computer store or Tri-Star Corporation, P.O. Box 1727, Grand Junction, CO 81502.

AM/FM/CB Disguise Antenna

A new 3-way antenna system by The Antenna Specialists Company disguises the fact that a CB radio is in the vehicle, helping to prevent theft. The antenna looks like a standard auto antenna and has no visible coil to show that it works on CB. It simply mounts in place of the standard AM/FM

cowl mount antenna. Special hidden couplers permit it to give excellent performance on CB as well as AM and FM broadcast reception. Called the model M-266, the antenna includes a solid-state pre-amplifier to significantly boost FM signal reception. By providing up to 15 dB of signal boost, it helps



CIRCLE 44 ON READER SERVICE COUPON

prevent noisy reception from distant FM stations and also reduces the "picket fencing" caused by rapidly changing signal strengths during highway driving. The suggested retail price of the new model M-266 antenna system is \$49.95. Complete details are available from A/S antenna suppliers or by writing directly to The Antenna Specialists Company, 12435 Euclid Ave., Cleveland, OH 44106.

Light Show Control

Edmund Scientific offers a 3-channel Sound to Light Control Unit for producing special music/lighting effects. The unit visually displays the frequency, and amplitude or loudness content of music. Three controls allow you to break down the music into



CIRCLE 36 ON READER SERVICE COUPON

three basic frequency ranges: low (bass), medium (mid-range), and high (treble). Using ordinary incandescent light bulbs, the 3-channel Sound to Light Control Unit illustrates its sensitivity to these frequency ranges in the activity of the light signals. The unit will respond differently to different types of music and can be ad-

(Continued on page 16)

TURNER[®] ELEMENTARY CB Microphones



RK 76

Turner has combined noise cancelling features and the range-boosting advantages of a power mike. Noise cancelling keeps your transmission free of background noise while the preamp circuit assures you full modulation, maximum range and optimum clarity.

If you're really serious about CB, put your money where your mike is.

Serious CB operators who want to get the most from their transceivers have been setting aside the microphones that came with their radios and replacing them with Turner Microphones. In the United States, they've been doing this since the 1950's. Now they are doing it in 33 countries around the world.

Why?

Radio manufacturers, in order to keep the cost of radios competitive, have designed simple, inexpensive microphones that are just that and nothing more. Turner amplified mobile mikes, on the other hand, with 0 to 15 dB gain controls can supply the extra "talk power" that will fully modulate the radio. Noise cancelling Turner mikes eliminate the unwanted background noise in truck cabs and tractors while delivering clear modulation of the desired signal. Amplified Turner desk mikes with gain controls, push-to-talk switches and lock levers allow the base station operator ease of operation, flexibility and much more "talk power" than the original microphone.

So, if you want to improve your radio's performance quickly, inexpensively and effectively, then get serious and put your money where your mike is — on a Turner Microphone.



RK 56

This is the "truckers' favorite" A combination of economy and exceptional noise cancelling, dynamic performance. In large truck cabs, an extra long rugged coil cord provides easy mike handling and the noise cancelling feature blocks out unwanted background noise for clearer transmissions.



Super Sidekick

This is an outstanding base station mike for SINGLE SIDEBAND operations. The Super Sidekick power mike has two gain adjustments to match the sensitive input requirements of both high and low impedance transceivers. If you're a sidebander — you'll be QSA-5 with this mike.



+3B

The rugged die-cast case, temperature-stable silicon transistors and humidity-resistant ceramic element make this power mike practically indestructible. Maximum -23 dB output is easily adjusted by a gain control on the front panel for powerful audio — free of QRM.

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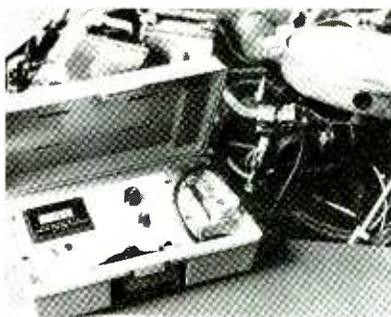
NEW PRODUCTS PARADE

(Continued from page 14)

justed to suit the listener's musical preference. The 3-channel Sound to Light Control Unit sells for \$24.95 plus \$1.75 handling and guaranteed delivery. For complete information and catalog, write to Edmund Scientific Company, 7802 Edscorp Building, Barrington, NJ 08007.

Gas Saver

Heath's new portable digital engine analyzer, the CM-1550, handles several tune-up measurements, including dwell for 4 through 8-cylinder engines, RPM to 10,000 in two ranges, DC voltage to 200-volts in two ranges, resistance to 2-megohms in three ranges, and direct current to 20 Amperes. With the optional CMA-1550-1 Shunt Accessory, the CM-1550 will also measure starting current and battery charging/discharging current, up to 400 Amperes. The CM-1550's liquid crystal display shows all measurements. Power is supplied by a 9-volt battery (not included). The inductive pick-up for the RPM readings is attached to any spark plug wire. The CM-1550 can be assembled in two or three evenings, with just one circuit board



CIRCLE 49 ON READER SERVICE COUPON

to wire. It is mail order priced at \$94.95, while the optional CMA-1550-1 400-Amp Shunt Accessory sells for \$13.95, mail order. For more information on the CM-1550 Engine Analyzer, send for a free catalog to Heath Company, Dept. 350-180, Benton Harbor, MI 49022, or pick up your copy at the nearest Heath Electronic Center.

Logic Probe Kit

"We took a lesson from the leaders in the kit business," explained Continental Specialties President

Ron Portugal, "in designing the manual for our \$19.95 Logic Probe Kit. We made each step simple and obvious. As a result, the LPK-1 is an easy one-night project." The Continental Specialties LPK-1 Logic Probe Kit is a full performance CSC Logic Probe in kit form



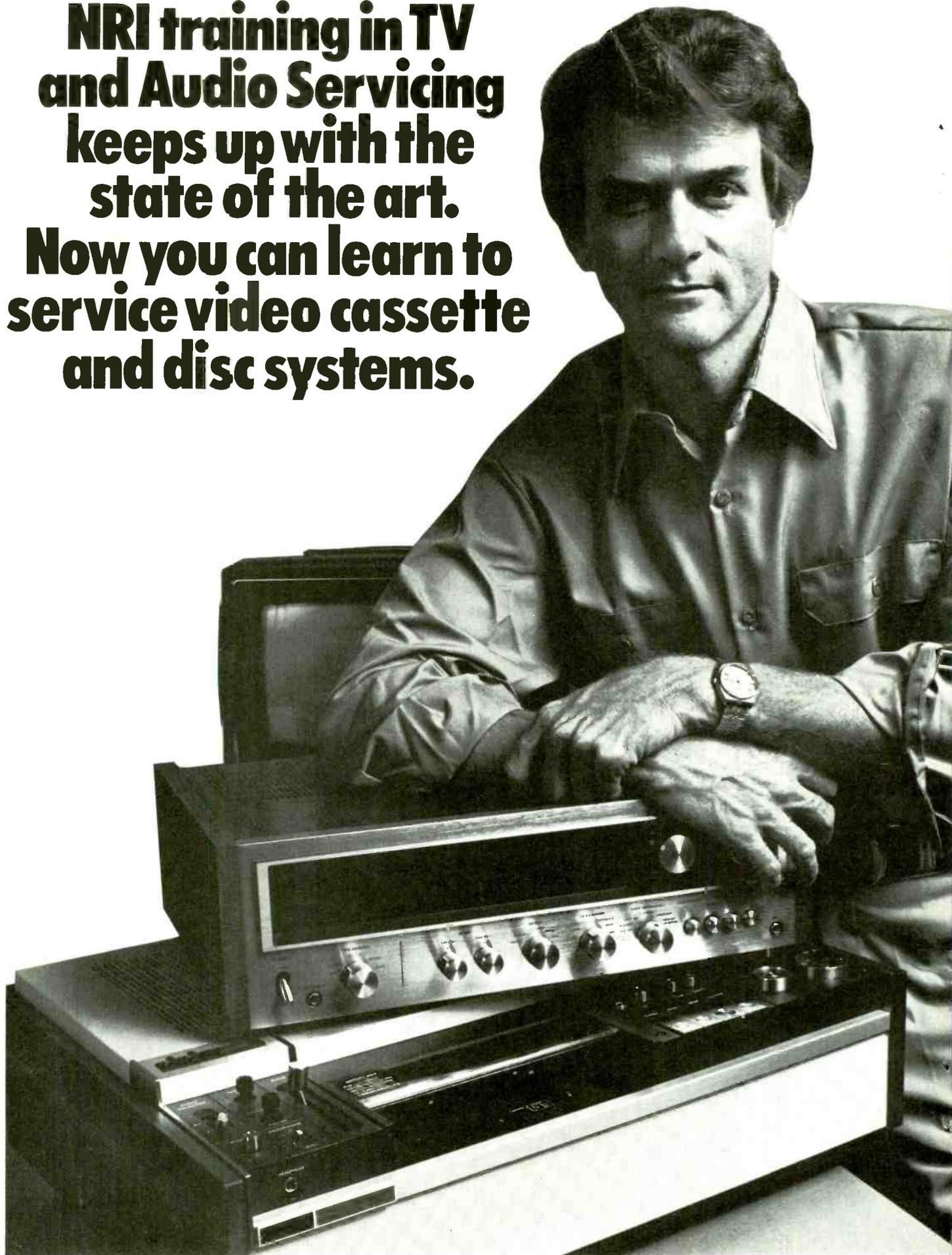
CIRCLE 43 ON READER SERVICE COUPON

including all the parts, hardware and instructions necessary to put it together the day it arrives. With it, logic levels in a digital circuit translate into light from the *Hi* and *Lo* LEDs; pulses as narrow as 300 nanoseconds are stretched into blinks of the *PULSE* LED. The LPK-1 is completely circuit-powered. Its input impedance is 300,000-ohms. High and low logic thresholds are taken at 70% and 30% of the applied Vcc, respectively. The input to the LPK-1 is protected to ± 50 VDC continuously applied, and up to 117 VAC for up to 15 seconds. Power is provided from the circuit under test through a 36-inch long power cord which features a molded strain relief collar and pre-attached color-coded insulated alligator clips. The \$19.95 price puts it within the reach of everyone. The LPK-1 is now available at most CSC distributors. For additional information or the name of your local distributor, call Continental Specialties Corporation toll free at 1-800-243-6077 or write to them at: 70 Fulton Terrace, New Haven, CT 06509.

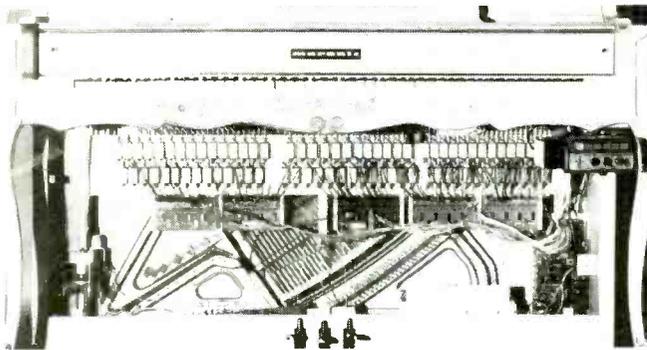
Pianocorder Kit

A do-it-yourselfer can now transform his or her idle home piano into a full-time musical entertainment center with the help of a newly-patented retrofit kit from Superscope, Inc. The kit contains a Pianocorder reproducing system, an electronic mechanism which enables a normal piano to record and play "live"—by itself

**NRI training in TV
and Audio Servicing
keeps up with the
state of the art.
Now you can learn to
service video cassette
and disc systems.**



—with the touch and interpretation of the recorded pianist. It can be adapted to fit almost any upright, spinet or grand model without affecting the piano's normal functioning. Based on computer technology, the Pianocorder system utilizes digital tape cassettes to

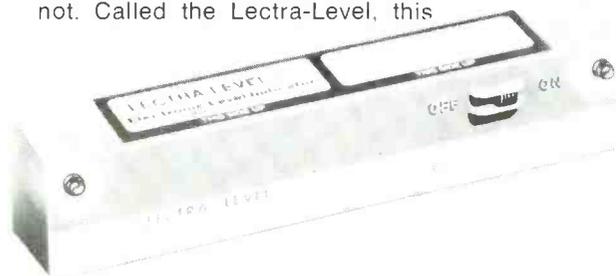


encode, then reenact a performance as it was originally played. The cassettes are inserted in a small tape recorder which activates the piano keys via a logic circuit board mounted across the open space behind the keys. Installation takes from 8 to 12 hours. Pianocorder kits, including all componentry, step-by-step instructions and a bonus set of ten tapes, start at \$1495. For more information or direct ordering, write Superscope, Inc., 20525 Nordhoff St., Chatsworth, CA 91311.

CIRCLE 38 ON
READER
SERVICE COUPON

LED Level

Here's a totally new kind of level indicator—unique because it operates electronically. The flick of a switch activates two LEDs when the surface is level—only the light on the high side is lit when it is not. Called the Lectra-Level, this



battery-operated tool is accurate to professional standards. The Lectra-Level is ideal for the weekend handyman and do-it-yourselfer, who wants to level shelves, pictures, clocks, thermostats, refrigerators and ranges, washers, dryers, etc. Its suggested retail price is \$13.95. For additional information, write to Martronics, Corp., 8700 Waukegan Road, Morton Grove, IL 60053.

CIRCLE 46 ON
READER
SERVICE COUPON

ok BW-2630 Battery Tool



BW-2630 \$19.85*
BT-30 \$ 3.95*
BT-2628 \$ 7.95*

BW-2630 BATTERY TOOL

The new BW-2630 is a revolutionary battery powered wire-wrapping tool. The tool operates on 2 standard "C" size NiCad batteries (not included) and accepts either of two specially designed bits. Bit model BT-30 is for wrapping 30 AWG wire onto .025" square pins; BT-2628 wraps 26-28 AWG wire. Both produce the preferred "modified" wrap.

Designed for the serious amateur, BW-2630 even includes both positive indexing and anti-overwrapping mechanisms — features usually found only in industrial tools costing five times as much. Pistol grip design and rugged ABS construction assure performance and durability. In stock at local electronic retailers or directly from

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Build Color TV with Computer Programming

As part of your training in NRI's Master Course in TV/Audio/Video Systems Servicing, you actually assemble and keep NRI's exclusive designed-for-learning 25"

Learn at home at your convenience.

(diagonal) color TV. It's the only one that comes complete with built-in computer tuning that lets you program an entire evening's entertainment. As you build it, you introduce and correct electronic faults, study circuit operation, get practical bench experience that gives you extra confidence.

You also construct a solid-state stereo tuner and amplifier complete with speakers. You even assemble professional-grade test instruments so you know what makes them tick, too. Then you use them in your course, keep them for actual TV and audio servicing work.

NRI Includes the Instruments You Need

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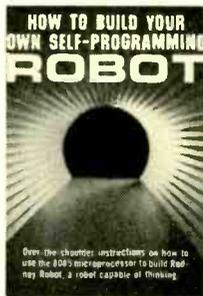
It's a Book! Heath Continuing Education, a division of Heath Company, has introduced a new learn-at-home electronics program on phase-locked loops. Heath's Phase-Locked Loops program, EE-104, discusses the uses, designs and operation of PLLs widely used in television receivers, FM receivers, CB and 2 meter transceiv-



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ers, industrial telemetry circuits and motor controls. Price is FOB Benton Harbor, MI. For further information on this and other advanced electronics programs, write for a free catalog to Heath Continuing Education, Dept. 350-160, Benton Harbor, MI 49022, or pick up a copy at the nearest Heathkit Electronic Center, or circle number 1 on the reader service card.

D2R2. Here's a fascinating and fantastic project in machine intelligence and robotics—a project an experimenter can carry as far as he wants, deciding just how advanced his robot will be! *How to Build Your Own Self-Programming Robot*, by David L. Heiser, takes the reader through every step—every circuit, switch, program, and byte of memory. This is more than just a projects book, however; it's a straightforward how-to introduction to the sophisticated



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subject of robotics and machine intelligence, a practical guide that shows how to build a robot capable of learning how to adapt to chang-

ing circumstances in its environment. The unique little creature described in this book, named Rodney, can pick up signals and stimuli from his environment and develop perceptions just like humans and higher animals do. Yet Rodney is fully trainable, and his personality can be altered and molded by human intervention. All in all, Rodney is in a class by himself, and is a most remarkable and fascinating machine—he can program himself to deal with the problems of the moment, and devise theories for dealing with similar problems in the future. Yes Rodney is self-programming, and as a result no two Rodneys behave exactly the same way. In fact, if his self-generated memory is wiped out, he'll develop another one that's somehow different from the first. Published by Tab Books, Blue Ridge Summit, PA 17214. Circle number 61 on the reader service card.

Latest CPU. *Programming the Z8000*, by Richard Mateosian, presents a comprehensive description of the Z8000—an advanced and sophisticated CPU. *Programming the Z8000* will be of special interest to all PDP-11 users and valuable to anyone



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320 pages
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interested in learning machine language programming. The text covers input/output techniques, Z8000 peripheral components, utility programming examples, Z8000 addressing modes, Z8000 hardware organization, and contains a complete instruction set. The book instructs the user, by example, how to write clear, well-organized programs. Published by Sybex, 2344 Sixth Street, Berkeley, CA 94710. Circle number 60 on the reader service card.

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CIRCLE 4 ON READER SERVICE COUPON

HI-FI REPORTS

REMOTE CONTROL

BY GORDON SELL

□ The room was quiet as the young woman picked up the microphone and said "power." A small LED lighted on the panel of the stereo control and all the components responded with similar LEDs and dial lights, and a metallic voice echoed across the room "okay." The woman and the voice continued the conversation.

"Tuner" said the woman.

"Okay," responded the machine.

"Channel Two," said the woman mumbling the word "two."

"Repeat?" queried the machine.

"Channel Two," she repeated, clearly.

"Okay," said the machine as the LED channel display switched to the pre-programmed channel.

"Volume up," said the woman.

"Okay," and the sound came on quietly. A few more "Volume up" commands later the sound was flooding the room.

Glimpse of the Future. This remarkable demonstration was of a prototype remote control system developed by Toshiba. The machine can control a tape deck and turntable in addition to the tuner. In fact it can do everything but put a record on the platter and flip it, and insert cassettes. Hopefully such a system will be available to consumers in the near future.

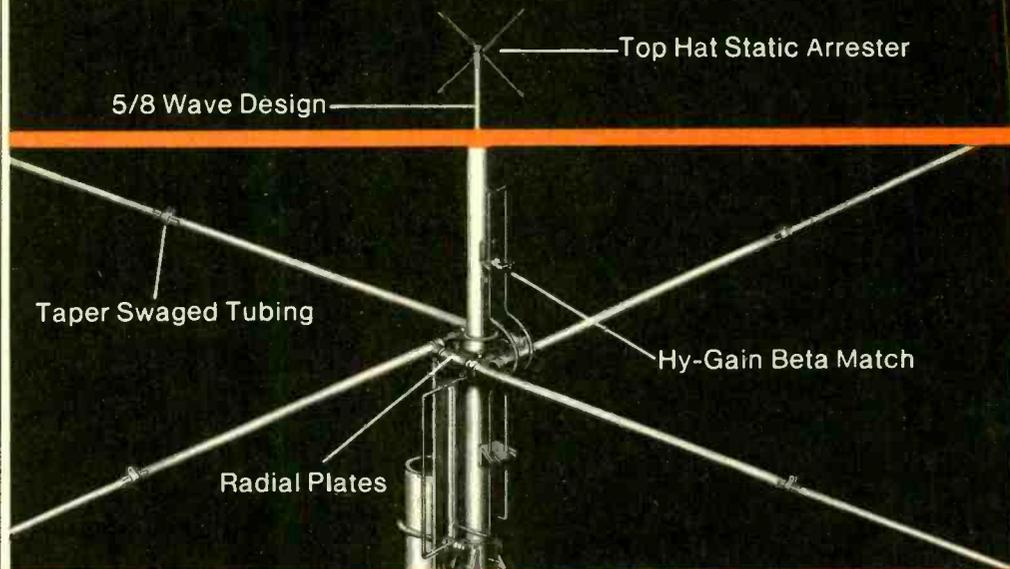
A lot of other remote control systems are already a reality.

Kenwood, Technics and JVC recently introduced remote control systems that operate with infrared control units much like television remote controls. All three are capable of controlling tuners, turn-



Toshiba's prototype remote control system is just a peek at the future of hi-fi systems. It can understand 15 words and put them together to make 19 total instructions. If it doesn't understand it asks the operator to repeat and it lets the user know he was understood verbally. Circle number 92 on the R. S. coupon.

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Model 542 SDB 6

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HI-FI REPORTS

tables, cassette decks, and integrated amplifiers. On the tuners they control on/off and cueing functions and on the cassette decks all functions are controlled.

Another interesting development is Eu-mig's computer-controlled cassette deck. It is designed to operate under the control of any 8-bit microcomputer, and up to 16 of these decks can be controlled by one computer.

What we've seen so far is just the beginning of remote controlled audio. In the near future you can look forward to home audio systems with multiple speaker systems that will be operable from anywhere in the home with a pocket size remote controller. The audio industry has only scratched the surface in this exciting area.



Technics remote control system is available today. It consists of a tuner/preamp (ST-K808), a 40-watt-per-channel amplifier (SE-A808) and SH-R808 remote control unit. These three together cost \$900. A turntable (SL-D33 at \$260) and cassette deck (RS-M45 at \$400) round out this interesting and futuristic system. Circle number 91 on the R. S. coupon.

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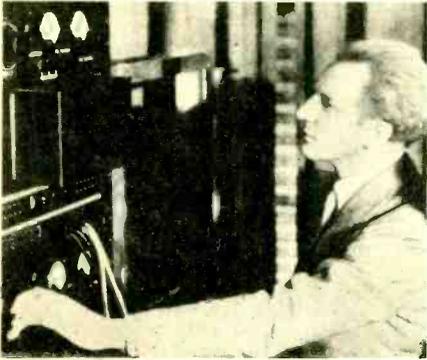
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Two Men in Early Stereo

For Arthur C. Keller of Bell Labs, the winter of 1931-32 was memorable for him, and historic for the world. Nearly every weekend, Keller and several Bell Labs associates would take their gear to the Academy of Music in Philadelphia. There, they matched their electronic wizardry with the musical virtuosity of Leopold Stokowski as he conducted rehearsals and live performances of the Philadelphia Orchestra.

Even then, Stokowski was a legend among conductors. "No one denied that his tenure in Philadelphia had



Leopold Stokowski is shown at Washington D.C.'s Constitution Hall adjusting the controls on some early stereo equipment. Music played by the Philadelphia Orchestra at the Academy of Music in Philadelphia was transmitted to Washington over the Bell System's underground telephone cables.

altered the course of symphonic music in America," music critic Glenn Gould wrote in *The New York Times*. "... He had created, in his own image, an orchestra that could stand comparison with the greatest in the world—and by the time he left it, indeed, may have been the best in the world."

"I found Stokowski very personable," Keller recalled. "He had a dynamic personality. He was always very interested in our work, and cooperative with what we were trying to accomplish."

The Bell Labs engineers hadn't chosen their collaborator accidentally. Harold D. Arnold of Bell Labs enlisted Stokowski's cooperation because the development team needed a sound source that would push their

new recording equipment to its limits, and in Stokowski's orchestra, they had found the greatest.

"Stokowski's assistant would sometimes warm up the orchestra while we adjusted our equipment," Keller said. "Then Stokowski would step in, and it would be a different orchestra! It seemed to have a greater volume and range, more zip; and he added flourishes that hadn't been there before."

Keller recalls vividly the time he and Rafuse recorded Stokowski conducting Berlioz' *Roman Carnival Overture*, something Stokowski didn't often perform because it took so much of his energy. "I was getting pretty cocky by then," Keller said. "I went to Stokowski and asked him for a demonstration of the most his orchestra could do in volume and frequency range. I sat in the middle of the orchestra while Rafuse monitored the controls in the basement. After the magnificent 10-minute performance," Keller continued, "I checked with Rafuse and he reported, 'It looks like a good recording.' We came back to tell Stokowski, and he was completely exhausted, soaked with perspiration."

Only four other recorded performances of the *Roman Carnival Overture* by Stokowski exist, all done many years later. Stokowski's enthusiasm for the Bell Labs project was revealed, Keller said, when the conductor visited the company's headquarters, then on West Street in New York City, to hear the *Roman Carnival Overture* recording. According to Keller, Stokowski remarked, "This is undoubtedly the finest recording I have ever heard!"

Now retired, Keller identified and classified the Stokowski discs from among some 6,000 early recordings stored in the archives of Bell Labs. Selected copies of these recordings were presented to The New York Public Library and the Library of Congress.

Servo IC for RC Cars

A complete servo controller system on a single chip, designed to drive radio-controlled model cars has been introduced by Exar Integrated Systems, Inc. The XR-2266 is a

monolithic integrated circuit consisting of two separate servo control channels on the same chip. One channel steers the model car; the other controls the direction of travel (forward or reverse) and speed.

While the speed/direction channel requires external power transistors, the steering channel is completely self-contained, with an internal ± 350 milliamp output drive capability. The XR-2266 servo controller system contains controls for the accessory functions available in model cars, such as turn-signal indicators and back-up lights, all on one 18-pin dual-in-line plastic package. The XR-2266 contains five separate subsystem blocks. It has two servo control systems, one for steering and one for forward-motion control. Next, it has a channel divider that automatically separates the composite con-



A complete receiver and servo controller on one chip, EXAR's XR-2266 can receive and act on all commands necessary to control every function of this radio-operated model car, even to turning on the directional signals and back up lights. It may be the heart of next year's Christmas best-sellers.

trol signal into speed and steering inputs, directing each to the appropriate servo controller channel. And last, it has two detectors, one each for turn-signal and back-up light indicators. The chip operates on batteries rated at 3.5 to 8.0-volts.

The XR-2266 is priced at \$4.45 in quantities of 100 or more and at under \$2 each in mass-production quantities. Hopefully, the prices will come down before Christmas. ■

DX CENTRAL REPORTING

A WORLD OF SWL INFO

BY DON JENSEN

□ To steal a line from a well-known newscaster, 'let's hopscotch the world for headlines.' In this ever-changing world of shortwave broadcasting, there are plenty of highlights and sidelights to report this month.

There seems to be a growing number of illicit, unlicensed shortwave "pirate" stations on the air lately, with the so-called free radio stations in North America joining their generally longer established cohorts in Great Britain and Europe. Often the operators of these illegal ventures profess to want to bring a different sort of programming to SW.

That's the idea of ex-SWL Joseph Costello, owner of rock format FM station WRNO in New Orleans. But Costello's plans are for a legally-licensed U.S. shortwave station that would broadcast rock music.

Costello sees commercial shortwave radio as a viable proposition and, reportedly, a 100 kilowatt shortwave transmitter is already on order. At this writing, the Federal Communications Commission had not approved a construction permit for WRNO SW, but if granted, the station could be on the air before the end of the year.

There are several spots on the earth that, for whatever reason, seem to catch the imagination of shortwave listeners. These exotic locations apparently have a special attraction to many people, making SW stations in these areas special targets for listening efforts. Tahiti is a prime example, and so are Nepal and Zanzibar and the southernmost continent of Antarctica.

For several years, the U.S. has operated a shortwave station—American Forces Antarctic Network (AFAN) at our McMurdo base—on 6,012 kHz. While it has been heard by DXers in the States and Canada, the station isn't powerful and the frequency is subject to considerable interference. So, Antarctica has been a very tough spot to log on SW.

It became a somewhat easier task last fall when a new Antarctic shortwave station came on the air, to the surprise of most SWLs. The new station, Radio Nacional Arcangel San Gabriel has been operating on a

frequency of 6,029 kHz, also in the 49 meter band, from the Argentine military base Esperanza in the Antarctic. Programming is in Spanish, and DXers have been hearing it best at signon time, just before 0000Z.

Shortwave news also is being made in southern Africa too. For several years, South Africa has been creating what it terms "Independent Homelands" for its various black African tribal groups. These "countries" have not been recognized as truly independent by the rest of the world, however.

A few months ago, shortwave broadcasting came to one of these Homelands, Transkei. The commercial station at Umtata, Transkei is called Capital Radio. With an emphasis on pop music, it sounds a good bit like South Africa's own

Radio 5 home service commercial radio. Capital Radio has been heard here at DX Central around 0430 GMT on a frequency of 7,160 kHz.

Reports that a new shortwave service will begin operation in South West Africa, now known as Namibia seem solid. Watch for a new, and probably quite powerful station at Windhoek, the capital city, early sometime this autumn.

Israel Radio has long hoped to begin shortwave transmissions to North America during the prime time evening hours. But until early this year, various problems prevented Kol Israel from broadcasting in English to listeners in the U.S. and Canada during this optimum listening period. That changed on January 31, when the Israeli station inaugurated direct English radio transmissions at 0000,

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DX CENTRAL REPORTING

0100 and 0200 GMT. Initially, the frequencies used were 7,412, 9,815 and 11,637 kHz. Further data on future program schedules and frequencies can be had by dropping a note to Kol Israel, Box 204, Cheltenham PA 19012.

Last Call. Time is growing short, but there is still time for shortwave listeners and all other DXing fans to attend the ANARC 1980 convention at Irvine, CA. ANARC—the Association of North American Radio Clubs—is the umbrella organization affiliating the major listening hobby clubs in North America. Each year it sponsors a gathering of DXers. ANARC '80 welcomes all persons with an interest in the fascinating hobby of listening to distant stations, whether beginner or veteran, whether a member of one of the ANARC affiliated clubs or not.

The 15th annual convention is scheduled for July 18-20 on the University of California-Irvine campus. Expected to be on hand for the three-day event are some of the broadcasters you know from your shortwave listening from stations around the world, plus other listeners—several hundred of them—from across the continent and abroad.

There will be talks, panel discussions, displays of equipment and the opportunity to meet and talk with other hobbyists and broadcasting personalities. The registration fee is \$10. If you plan to attend the Saturday night banquet, a highlight of the event, an additional \$10.50 fee is charged. Those wishing to stay in convention lodgings right on the campus may reserve accommodations. The rates are \$23 per person, per day, single occupancy, with meals included; or \$20 per person, per day, double occupancy, with meals. The convention hosts will try to pair you with another person in a double room, if you request it. I guarantee you'll find the convention interesting, informative and, yes, fun! Contact Steward MacKenzie, Convention Chairman, ANARC '80, 16182 Ballad Lane, Huntington Beach, CA 92649.

Marketplace. There are a number of receivers on the market which take advantage of newer technology, including and especially, direct digital frequency readout. The ability of a receiver to display numerically the exact frequency to which a receiver is tuned may be the single most im-

portant factor in taking the guesswork out of shortwave listening.

I've been intrigued by the pre-release publicity on a brand new SONY shortwave receiver called the ICF-2001, which seems to take the new technology one step further. The ICF-2001 does away with the business of tuning a dial. With frequency synthesizer and microcomputer built in, tuning is a matter of punching in the desired frequency. Additionally the ICF-2001 can also scan the bands. It looks like a technological breakthrough in the shortwave receiver field for what I am told is a surprisingly favorable price.

Interested in knowing when and where to tune on shortwave to hear English language programs? Veteran SWL Dan Ferguson, with the aid of a computer, keeps track of that sort of data and issues regularly updated lists, compiled both "by country" and "by time." The lists are regularly updated to include the latest information available. A copy of the latest list is available from Ferguson for \$2.00. Write to: English Language Programs, Box 8452, South Charleston, WV 25303.

Handler Enterprises Inc., P.O. Box 48, Deerfield, IL 60015, has a new publication, *The Radio Communications Guide*. The book, priced at \$6.95 (plus 42¢ tax for Illinois residents), is designed for the shortwave listener and VHF-UHF scanner monitor. It lists frequencies and other data for many government and military two-way utility radio services.

And, of course, I must note that

DX GLOSSARY

AM = amplitude modulation, the normal shortwave and medium wave broadcasting mode, but the term is often used to mean medium wave broadcasting in the 540 to 1600 kHz range.

DX, DXer, = distant broadcasting stations; one who listens to such 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.

Pirate = unlicensed, unauthorized and illegal broadcasting stations
SW, SWL = shortwave, shortwave listener

the *World Radio TV Handbook* 1980, the "bible" for SWLs, containing schedule, frequency, programming, address, and much much more data on worldwide SW operations, is available from Gilfer Associates, P.O. Box 239, Park Ridge NJ 07656 for \$12.95.

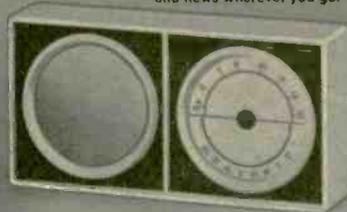
Bandsweep. (Times in GMT, frequencies in kHz)—3,250—Earlier in the column, I referred to South Africa's popular Radio 5 home service programming, probably less familiar to many SWLs than the nation's Radio RSA external service. You can find Radio 5 on this frequency around 0330 GMT . . . 3,985—Switzerland down here in the 75 meter band, supposedly off-limits to international broadcasting? Yes, because this frequency of Swiss Radio International is intended for regional European audiences only. But the station is often well heard in North America around 0600 and later . . . 4,820—Honduras is not in all SWLs' logbooks because the handful of stations in this Central American country broadcast in Spanish. The exception, though, is HRVC, a religious missionary station, which has English language programming at 0300. If you are willing to tackle a Honduran station programming in Spanish, try Radio Juticalpa on 4,780 kHz, signing on just prior to 1100 . . . 6,730—After a silent period, Canadian shortwaver CHNX, the Maritime Broadcasting Co. station at Halifax, Nova Scotia returned to the air. Chief Engineer Dick Parker and Assistant Engineer Douglas Hiltz are looking for reports of reception, especially from Canadian ships at sea. Reports go to Box 400, Halifax, N.S. B3J 2R2 . . . 9,835—This is a good bet for beginning SWLs, Radio Budapest, Hungary. The frequency is a bit off the beaten track, at the high end of the popular and usually crowded 31 meter band, hence rather easy to find. Listen for English programming at 0300 . . . 11,695—Radio Peking falls in the same category, fairly easy to find at the low end of the 25 meter band, with a solid signal strength. This one airs English programming at 0100 . . . 21,545—Here is a station with a really high SW frequency, Radio Kuwait. One listener reports this one with no interference and good signals at 0530, in English.

(CREDITS: Robert RANKIN, KA; Larry DANKO, NJ; Jack JONES, MS; Ruth HESCH, NY; Carl DURNAVICH, IL; Richard MILLER Jr., WV; Aaron SOLOMON, Nova Scotia, CANADA; North American SW Association, Box 13, Liberty, IN 47353).

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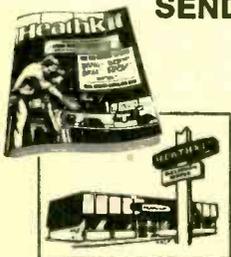
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What's New for Morse Code

A closeup look at the computerized revolution in working CW

BY ROBERT GROVE



□ It used to be so simple. You pressed your key, turning the transmitter on and off as you sent Morse code. Through the crackle of the earphones or speaker you listened for the reply. While the majority of hams still send and receive CW (continuous wave) by ear, a growing number are using automatic keyers and readers.

Among the earliest contributors to automation in Morse code was Vibroplex, with their "Bug"; it was a variation on the "side paddle" in which dots and dashes were composed by a left and right motion of the key finger grips rather than the classic up-and-down motion. But the "Bug" had another advantage. As long as it was held to one side, it would send repeated dots—perfectly spaced. This was (and still is) accomplished by a vibrating flat spring, and the speed was adjusted by a sliding weight.

Inevitably, electronics caught up with the old Morse code key, and now dots and dashes may be sent with automated precision. Automatic keyers employ integrated circuit timers to assure correct dot-dash time relationships as well as proper spacing. Even the beginner can now copy speeds in excess of 50 words-per-minute using Morse readers. Manufacturers offer a variety of CW send/receive options which may be used with existing computers, video monitors, and stand-alone terminals. For the veteran CW operator who still enjoys the thrill of the chase, active filters, regenerators, and "scrubbers" may be used to clean up received signals making manual copy much easier.

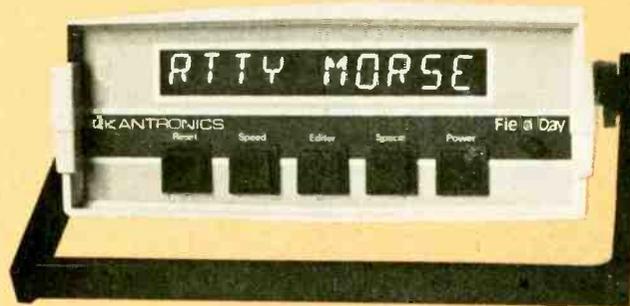
We are going to take a closer look at a sampling of the better-known equipment now on the market intended as aids for CW operators. Because of the digital similarity between CW and radioteletype, many of these instruments may be used with both modes of communications.

Kantronics "Field Day." One of the most compact dual-mode readers we have seen is this unit from Kantronics. It is a Morse/RTTY reader with a built-in LED digital display to show full alphanumeric text on four standard teletype speeds (60/66/75/100 words-per-minute). In addition, it will display received Morse code at speeds of up to 80 words-per-minute! Two LED characters may be punched up to display the speed of the incoming CW signal. Owing to the promise of these features, we decided to have a look at one for ourselves. Upon opening the package, we were amazed at how lightweight this little unit is. It contains its own power supply and measures roughly 3½-inches by 8½-inches by 9-inches.

When plugged into the external speaker or headphone



The HAL DS-3100ASR is a top-of-the-line unit which really has all the bells and whistles. It features send/receive automation for Morse, RTTY, and ASCII modes. Circle 76 on R.S. Coupon.



The "Field Day" by Kantronics is a highly compact Morse Code and RTTY reader, with a bright LED display. It can read Morse at up to eighty words per minute. Circle 74 on R.S. Coupon.



The HAL DS-200KSR offers RTTY with five speeds. It is modular, and can be expanded to include CW. A video monitor can also be added later. Circle number 76 on the R.S. Coupon.



Microcraft's "RTTY Reader" is an economy way to get in on the RTTY reception game. It features an eight-character LED display, and is available in kit form. Circle 71 on R.S. Coupon



MFJ's Grandmaster Memory Keyer model MFJ-482 is one of a line of automatic Morse Code keyers with memory. The model 408 includes a speed readout meter. Circle 73 on R.S. Coupon.

jack of a receiver, the unit displays received CW signals "Times Square" fashion, the ten giant half-inch-high letters moving from right to left across the bezel. An internal speaker allows audible monitoring of the signal.

Although the unit will provide copy of weak signals and even those signals experiencing interference, it is rather unforgiving of a poor "fist." Erratically-spaced characters will appear as erroneous letters and numbers. But for all-around flexibility and versatility, the Kantronics Field Day is a very useful receiving accessory, priced at \$449.95 from Kantronics, 1202 East 23rd Street, Lawrence, KS 66044.

Info-Tech M-200E. One of the most professional items we have had the pleasure of testing first-hand is this new tri-mode converter from Info-Tech. This handsome unit is designed to act as an interface between a ham receiver and a video monitor. For our tests, we fed the video output into a Radio Shack TRS-80 video display. (An internal connection was required on the video monitor; it will not accept video through its interconnect cable). CW and RTTY were received on three different receivers to test the flexibility of the Info-Tech converter. It performed faultlessly with all three. The M-200E copies all four common teletype speeds, and CW to at least 55 WPM. Additionally, the versatile unit will copy ASCII. All three outputs may be fed to a serial line printer as an alternate to video presentation.

Many thoughtful features (mark/space centering LEDs, level meter, automatic limiting and threshold, unshift, and access jacks) make the Info-Tech M-200E a rather special piece of equipment. It retails for \$525 in the 72 character/line version, \$500 in the 32/line version from Info-Tech Incorporated, 2349 Weldon Parkway, St. Louis, MO 63141.

XITEX MRS-100 Transceiver. For CW enthusiasts who already own the popular Radio Shack TRS-80 computer system, the MRS-100 Morse code transceiver and serial interface from Xitex make a good combination.

If CW speeds which sound like a buzz are appealing to you, the MRS-100 is capable of sending and receiving up to 150 WPM! The nice part is, of course, that you don't have to do the work. Just type away at your own pace on the TRS-80 keyboard, and the serial I/O unit will translate the ASCII to CW. For reception, the reverse takes place. All you have to know is how to type and read.

The MRS-100 and I/O unit are designed to be programmed by the companion TRS-80 keyboard. A software program and cassette accompany the converter. The singular drawback from such a system is the radio frequency interference generated by the TRS-80 computer terminal itself. But we are advised that Radio Shack is working diligently to reduce RFI in its popular computer. If you don't have your own TRS-80 computer, XITEX also offers a matching video terminal. The MRS-100 lists for \$295 assembled, and \$225 in kit form from XITEX Corporation, 9861 Chartwell Drive, Dallas, TX 75243.

Microcraft "RTTY Reader". For radioteletype reception only, this should fit the bill. It features an eight-character moving LED display and copies all four standard RTTY speeds as well as 110 baud ASCII. Like most other teletype converters, the Microcraft unit works directly from the speaker output of a receiver. It features front panel selection of teletype speed, shift bandwidth selection, and mark/space tuning LEDs. Narrow/medium/wide shift selection is also made from the front panel.

The RTTY Reader is a logical outgrowth of the popular and innovative "Morse-A-Word," a Morse code reader for which Microcraft has become famous. A companion unit to the teletype unit, the "Morse-A-Word" provides silent CW copy up to speeds of 35 WPM. Like the competitive Kantronics "Field Day," the "Morse-A-Word" demands a

good "fist" for reliable display of received CW. For the beginner, a built-in code practice oscillator is included. The RTTY Reader goes for \$269.95 assembled, and \$189.95 in kit form. The Morse-A-Word retails for \$249.95 assembled, and \$169.95 in kit form. They are both available from: Microcraft Corp., Post Office Box 513, Thiensville, WI 53092.

Microlog AVR-2 Video Display Terminal. This is designed to work with a conventional video monitor (or their matching 9-inch screen, VM-4209). It features Morse, RTTY and ASCII reception. The rear apron features a row of controls and jacks to allow enormous custom flexibility, including oscilloscope presentation, computer cassette interface, positive/negative video, and "zoom" display. A more advanced model 6800 has just been announced; it is a complete computer terminal in addition to copying CW/RTTY. The AVR-2 retails for \$499 from the Microlog Corporation, 4 Professional Drive, Suite 119, Gaithersburg, MD 20760.

Macrotronics M80 Ham Interface. One of the least costly of the automatic RTTY/CW accessories is the M80 from Macrotronics. A new circuit board with extra features is now available. It requires the use of a software program and an accompanying Radio Shack TRS-80 set up for level II. It includes 10 message memories, a keyboard buffer (so you can type ahead), a random Morse generator for code practice, and several on-air control functions.

The M80 is designed to accommodate the M800 deluxe RTTY attachment which expands the flexibility of the system. Additional memory messages, output speed control, instant text replay, split screen display, and several other features are possible with this accessory. System versions for PET, Apple, and Sorcerer computers are also available. The M80 retails for \$149, the M800 for \$99, from Macrotronics Incorporated, Post Office Box 518, Keyes, CA 95328.

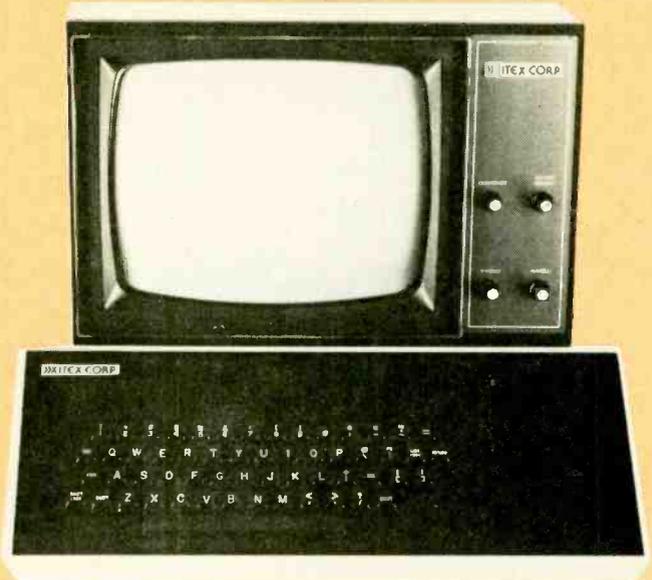
HAL DS3100 ASR. Unquestionably, some of the most luxurious units on the market are available from HAL. Representative of the sophisticated line of equipment marketed by that company is the model DS3100 ASR electronic communications terminal. It features send/receive automation for Morse, RTTY, and ASCII modes, and retails for \$1995.

Five speeds of teletype at Baudot rates, and 9 baud rates of ASCII are preprogrammed. Standard Morse code alphanumeric characters, punctuation, and abbreviations are also included. Transmit and receive speeds of up to 199 WPM are settable in increments of 1 WPM. Extremely flexible ROM and RAM storage provides a variety of message memories.

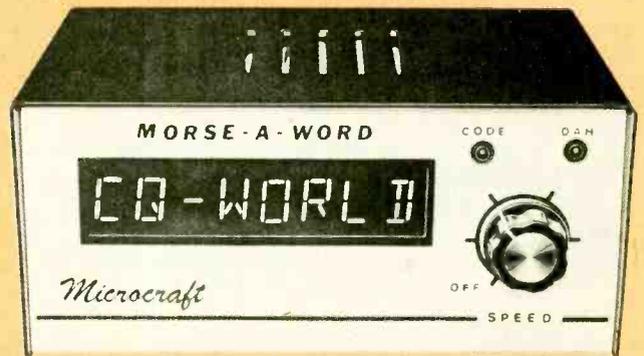
For those radioteletype operators with less stringent requirements, the low-cost DS2000 KSR send/receive keyboard terminal (\$449) may be just the thing. It is a modular system which can be expanded to include CW (\$149 extra). A video monitor accessory is also available at additional cost. Like its bigger brother, the 2000 includes 5 teletype speeds and plenty of message memory.

At the economy end of the price sheet, the low-cost ST-6000 (\$495) and ST-5000 (\$225) RTTY demodulators are available. While much lower in cost, there is no compromise in quality. We would recommend interested readers to write to HAL Communications Corporation, Box 365, Urbana, IL 61801 for their informative catalog.

Daytronics MIMIC. For the CW buff who wants enormous flexibility while sending in that mode, the MIMIC programmable keyer from Daytronics should fill the bill. Four programmable memories store an average of 60 letters each.



The XITEX MRS-100 is a complete unit which will allow owners of the TRS-80 computer to interface with their rigs to send and receive CW at speeds of up to 150 WPM. Circle no. 72.



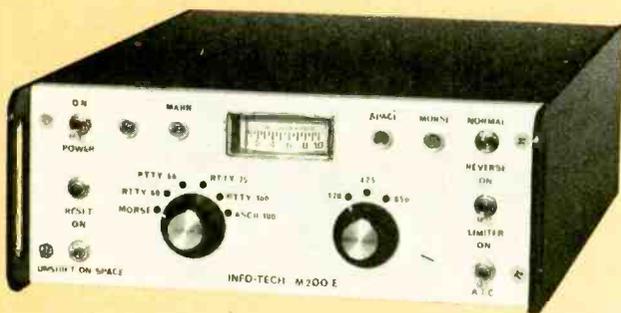
The "Morse-A-Word" by Microcraft is a CW only reader with eight digit LED display. Like all CW readers, it works best with a good fist on the other end. Circle no. 71 on the R.S. Coupon.



HAL's ST-5000 offers RTTY demodulation at a relatively low cost. It is a compact unit, with very clean styling and simple operations. For more information, circle number 76.

It is fully iambic with dit and dah paddle memories, self-completing characters with automatic spacing, automatic weighting, and a built-in sidetone monitor. The MIMIC will cost you \$99.95 wired, and \$79.95 in kit form. It's available from the Daytronics Company, P.O. Box 426, Selden, NY 11784.

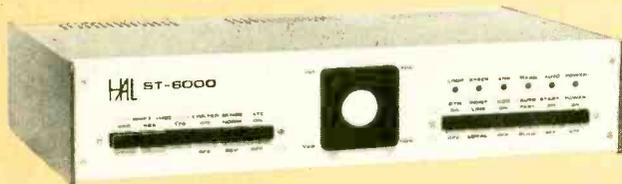
TRAC. A series of electronic keyers is available from



The Info-Tech M200E is a tri-mode converter designed to interface with a video monitor and rig. It permits copy of ASCII, RTTY and CW. For more information circle number 75.



With this XITEX keyboard and CRT, you can type at virtually whatever speed you please, and out will come perfect copy CW. Also reads out, too. Circle no. 72 on the R.S. Coupon.



The ST-6000 from HAL has the useful addition of a miniature CRT, which allows very precise adjustment. It is fine for Morse Code conversion. For more info, circle no. 76 on the R.S. Card.



Professor Morse is a neat little Morse Code teacher that will fire random Morse letters at you, by way of training in the art of copying CW. Circle no. 73 on the R.S. Coupon for info.

TRAC. Beginning at \$49.95, various levels of flexibility and memory options are featured. Contact TRAC Electronics, Inc., 1106 Rand Building, Buffalo, NY 14203.

MFJ 408 Deluxe Electronic Keyer II. Unquestionably, one of the most prolific manufacturers of high-quality, low-cost accessories for the ham and shortwave listener is MFJ. Their new model 408 Deluxe Electronic Keyer II has a

speed readout meter and an accessory socket to allow the use of Curtis add-ons, including external memory, random code practice generator and keyboard, and retails for \$79.95.

The 408 is built around the Curtis 8044 IC keyer chip, and sends iambic, automatic or semi-automatic, and manual CW. Memory provides even keying, and the 100% solid state keyer permits keying of tube or transmitter rigs. The unit is battery-operated, but an AC adaptor is available at additional cost.

The newest CW accessory available from MFJ is the unique 410 Professor Morse, a code teaching computer which retails for \$149.95. Combining a random code generator and keyer, the 410 sends letters, numbers, and punctuation without ever repeating itself! Code speed is continuously adjustable from five to fifty words-per-minute. Spacing between characters is independently adjustable so that the operator may learn to recognize rapid keying without being discouraged at first by a barrage of characters. Both are available from MFJ Enterprises, P.O. Box 494, Mississippi State, MS 39762).

AUTEK. One of the pioneers in active filters to enhance CW reception, AUTEK is now offering their model MK-1 programmable keyer. Its built-in memory recalls names, locations, or anything you wish to record in four messages of up to 25 characters each. It will even call CQ while you sit back and enjoy the luxury of automatic keying. The MK-1 retails for \$99.50 from Autek Research, Box 5127, Sherman Oaks, CA 91403.

Enhancement Accessories. While we have presented a cornucopia of products for transmission and automatic transmit/receive control of CW and teletype, we haven't even scratched the surface of accessories designed to enhance the manual aural reception of CW.

The "Amcoder," from AMC Engineering is designed to select any CW signal and lock on to it at the mutual exclusion of nearby audio signals. It will selectively seize any audio note (400-1500 Hz) which may be only 20 millivolts above receive noise, and transform it to any desired listening audio frequency (100-2000 Hz). Even a meter-bending signal right on top of the desired signal cannot come through, just so long as it is separated by at least 50 Hz difference in frequency! The AMCODER costs \$89.95 wired, or \$69.95 in kit form from AMC Engineering, Post Office Box 427, Jessup, MD 20794.

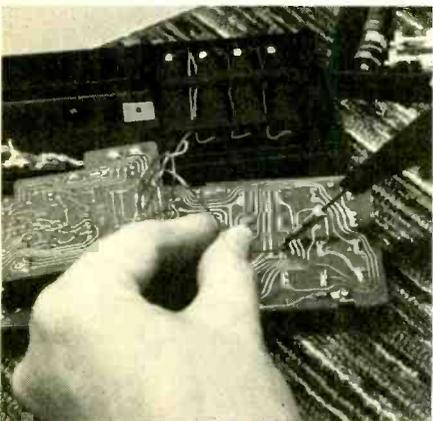
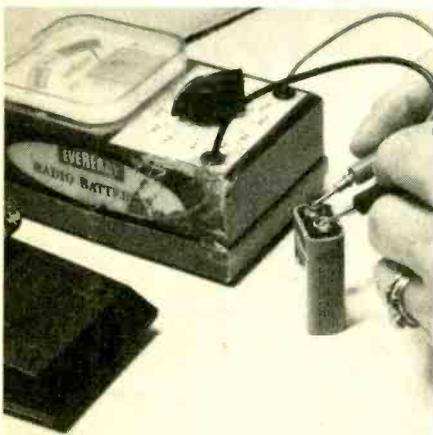
For additional CW reception aids, we would recommend serious consideration be given to one of the excellent active filters now available. These devices all have a common function; they lock in on one audio note at the exclusion of background noise and signals, and present that isolated signal to the earphones or speaker of the listener. They certainly do reduce listening fatigue and are well worth the investment. Most of them do a credible job on enhancing voice signals as well. For additional information on these fine filters, we would recommend that readers request catalogs from the manufacturers. Three of the best include: MFJ Enterprises, Post Office Box 494, Mississippi State, MS 39762; AUTEK Research, Box 5127, Sherman Oaks, CA 91403; and ERC, 1280 Southfield Place, Virginia Beach, VA 23452.

Summing Up. While Morse code began as the simplest method of electronic communication, it has become enshrouded with computer-age sophistication. What began nearly a century ago as a raspy spark-gap-generated signal, picked up miles away by a crude Marconi coherer—a primitive crystal set—has enjoyed a renaissance. It would appear that CW is far from being an obsolete form of two-way communications—if anything, it is enjoying a free ride on the shoulders of progress! ■

Simple Calculator Repairs

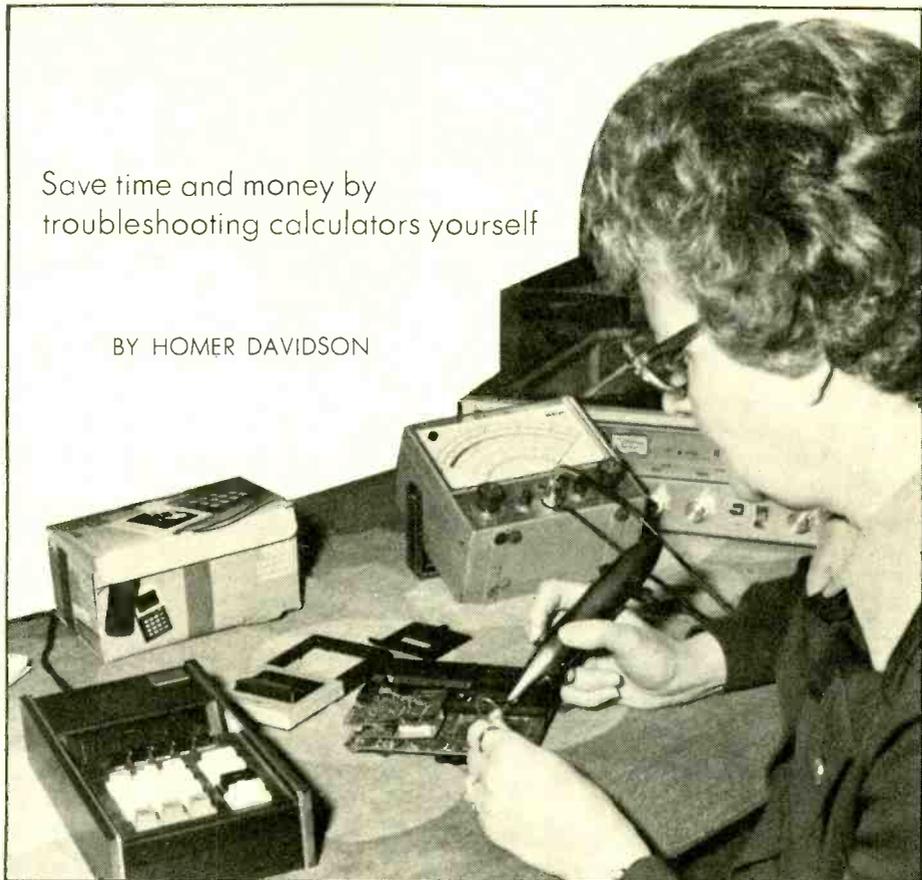
CHHECKING OUT A MALFUNCTIONING pocket calculator is much easier than tackling a portable radio. There are fewer parts and they are not all squeezed together. Most problems found with the small calculator are quite simple and can be done quickly.

Most calculators are warranted for 90 days. If the calculator breaks down in the warranty period, check the small warranty slip found in the original box, provided you didn't throw it away. A defective calculator may be returned prepaid to the manufacturer's service department. But, when the calculator breaks down after the warranty runs out, you may be able to put it back into operation with a few simple checks. Also, if you picked the pocket calculator up second-hand at a bargain table, you may find the minimum factory repair charge is more than you paid for it.



Save time and money by troubleshooting calculators yourself

BY HOMER DAVIDSON



Checking the Batteries. Check for defective batteries since most pocket calculators are operated from only two power sources. You will find very tiny batteries in those thin type calculators. Be very careful when removing them, and always observe the correct polarity. Most battery polarity terminals are marked right on the plastic case. The calculator will not function if the batteries are put in backwards. In fact, you may damage some internal compo-

A simple battery tester like the one shown is a useful basic tool for checking and repairing small battery-operated calculators.

Cracked PC Board. You may find a cracked PC board after careless handling or after an accident. When the calculator is accidentally dropped or knocked around, check for broken wiring connections or a cracked PC board. In one particular instance, a pocket calculator was accidentally dropped upon the cement floor of a garage and the cover accidentally run over by a car. The only damage incurred was a broken corner of the cal-

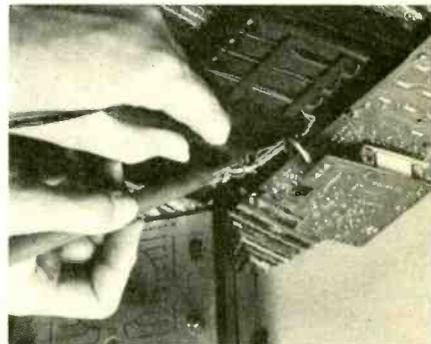
Great care must be used when working on a delicate PC board. Note the fine-tipped soldering iron, perfect for these spots.

nets by reversing battery cells. The suspected battery may be tested in a battery tester or with a VOM. If their quality is suspicious, replace them.

Since the small calculator pulls very little current, the batteries may last to the end of their shelf life. In other words, these small batteries should be replaced every year or so to prevent connection or component damage. When used constantly, they may need replacement three or four times a year. It's best to choose a battery that won't leak after a long period of time. You may find two or more small batteries in the pocket calculator.

culator case and PC board.

Simply use small, solid hookup wire and join the broken foil ends. In very small pocket calculators, the PC foil is very thin and closely spaced. Scrape the PC foil with a pocket knife to bare any insulated areas (some PC boards are sprayed with a clear plastic liquid) then join the broken area with a piece of bare hookup wire. Be very careful not to overlap the soldered connection onto any adjacent PC foils. If the PC foil is really thin, select one strand of copper wire from stranded hookup cable and use it to join the broken areas back together.



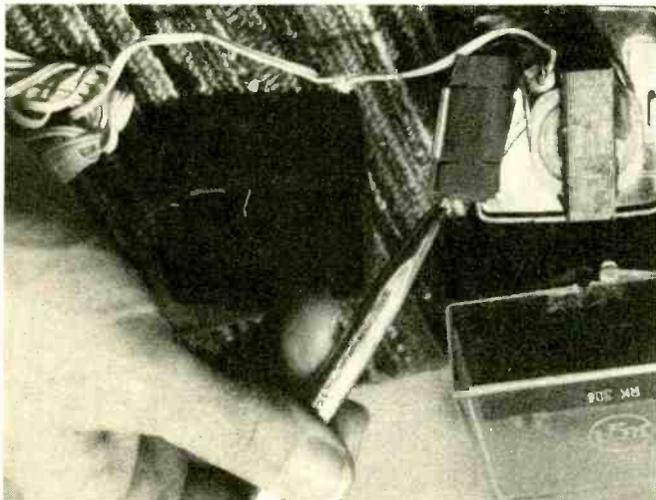
Broken Terminal Wires. After carrying the calculator to school through the rush hour, and dropping the unit several times, you may find a broken terminal wire or two. If the calculator will not function after battery clean-up and replacement, suspect a broken connection wire. Check the wires going to the battery terminals. Also, check to see if a voltmeter is vital for checking out the electrical continuity, finding shorts and tracing through the circuitry. Pocket calculators very often show signs of abuse.

the On/Off switch wires are still connected to the terminals. Sometimes you may find a broken connecting wire from the pushbutton assembly to the main PC board. You may find a broken terminal connection from the LED display unit to the PC board. Generally, the display unit is tilted at an angle to shield the display from overhead light. Use a very low-power soldering iron when making soldering connections on these delicate calculator boards.

Defective Power Adapter. The battery eliminator or power converter plugs directly into the AC power outlet with the male plug inserted into the calculator socket. These small AC adapters or gadgets can save you money in the long run. Since leak-proof batteries are quite expensive, you may want to use the AC adapter instead. Check the enclosed literature, and you may find the operating voltage of your calculator. For instance, if the calculator uses three 1.5-volt batteries, the 4.5-VDC voltage adapter plug is used. If the calculator uses four 1.5-volt batteries, use the 6-VDC adapter plug. You may want to select a universal AC adapter with four different voltage sources.

If your battery eliminator or AC adapter is suspected of failure, measure the DC voltage at the male plug. No voltage at this point may be caused by a broken male plug, a broken cable or a dead power pack. Determine if the cord may be broken right at the male plug, or where it enters the AC adapter's case or housing.

It is possible to avoid replacing a defective AC power adapter by making a few simple repairs to the unit. Always measure the DC voltage at the male plug end to determine if the fault lies with the power adapter.

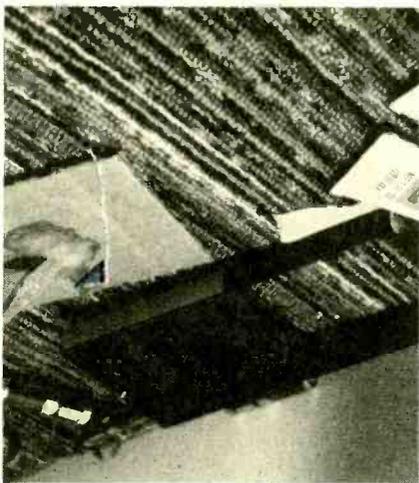


If one wire is broken at the male plug, cut off the cable about one inch up from the plug end. Always unplug the AC adapter while repairing it. Now scrape back the insulation and measure the DC voltage. If voltage is present, locate another male plug. Generally, these male plugs are of the molded type and cannot be used again. You may select a headphone-type plug the same size and install it. Be very careful to obtain the correct DC polarity at the male end to operate the small calculator without damaging it.

A Cracked Case. Rough handling or dropping the calculator may damage or break the plastic case. If the calculator ends up in a dozen little pieces, the plastic case may not be repairable. Some of the cases are made of tough plastic or impact material, and these may wind up with only a crack or two. You can put the small calculator back into operation by repairing the cabinet with epoxy cement. Simply mix up the epoxy evenly upon a piece of cardboard. Then stick the broken pieces together, and apply a thin coat inside the container and on the outside. A broken corner may be repaired with a layer of thin cardboard held with masking tape on the inside. Then, apply a

coat of epoxy over the broken area. Several layers of masking tape will hold the liquid epoxy in line until it sets up overnight. Sand down the rough corners with sandpaper or a coarse file. If the repair is too unsightly, spray paint the area, or the entire cover. This list of troubleshooting hints should help you cure most of the common pocket calculator problems. And, especially these days, we can all use the savings in repair or replacement costs on these handy devices.

Simple cracks or breaks in the plastic of the calculator's housing can be repaired with epoxy cement. After applying epoxy, spray paint the case in its original color.





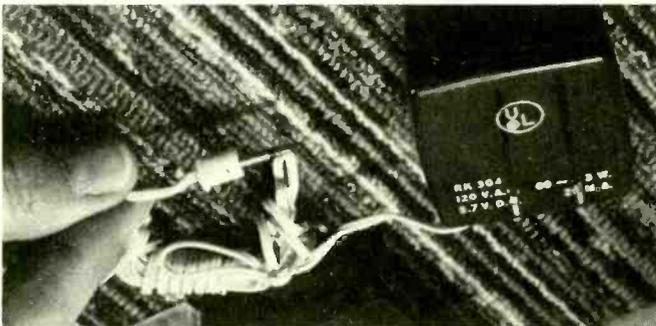
Sticky Buttons. After a few years of operation, several of the most used buttons may not want to press downward, or they may want to just stay down. In fact, you would swear someone is pulling down on these small buttons. When plastic buttons work against plastic or metal areas, they have a tendency to the point where they have fused.

You can cure this problem quickly by spraying contact lube or tuner cleaner down around the button area. A drop or two of light oil will work as well. Work the button up and down until it is free. You might as well clean up all the buttons while you're at it. Wipe off all excess oil or cleaner with a soft cloth. Sticky buttons are a nuisance when trying to figure your income tax, adding today's enormous grocery bills or balancing checkbooks.



Corroded Battery Terminals. When batteries are left unused for a long period of time, they begin to leak and corrode around the battery terminals. Try to keep fresh batteries in the calculator to prevent corroded terminals. Replacement with leak-proof and long life batteries helps, but after a long it takes only a very small amount of corrosion to prevent juice from getting to the calculator's circuitry. A light going over with alcohol very often does the trick.

time they too may leak all over the battery case, corroding it. Clean the battery terminals with alcohol or cleaning fluid. If the contacts are very corroded, scrape them with a pocket knife. Try using a small strip of sandpaper on the battery terminals. If the contacts are partially eaten away, you may have to make new metal contact strips. Select a piece of springy brass or copper material for this purpose and solder it on.



Bad AC Adapter Jack. When the calculator will function on batteries and not with the AC power supply, suspect a defective power supply or adapter

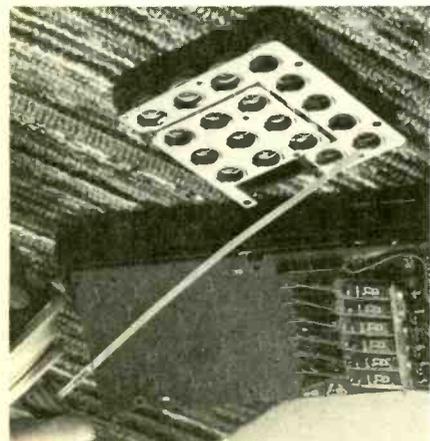
jack. If you had been using the calculator from the power line when it went dead, substitute batteries to determine if the calculator is at fault. You can

measure the DC voltage at the output of the AC adapter jack with a VOM. If the DC operating voltage is present from the AC adapter, check for a defective female jack. A lot of these female jacks are very tiny and may be easily damaged. Generally, they are the self-shorting type, so when the AC adapter plug is out of the calculator, the batteries are switched into the circuit. First try to clean the jack contacts with tuner or contact spray. Move the male plug in and out to help clean the contacts. The broken or defective jack may often be replaced with a small ear-phone type jack found at Radio Shack

Defective Switch. If the calculator will not light up after new batteries are installed, suspect a defective On/Off switch. Wiggle the switch back and forth while checking for the numbers to come on. A dirty On/Off switch may produce erratic operation. Try spraying tuner or contact cleaner down into the slide switch area. You may be surprised to find that the lights come on and you can now add or subtract once again after this.

When the switch appears broken or doesn't make contact, check for poor switch continuity. Remove the back cover to get at the switch. Notice if all wires connecting to the switch are soldered in place. Now measure the resistance across the switch terminals. Make sure the batteries are disconnected in place. Now measure the resistance across the switch terminals. Now, repeat the continuity test. Try to clean the switch contacts before ordering a replacement. In some small units, you may have to replace the whole keyboard, since the On/Off switch is sealed inside of it.

Spraying with one of the silicone cleaning and lubricating aerosols in very often a cure for problems with switch contacts.



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EXCLUSIVE! TRAIN WITH THE NEW H89 NTS/HEATH ALL-IN-ONE MICROCOMPUTER!
 NTS's Master Course in Microcomputers now includes this remarkable new desk-top computer. Features floppy disk storage, "smart" video terminal (terminal has its own microprocessor, doesn't share one with computer as do most desk models), two Z80 microprocessors, 16K RAM expandable to 48K, professional keyboard.

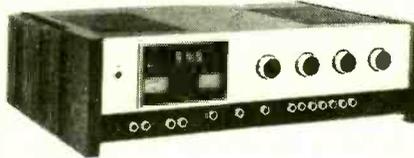
The new H89 (pictured above) is here and NTS home training has it! An exciting way to explore the very latest in microprocessor technology.

Of course if your interests lie in other areas of electronics, NTS has 14 programs to choose from. And they include the widest array of solid-state and digital equipment ever offered by any home-study school.

Besides the latest in microcomputers, students may work with the NTS/HEATH



NTS/Heath Digital Receiver



digital color TV (25" diagonal with optional programming capabilities), digital test equipment, an NTS/HEATH digital stereo receiver (70 watts per channel), plus much more field-type equipment to make your training exciting and relevant.

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Digital Multimeter



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E/E CHECKS OUT THE...

YAESU FT-207R 2 METER HANDY-TALKY

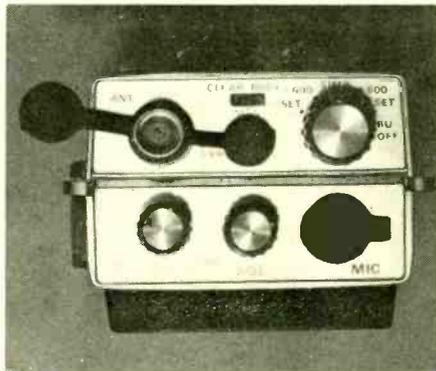
Digital electronics make this a top 2 meter performer

THE ONE DREAM THAT HAUNTS all devotees of the two meter Amateur band is to own an FM handy-talky that is frequency-synthesized, has digital readout display, microprocessor-controlled frequency selection, up/down scanning, clear or busy channel option, memory, built-in Touch-Tone pad, synthesized sub-audible tone option, and maybe even a removeable battery pack. Well, dream no more, because Yaesu Electronics Corp. has introduced a real live handy-talky, the model FT-207R, and it has all these features and more.

Features. This little rig is compact enough to fit into a pocket or attaché case. Its dimensions are not much larger than Yaesu's crystal-controlled model FT-202, but the unit is packed with circuitry that is a great deal more complex. As mentioned, the FT-207R is microprocessor-controlled, and includes five channels of memory for frequently used repeater channels. There's a neat little priority channel provision, in which the unit will silently monitor a specifically desired frequency, and shift back to it when it senses any activity. A PLL (phase-locked loop) synthesizes frequency in 10 kHz steps normally, with frequencies entered from the front panel keyboard. A plus 5 kHz switch on the front panel provides coverage for the in-between repeaters. The keyboard also is used to control the memory option and scanning. During transmit, it acts as a dual-tone (Touch-Tone) encoder through a MC14410p chip for autopatch use. The LED digital frequency display is of course automatic, and can be switched from either "always on" or about "one second on" via a front panel switch.

The usual plus-or-minus 600 kHz repeater offsets are selectable from a rotary switch on the top of the unit, with simplex (transmit and receive on the same frequency) another option. But this little transceiver also has the unique option of selecting odd repeater splits of virtually any frequency. That trick is especially useful in crowded urban and suburban areas, where the usual 600 kHz offset frequencies are

often all taken, and repeaters have to set up transmit-receive frequencies that are unusual distances apart. The same rotary switch has a position that disables the memory, which, while it is a useful function, nevertheless draws



The top panel outlets for: (clockwise) antenna, earphone, scan select, offset split, microphone, squelch/tone, on-off volume.

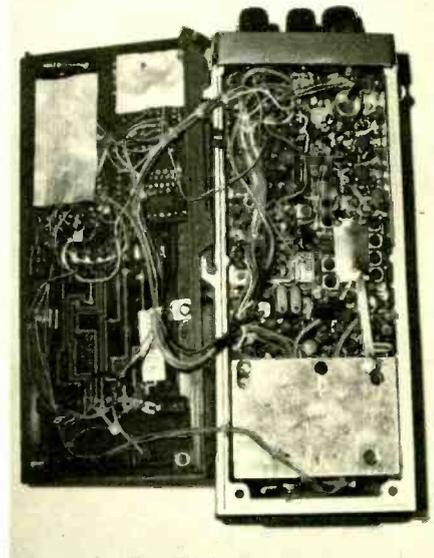
about 4 mA while the unit is turned off, exhausting a complete battery charge in about three days.

Performance. When we put the Yaesu FT-207R to work, we were in for some pleasant surprises. First of all, RF power output was 3.3-watts, a bit higher than the rated 3-watts. On a Cushman CE-15 spectrum analyzer, we found the transmitter output to be clean, and all spurious radiation to be at least 60 dB down from the fundamental frequency output. Audio was also clean and crisp, and was described by some stations as pleasant and mellow. A built-in condenser mike aids in attaining the high level of audio quality.

On receive, the FT-207R really shone. The rated sensitivity of the FT-207R is 0.4 μ V for 20 dB of quieting—our unit bettered that by 0.05 μ V. The selectivity of plus-or-minus 7.5 kHz at -60 dB checked out as rated. Audio output is claimed to be 200-mW at 10% total harmonic distortion, a figure we had no reason to dispute. Overall, we were very impressed with the design and performance of the receiver. The synthesizer displayed no birdies—a



CIRCLE 89 ON READER SERVICE COUPON



The interior of the Yaesu is incredibly dense, with circuit boards in both cabinet halves. Circle 89 on the reader service card.

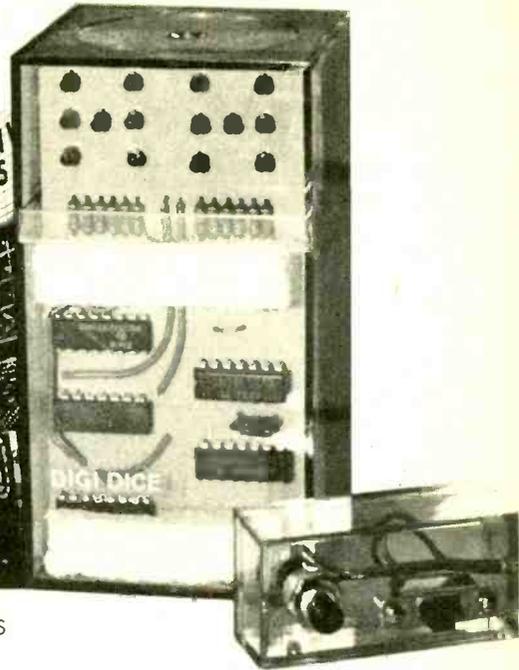
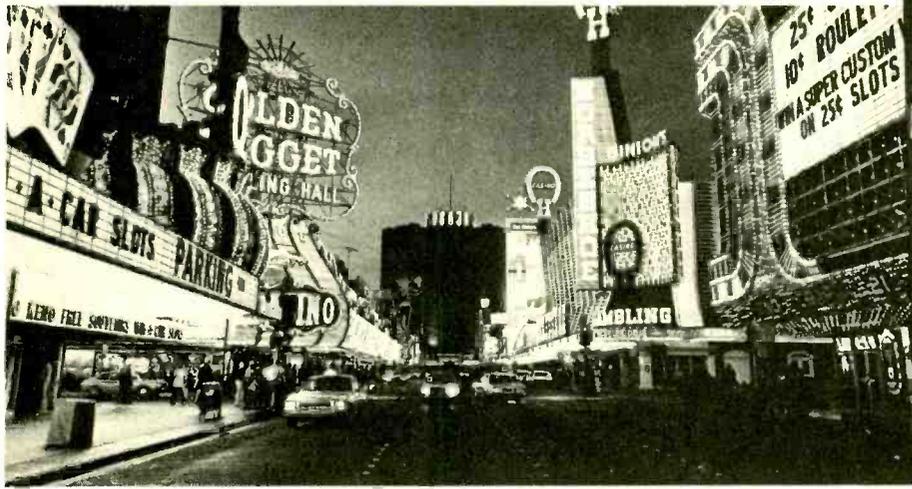
problem with some synthesizer designs. In heavily RF congested New York City, the receiver worked remarkably well. In the strongest RF fields, the front end was not desensitized and there was no noticeable intermodulation distortion or cross-modulation. In an area where there are literally hundreds of repeaters, the superb selectivity really showed up well.

Power Consumption. We also checked the battery drain of our Yaesu FT-207R, and on transmit, with the final pumping out 3.3-watts, it draws a hefty 800 mA. That's a lot for a battery pack, and Yaesu has made some provision for reducing the drain. As mentioned, the LED display is switchable, saving a few mA, and the memory can be turned off as well. But the major saving

(Continued on page 84)

DIGI DICE

BY ROY AUER, Jr.



An electronic dice game with infinite possibilities

HERE IS A PROJECT for those of you tired of rolling old fashioned mechanical dice. *Digi Dice* can be used anywhere normal dice are used, and has been designed to be cheap, portable, and fun. And, since it is an electronic device, it is probably more random than any regular dice with their inherent mechanical imperfections. Construction time will vary, of course, but we built our dice in an afternoon

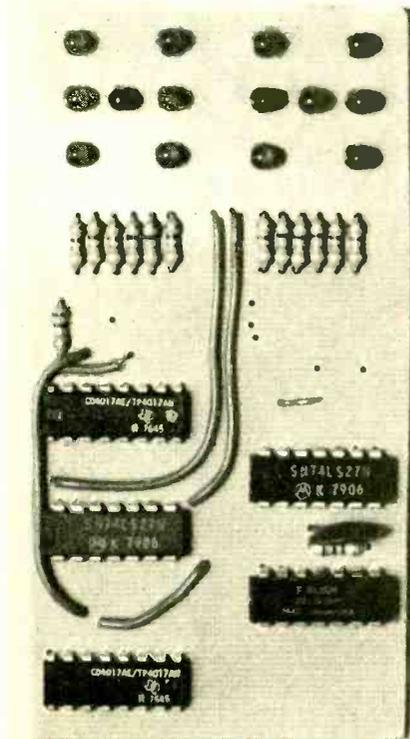
and by evening were "rolling" in a game of craps. Total cost should run about \$12 to \$15, depending on how much spare junk you have lying about and where you buy the needed parts.

The Circuit. Referring to the block diagram, you can see that *Digi Dice* is composed of three main blocks. Block A, the oscillator, is made of two 74LS inverters connected as an oscillator, using a resistor and capacitor to regulate the frequency. The output of this oscillator is sent to block B, the counter. This consists of two CD 4017 decimal decoded counters, each wired to reset at a count of six, such that its sequence is 0, 1, 2, 3, 4, 5, 0, 1, etc. The first IC (U1) gets its input directly from the block A oscillator, while the second (U2) receives its pulses every time its partner resets itself to zero. Obviously, the second 4017 only counts one sixth as fast as the first.

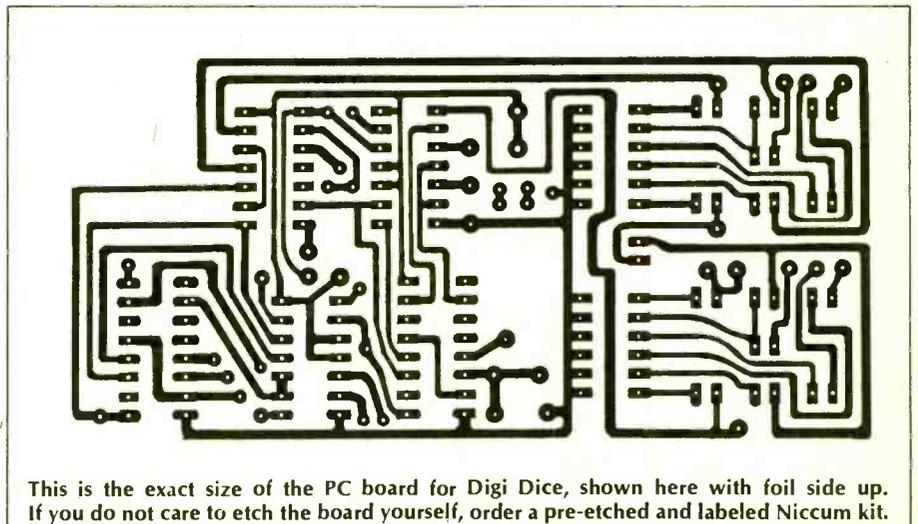
The net result of all this is a two-place base six (modulo six) counter. If we now interrupt the count at some point, each 4017 will contain a value of 0 through 5. If then, and this is the heart of the circuit, we run the counters so fast that we don't know where they are when we halt them, we have devised two independent and "random" six counters. But that is exactly what mechanical dice are, so now all that must be done is to display our results in some suitable way.

Block C, decoding and driving, does this by interpreting the values present in the CD 4017s and displaying them using red LEDs arranged to give the appearance of a pair of dice.

Now, look at the schematic diagram for a more complete idea of how the circuit operates. Switch S1 is power on-off. S2 is a normally closed momentary-contact pushbutton which inhibits



This front view of the PC board shows the arrangement of ICs and the LEDs that read out the score. "Snake eyes" lights up first.



This is the exact size of the PC board for Digi Dice, shown here with foil side up. If you do not care to etch the board yourself, order a pre-etched and labeled Niccum kit.

counting in both U1 and U2 by holding pin 14 at ground. Opening (pushing) S2 allows R14 to pull pin 14 to a high level, thereby allowing the counters to run. When this happens, the decoder/drivers will be displaying the contents of the U1 and U2 using the LEDs, but so quickly that the eye cannot follow. Releasing the pushbutton switch (closing S2) will freeze the count in each 4017, which can now be seen displayed by the LEDs.

Construction. A full size PC board layout is shown for your use. As the pattern is very tight, we recommend that only advanced hobbyists attempt a reproduction. Wire wrapping is a bit more tedious and time consuming, but easier to correct. Anyway, if you do

choose the PC route, carefully check for breaks and shorts in the foil with an ohmmeter, since they are easy to miss by visual inspection.

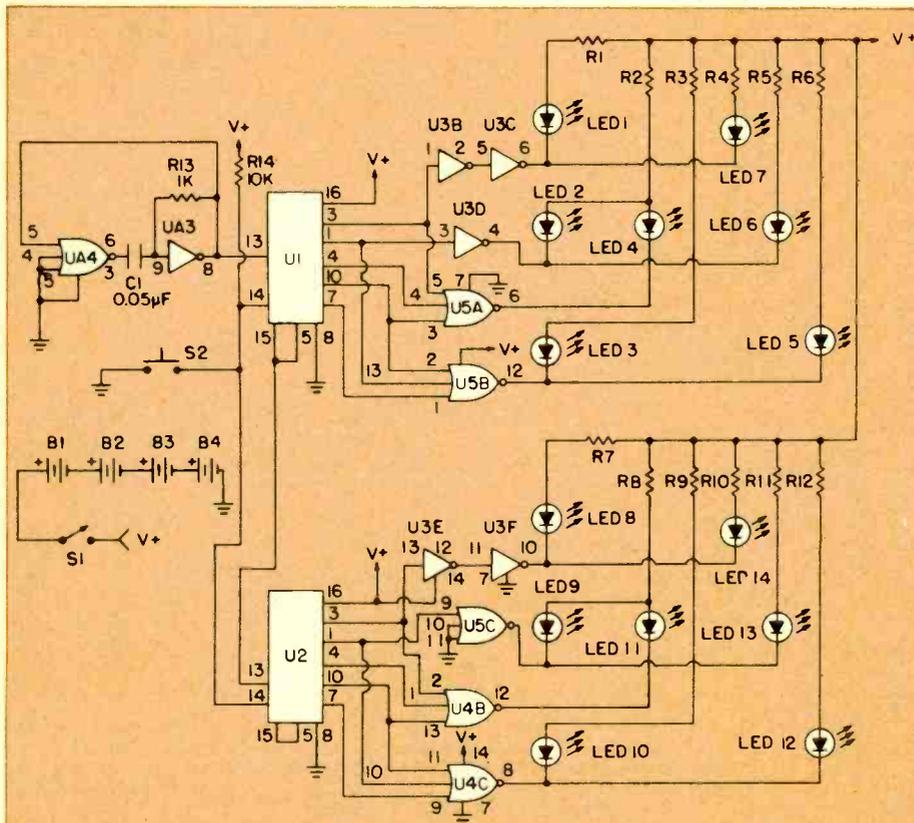
Follow the parts layout guide when assembling the PC board, and be sure you have the correct orientation of the chips; a small notch is present at pin #1 of each chip. Also, don't arrange the LEDs backwards. The anode lead (+), which is usually longer than the cathode lead is always nearest to the ICs on the board. Reversing this won't hurt the LED but it won't light either.

The entire project fits neatly into a 2¼-inch by 2¼-inch by ¼-inch plastic box available in art supply stores. We ran four wires out of the main box to a smaller matching unit in

which we mounted switches S1 and S2. Ribbon cable is perfect for this. The battery and circuit board are stabilized by styrofoam strips and blocks cut to the necessary shapes and either glued or press-fit into the large box. When the time comes to change batteries, the holder is easily unclipped and slid out of the case. Incidentally, any 5-volt to 6-volt source can be used in place of the dry cells. The absolute maximum voltage the 74LS chips will tolerate is 7 VDC, so be careful.

Operation. Closing switch S1 activates the circuit. Don't be surprised if an unusual combination of lights appears when the unit is first turned on. Now press pushbutton switch S2. All of the LEDs will illuminate, some more brightly than others. Releasing the pushbutton will force *Digi Dice* to display two random values. Repeat the sequence for further play.

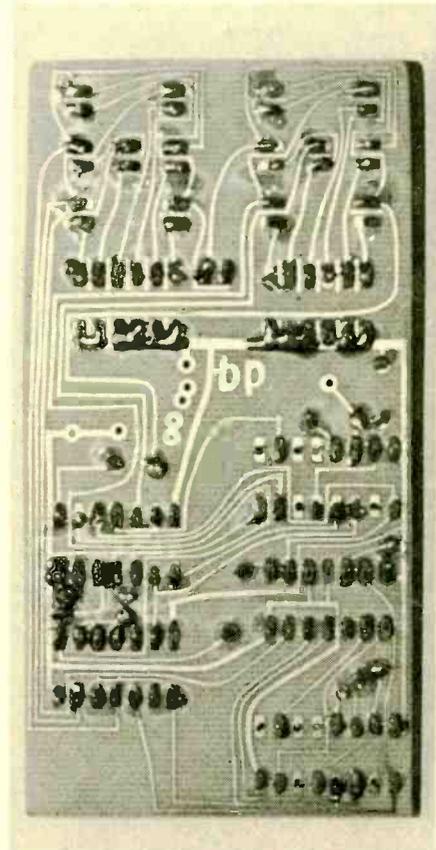
To test the theory of randomness, we "rolled" *Digi Dice* one hundred times. A summary of the results is shown. Although the tabulation was not checked using statistical analysis, you can see



PARTS LIST FOR DIGI DICE

- B1 thru B4—1.5 VDC battery
- C1—0.05- μ F, 50 VDC ceramic disc capacitor
- LED1 thru LED 14—light emitting diode rated 20 mA @ 1.7 VDC
- R1 thru R12—470-ohm, ¼-watt resistor, 10%
- R13—1,000-ohm, ¼-watt resistor, 10%
- R14—10,000-ohm, ¼-watt resistor, 10%
- S1—SPST subminiature slide switch
- S2—SPST normally closed pushbutton switch
- U1, U2—CD4017 decade counter integrated circuit
- U3—74LS04 hex inverter integrated circuit
- U4, U5—74LS27 three section, triple input NOR gate integrated circuit
- Misc.—battery holder/clip, suitable enclosure, IC sockets, hookup wire, solder etc.

A complete parts kit including PC board and all components is available from Niccum Electronics, Rte. 3, Box 271B, Stroud, OK 74079. Price for the complete kit is \$24.50; a pre-etched and labeled PC board only is \$5.50. No CODs, please.



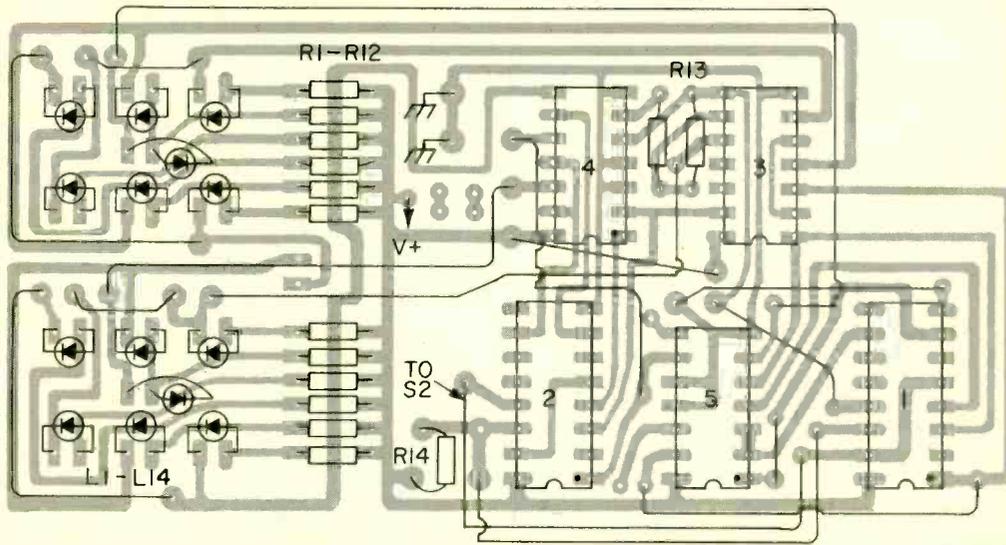
The foil side of the completed PC board is a gem of neat solder connections. The unit fits into a variety of handy plastic cases.

that the theoretical $16\frac{2}{3}$ frequency for each level is closely approached—the small variations are just random fluctuations in this relatively few number of trials. *Digi Dice* draws about 20 to 60 mA from the supply, depending on how many LEDs are lit. Alkaline cells are best for long life, but regular carbon-zinc batteries will provide several hours of “rolling.” Be sure to try this circuit

in a game of backgammon. It runs much more quickly and a third person can get into the game as a dice roller.

Conclusion. We'll add the usual caution at this point about getting involved with “money” games. While *Digi Dice* has been designed to be as “random” as is possible for a project of this nature, we certainly do not wish to become referees in arguments between

you and your friends (or your victims). *Digi Dice* is intended for entertainment only, and any other use of this project (either with a modified circuit or not), especially for gambling, is done against our strongest recommendation. If you're all that hot to *really* gamble, the Chamber of Commerce of Atlantic City would no doubt like you to visit the town's casinos instead! ■

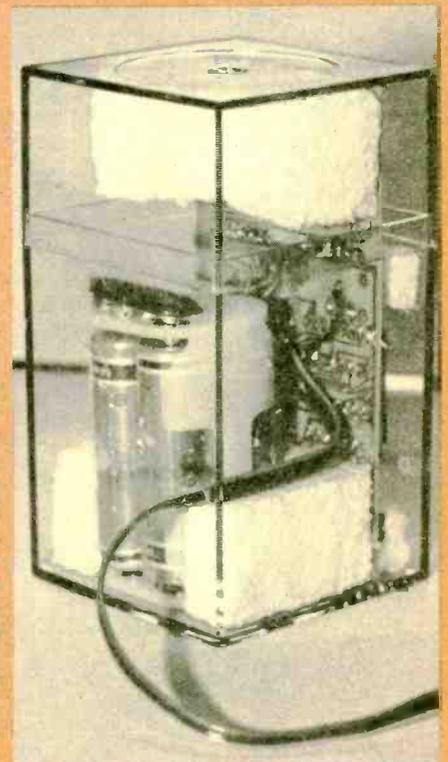


The parts overlay diagram shows the placement of components on the PC board. As in all projects using a number of delicate ICs care must be taken with the pins and with the use of soldering irons too near to the chips. *Digi Dice* is a project to gladden a gambler.

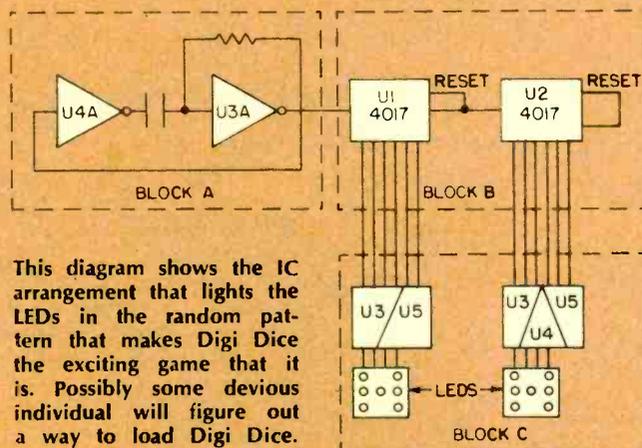
STATISTICAL BREAKDOWN OF 100 ROLLS

Face Value	Die #1/100 Rolls	Die #2/100 Rolls
1	18	16
2	14	18
3	18	14
4	15	17
5	18	16
6	17	19
Total	100	100

This chart shows how truly random *Digi Dice* is, much more so than old-fashioned “bones.” While it may be possible, we know of no way to rig *Digi Dice*.



The battery pack holding the four 1.5 volt cells that power *Digi Dice* fits neatly into one of the common rectangular plastic boxes which can be found in a variety of shops. Styrofoam or a similar material can be used to take up room in the box, since the PC board and battery pack aren't likely to fill the entire box.



This diagram shows the IC arrangement that lights the LEDs in the random pattern that makes *Digi Dice* the exciting game that it is. Possibly some devious individual will figure out a way to load *Digi Dice*.

E/E CHECKS OUT...

A P Products Hobby Blox

Prefitted color-coded building blocks make for easy perf-board project assembly

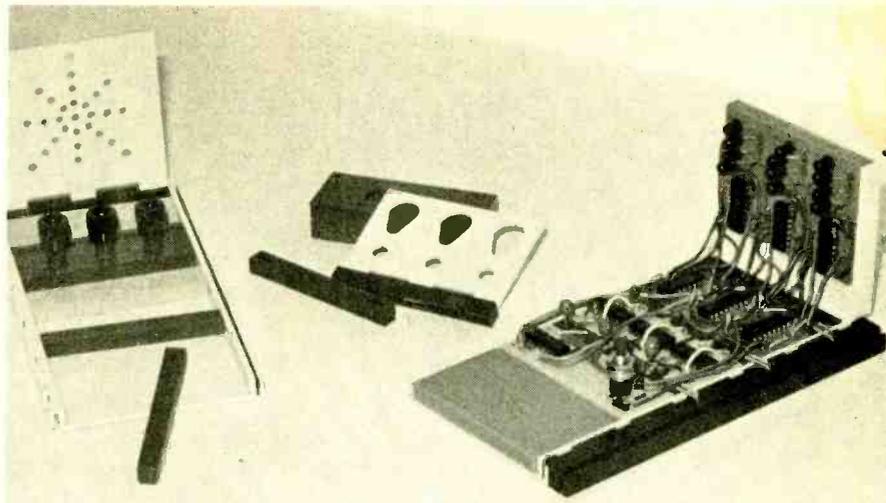
INFLATION BUSTING begins at home, and electronics hobbyists can help by saving cash on the price of their solderless breadboards. Until now, electronics hobbyists had to buy pro-type solderless breadboards and pay "professional" prices to build those projects. Hobbyists have long dreamed of a total breadboard system which would allow the user to customize the board to fit his projects while being both economical and flexible. Well, it looks like the hobbyists have what they want with help from A P Products. Recently, ELEMENTARY ELECTRONICS had a sneak preview of their HOBBY-BLOX, a new modular circuit-building system designed and produced by A P Products.

At the core of the HOBBY-BLOX system are two starter packs; one for discrete component projects, the other for integrated circuit projects. Each

system comes with a number of modules which fit into a tray and an accompanying project booklet that describes step-by-step how to build ten projects with the existing packaged parts. For a suggested retail price of under \$7.00, the hobbyist has everything he needs in breadboards at his fingertips.

The Benefits! Every hobbyist (from beginner to more advanced) who gets his hands on the HOBBY-BLOX system will probably make his own list of benefits for this system. Just to give you an idea of the positive features you'll discover, the HOBBY-BLOX system is modular. It doesn't matter what pack you start with, all the modules are interchangeable. A color keyed system is very helpful to the hobbyist because each module is grouped in a different color as it relates to its function. This simplifies building and eliminates two errors in wiring common to uni-colored solderless breadboards. The hobbyist can quickly select the light gray structural modules or the yellow terminal strips, etc.) Every module is easily recognizable. Another feature which is

The Hobby Blox system gives the project building hobbyist an easy vehicle for assembling circuits to a professional level without having to resort to expensive and often complicated solderless breadboards.

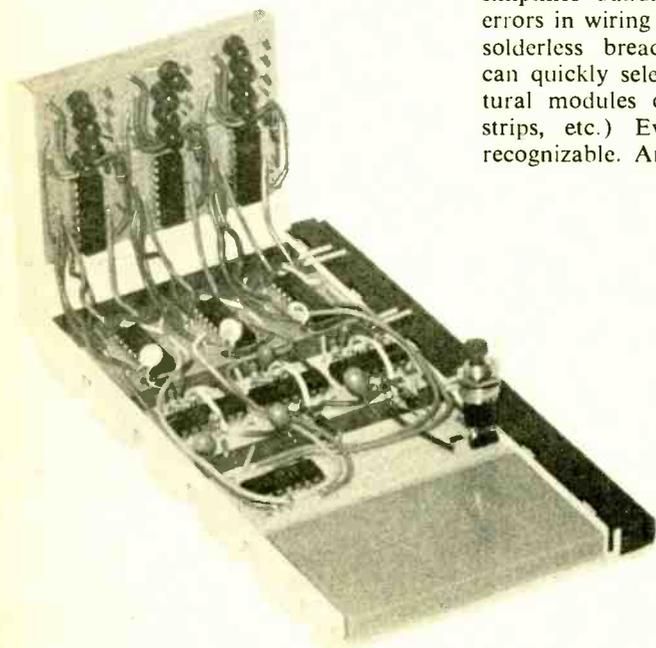


CIRCLE 98 ON READER SERVICE COUPON

a big plus to the new system is the benefit of being expandable by allowing the hobbyist to add modular parts to design new projects or expand on existing ones. The HOBBY-BLOX system includes 14 separate modules which can be purchased individually.

Two features, compatibility and affordability, are probably the most important to the hobbyists. This system is compatible with DIPs of all sizes and a wide variety of discrete components with wire lead diameters from diode size to 1/2-watt resistor size (.015" to .032" diameter). In terms of affordability, it would seem like A P Products has thought of everything, even down to the important aspect of costs. Here again, the hobbyist doesn't have to be a Rockefeller to enjoy his pastime. The HOBBY-BLOX system costs less than professional systems with individual modules available to choose only what the hobbyist needs.

The Way We See It! By offering a variety of modules, A P's HOBBY-BLOX system allows the electronics hobbyist to use his imagination to build and expand on a multitude of projects. ELEMENTARY ELECTRONICS saw this concept in its developmental stages and even at that time, the system met the primary objectives of expandability and affordability. The idea of color coding and indexing as well as offering a modular system allows the hobbyist to progress and learn with each project completed. For the experienced hobbyist, here's a fast way to modify projects, and troubleshoot them when circuit design failures occur. To find out where you can buy HOBBY-BLOX system call this toll free number (800) 321-9668; or write A P Products, Inc., 1359 W. Jackson Street, Painesville, Ohio 44077. For more information, circle number 98 on the reader service coupon. ■





BUILD FASTOUCH

An electronic party game that's fun for any occasion

BY JAMES J. BARBARELLO

ELECTRONIC GAMES ARE "in," and most of the major toymakers (most notably Mattel) now have their own electronics divisions, hoping to cash in on the latest party craze. Unfortunately, because the demand for these games has been so great, we really haven't seen any real price breaks on them, and the prices are starting to climb, even for the simplest of games.

If you've been itching to get one, but have resisted thus far because of inflated prices, then why not build *FasTouch*? Like its commercial counterparts, it's useable by up to 4 players, and it moves fast enough so that many can get their hands on it during the course of a party or rainy afternoon.

It's a game of reflex and recognition which allows mixes of players from any age group. Two flashing LEDs, actuated by a "FLIP" button, alternate on and off for a few seconds, with one eventually staying on continuously. If the one that stays on is the "+" LED, then the first player to hit his or her scoring button will light his or her scoring LED and receive 1 point. In addition, the other players' scoring LEDs will be locked out, keeping them from scoring. If the "-" LED lights, any players pressing their scoring buttons will cause their scoring LEDs to blink on and off, signifying loss of a point. You can set a winning score of any number, but to help the game move faster, 10 is usually the best compromise. Of course, that's based on our tests. As you can see in the picture above, our editorial staff subjected *FasTouch* to extensive tests, so intensive in fact, that we eventually had to hide the battery in order to get some work done around here. *FasTouch* can be addicting, so be warned!

Getting back to economics, we should mention that *FasTouch* uses readily available CMOS ICs, is powered by a single 9-volt battery, and can be built for under \$20.00 with some judicious shopping around for parts, even if you purchase the pre-etched printed circuit.

The Circuit. Referring to the schematic, you can observe that closing S1 allows capacitor C1 to charge towards the V+ potential. Closing S2 ("FLIP") rapidly discharges C1, causing NAND gate U1A to go high, and gate U1B to go low. Opening S2 allows C1 to begin charging towards V+ in a time proportional to R1 times C1. As the voltage across C1 passes $V+ \div 2$, U1A is forced low, and U1B is forced high.

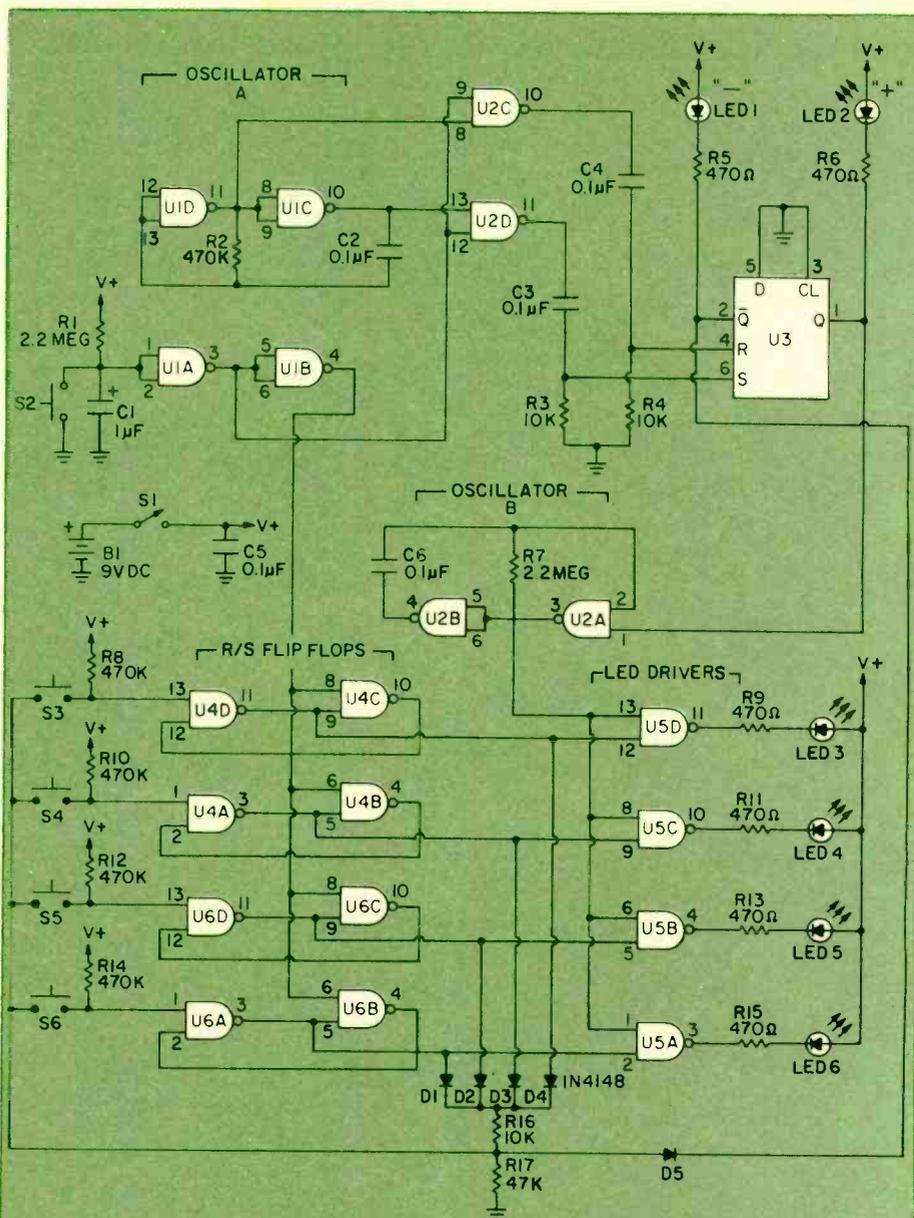
During the time that gate U1A is high, the two complimentary output signals from oscillator A can pass inverted through gates U2C and U2D. These square waves are transformed into pulses by the C3/R3 and C4/R4

high pass filters which alternately set and reset flip-flop U3A. This is seen as a rapid blinking of LED1 (“+”) and LED2 (“-”). At the end of the C1 timing interval, when gate U1A is forced low, the set and reset pulses stop and the LED on at that instant remains on. The LED which stays on is chosen by a random sequence, with the chances being essentially equal.

Two gates each are wired together to create the four R/S (Reset/Set) flip-flops—one for each player. Setting a flip-flop is accomplished by providing a low level to one gate by way of the scoring switches (S3 thru S6). Resetting the flip-flop requires a low level to the other gate (in this case, via the common line from gate U1B). During the time LED1 and LED2 are blinking, the low output from gate U1B resets all flip-flops, none of which can be set until the low reset level is removed. When the blinking stops, gate U1B goes high, and the first scoring switch closed sets that flip-flop. The one which is set will provide a high level to its LED driver (one of the gates U5A thru U5D). This high level is also transmitted through the discrete OR gate made up of D1 through D4, R16 and R17. When this happens, the common line for the scoring switches is at a high level, thereby disabling all of them.

The above sequence of events occurs, however, only when LED1 is energized, since the high output to LED2 (pin 2 of U3) reverse-biases D5. Conversely, when pin 2's output is low (energizing LED2), D5 is forward-biased and clamps the scoring switch common line low. Now, any number of flip-flops can be set without disabling the other player switches. Since LED2 is energized, this is the “-” condition where the player scoring LEDs (LED3 thru LED6) blink. This is a result of the output from oscillator B turning the LED drivers on and off at the oscillator rate. With LED1 energized (the “+” condition) the low output from U3 disables oscillator B, whose output to the common input line of the LED drivers is high. This accounts for the steady illumination of the player scoring LEDs during the “+” condition. Power is supplied through switch S1 by a single 9-volt battery. Capacitor C5 bypasses any transient signals on the power line to ground, preventing erratic operation.

Construction. Because of the use of CMOS devices, a PC board is recommended. Soldering should be accomplished with a low-wattage (35-watts or less) pencil-type iron, using thin core



PARTS LIST FOR FASTOUCH

- 31—9-VDC transistor battery
- C1—1-μF, 10-VDC electrolytic capacitor (with radial leads)
- C2, C3, C4, C5, C6—0.1-μF, 100-VDC ceramic disc capacitor
- D1, D2, D3, D4, D5—1N4148 diode
- LED1 thru 6—light emitting diode rated 20 mA @ 1.7-VDC (NSL5053 or equiv.)
- R1, R7—2,200,000-ohm, ¼-watt resistor, 10%
- R2, R8, R10, R12, R14—470,000-ohm, ¼-watt resistor, 10%
- R3, R4, R16—10,000-ohm, ¼-watt resistor, 10%
- R5, R6, R9, R11, R13, R15—470-ohm, ¼-watt resistor, 10%
- R17—47,000-ohm, ¼-watt resistor, 10%
- S1—SPST slide switch
- S2 thru S6—normally-open SPST pushbutton switch
- U1, U2, U4, U5, U6—CD4011 dual input quad NAND gate
- U3—CD4013 dual D flip-flop
- Misc.—battery clip, stranded hookup wire, suitable enclosure, solder, IC sockets, etc.

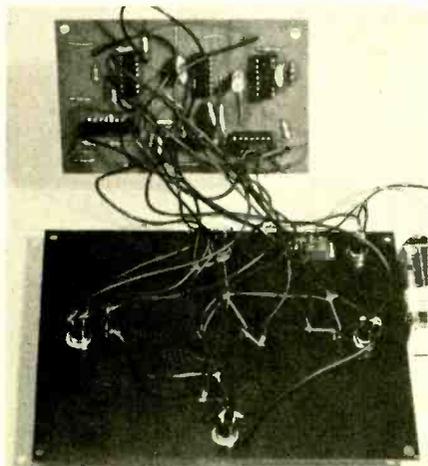
Note: A pre-etched and drilled printed circuit board for FasTouch is available for \$8.95 from: BNB Kits, RD #1, Box 241H, Tennent Road, Englishtown, NJ 07726. U.S. orders include \$1.00 (Canada \$2.00 U.S.) for postage and handling, and allow 3 to 6 weeks for delivery. Please, no C.O.D.s or overseas orders.

rosin solder. Apply only enough solder and heat to form a good joint. When inserting the CMOS ICs in their sockets, avoid handling them by their leads. Mount all components on the PC board as indicated in the diagram, being sure to observe polarity of C1, D1-D5 and U1-U6. Form 6 jumpers from the clipped-off component leads and mount where indicated by a "J" in the component layout guide. Prepare 14 lengths of the stranded wire for wiring of the front panel. Mount these wires as indicated in the front panel wiring guide.

Checkout. Check out the unit by snapping in a 9-volt battery and turning S1 on. LED1 and LED2 should blink for a few seconds and then cease, with either LED1 or LED2 remaining on. Press S2 ("FLIP") and note that this happens again. Press S2 a sufficient number of times to insure that both "+" and "-" outcomes occur. On a "+" outcome, press one scoring switch. Note that the corresponding LED lights (LED 3 for S3). Note that pressing any other scoring switch does not light any other scoring LED. Press S2 and note that the scoring LED goes out. On a "-" outcome, press all scoring switches and note that all scoring LEDs come on and blink. Press S2 and note that all scoring LEDs extinguish. This completes the assembly and checkout.

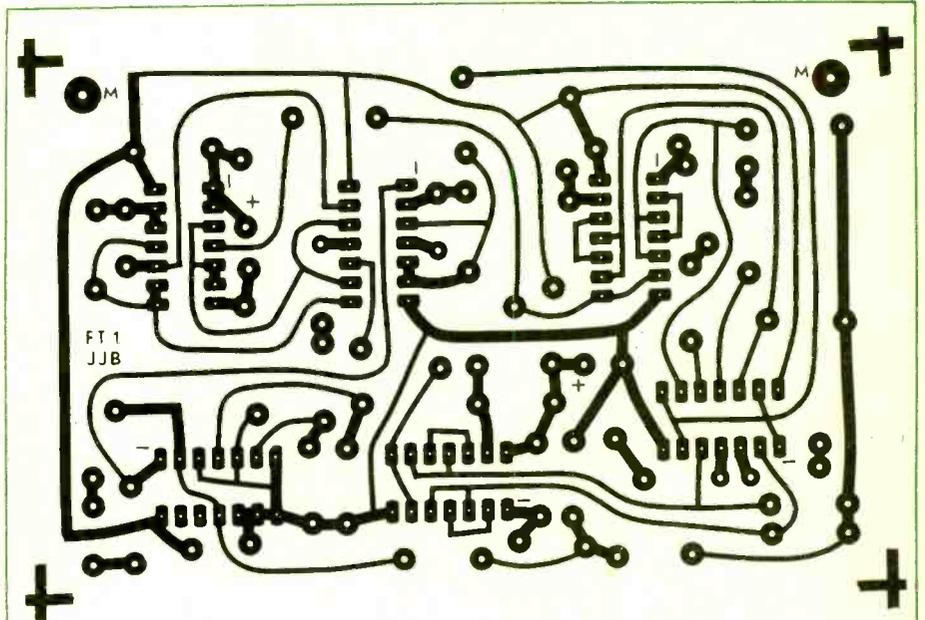
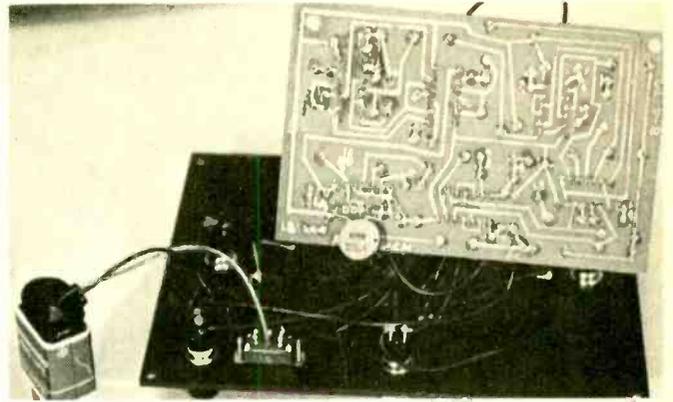
Playing It. Each player should position himself at his scoring switch. All players should be able to see the "+" and "-" LEDs easily. When all players are ready, one player presses the "FLIP" switch. As stated above, the object is to be the first player to press the scoring switch for a "+" outcome, and avoid pressing on a "-" outcome. There is only one technical rule—A player cannot press his scoring switch

(Continued on page 86)

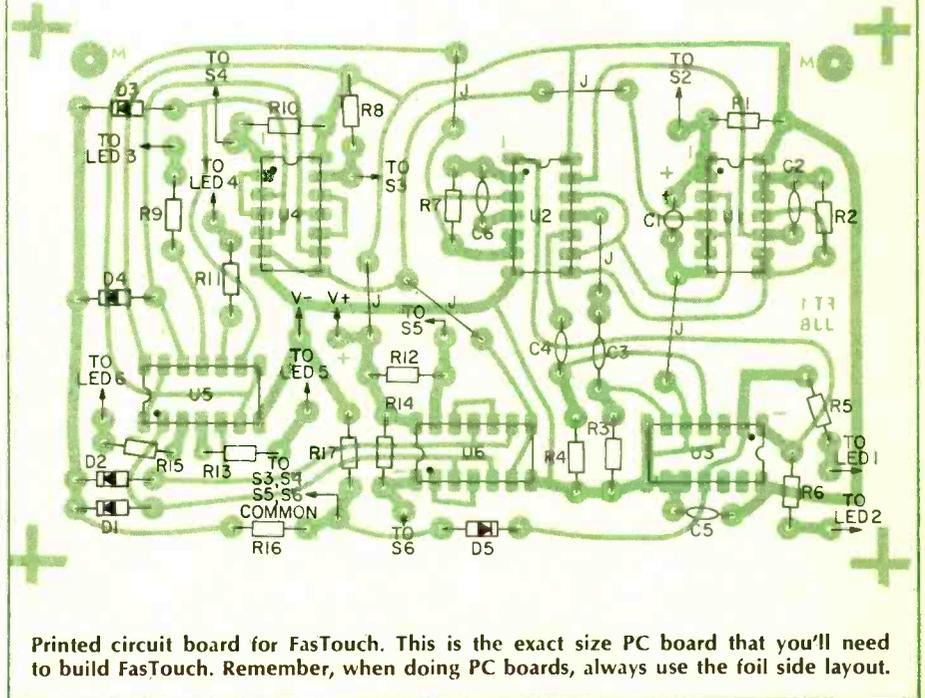


Board to panel connections and wiring of FasTouch. There's a lot of wiring, so be sure that you keep track of it all, and are careful.

Foil side photo of FasTouch. As you see, very few of the components are mounted on the foil side. The foil isn't too critical, but watch out for solder bridges.



This is the parts location sketch for FasTouch. While FasTouch is not exactly an easy kit to build, there really aren't any stumbling blocks on the component layout side.



Printed circuit board for FasTouch. This is the exact size PC board that you'll need to build FasTouch. Remember, when doing PC boards, always use the foil side layout.

The Electronic Bike Light

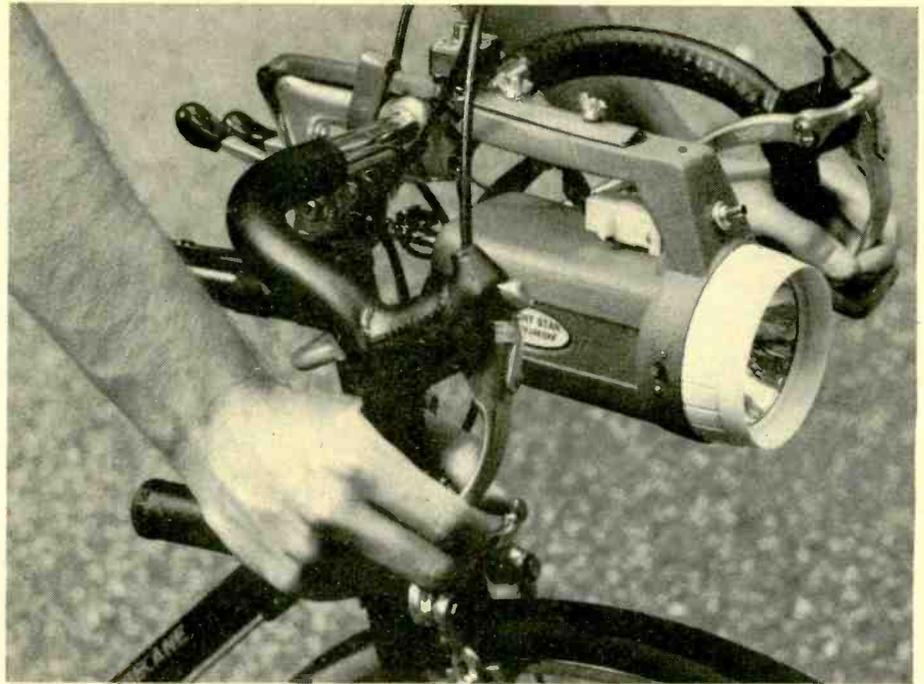
A nighttime lifesaver for the cyclist

BY ERIK HYYPIA

WHETHER YOU BICYCLE TOUR for sport and pleasure or ride your two wheeler on errands to save gas, you will sooner or later need to ride at night. This can be exhilarating, but it can also be very dangerous unless you can be easily seen by motorists, and provided you can see every one of those potholes and rocks.

The Electronic Bike Light system shoots a powerful beam of light some 150 feet up the road in front of you, illuminating every pebble and hole, and gives you brake lights, running lights and directional signals as well! You can be seen from all directions and be much safer for it. You can even take the lantern off the bike and use it as a regular flashlight.

The heart of the Electronic Bike Light is a 6-volt lantern which can be mounted between your handlebars. It contains, not only the battery and headlight, but the electronic circuitry for the brilliant flashing directional signals as well. All components mount inside



the plastic lantern housing to provide weatherproofing and resistance to vibration and road shocks.

Triple Lighting Safety. There are three separate lighting systems in the Electronic Bike Light: the headlight, brake and running lights, and the blinking directional signals. The headlight is turned on with a miniature slide switch (S5) mounted on the side of the lantern's plastic housing, and can be turned off when you are parking (with only the rear running lights on).

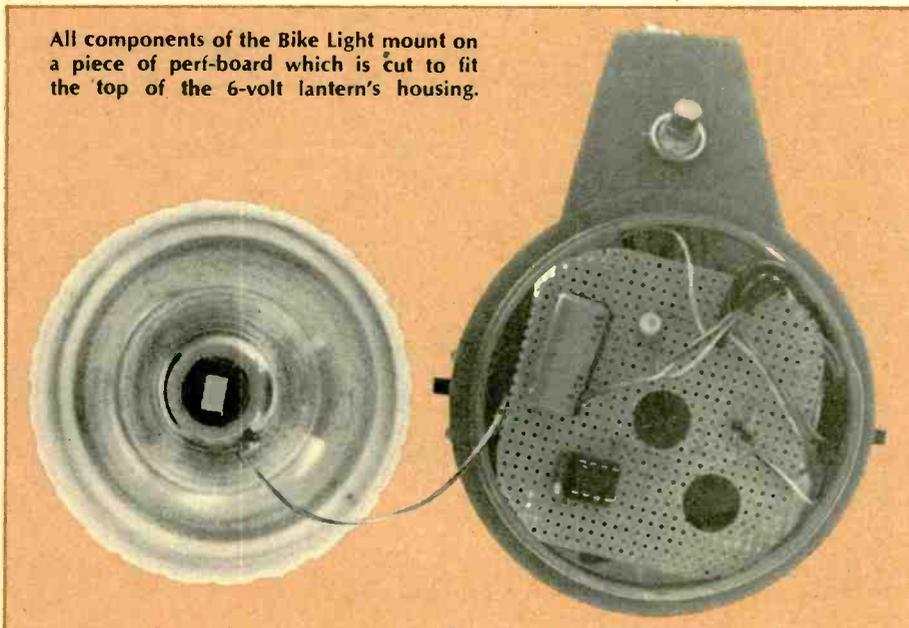
A second slide switch (S1), mounted on the opposite side of the shell, controls the running lights (L3, L4), which glow at the rear of the bike to warn

traffic coming up from behind. When the brake levers are squeezed, these running lights double their brilliance, just like the brake lights on a car. The directional signals flash brightly at a rate of about five times per second and are really eye-catching from as much as 1000 feet away. They can be controlled from a single switch mounted on the handlebars, or by two momentary contact switches mounted on the grips for easy reach. The master switch (S6), originally part of the flashlight, cuts off power to all lights and circuitry.

The lantern shown here is a Bright Star, which costs about \$6 complete with battery; however you can use almost any lantern provided it has space inside for a few electronic components. The parts are mounted on a perf-board cut to the same size as the top of the battery (see photo). The lantern is connected to the bike leads by means of a multi-pin connector, which allows you to unplug the flashlight at a moment's notice and use it away from the bike.

Circuit Theory. An LED Flasher Integrated Circuit, available at Radio Shack and other well-supplied electronics houses, provides the blinking action for the directional signals. It flashes at a rate of about 5-Hz, though its timing can be adjusted by changing the value of capacitor C1. A PNP germanium transistor (type 2005) amplifies the IC's strobing pulses to drive the 2.3-volt directional signal lamps. Each time the IC strobes, it energizes the transistor's base, which turns on the proper directional signal lamp. The lamps are driven at a slight over-voltage because

All components of the Bike Light mount on a piece of perf-board which is cut to fit the top of the 6-volt lantern's housing.



the timing pulses last only about 6 milliseconds, but they are not damaged because they cool sufficiently between pulses received.

The LED, mounted on the top of the lantern housing, provides the rider with a visual indication that the turn signals are working. It also functions as a voltage divider to supply the proper amount of current to the base of the transistor, and as a pilot light to prevent you from inadvertently letting your signals blink when you don't need them.

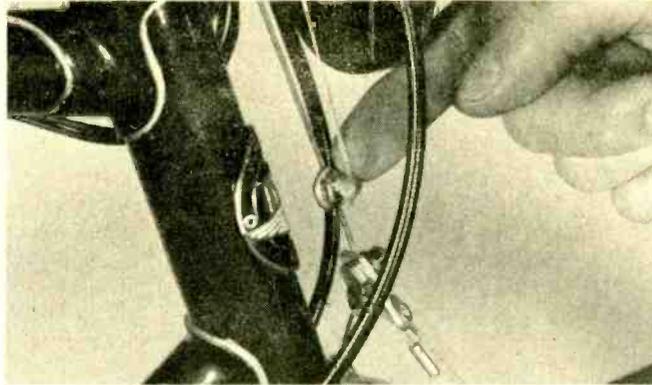
When Switch 2 is flipped in either direction, current flows from battery negative through the switch, and through the chosen directional signal lamp. At the same time, the IC is energized, and begins strobing the transistor, which completes the circuit through the directional signal lamp. Diodes D1 and D2 prevent both signal lamps from being energized at the same time. A 100-ohm resistor (R3) reduces the voltage from the IC going to the diodes.

The brake/running lights are controlled separately, by means of two roller micro-switches (S3, S4) tied to the brake cables. When a caliper brake handle is squeezed, and the brake cable tightens, the micro switch contact closes, brightening the brake lights. (See drawing). Two micro switches are used, one for the front brake, and one for the rear brakes). These are wired in parallel, so that squeezing either brake handle brightens the brake lights.

The running lights are controlled by a switch (S1) mounted on the lantern housing. When the switch is off, the brake lights operate normally. When the switch is on, the brake lights glow at half brilliance for use as running lights. Now, when the brake levers are squeezed, the running lights will double in brightness, acting in the same manner as brake lights on a car. A 7-ohm dropping resistor (R1) determines the brightness of the brake lights, and an 11-ohm resistor (R2) the brightness of the running lights. A further voltage dropping action is achieved by wiring the brake/running lamps in series.

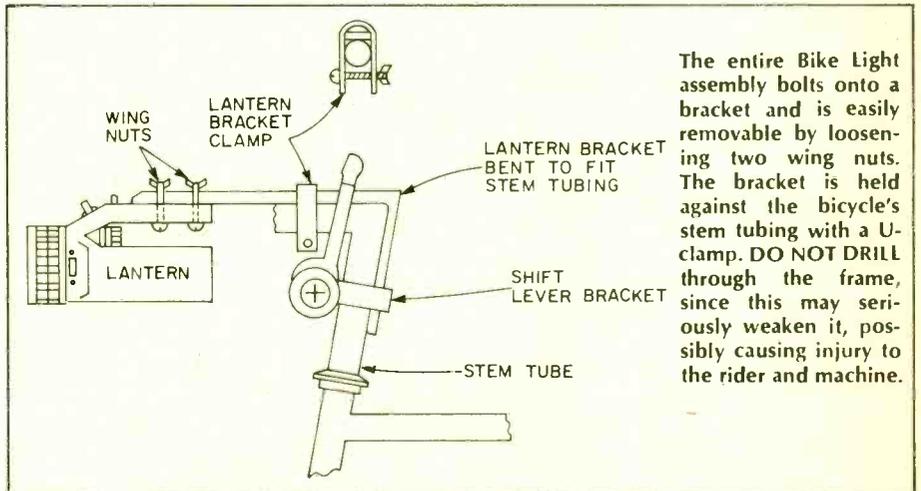
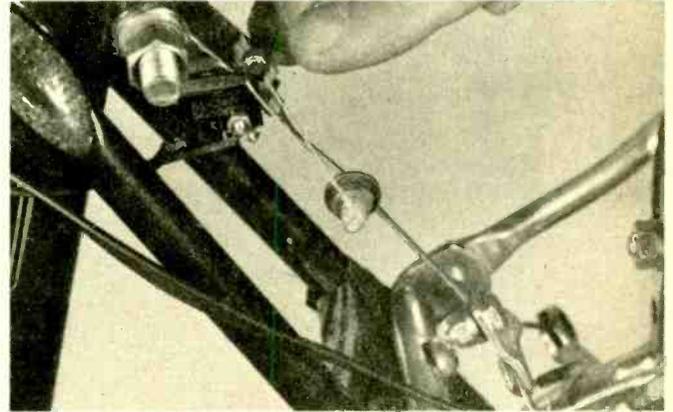
The headlight is controlled by a slide switch mounted on the lantern shell. The original pushbutton switch on the lantern is rewired to act as a master switch, controlling current to all lamps and circuitry.

Perf-board Assembly. To begin construction of the Electronic Bike Light, cut the perf-board (see parts list) to the same size as the top of the battery, and drill two holes for the battery's spring contacts as shown to allow the circuit board to lie flush with the top of the battery. This minimizes the space occupied by the circuitry.

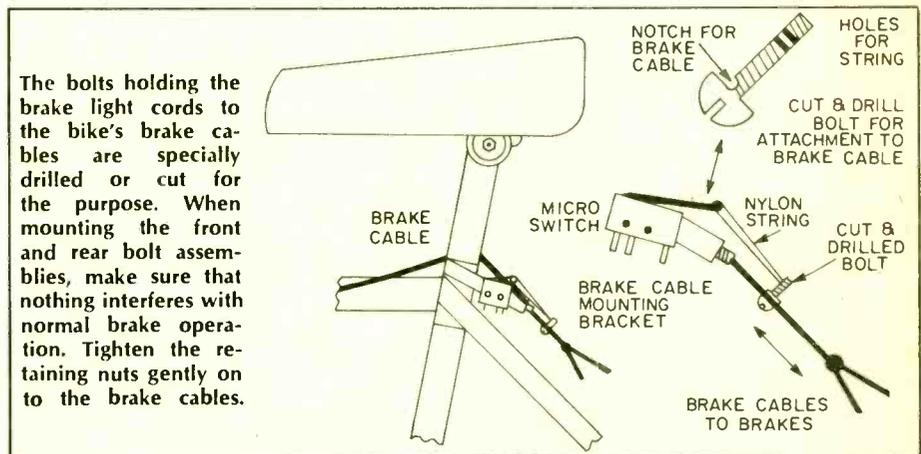


The front brake light switch is attached to the brake cable with strong nylon cord. The cord is in turn fastened to a specially drilled bolt which, when tightened onto the brake cable, tensions it to the switch.

The microswitch mounted over the rear brake controls the brake lights when the rear brake lever is squeezed. Nylon cord is attached to the rear brake light control switches in the same manner as in front. Use hot-melt glue on the cord ends.



The entire Bike Light assembly bolts onto a bracket and is easily removable by loosening two wing nuts. The bracket is held against the bicycle's stem tubing with a U-clip. **DO NOT DRILL** through the frame, since this may seriously weaken it, possibly causing injury to the rider and machine.



The bolts holding the brake light cords to the bike's brake cables are specially drilled or cut for the purpose. When mounting the front and rear bolt assemblies, make sure that nothing interferes with normal brake operation. Tighten the retaining nuts gently on to the brake cables.

Wire all the electronic parts to the perf-board, and leave all the leads from the board at least eight inches long; any shorter and you will not be able to remove the battery once the circuit board is wired into the lantern. Use stranded wire for all wiring between the board and the other parts to prevent breakage from vibration and strain.

Mount the two tiny slide switches inside the housing of the lantern with their levers protruding on opposite sides, just to the rear of the headlight-reflector assembly. Make sure there is enough clearance for the battery to pass between them and for the reflector to be screwed down tightly.

Next, cut holes for mounting the multi-pin connector under the handle of the lantern, and drill a slightly larger hole through which to pass the connecting wires.

Mount the LED in a small hole in the top forward part of the handle. You can secure it with some plastic cement

Rewire the master switch to go to the circuit board instead of the headlamp, and connect the headlamp contact to one of the slide switches. From a scrap of copper, make another battery contact similar to the one which came with the flashlight, and wire it into the circuit to connect with the negative (center) terminal of the battery. Make sure that you label the two battery contact connectors for polarity, so that you do not blow out your IC and transistor when you switch on.

Cut all leads going to the multi-pin connector to the same length, and solder the connector pins to them. When the rest of the circuit is wired to the lantern's battery, switches and LED, pass these connectors through the hole under the handle, to the housing of the multi-pin connector. Press each connector firmly and deeply into the plastic housing with a screwdriver until it locks. To make sure that you know which contact is connected to what,

draw a diagram of the connector and label all of the pin positions.

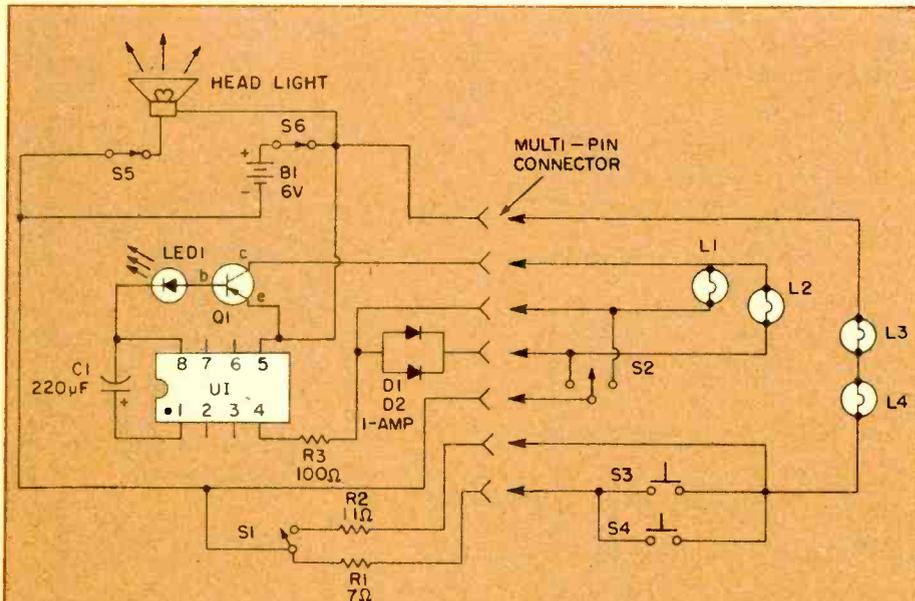
Check the wiring of the lantern, and make sure that *all* of your connections are securely soldered. Soldering is vital here, because of the inevitable vibration and moisture.

Wired for Light. Wiring the bicycle can be done permanently, as shown here, or temporarily, by wrapping the cables around the frame tubing of the bicycle for easy removal. Five-lead antenna rotor cable makes an excellent wiring choice, since all the leads are bound together in a flat ribbon which can easily be attached to the frame tubing. However, almost any type of stranded wire or thin cord will do.

Run a five-lead cable from the handlebars to the rear of the bike under the top horizontal frame tube to carry the signals to the brake/running lights and the directional signals. Heavy double-stick cloth tape used to tack down rugs will hold the cable to the frame tubing. Be sure that you allow enough slack for the cable to move freely around the handlebars as you rotate them; also make certain that it does not bind in the brake cables or in the derailleur levers. Run two-lead cable to both the front and rear caliper-brakes. (You may want to connect the brake switches to the brake levers on the handlebars, but this is a much more delicate operation and can interfere with riding and braking).

If you want to control the directional signals with dual momentary contact switches, run two leads out to each side of the handlebars, and mount the switches wherever you find them comfortable to use in your normal riding position. Radio Shack's subminiature roller-lever switches, like those used for the brake lights, make an excellent choice for directional signal switches. If you want to control the signals with a single switch, as we did, run shorter cables up to the center of the handlebars where the SPDT Center-Off switch is mounted.

To mount the lantern on the front of the bike, bend a rigid metal bar to fit as shown—down the stem, and protruding forward between the handlebars. It is clamped to the stem using the same assembly which holds the gear-shift levers, and fixed to the handlebar arm (which connects the handlebars to the vertical stem) with a "U" shaped clamp. *Never* drill through the frame tubing of the bike, because this will weaken it, maybe dangerously. Instead use a pipe-clamp bent to fit the lantern



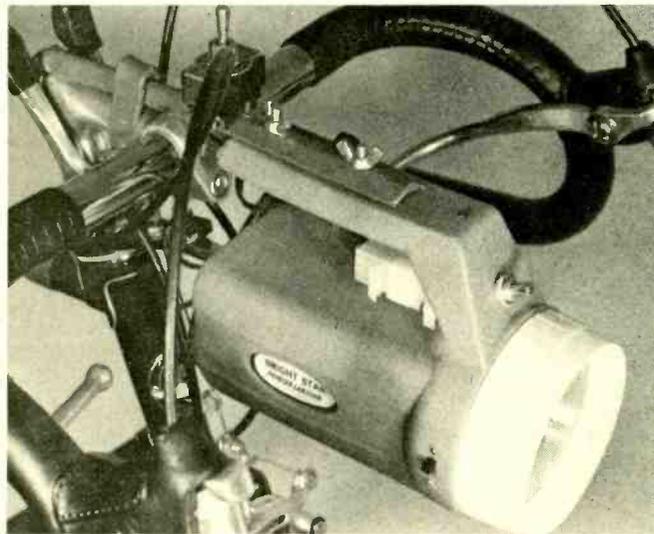
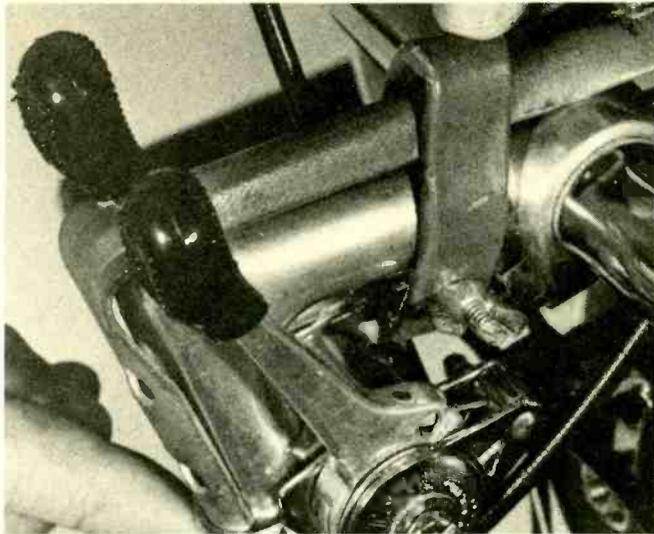
PARTS LIST FOR THE ELECTRONIC BIKE LIGHT

- B1—6-VDC lantern battery
- C1—220-μF, 16-VDC electrolytic capacitor
- D1, D2—1-amp switching diodes
- L1 to L4—2.3-volt bulbs, type PR-4 or #222
- LED1—Light Emitting Diode, 1.75-VDC
- Q1—PNP germanium transistor, type 2005
- R1—7-ohm; 1-watt resistor
- R2—11-ohm, 1-watt resistor
- R3—100-ohm, ¼-watt resistor
- S1, S5—DPDT miniature slide switches (Radio Shack 275-407 or equiv.)
- S2—SPDT Center/Off switch for directional signals
- S3, S4—Subminiature roller microswitches

- (Radio Shack 275-017 or equiv.)
- S6—Master switch (original to lantern)
- U1—Flasher/oscillator Integrated Circuit LM-3909

MISC.—Bright Star or similar 6-volt lantern, perf-board sized to fit top of lantern, 5-lead antenna rotor cable (10 feet), one 8-pin IC socket for U1, 9-pin male/female molded nylon quick-disconnect connector ("Molex-type"), two ¾-inch bolts with nuts and washers, two 1½-inch bolts with wing nuts and flat washers, other hardware as needed.

The mounting bracket for the Bike Light is made from a piece of soft steel, bent to fit over the stem piece of the bike. Cover the bracket with weatherproof vinyl tape to make for a nicer installation and round off possible edge roughness.



When the Electronic Bike Light is mounted between the handlebars, all controls are in easy reach. Whether in the rest position or "down on the grips," the rider has access to everything. This allows instant response in all bicycling situations.

mounting bracket and handlebar arm as shown in the diagram.

Drill two holes in the lantern mounting bracket for attaching the lantern, and two more in the handle of the lantern itself. The lantern can be bolted to the bracket with 1/2-inch bolts and wing nuts for easy removal. The lantern we used has a hollow handle, which should be reinforced. Cut the end of the handle open, and slide a block of wood inside the handle so that it provides a rigid filler to strengthen the mounting of the lantern on the bike.

When you have mounted the lantern on the bike, cut the cables for the brake and directional signal switches and lamps so that they reach the multi-pin connector mounted on the lantern. Leave some slack so that the cables move freely when the handlebars are turned as far as they will rotate to the left and to the right.

Now wire the multi-pin connector to the cables on the bike. (Make sure you get all the connections straight—use your diagram of the connector on

the lantern, and solder them well.)

Wire the lamps (2.3 volt type PR-4 or #222) to the rear of the bike and mount them. If you have rear baskets, you can simply attach the bulbs to the baskets. If you do not have baskets, you can make a mounting bar of wood or, preferably, from polyethylene tubing, and attach it underneath the seat. Plastic tubing is better than a wooden dowel because it will bend and snap back if it hits an obstruction as you ride. The lamps should stick out about eight inches on each side of the frame.

Your final job is to mount and connect the brake switches. Radio Shack roller-type micro-lever switches work well for this. Mount one on the arm above the rear brake which holds the end of the brake tube, and position the switch with its lever pointing upwards and to the rear of the bike. Cut a 1/2-inch bolt as shown to fit on the brake wire, and drill two small holes in the shaft of the bolt. Attach the bolt midway up the exposed brake wire, making sure that it does not interfere

with normal braking. Now run a thin, strong nylon cord through the roller on the micro switch, and pass its ends through the holes drilled in the end of the bolt attached to the brake wire. Tie them so that the lever of the micro switch is pulled *down* when the brake is released, and *up* as soon as the brake levers on the handlebars are squeezed. This method of mounting assures that the micro switch will not be damaged by hard braking action, since the lever of the micro switch is *released* when the brake lever is squeezed. Make sure that the switch is securely mounted to the frame, and that it does not swivel, then cut and solder the electrical lines for the brake lights to the proper terminals on the switch. Remember, the brake lights should go *on* when the brake levers are squeezed.

Mount a second micro switch in like manner on the front brake assembly of the bike. Make sure the nylon string which pulls the lever of the micro switch does not bind or rub against anything sharp, and that it does not interfere with the free movement of the brake cables as the handlebars are turned. Solder the cable to the correct switch contacts with care.

Ready to Roll. With everything connected, plug the multi-pin connectors together and test the circuitry. With the running lights off, the brake lamps should light when the brake levers are squeezed; with the running lights on, the lamps should *brighten* when the levers are squeezed. The directional signals should flash about five times per second (highly visible at night); they will not work properly unless *both* bulbs are in place. The LED on the lantern should synch with the directional light flashings.

Try the assembled unit at night on the bicycle. The lantern should be angled downward slightly, so that the main beam illuminates the road 100 to 150 feet ahead of the bicycle. This distance allows you time to spot dangers in plenty of time to take evasive action. The scattered light from the reflector of the lantern does a good job of illuminating the road in front of the bicycle with an even, well distributed light.

Try riding the bike as a friend watches from the rear. The directional signals on our model are bright, and should be visible from 600 to 1000 feet away. The running and brake lights also increase visibility of the bicycle dramatically. You will find that the arc of bright light thrown from the headlight is also easily spotted by oncoming cars, and those coming up from behind you on the road as well. Safe riding! ■

CB SPECTRUM

THREE FINE U.S.-MADE ANTENNAS

BY KATHI MARTIN KGK3916

IT WAS ONLY a few short years back that just about everyone believed in two cars in every garage and two CB transceivers in every car. The public was buying CBs as fast as they were manufactured, and it was not unusual for a foreign-built antenna to be thrown in either for nothing, or maybe \$10.

It appeared to be a terrific deal because the "throw-in" looked just like the more expensive American product. Trouble was, they just looked that way. Sometimes it wasn't even weeks before hardware cracked, connections opened, or rust set in.

A good, well-made, reliable antenna takes time to design, time to manufacture, and costs money. You can't get one free—no way.

In addition to quality, a U.S.-manufactured antenna delivers extras in the way of installation conveniences. Fact is, that's where much of the difference comes in, and three new antennas that will illustrate the "installation extras" will be our topic this issue.

I don't want to get involved in any hassles over which antenna puts out more RF, or receives better, or anything else like that. I leave it to you to determine which antenna length or type might be best for your particular needs and budget, I will simply illustrate three excellent antennas from the viewpoint of the installation itself.



The Super Stix from Hy-Gain is a nearly indestructible "sky hook." Circle number 47.

Super Stix from Hy-Gain. The first of the antennas I looked at is Hy-Gain's *Super Stix* which I consider to be of special value to those who use bumper and Hollywood-mirror antenna mounts. The Super Stix is wound on a fiberglass/resin rod using a combination of continuous and top loading. The antenna is sheathed in a Polyvinyl jacket with a removable cap at the top. To adjust the antenna for minimum SWR (if needed) you simply remove the cap, remove (unwind) whatever it takes to get a low SWR and replace the cap.

The antenna is available in three sizes: 30, 48 and 60 inches, all in your choice of red, white or blue jackets.

The mounting end is equipped with the standard $\frac{3}{8}$ "-24 threaded stud, which fits all standard $\frac{3}{8}$ " mounts.

What I like best about the Super Stix is that it is virtually indestructible (I know, 'cause I tried to break one). The rod itself is extremely rigid with virtually no "give" even at top highway speeds, yet a clunk into a solid tree branch or overhang won't damage the antenna.

Super Scorpion from Antenna Specialists. Another fine antenna is the extra lightweight base loaded, trunk lip mounting Antenna Specialists M-2000 *Super Scorpion*. If you want an antenna that's easily removed for storage, that takes up next to no room in the trunk, and won't leave any marks that might affect trade-in value at a later time, then the M-2000 is your sky hook.

The Super Scorpion looks at first glance to be similar to many other base



Suction base on American Antenna's Super Scorpion holds tightly. Circle number 48.

loaded antennas. Closer inspection of the base, however, reveals a small lever labeled *open* and *lock*. When set to *open* the bottom of the antenna is separated electrically and mechanically from the trunk lip bracket, which measures only $2\frac{1}{4}$ " square by $1\frac{1}{4}$ " high.

The base can be disassembled for through-the-roof mounting; however, I suggest you leave this to a professional

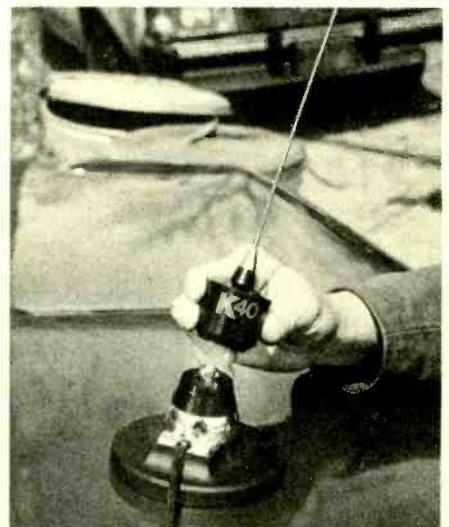
K-40 from American Antenna. The last of the antennas I looked at is the American Antenna K-40.

I have had it up to here with magnet base antennas that fly off vinyl covered auto tops. Up until the K-40 I never had one stay put at high speeds or when striking a low branch. Not so, however, with the K-40.

The basic component is the base loaded K-40 antenna, which comes with an integral trunk-lip mount.

If the baseloading coil is twisted about $\frac{1}{8}$ -turn the antenna separates from the mount at a keyed boss. When converting to a magnetic mounting this entire antenna assembly is inserted into a 5-inch magnetic base. The trunk lip hardware drops inside the magnetic base where it cannot be seen, and it's secured with a hefty bolt.

Regardless which antenna you select, keep in mind that like all loaded antennas (with rare exception), they must be tuned for minimum SWR. ■



Antenna Specialists' Super Scorpion has a levered suction base. Circle R.S. No. 44.

ONE WARM SPRING AFTERNOON I was sitting in my ham shack with visions of faraway places dancing in my head. A distant roll of thunder over a nearby mountain suggested the approach of an electrical storm. The sharp crack of static interference from lightning discharges grew stronger in my receiver but I wasn't worried. Lightning only strikes high places, and I was nestled safely in a hollow between two high, protective mountains.

Suddenly—CRACK!—A nearby stroke hit our power line! A shower of sparks burst from the main fusebox! The radio was silenced. A tape recorder—turned off but plugged into the wall socket—refused to play when I attempted to switch it on. Trying the beam rotator, I discovered that it too had been put out of commission.

The impossible had happened: lightning had wiped out the ham shack, and it hadn't even been directly hit! Fortunately, insurance covered a portion of the monetary loss, but the cost of the inconvenience couldn't be calculated in dollars and cents.

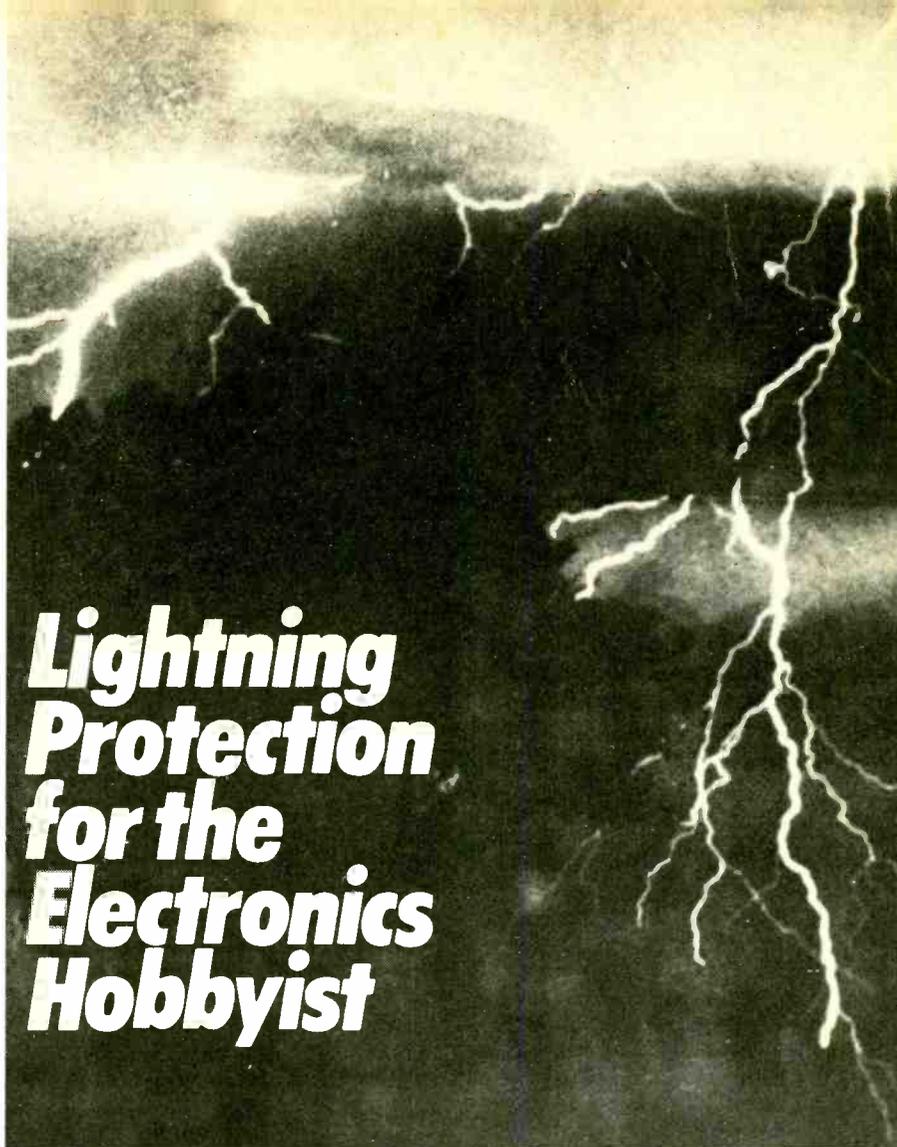
Sadder but wiser, I decided to go about the sorrowful prospect of repair and replacement. But this time I would use better sense and plan to avoid such devastation next time.

Line Transient Wipeout. Assessing what had happened, I decided that the cause of the wipeout was a line transient: a sharp pulse of high voltage energy impressed upon the power line by the lightning stroke.

Lightning doesn't have to strike the line *directly*; a nearby stroke will induce a spike of high energy flow in a long power line, just as current flowing in the primary winding of a power transformer can induce current to flow in the secondary. And these pulses can be enormous—as much as *several times* the normal voltage in the power line!

What can be done to protect equipment from this freak of nature? After all, we can't always be around when a summer storm whips up. The most obvious answer, of course, is to disconnect your equipment from the power line when it is not in use. And don't forget to disconnect the antenna line while you're at it; a *direct* hit from lightning is even worse!

Since virtually all of us power the equipment in our radio installation from a common distribution line, there is a simple solution. Install a circuit breaker or main power switch at the operating position which feeds all the equipment. The switch must interrupt both sides of the line to insure complete isolation. A switching arrangement is actually more convenient, too; the entire station



Lightning Protection for the Electronics Hobbyist

Simple precautions that can save lives and property

BY ROBERT GROVE

may be activated or shut down at the flip of a switch.

Unless you enjoy constantly resetting the time, your AC-operated clock must remain connected to the uninterrupted side of the power line. Battery operated digital clocks are far more practical in this respect; they need no AC.

A similar switching approach may be followed with the antenna circuit. A coax antenna switch will disconnect the antenna from the radio when not in use, and ground the antenna line at the same time.

Ground That System! Additional safety measures should be used to back up this preventative system. Good electrical grounding is essential for such an installation. Not only does it provide a discharge path for a sudden burst of static electricity, but it will afford shock protection for the operator by keeping all metal cabinets at ground

potential as well. Even more, electrical noise interference probably will be reduced measurably. All radio metal chassis parts are connected together by a common ground bus of heavy wire.

What constitutes a good ground? At least 8 feet of metal pipe or rod driven into conductive earth, attached to the equipment by a short length of heavy gauge wire. While a cold water pipe will often work, it is second best. Use *both* of these grounding techniques if available. If it is impossible to drive a ground rod that deep, several separate ground rods may be employed.

In some commercial antenna installations, another technique is used to reduce lightning damage from a direct hit. Because a lightning stroke occurs so swiftly, it behaves like a partial cycle of a high-frequency signal. By coiling a dozen or so turns of the coaxial cable at the base of the antenna before it

enters the building, the coax acts like a giant RF choke, restricting the amount of lightning-induced energy allowed to pass through the turns. At low frequencies, (such as shortwave) the extra cable length won't affect signal strengths in the least.

Naturally, any metallic tower or mast should be well grounded directly at its base. Non-metallic towers may be protected by a ground wire leading down from any upper metallic supports.

Another simple expedient to protect the antenna input of your radio from static electricity is the "Blitz Bug," an in-line voltage arrestor. Available from most electronics suppliers, these units are made by a variety of manufacturers. They cause no insertion loss, and may be used well into the UHF range at full Amateur transmit power.

There is another component available from a variety of industrial suppliers which can provide extensive line voltage protection: the transient surge protector. In the early days of radio, high voltage spikes were not that much of an equipment threat; vacuum tubes were very forgiving of short-term abuse. But solid state devices are not. Bursts of high energy will fuse the junction of a transistor or diode in a fraction of a second. Fortunately, voltage-sensing protectors are currently available at reasonable cost.

MOV Protectors. Individual pieces of equipment may be protected by metal oxide varistors. MOV's are semiconducting devices which change their resistance with applied voltage. They are connected across the AC line of the protected equipment. So long as the line voltage remains close to the specified value, the MOV doesn't conduct. However, as soon as a high voltage spike occurs, the MOV goes to work by lowering its resistance, effectively short-circuiting the voltage pulse.

Because of the short cycle time, tiny MOVs—about the size of a standard disc capacitor—provide momentary clamping action on many amperes of damaging surge current.

Despite the large number of manufacturers of these devices, they are not readily available from the usual hobby parts houses. You will have to check industrial suppliers for these useful components. A list of manufacturers is provided for reference; you may wish to write to their sales offices for more information and applications literature.

Representative of the high-quality MOVs available for lightning protection is the Panasonic ERZ-C10DK221.

It is UL listed and available through the Allied distribution network.

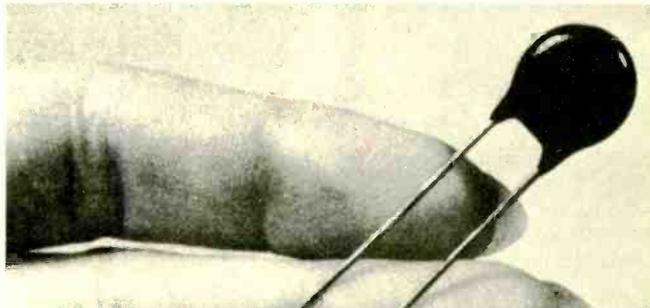
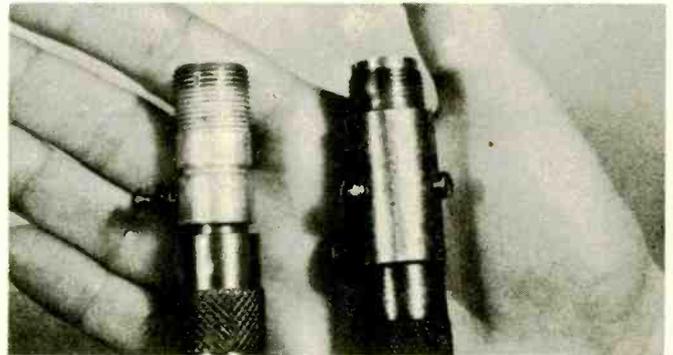
There are transient absorbers available which can be connected across the mains to protect the entire house, but these are quite expensive. An inquiry to your local power company service representative will provide the answer as to their availability in your area. Many power companies will install the large suppressors free of charge if the devices are furnished by the customer.

If you live on the highest hill around,

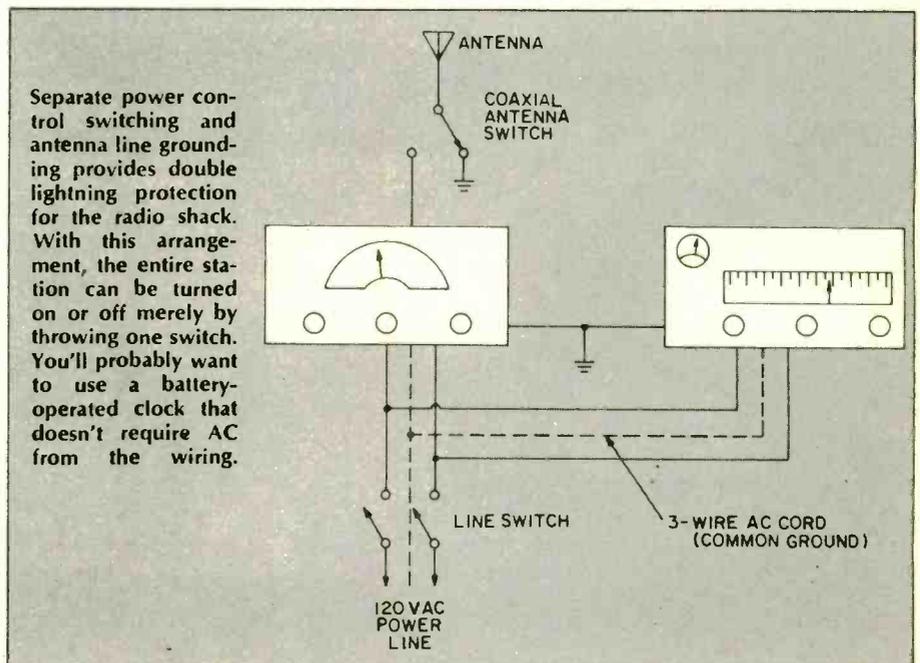
and if you have an outside antenna, you are a sitting duck for a lightning strike. Because of the capricious nature of lightning, even those of us in lower terrain are vulnerable.

Lightning protection is a must for safeguarding lives, equipment and property. It was Ben Franklin—that inveterate flier of kites in electrical storms—who said, more than two centuries ago, that "an ounce of prevention is worth a pound of cure." That advice holds just as true today. ■

In-line voltage arrestors like these Blitz Bugs provide a large element of protection against surges of static electricity in antenna lines. Directly inserted into the line, they do not cause a great loss.



Metal oxide varistors are installed across AC power lines, protecting against line transient surges caused by lightning hitting a nearby power line.



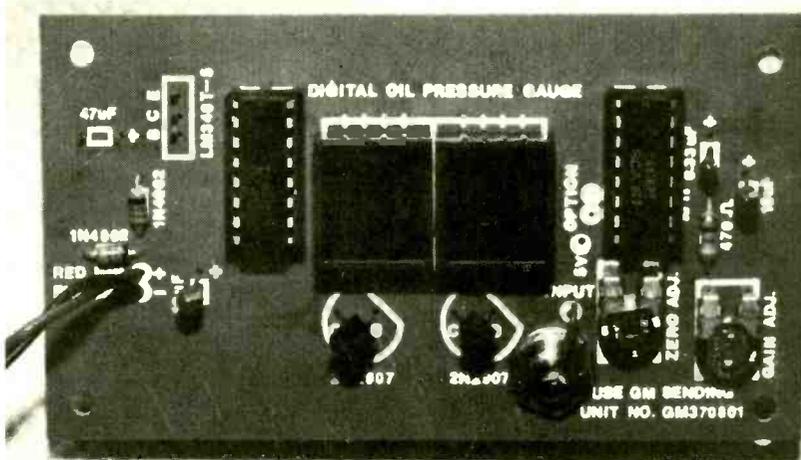
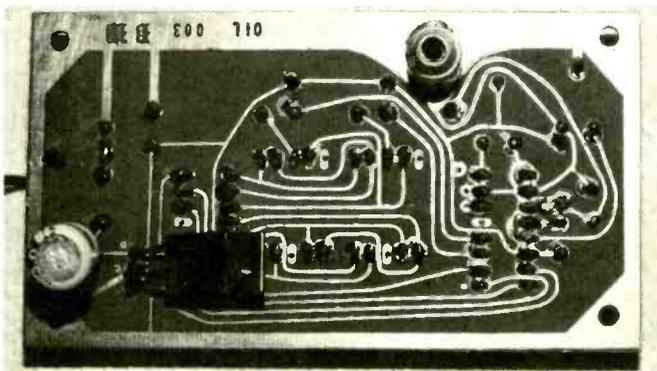
THERE ARE TWO MAIN CAUSES of "blown" engines, and they both relate to the subject of oil. Either there's not enough to sufficiently lubricate the engine, or it is circulating under too low a pressure to reach all of the areas it is supposed to. In any event, if either condition persists too long, you're likely to be looking for a new mill in very short order, something which can run you anywhere from \$300 to \$1,000, not to mention the cost of labor involved.

For a few dollars, and with some basic attention to the markings on your dipstick, you can build a highly accurate oil pressure gauge and with it, establish good maintenance habits which can prolong the life of your car or boat engine for thousands of extra miles. Why should you add a gauge if your car already has a dummy light? A dummy light will only signal you when oil pressure has *already* dropped to a dangerously low level. At this point, it's usually too late, and the pistons will seize against the cylinder walls, causing the car to stop as if hit head on by a truck. A gauge, on the other hand, allows you to establish the normal operating pressures for your car, and can take note of the fluctuations caused by worn oil pump gears, jammed oil pump pressure relief pistons, leaking seals and gaskets, and can even tell you, by indicating an increase in pressure, when it's time to change your oil filter. In some cars, a gradual drop in oil pressure can indicate low oil levels, although the only *positive* method for determining the amount of oil left in the oil pan is by checking the dipstick itself.

One of the best features of this gauge is that it is installed so as not to eliminate the function of the dummy light system. In effect, the dummy light serves as a fail-safe against the possibility of gauge or sender malfunction.

The Circuit. Regular readers of this magazine will no doubt recognize the basic design of the oil pressure gauge from those of the voltmeter and temperature gauges. The same three versatile ICs are used again here.

A view of the foil side of the PC board for our Digital Oil Pressure Gauge. Note the clean layout. If you mount the regulator chip on the foil side, carefully bend it parallel to the board, making sure that nothing shorts out.



Dashboard Digital Oil Pressure Gauge

The single most important instrument for engine protection

BY FRED YOUNG SR. AND FRED YOUNG JR.

The ignition input (+12 VDC line) should be connected to some point on the car's electrical system that is active only when the ignition switch is on, and the motor is running. At all other times, the ignition line should be off. The most desirable connection would be the same fuse terminal that the horn or windshield wiper is connected to.

Note the point marked OPTION on the schematic. With pin 6 of the CA3162E 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 Hz 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 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 variance from stated values.

The multiplexing digit driver pins (pins 3 and 4) on the CA3162E switch the two transistors that drive their respective 7-segment displays. The CA3162E determines which display is to be on, and sends the BCD (Binary Coded Decimal) information to the display that is on. The BCD information is converted into a 7-segment output by the CA3161E. This, in turn, causes those segments to be lit that correspond to that BCD number.

Note that across pins 8 and 9 of U2 there is a 50K (R2) potentiometer connected. Pin 12 of U2 has a 0.33- μ F tantalum integrating capacitor (C4). These components (in conjunction with the CA3162E) generate the necessary waveform for that IC to perform the conversion. The operation of the 50K potentiometer (ZERO ADJUST) will be covered in the calibration procedure.

Sending Unit Operation. The maximum voltage differential that can be read by the CA3162E is 999 mV. With this in mind, examine the circuit configuration. The sending unit specified must be used because of its 1/4-inch pipe thread and its electrical characteristics. With the application of pressure, the sending unit's resistance change is virtually linear. At 40 PSI (pounds per

square inch), the resistance is approximately 40-ohms.

Let's now consider what happens when voltage is applied to the sending unit and the digital oil pressure reading which results. By applying a small current through the 470-ohm resistor to the sending unit, the resulting voltage is almost linear in relation to pressure. At 40 PSI there are approximately 400 mV developed across the sending unit. The voltage enters pins 11 and 10 of U2 by means of the coax cable coming from the sending unit to the display board. There the 400 mV is converted to a BCD equivalent. The BCD information enters the CA3161E (U3), a current-limiting, decoder/driver IC. This causes the 7-segment display to

display 40 pounds of pressure. An Ohm's Law calculation will show that the voltage is actually slightly less than 400 mV. This requires compensation, which is corrected (or compensated for) by using the GAIN ADJUST.

Assembly. After etching your PC board, (or receiving one from Digital World) check the finished product for foil bridges and other imperfections which might create difficulty during assembly and calibration. Leaving installation of U2 and U3 for later, install all other components on the board, following the component placement guide. Be sure to observe polarity with respect to diodes and capacitors.

We strongly suggest that you make use of IC sockets when installing U2

and U3. These two chips are highly sensitive to static electrical damage caused by handling without insulated tweezers. In addition, stray AC from the tip of your soldering iron (not to mention excessive heat) can also cause irreparable damage to the chips.

With all components installed, make a final check of the board against the component layout diagram as a precaution. If the final check is positive, proceed to wire in the 2 leads for the 12-volt power source. The unit is now ready for calibration.

Calibration. The degree of accuracy ultimately attainable with the gauge will be determined to a great extent by how carefully you adhere to procedures.

Begin the calibration by applying 13.8 VDC to the voltage input lines. While the LM340-T (U1) is a darned good regulator, seeing as how you'll be powering the gauge from 13.8 VDC during operation, why not try to duplicate operating conditions during calibration? At this point, you should get some sort of reading on the LED displays. If not, skip ahead to the Troubleshooting section to clear up the difficulty.

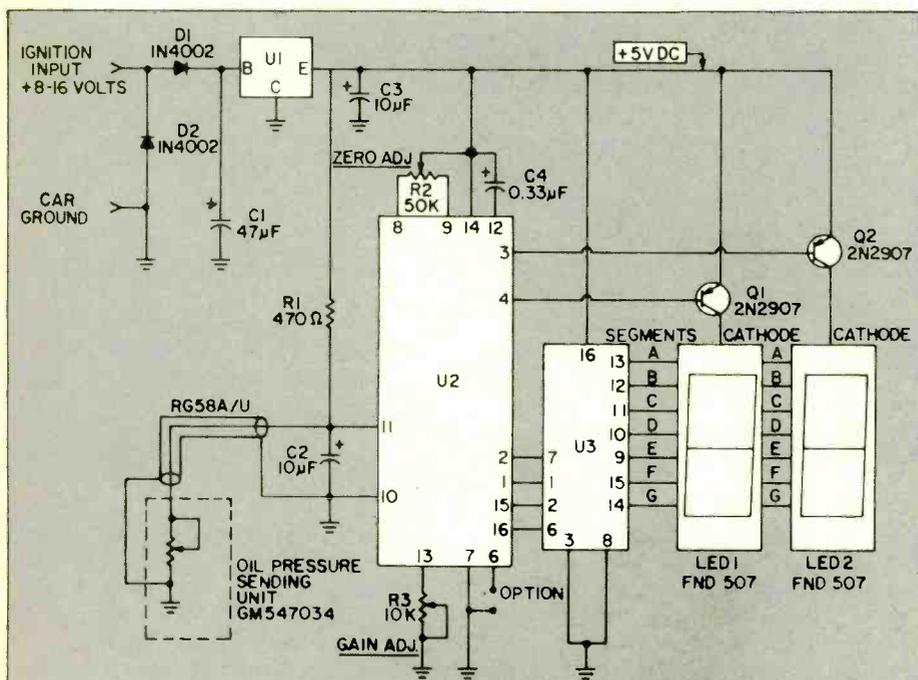
Assuming all is well, momentarily ground pins 10 and 11 of U2 to circuit ground, and adjust R2 until the LEDs read "00." Avoid rapid movement of the wiper on R2, as the range is very short, and you may pass the desired point before realizing it. Remove the ground on pins 10 and 11.

Momentarily disconnect the sending unit's coax plug from the board and insert a 47-ohm resistor across J1. Slowly adjust R3 until the displays read "47." This completes the calibration procedure, and the unit is now ready.

Troubleshooting. If, as mentioned above, the displays do not light when power is applied, recheck to see that you have not created any solder bridges which may be shorting out some components. Check to make sure that all diode polarities are correct, and that the input power line polarity is also correct. Additionally, check to make sure that the wiper of R2 is centered. If the displays light only dimly, check to make sure that Q1 and Q2 have been installed correctly.

Some GM sending units may generate electrical noise during their operation, which may result in rapidly fluctuating readings. If this is the case, you may either replace the unit with another one, or try replacing C2 with a 100-uF, 16-VDC electrolytic capacitor. This may filter out the undesired noise.

Mounting The Unit. Determine where



PARTS LIST FOR DIGITAL OIL PRESSURE GAUGE

- C1—47-uF, 25-VDC electrolytic capacitor
- C2, C3—10-uF, 16-VDC tantalum capacitor
- C4—0.33-uF, 35-VDC tantalum capacitor
- D1, D2—1N4002 diode
- LED1, LED2—FND-507 7-segment, common cathode display
- Q1, Q2—2N2907 PNP transistor
- R1—470-ohm, 1/4-watt resistor, 5%
- R2—50,000-ohm linear-taper potentiometer
- R3—10,000-ohm linear-taper potentiometer
- U1—LM340T-5 voltage regulator integrated circuit
- U2—CA3162E analog-to-digital converter integrated circuit
- U3—CA3161 BCD decoder/driver integrated circuit
- J1—RCA-type phono jack
- P1—RCA-type phono plug
- Misc.—General Motors oil pressure sending unit #547034 (fits 1966-79 Chevy, Buick, Olds), 1/4-inch brass pipe tee fitting (available at most auto supply/speed equipment distributors), 1 to 2-inch length of 1/4-inch diameter extender pipe, teflon plumber's tape (for sealing pipe threads), 10 to 15-foot RG58A/U coaxial cable, IC sockets, spacers, red plexiglass contrast panel, hookup wire, solder, etc.

A complete parts kit for the Digital Oil Pressure Gauge is available from Digital World, P.O. Box 5508, Augusta, GA 30906. Price is \$28.50 for the kit (less GM sending unit, coaxial cable, plexiglass or brass fittings). All shipments prepaid in the U.S. and Canada.

the gauge will be installed and how it will be mounted; i.e., glued, bolted, or clamped. This will, of course, vary from car to car. Try to keep it out of direct sunlight, because the less direct light there is, the brighter the displays will appear to be.

The plexiglass panel should be cut and fitted to the circuit board (then removed) before the board is assembled.

A plexiglass panel with a metal rim may be purchased from Radio Shack for several dollars. Ask to see the die-cast bezels. We have no information at this time on the availability of multiple display bezels. The single unit bezels look "pro" and are relatively easy to fit, requiring little or no modification.

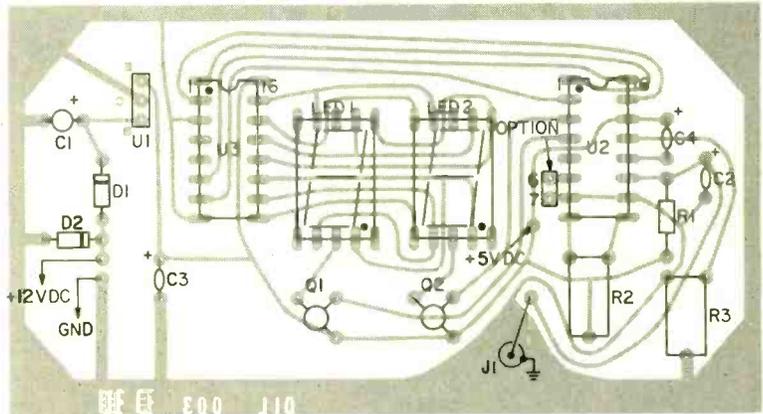
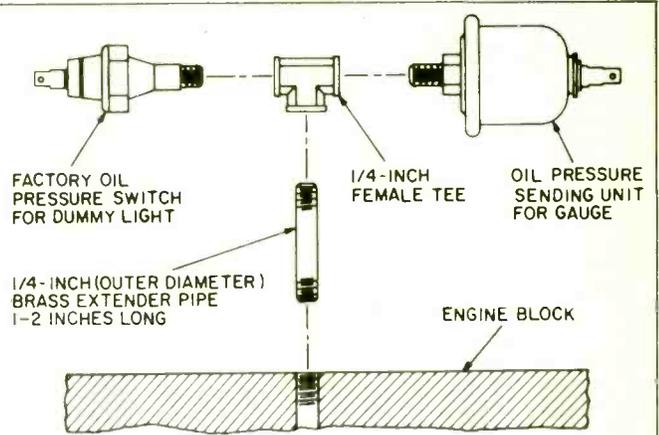
You may wish to use a larger piece of plexiglass for a multiple display panel, attaching several units to it. This requires detailed planning in layout, care in cutting the total panel, and patience in the drilling of the holes for the four retaining bolts (for each gauge) to be mounted behind it.

Another idea is to place the LEDs (for a series of gauges) on a "perf-board" behind the single panel, putting the units elsewhere, out of sight but easily accessible for repairs. However, this requires extensive wire hookups between the circuit boards of the several units and the corresponding display LEDs. Such a project is not recommended for the hobbyist just starting to work with digital units.

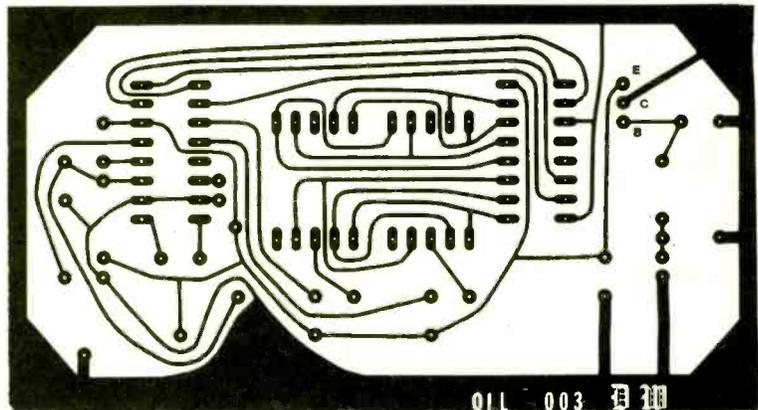
The Coax Connector. What length should the coax cable be? A simple way is to use a piece of string to measure sufficient coax length. A coax piece too short must be spliced and could be of questionable operational efficiency. Measure distance from the sending unit, routing it about the motor to points where it may be easily and firmly secured and which are well away from the hot manifold and the vicinity of the spark plug wires. Cut a sufficient length of RG58A/U cable (coax) to go from the sending unit to the display board dash location. It is wise to allow at least an extra 18-inches, permitting possible relocation, should a second location be selected later.

Solder the center conductor wire to the terminal of the sending unit, and the shield to the case of the sending unit. Do not rely on the car chassis ground to complete the path of current flow for the sending unit. The properly installed shield acts as the ground. The coax cable should be further secured and protected by being heavily taped to the sending unit. Failure to do this could result in the cable being broken at the connections because of car vibrations and/or turbulent winds under the

A drawing of the sending apparatus. This system insures that both the gauge which we're installing and the original oil warning light will keep operating. Thus, there are two warning devices, backing up each other, thereby bringing about real auto safety.



Parts layout for the Digital Oil Pressure gauge. There are relatively few components to worry about, those that there are, are relatively well-spaced. VCR's on other side.



Here's the printed circuit board for the Digital Oil Pressure Gauge, foil side up. This is exactly the way the board you make for the unit should look. Watch for solder bridges!

car at higher speeds. At the dashboard end of the coax, the center connector is soldered on to the middle-pin of P1, and the shield is soldered to the outer skirt. The plug is then ready to be inserted into the female jack on the back of the circuit board. Again, thread and secure the coax away from the hotter parts of the motor and the ignition system wiring.

The Dual System. Examine the dual system connection diagram. To use the

dual system, a brass "tee" adaptor is required. Use a 1/4-inch, 3-input female adaptor, which should be available at your local plumbing supplier. Purchase, also, a 1-inch or 2-inch piece of standard 1/4-inch brass pipe (long enough for the sending unit to clear the engine block and other components). Next, screw the pipe extender into the center of the "tee" adaptor. Now, screw the other end of the extender pipe into the
(Continued on page 85)

E/E CHECKS OUT THE...

Radio Shack PRO-2008 Direct Entry Scanner

CIRCLE 32 ON READER SERVICE COUPON



With direct entry, you don't need to be a computer expert to program this scanner

IN THE PAST FEW YEARS, VHF-UHF scanners have become almost as complicated and expensive as they are popular. Many of the devices require a cumbersome programming code book for converting frequencies to switch positions—and their price tags have topped the \$400 mark. Now, Radio Shack has hit the market with its PRO-2008. It's packed with features and quality, is simple enough for anyone to operate right out of the carton, and sells for only \$259.95.

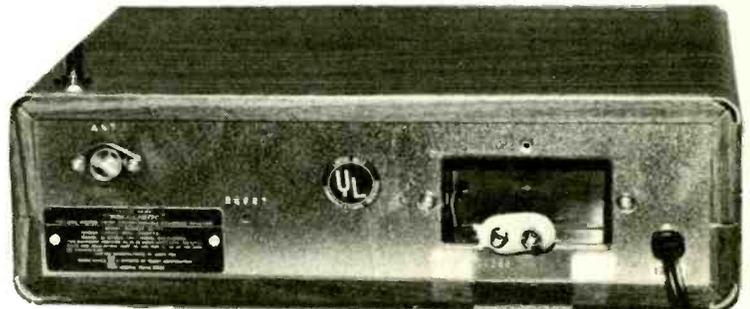
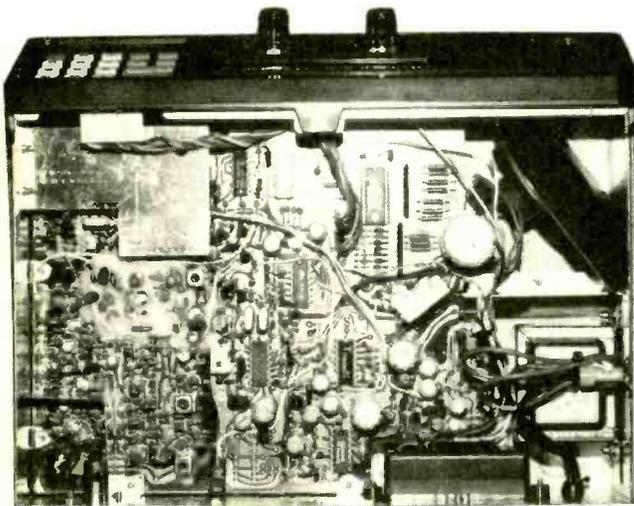
Features For A PRO. The PRO-2008 has just about everything needed for automatic, convenient scanning. Its microprocessor-controlled circuitry gives direct keyboard access to 18,160 frequencies spanning six action bands: VHF-Low, 30-50 MHz; 2-meter Ham, 144-148 MHz; VHF-High, 148-174 MHz; Ham / Government, 410-450 MHz; UHF-Low, 450-470 MHz; and UHF-High 470-512 MHz. A large, multi-purpose fluorescent display shows

which channels and frequencies are being scanned, monitored, or programmed, as well as the status of the channels. There's a Channel Lockout function, the option of a two second Scan Delay function, which eliminates missed replies, and a 9-volt backup battery provision to hold memorized frequencies in the event of an AC power failure. The AC power supply is built in, and a screw-in telescoping antenna is included.

Simplified Operation. It couldn't be easier to get this unit working. After installing the 9-volt battery, and either an outdoor or the telescoping whip antenna, you're all ready to start using the PRO-2008. The display has, besides the 6-digit frequency display, a digit which reads out the number of the channels being scanned, monitored, or programmed and a Status Descriptor which shows whether the receiver is in the Program mode, if the channel is under Scan Delay, or if the channel is

locked out entirely. In order to scan properly, it's necessary to lock in the Squelch by adjusting it to the point at which the receiver's rushing noise just stops.

When turned on, the receiver automatically enters the scanning mode. To enter a specific frequency, you need only press the MAN key. The PRO-2008 will stop scanning and get ready for your instructions. You then simply enter the desired channel by pressing a numeral key, and hit PROGRAM. The memory for the channel you've selected is now ready to store a frequency. Use the keyboard to enter the desired frequency, hit ENTER, and you've stored the frequency in memory. To program more channels, press PROGRAM to advance the channel by one, and punch in another frequency and ENTER. You've got up to eight channels of memory in the PRO-2008, and they can be spread across any of the different frequency bands, from 30 MHz to



Above is an inside look at the Realistic PRO-2008. There's a lot in here, but it's all laid out with care. Circle number 32 for info.

At left is rear panel shot of the PRO-2008. The battery compartment is open. The 9-volt battery lets the unit hold its memory without AC.

512 MHz. When you're done entering the frequencies, press SCANNER to return the receiver to the normal scanning mode.

Plenty of Frills. The PRO-2008 offers a number of useful programming options. As mentioned, there's a Channel Lockout, which disables those frequencies that are occupied continuously—otherwise the scanner would lock on to them. To show how simple it is to use the PRO-2008, pressing MAN to bring up the channel to be disabled, and then punching OUT is all it takes to activate the Channel Lockout function. Scan Delay is another feature that will prove especially worthwhile. Often, transmission interchanges occur on specific frequencies, and the reply to a message is lost because during the break the scanner moves on to its next frequency. Scan Delay imposes a two-second delay on the channel of your choice, in effect asking the scanner to wait to see if there's any answer to the transmission it senses. It's exceptionally valuable on busy police and fire frequencies, where transmit and receive may be done on the same channel.

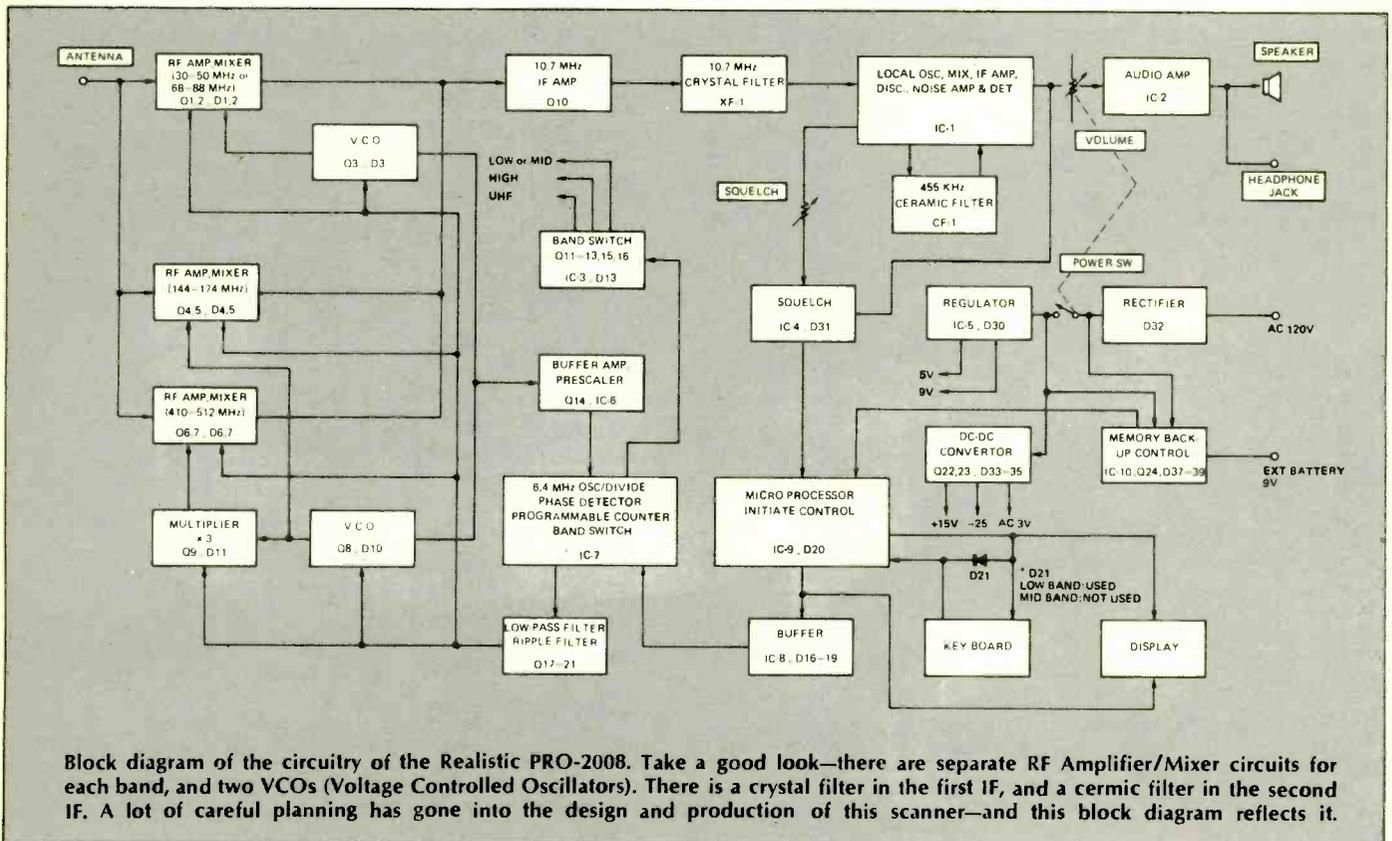
Scanning Our Results. This scanner worked like a charm. It was tested in RF-jammed New York City, where there are megawatts pumped out from

virtually every rooftop. The Pro-2008 instruction manual warns the user about potential birdies—internally generated signals mixing with external signals like TV and FM broadcasts. We didn't see a sign of them! This is certainly a tribute to the "cleanness" of the receiver. Radio Shack specifies a spurious rejection figure of 50 dB at 40 MHz and 160 MHz. We measured closer to 55 dB at those frequencies. Spurious rejection is how well a receiver keeps out unwanted signals. Selectivity, a measure of how well a receiver separates adjacent signals, turned out a bit better than the rated 6 dB down at ± 9 kHz, and 50 dB down at ± 17 kHz. These figures are quite good, and also attest to the "cleanness" of the receiver. Sensitivity—not really an issue at our location—was as good as the 1.0 μ V (2.0 μ V at 410-512 MHz) claimed by the manufacturer. Audio output is 2-watts maximum.

Circuit Features. For those who are interested in what goes on inside the receiver, the PRO-2008 has some pretty classy circuitry. There are separate RF Amplifier/Mixer circuits for each band, two VCOs (Voltage-Controlled Oscillators), and a double conversion IF (Intermediate Frequency) strip. The first IF is at 10.7 MHz, and employs a crys-

tal filter, and the second IF is at 455 kHz, and incorporates a ceramic filter. This combination of RF and IF circuitry is what accounts for the exceptional cleanness of the receiver. Program and Scan functions are controlled by a custom-designed, dedicated microprocessor—really almost a little computer on a chip! Voltage regulators provide the stable 5 VDC and 9 VDC required by the microprocessor.

In Summation. As we said, we subjected this receiver to a very difficult set of operating conditions. We entered frequencies from all its bands, to get a sampling of its actual operation at all frequencies. It provided uniform, high-quality reception under all circumstances. In addition, it has been totally reliable, never displaying any idiosyncracies or surprises. We enjoyed using it, and especially appreciated the simplicity and straightforwardness of its programming. This is a scanner for everybody—and anyone can set it up and get it scanning without a bit of previous experience. We can heartily recommend it from design, operational, and price aspects. Radio Shack's address is One Tandy Center, Fort Worth, Texas 76102. For more information, circle number 32 on the reader service coupon. ■



Block diagram of the circuitry of the Realistic PRO-2008. Take a good look—there are separate RF Amplifier/Mixer circuits for each band, and two VCOs (Voltage Controlled Oscillators). There is a crystal filter in the first IF, and a ceramic filter in the second IF. A lot of careful planning has gone into the design and production of this scanner—and this block diagram reflects it.



Getting the most from your Video Recorder

A versatile distribution system for VCR and home TV

BY HERB FRIEDMAN

WHILE THE POLITICIANS have given us two chickens in every pot, and many of us have two or more TVs in the home, we have not yet reached the stage where the average TV viewer has more than one video cassette recorder. So what do we do when Junior wants to watch last evening's *Star Trek* off the tape, while Sis wants to view tonight's *Mork & Mindy*?

The solution to your programming problems is an antenna/recorder distribution system: your own private TV network that brings the tape or antenna signal to every set in the house.

While you could go out and spend a bundle on an amplified master antenna system, for a very modest cost you can install a TV distribution system specifically tailored to meet most of your home's viewing needs. You might not get every possible combination of antenna and recorder programs at every set at the same time, but you won't be spending a hundred dollars or more for the system either.

Here are several popular and convenient TV signal distribution systems that do not require extra booster amplifiers, so long as your picture isn't already filled with "snow" from excessively weak signals. All three are possible because of a device called the hybrid splitter/coupler, which we will cover before getting into the actual wiring of a TV network for your home.

The Splitter/Coupler. A splitter, or coupler, is generally a device that can take one signal source input and split it into two or more outputs, so that more than one TV receiving device—receivers and/or video recorders—can be connected to the same antenna. You

normally cannot simply connect two or more receivers or recorders across the same antenna wire. Under most conditions it won't work, unless all are tuned to the same station, and even then the connection can produce severe "ghosts." Basically, the splitter/coupler isolates each device from all the others, so that the input tuning of one TV tuner does not affect the others. For example, if two TVs are connected across the same antenna lead-in, and one is tuned to a VHF channel while the other is tuned to UHF, the UHF set will usually short circuit the VHF signal. This does not occur when the TVs are isolated by a splitter/coupler.

The problem is, the inexpensive splitter/couplers isolate each output through resistors, which produce considerable loss of original antenna signal. If your received signal is moderate to weak, by the time it comes out of the splitter/coupler it might not be sufficiently strong to overcome the inherent noise of the TV set itself, which is reproduced on the screen as "snow."

Minimum signal loss is produced by a special type of splitter/coupler called a *hybrid/splitter/combiner*. This is a two-way device which uses coils rather than resistors. A hybrid splitter/combiner can take one input and split to two or more outputs, or it can be reversed, and mix several inputs into one output. You can series-connect several hybrid splitter/combiners before their loss equals one resistive splitter. For our purposes, all references to a *splitter* mean specifically the hybrid type. Not all manufacturers spell it out clearly, so a general rule of thumb is: if it doesn't say *hybrid*, but it does say

splitter/combiner, it is the low-loss hybrid coil type. In the easiest TV/recorder distribution system, the antenna connects directly to the VCR (video cassette recorder) and the output of the VCR connects to a 2, 3 or 4-output splitter. All VCRs have an antenna switch that provides either the antenna or tape playback signal at the VCR output. When the switch is set for the antenna, the splitter is fed broadcast signals, and all the TVs can tune any TV station. When the switch is set to VCR, the tape playback is fed to the splitter, and then on to all the TVs.

All current VCRs have separate UHF antenna connections. Actually, the UHF signals get through the VCR's own built-in splitter, so you can receive UHF on the TVs by using a VHF/UHF splitter directly at each TV.

Adding a DPDT switch to the circuit gives considerably more flexibility in signal distribution. The antenna signal can be fed to one, or more TVs, while the VCR feeds the remaining TVs. Remember, the VCR output signal can come from the antenna or the tape. When the switch is flipped, the TV gets the VCR, and the "remote" TVs get the antenna signal through the splitter.

Putting It All Together. A distribution system is generally wired with 75-ohm RG-59/U coaxial cable, although some stores sell a more expensive, supposedly low loss coax similar to RG-59/U. RG-59/U will work just fine unless you're out in the boondocks, where reception is best described as "deep fringe." The standard TV coax connector is the solderless F-59, available from stores selling closed-circuit TV

equipment. This is the same connector used for VCR outputs. The F-59 usually cannot be used for the low loss coax whose diameter is somewhat larger than RG-59/U. This requires the F-56 connector, which looks very similar to the F-59. Make certain you get the correct one. The F-56 connector can be used for either cable; but the F-59 can only be used with RG-59/U and similar sized coax.

The connectors are held to the coax with a separate or integral crimp ring. These are very easy to apply if you know how to do it, and have the right tool. If you have never installed an "F" connector, make certain someone at the store tells you which type you

have and how to install them.

Prepare for expansion now. If you presently have only two TVs, consider if you will eventually get a third or fourth. If so, install a three or four-way splitter. You can always use extra outputs for the FM tuner if you don't like to see empty sockets.

To avoid a rat's nest of wires in the living room or den, it's best to install the splitter somewhere in the basement or attic, and branch wiring out to each set. The basement is generally better than the attic, since you don't have to worry about falling through a ceiling. If you live in an apartment, a closet is the best location for the splitter.

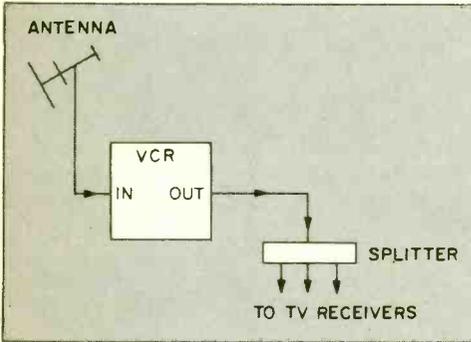
Normally, unused splitter outputs cause no problems. But if the TV picture looks smeared, or if there are "ghosts" you didn't have before, install 75-ohm terminations on the unused outlets. These are made by simply putting a 75-ohm, 1/2-watt carbon resistor inside an "F" connector and soldering one end to the connector shell (ground). The free resistor lead is passed through the connector; leave 1/8-inch beyond the front of the connector as the center conductor pin.

If you plan on using an antenna/VCR transfer switch, it's easier and sometimes cheaper to modify a Radio Shack Archer 4-way hybrid splitter than to purchase a batch of connectors and install them in an aluminum box.

To modify the Radio Shack splitter, first remove the back, which is held in place with a soft mastic adhesive. Using a sharp shop knife, cut through the mastic and then pop the cover off with a screwdriver. If the cover gets bent, it's easily straightened with a hammer.

Unsolder the coils and remove the top connector (just remove the mounting nut and the connector drops out). Install a Radio Shack DPDT mini-switch in place of the top connector and, using very fine wire (#26 is perfect), wire the switch to the remaining connectors to make a DPDT "reversing" circuit. Cement the cover in place (use rubber or contact adhesive) and the coaxial switch is completed. Generally, the best mounting location for the transfer switch is on the back of the TV on which the VCR is located. Place it out of sight, but high enough so it's easily reached.

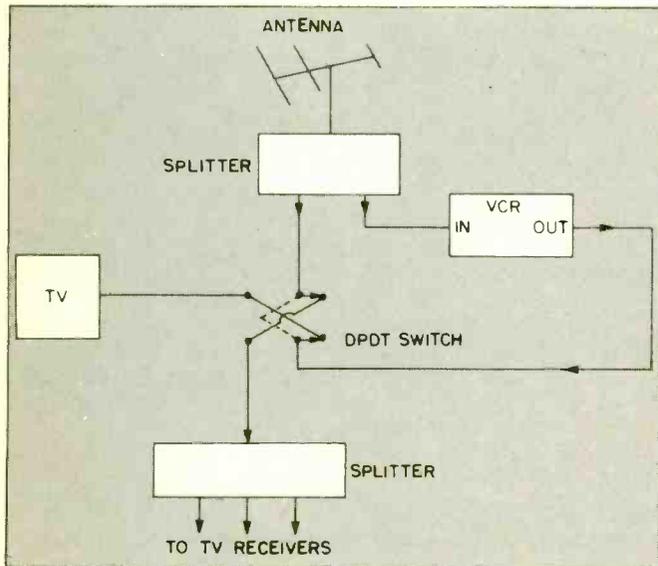
Impedance Matching. If your TV antenna downlead is 75 ohms, and some
(Continued on page 84)



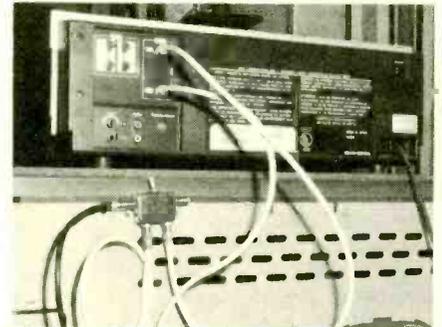
Shown here in its simplest form, this VCR system carries signal from the antenna, to the VCR itself, and then to the various TVs.



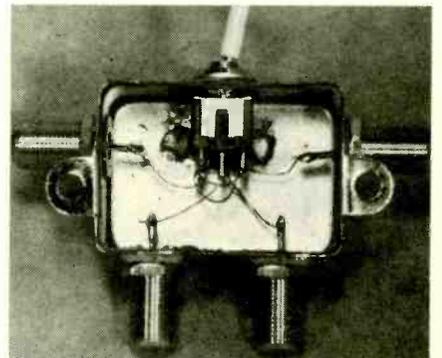
This close-up diagram shows the heart of a video distribution system for the home.



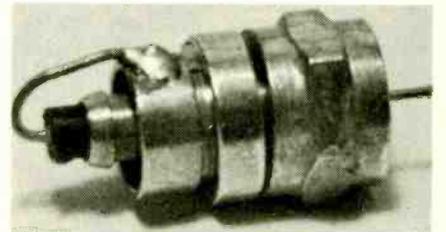
This is a diagram of a fancy home VCR system. It feeds up to four separate sets, and can be switched to provide live TV, or "canned" video programming. Without getting into elaborate and expensive equipment like metal towers or cable TV grade hook-ups this system will give a great deal of satisfaction for a reasonable pricetag.



The DPDT switched splitter is attached to the main TV set. Note the wiring layout.



Line splitters are easily modified to take a switch. This switching ability is vital.

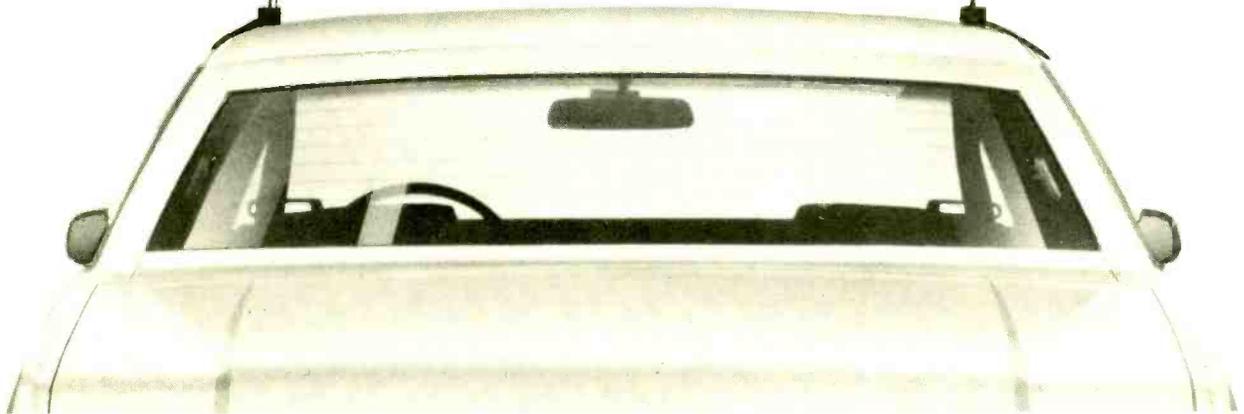


If you get "ghosts" from unused splitter outputs, make up terminations from F-type connectors and 1/2-watt carbon resistors.

CO-PHASED ANTENNAS

To twin or not to twin—that is the question we'll answer

BY JOSEPH J. CARR C.E.T.



CB ANTENNAS CAN CAUSE a great deal of heated debate among otherwise knowledgeable people. Opinions build upon opinions, but many of us never really seem to know much about the performance of the antennas that we buy and install. One of the most heated discussions that we've ever witnessed regarded the directivity of CB twin antennas and co-phasing. One technician claimed that the pattern of two antennas together fed in-phase was as omnidirectional as that of a single antenna, while the other technician claimed that the pattern would be a "figure-8," which is definitely *not* desirable in mobiles.

In another argument, two people engaged in VHF FM servicing (mostly

landmobiles) tried to determine the effects on the radiation pattern of different installation locations on the vehicle.

Settling such antenna arguments is very difficult without some type of antenna test range. It is not sufficient to measure samples of signals from various locations in an effort to determine which direction seems best. The question is, how do you measure antenna polar patterns?

How The Pros Do It. Antenna fields are severely affected by nearby objects, so at high frequencies, i.e. under about 40 MHz, it is not always practical to use full vehicle size (except perhaps in the flatness of the Great Plains) because hills, buildings, and other nearby

obstructions foul up the pattern.

We recently had the opportunity to visit a professional antenna laboratory operated by the U.S. government. It is standard practice to build a small model of the vehicle and antenna configuration, and place them in an RF-absorptive anechoic chamber (similar to those used in loudspeaker system design labs). The antenna, of course, is *scaled down* in size, so the frequency must be scaled *up*. Fig. 1 shows a scale model of a passenger car with a monopole installed in the center of the roof. In the case of Fig. 1 a 1500 MHz monopole (quarter-wavelength) is scaled to simulate the situation of a 150 MHz quarter-wavelength monopole on a full size



Fig. 1. In a special, non-reflective RF testing chamber, NASA technicians are able to measure the effects of antenna placement on a vehicle using a reduced scale model and appropriate harmonics.

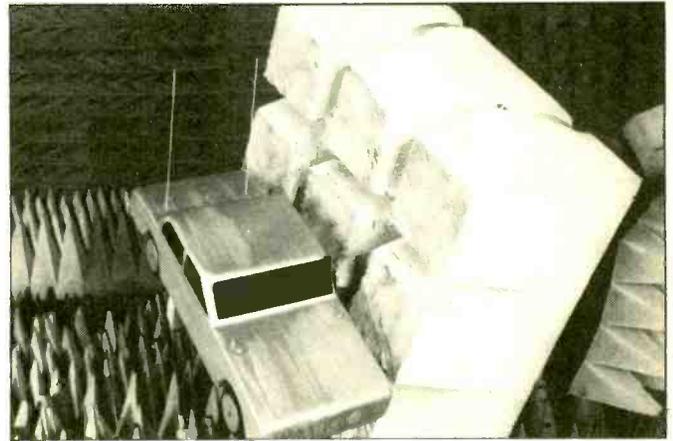


Fig. 1A. In this test, co-phased trunk-mounted monopoles are used to simulate 30 MHz (roughly the CB band) signal patterns. Due to the 1/10 scale, a frequency of 300 MHz is fed to the antennas.

automobile. In Fig. 1A, 300 mHz twin quarter-wavelength monopoles simulate 30 mHz (i.e. CB) phased antennas mounted on the trunk of the car.

In the laboratory, it is noted that an antenna's receive pattern is the same as

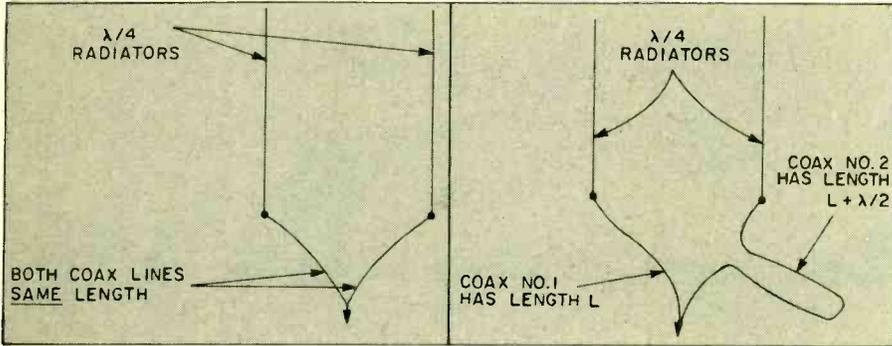


Fig. 2. Configuration depicts a co-phased array using equal length feed lines to obtain a 0-degree phase relationship.

don't take time to define just what they are talking about, under what circumstances "facts" are true, and what type of evidence constitutes "proof." Space would not permit coverage of all known types of antennas, so among our ground

Fig. 2A. In order to obtain 180-degree phasing, a $\frac{1}{2}$ -wavelength loop is added to one transmission line to create "delay" effect.

rules will be a basic limitation. We are not considering *shortend* (i.e. loaded) antennas, only quarter-wavelength vertical monopoles.

Furthermore, we will not consider any installation involving two monopoles unless the spacing between them is proper, i.e. multiples of one-eighth wavelength. Since only the quarter and one-eighth wavelength antenna spacings at 27 mHz are practical, we will assume spacing of either 4.5 or 9-feet.

Fig. 2 shows how the vertical radiators are configured. It takes a certain amount of time for the signal to travel

down the transmission line, so if we want the radiators *in-phase*, i.e. $\theta = 0^\circ$, then we must feed them in parallel with equal lengths of coaxial cable (Fig. 2A). But if a phase angle of 180° is desired, then one cable must be exactly one half-wavelength longer than the other cable. This situation will delay the current applied to one antenna by exactly 180 degrees. Incidentally, it isn't terribly important how long the lines are, unless some impedance transformation is required, only that one be exactly 180 degrees longer.

Fig. 3 shows the patterns for quarter-wavelength radiators spaced one-eighth wavelength apart. Oddly enough, the theoretical, or ideal, patterns are the same for both spacings (although the gain scale is slightly different). Furthermore, the pattern is very similar at other spacings that are integer multiples of one-eighth wavelength. Fig. 3 shows actual patterns measured on a vehicle. In neither case could this configuration be a good mobile antenna, because there are *nulls* (i.e. dead spots) in the polar pattern fore and aft; your poorest direction for getting out is up the road in front of the vehicle and from immediately behind the vehicle. Such an antenna could be useful on a base station installation for directing the beam and cutting undesired reception.

In Fig. 4, we considered the case of a 0-degree phase angle and quarter wavelength spacing (9-feet). But to a CB operator, especially in an automobile, this means 9-foot spacing. A more reason-

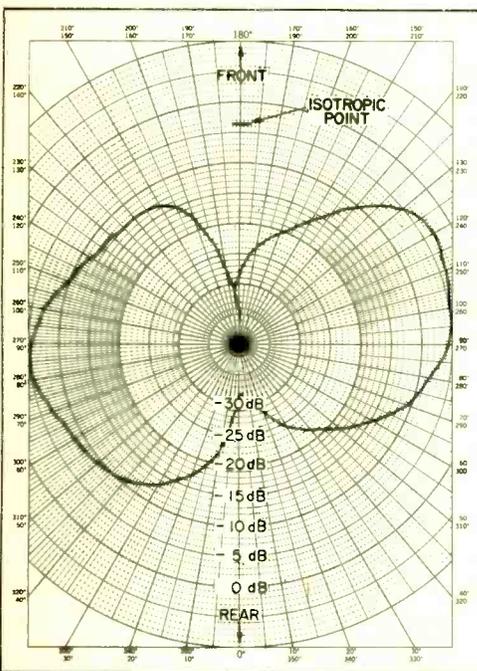


Fig. 3. A co-phased array utilizing $\frac{1}{2}$ -wave radiators spaced $\frac{1}{8}$ -wavelength apart will give a radiation pattern similar to this. This is not a particularly effective pattern for mobile use, as the maximum amount of energy is radiated off the sides of the array instead of front and back as is needed for road usage.

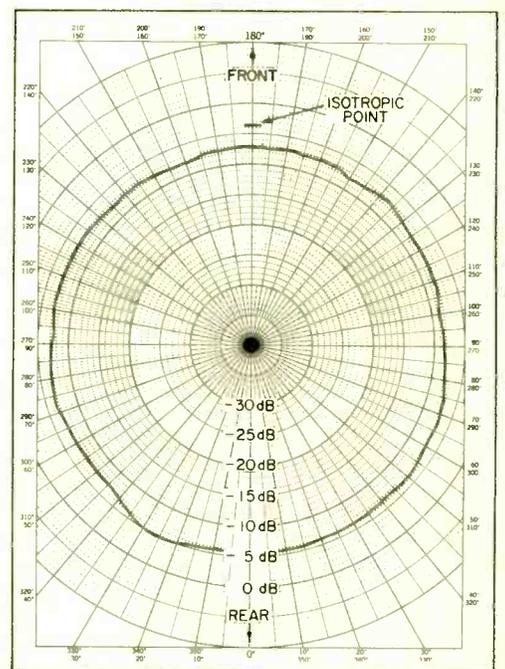


Fig. 4. An array with 0-degree phasing and $\frac{1}{4}$ -wavelength element spacing (9-feet) puts out a nice omnidirectional pattern, but how many people do you know that have 9-foot wide automobiles?

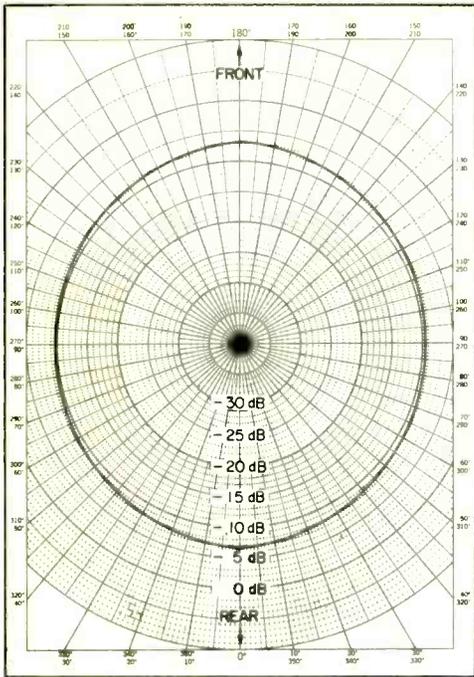


Fig. 5. The ideal radiation pattern for $1/8$ -wavelength spacing of elements results in a fat ellipsoid. It's strongest front to back.

able example for CB operators is the one-eighth wavelength spacing, because this reduces to 4.5-feet between elements. This spacing is nearer the spacing of co-phased whips on the trunk

The perfect pattern for a 0-degree phasing and eighth-wave-length spacing is shown in Fig. 5. It is a very fat, almost circular, ellipse. But that is the pattern for perfect antennas over a perfectly conducting ground plane. Look what happens when the antenna is on the imperfect ground plane that is a

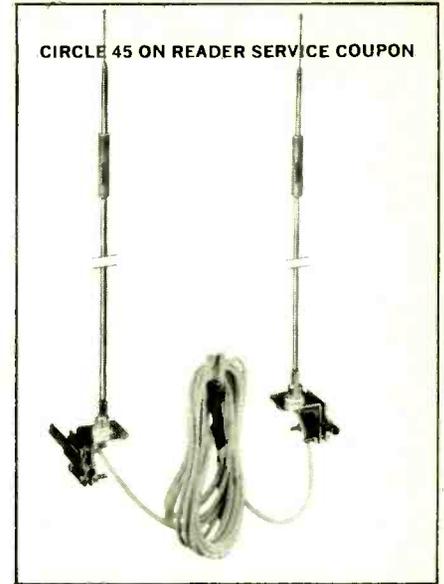
motor vehicle. The ellipsoid in Fig. 5A becomes almost omnidirectional. The pattern came as a surprise to us, because a lot more directivity was expected from too many "coffee break" arguments that we had "bought."

150 MHz VHF Antennas. Tests on scaled-down VHF antennas are shown in Fig. 6. Ideally, a quarter wavelength monopole over a perfect ground plane produces a circular pattern. But again, the motor vehicle is far from being a perfect ground plane. It is nearly so at 150 MHz, but the geometry of the automobile is not circular, so some distortion is to be expected.

Few surprises resulted from this set of tests. True to the two-way technician's savvy, the best pattern resulted from installation in the center roof, while center trunk installation came in a close second.

Conclusion. What then is the "bottom line" regarding the effectiveness of the co-phased antenna? Quite simply, it is this: In theory, there is absolutely nothing wrong with the co-phase principle. Unfortunately, in practical applications on a motor vehicle, it is very difficult, if not impossible, to achieve the correct one-quarter or even one-eighth wavelength spacing between the two radiating elements, and even harder to get what might be considered an acceptable ground plane on today's cars.

Modern automotive construction, which is to be applauded for its weight-saving and space-saving techniques, has failed miserably to take into account the use of the car's body as an RF radiator. Many body parts are electrically isolated from the rest of the main



Avanti manufactures many types of co-phased arrays. The AV526 is made for mounting on truck's side rear view mirrors.

body, and therefore present problems with conduction. Additionally, as the cars become smaller and smaller, and the body styles tend to run away from the standard sedan configuration of the past 40 or so years (i.e. the VW Rabbit, Ford Fiesta, Chevy Chevette, Dodge Omni, etc.), there simply may not be sufficient area to mount a co-phased array efficiently.

Therefore, if you're planning to mount twin antennas, make sure that you have the room and the "iron" to make a good job of it. If not, stay with your monopole and try to optimize your installation location. ■

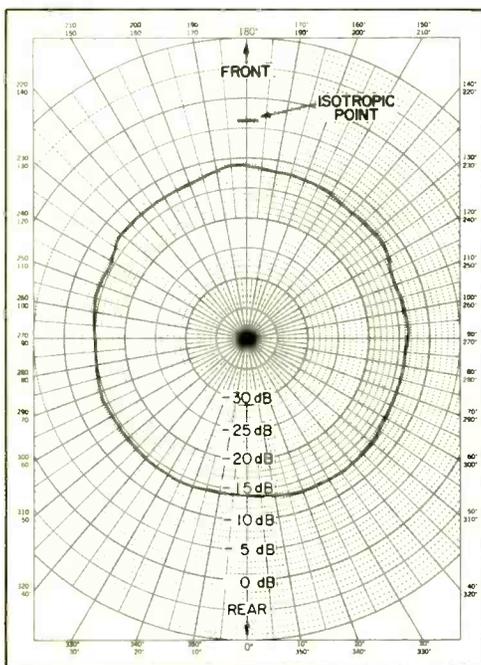


Fig. 5A. In practice, the ellipsoid of Fig. 5 becomes an irregular circle (omnidirectional), but the emitted radiation pattern is still a useable one.

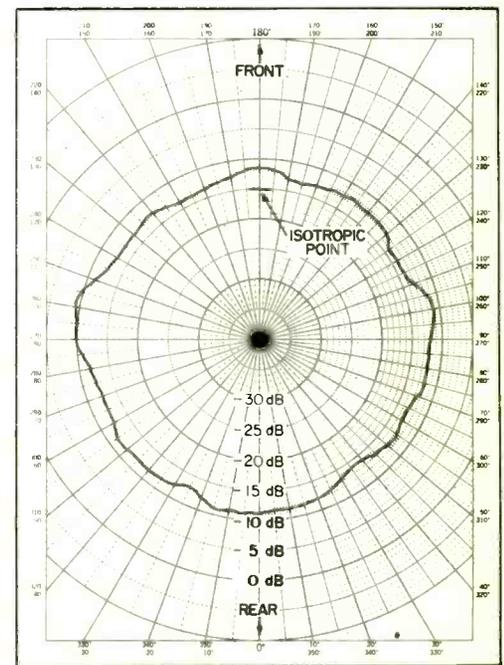


Fig. 6. The radiation pattern of a single element 2-meter whip mounted on the roof should be circular, but the irregular geometry of the car's shape precludes this.

E/E CHECKS OUT THE...

Universal Security Instruments TEL-1000 Intelli-Phone



CIRCLE 80
ON READER SERVICE
COUPON

With memory, training, hold, and alarm, this microprocessor telephone offers everything

IT HAD TO COME. It was only a matter of time before we had the ultimate telephone—with memory for eleven separate numbers, hold option, automatic redial for numbers that are busy and that don't answer, elapsed time timer, ringer-off option, built-in alarm clock, electronic note pad, and digital readout display. Sounds impossible? Not in the least, for Universal Security Instruments' *Intelli-Phone*, model TEL-1000, does all this and more, and for a price of only \$199.95.

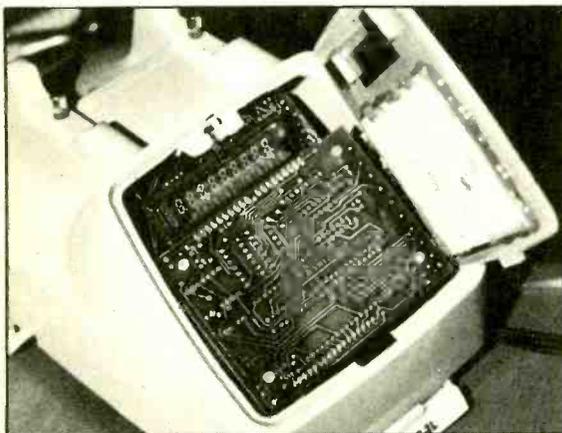
Okay From Ma. The first things you'll notice in the *Intelli-Phone* literature are a few warnings from the manufacturer. First of all, the *Intelli-Phone* won't work with PBX systems, or systems that require dialing "9" for an outside line. Also, while the *Intelli-Phone* is registered with the FCC and meets all FCC requirements and can be connected directly to the telephone network through telephone company-installed receptacles, you are still required to notify your local telephone company business of-

fice of what you intend to connect to their lines.

Once you're familiar with these and other stipulations—nothing serious—you'll be ready to install *Intelli-Phone*. There is a hefty AC supply which plugs directly into the AC wall receptacle, and the modular telephone jack. That's it for installation. It's recommended that you install a 9-volt alkaline battery in a receptacle on the underside of the phone. The battery will retain the memory and keep the clock running in the event of a power outage or a removal of the AC plug. *Intelli-Phone* will work on either a Touch-Tone or a rotary dial phone system.

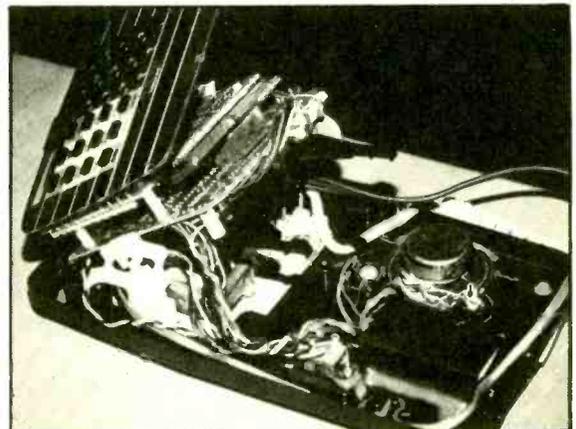
Operation. The rest is all a matter of learning to use the little computerized phone. You're in for a nice surprise when you plug the *Intelli-Phone* in. The bright green fluorescent display lights up to say "hello." It will also read "hello" if there has been a power outage. If you haven't installed the recommended 9-volt battery, or if the

battery voltage is low, the display will flash decimal points between each digit. The next step is to set the Dial Speed switch. If it works in the Hi position, great, otherwise it gets set in the Lo position. You can then begin storing phone numbers. The *Intelli-Phone* will accept individual numbers up to fourteen digits long, and the total memory capacity is 109 digits. To store a number, just press the Store button and then the number of the location desired. The display will read the number of the location, and when you start entering the actual phone number, it will read across the display from right to left, until the entire number (less the area code) is displayed. When the number is complete, pressing the Off button stores it in the memory. To dial from memory, just press the "#" button, and the number of the location you want. To dial the special Help number, which usually stores the Police or Fire Department number, you just press
(Continued on page 85)



Intelli-Phone with its front dial plate off. You're looking at the nine-digit fluorescent display, and the foil side of the PC board. Circle R. S. number 80.

There's really a lot of room inside. The speaker is on the right, and in the foreground there's the fast/slow pulse switch, matching different phone lines.



Antique Radio Corner

Restoring Vintage Power Supplies

BY JAMES FRED

□ COLLECTING RADIOS AND SPEAKERS is the backbone of our hobby, but have you ever considered all the other items of an electrical nature that are collectible? In this column, during years past, I have covered test instruments, speakers, magazines, tubes, "A" and "B" battery eliminators, etc. As you travel and visit flea markets, garage sales, ham fests, etc., you probably have seen many other related items such as pinball machines, battery chargers, movie projectors, etc. The list of materials related to electricity, radio, telegraphy and telephony are endless.

Grab Bags. There is nothing I like better than buying a box of electrical junk and finding an item I can restore and use again. Several years ago, I attended a farm auction where one of the children in the family had gotten interested in radio in the early 1920's. He died in the 1940's and apparently nothing he had owned had been touched until the auction was planned. The farm

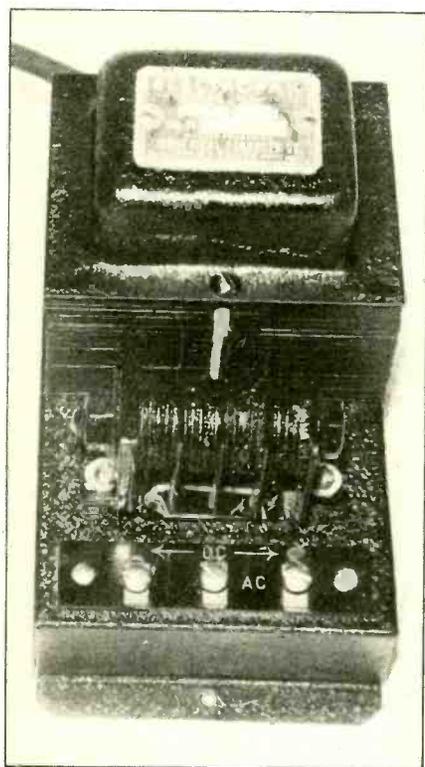
consisted of a house, 2 barns, a milk house, and several smaller outbuildings. Radio equipment was found in the hay-mow of one barn, in one outbuilding, and in the milkhouse, which must have been his radio laboratory. They had moved the complete radios and speakers out into the barnlot for the sale. Left in the milkhouse were rusted radio chassis, dirty radio tubes, speakers with the cones torn out, magazines that had pages chewed up by rats and mice, plus many dirt-covered parts. I saw several things of interest there so I made a deal with the owner to clean out anything I wanted in the milkhouse. I paid \$25.00 for the privilege of cleaning it out.

Needless to say, I covered the bed of my pickup with anything I thought I could use. I took the stuff home and stored it in the loft of my pole barn. A few weeks ago, I was looking for some parts I had misplaced and found the power supply shown in one of the photographs. The supply consisted of a small steel chassis on which was mounted a transformer, a copper-sulfide-magnesium rectifier, and a terminal strip. I had never seen a power supply just like it and was surprised to find it rated at 12-volts DC. The best guess I can make is that it was a pinball machine power supply. There are many relays and stepper switches that operate on DC in these machines. The output current wasn't specified, but from the

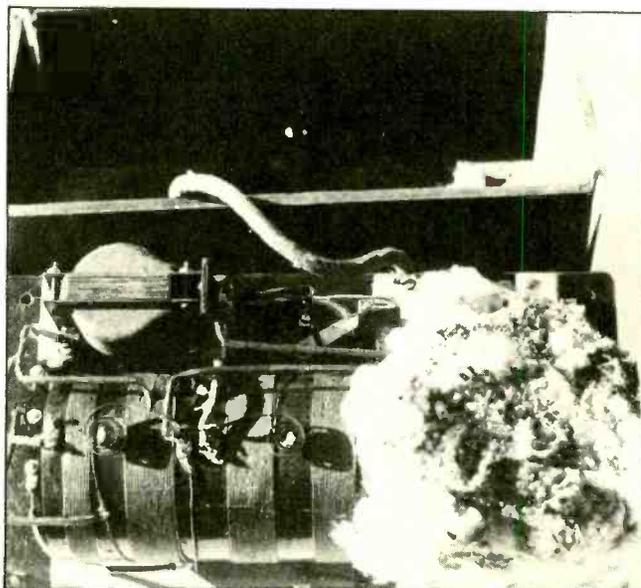
physical size of the rectifier, I judged it to be a 4 Ampere unit. The rectifier had drawn moisture which had rendered it absolutely useless.

To restore it to its nearly new appearance, I cleaned the metal name plate with 0000 steel wool, I painted the chassis and transformer black, polished the terminal strip and filled the lettering with white lacquer. To restore it electrically, I attached a new line cord. I baked the transformer for 4 hours in an 85°C oven to drive out any retained moisture, and installed a 6 Ampere, 50 PIV silicon bridge rectifier. The rectifier was a molded type which made installation very easy. The rectifier is nearly hidden, which adds to the illusion that the old rectifier, painted black and still mounted in place, is being used. I fabricated and painted a sheet metal bottom to complete the restoration. Since the new rectifier is more efficient, the supply now supplies 16 VDC at no load. This is ample to charge 12-volt storage batteries, power model trains, do electroplating, or do any other job where 16-volts DC might be needed. The cost of the AC line cord and rectifier was less than \$4.00. A comparable power supply could cost \$25.00.

Tech Tip. In every older radio using triode tubes, and even in some using tetrode tubes, i.e. 227, you will find a "Grid Leak Detector." There are several types of detectors, but this type de-



Discovered at a farm sale, this Electropak power supply responded beautifully to care and attention. The unit delivers 16 volts DC and 6.3 volts AC, handy to have.



Mice had apparently made a home for themselves in the wooden case of this 1920s era variable power supply. When cleaned off, this piece of equipment found a prominent place in the collection as an example of its type. A great number of finds like this one are to be unearthed at sales of "junk" from barns, attics and basements.

Antique Radio Corner

ector is the type most sensitive to weak signals. A detector is a rectifier that uses only one-half of the radio wave, the other half of the wave is wasted, and the grid leak serves as the path leading the wasted energy away from the vacuum tube. By this leakage method, it is possible to accurately control the operating conditions of a tube. Another text book explains it this way: In operation, electrons are trapped on the grid, building up a negative pressure and the high frequency variations on the grid vary around a mean or average grid voltage which becomes increasingly negative. This reduces the plate current, and if the grid were insulated from the rest of the circuit, it would finally reduce the plate current to such a low value that the tube would be cut off. To prevent this, it is necessary to remove the accumulated negative charge from the grid in order to restore it to its initial condition for the arrival of the next wave train. This can be done by connecting a high resistance from 1 to 10 megohms, known as a grid leak, either across the grid capacitor or connected directly between the grid and the filament. The illustration shows these connections.

In actual practice, grid leaks vary in value from 100,000 ohms to 10 megohms. There is some advantage in trying different values of grid leaks in a receiving set. Some sets work better with a low value and some work better with a high value. This is the reason the grid capacitor usually has spring clips riveted to it so that a grid leak resistor can be snapped into place. Most grid leaks consist of a 1/4-inch diameter glass tube

about 1 3/8-inch long, with bullet-shaped metal ends that make contact with the grid capacitor spring clips. Unless you have a high resistance reading ohmmeter, it is hard to tell if a grid leak is good or bad. I have about 50 grid leaks, so I measured the resistance of each. I found that nearly half were open and measured no resistance at all. In one of the photos you will see the component parts of a grid leak. The resistive element is a composition strip dipped into carbon paint and baked to stabilize the resistance. To insure good contact to the end caps, metal clips are fastened to each end. A quantity of "Woods Metal" is put into the end caps and the resistive strip and glass tubes are pushed into the molten metal. When the assembly is moved away from the source of heat, the metal becomes solid and holds the assembly together. "Woods Metal" is an alloy of tin, lead, and bismuth and melts at 180 to 200 degrees Fahrenheit.

Restored Grid Leaks. I have restored a number of grid leaks by softening the Woods Metal and re-sealing the glass tube, resistive strip, and end caps back together again. Of course there are other ways to make grid leaks, but at least 90% of mine were made this way. You can improvise an acceptable grid leak by connecting a 500,000 ohm, 1/2-watt resistor into the grid circuit.

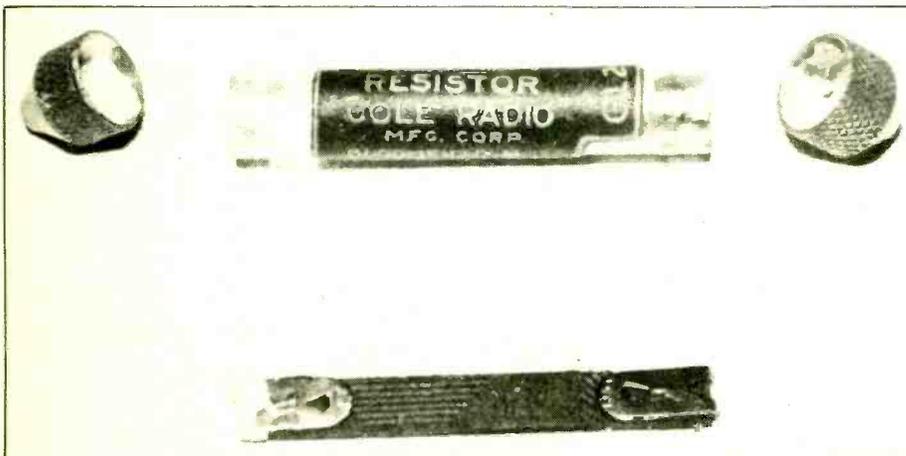
Apple Polishing. I have been trying several different kinds of cleaning materials that can be purchased at your local supermarket or drug store. One such cleaner is household lye, but it is dangerous to use and many persons are afraid of it. A milder cleaner is "Sno

Bol," a toilet bowl cleaner which I have been using to clean a telegraph key. After dipping the key for several hours, I washed it in hot water. I then rubbed it with 0000 steel wool. You can also buff or use brass polish to finish it. Cleaning radio speaker grill cloth is difficult. I found a spot remover at the drug store which works fine. You spray it on, let dry, then brush it gently with a soft paint brush. It is nearly impossible to get any cloth that resembles old fashioned grill cloth today. The hi-fi stores carry plastic or foam speaker coverings that don't suit the old radios at all. Look for *Afta* in the store.

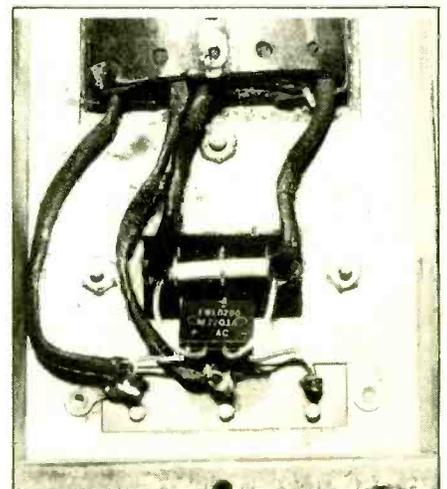
You can get a good brass polish called "Brasso" at many grocery stores, "Tarn-X," a silver corrosion remover, at drug stores, "International Silver Polish" at department stores, and "Simichrome" polish at bicycle shops.

Resistance Wire. Several readers have written wanting to know where to buy small quantities of resistance wire. I've had a close association with resistance wire for many years and can tell you that it is nearly impossible for an individual to buy it. There are about five major manufacturers in the U.S. who supply all the resistor and heating element manufacturers. There are many different resistance wire alloys to fit all the different requirements. All the wire companies have very large minimum order amounts, which makes it impossible to buy small amounts. Burstein Applebee Company lists some wire in their catalog, the Rogers Supply Co., Chicago, Ill. has heating elements to sell, Antique Radio Parts, Box 42, Rossville,

(Continued on page 86)



These parts make up one type of old grid leak. The grid leaks in use during the early days of radio tended to vary from 100,000 ohms to 10 megohms. While purists will insist on accurate restorations or replicas, a 500,000 ohm, 1/2-watt resistor is as good.



To keep this restored power supply looking authentic, the modern rectifier was hidden.

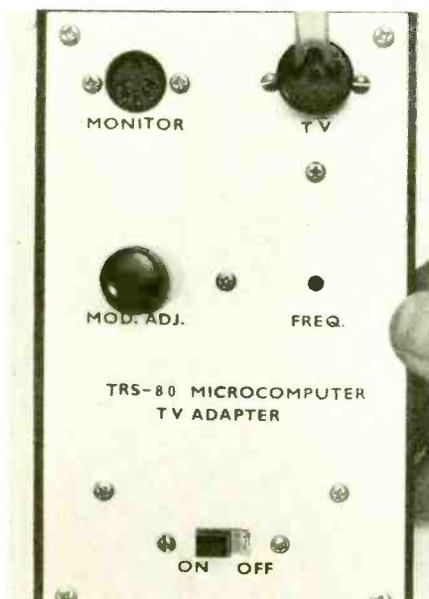
TRS-80 TV Adapter

Use your home TV for computer readout with no internal modifications

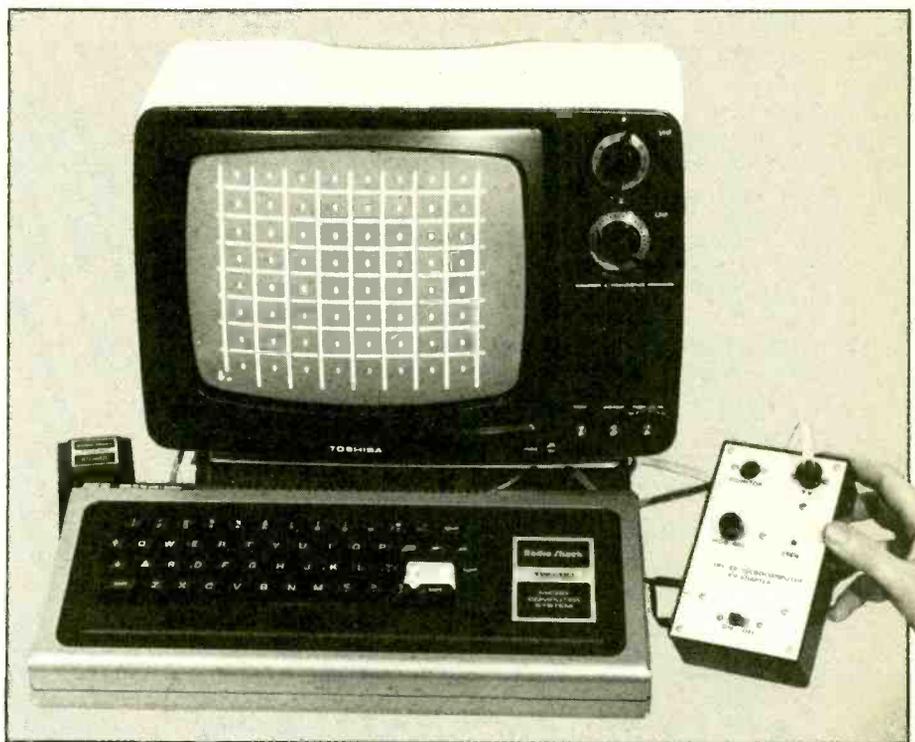
BY ADOLPH A. MANGIERI

EVERY EXTRA USE of your microcomputer adds to its value. With this RF modulator and a program, you can easily adjust your color TV for best possible reception. The TV adapter uses a commercial RF modulator and an auxiliary interface circuit which allows adjustment of video blanking level from a panel control. This makes it possible to optimize the quality of the display when using the adapter and a TV as a computer monitor. Adjusting the TV fine tuning and modulator together makes a lot of difference in the quality of the display.

Although designed and optimized for use with the Radio Shack TRS-80 microcomputer, this adapter can be used with any microcomputer delivering a composite video signal with sync



The completed project, showing modulation and frequency adjustment controls in front.



tips at ground and video white level at about 1.4-volts. The TV adapter also allows tandem display of the TRS-80 and a TV for group viewing.

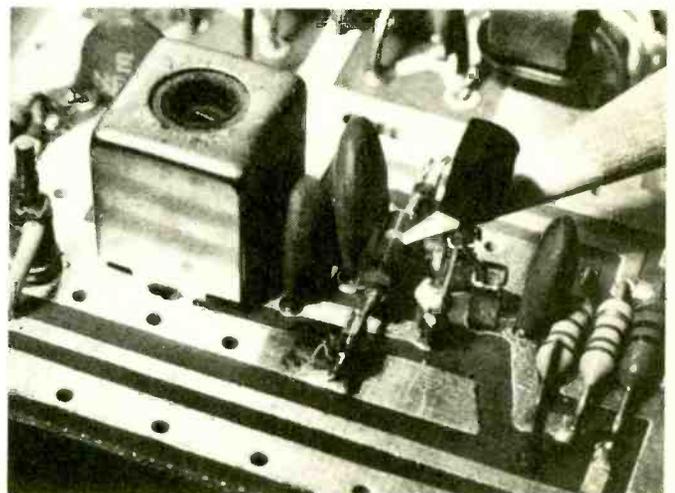
Circuit Operation. The TRS-80 TV adapter uses the *Videocube* RF modulator (see parts list). The *Videocube* is an FCC approved device for use with video games. In the block diagram, an RF oscillator feeds the carrier to modulator diode Dm. A composite video signal is applied to the modulation input terminal and varies diode current. Non-linear characteristics of the diode result in amplitude modulation of the carrier. The modulated carrier passes through a filter network to a balun transformer which matches the 300-ohm balanced input at the TV antenna terminals.

You adjust modulation and blanking

level by altering the sum and ratio of resistors Ra and Rb. This can be difficult since adjustments interact and sync and other problems may arise. To overcome these problems, a two-transistor interface was developed allowing optimum adjustment for graphics or display of text on almost any TV.

Transistor Q1 serves as a unity-gain buffer and isolator. Resistors R2 and R3 set the level of video appearing across R4. Transistor Q2 is an adjustable constant-current source which sets and closely maintains the operating point of diode Dm. Plug P1 plugs into the TRS-80 video socket. Socket J2 accepts the cable from the TRS-80 wide-band monitor for tandem display on two screens. The adapter operates off a nine-volt battery or an AC adapter.

The pencil is pointing to the new resistor (1000-ohm) installed between the emitter and ground of Q1 in the *Videocube* module. It is used in place of the 22K-ohm unit originally supplied to boost the RF output.



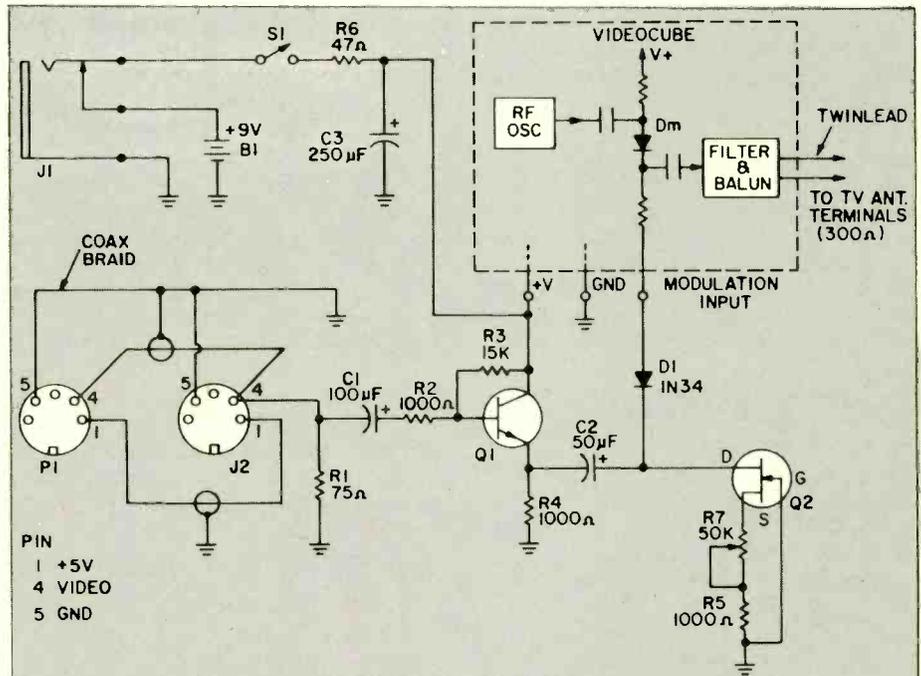
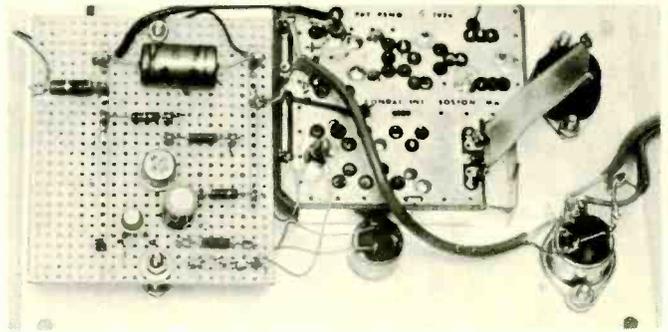
Uniquely providing user's control of modulation, the adapter affords means to largely compensate for the restricted bandpass of a TV. TV fine tuning is adjusted slightly off-carrier in a direction to slide more of the higher frequencies of the carrier sideband into the bandpass window. These frequencies are essential for display of fine detail. Ordinarily, off-carrier tuning will result in loss of sync since this discriminates against the carrier and lower frequencies in the sideband. To maintain reliable sync with off-carrier tuning, R7 is set to favor greater modulation of the sync pulse side of the composite video signal. This results in stable sync and optimum display for the TV.

A scope connected to view the video waveform at the CRT's cathode shows that an adjustment of R7 shifts the blanking level up or down, altering the relative amplitude of the sync pulse on one side and video pulses on the other. The peak-to-peak swing remains almost constant. Best displays occur when the sync pulses occupy fifty to seventy-five percent of peak-to-peak swing. In contrast, sync pulse amplitude in the standard composite video signal is about twenty eight-percent. The relative reduction of video pulse amplitude actually improves the display by reducing flaring of dots.

Construction. Assemble the *Videocube* using the instructions provided. Install flea clips for the emitter resistor of the RF oscillator. Bolt the metal shield of the *Videocube* to the panel of a small case and drill a hole for adjustment of the oscillator coil. Assemble the perfboard circuit using flea clips or wire-wrap techniques. You may use T49 Klipwrap posts (Vector Electronics) for easy experimentation with resistor values. Resistor R1 and capacitor C1 may be installed on the modulator PC board by installing T49 posts along one edge.

At nine-volts operation, a 22K resistor should be used for the emitter resistor of the RF oscillator. However, a 100-ohm resistor was used to boost RF sufficiently to activate TV AGC circuits with much better results. You can use a length of 75-ohm coaxial cable and a separate wire to connect plug P1 to socket J2, but a length of dual audio cable (Belden 8416-25) was used and performed just as well. Use an audio-type plug and socket for the twinlead connection between adapter and TV. Install jack J1 on the side of the case. Operation of the *Videocube* from other than the computer's five-volt supply

This photo depicts the two-transistor interface and the *Videocube* mounted to the faceplate of the chassis and fully wired. Follow our layout for best results.



PARTS LIST FOR TV ADAPTER

- B1—9-volt transistor battery
- C1—100-µF electrolytic capacitor, 15 VDC
- C2—50 µF electrolytic capacitor, 15 VDC
- C3—250-µF electrolytic capacitor, 15 VDC
- D1—1N34 diode
- J1—miniature phone jack (closed circuit type)
- J2—5-pin DIN female jack (to match P1)
- P1—5-pin DIN male plug
- Q1—2N3904 NPN RF transistor
- Q2—2N3819 n-channel FET
- R1—75-ohm, ¼-watt resistor, 10%
- R2, 4, 5—1,000-ohm, ¼-watt resistor, 10%
- R3—15,000-ohm, ¼-watt resistor, 10%
- R6—47-ohm, ¼-watt resistor, 10%
- R7—50,000-ohm miniature potentiometer
- S1—miniature SPST slide switch

Misc.—case, perfboard and clips, solder, knob, short length of 75-ohm coax cable, short length of 300-ohm TV twinlead, hookup wire, etc.

Note: The Videocube™ modulator is available from John Meshna, Inc., P.O. Box 62, East Lynn, MA 01904 for \$8.00 postpaid. Please allow 2 to 3 weeks for delivery.

eliminates problems with a noisy supply, but you can experiment.

Circuit Checkout. Using an ohmmeter check the wiring of plug P1 and socket J2 for errors or shorts. Connect a DC milliammeter in series with diode D1 and vary R7 over its range. You should be able to vary diode current from under one-hundred microamperes up to two and one-half to three milliamperes. If the current is much higher, increase the value of R5. If much lower

than two and one-half milliamperes, reduce R5 to zero if necessary. This failing, Idss of Q2 is too low, and another type of FET will be required.

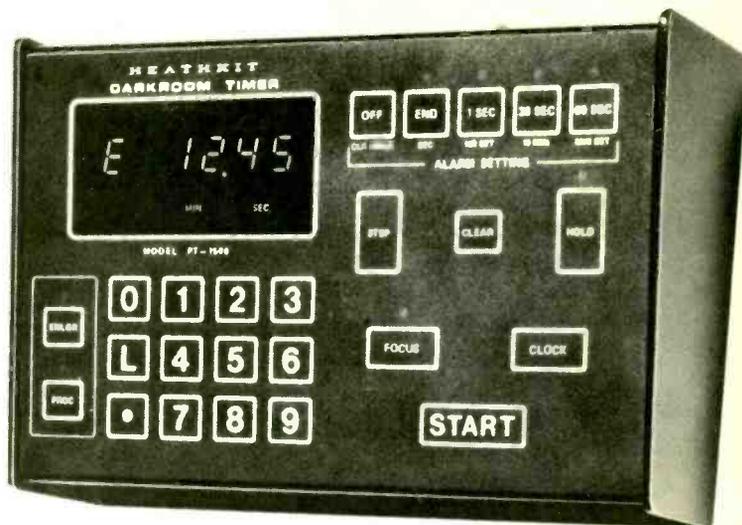
Disconnect the TV antenna or cable connection from the TV when using the adapter. Keep the twinlead well removed from the computer, cables, and power cords. Adjust the *Videocube* for reception on channel 3 or 4. Starting with a 22K resistor, try successively

(Continued on page 86)

E/E CHECKS OUT THE...

Heath PT-1500 Darkroom Timer

CIRCLE 59
ON READER SERVICE
COUPON



This versatile timer/controller handles many darkroom chores

THE HEATHKIT PT-1500 DARKROOM TIMER is a microprocessor-controlled, programmable timer that centralizes all darkroom timing functions at your fingertips. Whether it's timing an enlarger's exposure, how long a film is in the developer, or the individual steps of color film and color print processing, the PT-1500 keeps accurate control of what's happening now, and what's to come later.

Operation. For example, let's assume we want to process an ordinary roll of black and white film. (The PT-1500 can be programmed to "remember" the required processing times in several of up to nine memories.) When the developer is poured into the film tank, the timer's START switch is depressed, and the timer starts counting down. Every 30-seconds, the timer beeps to remind you to agitate the film tank. At the end of the set period, a series of beeps indicates that the film is developed. Also, the time automatically jumps to the programmed time for the wash, and when the START

switch is depressed, the timer counts down the wash time, again beeping every 30-seconds, and at the end. Then the timer automatically jumps to the hypo time. When the START switch is depressed, the hypo time is counted off. Finally, the counter jumps to the wash time and counts off the wash when the START switch is activated. The beeps, which count off 30-second intervals, can be instantly reprogrammed for 60-seconds, if desired, for the wash period, or the beeps can be turned off.

Another example of using the Heathkit Darkroom Timer is for enlarger exposure, which can also be programmed to signal processing time. Let's assume you are printing black and white with a 10-second enlarger exposure followed by a 2-minute paper development.

When the START switch is pressed, the safelight is turned out and the enlarger outlet is turned on for 10-seconds. At the end of the exposure, the enlarger is turned off, the safelight is turned back on, and the time auto-

matically jumps to the process timing mode. When the paper is removed from the enlarging easel and placed in the developer, the user presses the START switch again. At the end of the two minute countdown, the times beeps to indicate development is completed. As with the film processing previously described, the timer can be programmed to automatically jump for timing the paper stop bath, hypo immersion, and wash processes.

Features. The PT-1500 has three operating modes: first, a four-digit, 12-hour digital clock; second, a programmable enlarger time to 99-minutes 59-seconds, or 999.9 seconds—the microprocessor automatically converts a entry in seconds to minutes and seconds; third, programmable processing time. The enlarger mode has one memory; when programmed, it will provide the same timing operation at the touch of the START switch until changed. The processing mode has nine memories that can be individually programmed and individually called up. When the timer is set to the AUTO function, it jumps from enlarger to the first programmed process memory. In the process mode, the timer will jump to the next memory after the one initially selected by the user. For example, if the user starts off on memory #3, the jump will be to memory #4.

The unit is housed in a metal cabinet 9¼-inches wide by 3⅞-inches high by 5⅞-inches deep. The underside has rubber feet for table mounting and screw-slots so that the timer can be secured to a wall for added stability.

A *Litetouch*TM keyboard provides all switching and the LED display viewing "ports," and a waterproof seal for the front surface. The keyboard is a sort of plastic "sandwich" with crossed foils (switches) that touch when pres-



Here the PT-1500 is being programmed to time an enlarger exposure. There is an AC outlet on the back for switching the enlarger on and off.

sure is applied to selected areas of the surface. The surface is imprinted with the switching functions at the foil crossings, and is transparent for the LED display and the backlighting. If chemicals are splashed on the keyboard, they cause no damage and can be simply wiped up.

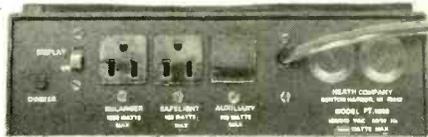
The switching provided consists of a 0-10 keypad for time and memory selection, and an "L" for loading the selected time into the enlarger or a process memory; a START switch that commences all timing functions; selectors for enlarger or process timing; FOCUS, which turns on the enlarger for focusing; CLOCK, which displays the time; STEP, which sets the unit for automatic jump to the next process step; CLEAR, which clears the enlarger or a process memory programming; HOLD, which stops any timer mode and then restarts; and five switches labeled OFF/CLK HOLD, END/SEC, 1 SEC/HR SET, 30 SEC/10 MIN, and 60 SEC/MIN SET.

The five dual-purpose switches provide the timing beeps at 1-second, 30-second and 60-second intervals, and also at the end of a timing mode. Each can be individually turned on and off, or all can be simultaneously turned off with the OFF switch. In the CLOCK mode, the same switches are used to set the clock.

The mode being used is indicated by a C, P or E to the left of the digital time display. The user can switch back and forth between the clock and the enlarger or process timing without affecting the "count" of either function. In the event the user attempts an improper function change or timer entry, the microprocessor prevents the change and signals that the change has not been accepted by causing a longer than usual beep to be sounded. Actually, the tone, or beep, that normally in-

dicates a "key closure" is more akin to a "tick," and cannot be confused with the longer beep signifying an improper procedure or entry.

As normally supplied, the timer has two outlets on the rear for the enlarger and the safelight, and an oscillator/speaker whose beeps signal "key closures," intervals, and the end of a timing cycle. The rear apron, in addition to the enlarger and safelight outlets, is predrilled for a third outlet and two control sockets which are



The back panel of the PT-1500 shows the 2 supplied jacks, as well as the cutout for the optional third jack for accessory use.

utilized by optional accessory kits that are best installed at the time of original construction, because their addition after final assembly is not among the easiest of procedures. One kit provides an auxiliary outlet that is powered during a timing cycle in the same manner as the enlarger outlet. It might be used, for example, to precisely power the motorized agitator for a color developing drum. Another kit provides a foot control switch that functions as another FOCUS or START switch. The final optional accessory, a dual foot switch, functions as both another FOCUS switch and START switch.

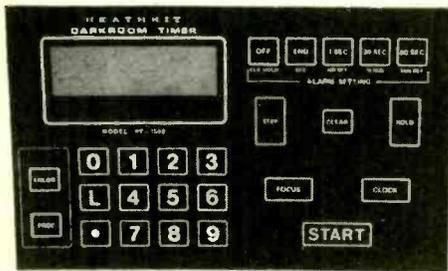
Building the Kit. Except for the AC outlets on the rear apron along with a display/panel-light on-off switch and a dimmer control, the entire project is assembled on a single printed circuit board which is solder-masked to reduce the possibility of solder bridges across closely-spaced connections. The critical integrated circuits, which could possi-

bly be damaged by excessive soldering heat, are installed in sockets. Except for the handling of the CMOS microprocessor, which is sensitive to high static voltage, nothing about the assembly is critical or difficult. The CMOS microprocessor IC can be handled without need for a grounding strap around your wrist by simply following Heathkit's instructions to remove the IC with both hands, keeping one hand in contact with the IC until it is installed in its socket. If you must put the IC down before installation, use both hands to push the IC down into the conductive foam on which the IC was packaged by Heathkit.

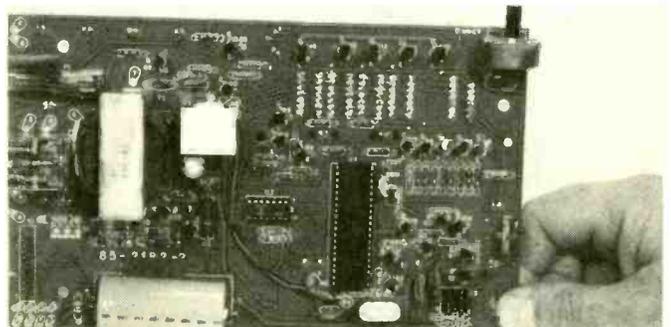
About the only critical procedure is the assembly of the keyboard. As we said earlier, the keyboard is a thin plastic sandwich, with the switching contacts between the "slices." A contact adhesive is applied to the back of the keyboard; it is protected by peel-off paper strips. To install the keyboard, you peel off the protective paper and place the keyboard directly on the cabinet. The adhesive *instantly* grips firmly; you don't get a second chance. If the keyboard is misaligned, it must stay that way because any attempt to "lift" the keyboard will result in permanent damage. So take extra care with the keyboard installation. Position it carefully before letting it touch the cabinet; if so much as a corner touches the cabinet before the keyboard is positioned, you might not be able to work it free.

The keyboard's contacts are connected to the rest of the circuit through an attached, flexible multi-conductor ribbon with connector. The builder makes no connection to the keyboard. He or she just plugs it into the matching connector on the PC board.

A check-out (test) system is built
(Continued on page 84)



The front panel, which is made up of the switch matrix, has a very tough adhesive on it. If you apply the panel unevenly to the chassis, that's the way it will stay, so be very very careful!



This is the completed circuit board, with the lone LSI chip seen at right center, and the power supply transformer at the left. It connects with the switch panel via a ribbon connector.

NEXT TO ANTENNAS, probably few topics of discussion have as many myths and notions associated with them as the subject of transmission line.

What is impedance? Is my signal being eaten up by SWR? Are all coaxial cables the same? Do I need low-loss cable? Is twinlead really better? The list seems endless.

The basic purpose of transmission line is to act like a duct for radio frequency energy. In this way it is analogous to a frictionless waterpipe. If it were possible for water to enter one end of the pipe and exit from the other without having any effect from the confinement, pressure or friction, that arrangement would be ideal. Similarly, if it were possible for radio frequency energy to enter one end of the transmission line and exit unaffected by resistance and more complex assaults like capacitive and inductive re-

COAXIAL CABLE

Choosing the right antenna line for the job
BY ROBERT GROVE

actances, the line would behave like a transparent duct for electromagnetic energy. Unfortunately, things seldom work out ideally, and so it is with transmission lines.

Generally speaking, the larger the separation between conductors the better. The closer conductors are to one another, the more they behave like capacitors. This results in signal losses and wasted power, which gets worse with increasing frequency.

The least "lossy" of all transmission lines is single wire feed. This scheme was used extensively in early commercial communications installations and by amateurs in the 1920s and 1930s. But the single wire feeder has limitations. It can radiate a signal before the signal gets to the antenna, and nearby conductive surfaces may absorb power from the feeder.

Open wire feeder (ladder line) is commonly used in rural areas where incoming TV signals are weak. Still, it is open construction and tends to be vulnerable to the same environmental influences as the single wire feed line. Vinyl coated TV twinlead has a higher loss than open wire, but it is very commonly used in nearly all home TV installations due to low cost.

While fresh vinyl coated TV twinlead is quite low-loss when compared

to coaxial cable, it has a tendency to deteriorate with age. Cracks, moisture, surface salts and contaminants degrade signal quality severely, especially at the higher UHF frequencies. Additionally, unshielded lines like twinlead cannot be run along metal surfaces or installed with sharp bends and loops. Even worse, unshielded transmission lines are susceptible to electrical interference from nearby AC lines and appliances. The TV ribbon is cheaper, so its use in indoor residential application will continue for some time to come. Shielded 300-ohm twinlead is available at increased cost. Coaxial cable is used exclusively in commercial, military and industrial radio frequency applications and systems.

Coaxial Cable. Coaxial transmission line is so named because the inner conductor shares the same axis as the outer shield. The physical dimensions, spacing and composition of the conductors and insulators are important considerations in coaxial cable manufacture. The inner conductor, which may be solid or stranded, is either pure copper or copper plated steel. Around it is a dielectric (insulator) of polyethylene plastic. That dielectric may be solid or foam, with the latter preferred for low loss cable in VHF and UHF frequency applications.

A braided outer shield covers the dielectric; it may be accompanied by a metal foil wrapping to improve shielding. At low frequencies, only 60% shielding might be adequate; but at VHF and UHF, the more shielding the better. This is an important consideration when choosing coax for applications above 30 MHz. The outer vinyl jacket offers weatherproofing.

To a radio signal, the coaxial cable appears as a continuous length of capacitance and inductance; the resultant effect upon the radio signal is known as the impedance of the line. Typically, this will be 50 or 75 ohms.

SWR in Transmission line. If 50-ohm cable is chosen, it needs to be connected to a circuit which appears to be 50 ohms impedance. This may be a simple 50 ohms resistance or it may be a complex set of inductive and capacitive reactances which average out to 50 ohms impedance. If a 50-ohm impedance is *not* present at the termination of the line, but instead 25 or 100 ohms, then there is a mismatch ratio of 2:1 in the line.

Minor mismatches are of little consequence in most installations. 2:1 or even 3:1 SWR readings may be tolerated in all but the most critical situations. Simply stated, the primary disadvantage of high SWR is that voltage



builds up on the transmission line. This voltage may appear in the transmitter, damaging components, or it may encourage power to be wasted heating up the coax to no purpose.

Ever wonder how they get that long wire through the middle of the plastic insulation? According to a spokesman at Alpha Wire and Cable, the plastic is extruded (squeezed) through a die while in a hot, molten state. A wire is simultaneously passed through the die so that the plastic is extruded around the wire. The hot wire and insulation are then passed through a cooling trough. When sufficiently cooled, a braider (really nothing more than a patent weaving machine) applies the braid around the insulation and center conductor. A second extrusion process

applies the vinyl weather jacket to the outside of the cable. In some types of armored military cable, another woven braid is applied to the outside of the vinyl jacket.

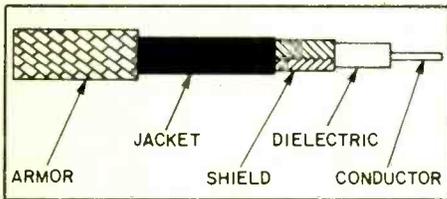
Which Coax to buy? With the general recommendation that we should use coax for communications applications, how do we go about choosing the correct type? Generally, at low frequencies (shortwave and CB), and at low power (under 100 watts), nearly any kind of standard coax will work for runs of up to 100 feet. Even the least expensive coax will usually perform adequately on a CB rig, whether mobile or base. The use of inexpensive RG-58U (50-ohm) or RG 59U (75-ohm) will yield excellent results; the most expensive, large diameter, low-loss, foam-dielectric RG-8U will probably have no effect on signals transmitted or received!

A fourfold power increase is required before one S-unit difference will be noted on a receiver. Since even that amount is barely detectable to the ear, it is reasonable to assume that 1/4 that amount would be undetectable. Yet that is the meager improvement we gain by switching from low-cost RG-58U to premium RG-8U. We gain only 1/4 of an S-unit (1.5 dB), even assum-

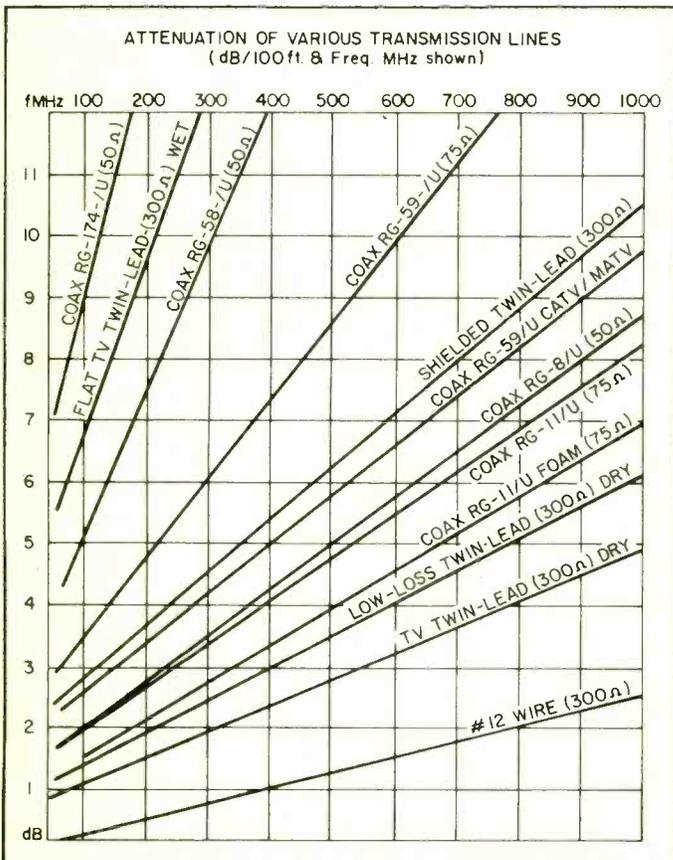
ing that we are using a full 100 feet of coax on CB! At lower shortwave frequencies such as on the amateur 3.5, 7, 14, and 21 MHz bands, the improvement is even less. Only when high transmit power or excessive SWR is anticipated is the larger coax recommended for use.

Coax for High Frequency. Above 30 MHz, it's a different story. All transmission lines have high loss; and substances which behaved as effective insulators at the lower frequencies begin to conduct at higher frequencies. Signal strengths are generally low anyway, due to smaller antenna sizes, and signal absorption by obstructions like trees, moisture and buildings.

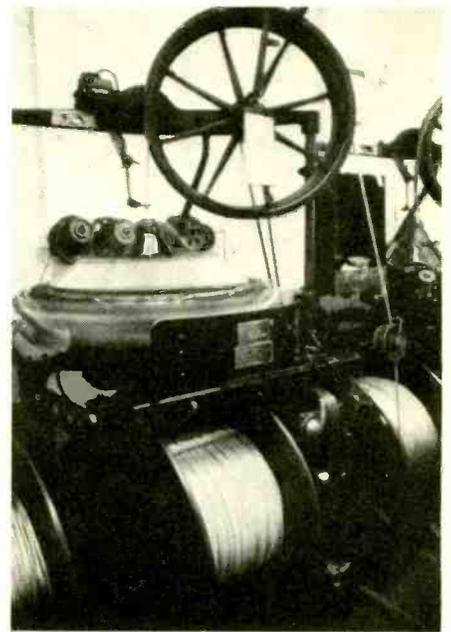
At VHF, and especially at UHF,
(Continued on page 85)



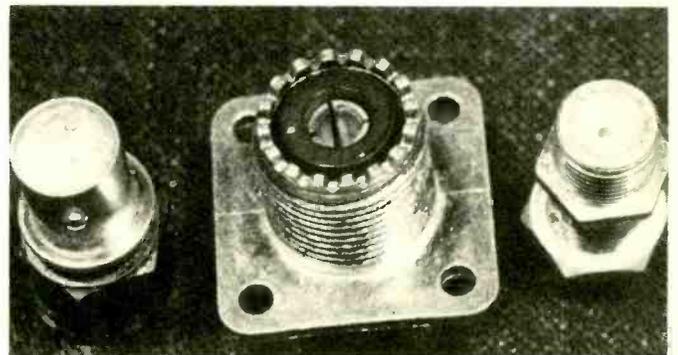
This cutaway diagram shows the several concentric (or coaxial) layers which make up coaxial cables. Armor is an optional item.



The table shows the attenuation characteristics of various transmission lines; calculations are for 100 foot lengths under wet and dry conditions. Measurements show dB attenuation as it corresponds to frequency in MHz. It shows the variance.



A patent weaving machine is used to spin the shielding braid around the foam dielectric in this photo from Alpha Wire Corp.



The most commonly used coaxial connectors are, from left to right, the BNC, SO-239 and F-type. These cover nearly every coax use.

Electronics Notebook

No matter what type of radio, from the cheapest pocket transistor to the most complicated ham rig, the basic building blocks are relatively similar. Learn the basics of radio receiver design in another page from our workbench notes.

What you will learn. When you have finished reading this article you will have learned what the parts of a radio receiver are, how they are similar to the parts of a radio transmitter, and how they separate the incoming radio frequency carrier waves (the carrier medium) from the audio frequency sound waves, which are the desired signal. You will also have learned that the important parts of the receiver are similar to the parts of a transmitter. Finally, you will have learned that CB Radio transceivers make use of this similarity of parts of the transmitter and receiver to make most CB sets into what are called transceivers.

A RADIO RECEIVER

The block diagram for a radio receiver similar to the one in your home shows its major parts and how they feed the signal from antenna to loudspeaker.

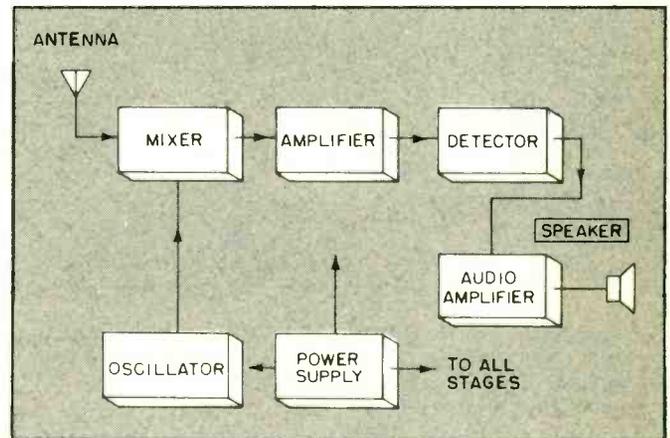
The purpose of the radio receiver is to convert the amplitude modulation on the carrier back to its original sound. As the carrier increases in ever-widening circles on leaving the transmitter antenna—like ripples in a pool—its energy decreases in amplitude. The increasing circumference of the circles causes power in the waveform to be distributed over an ever-increasing area. By the time the signal reaches the receiver antenna it is rather weak, usually around a few thousandth or millionths of a volt. The receiver, therefore, must amplify the received signal to a level that will operate the speaker within the hearing range of the human ear. The receiver must also extract the audio component (the **envelope**) from the carrier. The carrier brings the signal to the receiver, but has no function in reproducing the audio frequency in the receiver.

The Power Supply—Each receiver has a power supply. Its purpose is to convert 115 volts AC from an electrical outlet to DC voltages that will operate the receiver properly.

The Antenna and Mixer—Radio frequency carrier waves from all stations within range of a receiver appear at the antenna of the receiver. When you turn the dial of your radio to a specific station, you adjust the electronic components of the **mixer** input so that the receiver will accept a particular carrier frequency and reject all others. The received carrier enters the mixer to be amplified. CB radio receivers, as well as other sets which need to be very sensitive because they must receive very weak signals (from weak transmitters,

or from transmitters which are distant), must have an additional stage between the antenna and the mixer. This stage is called an RF (radio frequency) amplifier.

TYPICAL RADIO RECEIVER BLOCK DIAGRAM



QUESTIONS

- Q1. What part of the received radio wave does the receiver convert back into original sound?
- Q2. A radio wave decreases in power as the circumference of its area increases. What is the approximate amount of voltage that enters the receiver antenna?
- Q3. The _____ converts AC to DC voltages required to operate the receiver circuits.
- Q4. A single broadcast frequency appears at the input of the (antenna, mixer).
- Q5. CB radio receivers feed the incoming RF signal directly from the antenna to the mixer stage (true, false).

ANSWERS

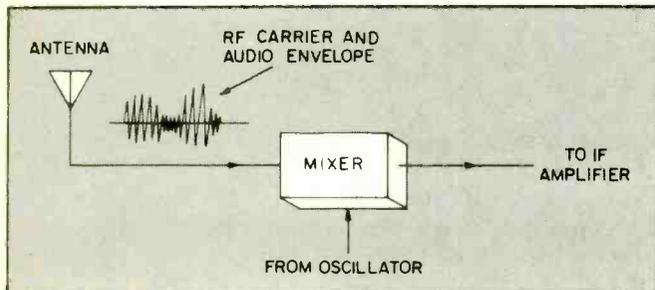
- A1. The **amplitude modulation** (or audio envelope).
- A2. **A few thousandths or millionths of a volt.**
- A3. The **power supply** converts AC to DC voltages required to operate the receiver circuits.
- A4. A single broadcast frequency appears at the input of the **mixer**.
- A5. CB receivers feed the incoming RF signal directly from the antenna to the mixer stage. **False.**

The Oscillator—The receiver oscillator is similar to its counterpart in the transmitter. Both generate a signal of constant frequency and amplitude. The purpose of the receiver oscillator is slightly different, however. It

Electronics Notebook

is designed to generate a frequency that is a constant number of kilocycles above the carrier frequency regardless of the transmitting frequency the receiver is tuned to. Tuning the dial changes the value of the electronic components in the frequency-generating part of the oscillator at the same time it adjusts the frequency-determining components of the mixer (in CB sets the channel selector changes the frequency-determining components). The arrangement is such that the oscillator will always be tuned 455 kHz above the frequency of the carrier being accepted by the mixer. The output of the oscillator is fed to the mixer.

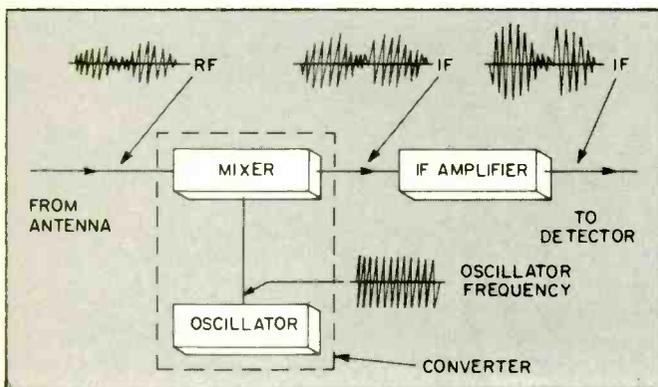
ANTENNA AND MIXER STAGE



In CB sets the frequency to which the oscillator is tuned is often two to 11 MHz above (or below) the incoming RF carrier frequency, instead of 455 kHz.

The Mixer—The carrier and oscillator frequencies combine in the mixer stage and four different frequencies appear at the output. One of these four is the **difference** between the oscillator and the carrier frequencies, and is usually 455 kilohertz. The other three are rejected by the next stage. The mixer and oscillator together are called the **converter**.

MIXER, OSCILLATOR, AND IF AMPLIFIER

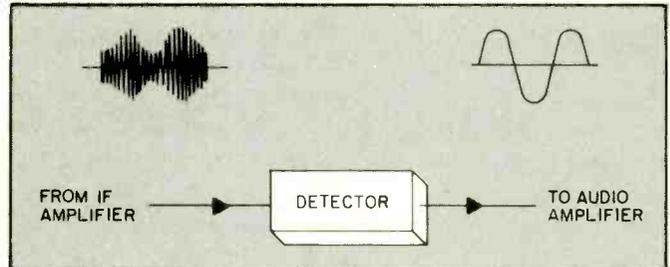


The IF Amplifier—The abbreviation for **intermediate frequency** is **IF**. In most home receivers the IF is 455 kHz. Amplifying a single frequency in the IF circuit is much easier and causes less distortion than if it were necessary to tune this amplifier to each of the many station frequencies. The only purpose of this stage is to amplify the IF (which still retains the original audio frequency) and pass it on to the detector.

The Detector—The purpose of the **detector** is to re-

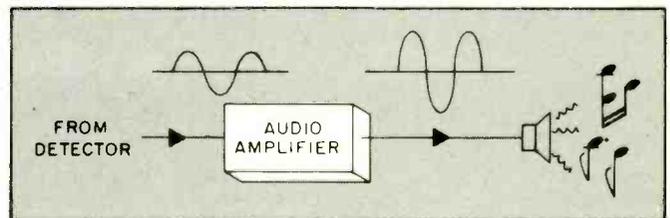
move the audio component from the IF waveform. The audio envelope is the same (although reversed) at the top of the waveform as it is at the bottom. The detector circuit is so designed that it accepts only the audio frequency at the top and rejects the IF frequency in the waveform.

DETECTOR STAGE



The Audio Amplifier—The final circuit in the receiver amplifies the AF fed to it by the detector. The amount of amplification can be varied by the volume-control knob on the front of the receiver. The output of the audio amplifier is applied to the speaker voice coil, causing the speaker cone to reproduce the sound that originated at the studio.

AUDIO AMPLIFIER AND SPEAKER



QUESTIONS

- Q6. The _____ removes the AF from the IF waveform.
- Q7. The oscillator develops a signal at a constant _____ and _____.
- Q8. A converter combines the functions of _____ and _____.
- Q9. The IF (intermediate frequency) of most home AM sets is (455, 680, 1041) kHz. CB sets often have IF amplifiers set for (2-11, 5-20) MHz.

ANSWERS

- A6. The **detector** removes the AF from the IF waveform.
- A7. The oscillator develops a signal at a constant **amplitude** and **frequency**.
- A8. A converter combines the functions of **mixer** and **oscillator**.
- A9. The IF of most home AM sets is **455 kHz**. CB sets often have IFs set at **2-11 MHz**.

FREQUENCY MODULATION

The transmitter and receiver with which you have just become familiar employs amplitude modulation (AM) to carry the audio. Another method of super-

imposing audio on a carrier is called **frequency modulation (FM)**. Its process is quite different. The two are compared in the drawing.

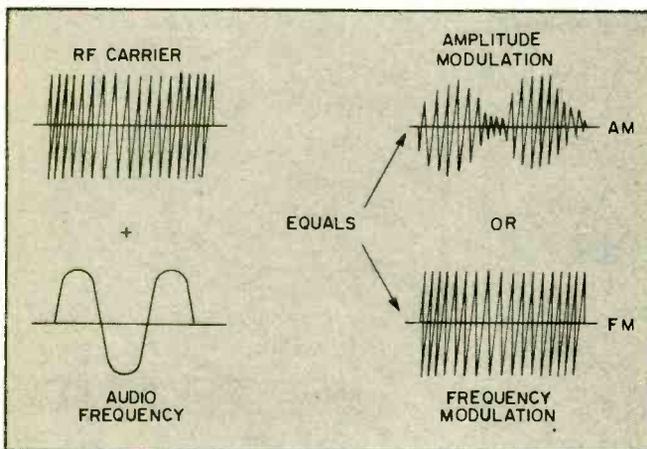
Both AM and FM start out with a carrier frequency and an audio frequency (sound originating in the studio). In amplitude modulation, as you already know, the sound is superimposed on the carrier frequency (which is constant) by varying the carrier **amplitude** in conformance with the voltage and frequency of the audio.

In FM, however, the audio is mixed with the RF in such a way that the carrier **frequency** is varied in accordance with the amplitude of the sound. As the audio cycle goes positive, the RF carrier frequency increases. When the audio cycle goes negative, carrier frequency decreases. The sum of the two changed frequencies in one audio cycle is still equal to the original carrier frequency.

One of the advantages of frequency modulation is its freedom from distortion. Noise and other forms of distorting voltages in the atmosphere or receiver are added to amplitude modulation. Since FM does not depend on changing amplitude to carry audio, noise has little or no effect on it. This is part of the reason for the clarity of sound that you get from an AM receiver.

CB sets for many years (1958 until the early 70s) used AM to carry the audio information. Now, in order to get more distant reception, and to get more stations into a given amount of radio frequency spectrum, CB sets which use single sideband transmission are being manufactured. This is more complicated than ordinary AM, or even than FM. It is a special kind of AM, and will be used increasingly in the future, as more and more CB sets keep going on the air and crowding the radio spectrum.

COMPARISON OF AM AND FM WAVEFORMS



QUESTIONS

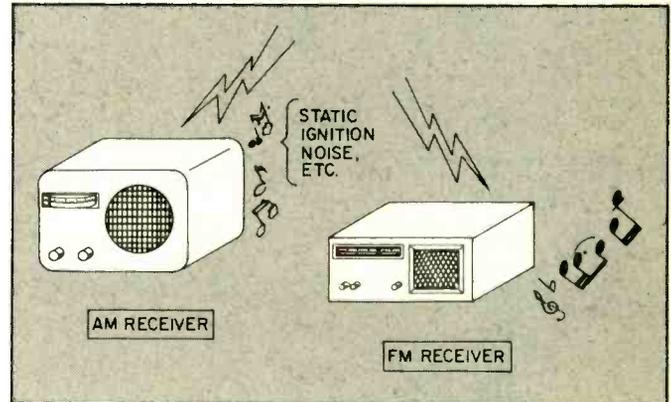
- Q10.** In AM, the carrier _____ changes to match the audio.
- Q11.** In FM, the carrier _____ changes to match the audio.
- Q12.** An FM receiver is (more, less) subject to atmospheric noise than an AM receiver.

Q13. Single sideband (SSB) transmission is a special kind of (AM, FM) which has some advantages over standard amplitude modulation.

ANSWERS

- A10.** In AM, the carrier **amplitude** changes to match the audio.
- A11.** In FM, the carrier **frequency** changes to match the audio.

NOISE HAS LITTLE EFFECT ON FM



- A12.** An FM receiver is **less** subject to atmospheric noise than an AM receiver.
- A13.** Single sideband (SSB) transmission is a special kind of **AM (amplitude modulation)** which has advantages over regular AM.

WHAT YOU HAVE LEARNED

All carrier signals within range are picked up by the receiver antenna. The tuning control on the front of the receiver adjusts the input of the mixer or converter stage so that only the desired station carrier frequency is received. At the same time, it adjusts an oscillator to generate an IF above the carrier frequency. Carrier and oscillator frequencies are joined in the mixer or converter and the difference between the two, the intermediate frequency, is amplified and fed to the IF amplifier. Here the signal and its audio component are further amplified. The next stage (detector) extracts the audio component and passes it to the final stage (audio amplifier). The audio is amplified and fed to the speaker, causing the cone to reproduce the sound that originated at the studio.

Amplitude (AM) and frequency (FM) modulation are two methods of transmitting audio on a carrier. When AM is used, the amplitude of the carrier varies according to the loudness (amplitude) and frequency of the audio. In FM, the frequency of the carrier is varied instead of the amplitude. FM transmissions are less bothered by atmospheric and receiver noises.

Single Sideband (SSB) is a special kind of AM which has the advantage of being received over greater distances than standard AM signals of the same power. It also uses up less space in the radio frequency spectrum, so a given amount of frequency spectrum can accommodate more transmitters. ■

ELEMENTARY ELECTRONICS HOBBY MART

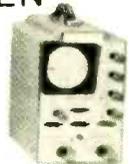
SAVE! HEATHKITS AT BARGAIN PRICES

We're overstocked with kits purchased for our students.

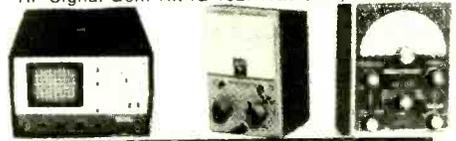
These are brand-new kits in unopened cartons, with complete instructions. All units operate on 120/240 volts.

VECTORSCOPE COLOR GEN

KIT IO-101
Two units in one: a vector-scope for the petal pattern and a color bar/pattern generator. 12 patterns, front panel controls, etc. Was \$140.; Sale price \$50.00



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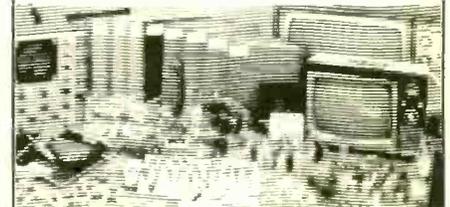
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VCR System

(Continued from page 66)

or all of your TVs have 75-ohm VHF antenna inputs, you've got it made. Just connect everything together. If the antenna and/or TVs are 300 ohms, you'll have to use 75-ohm matching transformers (available from Radio Shack and others) if you want the sharpest possible picture. Mismatching generally produces a slight "ghosting" that appears as a loss in sharpness.

The 75/300-ohm matching transformers have an "F" connector on one end and short piece of 300-ohm twin-lead on the other. (Warning: Some transformers made in the Orient have an oddball coax connector and screw terminals for the 300-ohm output. Avoid them like the plague.) Install one matching transformer between the 300-ohm antenna downlead (inside the house, where it's protected) and one at each TV that doesn't have a 75-ohm VHF tuner input. If you're trying to keep costs to an absolute minimum, use the matching transformer between the antenna downlead and the coax.

If you move the TVs from room to room make life easy by using plug-in coax connections from the TVs. Terminate the leads from the splitter(s) with a Motorola-type socket installed on a plastic plate and box, as shown in the photographs.

Heath PT-1500

(Continued from page 76)

into the timer. When assembly is completed, the user moves a wire from a NORM (normal) push-in terminal to an adjacent TEST terminal. When the line cord is plugged in, all segments (seven) in a given display will light individually, then all segments will light at once, and the process will repeat on the next display, and so on until all five LED displays are tested. After the LEDs are checked out, the user tests the remainder of the system by observing the "response" indicated when each key (switch) is touched. For example, touching the ENLARGER switch will produce a digital display of "E 18," while touching keypad numeral nine results in an "E 09," etc. The instruction manual shows the desired response for each key.

When everything checks out, the user simply restores the wire to the NORM

Shop Around First. The cost of parts for a TV distribution system can vary by as much as 40%. Shop around before you purchase any electronic components. We have seen the same hybrid splitter selling for \$4.95 and \$9.95. We have also purchased 100 feet of white RG-59/U for \$10 and 100-feet for \$14.95. Similarly, a blank plastic "TV outlet cover" which we drilled for the Motorola socket cost us \$1.98. We then purchased a sturdier "electric outlet" plastic cover for 69¢ in an electrical supply house.

Final Checkout. First, make certain you can make a VCR recording from the antenna system. If not, you have a wrong connection to the splitter or switch. Then, feed the tape playback through your system and check that the rooms which should have the tape have it, and that the rooms with antenna feed actually have a signal from the antenna. If not, doublecheck the switch connections, if you have used a switch in the system.

When the switching is working as you intended, check the picture quality. It should be razor sharp. If not, or if some outlets are sharp while others are not quite as sharp, try terminating unused splitter outputs. Make certain you're using 75/300-ohm matching transformers where required.

If you thought things out well before you started, you should have a system that handles most, if not all, of your family's TV viewing needs. ■

terminal and the timer is ready to go.

Performance. The PT-1500 Dark-room Timer does exactly what Heathkit claims it will do—no more, no less. It is certainly convenient for the serious photographer who processes his own films and/or makes his own color prints. As a straight enlarging timer, it's a bit too complicated as you don't need that much computer capacity just to time an exposure of ten seconds.

We had no complaints with its operation, which proved consistently dependable. One characteristic, which proved valuable in actual use, is a 10-second warning beep and then end-of-timing-cycle beeps when the END key is on. The 10-seconds gives you sufficient warning so you are not suddenly surprised to find a cycle has ended.

All in all, the PT-1500 is a decided asset to any serious photo hobbyist's darkroom. The PT-1500 retails for \$119.95 in kit form. For more information, contact The Heath Company, Benton Harbor, MI 49022, or circle 59 on the reader service coupon. ■

Yaesu FT-207R

(Continued from page 42)

comes from the switchable transmitter RF output. Our unit has the option of 3-watt or 200-mW outputs. A lot of repeaters can be worked with the lower output—we accessed one repeater on a mountain top seventy miles away with the 200-mW output, and our signal was only slightly noisier than with the full 3-watts output. Yaesu tells us that later models will have a switchable 3-watt/1-watt output.

Another Yaesu feature that aids in hedging against the battery drain is the removable battery pack. It's possible to purchase two, three, or even more battery packs, keeping several charged and ready to just pop into the FT-207R if the pack in use becomes exhausted. Along this line, Yaesu has a unique quick charger, the NC-2, available for the FT-207R. The NC-2 rapid-charges the battery pack through the pulse charging technique. Monitoring the temperature as well as the voltage of the battery, the NC-2 pulses large amounts of current into the battery for short durations of time until it reaches full charge in a few hours.

Add-Ons. Another accessory of particular note is the synthesized sub-audible tone generator. This unit generates thirty-two tones as programmed from a switch mounted on the back of the rig. It is of special use for two meter enthusiasts who operate on more than one of the "closed" repeaters that require a particular sub-audible tone for access. Yaesu also offers a remote speaker mike, which allows the user to clip the rig to the belt.

Our lab people had one further suggestion that they felt would make a superb HT even better. If you really want a jolt, try replacing the standard "rubber-ducky" flexible helical antenna with the optional, telescoping ¼-wave whip antenna. The ¼-wave whip provides a 6 dB gain in effective radiated power over the helical antenna. With 3.3-watts of output and a ¼-wave whip, the little FT-207R will run rings around virtually anything that you'll ever see.

Conclusion. We've had a great deal of fun with this rig, and can tell you that our ham radio staff and lab people felt they lost a friend when it was time to send the rig back to Yaesu. We recommend it without reservation. The Yaesu FT-207R lists for \$399.00. Yaesu's address is P.O. Box 498, 685 Walthall Way, Paramount, CA 90723. For more information, circle number 89 on the reader service card. ■

Coax

(Continued from page 78)

choice of coax is critical to acceptable performance. UHF coaxial cable usually has foam dielectric, extra shielding (often a double layer), or may even be helium filled in the most critical military and commercial applications.

One type of coaxial cable frequently available on the commercial market is RG-6U. It is popularly used in the cable TV industry, and occasionally spool ends may be obtained from installers at low cost.

Although RG-6U has a nominal impedance of 75 ohms, it is applicable virtually everywhere that you would normally use 50-ohm line. Its excellent electrical characteristics more than make up for slight impedance mismatch. Advantages include low loss well into VHF, and double shielding for excellent noise immunity and low radiation properties.

The major disadvantage of RG-6U is its unconventional diameter, making it difficult to mate to common connectors. For this reason, the proper F connectors are recommended. However, by shaving a slight amount of vinyl off the end to be connected, the RG-6U can then be slipped into any standard connector which will accommodate regular size RG-59U cable.

Making Connections. Even after the choice of cable has been made, the prospective user is often confused by the array of connectors available. Obviously, the choice is easier once a decision is made as to what equipment will be connected to the line. For CB and amateur HF and VHF applica-

tions, the standard "UHF" PL-259 (military nomenclature) male connector will mate with the SO-239 female connectors found on most of that equipment. Although the PL-259 and SO-239 are traditionally called "UHF" connectors, other connectors are recommended for applications above 300 MHz.

The military uses type N assemblies for UHF. These are rarely found in commercial equipment, and never found in consumer radios. BNC connectors are quite plentiful, and popularly used in commercial test equipment. They perform well for UHF.

The type F fitting found on closed circuit TV sets and TV coaxial systems is also an excellent choice for these higher frequencies. It is inexpensive, easy to install, and a reliable performer through at least 1000 MHz.

Years ago, the automotive industry standardized on the venerable Motorola antenna connector. It works fine at the lower frequencies, but performance of the flimsy plug is questionable at VHF and UHF. Nevertheless, scanning radios have perpetuated the use of these little devices, and they must be used to connect antennas to scanners.

Coax Conclusions. Once the aura of mystery surrounding antenna cable is removed, system planning is very straightforward. Use economical coaxial cable up to 30 MHz, and low-loss foam above that. Use standard PL-259 connectors up to 300 MHz, type F or BNC at higher frequencies. And 50 or 75-ohm coax may be used interchangeably in virtually all installations with no practical difference.

Now, take a look at your antenna installation and see what improvements you can make! ■

Intelli-Phone

(Continued from page 70)

Help. That's all there is to it.

You'll also have to set the internal clock, and the alarm times if you want to use it. The elapsed time feature begins to count as soon as a call is connected. You can use it to tell how long a call is running by pressing the Timer button.

Other Goodies. The *Intelli-Phone* has lots of other features. There's on-hook dialing, which allows you to listen to the number you've called on the internal amplifier and speaker to see if it is answered without picking up the receiver. There's a Hold button, which does just that, and reads out "hold" on

the display when it's employed. A ring silencer turns the electronic ringer off; a "busy dial" feature will command the computer to re-dial a number that's busy—or doesn't answer—automatically once a minute for up to ten minutes. There's a way to use the memory for scratch pad storage, and to dial the last number called by simply pressing the "*" button.

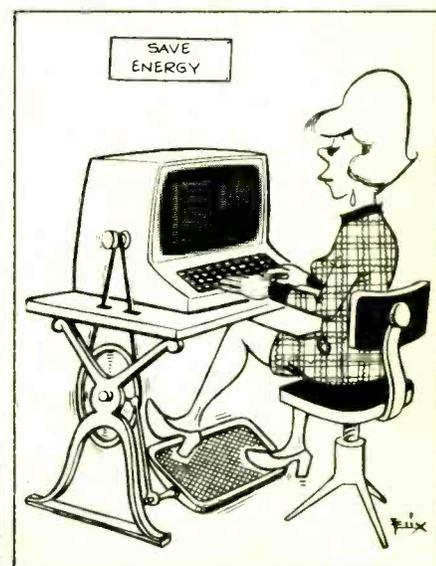
All the while, the fluorescent display reads out the nature of the command which has been entered, and the numbers dialed. The *Intelli-Phone* is a lot of fun to use, is practical, and worked like a charm. We liked it a lot. The address of Universal Security Instruments, Inc., is 10324 South Dolfield Road, Owing Mills, Maryland 21117. Circle reader service number 80 for more information. ■

Oil Pressure

(Continued from page 61)

engine block where the factory switch was installed. The two remaining arms of the tee are used to attach the factory warning light switch on one end and the GM sending unit on the other. On foreign cars using the metric standards, it may be necessary to use an adaptor for the 1/4-inch extender pipe, or to secure a blank brass pipe and have a machine shop thread an extender pipe to that car's metric specs. Stop the oil leaks before they occur by using a pipe cement or plumber's teflon tape when assembling the fittings. Exercise caution when tightening this fragile piping, especially when tightening it in the motor block. It is frustrating work to remove a sheared piece from the motor block hole.

Conclusion. There you have it, a relatively easy (as promised) method of keeping watch on one of your car's most important systems. Combined with the digital voltmeter and temperature gauge, and those gauges coming up in later issues, this represents one of the most important weapons you can have in your arsenal in the fight against the ever-rising costs of automotive maintenance and repair. In addition, you will possess a set of instruments of far greater accuracy than those analog devices commonly available for aftermarket installation. This is one instance in which you could not possibly buy anything better than what you can put together on your workbench in a few hours' time. Good luck, and, as the tiger used to say, "Happy Motoring!" ■



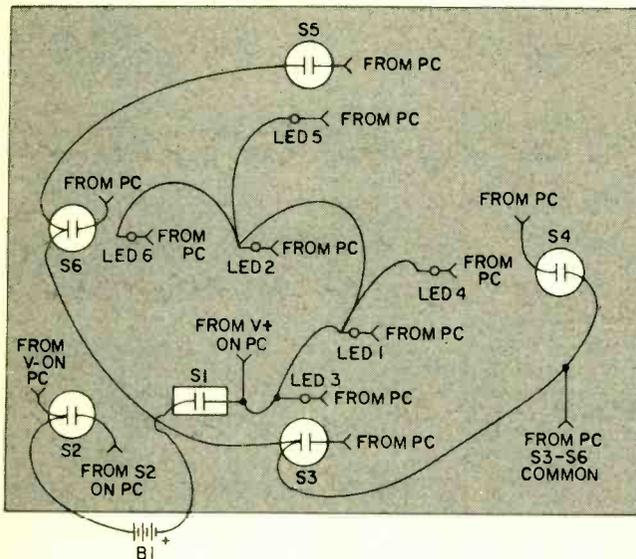
Fastouch

(Continued from page 49)

before the "+" and "-" LEDs stop blinking. If he does, his scoring LED will blink, indicating a "foul" and he should be penalized one point. No further scoring should be allowed for that round (i.e., when the "+" and "-"

LEDs stop blinking). It is advisable to use pencil and paper or some other apparatus for scoring since, as the game progresses, scores will be constantly changing. *FasTouch* will not guarantee that you'll be the hit of the party, only that your parties will be a bit more lively when it's out on the coffee table.

If you have enjoyed building and playing *FasTouch*, why not drop us a line and tell us. ■



Outline of the PC board to panel connections of *FasTouch*. It's simple, so just follow this diagram, and go ahead! Lots of luck.

Antique Radio

(Continued from page 72)

IN 46065, has a few spools of wire they will sell by the foot, and Alan Douglass, Box 225, Pocasset, MA used to sell resistance wire.

If you cannot get resistance wire, the next best thing is to buy a cone-shaped heating element at your hardware or electrical supply store, or a coiled wire clothes dryer heating element. When unused, the resistance wire is quite easy to unwind and straighten out. After it is heated up once, the wire oxidizes and becomes brittle. You can use it to re-wind power rheostats.

Gold Mines. One source of antique scientific apparatus often overlooked are laboratories in high schools and colleges. I know one collector who is an instructor at a midwestern university. Quite by accident, he found that the university was cleaning out the Chemistry-Physics stockroom. He obtained permission to take home all the discarded equipment. He was able to find several car loads of very desirable collectibles. You too may be able to find such a horde of old equipment.

Some items to be found in outmoded laboratories are books, electrical meters, X-ray tubes, vacuum tubes, glass cell batteries, small electric motors and generators. Almost every time a new high school is built, the old laboratory equipment becomes surplus.

The Bible. I often get letters from readers requesting that I recommend a book or books that will teach them all they should know about repairing old radios. Now this is very difficult to do, but if I were to name the one most outstanding book to buy, it would be *Modern Radio Servicing*, by Alfred A. Ghirardi. The book was originally published by Murray Hill Books in 1935. It went through many reprintings as well as revisions. You will have to look everywhere if you expect to find this book today. I know you can find them because in 10 years, I've found and sold five and still have my own copy.

There are several places you can look. First, try flea markets, used book sales, libraries, high schools, ham fests, and antique stores. Many individuals may have this book, such as teachers, older Amateur radio operators, older radio repairmen, and radio collectors. However much time you spend will be well repaid if you can find a copy of this book.

So long for now. I hope to see many collectors this summer as we travel to several antique radio collector meets. ■

TRS-80 TV Adapter

(Continued from page 74)

lower values for the emitter resistor of the RF oscillator until you observe quieting of noise in the TV raster. This will depend on the setting of R7 and actual current in diode Dm. At some middle setting of R7, the raster should be free of noise.

Connect the TRS-80 to the adapter and type in a graphics program placing a few horizontal lines or the crosshatch pattern on the screen. You may be able to tune in a stable display on two adjacent channels depending on the TV and setting of the RF oscillator. Select the best, touching up the oscillator coil for best reception. Adjust TV fine tuning until you observe a somewhat stable interference pattern in the background reminiscent of the sound bar effect, and back off for a clean display. Adjust R7, TV brightness, and contrast for best display of graphics or text.

TV Monitor Usage. The use of an unmodified TV and an RF modulator as a computer monitor is of interest to many computer hobbyists. The bandpass of TV IF and video amplifiers is about 3 to 4.5 MHz depending on model and screen size. The bandpass of video am-

plifiers in a computer monitor is much wider, with some extending to 10 MHz and beyond with high resolution monitors. Containing the finest of display detail, an alphanumeric character is made up of dots. The dot is formed on the screen by a very narrow video pulse containing significant odd harmonics extending beyond 4.5 MHz. Within the restricted bandpass of the TV, higher harmonics are lost or phase-shifted. This distorts and attenuates the video pulse resulting in an oval dot and loss of sharpness.

Conclusion. While this adapter provides a measure of compensation for limited TV bandpass, the results you will obtain depend on the number of characters per line, the TV itself, and care in adjustments. At sixty-four characters per line, side-by-side M's, N's, and other characters with vertical sides touch adjacent characters or are barely separated. Even so, this occurs at random places in a program list and the overall legibility is judged as fair to good, considering the task imposed on the TV. Tests at thirty-two characters per line were not possible with Level I BASIC, but the expected results should be excellent. With graphic displays, horizontal lines tend to be brighter than vertical lines, but it is possible to adjust the controls for a uniform display. ■

LITERATURE LIBRARY

403. *PAIA Electronics* gives you "Advanced Electronics For The '80s and Beyond." Brochure features computerized music synthesizers.

402. *Technical Electronics* has descriptions galore of all kinds of electrical gadgets—transistors, computer power supplies, and logic probes—in its latest (6-80 B) mail order catalog.

401. *AP Products'* "Faster and Easier Book" is designed to eliminate any problems with breadboarding, interconnection and testing devices. All-circuit evaluators with power are featured.

400. *Global Specialties* provides new product info in its catalog of Testing and Design Instruments. A Digital Capacitance Meter and Tri-Mode Comparator are just some of the featured projects.

399. "Firestik" *Antenna Company* has introduced a new and informative product catalog on top-loaded, helically wire-wound antennas and mounts.

398. *Hamtronics, Inc.* has announced a new model R110 VHF AM Receiver Kit which employs an AM detector and a dual-loop agc system. A complete catalog is yours for the asking!

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* explains the technology of wire-wrapping, complete with illustrations, in its catalog of industrial and hobby products. The 60-page book (80-36N) is available now.

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 electronics 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 looking 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.

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.

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

377. *John J. Meshna, Jr., Inc.* has a super-saver catalog out (SP-16) featuring walky talkies, police radar detectors, vacuum pump compressors and other fascinating products to choose from.

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 Amateur 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.

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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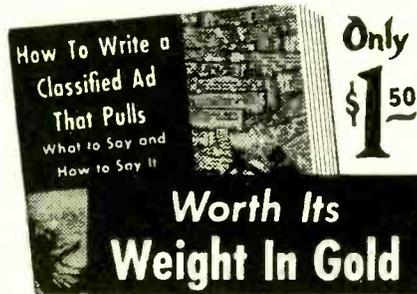
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INPUT/OUTPUT



BY HANK SCOTT

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

Hank Scott
ELEMENTARY ELECTRONICS
380 Lexington Avenue
New York, NY 10017

Fudge It

I have an old Fada portable radio, model P38, that needs a double-section battery rated at 1.5 VDC and 67.5 VDC. Do they still make it?

—R.R., Bangor, PA

I'd say yes, but I've looked for one and can't find it. It is not economically feasible to stock batteries of this type because the demand is low. I suggest you use separate sections: a D-cell for the 1.5 VDC supply, and a standard 67.5 VDC battery for the "B" supply.

Our Thanks

Reader Raymond Fisher generously donated some of his AM broadcast reception reports and literature from 1922. Some of the old calls responding were: NOF-Anacostia, D.C.; PWX-Havana, Cuba; WHB-Kansas City, MO; WHAS-Louisville, KY; 3XW and 3ZO (?)—Parkeburg, PA; and KHJ-Los Angeles, CA. Also received was a copy of the "Crosley Radio Weekly and WLW Programs" for the week of February 19, 1923. These mementos of radio's history were forwarded to Jim Fred, our Antique Radio Editor, who will find a suitable home for them. We commend Raymond Fisher's generous gift with the realization that it must hurt him some to part with these mementos of radio's past.

About Kid Stuff

How come walkie-talkies do not require operators with CB licenses? I checked the CB rules and there are no exceptions.

—D.L., West Orange, NJ

The new walkie-talkies operate on 49.860 MHz and require no license, provided the rigs are FCC approved! The frequency tells you that these transceivers are not in the CB band, thus not under their rules. If you use an old 27 MHz CB walkie-talkie, you will need a CB license to operate it even if it is 100 mW or under as per the new rules. The rule change put the kiddies outside the CB band. The few kiddies you do hear are over 18 years old.

Learn First

Hank, I bought a TRS-80 recently. After I had become proficient at handling Arthur (my computer), I spent most of my time programming him to play games with me and do my homework. My trouble is, I'm only fourteen (eat your heart out,

Larry Friedman), and besides keeping inventory and the like for an imaginary corporation, all Arthur does is raise the electric bill. And since my folks have started to turn their noses up at Artie, I've felt it's time to put him to work. I read an article in another magazine where a man had programmed his home computer to literally run his house. The article also made reference to making use of the BSR X-10 control system. How can I get Arthur to mimic the ultrasonic tones necessary to run the system? I'm also looking into Speechlab. One last thing; I have a friend who's thinking about expansion. What's your opinion on Ithaca Audio's 16K memory upgrade kit?

—T.H., Great Fall, MT

Boy, that was a long letter! First off, I believe hobby computers are for learning, and not for playing games or doing work. I fashion myself as a pretty good BASIC programmer, but I know I have a long way to go before I can fully apply Level II BASIC, not to mention other formats. A hobby computer is too valuable to control the lights in a home, turn a radio on or off, or provide wakeup service. What you propose to do, do without your TRS-80. Use it for learning. As for the Ithaca Audio 16K memory upgrade kit, even Larry Friedman knows it was reviewed in ELEMENTARY ELECTRONICS early this year. It's a good buy for your TRS-80.

Sound TV

I have a General Electric television set which I would like to use as an audio amplifier for a record player or tape recorder. What should I do?

—A.C., Eastman, GA

Your letter went on to give the TV's model number, and it happens to be an AC intercarrier set using vacuum tubes. This is a power-transformerless rig that offers a serious safety hazard when interconnecting audio devices such as a turntable, tuner, cassette deck and speaker. Also, if it had a transformer power supply, too much of the guts would have to be disconnected, upsetting the load on the power supply. The B-plus voltage would increase, possibly overloading the circuit's electrolytic capacitors and the audio circuit. Old sets can't take this treatment without increased failure rates. Also, an

old TV set is filled with old parts. New audio amplifiers in kit, modular and cabinet form are inexpensively available both new and used. I suggest you junk the TV!

Capacitor Tips

In the Sept./Oct. 1979 issue of ELEMENTARY ELECTRONICS, there was a project called the "Li'l Wailer." Only one part has withheld me from finishing it. This part is a mylar capacitor with a 0.22- μ F, 15-VDC rating. I've checked all the companies in the Hobby Mart section, such as Digi-Key, Poly Paks, and others. Would you know where to find a capacitor with this low voltage? Thanks!

—G.B., N. Royalton, OH

Any mylar, epoxy-coated or disc capacitor rated at 15 VDC or better, will do the job. In my capacitor parts bin, I found two 0.1- μ F, 15 VDC mylar capacitors which, when connected in parallel, equal 0.2- μ F, close enough to work well in the circuit. I also found two 0.22- μ F disc capacitors rated at 35 VDC and 200 VDC. Either will work as well in the circuit. I don't remember buying the 35 VDC unit, but the 200 VDC unit was purchased in quantity some time ago to save a few pennies. The high voltage is not critical in capacitors of this type—but the voltage rating must equal or exceed the rating specified. Whenever I buy a capacitor, I buy in quantity, or look for it in a bargain mixed package. It's the only way to buy.

Old Tubes

Are you looking for a 2A5, 2A6, 6B7, 6Y6, 6Y7, 24, 26, 27, 30, 35, 36, 38, 39/44, 45, 46, 47, 53, 55, 56, 57, 58, 59, or 76 vacuum tube? Then get in contact at once with J. Leach, 406 Federal, Milton, DE 19968. He's willing to swap for 50C5, 50B5, 50EH5 or any 50-volt, 150 mA filament tube on a tube for tube basis.

Lend a Hand

Not too many requests this issue, so let's see 100% satisfaction for those asking for help. Next issue may see your request published.

△ Knight R-100A receiver; needs instruction manual and schematic diagram; Donald B. Watkins, 428 Oak St., Warren, AR 71671.

△ Hallicrafters S-38E; wants tube position layout and schematic diagram; Tim Quinney, Rt. 1, Box 167, Rurcellville, VA 22132.

△ Hallicrafters CB-3A; needs schematic diagram and help to wire to AC line and two-wire microphone; Joseph DeFusco III, 27 Lyman Rd., Waterbury, CT 06704. ■

NOW AVAILABLE!

WATT WIZARD™

POWER FACTOR CONTROLLER CUTS THE COST OF RUNNING ELECTRIC APPLIANCES BY AS MUCH AS 50% -- AND YOU CAN EVEN SEE THE SAVINGS!

For over a year now, in magazines and newspapers the world over, there have been enthusiastic write-ups on a remarkable new device that can cut your electric bill while helping the U.S. save huge quantities of fuel.

"The NASA/Nola power saver," wrote a **Popular Science** senior editor, "was developed by Frank Nola at NASA's George C. Marshall Flight Center as an offshoot of a program to reduce power consumption in spacecraft motors. Nola calls it a PFC — 'power-factor controller. I prefer to call it a power saver, however, because that's what it does.'"

NASA TESTED IT

According to Clyde S. Jones of NASA, "The device has been tested at Marshall Center on over 40 types of motors, with power savings ranging up to 60%, depending on the loading. The motors tested were both single-phase and three-phase, ranging from ½ H.P. to 5 H.P. Most motors will show up to 40-to-50% savings when running lightly loaded or unloaded, and some will show 5-to-7% savings at rated load."

NASA's Technical Support Package showed the test results and noted that "The Power Factor Controller applies to induction type electric motors — the most commonly used type in all major home appliances and the most commonly used by industry."

HOW IT SAVES POWER

Popular Electronics explained it this way: "AC induction motors characteristically run at a nearly constant speed that's fixed by power-line frequency and independent of load and supply voltage. When heavily loaded, the motor draws line current that is nearly in phase with the applied voltage... Under light load conditions, the motor develops less torque by allowing more lag between the voltage and current. This reduces the power factor while leaving the current essentially the same in magnitude.

"Though the low power factor means that conversion of electricity to mechanical power is small, the large current causes considerable (heat) losses in the supply lines and motor windings. This is what reduces efficiency.

"To minimize this waste, Nola's device monitors the motor's power factor and, when it detects light load conditions, it reduces the supply voltage... The current, now more nearly in phase with the voltage, therefore does as much useful work as before, but it and the voltage are smaller, resulting in a net savings of electric power."

THE SAVINGS CAN ADD UP

Like everything else, the cost of electric power keeps going up. Not only is the basic rate you pay going up, the power companies have now added on a "fuel adjustment" charge to help pay for running their generators. In 1980, 1981 and beyond, you'll pay more and more for the privilege of running your electric appliances.

*National Aeronautics
and Space Administration
Patent No. 4,052,648*

Right now, the typical consumer pays about \$8 per month to operate a 16.5 cu. ft. frost-free freezer... \$10 to run a 17.5 cu. ft. frost-free refrigerator... \$8.25 for an attic fan operating 12 hours a day... and about \$60 for an air conditioner used during summer months. It's not hard to figure out what you're paying per year just to run **one** of these appliances. And in many parts of the country, the cost is even higher.

That's why Nola's power saver can soon pay for itself, then start reducing your electric bills — the amount of savings, of course, depending on which appliance(s) you use it with.

There's just one catch. Until now, the device has not been **available** — except for industrial models priced at \$80 or more.

INTRODUCING THE WATT WIZARD

Cynex, an American manufacturer of electrical and electronic products and a prime contractor for the U.S. Government, has been licensed by NASA to manufacture Frank Nola's power saver. Cynex calls it the Watt Wizard.

"The Watt Wizard," says Ray Beauchea, the firm's Marketing Director, "regulates the voltage fed into an induction motor, reducing or boosting power as required, when loads go up or down. Simply stated, it makes motors run more efficiently, especially when idling. It reduces motor heat, affording longer motor life and reducing the amount of air conditioning required for cooling (rooms) in summer months. It saves electric power, because kilowatt hours are greatly reduced. And it causes the motor to run quieter."

SIMPLE TO USE

Cynex makes several models of the Watt Wizard (all with solid state design), including the 110 V AC plug-in model we're offering. It's for single phase fractional H.P. motors (less than 1 H.P.) which is the type used in most made-for-the-home freezers, refrigerators, window and attic fans, swimming pool pumps, furnace fans, vacuum cleaners, sewing machines, power drills, etc.

Simply plug the Watt Wizard into any electric outlet, then plug the appliance into the Watt Wizard. There's no wiring required. Unlike some competitor's models (if and when available), the appliance does **not** have to be turned on before being plugged into the power saver. You can leave the appliance — whether on or off — plugged into the Watt Wizard all the time. Or you can move the Watt Wizard to various locations, depending on which appliance is being used. (Better yet, order several Watt Wizards.)

CIRCLE 30 ON READER SERVICE COUPON



OTHER MODELS AVAILABLE

Air conditioners, washers and dryers require wire-in model. If you lack mechanical skill, you probably need an electrician to install it. We also offer it in 220 VAC single or three-phase.

ADVANCE FEATURES

The Watt Wizard also includes two more unique features. It's fused, so if you accidentally overload the device, it won't burn out. Just change the fuse, which is available at any auto supply store.

And the Watt Wizard features an LED readout, so you can actually tell, at any moment, exactly how much power you're saving — 10%, 20%, 30%, 40% or 50%.

There's a "Power On" light, too. And the Watt Wizard comes with the manufacturer's 1-year limited warranty.

LOW COST — AND A TAX CREDIT

We're offering the Watt Wizard for only **\$39.95**, with **immediate delivery**. Want two? Then it's just **\$37.95** each. Or splurge and get three at **\$34.95** each. Wire-in models for heavy duty motors are **\$6** more for each unit. Add just **\$2.50** postage/handling for each **order** (not each unit).

And next year, when you fill out your tax return, you can deduct a full 15% energy tax credit — for additional savings.

30-DAY MONEY-BACK GUARANTEE

Try the Watt Wizard for up to 30 days. If not completely satisfied, return it (insured) for a full refund.

The sooner you send for the Watt Wizard, the more you can save on your electric bills. To order, send your check or money order to the address below. Or charge it to your Visa, MasterCard, American Express or Carte Blanche credit card. If using your charge card, you can also order via our toll-free phone number:

800-257-7850

(In New Jersey, Call: 800-322-8650)
N.J. residents, add 5% sales tax.

Or mail your order to:

Dept. H Lakewood Plaza
Lakewood, N.J. 08701



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

The "Edu-Kit" offers you an outstanding PRACTICAL HOME RADIO COURSE at a rock-bottom price. Our Kit is designed to train Radio & Electronics Technicians, making use of the most modern methods of home training. You will learn radio theory, construction practice and servicing. THIS IS A COMPLETE RADIO COURSE IN EVERY DETAIL. You will learn how to build radios, using regular schematics; how to wire and solder in a professional manner; how to service radios. You will work with the standard type of Punched metal chassis as well as the latest development of Printed Circuit chassis. You will learn the basic principles of radio. You will construct, study and work with RF and AF amplifiers and oscillators, detectors, rectifiers, test equipment. You will learn and practice code, using the Progressive Code Oscillator. You will learn and practice trouble-shooting, using the Progressive Signal Tracer, Progressive Signal Injector, Progressive Dynamic Radio & Electronics Tester, Square Wave Generator and the accompanying instructional material.

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

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

THE KIT FOR EVERYONE

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

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

PROGRESSIVE TEACHING METHOD

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

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

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

THE "EDU-KIT" IS COMPLETE

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

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

FREE EXTRAS

• SET OF TOOLS

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

SERVICING LESSONS

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

FROM OUR MAIL BAG

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

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

SOLID STATE

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

Progressive "Edu-Kits" Inc., 1189 Broadway, Dept. 603-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. 603-DJ Hewlett, N.Y. 11557

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.