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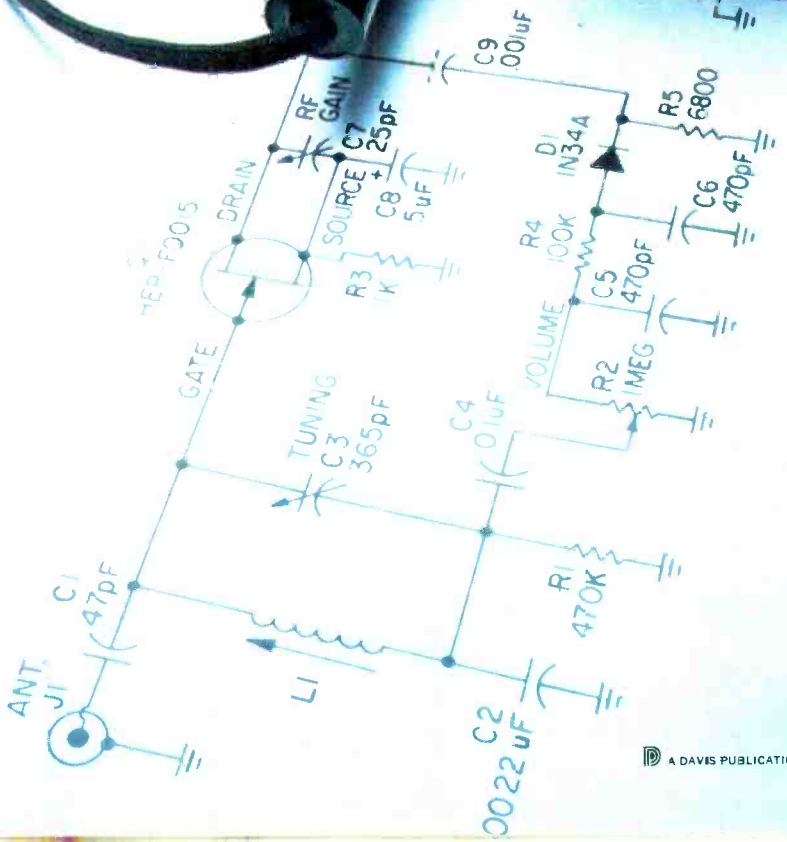

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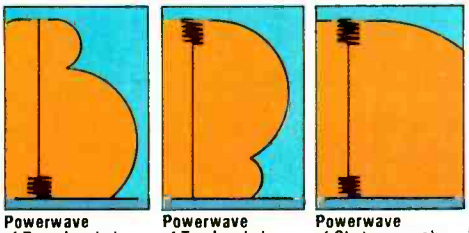

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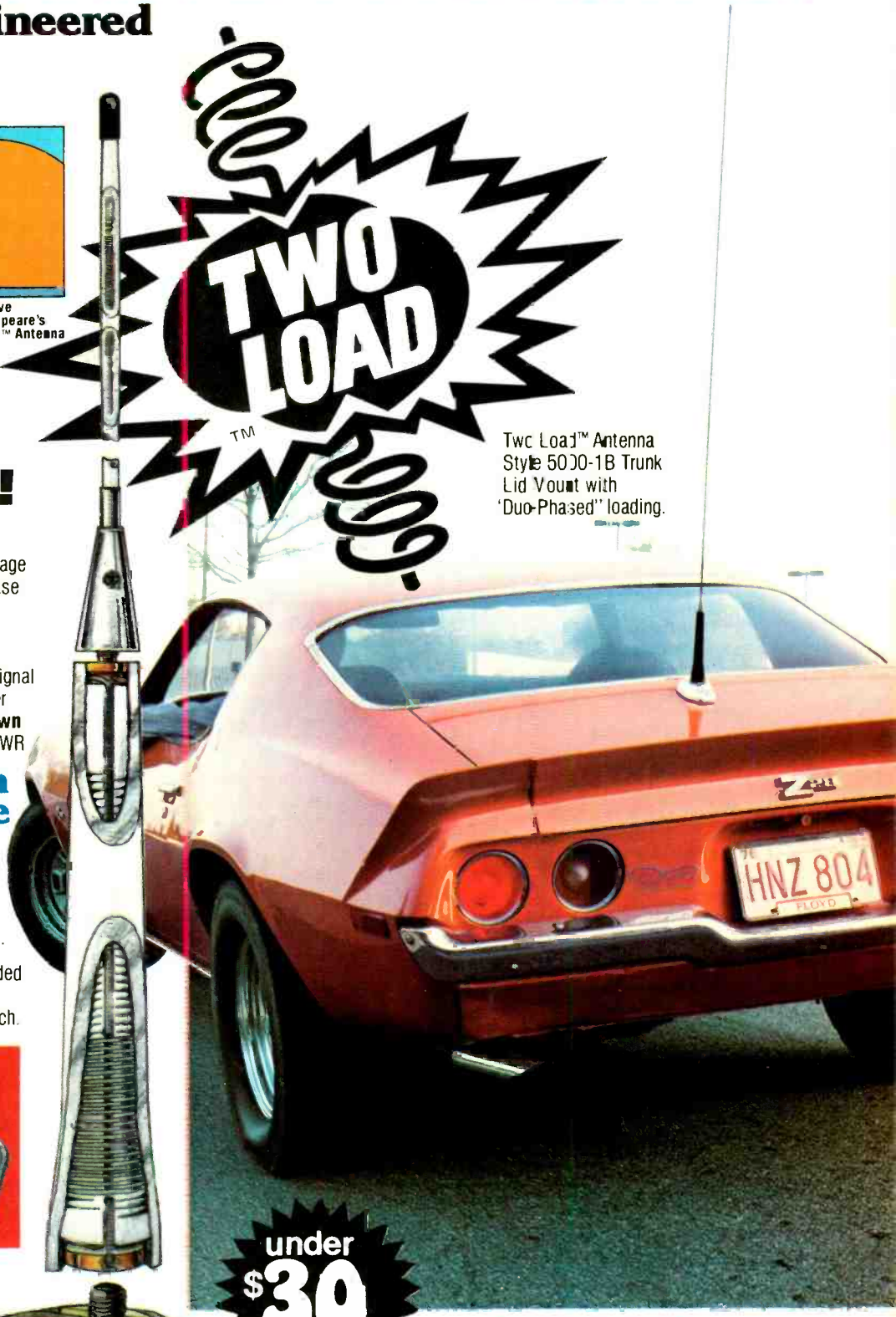

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CIRCLE 19 ON READER SERVICE COUPON

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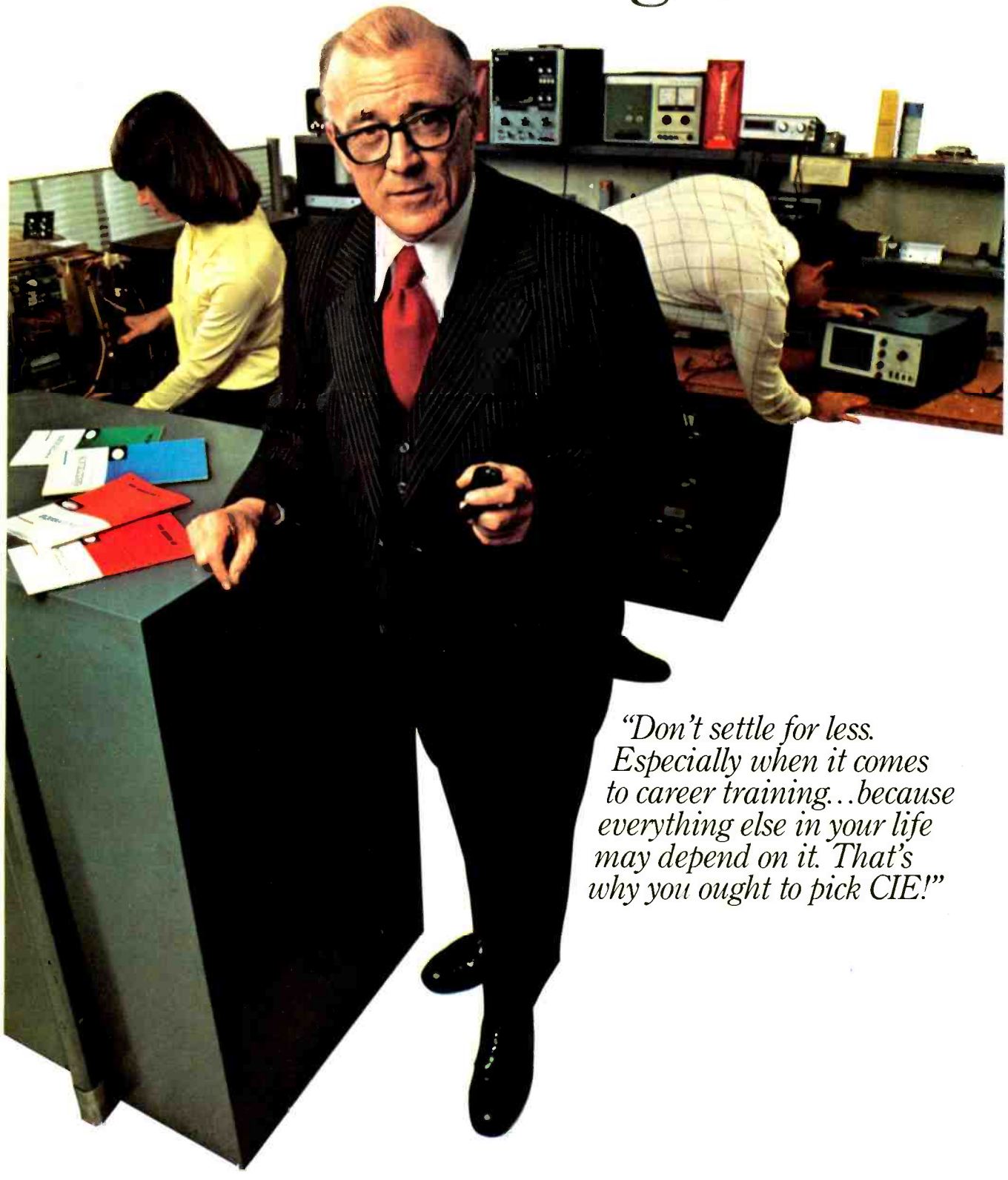

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Our step-by-step learning includes "hands-on" training.

At CIE, we believe theory is important. And our famous Auto-Programmed® Lessons teach you the principles in logical steps.

But professionals need more than theory. That's why some of our courses train you to use tools of the trade like a 5 MHz triggered-sweep, solid-state oscilloscope you build yourself—and use to practice troubleshooting. Or a beauty of a 19-inch diagonal Zenith solid-state color TV you use to perform actual service operations.

Our specialists offer you personal attention.

Sometimes, you may even have a question about a specific lesson. Fine. Write it down and mail it in. Our experts will answer you promptly in writing. You may even get the specialized knowledge of all the CIE specialists. And the answer you get becomes a part of your permanent reference file. You may find this even better than having a classroom teacher.

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Patterns shown on TV and oscilloscope screens are simulated.

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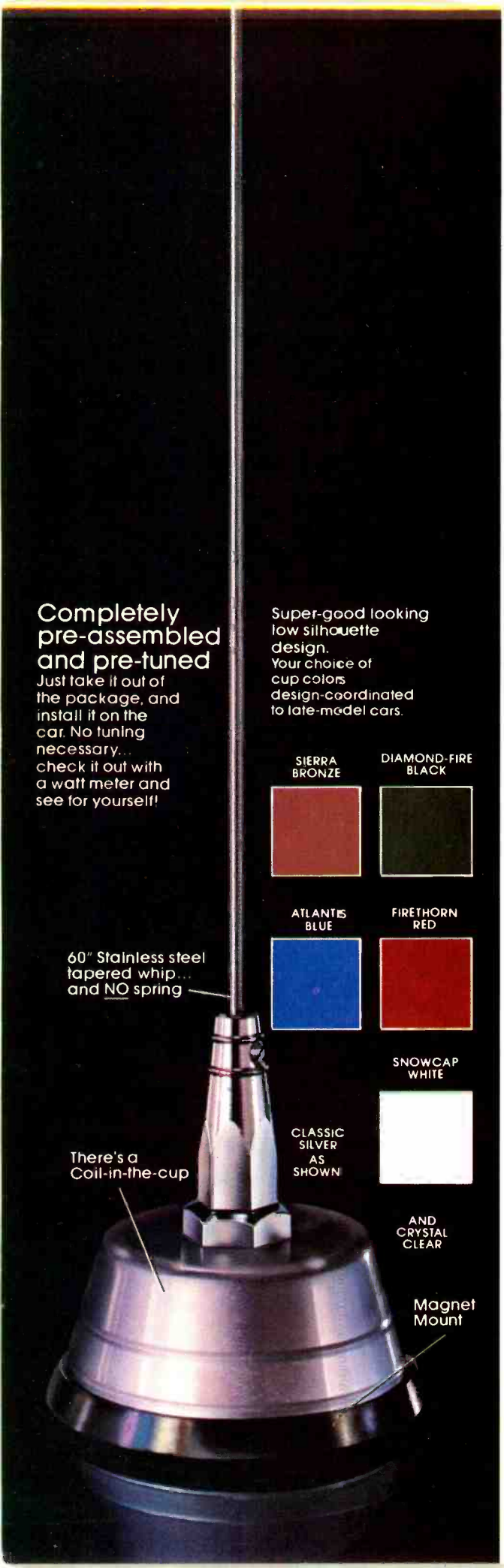

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When you buy this antenna, my reputation... built over 38 years in the antenna business... will be riding on your roof. I'm confident that the Persuader Antennas will persuade you... you've chosen the Best.

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CIRCLE 24 ON READER SERVICE COUPON

Hey, look me over

Showcase of New Products

Call for Echo

An analog echo unit with no moving parts and a two-position output level selector, which controls signal strength for use either in home stereo systems or electronic musical instrument systems is the RolandCorp DC-10. This versatile unit provides a full range of effects, from single delay to the recreation of sound

CIRCLE 48 ON READER SERVICE COUPON

as it might be heard in a large concert hall. The lightweight model features stereo output, and allows remote control of echo effect through an optional footswitch. Single delays, acoustic echo effects, sustained echos and chorus effects similar to those achieved by a phase shifter can be achieved, but all of them can be by-passed by the footswitch, which changes the effects instantly to direct, unaffected sound. A three-position input selector (—20, —35, —50 dB) makes it easy to accept nearly any kind of input. The DC-10 analog echo unit sells for $390. For more info, write to RolandCorp US, 2401 Saybrook Avenue, Los Angeles, CA 90040.

Three New Oscilloscopes

Quick and easy set-up and operation are the key features in a new line of push-button-triggered oscilloscopes introduced by Hickok. They consist of three models which feature automatic triggering, color-coded front panels, and conveniently grouped controls. The Model 532 at $995 (including probes) is a dual-trace 30 MHz scope with 11.7 nSec risetime and a

CIRCLE 47 ON READER SERVICE COUPON

built-in delay line for leading edge viewing of fast risetime pulses. Full time 4X expansion allows any portion of a pulse train up to 40 full divisions long to be viewed without the use of a multiplier. It is well suited for logic and pulse circuit applications. The Model 517 is a dual-trace 15 MHz scope with 5 mV/cm sensitivity and reliable triggering up to 30 MHz. Priced at $695 (including probes) the Model 517 features automatic selection of chopped or alternate operation in dual trace mode depending on sweep speed selected. The Model 517 is ideal for TV, VCR, audio and video maintenance and repair, as well as design and troubleshooting of most digital logic circuits. The Model 515 offers most of the features of the Model 517 in a lower-priced ($495 including probe) single trace version well suited to servicing and hobby applications. TV sync separators are built-in for easy locking to complex TV video wave forms at any sweep speed and, like the Model 517, it provides x-y operation for vectorscope measurements. For all the facts, write to the Hickok Electrical Instrument Co., 10514 Dupont Ave., Cleveland, OH 44108.

Mighty Mite

Radio Shack's Realistic STA-7 AM/FM stereo "mini" receiver delivers 10 watts-per-channel RMS into 8 ohms over 20-20,000 Hz with a 0.5% total harmonic distortion. The low-profile receiver features an equalization (EQ) circuit which produces high-fidelity sound from the latest "mini" speaker systems like Radio Shack's Minimus-7s. The EQ circuit uses both voltage and current negative feedback to tailor the low-end response for

CIRCLE 32 ON READER SERVICE COUPON

50 Hz bass in "mini" speaker systems. The circuit can be switched out for use with full-size speaker systems, too. It sells for $159.95 and $219.95 with the Minimus speakers shown, in Radio Shack stores nationwide and in Canada.

Stereophone

The Koss K/6A Stereophone offers the pleasures of private listening for those starting their interest in high fidelity. It features low-angle drivers which mini-

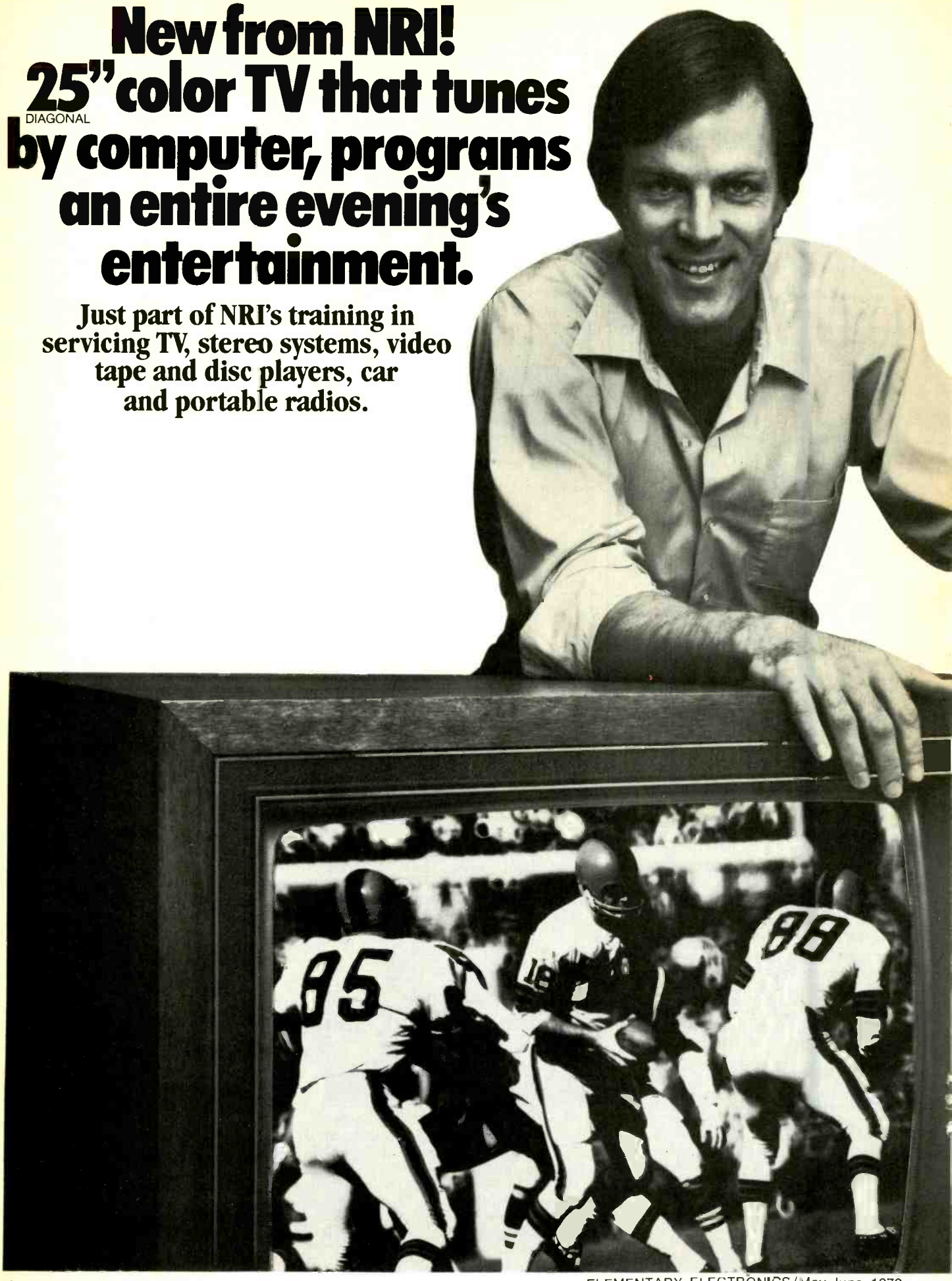
CIRCLE 49 ON READER SERVICE COUPON

mize distortion, 10-16,000 Hz frequency response range, contoured earcushions, professional styling, and space-age durability. Suggested retail price of the K/6A is $24.95. For more information, write to Koss Corporation, 4129 N. Port Washington Ave.. Milwaukee, WI 53212.

(Continued on page 14)

New from NRI! 25" DIAGONAL color TV that tunes by computer, programs an entire evening's entertainment.

Just part of NRI's training in servicing TV, stereo systems, video tape and disc players, car and portable radios.



Only NRI home training prepares you so thoroughly for the next great leap forward in TV and audio... digital systems. Already, top-of-the-line TV's feature digital tuning, computer programming is appearing, and new digital audio recording equipment is about to go on the market.

NRI is the only home study school to give you the actual "hands-on" training you need to handle servicing problems on tomorrow's electronic equipment. Because only NRI includes this designed-for-learning, 25" diagonal color TV with electronic tuning, built-in digital clock, and computer programmer as part of your training. With this advanced feature, you can pre-program an entire evening's entertainment... even key lock it in to control children's viewing.

As you assemble it, you learn how digital tuning systems work, how to adjust and service them. You work with the same advanced features used in the new programmable TV's and video tape recorders. It's exclusive NRI training that keeps you up with the leading edge of technology.

Exclusive Designed-for-learning Concept

The color TV you build as part of NRI's Master Course looks, operates, and performs like the very finest commercial sets. But behind that pretty picture is a unique designed-for-learning chassis...

the only such unit in the world. Rather than retrofit lessons to a hobby kit or an already-built commercial set, NRI instructor/engineers have designed this television so each step of construction is a learning experience.

As you build it, you perform meaningful experiments. You see what makes each circuit work, what it does, how it interacts with other circuits. You even introduce defects, troubleshoot and correct them as you would in actual practice. And you end up with a magnificent, big-picture TV with advanced features. One you can sell or use in your home.

Also Build Stereo, Test Instruments

That's just a start. You demonstrate basic principles and circuits on the unique NRI Discovery Lab,® then apply them as you assemble a fine AM/FM stereo receiver, complete with speakers. You also get practical experience as you build your own test instruments, including a 5" triggered sweep oscilloscope, CMOS digital frequency counter, color bar generator, and transistorized volt-ohm meter. Use them for learning, use them for earning as a full- or part-time TV, audio, and video systems technician.

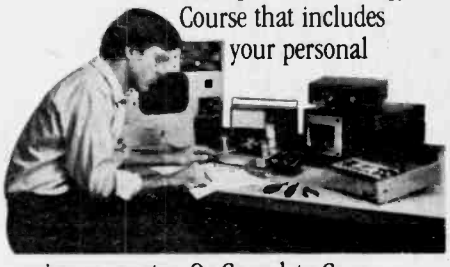
Complete, Effective Training Includes Video Systems

Using NRI's exclusive methods, you learn far more than TV servicing. You'll be prepared to work with stereo systems, car radios, record and tape players, transistor radios, short-wave receivers, PA systems, musical instrument amplifiers, electronic TV games, even video tape recorders and tape or disc video players. Your training covers just about every kind of electronic entertainment equipment available now or in the near future.

And because NRI has unmatched experience gained in over 60 years and a million students worth of training, your course is designed for ease of learning and practical utility. You need no previous experience of any kind. Starting with the basics, exclusive "bite-size" lessons cover subjects thoroughly, clearly, and concisely. "Hands-on" experiments reinforce theory for better comprehension and retention. And your personal NRI instructor is always available for consultation, ready with explanations, answers, and advice.

Send for Free Detailed Catalog... No Salesman Will Call

Get all the facts on this exciting course and its potential for you by mailing the postage-paid card today. Our free 100-page catalog includes color photos of all kits and equipment, complete lesson plans, convenient time payment plans, and information on other electronics courses. You'll also find out about NRI's new Computer Technology Course that includes your personal



microcomputer. Or Complete Communications with 2-meter transceiver that gets you ready for opportunities in broadcasting, 2-way radio, microwave, and other growing fields. If card has been removed, write to:

NRI McGraw-Hill

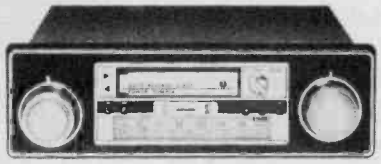
NRI Schools
McGraw-Hill Continuing Education Center
3939 Wisconsin Ave.
Washington, D.C. 20016

HEY, LOOK ME OVER

(Continued from page 9)

Power Pumper for Car

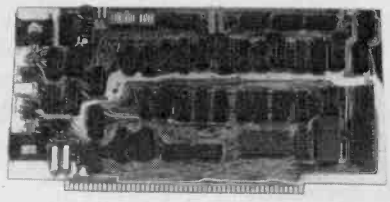
Added to the J.I.L. "Power Pumper" Line of high-powered car stereo units is the Model 633 AM-FM-MPX/Cassette unit which incorporates a special power boost switch that enables the unit to deliver a full 20-watts RMS per channel maximum, for big, home-stereo-like sound. The tuner section features an FET front end and a phase-lock-loop circuit in the multiplex for top broadcast reception and excellent FM-stereo separation. A Local/Distance switch and FM muting are also incorporated. Model 633 offers automatic reverse, push button eject, locking rewind and fast forward, and tape direction indicator. Adjustable shafts simplify installation. It's priced at $244.95. For complete information, write J.I.L., Department P, 737 West Artesia Blvd., Compton, CA 90220.



CIRCLE 42 ON READER SERVICE COUPON

S-100 Video Board

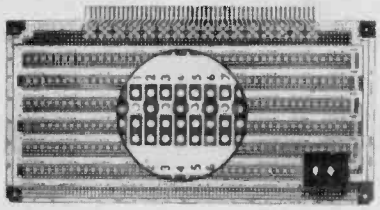
SSM (formerly Solid-State Music) has introduced the VB2, an I/O-controlled video interface board. The VB2 has its own keyboard input port, so there is no need for another I/O board for either keyboard or video display. The hardware-controlled cursor for *line feed*, *carriage return*, *backspace*, and *clear-screen* frees up valuable memory space. The display is 64 by 16, and features all upper case letters as well as numbers and symbols, and is switch-selectable for white-on-black or black-on-white. VB2 is available in kit form, priced at $149.95. For further information contact SSM, 2116 Walsh Avenue, Santa Clara, CA 95050.



CIRCLE 44 ON READER SERVICE COUPON

Prototyping Board

A new prototyping circuit board, bus and shape compatible with Altair and Imsai microcomputer boards, holds up to seventy 14- or 16-pin DIPS or any combination of DIP sockets with 0.3-, 0.4-, 0.6-, or 0.9-inch lead spacing. Designed by Vector Electronic Company as their "ANY DIP" Plugbord, the Model 8804 board's convenient power and ground-plane network makes it ideal for "homebrew" computers or custom-interface construction. The 5.3-inch by 10-inch by 0.062-inch board has 100 (50 each side) card-edge contacts on 0.125-inch centers to accommodate an S-100 bus organization. Two 100-hole rows of individual 0.1-inch spaced pads across the top of the board, permit additional input/output via ribbonwire assemblies. Inexpensive wrap posts may be fabricated by inserting Victor's T46-5-9 wrapped-wire pins into the holes. One corner of the 8804 may be used for a low-profile heat sink with two regulators in TO-220 packages. 8804 Plugbords are priced at $21.95 singly, and $19.76 each in quantities of five or more. Write to Vector Electronic Company, 12460 Gladsone Avenue, Sylmar, CA 91342, for further information.



CIRCLE 46 ON READER SERVICE COUPON

(Continued on page 16)

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PROGRESSIVE HOME RADIO-T.V. COURSE

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Training Electronics Technicians Since 1946

Now Includes

- ★ 12 RECEIVERS
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- ★ SQ. WAVE GENERATOR
- ★ SIGNAL TRACER
- ★ AMPLIFIER
- ★ SIGNAL INJECTOR
- ★ CODE OSCILLATOR

- ★ No Knowledge of Radio Necessary
- ★ No Additional Parts or Tools Needed
- ★ Solid State Circuits
- ★ Vacuum Tube Circuits

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

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

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

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

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

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

THE KIT FOR EVERYONE

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

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

PROGRESSIVE TEACHING METHOD

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

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

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

THE "EDU-KIT" IS COMPLETE

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

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

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."

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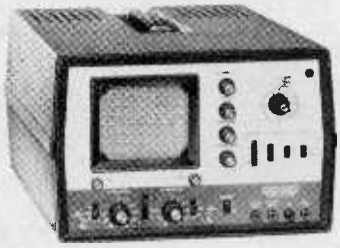
CIRCLE 14 ON READER SERVICE COUPON

HEY, LOOK ME OVER

(Continued from page 14)

Oscilloscope Kit

A new, low-cost, DC-to-5 MHz Dual Trace Oscilloscope kit, the Heathkit IO-4205, features a vertical input sensitivity of 10 mV/cm, a stable triggering circuit for solid waveform displays, seven calibrated time bases from 200 mS/cm to 0.2 μS/cm, a regulated vertical amplifier, and horizontal sweep circuit power supplies. Other IO-4205 features include a partial mu-metal shield, an extra-bright 5-inch flat-screen CRT, and a lightweight durable cabinet with flush-mounted handle for easy carrying and "stackability" with other instruments. All controls and

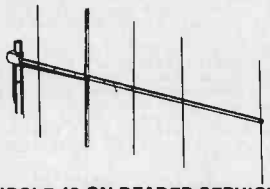


CIRCLE 1 ON READER SERVICE COUPON

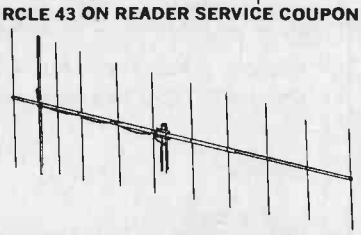
inputs are front panel-mounted for simple, convenient operation. It sells for $259.95 FOB Benton Harbor, MI. For more information on the new, low-cost IO-4205 Dual Trace Oscilloscope kit, send for the latest Heath-kit catalog. Write Heath Company, Department 570-130, Benton Harbor MI 49022.

2-Meter Yagi Antennas

Two models of the new Star Tracker series of Hustler 2-meter yagi antennas are 5 and 11-element rotatable beam antennas. They are completely tuneable, from 144-148 MHz with an unique adjustable matching system for 1.5:1 or better SWR. At resonance, SWR is typically 1.1:1. This system provides for optimum energy transfer without sacrificing gain or pattern control Each model can be easily mounted for vertical or horizontal polarization for station-to-station VHF DX work. The Star Tracker



CIRCLE 43 ON READER SERVICE COUPON



Model ST-5 is a compact, 54-inch, 2-meter beam with 5 optimumly-spaced elements. Forward gain is greater than 10 dB and the front-to-back ratio is greater than 22 dB over the antenna's 4 MHz bandwidth. Half-power beamwidth is normally 50°. The Model ST-11 Star Tracker is a 144-inch center-mounted 11-element beam. Optimum element spacing provides a forward gain of greater than 13 dB. Front-to-back ratio is greater than 27 dB over the 4 MHz bandwidth. Half-power beamwidth is normally 36°. Hustler furnishes all stainless steel hardware and the corrosion-resistant steel clamps. There are no mounting holes in the elements or boom, thus providing extra strength. The suggested list price of the Model ST-5 is $39.95. The Model ST-11 is $59.95. For further information on these or any Hustler products, write to New-Tronics Corporation, 15800 Commerce Park Drive, Brookpark, OH 44142.

Hand-Held CB

A 40-channel, hand-held CB transceiver, the Dyna-Com 40, made by Lafayette Radio, is a full-powered unit, priced at $149.99. The Lafayette Dyna-Com 40 incorporates full five-watt input at the final amplifier with an LED (light emitting diode) channel indicator, and digital Phase Lock Loop (PLL) circuitry. Other features are a full-time "range boost" circuit that concentrates more audio power into the sidebands for greater transmission range, squelch control, automatic gain control, automatic noise

CIRCLE 45 ON READER SERVICE COUPON

limiter, S/RF power meter, battery condition indicator, and an external microphone input jack. Lafayette Radio Electronics Corp. sells nationwide through 140 company-owned stores, an extensive direct-mail operation and nearly 300 associate stores and authorized dealers.

What You See is What You Get

Sparkomatic's new car stereo graphic equalizer/booster amplifier enables the traveller to "see" the amplifier response shaped by the various tone controls on the unit. The AcoustaTrac GE-500 pro-

CIRCLE 50 ON READER SERVICE COUPON

duces a visual response curve on an illuminated screen which graphically shows how the amplifier performs, in order to create the most acceptable sound for individual listening tastes. As the controls of the GE-500 are moved to

adjust for tone, an illuminated flexible rod changes its shape in conformance with the control movement. The GE-500 contains integrated circuitry for maximum reliability, wide frequency response, and 40 (20 + 20) watts of undistorted RMS stereo power. Other features include slide controls that infinitely adjust five different frequency bands, a front-to-rear fader control, a power indicator light, and an audio by-pass switch. The unit can be used with all tape decks and radios and with all speakers that have a power handling capability of 15 watts or greater. Suggested retail price is $89.95. Get all the facts direct from the Sparkomatic Corp., Milford, PA 18337.

On-the-Road Convenience

Courier has added a new mobile AM/SSB transceiver to their line. The Courier Galaxy is a straight-forward under-dash unit with features designed with the operator in mind. It has controls for noise blanker, SWR calibration, clarifier, mic and RF gain and PA capability. The Galaxy also has a large LED channel indicator and a three-in-one SWR, calibration, and S/RF meter. One popular feature is a channel 9 priority switch that

CIRCLE 78 ON READER SERVICE COUPON

allows selection of channel 9 without tuning the dial. Its suggested retail price is $279.95. For more information write to Fanon/Courier Corporation, 990 South Fair Oaks Avenue, Pasadena, CA 91105.

TRS AM/SSB BASE

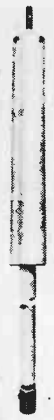
This handsome looking AM/SSB base station transceiver from TRS is a full-function CB with a complete set of controls. The TRS Challenger Model 1400 has separate S and SWR meters, digital channel indicator, and a built-in digital clock/timer. The 1400 also features RF gain control, switchable noise blanker, adjustable squelch, ANL, Delta tuning and tone control. According to TRS the Model 1400 puts out 4 watts RMS

CIRCLE 79 ON READER SERVICE COUPON

on AM and 12 watts PEP on SSB. The modulation is limited to 100 percent and spurious and harmonic suppression is —60 dB. The manufacturer claims an AM sensitivity of 0.7 uV and an SSB sensitivity of 0.3 uV. It operates on 117 VAC. Retails for $599.95. For more information write to TRS Marketing Inc., 137 East Savarona Way, Carson, CA 90746.

CB/VHF Marine Antenna

Antenna Specialists' new ASM-107 dual band VHF/CB marine antenna is now in limited production. The ASM-107 is a



CIRCLE 80 ON READER SERVICE COUPON

17-foot fiber-glass whip capable of simultaneous high performance on both VHF (156-163 MHz) and CB (all 40 channels). What makes it possible is an electronic isolation coupler which separates the signals and feeds the two transceivers. The advantages of the ASM-107 are extra safety and the convenience of two separate two-way radio systems aboard without the work, hassle, and cost of drilling extra holes, mounting extra hardware, running an extra coax cable, and buying two antennas. Sells for $149.95. For more details on the ASM-107 and the complete A/S marine products line, contact The Antenna Specialists Co., 12435 Euclid Avenue, Cleveland, OH 44106.

Organized Sound

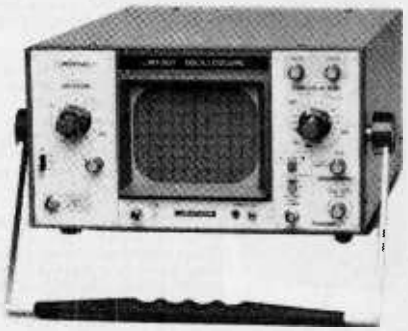
Shakespeare Marine Electronics has a deck hailer, called the Shakespeare Sound Center, that is designed to co-

CIRCLE 81 ON READER SERVICE COUPON

ordinate all on-board communications functions, including high power audio talking and listening from stem to stern, intercom, manual or automatic fog horn sounding and, with optional component connections, an alarm system for bilge leaks, engine fires, or unauthorized entry. It is constructed of corrosion protected aluminum and transistorized electronic parts, with a molded high-impact front panel and vinyl-clad aluminum casing. The Sound Center permits the boat's crew to project and amplify voices to hail people on-board or on passing vessels, docks or bridges. In the listen mode, it can amplify conversations, buoys or noises from nearby craft. Sells for $199.50. Get all the details direct from Shakespeare Marine Electronics, 229 N.W. 14th St., Miami, Florida 33125.

20 MHz Triggered Scope

The Leader LBO-507, a 20 MHz triggered scope is designed for broad use in industry, hobby, laboratory and service. The LBO-507 offers automatic triggered circuitry to assure maximum display stability with minimal adjustments as well as a trigger sensitivity over the entire operational range. It



CIRCLE 72 ON READER SERVICE COUPON

provides convenience of pushbutton switch selection for every functional demand; 10 mV/cm vertical sensitivity calibrated in 11 steps—in a 1-2-5 sequence up to 50 V/cm with variance control; and a 17.5 nanosecond rise time. Bandwidth is DC to 20 MHz. Sweep speed for the LBO-507 is 0.5 uSec/cm, 18 steps in a 1-2-5 sequence up to 500 mS/cm with variable control. The LBO-complete with low capacitance probe and terminal adapter. Get the complete specs 507 is priced at less than $500 and is direct from Leader by writing to Leader Instruments Corp., 151 Dupont St., Plainview, NY 11803.

3½ Digit DVOM

The new 3½ digit Model 3300 digital VOM just introduced by the Triplett Corp. features an extra-visible .3-in. high digital LED readout display with Polarity Indica-

CIRCLE 71 ON READER SERVICE COUPON

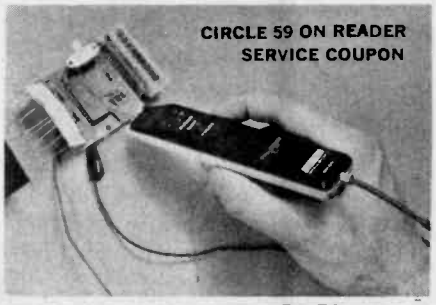
tion, .5% accuracy and low-power ohms readings. The five function, 22 range Model 3300 offers complete portability with precision measurement capability.

HEY, LOOK ME OVER

The new DVOM sells for only $175.00, complete with long life Ni-Cad batteries and AC Adaptor Charger plus test probes with safety boots. The Triplett Model 3300 is a safety-conscious design with no exposed metal parts and it includes a high energy 2A/600 V fuse for ample overload protection. A fused probe provides for both high energy and normal use circuit protection. Over-range is indicated by a blinking display and a low battery warning is included. DC polarity is automatic with indication directly on the readout display. Full details on the new Model 3300 DVOM and its complete line of accessories may be obtained at leading electronic distributors, or write to Triplett Corporation, Bluffton, OH 45817 or call (419) 358-5015.

50 MHz Logic Probe

Dynascan's new B&K-Precision logic probe is capable of measurements from DC to 50 MHz. The new probe, Model DP-50, is a multi-family device that is compatible with TTL, DTL, RTL, HTL, CMOS, MOS, and high-noise immunity logic (HiNIL). Three bright LED indicators display pulse presence and high



and low logic states. The DP-50 will continue to indicate pulse presence through its maximum frequency of 50 MHz. For high-speed or intermittent pulses, the DP-50 offers a memory mode to "freeze" and store the pulse display. In the pulse mode, short duration pulses are "stretched" for a clear visual indication. Input impedance is 2 megohms in all modes. The DP-50 is overload protected and will withstand ±50 VDC at the input. Reverse polarity protection for the power leads is also 50 volts. Sells for $50.00. For additional information, contact B&K-Precision, 6460 W. Cortland St., Chicago, IL 60635.

Two Meters in a Fist

The YAESU amateur radio hand-held transceiver, Model FT-202R, provides 1-watt performance in a lightweight, completely portable package on 2-meter FM. With the flexibility of six crystal-controlled channels (three installed), the unit may be powered with eight nicad size AA cells, or seven alkaline dry batteries, to provide 1 watt output. Options include external speaker / microphone, battery charger, and leather carrying case. The FT-202R comes with the "Rubber Ducky" antenna, dummy battery, vinyl carrying case and shoulder strap, and sells for $199.00. Bat-

(Continued on page 87)

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 CIRCLE 1 ON READER SERVICE COUPON

DX central reporting

A world of SWL info!

BY DON JENSEN

RADIO MOSCOW IS TRYING to cover all the bases in its attempt to increase its English-speaking audiences, especially those right here in North America.

Faithful and diligent SWLs have, no doubt, already noted that it is now possible to hear English programs from Radio Moscow around the clock, thanks to the new World Service, instituted last fall to fill around the former evening services to North America.

The expanded World Service, in direct competition with the British Broadcasting Corp. and the Voice of America, has a heavy emphasis on news and current events.

It is said the expansion was made possible by the addition of two dozen half-million-watt shortwave transmitters. However, reliable sources indicate that these high powered monsters really have been on line for a number of years. Supposedly the first of the French-built Thomson-CSF transmitters was heard as far back as mid-1974.

One Million Watts? And I wouldn't be too surprised to find the Russians are hooking up pairs of these high wattage units in tandem to sock out a million watts per!

Closer to home, though, it will be possible to hear Radio Moscow English programs on your favorite hometown AM radio station!

American stations are being offered the opportunity to broadcast, via tape recordings, honest-to-goodness Radio Moscow English programs.

Gheli A. Shakhov, editor-in-chief of Radio Moscow, in a letter to U.S. radio stations, offered to provide free tapes of some of the better known—to SWLs at least—programs and featurettes of good ol' R.M.

These include the familiar "Moscow Mailbag" program, the 15-minute show featuring the pudgy and personable Joe Adamov and his answers to listeners' letters. Another program offered is Vladimir Pozner's views on domestic and foreign policy, "Moscow Meridian." Other shows known to DXers featuring USSR folkmusic and focuses on Russian science and the arts are also in the free package.

Though the offering is said to be without cost to the stations, Shakov made it clear that after airing the tapes, the stations are expected to return them to Radio Moscow.

Detente Tuning. In concluding, Editor Shakov expressed his wishes for "fruitful cooperation between your radio station and Radio Moscow."

According to United Press International, at least one AM station in Illinois, WSDR in Sterling accepted the program offer.

If other stations across the U.S. follow suit, R.M. Will have managed to expand its program audiences to far more than SWLs.

AWR Expanding. Many shortwave listeners are familiar with the programs of Adventist World Radio, the voice of the Seventh-day Adventist church. Since 1950, AWR programs have been aired, during purchased time, by the transmitting facilities of the Sri Lanka Broadcasting Corp., Sri Lanka, of course, is the former Ceylon, the large island off the southern tip of India.

And since 1971, AWR programs have been broadcast, under a similar arrangement by the German-owned shortwave facility called Radio Trans Europe at Sines, Portugal.

Now, however, Adventist World Radio is expanding its operations with its own facilities in Guatemala. The project began last August and shortwave, medium wave and FM transmitters were expected to be operational this year. The AM-FM outlets may already be on the air, with the shortwave transmitter in Guatemala, planned for "international outreach," to be on the air by mid-year.

An even more ambitious AWR project was approved at the Seventh-day Adventist annual council in Washington, D.C., last October. That program, to begin also in 1979, though probably not to be completed this year, calls for four shortwave transmitters to be located at a site in Liberia, West Africa.

The AWR international transmitters will be one of 250 kilowatts, two of 100 kilowatts and a single 50,000 watt SW unit. A medium wave station will serve local Liberian audiences.

DX Programs. Ambrosio Wang An-Po, DX editor of Radio Exterior de Espana in Madrid, Spain, whom a number of North American DXers had the opportunity to meet at the Association of North American Radio Clubs (ANARC) convention sponsored by Radio Canada International in Montreal last summer, recently announced an expanded DX program.

Radio Exterior de Espana's DX programs from Madrid will include, he notes, announcements about the most important news of other stations with DX programs, such as changes in times and frequencies, new services, contests and meetings or anniversaries.

The station's DX program in English is, at this writing, aired every Sunday, 2115 to 2130 GMT, and is repeated an hour later, on 6,100, 7,275, 9,505 and

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CIRCLE 30 ON READER SERVICE COUPON

DX CENTRAL

11,840 kHz.

June in Minneapolis. The mention of the bang-up 1978 convention of the Association of North American Radio Clubs in Montreal last summer reminded me to remind you readers that the '79 gathering of listeners from across the continent is scheduled for the weekend of June 22-24 in Minneapolis, Minn.

This convention will be hosted by the Minnesota DX Club in cooperation with the Department of Speech-Communication of the U. of Minnesota.

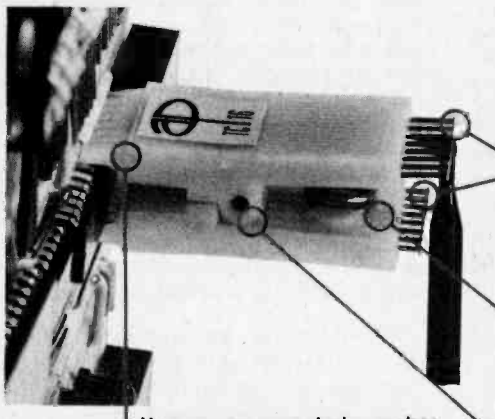
Kim Andrew Elliott, convention chairman, has indicated among the special events planned is a special ANARC television program, Saturday, June 23, at the Minneapolis campus of the U. of Minnesota.

For details, drop a note to ANARC Executive Secretary Dave Browne, care of Association of North American Radio Clubs, 557 North Madison Avenue, Pasadena, CA 91101. Be sure to include a stamped, self-addressed envelope so Dave can send you the data on how to register for the ANARC '79 Convention.

Down the Dial. (Times in GMT, frequencies in kHz) . . . *610*—National Broadcasting Service, the voice of Trinidad and Tobago, in the West Indies, upped its transmitter power from 10 kilowatts to 50 kilowatts. Some east coast broadcast band listeners have reported improved reception, as a result, prior to sign off at 0400 . . . *4,720*—The Spanish-speaking station you may log here late at night has been fooling some SWLs for a long time. The reason is that it doesn't belong here at all. It is a harmonic (the 8th multiple, to be exact) of the medium wave outlet of La Voz de Cuba which operates on 590 kHz . . . *5,055*—Costa Rica in Central America is one Latin country that many SWLs are hunting for. Try the outlet of Faro del Caribe, which translates as the Lighthouse of the Caribbean, TIFC, a religious station. You will find it in English prior to its 0400 sign off . . . *9,620*—Radio Yugoslavia is not the most commonly heard of the many European shortwave stations. But you can hear it broadcasting in English at 2200 . . . *11,642*—Looking for Radio Pakistan? Try this frequency at 1815 for English programming . . . *17,800*—The Voice of Chile has been reported here at 0115 with political commentaries in English. (Credits: Bob Foxworth, NY; Ernest Behr, ONT.; Wade Smith, MA; Richard McVicar, ONT.; Dean White, IL; National Radio Club, Membership Center, P.O. Box 118, Poquonock, CT 06064; North American SW Association, P.O. Box 13, Liberty, IN 47353) ■

NEW.

Meet Super Grip II, the great new test clip from A P Products.



New narrow-nose design makes it easy to attach on high-density boards. And now you can test ICs with only .040" between opposing legs.

New "duck bill" contacts are flat, won't roll off IC leads.

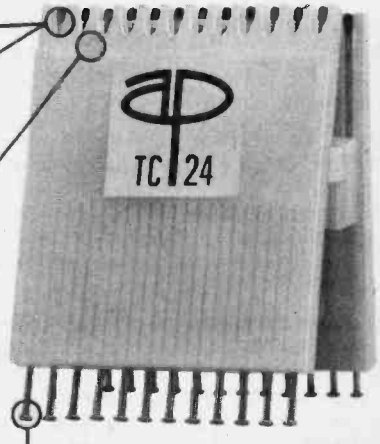
Open-nose construction enables probe at IC leg.

Pin rows are offset for easy attachment of probes.

Contacts are gold-plated phosphor bronze. "Contact comb" construction separates contacts with precision. No shorts.

Heavy-duty, industrial-grade springs for firm contact pressure—and a good grip when pulling ICs. They'll keep their spring indefinitely. No intermittents.

Steel pivot pin. Engineering-grade thermoplastic body molded around contact pins. Made to last!



New button-head pins keep probes from sliding off. (Straight pin models for logical connections.)

The new A P Super Grip II is, without question, the best way there is to trouble-shoot DIP ICs.

You get positive contacts. No intermittents. No shorts. Ever.

So it's endlessly useful to you—and it's built to stay useful indefinitely.

Try one. You'll find 8, 14, 16, 16 LSI, 18, 20, 22, 24, 28, 36 and 40-pin models at your nearby A P store. (Make sure it's your A P store.)

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Faster and Easier is what we're all about.

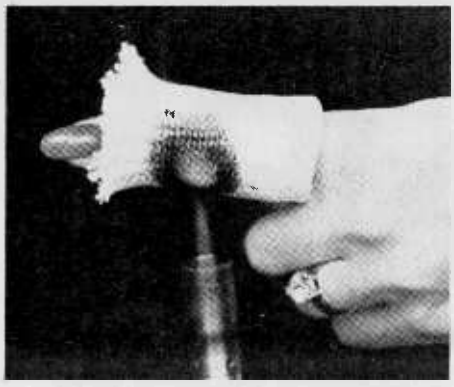
CIRCLE 26 ON READER SERVICE COUPON

newscan

Electronics in the News!

Ceramic Braid

In steel and glass plant furnaces and aboard America's new space shuttle, the Enterprise, a new material is solving many heretofore hard-to-handle heat problems—protecting vital cables, wires, meshes, tubes and hoses in high temperature environments. And a World War II uniform company is fabricating the product.



In addition to protecting materials against temperatures up to 2,600 degrees F for extended periods of time, SF2600, braided ceramic sleeving offers short term protection up to 3,000 degrees F. The sleeving retains its strength at elevated temperatures.

This "space age" insulating material, 3M Ceramic Fibers, is being fabricated in the form of protective sleeving by Santa Fe Textiles, Inc., Santa Ana, California. Specific applications for this new insulation, which Santa Fe calls SF2600, include protecting cables from open flames and shielding thermocouple wires as they measure the heat in ovens. In addition, the sleeves protect hoses from molten metals in steel plants, guard fire control systems, insulate furnace components to cut down on heat loss and serve as the sleeving over wire mesh for gaskets on the Enterprise.

In the home, braided ceramic sleeving can be used as a gasket around the doors of self-cleaning ovens. This material also is being used to insulate heaters, hair dryers, coffee makers and other home appliances.

Adding Memory With a Laser

A new approach to storing data in computers, using a tunable dye laser, is described in a U.S. Patent awarded to scientists at IBM's San Jose Research Laboratory. Based on a photochemical process called "hole burning," the technique greatly increases the amount of information that can be packed into a given space.

In the system described by the patent, each unit (called a "bit") of computer data is identified by its location in the frequency spectrum as well as by its location in two- or three-dimensional space. Potentially, many hundreds or even thousands of the "frequency coded" bits could be stored at a single, microscopically small region in space. The size of these regions could be as small as the "diffraction limit" of a laser beam, a dimension in the order of one micrometer (1/25,000 of an inch).

The invention depends on the use of a laser that can be tuned—like adjusting the station selector on a radio—so that it emits light of various colors.

IBM research scientists have invented a new approach to storing computer data that uses a variable-color laser beam to induce chemical changes in selected molecules of a storage material. By changing the frequency of the laser light, it becomes possible to select many hundreds or thousands of different molecular groups from the same sample of storage material. Each molecular group can be associated with a unit of computer data. This technique, called "photochemical hole-burning," offers the potential for storing data at much higher densities than can be achieved with other storage technologies known today. In the photograph, inventors (from left) Dietrich Haarer, George Castro and Roger Macfarlane are shown adjusting an apparatus that projects the light from a laser onto a sample of a photoreactive material.

Work on the new storage technique is still at a very early stage of research. "We have a long way to go before this can be made into a technology," says Dr. George Castro, manager of the IBM San Jose laboratory's physical science department. "So far we are investigating a variety of potential storage materials and trying to understand the temperature limitations of the phenomena. We still have to address the many unsolved problems that have prevented other optical methods of storage from becoming technologies. In fact, optical methods of storing information were expected to lose an important advantage, namely that of high storage density, as the storage densities in the existing magnetic recording technologies approach optical limits in the next decade. Hole burning breathes new life into optical storage by theoretically extending that density a few orders of magnitude." ■

Quartz-Lock
by Realistic.
±0.0005% Speed Accuracy.

Don't buy any turntable before you see the new direct-drive Realistic® LAB-500. It's already switched many an audiophile to Radio Shack's 22-year-old Realistic brand. The specs tell you why.

Speed accuracy of ±0.0005% just 1.5 seconds after start-up, wow and flutter of 0.025%, rumble of only −70 dB (DIN B). This kind of performance is superior to some broadcast and disco equipment, and is made possible by a massive 12-5/8". 3.1-lb. platter resting directly atop a 12-pole brushless DC servomotor controlled by a quartz oscillator and PLL circuitry. But there's still more to recommend the LAB-500. Like all Realistic turntables, the price includes dust cover and cartridge. And the cartridge is our best, made by Shure, factory mounted in an integrated headshell for minimum mass and precision tracking even at 3/4 gram. Audio response is a linear 20-20,000 Hz. The automatic arm-return is tripped optoelectronically — assuring no change in record speed even at the end of the disc. Out-front controls, including electronically actuated cueing, make operation easy. There are single-play/repeat and anti-skate controls, too.

All this, including the $49.95 value cartridge and hinged cover and low-profile walnut vinyl base, for 259.95*
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For Project Builders. *A Beginner's Guide to Making Electronic Gadgets* by R. H. Warring is a new project-by-project self-training course in modern electronic circuits and devices. It has a thorough introduction to the fundamentals, lots of easy-reading build-it instructions, and plenty of detailed circuit diagrams! The book explores every modern circuit type and device, and then shows how to use the information learned to create more complicated and sophisticated circuits. Step-by-step instructions, backed up by circuit diagrams containing parts values, show how to build a wide range of devices using all the latest semiconductors and miniature components like transistors, resistors, FETs, capacitors, etc. You can build circuits like audio oscillators, transistor radio boosters, DC amplifiers, stroboscopes, tuned amplifiers, band stop filters, RF and IF amplifiers, Hartley oscillators, telephone amplifiers, light-operated oscillators and output stages. Published by Tab Books, Blue Ridge Summit, PA 17214.

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Audio Builder's Guide. Now, with the over 100 projects contained in *The ABC Book of Hi-Fi/Audio Projects* by George Leon, anyone can boost the capability and performance of any hi-fi/audio system—or build a complete system from scratch if preferred. Each project is accompanied by a complete schematic wiring diagram and a detailed parts list. Many have PC board layouts ready for photo pickup. In this learn-as-you-build volume, the reader will find out how to design his own circuits, how to create new audio power supplies, how to build amplifiers, how to use timer circuits, how to make mockups of chassis layouts and control panel designs, how to construct enclosures, how to make mixer circuits, how to make printed circuit boards, how to build preamplifiers, how to modify and fu-

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turize his system in hundreds of ways. And one doesn't have to be an electronics whiz kid either—even a beginner can follow these simplified instructions and explanations—and then customize to his heart's content! Published by Tab Books, Blue Ridge Summit, PA 17214.

Optofun. Optoelectronics—the world of light, lasers, lenses and sicence-fiction devices—a world that's completely unfolded in a practical new book, project by project, in as plain a prose as one can find anywhere! The book is *Build-It Book of Optoelectronic Projects* by C. K. Adams. Step-by-step instructions and clear explanations tell how to build everything from a digital tachometer to a two-level logic probe to a garage nightlight. The reader learns by building optoelectronics packages loaded with goodies like LEDs, LCDs, displays, photodetectors, optoisolators, and photodiodes. Every project comes with complete parts lists, and pin data (every IC is listed by type number and detailed in separate package diagrams calling out every pin function), detailed circuit descriptions, fast-reading reviews of pertinent concepts, circuit options, and can be used in project after project. Published by Tab Books, Blue Ridge Sumit, PA 17214.

Optoelectronics in an illuminating package

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Getting the Data Out. *NCR Data Communications Concepts*, an introduction to the principles, characteristics, and testing of data transmission circuits, has been added to the Bugbook Reference Series. Edited by Titus, Titus, Larsen, and Rony, the text contains practical and useful information for electronic data processing technicians, communications engineering students, and computer hobbyists. The book concentrates on the properties and limitations of real transmission performance. The book discusses filters, equalizers, and other corrective devices from the user's point of view, and explains the use and testing of modems and other terminal equipment. ASCII codes and detailed guides to interpretation of communications circuit specifications are presented. Review questions stressing key concepts are included. Published by E&L Instruments, Inc., 61 First St., Derby, CT 06418. ■

Data transmission for the Computer Hobbyist.

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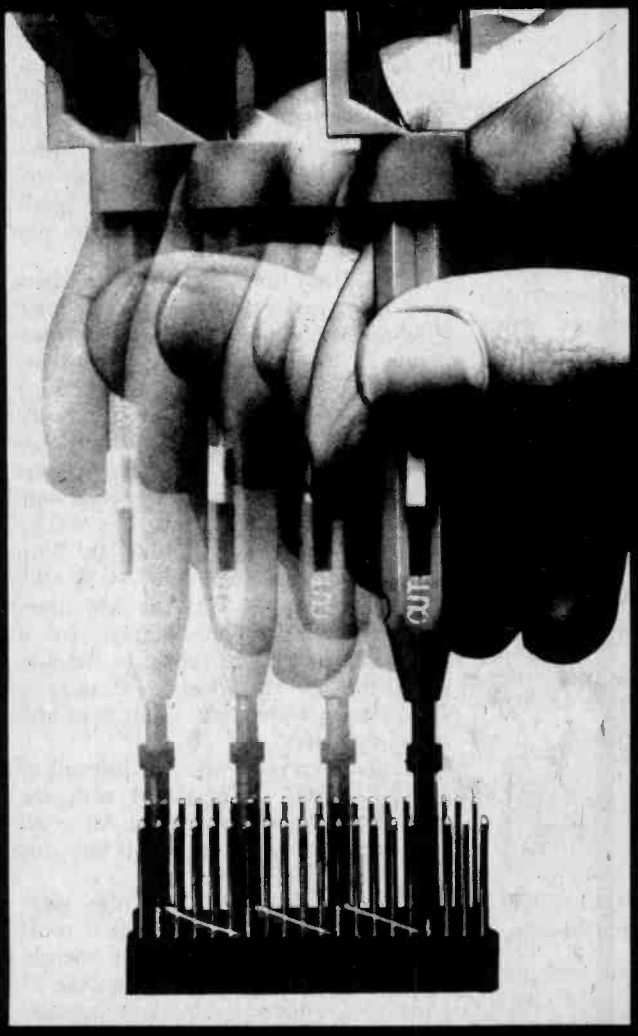
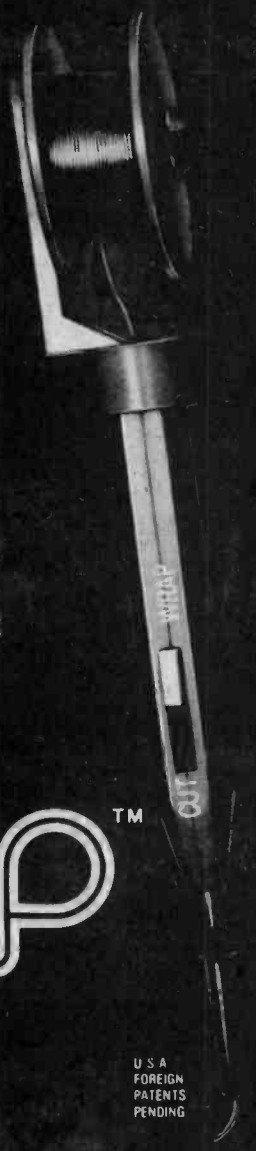
CIRCLE 60 ON READER SERVICE COUPON

NEW!





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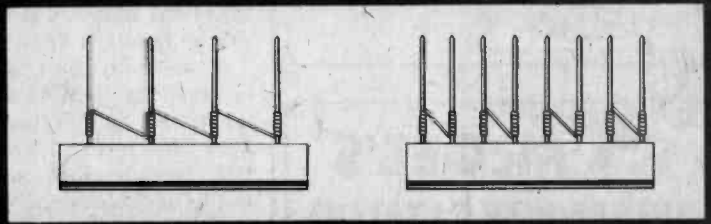

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CIRCLE 29 ON READER SERVICE COUPON

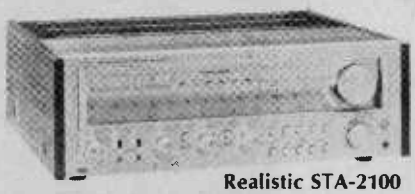
HI-FI REPORTS

A pair of performers that can keep in step with the demands of disco.

By Gordon Sell

☐ WITH THE BOOMING POPULARITY of disco dancing, disco music and disco parties many people are converting basements and spare rooms into discos, complete with flashing lights and high-power audio systems. The nationwide popularity of disco was recently brought home to me in a letter from a reader in Eugene, Oregon. He and a friend had rented a large old house together and wanted to use the giant living room for disco parties. They were trying to find a system that was high powered, yet rugged and easy to use in the often confused environment of a party.

In such a situation you need the power to drive four speakers at high



Realistic STA-2100

CIRCLE 32 ON READER SERVICE COUPON

levels—at least an 80-plus watt-per-channel (that's only 40 watts per channel with four speakers) receiver or power amp in order to avoid clipping at disco sound levels. Another consideration is more mechanical. Turntables are very sensitive to vibration, so try to put your system on something solid. A shakey or hollow cabinet can pick up vibrations that will give a turntable fits. Try to isolate it from the floor.

It was with these types of situations in mind that I chose the two units for lab testing in this issue. The Realistic STA-2100 is a real, earth shaking AM/FM receiver that pumps out 120+ watts, and Kenwood's KD-5070 automatic record player is specifically designed to minimize the effects of external shock and vibration.

Realistic STA-2100. This receiver is conservatively FTC-rated at 120 watts per channel RMS into 8 ohms but when we cranked it up to take-off power (clipping level) on the test bench it went to 135 watts without batting an LED. At this power the frequency response is flat (+0/−1 dB) from 20 to 20,000 Hz, with distortion (THD) no higher than 0.12 percent; just right for a disco.

The STA-2100 has plenty of nice features for the audiophile: dual phonograph inputs, one of which is adjustable for sensitivity; inputs for two tape systems and outputs for four speakers. There are level adjust controls for bass, midband and treble. The bass level is switch selectable for turnover frequencies of 150 Hz or 300 Hz, and the treble turnover frequencies can be selected at 3,000 or 6,000 Hz. It's almost like having a built-in five-band equalizer. The FM de-emphasis is adjustable for Dolby and non-Dolby signal sources.

The FM tuner features excellent selectivity and relatively broad 'center' tuning. The signal-to-noise ratio measures 73 dB. The high fidelity sensitivity on mono is 9 μV (60 dB quieting) while the stereo sensitivity is 80 μV (55 dB quieting). Full limiting is attained with 3.4 μV. At standard test level the stereo frequency response with 75 μSec de-emphasis measures +0.2/−1.2 dB from 20 to 15,000 Hz. With 25 μSec de-emphasis it is +0.3/−0.5 from 20 to 20,000 Hz. The AM tuner performance is about average for a receiver in this price range. In the amplifier section the stereo separation is 55 dB and the magnetic input hum and noise measures −63 dB.

Almost everyone who has listened to the STA-2100 is impressed with the clean sound in the midrange. All in all this receiver is an excellent buy for any hi-fi buff at $599.95.

Kenwood KD-5070. With this turntable the old adage 'steady as a rock' is more than just a figure of speech. The base is made from a composite of chunks of limestone, limestone powder, glass powder and polyester resin. This is compression-molded into marble-like

Kenwood KD-5070

CIRCLE 51 ON READER SERVICE COUPON

material that attenuates vibrations in the turntable base. The shock and vibration resistance is considerably su-

(Continued on page 87)

can you be bribed?

You get a $35.21 bribe when you try only 10 DAK ML90 high energy cassettes for only $2.19 each!

Hats off to Maxell. Their UDXL cassette established a new standard of quality for all cassettes.

The new DAK ML90 starts another new technology. A technology of extreme reliability and protection from Hi frequency losses.

Later we are going to offer you a valuable bribe, if you will test these cassettes, risk free; so read on!

YOUR TIME IS PRECIOUS

Imagine yourself just finishing recording the second side of a 90 minute cassette and horrors, the cassette jams. Tape is wound around the capstan, your recorder may be damaged and you've just wasted 90 minutes of your time and perhaps lost a great recording off FM.

I'm sure this is one experience we all dread, and is one of the main reasons to buy name branded guaranteed tape you can trust.

Enter DAK. We manufacture over one million units of cassette tape each month, and many of our cassettes are used for high speed duplication, which causes more cassettes to fail than any other use.

When we first started, DAK's cassettes failed, just like many others. So we installed over $20,000 worth of high speed duplication equipment at our factory and set out to design the perfect cassette.

FAILURE

Failure after failure. We substituted, remade, tested and retested the over 20 parts of our cassette, and checked everyone elses cassettes. Finally after over 6 years we positively linked cassette failure or the prevention of failure to the slip sheets, or liners in the cassette.

We were not alone. Scotch, TDK, and several others must have been doing the same research because they have also been coming out with special improved slip sheets.

MOLYSULFIDE

A new chemical named molysulfide, that reduces friction within the cassette several times better than graphite gave us success.

We developed polyester slip sheets with raised spring loaded ridges coated with a unique formulation of molysulfide and graphite.

The tape ran more smoothly than ever before within the cassette. The new formulation is also much tougher than the graphite formulation, so it is extremely resistant to wear.

Static electricity within the cassette was drastically reduced by the low friction, and easily bled off, so its tendency to erase very high frequencies was drastically reduced. A very important consideration for often played tapes.

The molysulfide formulation gives both superior electrical and mechanical performance, thus it has formed the basis for the birth of the new DAK ML cassette.

MAXELL IS BETTER

Yes honestly, if you own a $1000 cassette deck like a Nakamici, the frequency response of Maxell UDXL is superior to DAK and you just might be able to hear the difference.

DAK ML has a frequency response that is flat from 40cps to 14,500cps ±3db. Virtually all cassette recorders priced under $600 are flat from 40cps to about 12,000cps, so we have over 2000cps to spare, and you'll probably never know the difference.

No apology We feel that we have equalled or exceeded the mechanical reliability of virtually all cassettes and offer one of the best frequency responses in the industry. Maxell UDXL is truly the Rolls Royce of the industry, and DAK is the 100% US made Cadillac or Corvette!

Price DAK manufactures the tape we sell, you avoid paying distributor and retailer mark ups. While Maxell UDXL 90s may sell for $3.50 to $4.50 each, DAK ML90s sell factory direct to you for only $2.19 each.

YOU WIN

You are paying less for the 10 90 minute cassettes than you would pay for the bribes we are offering if you went to a Radio Shack Store.

Yours Free

CHECK THE VALUE OF THE BRIBES AT RADIO SHACK

Think of it, 10 six foot hook up cords with RCA plugs at each end. Whether you use the cords now, or when you buy new equipment, those of us who are tape recorder nuts, never seem to have enough. Radio Shack sells six foot cords for $1.89 each.

You will find dozens of uses for this deluxe battery eliminator AC adaptor around your home or office. 4 voltages, 3, 4.5, 6 and 9 volts. 4 plugs will fit virtually any calculator, radio, or battery operated recorder we have seen. You'll save a lot of money on batteries. Radio Shack sells a similar 4 voltage adaptor for $9.95.

The deluxe 12oz can of spray head cleaner will clean your tape heads for years to come. The handy snorkel included, can reach just about any tape head, even 8trk heads. Radio Shack does not sell a large 12oz can, but 12oz from them costs $6.36.

The Radio Shack prices are not list prices, but the actual prices you would pay when you walk in the door.

Yours Free

WE WIN TOO

Customers like you are very valuable in the form of future business. We anticipate receiving over 6000 orders and 4500 repeat customers from this advertisement. We are betting you will buy our cassettes again, and we are putting our money where our mouth is!

TRY DAK ML90 FREE

We want you to try these high energy cassettes on your own recorder without obligation for 30 days. If you aren't 100% satisfied for any reason, simply return the tapes and bribes to DAK for a full refund.

To order your 10 DAK ML90 minute high energy cassettes and receive your $35.21 bribe with your credit card, simply call toll free 800, 423-2636, (in Calif. call 213-984-1559) or send your check for $21.90 plus $3 for postage and handling for each group of 10 cassettes and bribes to DAK. (Calif. residents add 6% sales tax).

DAK unconditionally guarantees all DAK cassettes for one year against any defects in material or workmanship.

Why not order an extra group of 10 DAK ML90 cassettes for yourself or a friend? We will add one free ML90 cassette to reach additional 10 you buy and of course you get all 3 bribes with each group of 10 tapes.

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CIRCLE 39 ON READER SERVICE COUPON

Test semiconductors without testing your patience.

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B&K-PRECISION semiconductor testers are proved as highly cost effective answers to the needs of testing discrete semiconductor devices. Recently, they were evaluated by America's best known manufacturer of expensive test instruments and the $310 Model 530 compared favorably with a $30,000 custom test system! B&K-PRECISION has a model for most every application.

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CIRCLE 22 ON READER SERVICE COUPON

the Third EAR

by Walter Sikonowiz

This electronic servant will jump at the snap of your fingers

FOR MANY CREATURES on this earth, two ears are the norm. The two-eared arrangement does more than allow listening to your mother-in-law and wife at the same time. Thanks to some special neural circuitry (which, among other things, performs phase and magnitude comparisons between left and right ear signals) a two-eared individual can quite accurately tell where a sound is coming from. You know how marvelously well the present system works, but think of the possibilities afforded by a third ear.

Wait a second now, no one is advocating surgery as a hobby (à la Frankenstein). The *Third Ear* in this instance is a versatile, electronic, sound-actuated control system. It can spy on your friends, mind the phone, babysit, thwart would-be burglars and much more. Later on, the *Third Ear's* applications will be explored in detail, but first let's examine its circuit.

The Circuit. The heart (better yet, the eardrum) of the *Third Ear* is a tiny module, the ETCO S-210U sound trigger. This little device originally formed the nervous system of an electronic turtle. The species is now extinct, unfortunately, but its innards are available as a great surplus bargain. As you can see from the schematic, the S-210U contains a crystal microphone, a transistor amplifier, and an SCR. The module's black lead goes to the minus side of a battery, while the red and green leads will be shorted together in this application. The shorted leads connect to one side of a low-resistance load (like a relay), and the opposite end of the load goes to battery positive. Sound picked up by the microphone is amplified by the transistor and fed to the SCR's gate. If the sound is sufficiently loud, the SCR latches in a conducting state, thus drawing a relatively large current through the connected load. Power must be removed in order to turn off the device again.

A more versatile system should operate in either of two modes, latch or pulse. After the first triggering impulse of sound, the latch-mode system remains active. A pulse-mode system, on the other hand, remains active only for some pre-determined time interval after triggering. It then returns to its inactive state, where it rests until re-triggering occurs. Then, the process repeats itself.

Construction. Adding pulse-mode capability to the S-210U is a simple matter. All it takes is some auxiliary circuitry to sense the latching of the SCR and to unlatch it again after a user-selected time delay. Unlatching an SCR can be accomplished by opening a switch in series with the anode or closing a switch to short the anode and cathode together. The latter method is the one used in the Third Ear, but before getting any further into that, there are a few easy modifications that must first be made to the S-210U.

The pictorial diagram shows the four necessary modifications in detail. First, remove the 5000-ohm trimmer by unsoldering it. This device is unusual in that it has two mounting pins, not three. Wire a 2500-ohm potentiometer in series with a 680-ohm resistor so that the net resistance is a minimum (680 ohms) when the pot is fully clockwise. The two wires from the pot/resistor combination should be soldered into the holes vacated by the 5000-ohm trimmer. This new pot will function as the Third Ear's sensitivity control (with maximum sensitivity in the clockwise position).

The second modification requires that the 0.1-uF disc capacitor in the upper left-hand corner of the S-210U be unsoldered. In the holes vacated by the capacitor, install and solder a jumper of bare, solid hookup wire.

The third step is to cut the red wire

in the lower lefthand corner completely off at the point where it joins the PC board.

Finally, unsolder the 32-uF electrolytic capacitor from the board, and replace it with a similar unit having a higher working voltage; 16 VDC or higher. In general, your replacement may have a value anywhere between 22 and 47-uF, with 33-uF being about optimum. Remember that since you are dealing with electrolytic devices, the orientation must be correct. In the pictorial you can see that capacitor positive (+) must be pointing upward.

Now, let's see how the modified S-210U mates with the rest of the circuitry in our *Third Ear*. As the schematic diagram shows, the green and black leads of the module are its only connections to the external circuitry. Capacitor C2 bypasses the module's supply leads in order to keep the sensitivity high, while R1 isolates C2 to reduce its effects on the performance of the rest of the circuit. Whenever the module's SCR latches into conduction (due to sonic triggering), current will be drawn through relay K1 and the LED1/R2 combination. As a result, the normally open relay contacts will close, and the LED will light simultaneously. These two conditions will persist as long as the SCR remains latched.

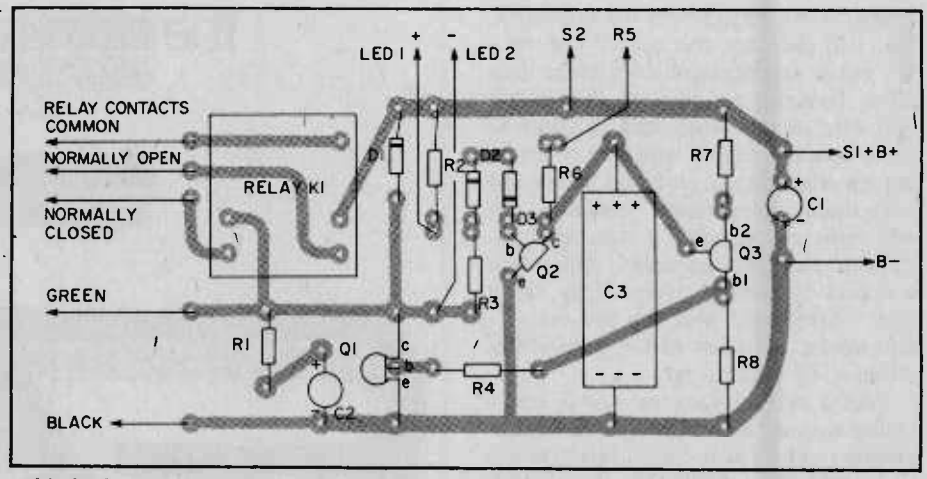
Note how switch S3 selects either the normally open (N.O.) or normally closed (N.C.) contacts of K1. This allows a load to be turned on or off, respectively, when the circuit is activated. Diode D1, connected across K1's coil, is normally reverse-biased (not conducting). When the SCR is forced to unlatch, however, K1's coil generates an inductive kickback voltage which could cause trouble if D1 were not there to clip it.

In order to see how unlatching is accomplished, let's assume that the SCR in the module is initially unlatched, and that mode switch S2 is closed in its "pulse" position. Since the SCR is not conducting, the voltage at the green lead of the module must be high (about 7 volts above ground). This potential drives sufficient current through R3, D2 and D3 into the base of transistor Q2 to ensure that Q2's collector is conducting current heavily. This prevents the voltage on C3 from rising, and nothing of interest happens.

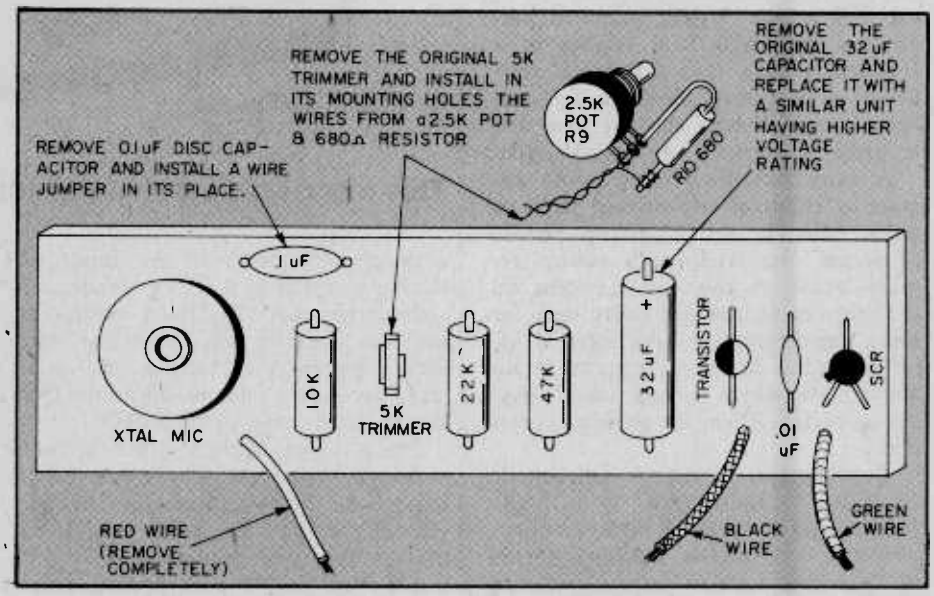
Suppose, however, that a sound triggers the module into conduction. The potential of the green lead drops to less than one volt, which is less than the 2-volt minimum needed to turn on the D2/D3/Q2 combination. Consequently, Q2's collector no longer conducts current, and the potential across capacitor C3 rises as charging occurs through R5 and R6. The rate of ascent is controlled by potentiometer R5; higher resistance causes the potential on C3 to climb more. Eventually, the voltage on C3 will reach a critical level, at which point unijunction transistor Q3's emitter-to-base 1 impedance will break down to a very low level. This rapidly discharges C3 and causes the appearance of a voltage spike across resistor R8.

This voltage spike drives current through R4 into the base of transistor Q1. As a result, Q1's collector conducts current heavily, thus shorting the module's green and black leads together. This deprives the SCR of anode current, causing it to unlatch. Because the voltage spike lasts only a brief instant, less than 0.1 second, Q1 soon loses base drive and ceases to conduct. When this happens, current can no longer activate K1 or LED1, and both will remain off until another sound triggers the module. As you can see, the circuit has returned to the state it was in at the beginning of this discussion.

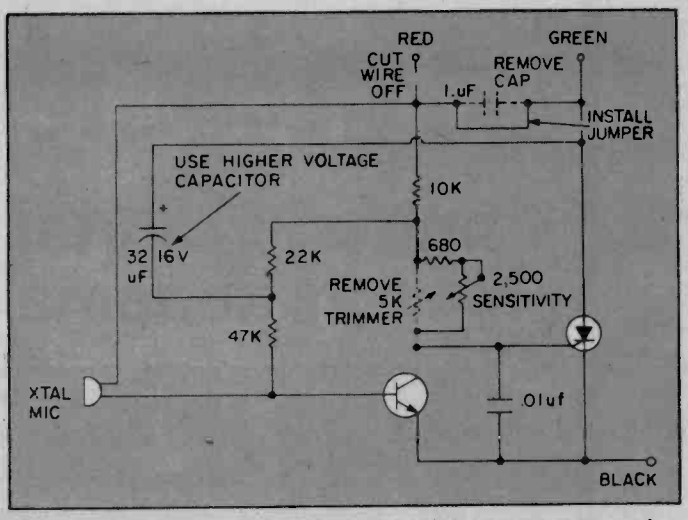
If mode switch S2 had been opened to its "latch" position, no current would have been able to flow through R5 and R6 to charge C3. Since the charging of C3 is an essential part of the unlatching process, it is clear that the module would have remained latched indefinitely. In fact, in the latch mode, the only way to reset the circuit to its inactive state is by opening power switch S1 for at least five seconds.



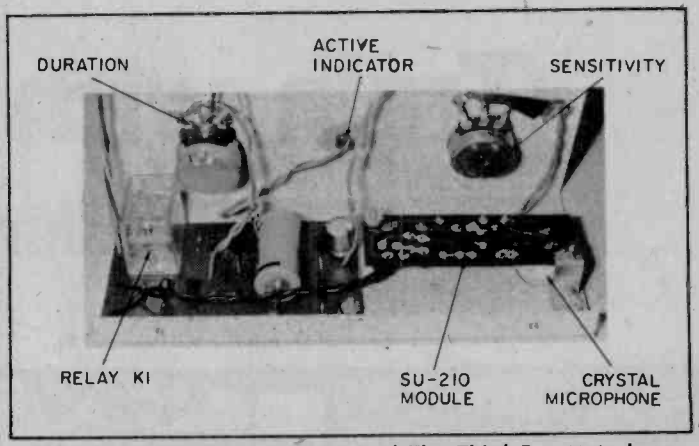
This is the component-side view of the main printed circuit board. The foil pattern is on the reverse side. If your K1 relay has mounting tabs you may have to make some holes.



This pictorial diagram shows all the modifications that are needed on the S-210U module. The 32 uF capacitor should be replaced by one with a 16-VDC or higher voltage capacity.



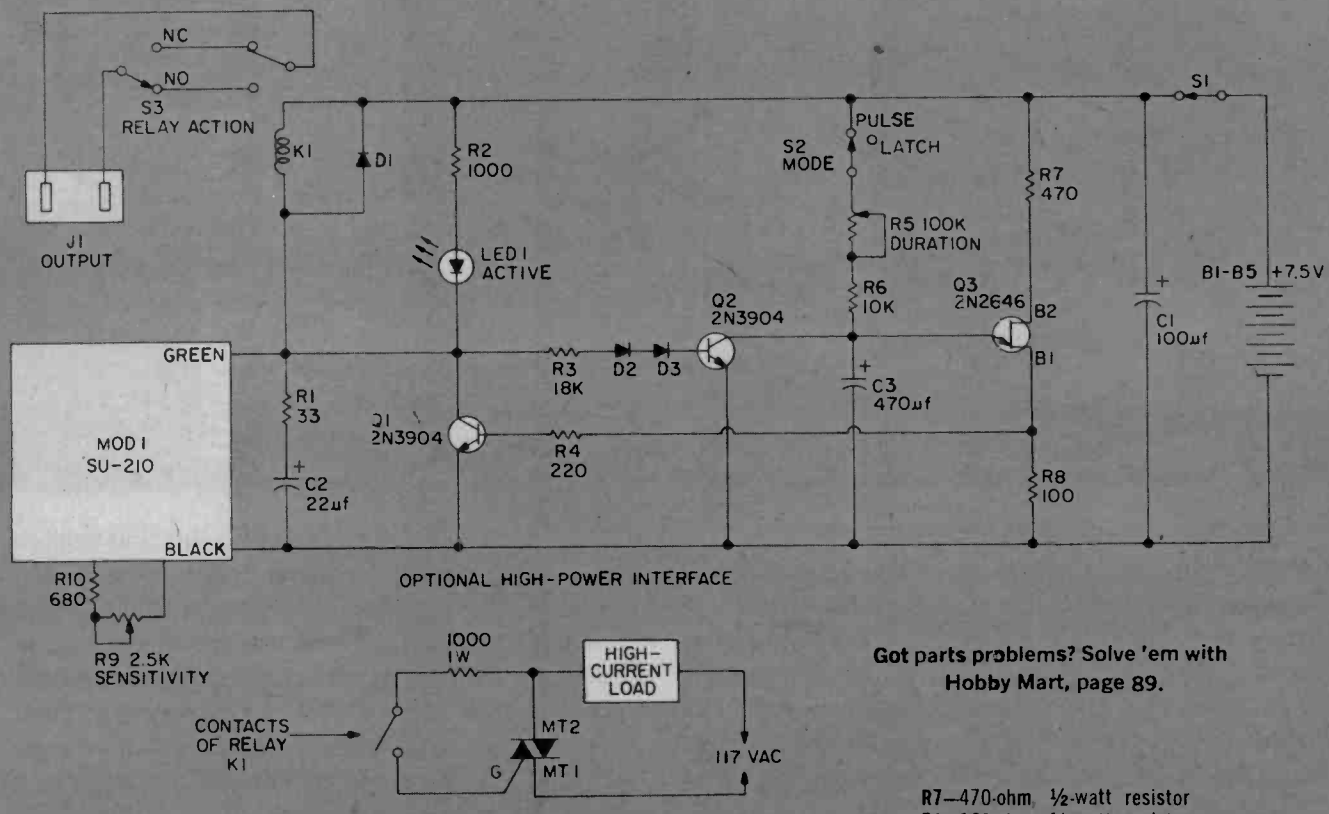
The above schematic shows the circuit of the S-210U. The module can be obtained from the company listed in the parts list.



This shows internal arrangement of The Third Ear. Note how the S-210U crystal microphone is mounted over the hole in the front panel of the case. Using a large, factory built case such as the one shown here makes assembly of a project like this a snap. The batteries mount in the other half of the cabinet.

This gives the various capacitors time to discharge completely, thus ensuring that the circuit will be inactive when S1 is again closed. Similarly, should you wish to manually unlatch the module in the pulse mode before the time delay elapses, the same procedure applies.

In the prototype's pulse mode, duration control R5 was able to produce time delays between 9 and 130 seconds. The actual control range obtained in your model is likely to be somewhat different because of variations in the characteristics of Q3 and C3. Fur-



PARTS LIST FOR THE THIRD EAR

C1—100-uF electrolytic capacitor, 16 VDC
C2—22-uF electrolytic capacitor, 16 VDC
C3—470-uF electrolytic capacitor, 16 VDC
D1, D2, D3—1N914 diode
J1—panel mount AC socket
K1—relay w/6 VDC coil; one set normally open contacts, and one set normally closed contacts
LED1—small red LED
MOD1—ETCO SU-210 sound trigger module
Q1, Q2—2N3904 NPN transistor
Q3—2N2646 unijunction transistor
R1—33-ohm, ½-watt resistor
R2—1,000-ohm, ½-watt resistor
R3—18,000-ohm, ½-watt resistor
R4—220-ohm, ½-watt resistor
R5—100,000-ohm linear-taper potentiometer
R6—10,000-ohm, ½-watt resistor
R7—470-ohm, ½-watt resistor
R8—100-ohm, ½-watt resistor
R9—2500-ohm, linear-taper potentiometer
R10—680-ohm, ½-watt resistor
S1—SPST slide switch
S2, S3—SPDT slide switches
Misc.—case, battery holders, batteries, knobs, hookup wire, etc.

Note: S210U is available from ETCO Electronics, Dept. K, Old Country Shopping Ctr., Plattsburgh, NY 12901

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thermore, any leakage within C3 will exert yet another influence on the time delay; the leakier the capacitor, the longer the charging time. With this in mind, it is wise to use a new, high-quality electrolytic capacitor for C3.

Power Supply. Power for the *Third Ear* comes from five "D" cells in series, yielding 7.5 volts. Electrolytic capacitor C1 keeps the power supply's impedance low. Inactive, the *Third Ear* draws only 2 milliamps, but current consumption jumps to 22 mA when the circuit is active. At these small rates of discharge, "D" cells will last a long time. Some readers might prefer to see the *Third Ear* powered by an AC supply; however, transformers hum at 60 Hz, and the Third Ear is sensitive enough to be triggered if a transformer is mounted inside its case. If you want to use an AC supply, a 6- to 9-volt DC unit will work well, but it *must not* be mounted inside the *Third Ear's* case.

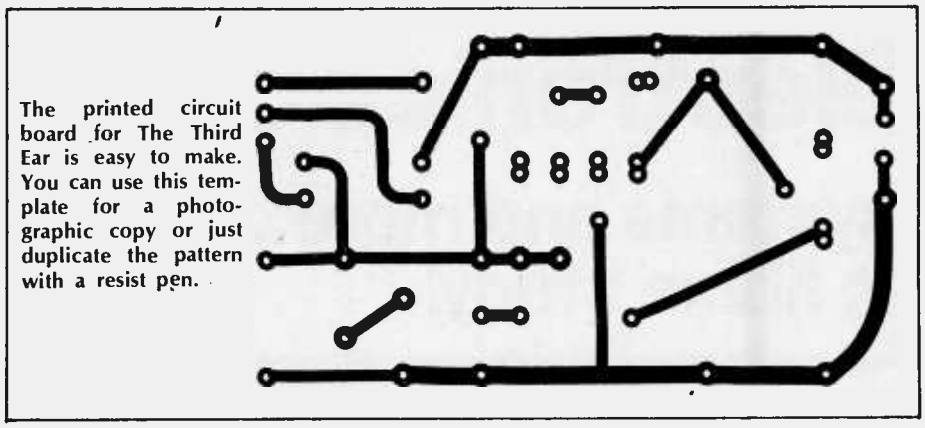
Construction. Construction is easy because you don't need to worry about the layout; anything will do. A PC board is not absolutely necessary, but if you like to give your projects that professional look, use the PC patterns provided.

You should test LED1's sensitivity before wiring it into the circuit. Bargain LEDs especially may not be sensitive enough to be used here. Hook your LED in series with a 1000-ohm resistor, and connect the combination to a 7.5 VDC source. (Get the polarities right.) If you do not obtain an easily visible red glow, try another LED. Red LEDs are more sensitive than green or yellow ones, so stick with red.

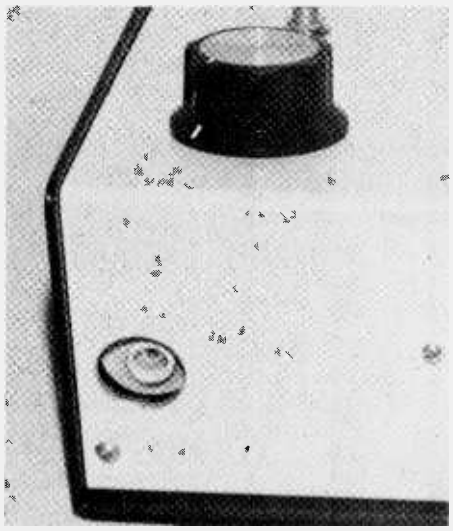
When wiring duration control R5, make sure you obtain maximum resistance in the fully clockwise position. This will then give you a maximum time delay.

When building your Third Ear, you would be better off with slide switches. When a toggle is snapped quickly, the click of the switch can activate your system, regardless of the sensitivity setting. Slide switches require very little operating force and are practically silent.

The contacts of relay K1 are rated for a load of up to one ampere, which is more than adequate for most applications. Sometimes, however, you may wish to control a high-power load, such as a flood lamp. One method of doing this would be to substitute a relay with a higher contact rating for K1, but high-current, good-quality relays are expensive. Besides that, all relays arc, especially with high-power loads, so a relay's lifetime under such conditions is limited. A cheaper, better solution is the high-power interface. Note that the triac controls the AC load, but the relay contacts control the triac. In this way, the relay contacts carry only the small gate current of the triac, and your *Third Ear* remains isolated from the AC line (and shock hazards) by the relay. Choose a triac with a current rating high enough for your load, and heat sink it. Mount the triac and heat sink in a well-ventilated *plastic* case to prevent accidental shocks.



The printed circuit board for The Third Ear is easy to make. You can use this template for a photographic copy or just duplicate the pattern with a resist pen.



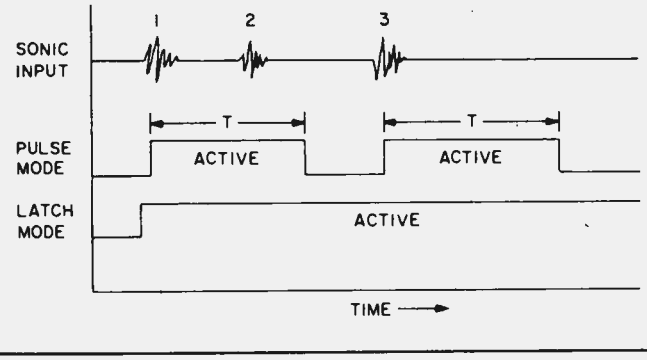
Make a three-quarter-inch diameter hole in the front panel of the cabinet or wherever you want to put the microphone. Adjust the sensitivity so that it triggers correctly.

Checking it Out. After construction is complete, you should check out the operation of your project. Set your *Third Ear* into the pulse mode, with R5 set for a minimum duration, and sensitivity control R9 placed at the midpoint of its range of rotation. Now, turn on power switch S1. LED1 should flash momentarily as power is applied. Snap your fingers directly in front of the microphone, and note the length of time that LED1 remains lit.

Next, rotate the duration control to maximum. Snap your fingers, and again make a note of how long LED1 stays illuminated.

Finally, turn the power switch off, and flip S2 to the latch mode. After five seconds, re-apply power. Snapping your fingers should now cause the LED to light and stay lit for as long as power is applied. You can do some experimenting with the sensitivity control, too. In the prototype, operation at maximum sensitivity was impossible because even the faintest ambient noise would trigger the circuit.

The applications for the Third Ear are only limited to the uses your imagination can find, and with its switching flexibility, it can control almost anything you may wish to operate around the home or office. ■



The Third Ear can be adjusted so that it triggers and holds, or so that it triggers and resets. This chart shows how the output level varies with incoming sound pulses.

WIRELESS MICROPHONES

Even if you're not a spy, come in from the cold on wireless mikes.

by Jorma Hyypia

Microphones have come a long way. Compared to this Prohibition era monster, AMC's Micro-Mini-Mike is truly microscopic. Its transmitter operates on FM in the 88 to 108 MHz band. It sells for $18.95, including battery. Circle 73 on Reader Service Coupon.

LET'S FACE IT! Wireless microphones have an "image" problem. There are people who still think of wireless mikes as merely toys or party-time novelty items, while other folk invariably associate these miniaturized electronic marvels with the nefarious bugging activities of cloak-and-dagger CIA agents, and with gum-shoe private eyes prying into other people's affairs for monetary gain. Such activities do go on, yet the fact remains that there are virtually endless applications for wireless microphones that are entirely legal and unquestionably ethical.

Regular readers of ELEMENTARY ELECTRONICS of course need not be reminded that there are proper and improper uses for just about anything, from dynamite to every conceivable variety of electronic gear. But just in case a reader loses his copy of EE, and it falls into the wrong hands, we hasten to append this warning: FCC rules clearly prohibit the use of wireless microphones for eavesdropping on the conversation of unsuspecting people. Getting caught at wireless snooping could lead to federal prosecution. Moreover, the citizen whose privacy has been violated is very likely to file a king-sized civil suit for damages.

Using the Mike. A wireless mike system can be a very handy electronic watchdog. You can hear the baby cry, respond to a call from a bed-ridden patient, or run for the telephone or door when either bell rings. Just plant your mike in the appropriate location and take your portable, battery-powered radio wherever you go into the house, or even outdoors, to know what's going on inside.

Having problems with intruders? Perhaps only the seasonal kind that splatter hard-to-remove raw eggs all over your patio bricks? Put a mike out in the yard as an effective early-warning system. On the farm, put the mike in the hen house to help catch that wiley four-footed intruder that has been eluding capture for so long.

When you install that new TV antenna, take a portable radio up on the roof. As you rotate the antenna, another person watching the TV screen down below can use the wireless mike to tell you when the picture is clearest. And what about the housewife who can't bear to miss that next episode of her favorite soap opera, yet absolutely must spend some time down in the laundry? She can put the mike in front of the turned-on TV and at least *hear* whether Mary will actually leave John to start cooking for Harry.

Countless other applications for wireless microphones relate to such broad activities as business, leisure-time activities, sports and education. Use your system as a hot-line, tag sale communicator, public speaking aid, or a secret prop during a magic show or other amateur theatrical performance.

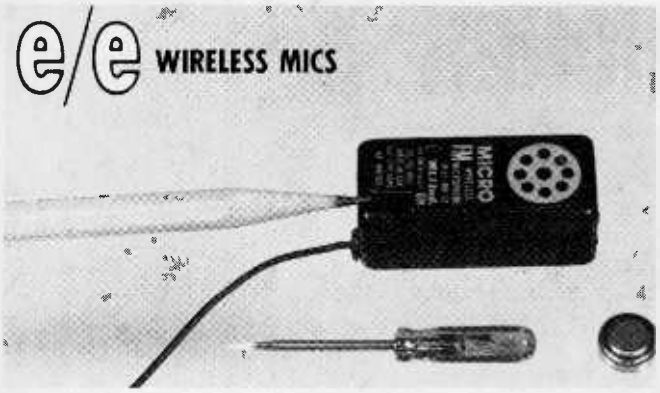
You can even hook your receiver to a tape recorder to obtain permanent records of your personal transmissions. Just plug the speaker output on your portable radio to the auxiliary input of a tape recorder. You can then wander anywhere in the house and dictate information onto tape.

It's an easy way to make an inventory of personal possessions without lugging around the whole tape recorder.

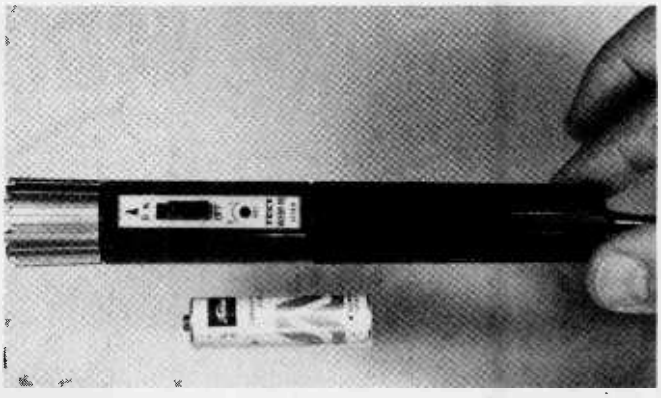
Choose Optimum Range. Our experience indicates that the factory-built wireless mikes have substantially greater range than the kit jobs. In some applications you need that extended reach, but in other situations it could be a handicap. If your home is on a large property, the more powerful mikes are best. But if your neighbors live only a few feet away, you may be better off with a mike having a limited range for two reasons: To keep from annoying your neighbor, and to keep your personal broadcasts truly personal.

As you read the following comments about our performance tests, bear in mind that many variable factors can materially influence the quality of transmission. The quality of your FM radio can be as important as the quality of the microphone you choose, for example. Even the physical orientation of the receiving radio can affect the clarity of reception. So, inevitably, you will have to do some practical experimenting to get the most from your system.

Our informal range tests were made in the following manner. An old manual darkroom timer was used to pro-



The Micro FM, from MLI, is the smallest unit we have found. It features a built-in on/off switch, obviating removal of the battery when it's not in use. Circle 74 on Reader Service Coupon.



Formula International's TECT model WEM-16 is powered by a penlite battery, and features an omni-directional electret condenser microphone element. Cost is $16.50. Circle 75 on Reader Service.

duce a noise having a constant pitch and intensity. This was put in the kitchen of a ranch-style house situated on one acre of real estate. Each mike was first carefully tuned to the selected FM frequency (usually about 108 MHz) by simply turning a small tuning coil (with screwdriver or alignment tool) until the nearby radio squealed. Each microphone was then placed in the same position near the noise-making timer while the output signal was monitored throughout the house and out-of-doors with the portable radio. *Warning:* the tuning coils in the mikes are very delicate and will absolutely not take heavy-handed abuse. Heed manufacturer warnings about using a light touch and against playing with the coils unnecessarily.

In the following summaries, we'll first provide pertinent manufacturer information, and then add our own test observations.

Micro FM Wireless Mike. (MLI Industries; $19.95 plus $1.50 postage and handling) is the smallest of the factory-built microphones, measuring only 1¾ inches by ¾ inches by ⅝ inches (less than one cubic inch!), yet it has one of the longest transmission ranges. The manufacturer says the range is up to 100 feet indoors and 300 feet outdoors. The tough aluminum case is black-anodized for durability, and the 1.3-volt mercury battery (included in the purchase price) is claimed to provide from 60 to 80 hours of continuous use. The mike is continuously tunable to any frequency between 88 and 108 MHz—the full FM broadcast band.

Semiconductors in the mike include an FET, one IC, one diode, and three silicon transistors. The modulation bandwidth is ±100 kHz and the field strength is 50 microvolts/meter at 50 feet (open area). It incorporates an electret microphone, has a permanently attached ¼-wavelength flexible wire antenna (29 inches long), and has FCC type approval.

The first thing we liked about this compact little marvel is the slide switch which helps prolong the life of the battery without the need to remove it. We were equally impressed by performance. With the receiver volume set only about one-eighth of maximum, the noise could be monitored anywhere in the house, even throughout the basement area. By turning the receiver volume gradually to maximum, clear pick-up was possible everywhere on the one acre of property. The test was made at 108 MHz, because the manufacturer recommends you start from this end of the FM band in the search for the first quiet zone.

Micro Mini Mike. (AMC Sales; $18.95 plus $1 postage and handling), Model WM-F2, measures 2¼ inches by ¾ inches by ½ inch (⅞ cubic inch). This second-smallest factory-built mike features a durable black metal case, 1.3-volt mercury battery, 27-inch flexible wire antenna, and the following semiconductors: one FET, two diodes, two transistors, and one IC. It has FCC type approval. Frequency deviation is +100 kHz/MHz and field strength is put at 50 uV/m at 50 feet.

The manufacturer specifies a range of up to 100 feet indoors and 300 feet outdoors. Battery life is said to be from 60 to 80 hours. It can be tuned anywhere in the 88 to 108 MHz FM band.

Tuning to 103 MHz seemed to produce better results than at 108 MHz. By turning the receiver volume to about halfway to maximum, the transmitted noise signal could be heard anywhere inside the house. By turning the radio volume to maximum, reception could be extended to reach a short distance outside the house, about 35 feet from the mike. The microphone was judged to have a somewhat more limited range than the feisty little Micro FM already discussed. On other drawbacks is that the lack of an on/off switch necessitates physical removal of the battery when the mike is not being used. Nonetheless, this mike was judged to be a good buy provided these limitations can be accepted, and a preferred mike if your home is close to neighbors and you *need* a limited range to ensure privacy of your in-house broadcasting.

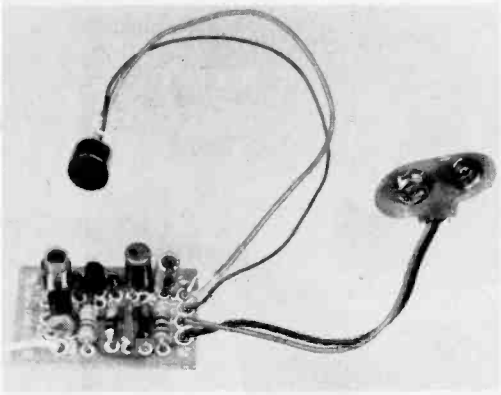
TECT FM Wireless Microphone, Model WEM-16 (Formula International; $16.50) is in a different class from the two "Micro" mikes just discussed, if only because of its relatively large size. This mike is 6¼ inches long and has a front-end diameter of just under one inch.

This three-transistor (one FET) mike features an omni-directional electret condenser type microphone element, a penlight single-cell power source, a 24" flexible cord antenna, attractive black-and-chrome casing, plus an on/off switch. Specifications include: frequency range from 88 to 108 MHz, radiation field intensity less than 15 uV/m at 100 m; maximum frequency tolerance ±75 kHz, and a current drain of 3mA maximum.

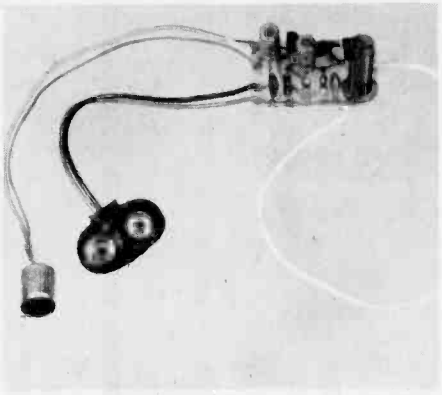
The oscillating frequency of this microphone is set at 90 MHz at the factory, but you can easily tune to any other frequency in the FM band by means of a coil accessible through a small hole near the switch. Battery life is put at about 100 hours.

With the receiver volume set at about one-fourth of maximum, the test noise could be heard anywhere inside the house, including the basement. By increasing the radio gain, excellent reception was obtained everywhere on the one-acre lot; sound quality was judged very good. If the larger size is no handicap, this mike should handle any domestic transmission conditions with ease.

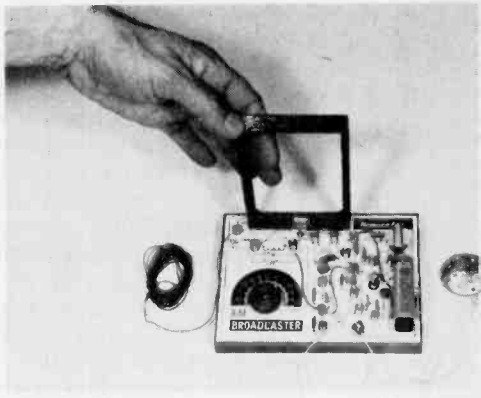
FM Transmitter Kit (Formula International; $6.95) requires the soldering of about 17 components, including



The FM Transmitter Kit, by Formula International, costs $6.95, less battery. Circle 75 on Reader Service Coupon.



Ramsey Electronics' FM-2 Wireless Kit sells for $4.95. You supply mike and battery. Circle 77 on Reader Service Coupon.



Radio Shack's AM Broadcaster costs $7.95, and includes everything except battery. Circle 32 on Reader Service Coupon.

the 2- to 3-foot long antenna wire, to a 1 inch by 1½ inch PC board. The component locations are marked on the PC board, albeit with somewhat blurred printing. However, if you start with the resistors, you should have no difficulty orienting the various parts. Helpful diagrams as well as a schematic are provided, but there are no step-by-step instructions. It's assumed you know how to read resistor value codes. Tip: when installing the coil, insert the leads bridged by a purple line into holes 1 and 2.

The manufacturer suggests you first test the assembled circuit with an ammeter, but this should not be necessary if the assembly has been done with care, especially being sure that the three transistors are oriented correctly. This kit comes with a small electret microphone and a battery cable, but you must provide the 9-volt battery.

This wireless unit was tested at 108 MHz. With the radio volume set at about halfway to maximum, the test noise could be heard in all parts of the house, including the basement. There was some "reach" into yard areas, to a distance of about 35 feet from the mike. The range was found to be roughly comparable to that of the factory-assembled Micro Mini Mike sold by AMC. The cost is lower, but you have the problem of finding a suitable case to contain the PC board and the much larger 9-volt battery. The mike otherwise seems suitable for use in areas where a limited range is desired.

The sound quality seemed a bit more ragged than that obtained with the AMC mike, which has the benefit of a metal case for shielding to minimize body capacitance effects.

Super Sens FM-2 Mike Kit (Ramsey Electronics; $4.95) requires soldering about 16 components, including a short 5 inch to 10 inch antenna wire, to a PC board measuring 1 inch by 1½ inches. There are no identifying markings on the PC board, but a clear diagram, good parts identification list, and a schematic of the circuit make the assembly easy. It should be noted that the kit does *not* include a microphone element, battery connector, or a 9-volt battery. You must find these locally. The manufacturer states that you can use a crystal, ceramic, or dynamic microphone. The crystal type is the most sensitive, but the dynamic type offers better fidelity. It's claimed that the mike works with a power supply of 3 to 9 volts, the higher voltage being preferable. You are cautioned that the antenna affects the transmitter frequency, therefore close movement next to it should be avoided.

The main problem encountered with this wireless kit concerned difficulty of tuning it to the desired FM frequency, mainly because body capacitance effects were very pronounced. Getting a hand near the antenna is unavoidable when adjusting the tuning coil. When proper response was obtained with the receiver during the tuning operation, it was immediately lost when the hand was moved away. Thus it appeared necessary to tune in "bits-and-pieces" making minor adjustments and then removing the hand to see if the frequency was locked in properly.

The mike was tested first with an electret microphone, and then with a crystal mike cartridge. The crystal seemed to give somewhat better results although we did not succeed in getting performance comparable with that of any other wireless discussed in the above sections.

Science Fair AM Broadcaster (Radio Shack, cat. no. 28-209, $7.95) is the only AM transmitter found on the market. The price includes everything you need, except a 9-volt battery. Assembly of the components on a 4¼ inch by 6 inch board requires no soldering because all connections are made to spring-type fasteners that plug into holes in the board. The tuning coil is made by winding 34 turns of wire around a plastic frame measuring 3 inches by 4½ inches, which is then mounted vertically at one edge of the main component board. The transmitter utilizes a crystal microphone, three transistors, a tuning capacitor, choke coil, modulation transformer, and several capacitors and resistors, all of which are clearly identified.

The manufacturer claims broadcast range can be as much as 40 feet under ideal conditions. The author managed transmission over a somewhat shorter range indoors. There is no critical coil tuning required. Just set your AM to any unused frequency and rotate the tuning knob on the components board to match the frequency.

Because of the limited range, and especially because of the bulk of this wireless, the Broadcaster cannot be put into the same class for comparison with the FM mikes already discussed. It's not intended to be a working mike, but a Science Fair educational kit. As such, it meets all claims made for it. ■

Manufacturers of Wireless Microphones

A.M.C. Sales, Inc.
Box 928
Downey, CA 90241

Formula International, Inc.
12603 Crenshaw Blvd.
Hawthorne, CA 90250

MLI Industries
50 Hunt Street
Watertown, MA 02172

Radio Shack
500 One Tandy Center
Fort Worth, TX 76102
(Buy from local stores)

Ramsey Electronics
P.O. Box 4072
Rochester, NY 14610

SIGNAL SNARE

An easy-to-build one-transistor reflex receiver

by Charles Green

AN AMPLIFIER STAGE that is used at two widely separated frequencies (such as RF and audio) is called a reflex amplifier. This type of amplifier circuit was used in the early days of radio because of its economical use of the then expensive vacuum tubes. Later, during the depression period of 1934 to 1937, reflex circuits were used in small home radios. When transistors first became popular, two transistor radios were manufactured in Japan and sold here for very small prices. These transistor circuits employed reflex amplifiers, usually in a TRF type of receiver with a crystal diode detector. One transistor was employed as a reflex RF amplifier and first audio stage, and the second transistor was used as the audio power amplifier.

You can experiment with the reflex circuit by building our simple one-Transistor Reflex Receiver project. The circuit employs a j-FET as a tuned RF amplifier and also as a stage of audio (after the signal is detected by a germanium diode). The circuit is laid out breadboard style for easy construction.

The Reflex Action. The reflex circuit is a system in which an amplifying device (transistor or vacuum tube) is made to function at both RF (or IF) and audio frequencies. As commonly used, the signal is amplified by the device, detected, and the resultant audio signal fed back into the same device for further amplification. Such a circuit has two inputs (one for each type of signal frequency) and two outputs, with filtering necessary to split the two sets of signals.

Look at the signal flow block diagram of the one-Transistor Reflex Receiver project. This is a diagram of a typical reflex circuit. Signals are amplified at RF frequencies and then fed through a signal splitter to a crystal diode detector. The detected output is filtered and coupled back through the tuned circuit to the amplifier, where the signal is now at audio frequencies. The audio frequencies are amplified and fed through the signal splitter to the low pass filter and to the headphones.

As shown in the block diagram and the schematic, radio signals are coupled through J1 and C1 to the tuned circuit of C3/L1/and to the gate of the field-effect transistor (j-FET) Q2. C2 places the bottom end of L1 and the rotor of C3 at RF ground. R3 supplies the bias for Q2, and C8 is the RF/AF bypass capacitor. R1 functions as the Q1 gate DC return and audio input load. The amplified RF signals from the drain of Q1 are coupled through C9 to R5 and detector D1. C7 is connected in shunt with the RF output of Q1 and is used to adjust the RF gain of the j-FET.

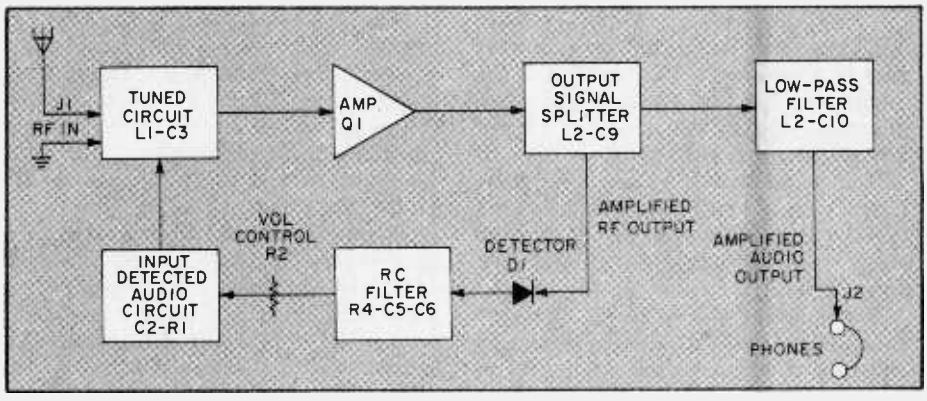
The detected audio signal is fed through the RC filter composed of R4, C5, and C6 to the volume control R2. The audio is then coupled through C4 to the junction of R1, C2, L1, and C3. C2 presents a low impedance to RF, but has a high impedance to audio. L1 has a high impedance to RF, but has a low impedance to audio. The two types of signals (RF and audio) are therefore applied directly to the gate of Q1, each being amplified therein.

The amplified audio signal at the drain of Q1 is coupled through L2 to the J2 headphone jack. L2 serves as both a component of the low-pass filter (L2/C10) and as an RF load for the signal splitting action of C9 to D1. L2 is chosen to have a high value of reactance over the broadcast band and serves to broadly tune the D1 detector circuit over the range of 550 kHz to 1500 kHz.

The DC power for the circuit is supplied by an external 6-volt battery (or DC power supply), and C11 serves as an audio filter for the power input.

Construction. The receiver, as shown in the photos, is built on a 6-inch long by 3¾-inch wide by 2-inch high plastic box with a perf-board section installed on top. Most of the components are mounted on the perfboard with push-in solder terminals. The input and output connectors, J1 and J2, are mounted on the front and rear of the box. The 6-volt battery, or power supply, is connected via two leads fed through a hole in the rear of the box. The tuning capacitor C3 is mounted directly on the perfboard with machine screws, and the volume control R2 is mounted on a small bracket made from sheet aluminum that is also installed on the perfboard.

Begin construction by cutting a perfboard section to size to fit the top of the box. Locate corner holes to fit the threaded molded screw retaining extrusions located inside the top corners of the box. Mount C3 on the perfboard in the location shown in the photo of



This block diagram shows how the signal is amplified as AF and RF, then split and fed back to the tuned LC circuit. The low pass filter separates the amplified audio signal.

the top of the receiver. The capacitor used in our model had threaded holes in the bottom for easy mounting with machine screws and washers to lift up the stator insulating panels from contact with the board surface. If your capacitor does not have these mounting holes, the capacitor can also be mounted by a small bracket cut from sheet aluminum to fit front mounting holes. Cut a bracket to fit R2 and mount it on the front of the perfboard in the general location shown in the photos. Use an internal toothed lock washer between the R2 mounting nut and the bracket surface to prevent accidental movement of the volume control.

Mount the remainder of the components on the perfboard with push-in solder terminals in the locations shown in the top of the board photo. The locations are critical, so follow the layout of our receiver model. Install a solder lug on the frame of the tuning capacitor C3 for connection to the rotor. Wire the board components as shown in the schematic and keep the connecting leads as short and direct as possible. L1 is mounted with two push-in terminals soldered to the coil connecting lugs.

Install the headphone jack J2 on the box front and the antenna/ground jack, J1, on the rear of the box as shown in the photos. Cut a hole in the rear of the box for the battery leads and complete the wiring of the perfboard with the interconnecting leads to the box components. Install lugs on the battery leads to fit your battery terminals. The leads on our model extended approximately 10 inches from the box, but the lead lengths are not critical and can be any convenient length to fit your particular installation. To minimize accidental breakage, the battery leads should be stranded wire (preferably color coded; red for positive and black for negative).

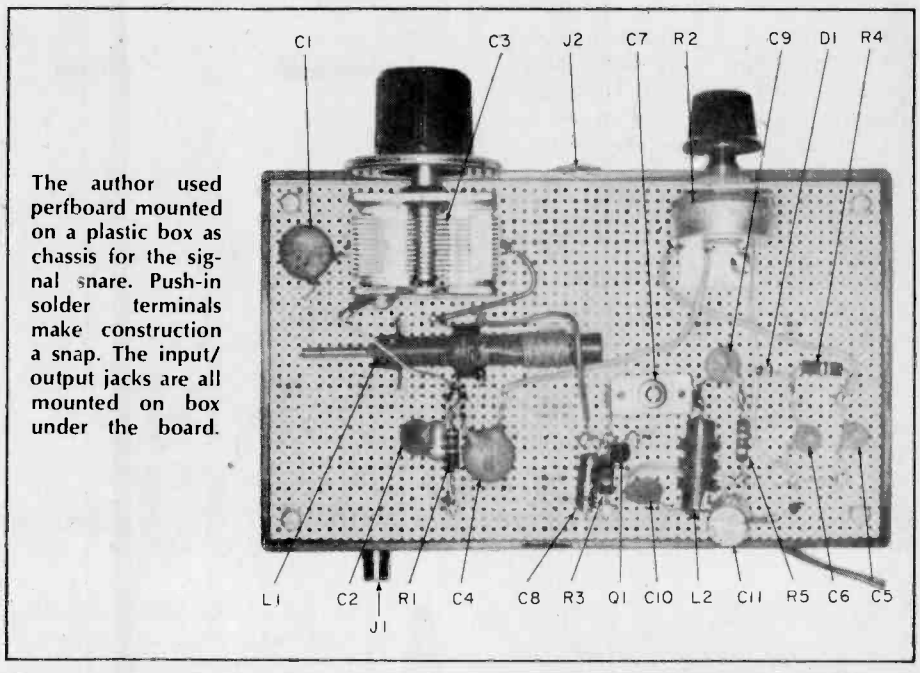
Testing Your Reflex. For best results, an outdoor antenna and a good ground should be connected to J1 (center connector to the antenna and the outer shell to ground). Inasmuch as the Reflex Receiver project only uses a simple tuned circuit, you may have some problems with overloading on strong local stations. C1 value can be changed to adjust the antenna loading; small capacitance (3 to 20 pF) for light loading and better selectivity, and larger capacitance (25 pF to 47 pF) for heavier loading, higher senstivity, but lesser selectivity.

Before connecting up the receiver project to the battery, check the wiring and then adjust the RF Gain control, C7, to maximum capacity (minimum RF Gain). Set the volume control R2 full counter-clockwise (for minimum audio gain). Check the lead polarity before connecting the 6-volt battery to the receiver, then plug in the headphones (2000-ohm type).

Tune the broadcast band with C3 while adjusting R2 for a comfortable audio volume. Adjust L1 for best band coverage for your particular location. Tune the slug in for more inductance. Adjust C7 for increased RF sensitivity over the band, and if oscillation occurs, adjust for maximum capacity (just short of the oscillation point).

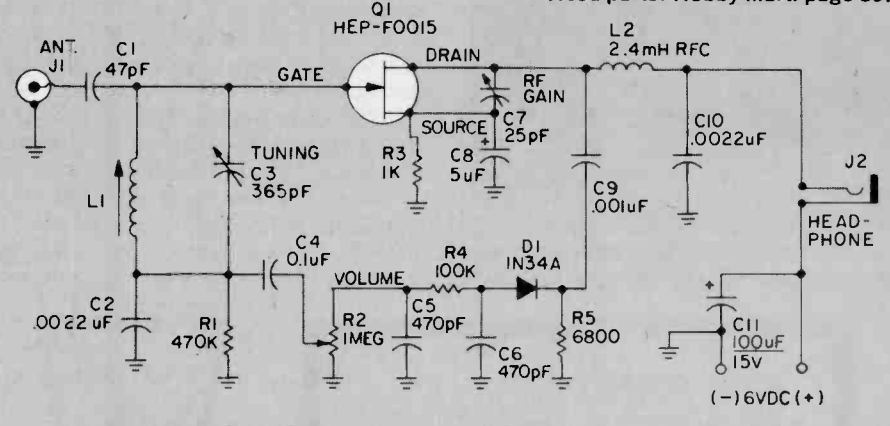
Check the RF amplifier action in the reflex circuit by tuning in a weak station and then connecting a 500 pF capacitor (approximate value) be-

(Continued on page 87)



The author used perfboard mounted on a plastic box as chassis for the signal snare. Push-in solder terminals make construction a snap. The input/output jacks are all mounted on box under the board.

Need parts? Hobby Mart: page 89.



PARTS LIST FOR ONE TRANSISTOR REFLEX RECEIVER

C1—47-pF ceramic disc capacitor, 15 volts
C2, C10—0.0022-uF ceramic disc capacitor, 15-volts
C3—355-pF variable capacitor
C4—0.1-uF ceramic disc capacitor, 15-volts
C5, C6—470-pF mica capacitor, 15-volts
C7—2 to 25-pF mica trimmer capacitor
C8—5-uF electrolytic capacitor, 15-volts
C9—0.001 uF ceramic disc capacitor, 15-volts
C11—100 uF electrolytic capacitor, 15-volts
D1—1N34A germanium diode (or equiv.)
J1—Phono jack (RCA type) for Ant. and Gnd. connector
J2—Phone jack (to fit your headphones)
L1—broadcast band loopstick antenna coil (Radio Shack #270-1430 or equiv.)
L2—24-millihenry RF choke
Q1—HEP F0015 NPN FET (Motorola) or equivalent
R1—470,000-ohm, ¼-watt resistor
R2—1-megohm potentiometer, audio taper
R3—1000-ohm, ¼-watt resistor
R4—100,000-ohm, ¼-watt resistor
R5—6800-ohm, ¼-watt resistor
Misc.—Plastic box, approx. 3¾ by 6 by 2-inches with perf-board top section, knobs, sheet aluminum bracket for R2, push-in clips for perf-board, hookup wire. Also: Hi-Z headphones (2000-ohms or higher) and a 6-volt battery or DC power supply.

The BBC's World Service

by Brian Rogers

The sun never sets on the British broadcasting empire

One of a DXer's best know addresses, Bush House, London—headquarters of the BBC.

AT THE AGE OF 12, while exploring the "shortwave" dial setting on our family radio, I picked up a transmission from the British Broadcasting Corporation in London. I'd never heard a foreign station before and I was thrilled that a fragile thread of energy called a radio wave could span a mighty ocean and link the far-off British Isles with the "Silvertone" console in our living room.

Since then, using receivers bearing names like Hammarlund, Hallicrafters, Drake and Realistic, I've heard the BBC countless times. But I haven't forgotten the evening, nearly thirty years ago, when I heard the station for the first time.

I still listen to the BBC today, and not just to recall a pleasant boyhood experience. Along with millions of other SWL's, I listen because, in its long broadcasting day, the World Service of the BBC offers a tremendous variety of programs received at good strength just about anywhere on the globe where you and your receiver happen to be.

Empire Service. Calling its shortwave programs the "Empire Service," the BBC began broadcasting on high frequency December 19, 1932. Six days later, on Christmas, King George V used the infant medium to address his subjects throughout the world. He spoke of radio's power to do good and bring people closer together.

A service in Arabic was begun in 1938 to counter Mussolini's anti-British broadcasts to the Middle East. Other foreign-language broadcasts soon followed.

World War II gave the BBC an opportunity to earn a reputation for impeccable accuracy and thoroughness in news coverage. A reputation it still enjoys today. Citizens of occupied countries learned they could trust the station because it always told the truth, no matter who the truth might hurt. England's setbacks and defeats were reported as faithfully as her triumphs and victories.

By 1945, almost everyone in Europe believed unquestioningly in BBC newscasts. On D-day, when General Eisenhower used these programs to instruct French civilians, thousands of people obeyed without hesitation.

Today the BBC External Services emply 110 journalists working in shifts to process the more than one million words a day that pour into the newsroom in London's Bush House. This flood is whittled down to fill 250 separate news programs in the 39 languages the broadcaster currently uses.

The English language "around-the-world, around-the-clock," World Service includes seventeen nine-minute bulletins of world news daily. Also heard are five-minute summaries of British

While the BBC doesn't normally send QSL cards, it does have frequent SWL contests. These DX certificates and World Radio Club banners are often an SWL's most prized possessions.

The main console in the control room in the BBC External Services headquarters. The BBC multilingual system is highly organized.

Henry Hatch, the resident engineering personality of the World Radio Club, demonstrates a crystal receiver of his own design.

news called "News About Britain," and reports from BBC correspondents in fifteen-minute "Radio Newsreel," programs.

World News Roundup. In addition to major wire services such as the Associated Press, United Press International, and Reuters, the BBC uses as a news source its own radio monitoring service. Located at Caversham Park, about 50 miles from London, its professional SWL's listen to over 400 news bulletins from more than 30 countries every day.

But BBC programming isn't all news. Of special interest to DXers is the World Radio Club, now boasting in excess of 30,000 members. "Meetings" of the BBC sponsored organization are held on the air weekly. The best time for North American listeners to hear these electronic conclaves is 2315 GMT (6:15 p.m. EST) on Wednesdays. The sessions are repeated at 2100 GMT (4:00 p.m. EST) on Fridays. Membership is granted free-of-charge to anyone who writes for it.

Long a favorite of shortwave buffs, retired BBC engineer Henry Hatch currently conducts monthly instructional talks called "Radio for Beginners," on the club programs. Also featured are reports of stations heard by noted DXers and what the "pros" at Caversham are hearing.

Listener Envolvement. Every month colorful pennants are awarded to 25 lucky listeners who correctly answer a question posed by Mr. Hatch. Subjects of recent queries have included such topics as elementary electrical math, the international 'Q' code, and schematic circuit diagram symbols. Names of club members providing correct responses are put in a container and a drawing is held to select the pennant recipients.

The BBC issues verification (QSL) cards only on special occasions. One such opportunity occurred in 1972 when the parent BBC organization celebrated its fiftieth anniversary of going on the air.

The BBC's worldwide reputation for clear, accurate and non-political news broadcasting is due to its large staff of highly trained and motivated reporters, editors and announcers.

Annually, in the summer, another chance for a BBC QSL is offered when the World Radio Club holds its members-only DX Award competition. Certificates are awarded to DXers who correctly report reception from various BBC transmission sites during the two-week contest period. Dates, times, frequencies and transmitter locations are typed on the attractive 8½- by 10½-inch award certificates.

Contemporary rock music found on the international charts is played by Brian Matthew during his "Matthew on Music" program heard Wednesdays following World Radio Club.

The BBC World Service is one of only a handful of sources for radio drama today. Programs called "Radio Theater" and "Theater of the Air" are heard weekly.

Relays. From the 50-studio center in the Bush House headquarters, BBC shortwave programs reach listeners via seventy high-powered transmitters located on ten sites throughout the world. North American listeners are best served by stations on Antigua, in the Caribbean; and at Sackville, New Brunswick, and Greenville, North Carolina. These relays are shared with other broadcasters, such as Deutsche Welle and Radio Canada International.

Other BBC relays are located on Ascension Island, Cyprus and Singapore. Programs reach these transmitters by means of undersea cable, SSB radio link, and satellite.

Many frequencies are used by the BBC to reach its estimated audience of seventy million and it would be impossible to list all those dial settings here.

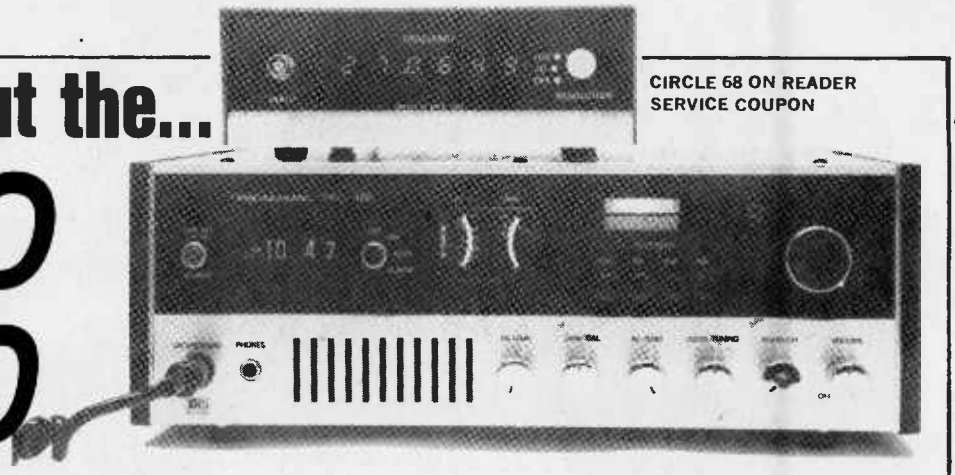
North American listeners might check 11,775 kHz in the morning however, and 6.175 kHz in the evening.

All World Service times and frequencies are listed in a monthly magazine known as "London Calling." It is available by mail for $10.00 per year. Pictures of station personalities and descriptions of upcoming programs are included.

"London Calling," as well as membership in the World Radio Club, can be obtained by writing to BBC World Service, P.O. Box 76, Bush House, London, WC2B 4PH, England. ■

e/e checks out the...

REDCO RFC-50



CIRCLE 68 ON READER SERVICE COUPON

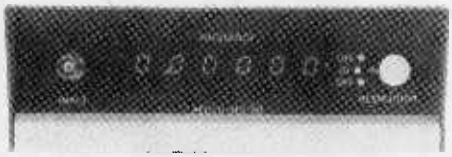
A frequency counter designed with the radio hobbyist in mind

IN THIS DAY AND AGE there is virtually no communications service that does not require precise measurement of the transmitter's carrier frequency.

Sure, if you plunk yourself down in the middle of one of the amateur bands, you can be reasonably certain that if other stations don't get on your back, you're somewhere in a legitimate segment of the band. But there's no way you're going to crowd the edges of the bands, where much DX hangs out, or accurately zero-beat a net, without a frequency counter built into the transceiver or transmitter, or an external counter. And unless you're in the market for one of those new, digital readout transmitters priced close to $1000, the external counter is your best bet. It certainly beats asking the receiving station if you're on frequency, for his receiver is most likely no better calibrated than your transmitter.

Why a Counter? Most important, precise transmitter frequency is often required for proper reception. For example, many modern AM CB transceivers are so selective, that even with delta tuning, a transmitter near the frequency toleranec limits will be received with "spitty," garbled modulation. Even worse, SSB requires the transmitter carrier be well within tolerance, for the receiver *clarifiers* often cannot properly tune a signal near the tolerance limits, and what you hear in this instance is a high pitched "Donald Duck" sound. For best reception on the receiving end, a modern CB transmitter should be within about ±1000 Hz of the channel frequency. If it gets beyond these limits, you really should have a service shop align the frequency synthesizer so your transmitter's carrier is as close to the channel frequency as is possible.

While a frequency counter is probably the most reliable way for the hobbyist to check transmitter frequency, using one can often be a first rate headache, for few are sufficiently sensitive to *sniff* the carrier leakage through the transmitter cabinet, or receive the signal with a short antenna. The way to get reliable, full-time measurement of the carrier is to have the counter work in-line, through a transmission line sampler. Better still, simply use a counter, such as the REDCO RFC-50, that has the sampler built in; a counter specifically designed for in-line connection to transmitters.



Front panel of the REDCO RC-50 contains a six-place 0.3-inch LED display, the power/ resolution selector, and a 50-ohm direct connection to the counter. The "10" and "100" resolution settings mean multiply the reading by 10 or 100 for the frequnecy in Hz.

The rear apron has a dual voltage power connector and an in-line "sampler" connection for the transmission line. The associated power cord automatically switches the power supply for 120 VAC or 13.8 VDC operation. The in-line antenna connection will accommodate transmitters on all frequencies to its upper limit of 40 MHz.

For full-time indication of the carrier frequency of AM and CW signals, for SSB signals of sufficient output power so the counter can be triggered by the carrier leak-thru, or for the "tune up" carrier of SSB transmitters so equipped, you just connect the transceiver or transmitter output to a UHF connector on the rear of the REDCO RFC-50, connect the transmission line to another UHF connector, and key the transmitter. The carrier frequency will be indicated by a six digit, 0.3-inch, LED readout. Since the RFC-50 works off a minute sample of the power in the transmission line it can be left permanently connected, ready to indicate the transmitter's output frequency at all times.

Specifications. The REDCO RFC-50 Communications Frequency Counter is housed in a 7½-in. by 8-in. by 2¼-in. cabinet. It can be powered by 120-VAC or 13.8-VDC, depending on which of two supplied power cords is plugged into a rear apron connector. The switching from one power supply voltage to the other is done automatically by the plug on the power cord.

The rated frequency range is 500 Hz to 40 MHz through a direct connection via a front panel BNC connector. Unlike most hobby type counters with direct connection, however, the input is not the usual 1-megohm; it is 50 ohms with back-to-back diodes across the load resistor providing protection against excessive input voltage. Two UHF connectors on the rear apron provide an RF sample from a transmission line for the counter input.

Operation. A *resolution* switch on the front panel positions the decimal point and provides the proper gate time for direct indication of MHz and kHz. It also serves as the power on-off switch.

Resoultion is 10 Hz, meaning that in any frequency reading, the last place is not indidcated. For example, 195.599 kHz is indicated as 0195.59 with the *resolution* selector at the "10" setting meaning that you should multiply the reading by 10. 0195.59 times 10 becomes 195.590 kHz. In another ex-

(Continued on page 88)

This tailgating gauge helps you to keep your distance.

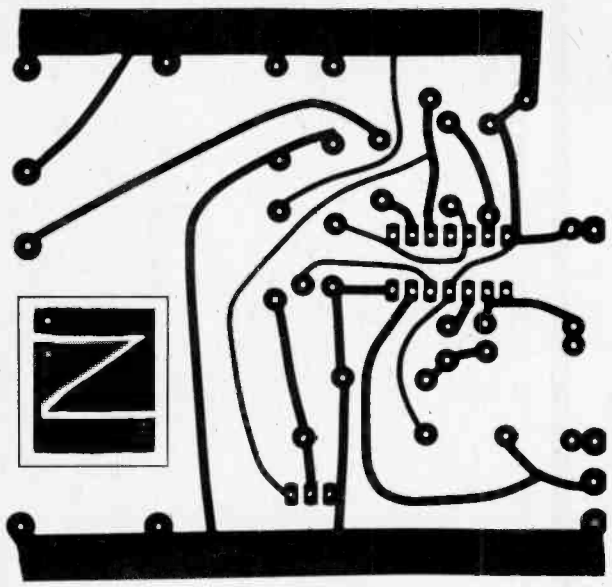
Space Cushion Timer

by Thomas R. Fox

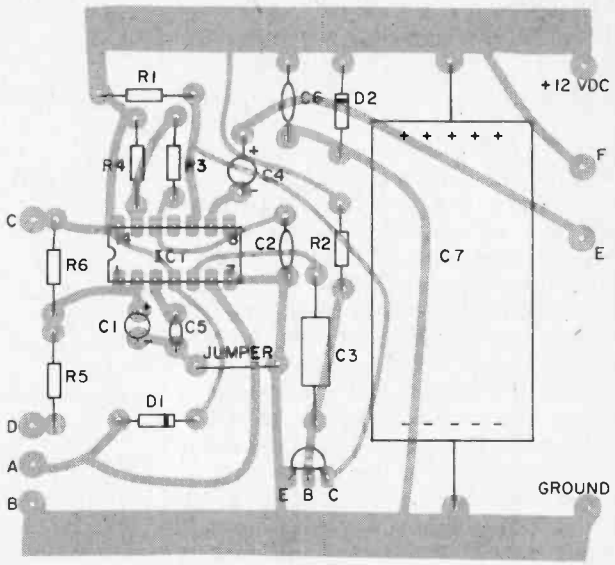
MOST OF US WHO DRIVE the highways these days have become witness, at one time or another, to the gruesome sight of a high speed, rear-end collision. With today's cars becoming smaller and lighter, the only way the auto makers can provide a margin of collision safety for the occupants is to design the cars to crumple on impact, thus absorbing the shock and hopefully leaving the passengers uninjured.

The drawback to this method is that while you and your loved ones may manage to avoid serious injury, your car is likely to be suited for use as nothing more than junkyard scenery.

The Principle. To help you avoid these unpleasant consequences, we suggest you build the Space Cushion Timer. This device works on the "two-second rule." The rule simply says that if a two-second interval is kept between cars at all speeds, ample braking distance will be provided for safe stops. In practice, you would fix a landmark at the side of the road, such as a light pole. When the car in front of yours passes the pole, two seconds should elapse before your car reaches that same spot. With our timer, you merely trip the touch plate, and 2.1 seconds later, a pleasant tone sounds. If you're at the landmark, then you are a safe dis-



Separate the template for the touchplate and make an individual printed circuit board for it. Make both PC boards very carefully.



The components all mount on the side opposite the foil pattern. Be sure to double check the polarities of electrolytic capacitors.

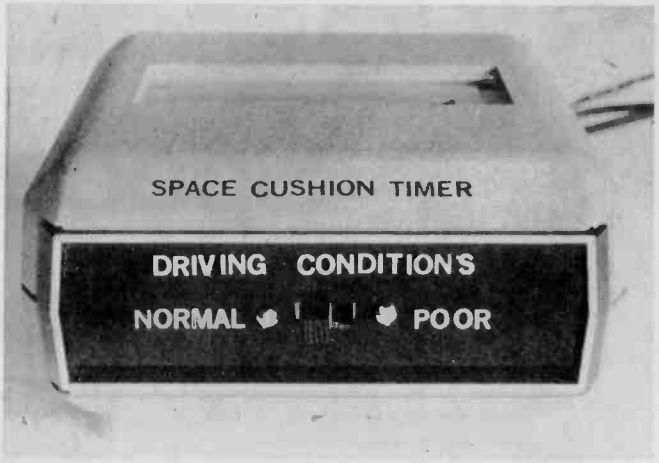
tance behind. If not, then adjust your speed accordingly.

Construction. Best results will be obtained by constructing the timer on a PC board. We have provided a template which you can use for etching your own board. All components, except for the speaker, switches, and the touch plate, are mounted on the PC board. The polarity protection circuit may be wired point-to-point on a small chunk of perfboard, and mounted on or near the car's fuse box, in order to save space within the timer's cabinet.

Instead of using a cabinet, especially if your car has a bit of room behind the dash, you may wish to mount the timer's PC board right inside, and have the touch plate and the switches mounted flush on the dash, in order to give the project that "built-in" look.

How it Works. IC1 consists of two 555 timers, one operating in a monostable mode, and the other in an astable mode. The monostable multivibrator is triggered when your finger contacts the touch plate. It has a pulse length of 2.1 seconds when S1 is in the *normal,* or closed position, and about 5.2 seconds in the *poor,* or open position. The output of this circuit goes to the base of Q1, which serves as a differentiator / inverter, shaping the pulse into a positive sawtooth, with a duration of 0.25 seconds. The reshaped pulse is then fed to the *reset* side of the astable oscillator which operates at 600 Hz. This oscillator will only produce an output when the *reset* input is held above ground potential (minimum of 0.4 volts). Therefore the oscillator will produce a 600-Hz tone for 0.25 seconds, which is fed into the speaker as the audible warning.

Operation. After connecting the protection circuit to the fuse box and the timer, you're ready for the safest driving you've ever done. Consult the table for the proper setting for the road conditions and the prevailing speed of traffic. The *look-ahead* feature of switch S3 allows you to set a considerably greater safety margin for conservative driving. You may wish to clip the table from the page and fasten it to the underside of your sun visor where it will be handy when you need it. *Remember!* The Space Cushion Timer will not prevent accidents if you don't use it, and even when you do use it, it's not intended as a substitute for seat belts and common sense. ■

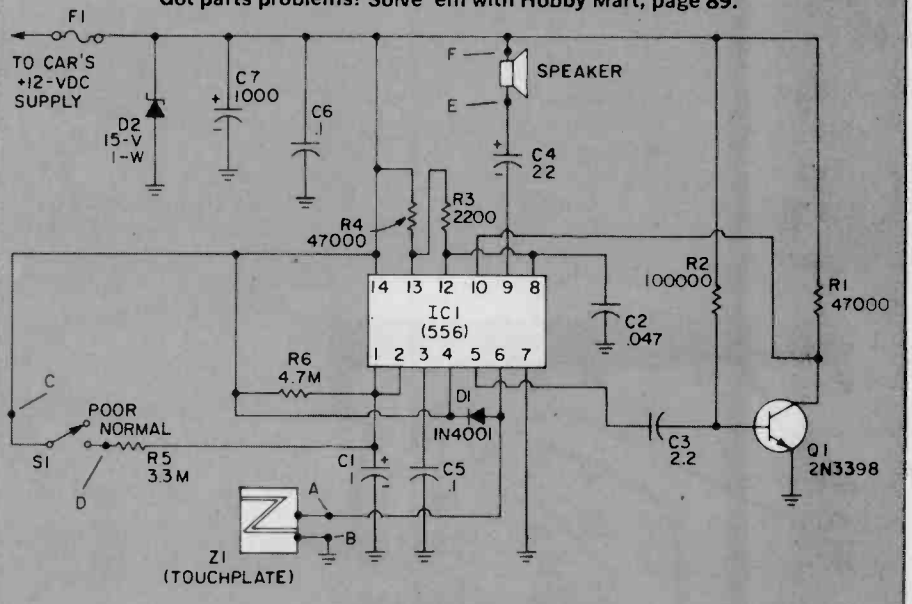


While almost any case can be used for the space cushion timer, this Radio Shack clock case seems ideal. This unit can be mounted at almost any convenient spot on the dashboard of your car.

Rationale For Two Seconds Following Distance

Car Speed	Feet Car Will Travel In 1 Second	At 1 Car Length For Each 10 M.P.H. You Will Be (based on 20 ft. vehicle)	2 Second Safety Rule You Will Be
30 =	44.4	60 ft. back	88.8 ft. back
40 =	58.6	80 ft. back	117.2 ft. back
50 =	73.3	100 ft. back	146.6 ft. back
60 =	88.0	120 ft. back	176.0 ft. back

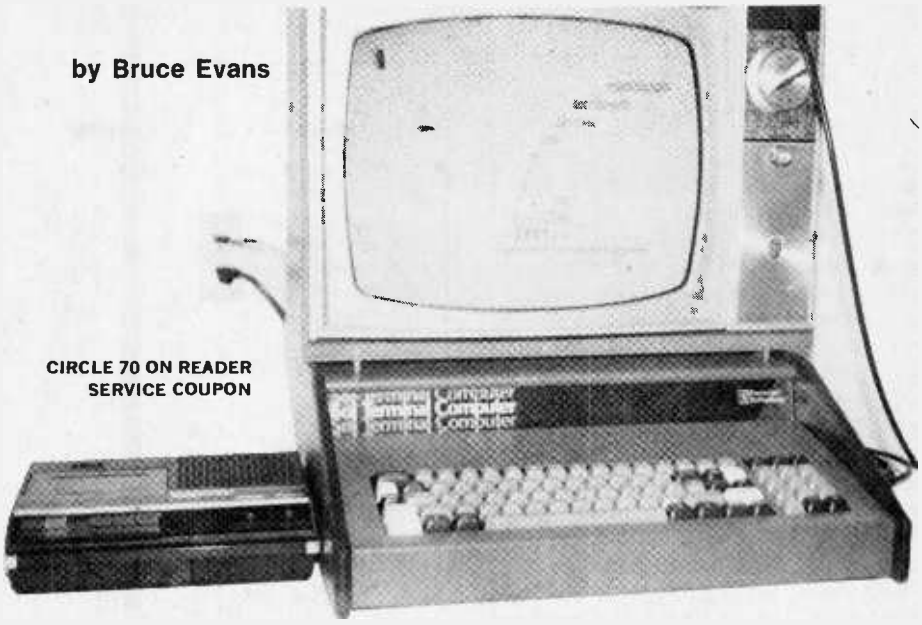
Got parts problems? Solve 'em with Hobby Mart, page 89.



PARTS LIST FOR SPACE CUSHION TIMER

C1—2.2-uF tantalum capacitor, 25-volt or greater
C2—0.047-uF ceramic disc capacitor, 25-volts
C3—2.2-uF non-polarized electrolytic capacitor, 25-volts
C4—22-uF electrolytic capacitor, 25-volts
C5, C6—0.1-uF ceramic disc capacitor, 25-volts
C7—1,000-uF electrolytic capacitor, 25-volts
D1—1N4001 diode
D2—1N4744 zener diode, 15-volts
F1—0.25-amp quick-acting fuse
IC1—556 dual 555 timer
Q1—2N3398 NPN transistor or equivalent
R1, R4—47,000-ohm, ¼-watt resistor
R2—100,000-ohm, ¼-watt resistor
R3—2,200-ohm, ¼-watt resistor
R5—3,300,000-ohm, ¼-watt resistor
R6—4,700,000-ohm, ¼-watt resistor
S1, —sub-miniature SPST slide switch
SPKR—8-ohm miniature speaker
Z1—touch plate (requires 1 square inch of PC board stock)
Misc.—cabinet, perfboard, hookup wire, etc.

by Bruce Evans



CIRCLE 70 ON READER SERVICE COUPON

The Hobby Computer... One SOLution

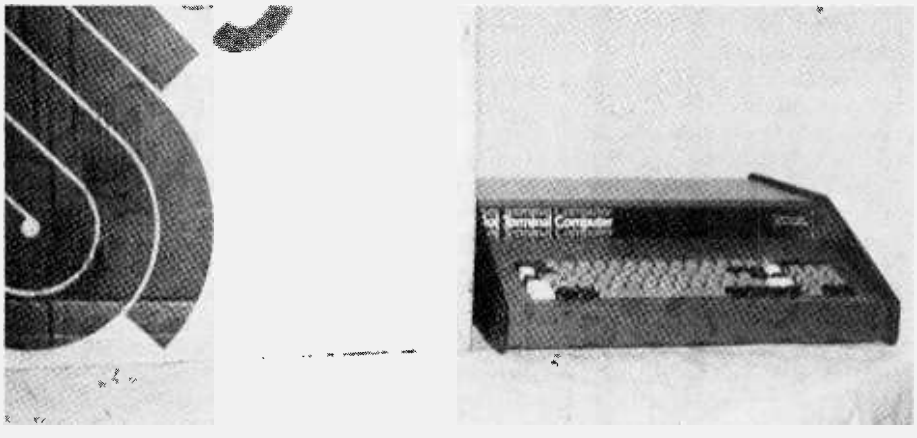
A user/builder report on the Processor Technology SOL-20 home computer

MY LOVE AFFAIR with microcomputers began with Popular Electronics' *COSMAC Elf* and progressed through the Bugbooks to the *Mark 80* by E&L Instruments Company. They were great instructors, but it was becoming obvious that what I needed was a full system with a mainframe microcomputer.

In choosing such a system, I wanted something that was compact and aesthetically pleasing. Front panels and separate keyboards may fit the image of the electronic experimenter's laboratory but they sure clutter one's desktop! I also wanted a complete system because although it puts the payments in one large lump sum, it is cheaper in the long run than shelling out a hundred dollars here for software and another couple of hundred dollars there for an interface or two. But probably the biggest factor in my choice of Processor Technology's *SOL-20* was the praise my friends had for this company's *VDM* and *CUTSboard* as well as their software including the *SOLOS* monitor program. Several of them have files full of Processor Technology material!

I am fortunate here in Toronto as there are three computer stores that sell the *SOL-20*. All were very helpful and their prices were very close. Here again I relied upon the advice of a friend who had dealt with them and chose The Computer Place on Queen St. West here in Toronto. I found their after service advice invaluable and they checked my results twice when my troubleshooting ability failed.

The kit came packaged in the original air cargo container. The flight crew could have kicked this well packaged box safely out the cargo door without doing any damage! However, I was a bit discouraged to find a revision notice right on the outside of the shipping box. What lay ahead?



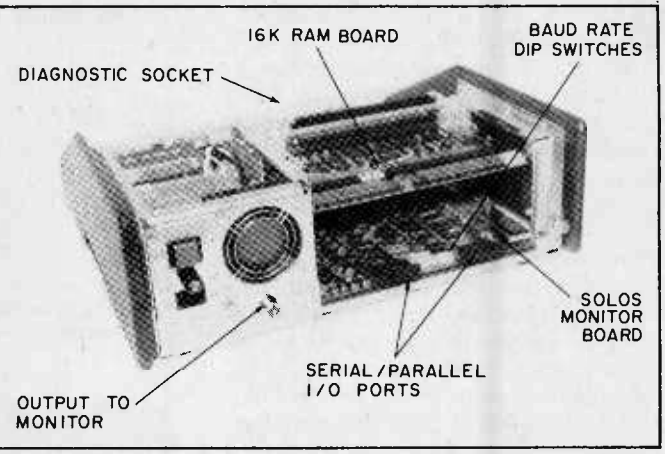
The people at Processor Technology certainly don't skimp on the packaging. The SOL-20 arrives in a massive case that belies the size of the computer kit that is inside of it.

The individual components were all of excellent quality. Most were made in the U.S.A. The PC boards were double sided, had solder masks and plated-through holes. More than enough Texas Instruments' sockets were included for the I.C.'s. One puzzle was that all the components were grouped and placed in numbered "zip-lock" plastic bags but no code to the numbering was included.

For instructions, I was expecting a schematic and a bag of components but I was very pleasantly surprised. The manual is huge and very well organized. It is not quite in the Heathkit category but still darned good. There is a section very clearly giving the theory of this computer and an excellent set of schematic and construction diagrams. All the software included in the *SOLOS*' "personality module", which acts as a firmware monitor, is clearly documented. Unfortunately, the BASIC-5 included is not.

The assembly instructions were well thought out and follow a logical plan, with tests carried out as each phase of construction progressed. One failing of the instructions is that it is stated than an oscilloscope is optional and that the function testing can be done with a VOM. I found that not only is a scope mandatory, but that I needed the 50-MHz Hewlett-Packard oscilloscope in the lab of the local community college since a 10-MHz bandwidth was insufficient.

Construction. At this point, I would like to give two construction hints that I have developed and which were very helpful in building this kit. There is a lot of detailed checking of very dense PC boards before and after soldering and for this I have always used a stamp collector's light with magnifying lens. These can be purchased quite cheaply



The SOL-20 is well laid out. There are a number of slots for additional memory boards. The power supply is behind the monitor output jack and cooling fan.

at any philatelic supply store. Also I use a soft nylon toothbrush to clean off the board after soldering to remove stray splatters of lead that can cause solder bridges. It works quite well.

Assembly starts with the power supply. It is self contained and very compact. The fan is much quieter than on other computers and is unnoticeable when the chassis is closed. On the PC board, a small modification had to be made to desensitize the "crowbar" circuit protecting against a power surge. Interestingly, a similar circuit was demonstrated in "Kilobaud Klassroom #6."

There is very little point to point wiring as snap-on connectors and two cable assemblies are included. Amphenol RF connectors are supplied and are of the highest quality. All voltage tests were passed with honors.

The keyboard came pre-assembled, and I was disappointed at missing the chance to build it. The store informed me that there had been too many construction problems with it. As you can see, it has a separate calculator type keyboard which duplicates the numbers on the QWERTY keyboard but is simpler when entering numbers. Again, all function tests were passed.

The 16K RAM board comes as a "semi-kit". This means that it is assembled, but jumpers have to be added or removed to create the options that you need. The board is not burned-in, but two programs are included to do this. Unfortunately, neither is on cassette or paper tape and must be entered manually. More annoyingly, both these programs require additional RAM to operate, and must be located at address 0000. This doesn't allow the use of the RAM on the main PC board, which is addressed in the high area of memory for the use of the monitor program and cannot be readdressed. You will have to borrow a working memory board which is properly addressed from a friend or the store where you buy the kit. Some people may nitpick that this particular memory board has dynamic rather than static chips, but the day is long gone when the CPU had to halt to allow refreshing and the average hobbyist will not be held up by the refresh time.

The main PC board was the major task. All ICs were socketted except two where there wasn't enough room. There are repeated cautions in the manual about the handling of MOS devices, but I found that using the bottom of the chassis as a work surface with the power supply plugged in provided a good grounded work surface and the fan kept the solder fumes away.

Here is where I encountered the necessity of a good oscilloscope. The clock and VDM circuits both passed their tests on my VOM, but the VDM refused to work. A shorted disc capacitor in the clock circuit proved to be the culprit, but this could only be traced by examing the waveforms. Also, the value of resistor number 80 had to be decreased to 270-ohms to increase the sync amplitude on the video output to enable it to be displayed.

Interfacing. I used a "Pixie-verter" to interface to an old T.V. I chose this method mainly because it was cheap but it also allows me to attach the computer to another T.V. without difficuly. Furthermore, most old TVs (the ones favored by hobbyists) lack schematics and have "hot chassis", which makes patching one's computer directly to the video amplifier circuit rather hazardous both to man and machine. I also tried the "Waterloo Modulator" featured in the January 1978 issue of Byte. This uses a 7413 to create an oscillator but the display was not as sharp. Another possibility I considered was a UHF modulator, but most old TVs don't have UHF tuners. Theoretically, a UHF modulator would not give RF interference, but my Pixie-verter doesn't seem to cause problems. However, the computer itself does cause considerable interference, which I believe is from the power supply even though it is shielded and well grounded. For this reason it is best to keep both your monitor and cassette as far from the computer as practical.

The chassis is of very heavy grade metal and sturdy. As I mentioned before, I used this as a grounded work surface. However, I feel that the solid walnut ends should be optional. I don't know the current price of walnut but I would have preferred to have seen the money going for more hardware or a larger version of BASIC.

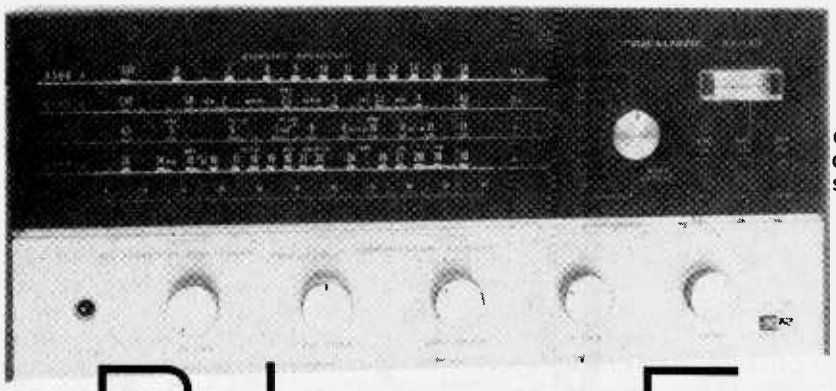
The backplane board is the equivalent of a motherboard but has only 5 slots. This does not present quite the hardship it sounds, as the VDM module and all I/O circuitry are on the main PC board and do not require space. Sockets are included for all five slots and a diagnostic socket is used on the top of the backplane board and can be used either as a sixth socket or for an extender board.

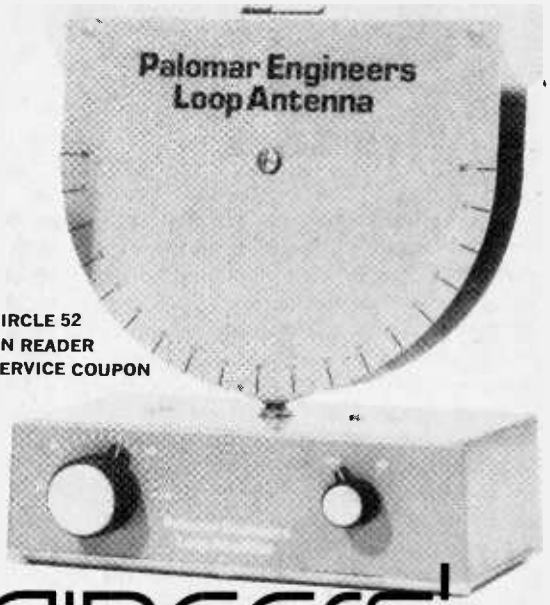
Unfortunately, their diagnostic socket is not the same quality as the other sockets. Mounting the backplane on the chassis was not an easy job and it is necessary to remove it if you want to remove the main PC board for servicing. Perhaps Processor Technology's designers feel that their products never need servicing!

Once the construction was finished, I had some difficulty loading BASIC from a cassette and my VDM had a "nervous breakdown" during the burning-in period. At this point, I found the service at the Computer Place, where I had bought the kit, to be excellent and the fault was detected and repaired in just over a week.

I learned a great deal about computers by constructing one and found the experience a lot of fun. As a "hardware man" I have many plans for the future of my *SOL*. I am planning a circuit to create a typing sound when information is entered on the keyboard, and a bell sound at the end of the line. Heathkit already uses such a circuit and it makes data entry easier for a person used to a standard typewriter. I also plan to build the modem described in the November 1977 issue of Kilobaud. Always remember that as long as you are still building, you can counter the inevitable question of: "But what's it good for?" with the answer, "Well, just wait until I have everything finished". You never will! ■

e/e checks out the...





CIRCLE 52
ON READER
SERVICE COUPON

Palomar Engineers' Loop Antenna

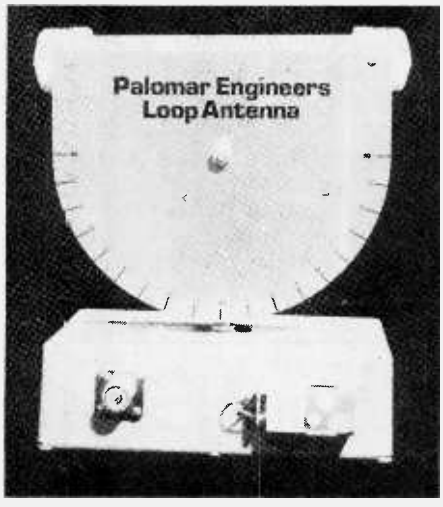
This DXer's delight can pluck a flea-powered station right out from under the nose of a clear-channel giant

HOW WOULD YOU LIKE TO tune to a "dead" part of the broadcast band, flip a switch, and suddenly find it's jam-packed with stations? That's exactly what happened to us when we tried the Palomar Engineers' BCB *Loop Antenna System!*

We connected everything together—the loop antenna system and a budget receiver—set the dial to the high end, between stations, so we could hear how the loop antenna first affected the reception of interstation noise. We expected the noise would give us some idea of whether the antenna system actually had "gain". Problem was, the instant we flipped the antenna system's power switch *on*, the radio was no longer tuned to a "dead spot;" rather, we got a signal booming in like the transmitter was out the back door.

Tuning the receiver told us we were not going to find any "dead spots," because the high end was filled with DX we'd never heard before. To make certain some unusual skip condtion wasn't playing tricks, we turned off the Palomar loop antenna system and the high end went almost dead as the proverbial doornail. Where we had heard S3 to S7 signals, we could no longer hear anything but noise—there wasn't a trace of a signal even with the receiver's BFO turned on.

Talk about digging out signals from under the noise. The Palomar loop antenna was digging out signals we didn't even know existed!



The single transistor-radio type battery used for the power supply is secured to the rear apron with a U-clip. Current drain of the internal amplifier is very low and the battery should last many months, if not its shelf-life depending on use. The UHF connector is the amplifier output.

Maybe if we had a longwire antenna we would receive those magical signals we received with the Palomar. But in this age of apartment houses with sealed windows, condominiums where you can't hang anything out the window, townhouses where any form of wire or antenna brings petitions of protest from the other side of town, and private homes with backyards no larger than a postage stamp, the longwire antenna is fast becoming a legend from the golden days of radio. Most BCB DXers are relegated to a piece of wire lying on the floor, or concealed under the carpet, for a skyhook.

The Palomar Engineers BCB Loop Antenna System has come to the rescue. The system consists of two separate devices. The first is a *loop amplifier*: a metal cabinet 7¼ x 6 x 2¼ inches that houses a broadband preamplifier, tuning capacitor, and power switch. The 9-volt battery power supply mounts on the back adjacent to a standard coaxial connector used for the output. The top of the cabinet has a phone-type jack mounted in the center of a 360° compass (which is also centered on the cabinet's top.)

The second part of the system is a somewhat oversize loop antenna assembly that plugs into the loop amplifier. The loop can be continuously rotated through 360°, or tilted ±90° from horizontal. A tilt scale is part of the loop assembly. The rotational scale is the 360° compass on top of the loop amplifier. The loop itself is but a small part of the total loop assembly; but the oversize hardware permits the loop to be positioned by the user without "hand effects" on the loop antenna itself.

e/e PALOMAR LOOP

When the antenna is plugged into the loop amplifier, the tuning capacitor (which is built into the amplifier) tunes the coil to the desired frequency or narrow range of frequencies, thereby providing the "amplification" associated with high-Q tuned circuits. Though the amplifier itself is rated by Palomar for a nominal gain of 20 dB, we attained signal improvements of 3 to 6 S-units, which represents a gain range of 18 to 36 dB—assuming the accepted value of 6 dB per S-unit.

The "extra" 16 dB of gain (63 dB −20 dB) is actually the result of tuning the loop, and the gain is realized in comparison with reception from a receiver having a built-in BCB antenna.

Peak or Null. For some unaccountable reason Palomar stresses using the device for *nulling* a strong signal in order to reduce interference to a weak signal, and both their instructions and descriptive literature concentrate on "nulling." This might reflect, the fact that they make loops for the 160/80 meter amateur radio bands, 150-550 kHz VLF, 40-150 kHz Loran, and 10-40 kHz OMEGA bands, where nulling of a strong local groundwave signal might be required in order to receive a skywave signal. (A loop antenna produces sharp nulls on groundwaves, but the nulls are broad or nonexistent on skywave signals. This permits local interference to be attenuated, or eliminated, while DX stations can be heard from all directions.)

But when it comes to BCB DXing it's the gain of the system that really pays off. It is possible, however, that some DXers might experience interference by a local station while monitoring DX, so we'll cover our results in both peaking and rejecting signals.

Hook up. The Palomar Loop Antenna system is connected to the receiver with a short length of coaxial cable: anything in the thin category such as RG-58 or RG-59 will suffice. Use the shortest possible length. If the receiver you're using for BCB DXing has a coaxial antenna jack simply use a matching plug on the end of the cable.

It is more than likely, however, that the shortwave radio, or hi-fi AM/FM receiver you're using has screw terminals for the BCB or AM antenna connection, so simply solder a set of solder-lugs to the free end of the coaxial cable.

If your radio/receiver has screw terminals it's possible that because of the extra-high sensitivity of the Palomar antenna a certain position(s) of the loop will cause "feedback" if the antenna system is mounted directly on the receiver, or immediately adjacent to the antenna terminals. The "feedback" is evidenced either by receiver blocking, or a loss of sensitivity in the receiver coincident with a whistle caused by self-oscillation of the system. Simply moving the Palomar unit a foot or so away from the receiver will eliminate the "feedback."

Set the loop antenna so there is no tilt, as indicated by the 0° index of the loop assembly pointing straight down. Set your receiver's tuning to a desired station, or to a "dead" frequency where you believe a station to exist. Switch on the loop amplifier and then adjust the loop amplifier's tuning knob for maximum received signal strength or noise. If you tune for maximum noise readjust the tuning knob after you have a station tuned in. Then, holding the loop's metal bracket and not the loop itself, rotate the loop assembly for maximum received signal strength.

If your receiver has an S-meter you will see an increase in the meter reading. If your receiver does not have an S-meter you will hear the signal increase in volume only if it was very weak—or not received—without the Palomar. If the signal was strong to start with, you probably will hear no effect from the speaker or headphones because the receiver's AGC (automatic gain control) will absorb the extra gain by reducing the receiver's gain an amount equal to the gain provided by the Palomar system.

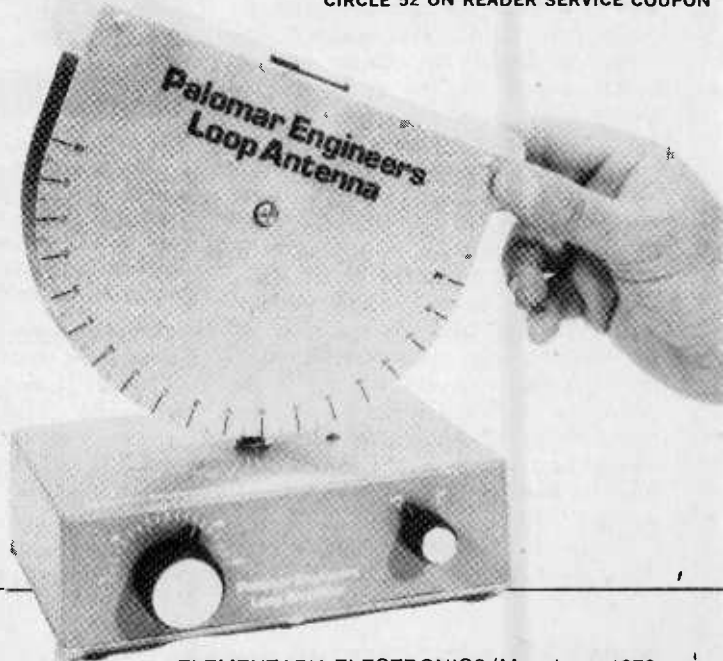
Now assume the DX station you want to receive is adjacent to the frequency of a strong local broadcaster. This is where you use the null feature. Remember, nulling only applies to a groundwave signal; you cannot null a skywave in order to receive another skywave.

One of the easiest ways to null is to first peak the Palomar to the undesired local signal; then rotate the loop for minimum reception, followed by adjusting the loop's tilt for additional null. With a little practice you can simultaneously adjust position and tilt to almost instantly null a station. The null is very deep; we have virtually eliminated all traces of a local broadcaster using a completely shielded Palomar-to-receiver input connection. When the receiver has screw terminals, some signal will be picked up by the screw itself and the short length of unshielded coaxial wire connected to the screw, but the pickup will be insignificant. The null is exceptionally deep, and we have actually extracted a skywave signal out from under the sideband interference of a local station by simply nulling out the local. (It really works!)

The nulling can also be used to reduce or eliminate local electrical interference. Say the motor or ignition system on your neighbor's oil burner, or a faulty flourescent light, is giving you broad-spectrum noise—hash all across the band. Under certain conditions (it doesn't work every time) you will be able to null out the electrical interference. We even got rid of the hash generated by a sewing machine motor in the next apartment.

Summing Up. If you already have a longwire outdoors there will be little, if any, advantage—unless you can util-

(Continued on page 86)



To null out an interfering groundwave signal the loop can be both rotated and tilted. Skywave signals are not affected when the loop is tilted. Loop tilt can also be used to reduce many forms of local electrical noise (interference).

e/e assembles the...

Heathkit AD-1304 Audio Processor

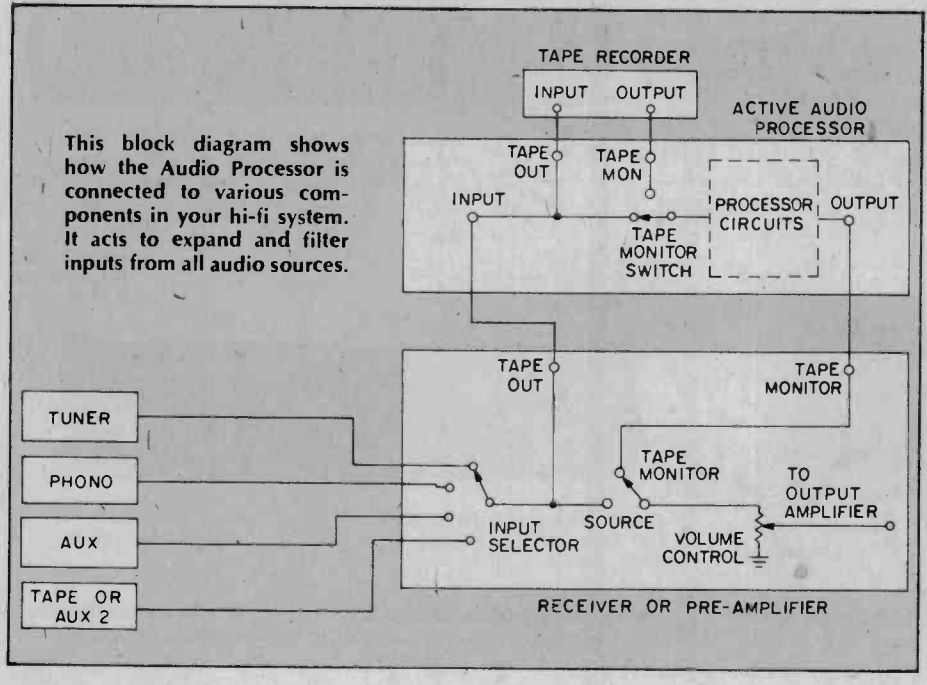
Hi-Fi add-on stretches your system's dynamic range and filters out some unwanted noises

THERE ARE CERTAIN CONDITIONS when the dynamic range of recordings or live broadcasts is limited to prevent overmodulation of the recorder or transmitter. There are also times that a relatively high background noise could be obtrusive. For the stereophiles for whom the occurance of dynamic range limiting or background noise might prove annoying, the marketplace offers several types of *audio processors* which expand the dynamic range and/or reduce high frequency background noise. One of the devices that provides both dynamic range expansion and high frequency noise reduction in a single modular component is the Heathkit Model AD-1304 Active Audio Processor.

The AD-1304 is a line-level device that connects between an amplifier's or receiver's preamplifier output and main amplifier input. This is generally accomplished by using the amplifier's tape connections and the associated tape monitor switch (same way you'd switch any other line-level accessory). The tape monitor connections are simply moved to the audio processor.

Three Functions. This in-line connection permits the AD-1304 to provide any combination of three functions: dynamic range expansion; noise reduction; high frequency filter. A separate on-off switch is provided for each of the functions.

The dynamic range expansion is applied to both the signal peaks and the lowest volumes in such a way that the normal dynamic range of the signal source is increased by approximately 7 dB at midband frequencies. Figure 1 shows how this is done.



This block diagram shows how the Audio Processor is connected to various components in your hi-fi system. It acts to expand and filter inputs from all audio sources.

Figure 1 is a picture directly off a spectrum analyzer oscilloscope. The horizontal sweep is calibrated from 20 to 20,000 Hz. Each major vertical division represents 5 dB; each minor vertical division is 1 dB. An unprocessed normal signal dynamic range of 20 dB is indicated by the two essentially straight lines two major divisions from the top and bottom. To this "normal" 20 dB range we apply the Heathkit dynamic expansion. The maximum signal is expanded approximately 1 dB at midband. But note the bass and high end are below the reference maximum level. The average between the low-high extremes and the midband is about 3 dB. Added to the 1 dB actual midband expansion, the effective value is about 4 dB.

The low level signal is attenuated 3 dB below the "normal" level at the midband by the expander. In total, the expander increases the dynamic range about 7 dB over most of the midband.

Noise Reduction. The AD-1304 is designed to suppress continuous high frequency noise. It does not suppress clicks and pops, such as you might hear from a dusty or mishandled record, or even radio static.

Noise suppression is accomplished by passing the signal through three triggered bandpass filters with center frequencies of 5 kHz, 9 kHz, and 13 kHz. The AD-1304 continuously monitors the program for high frequency content in the range of each filter. When there is no program content the filter is normally in-circuit, and the higher frequencies are attenuated, starting at about 2 kHz. Since continuous noise (hiss) are high frequencies it is attenuated by the bandpass filters.

If there is high frequency program information within the range of a filter it is sensed and the filter is shorted, al-

lowing the frequencies within the range of that particular bandpass filter to pass through to the output unfiltered.

Each filter continuously samples the signal, opening and closing in step with the program information. This is dynamic high frequency filtering, in contrast to a fixed high frequency filter that attenuates high frequencies regardless of the program signal's frequency distribution.

Figure 2 illustrates the dynamic noise filter. The more-or-less flat line is the overall response to high level signals in the range of 20 to 20,000 Hz. The roll-off, which starts at about 1.5 kHz, is the maximum filtering of high frequencies, obtained when there is no high frequency program information to "short" the bandpass filters. You can actually see the nulls of the center frequencies at 5k, 9k and 13kHz.

Fixed Filter. For those really tough noise problems, such as an old, worn 78 rpm record, the AD-1304 provides the fixed high frequency filter shown in Fig. 3. The straight line is the overall response with the filter switched out. Switched in, the filter is 3 dB down at about 7kHz, and 10 dB down at about 15kHz. This is what's known as a "mild" filter, meaning it can be used with most program sources, even modern recordings, and will not remove so much high frequency program information (if recorded) that the signal gets an overall "muddy" sound quality.

Adjust To Taste. Both the expander and dynamic filter have front panel sensitivity adjustments that allow the user to establish the optimum value of expansion and noise suppression for a particular system, or recording. Screwdriver adjustments on the rear apron for both the left and right inputs allow the user to match the sensitivity to the normal program line level.

Once connected to the associated amplifier, each function can be individually switched in and out, or the tape monitor can be switched in as the signal source for the processor. With all processing switched out the overall frequency response is +0/2 dB 20-20kHz at a distortion no higher than 0.1% THD.

Build It Yourself. The AD-1304 is available in kit form for $199.95 (mail order price). Most of the circuit is on printed circuit boards: There is a large "mother" board with sockets for plug in expander and control/bandpass filter modules which are also printed circuit assemblies. A separate meter assembly is provided for tests and adjustments. The meter "panel" is internal and not normally seen when the cabinet is secured.

There is extensive user alignment and adjustment. Not difficult, but time consuming and requiring considerable care; just don't rush through the adjustments if you want optimum operation.

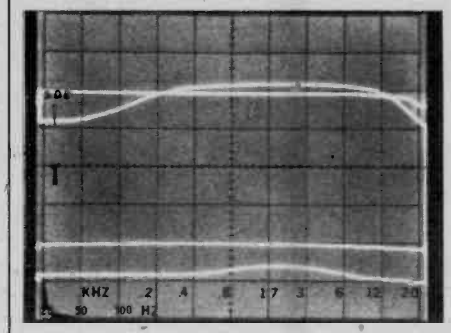
Performance. The expander does just what it's supposed to do: namely, expand the dynamic range. However, limiting during mastering is performed on signal peaks, not the average program level, yet expanders expand average program level. This produces minor volume surges which do not exist in the tape-to-record-master process.

As for the noise filter, it also works as claimed. If you have a very old tape recording with a relatively high hiss level, or are listening to a very weak FM station, the noise filter noticeably reduces the high frequency noise.

As with most expanders and noise reduction systems the Heathkit AD-1304 is somewhat limited in application if you are interested in high fidelity sound. But if you want larger than life dynamic range, and have signal sources that require "hiss" reduction, the AD-1304 might fill your needs.

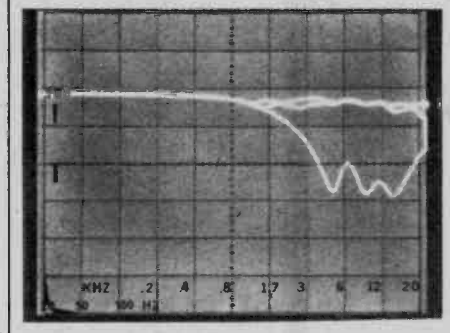
For additional information on the Heathkit AD-1304 circle No. 1 on the reader's service coupon. ■

Figure 1



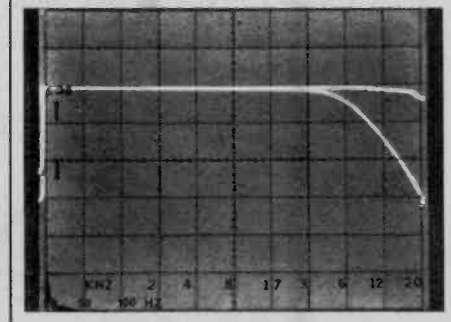
This oscilliscope photograph shows the AD-1304's dynamic range expansion, which is explained in the text on preceeding page.

Figure 2

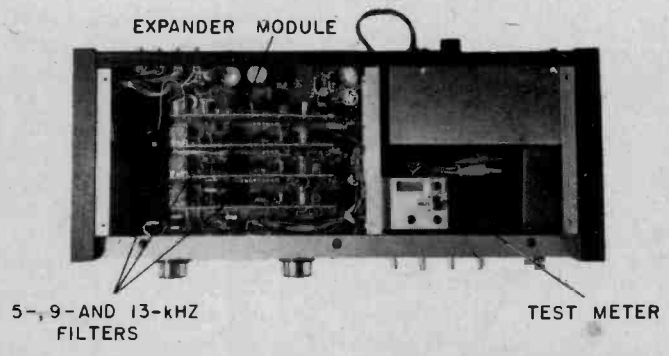


Here you can see the nulls of the 5-, 9- and 13-kHz dynamic noise filters. The top line shows when they are not activated.

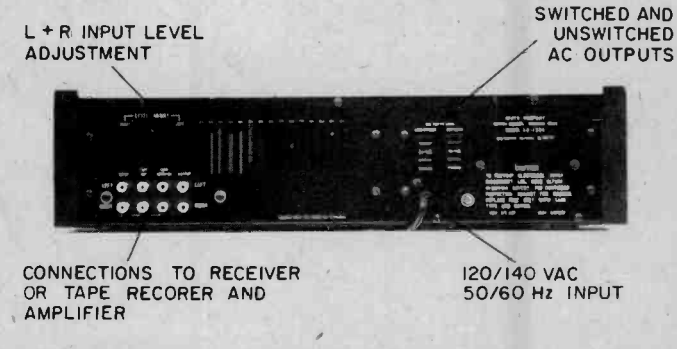
Figure 3



This 'scope shot shows how the high frequency filter affects the top end of the spectrum. The signal is 10dB down at 15 kHz.



The expander and three filter modules plug into the main board assembly. The test meter is built into the cabinet and is used for circuit alignment during construction and for circuit testing.



Since the processor will utilize a receiver's tape connections, the tape connections are moved to the processor along with the tape/source monitor switch. It can be built for 120 or 240 use.

The Complete Idiot's Guide to Becoming a Lid

(or how to be a lousy operator)

by Thomas R. Sundstrom W2XQ

THE ASTOUNDING GROWTH in the number of amateur radio licenses issued in the past few years has resulted in a virtual logjam on the bands. As a byproduct of this overcrowding, good operating practices are vanishing as rapidly as bottles of '64 Laffite Rothschild.

A poor operator is known as a "lid," and a lid is to be pitied, and hopefully educated, but not tolerated. If the educatory process is approached with tact, the errant operator's practices can be amended without alienating him or her. In this light, we bring you The Complete Idiot's Guide to Becoming a Lid.

On Tuning Up. Don't bother using one of those ridiculous oil-filled dummy loads for tuning up your transmitter. The only people who advocate their use are the people who manufacture them. The $20 to $30 which you might waste on them could buy a lot of beer. Instead, find the busiest frequency on the band, be it CW or phone. Since most of the activity is taking place here, it makes sense to load up your rig in the neighborhood in which you'll be operating, right? To allow for temperature variations, take at least ten minutes to accomplish tuneup, throwing a test tone about every 20 seconds or so, to allow for drift, and to let the other ops know that you're there.

On Calling CQ. Any frequency within your license segment is fair and legal territory for you to call CQ in. You don't necessarily have to be concerned with other stations transmitting on the same frequency, since you won't bother them while they are transmitting because they can't hear you.

Never answer another operator's CQ. Where's the challenge in that? You already know he wants to start a QSO. Instead, try calling a CQ right on the same frequency, and see who gets the first response. After all, why shouldn't every day be a contest day?

On CW. Now that you've finally gotten rid of that old manual key in favor of one of the new keyers, you can really burn up the ether with your speed. Always send just a bit faster than you can copy, because chances are the other op can't copy that fast either, and he'll have to ask you to QRS (slow down).

e/e BEING A LID

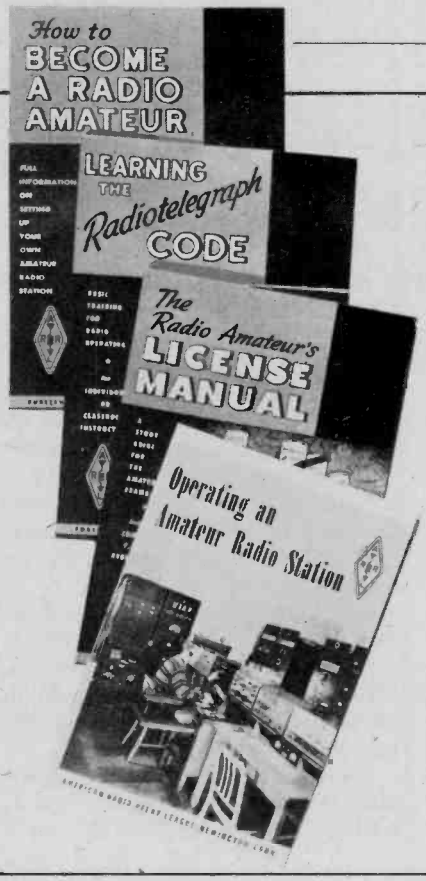
It's a lot better, and less embarrassing, than if he asks you to QRQ (send faster). After all, you did spend a lot of money on that keyer.

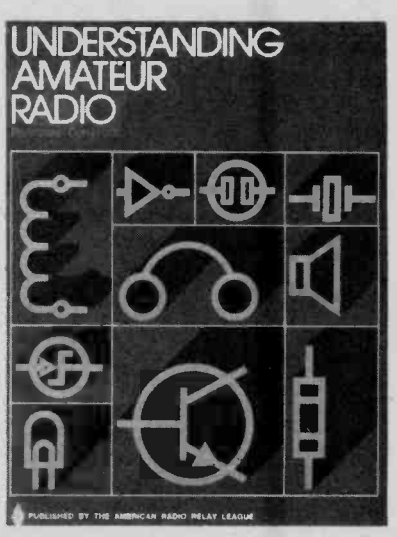
Since you did spend all that money with the idea of becoming a better CW operator, it's a good idea to stay away from all of those abbreviations and "Q" signals. Nobody understands them, and you get more practice if you spell every word out.

On Phone. Stay away from those international phonetics when sending your call. Tres passé. Something catchy and current is much better. If those foreign ops can't get it, that's tough. They should watch more television.

Remember, there are many more CB'ers than hams, and the CB lingo is now part of everyday English. There's absolutely nothing wrong with using everyday vocabulary on the ham bands. That textbook grammar is strictly kid stuff.

One of the most efficacious methods of "punching through" on the HF phone bands (below 30 MHz) is to turn up your speech compressor to maximum. The splatter will clear out anything within 10 kHz in either direction. Let's face it: if your phone signal is good within its limited 2 kHz bandwidth, it ought to sound five times as good with the additional space. Don't give in to those guys who inevitably will ask you to detune. If their rigs don't have enough receiver filtering, that's their problem, not yours.





These five ARRL publications, comprise an excellent desktop reference series for the Amateur. From basic principles of radio, to the finer points of station operation, these books are the answer to avoiding becoming what is known as a "lid." An outstanding bargain even at twice the price.

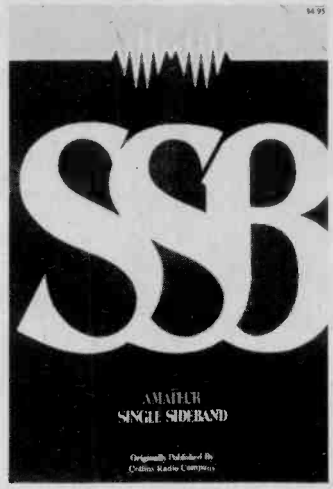
On Working DX. Don't wait until that DX station finishes calling CQ before you start answering. Start calling him as soon as you have his call down. He may have a local frequency manager listening on the side, who is taking down the calls of the stations answering the CQ, in order to have a list for the DX station to reply to. You can be first on the list, so why wait?

Regardless of how many other stations might be waiting to work him, always get the QSL routing information from your DX contact. Not only do you get the information you need, but you perform a service to the other operators waiting on frequency by allowing them to copy it also. Making the DX station repeat it a few times is always a good practice. Sometimes their English ain't too cool.

On VHF FM Repeaters. Always initiate a conversation by calling CQ. It's foolish to announce that you are listening on the frequency, because if you're not talking, it's obvious that you are indeed listening. Calling CQ will identify you as an A-1 HF operator.

Once you have the repeater, keep the pauses between transmissions to an absolute minimum, because there's always the possibility of losing the channel to someone else. First come, first served. Also, don't be misled by those people who yell "emergency!" That's just a ruse to get you off, and get themselves on. If there's a real emergency, they can use the landline. That's what it's there for.

Conclusion. Obviously, this has been a guide towards what *not* to do, and you can probably add to it based upon your own experiences. It is truly unfortunate that many operators substitute dollars and cents for common sense, and kilowatts for milliwatts when the latter, in each case, is sufficient to accomplish the task at hand. Remember, the whole world is listening to you. Think about it the next time you fire up the rig. ■

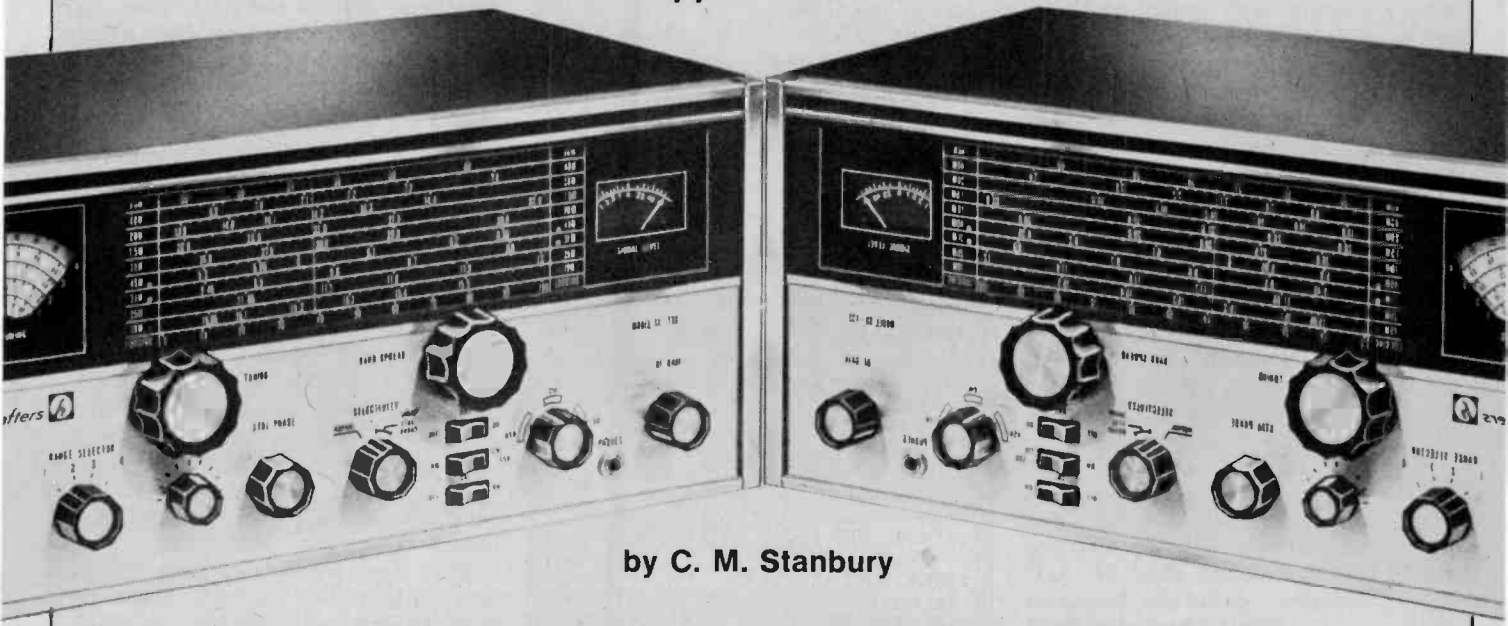


The Radio Amateur's Handbook, and Understanding Amateur SSB are excellent examples of the educational material available.

IMAGES

by C. M. Stanbury

Like mirages in the desert radio stations are not always where they appear to be



THE MOST ANNOYING PROBLEM faced by DXers and SWLs is the image. Unlike harmonics and other spurious signals produced by the transmitter, an image is not real—it is produced within the receiver itself. It causes novice SWLs to report stations on erroneous frequencies, and creates additional interference for DXers. You can't always cure them but every listener should be able to tell these phonies from the real thing.

Superheterodyne. All images are the result of superheterodying, i.e. the mixing of two frequencies in a circuit to produce two other frequencies—the sum and difference of the two original frequencies. If you mixed WWV's 2500 kHz signal with Voice of America's 6190 kHz Greenville transmission, WWV and VOA would appear on 8690 kHz (6190 plus 2500) and 3690 kHz (6190 minus 2500). All modern radio receivers take advantage of the superheterodyne principle to provide more efficient and less expensive amplification circuits.

Every receiver contains its own built in mini-transmitter known as a "local oscillator." In the simplest radio, whatever frequency you are tuned to the local oscillator will operate exactly 455 kHz higher. Thus, if you are tuned to Radio Surcolombia on 5010 kHz, your local oscillator would be on 5465 kHz. The two are combined in your receiver's "mixer" circuit producing, of course, that desired 455 kHz "intermediate frequency" (usually referred to as the "IF"). From there on, all amplification circuits in the receiver (except those in the audio section) can be pre-set to this fixed IF. Equally important, selectivity (the ability to separate the desired signal from those on adjoining frequencies) is considerably better at 455 kHz than on higher frequencies.

Suppose, while you are listening to Radio Surcolombia on 5010 kHz (and your local oscillator is at 5465), Radio Moscow has a strong signal on 5920 kHz. 5920 just happens to be 455 kHz above 5465 so if it mixes with your local oscillator it will also produce an intermediate frequency of 455 kHz. In other words, Radio Moscow's 5920 signal will show up as an image on 5010 kHz. Note that resultant frequency relationship—this type of image always shows up 910 kHz (two times the 455 kHz IF) below the real frequency. Therefore, your local oscillator and VOA's 6190 signal can produce a 5280 kHz image while WWV's 2500 kHz transmission might even show up at 1590 kHz on the standard AM band.

Another Kind Of Heterodyne. So far the kind of heterodyning process we've talked about has involved only radio frequencies. But there are also audio heterodynes. If you are tuned to BBC Ascension Island on 6005 kHz there may be interference from Radio Reloj de Costa Rica on 6006 kHz. No one need a pocket calculator to tell them that the difference between these two frequencies is 1 kHz 1000 Hz)—well within the audio range. When this (not-so-super) heterodyne reaches the receiver's audio circuit it will be amplified and emerge from your speaker or headphones as a very annoying whistle. To distinguish it from other forms of the heterodyning process, the audio heterodyne is usually referred to simply as a "het."

Just as real interference can cause a

het, so can image interference—but there is one important difference. When the local oscillator produces interference on the frequency to which you're tuned by mixing with a strong station on another frequency, the resultant het will vary in pitch as you tune across it—unless the image is caused by a pulse modulated station such as Loran or shortwave radar.

If, while listening to Radio Surcolombia on 5010 kHz, there is a het, turn the dial slightly. If the het varies in pitch, it is being caused by the Radio Moscow image (or some other strong station on 5920). If the het remains constant then there really *is* a second station within a few kHz of 5010.

Some Strategy. Short of actually modifying your receiver, or buying a new one, your most important defense against images caused in your local oscillator is the antenna tuner knob. Determine which antenna setting is best for each "band," or more precisely the best setting for each MegaHertz. If you find two stations and know that one is an image but don't know which, the real signal will be strongest at the proper antenna tuner setting while the image will be strongest at a slightly different setting.

The next step is to eliminate the het caused by that image—and, yes, you can. Tune the dial *very* carefully until the pitch of the het drops to zero. Unfortunately, most inexpensive receivers are a bit unstable so you may have to repeat this process every few minutes. However, if the image is caused by a broadcast station or even some utility stations with voice modulation, the worst of the interference will be eliminated so it is worth the effort. If the image is from radioteletype, facsimile, etc., the victory will be less clear cut.

Even if an image doesn't cause interference it can, as noted at the beginning of this article, lead you to report a station on a false frequency. Any time you hear a broadcast station about 910 kHz below a regular shortwave broadcast band (see our chart) check that band to make sure you can't find this same station with an even stronger signal. A station will always be strongest on its real frequency.

Overload. Sometimes signals will come in so strongly that a sensitive receiver cannot handle them. Under these circumstances, mixing will take place independent of the local oscillator—that hypothetical case of WWV (2500) and VOA Greenville (6190) producing images of 8690 and 3690 kHz. That

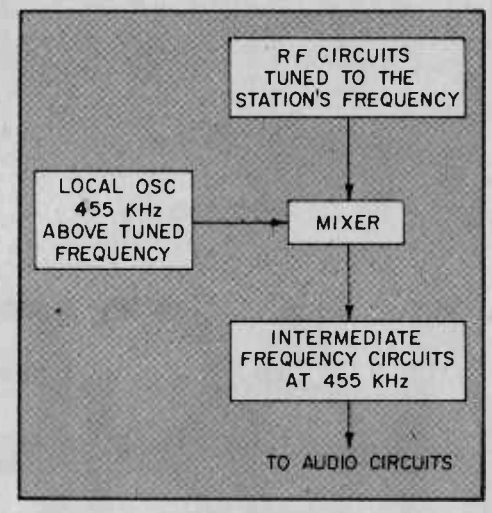
The Shortwave Broadcast Bands

3200-3400	Shared with utilities
3800-4000	Shared with amateurs
4750-5060	Shared with utilities
5950-6200	
7100-7300	Shared with amateurs
9500-9775	
11700-11975	
15100-15450	
17700-17900	
21450-21750	
25600-26100	

If you hear a broadcast station approximately 910 kHz below one of these bands, it may be an image. The frequencies listed on the chart shown above are in kiloHertz.

sort of extreme frequency spread usually occurs only with standard AM stations—if you lived in New York City you might find WQXR (1560) mixing with WMCA (570) on 990 (1560 minus 570) and 2130 (1560 plus 570)—and even then it may mean that small amounts of unwanted direct current are getting into the "RF" circuit" (see block diagram). If you use an external antenna, make sure it isn't "grounded." Check for bare antenna wires touching tree limbs, or insulators which have become saturated with moisture after several years use.

More difficult interference problems from overload images are the result of more complex mathematical relationships which can be expressed in multiples (called "harmonics") of the frequencies involved. If you are receiving very strong signals from VOA Greenville on 6190 and Radio Canada International 6140, they might produce an image on 6240 kHz (2 x 6190 minus 6140). This calculation is derived algebraically from the relationship (6190 minus 6140) plus 6190. Note the difference between the image frequency and the real frequency is relatively slight so your antenna tuner control won't help.



This block diagram shows how an image signal is formed. It will always be twice the intermediate frequency below the station. Double conversion receiver may cure image.

To make things still more complicated, such mixing may not be occuring in your receiver or antenna at all. If two transmitters are at the same location, a technical malfunction can cause mixing right at the transmitter site (in which case it is usually referred to as "cross-modulation." We once found VOA Greenville transmissions on 15140 and 15280 interfering with WWV on 1500 kHz (2 x 15140 minus 15280). Neither 15140 nor 15280 were anywhere near strong enough to overload our receiver so the Greenville signal on 15000 was obviously real. On medium and long wave, cross-modulation occasionally occurs in the ionosphere (the "Luxembourg effect"). This has been extremely rare in North America due to the absence of super-powered transmitters which can quite literally overload the ionosphere. We have not seen the Luxembourg effect reported on short wave in any part of the world.

Still More Complex. Certain other minor receiver defects can create some outrageously exotic mathematical combinations. Minute radiation from the 455 kHz intermediate frequency amplifier can mix with incoming signals, and the local oscillator may radiate at its second harmonic. Suppose a listener in the Buffalo, N.Y. area is tuned to 1495 kHz. His local oscillator will be at 1950 kHz (1495 plus 455) and its second harmonic will be at 3900 kHz (2 X 1950). Meanwhile, there is a powerful local (WKBW) on 1520 kHz and another (CHOW) on 1470 kHz. If WKBW overloads the receiver, we have the equation; 3900 −(1520 + 1470 + 455) = 455 kHz. Therefore WKBW and CHOW will appear on 1495 kHz. Fortunately such images, which can be detected via the variable het test previously described, are usually weak and generally limited to the standard AM band.

Then there are the new crop of synthesized frequency receivers. These use multiple local oscillators some of which deliberately radiate harmonics. Each model has its own particular arrangement of intermediate frequencies thus we cannot deal with them comprehensively here. However, note that overloading can be a major problem with the less expensive models. On the other hand, simple superheterodyne, local-oscillator-caused images are virtually eliminated by dual conversion.

Buying A New Receiver. When it

(Continued on page 87)

Getting burned by the high cost of electricity? Go Sun Power!

SOLAR SWINGER

Homer L. Davidson

HAVE YOU EVER seen a model ship inside a bottle? The next logical step is to build a small radio inside of a radio or TV vacuum tube! We call it the *Solar Swinger* and it has no on/off switch, batteries or power supply. If you want to turn the Solar Swinger off, just place a cap or hood over the tube. You may want to let it play all the time—it doesn't hurt a thing. No need to worry about batteries running down, for the little radio is solar powered. It will operate in the sun, shaded daylight or under a desk lamp in the evening. Of course, the radio won't blast your ear drums with music, but you can listen to local AM broadcast stations with ease.

Tube Preparation. Select a defective radio or TV tube with a bakelite base. The larger the glass tube, the greater building area for the small radio components. An antique radio tube is ideal, but not necessary. If you can't find one in the junk box, check with your local Radio-TV shop—they may throw out several hundred of these old tubes every year.

There are many old power output tubes available, such as 6L6G, 6C6G and 5U4G. Don't select a 6BK4 type as you cannot remove the top metal anode from inside the glass envelope. You may use a large tube (6LQ6) with a glass base and then mount it on top of a black tube base. Pickup five or six old tubes to practice on.

Before attempting to remove the bakelite base from the tube, let air into the bottom of it. All radio and TV tubes operate with an internal vacuum —the air having been pumped out. A small glass seal is located at the bottom of the tube.

Always wear a pair of gloves when working around glass or warm components.

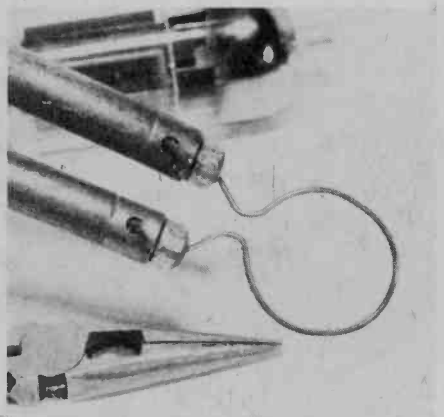
Now you want to let air back inside the tube. Break off the black bakelite center key locator between the tube side the tube. Break off the black bakelite center key located between the tube prongs. You should see the pointed glass seal. Take a pair of long nose pliers and break off the glass tip. You may hear a rush of air, or see a couple of white areas form near the bottom of the tube envelope.

To prevent glass pieces or excess solder from falling on the floor or work bench, do all of the glass preparation inside of a large pasteboard box.

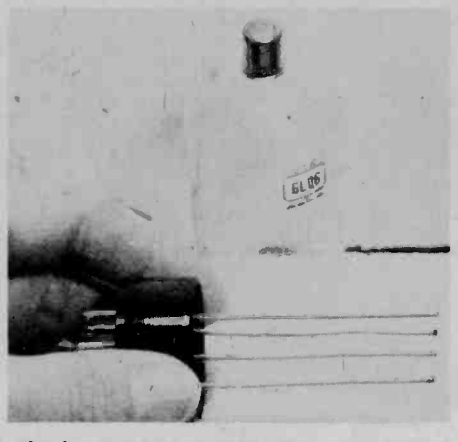
Next remove the soldering iron tip from a 150 or 250 watt soldering gun. Take a six-inch piece of number 14 copper wire, (you can remove the insulation from a piece of number 14 romex or a single conductor electrical wire for this purpose) and form a loop shaped soldering element. Wrap the bare wire around the base of the tube next to the bakelite base area and insert about one inch into the gun tip and bend over. Tighten down the soldering iron nuts—real tight. After cutting a couple of glass bases you may want to snug up the soldering iron nuts for a greater transfer of heat. Keep the copper loop close to the gun tips so

Break off the black tube-locator pin and the glass tip with some long nose pliers.

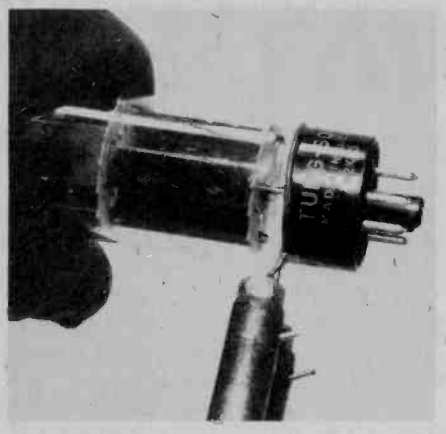
Note the clean easy cuts this technique produces. Make sure you have a back-up tube.



Form a loop of copper wire that fits snug around the tube and into a soldering gun.



The four copper support wires are soldered into the pin bases. The components are soldered and glued to these supports.



Put the loop over the part of the tube you wish to cut and hold the tube firmly. Wear gloves to keep from burning yourself on the hot glass. Next apply heat to the loop and rotate the tube until the glass cracks.

the loop will heat up faster. Pinch it close together, and snug, clear around the tube with a pair of long nose pliers. You have now constructed a copper wire loop to replace the soldering iron tip.

Slip the wire loop over the end of the tube base and press the loop together at the ends—but not so close as to touch. Now hold the tube in the left hand and soldering gun in the right. Very slowly turn the vacuum tube inside the heated loop. Within a few minutes you will hear the glass crack and break in a perfect cut at the base of the tube. Some glass tubes take longer to break than others. In the meantime you may smell a hot bakelite odor from the wire loop, which is normal. Often the glass will crack clear around and just a tap on the end of the bakelite base separates the two pieces.

If you have selected a tube with a metal cap on top, turn the inside components until the connecting wire breaks off. Be careful not to break the remaining glass envelope, which is very brittle. It's best to cut off the wires connecting the tube elements to the base with a small pair of side cutters. In case the tube elements and mica insulators will not pull through the small opening, use a pocket knife to cut out sections of the insulators. You may have to crush or remove the tube elements in sections. Again, proceed slowly to prevent breaking the glass envelope. If you break or crack the tube envelope, start on another one—one out of three is not a bad average.

If you choose a TV tube with a glass base (6LQ6), press the copper loop around the prongs and against the glass bottom of the tube. Break off the small glass seal between the prongs and let air into the tube. Heat up the soldering gun and rotate the tube until the glass cracks in a round circle. Now break and crush the glass base with the wire tube prongs into little pieces. Be very careful in removing the tube elements, they must be reduced in size until all parts fit through the small opening. You may want to cut and remove each element piece individually until all parts are removed from the tube envelope. Later on, you can glue this glass envelope over a separate bakelite tube base.

It's best to cut out three or four tube envelopes. After removing the tube elements, choose the best one. If the glass edge is a little irregular, don't worry; when placed upon the black base the area will be covered with rubber silicone cement and will look like it belonged there all along. Now wash out the white and dark areas inside the glass envelope.

Tube Base Preparation. To remove the remaining glass and connecting wires from the tube base, each tube prong must be unsoldered. Hold the tube base upright and over a pasteboard box. Apply heat from the soldering iron against each prong. Let the excess solder begin to boil and then fling the tube base downward and the excess solder will fall into the bottom of the pasteboard box. Use this method on each tube prong a couple of times to remove all of the solder. After the excess solder has been removed, pull the connecting wires out of the tube base area. You may have to break the glass in several pieces to remove some stubborn connections. Clean out the excess glass cement with a pocket knife and place the tube base with the glass envelope for safe keeping.

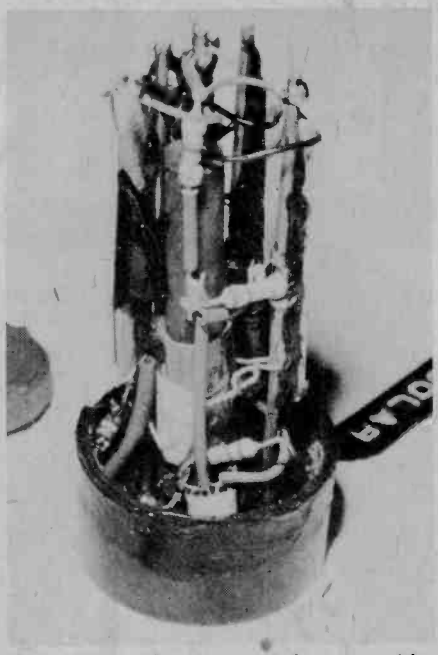
Tube Base Construction. Cut four pieces three inches long, of number 14 or smaller copper wire. These four support wires will become tie-in circuit and mounting supports for the small components. You may use any stiff wire for these supports as long as the wire itself can be soldered. Number 14 copper wire will just fit inside the tube pins and solder should be fed up from the bottom terminal. Also, you may solder the wire supports from the top side, down inside the tube base. Place support wires in terminals 1, 2, 6 and 8. Look at the bottom of the bakelite socket and start with Pin #1, to the

left of the center pin. (Although the tube locator pin is broken off you still can see where it was located.)

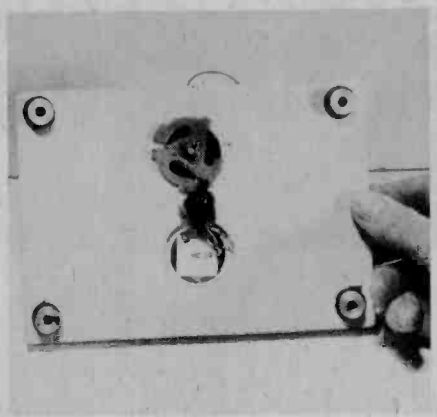
After all support wires are soldered into position, clean excess solder from each wire with a pocket knife. Scrape off rosin and excess solder down inside the base, next to the support wires.

Place a 6-32 ¾ inch machine screw and washer in the center hole of the tube socket. Slip a nut on the outside of the screw to hold it in position until the socket can be bolted to the wooden base. Temporarily, slip the glass envelope over the support wires to see if they will clear the top area. You may use longer support wires if the glass envelope is a lot longer in length. This may help string out the parts and keep them from shorting against each other. A cut glass envelope from a 5U4GT tube runs about three inches long.

A tube's pin terminal connections (bottom view) are shown. Remember the tie-wire supports are reversed when the tube socket is upright. Scratch a line straight up from the tube locator pin, along the side of the socket, with a pocket knife. Now place a piece of masking tape around it and mark the support wires. You can now solder to your heart's desire. The four supports will be used for component tie points and they are marked upon the schematic. Wire support number 8 is used only as a wiring tie-point for the small components. All other support terminals will be tied into the circuit after the tube socket is bolted to the wooden base.



The photo cells are mounted on two sides of the frame. The loop stick fits neatly in the middle of all the components. The transistors are in the base of the tube.



The only wood work needed is to make two large holes in the base. One for the tube and one for the tuning capacitor. A bolt through the base holds the tube in place.

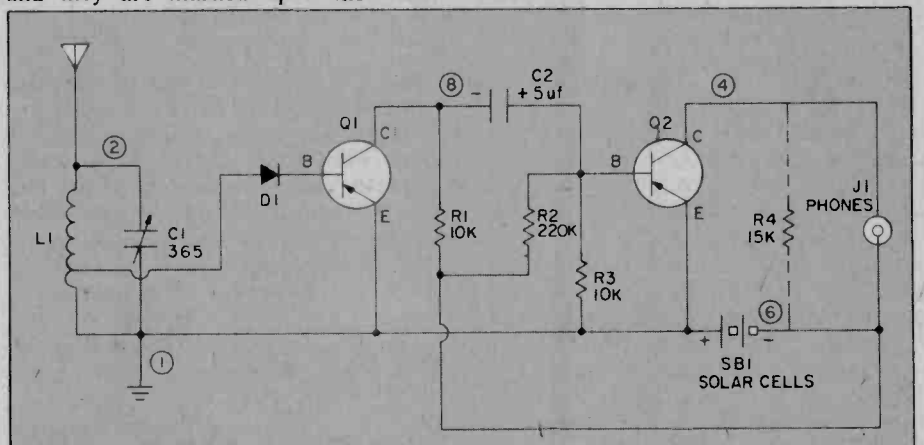
Wiring in the Parts. Mount the antenna coil (L1) in the center of the support wires since it is the largest component. Solder the top wire to pin 2 and the bottom terminal to pin 1. Leave it loose until all parts are soldered and then use a dab of silicone cement to hold it in place. Solder the collector terminal of Q1 and negative terminal of C2 to support wire number 2. Keep the leads fairly short and place a pair of long nose pliers next to the transistor body as a heat sink. The emitter terminals from each transistor will tie to terminal support number 1.

Now solder in all small components to their correct support wire terminals. Place a piece of spaghetti over the collector wire of Q2 and solder into pin terminal 4, if it is long enough. If not, lengthen the terminal wire with a piece of hookup wire. Connect the small diode between the coil tap (L1) and the base terminal of Q1. Slip a piece of spaghetti over the wiring to prevent touching of other components.

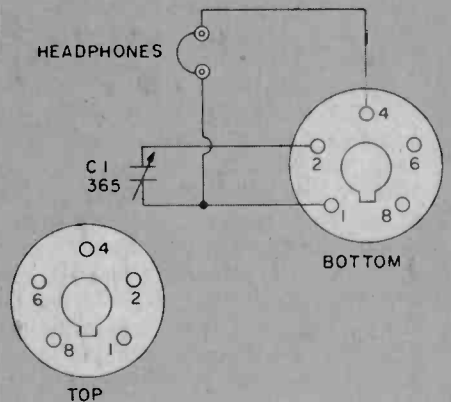
Mount the solar cells last—inside the tube area. Be careful to observe correct wire polarity. The positive terminal will solder to terminal 1 and the negative wire to 6. After all wiring has been completed inside the tube socket, double check each component and tie wire before bolting to the wooden base. Now tack the antenna coil (L1) and solar cell into position with a dab of silicone cement.

Base Layout. You may pick up a wooden base mounting plate at any novelty or hobby store. Ours was 6¾ by 4½ and cost .99 cents. They may come in many sizes and shapes with a higher or lower price tag. Mark the parts layout on the bottom side of the wooden base. The tube socket may be mounted 1½" from the rear and in the center of the base plate. Place a

(Continued on page 94)



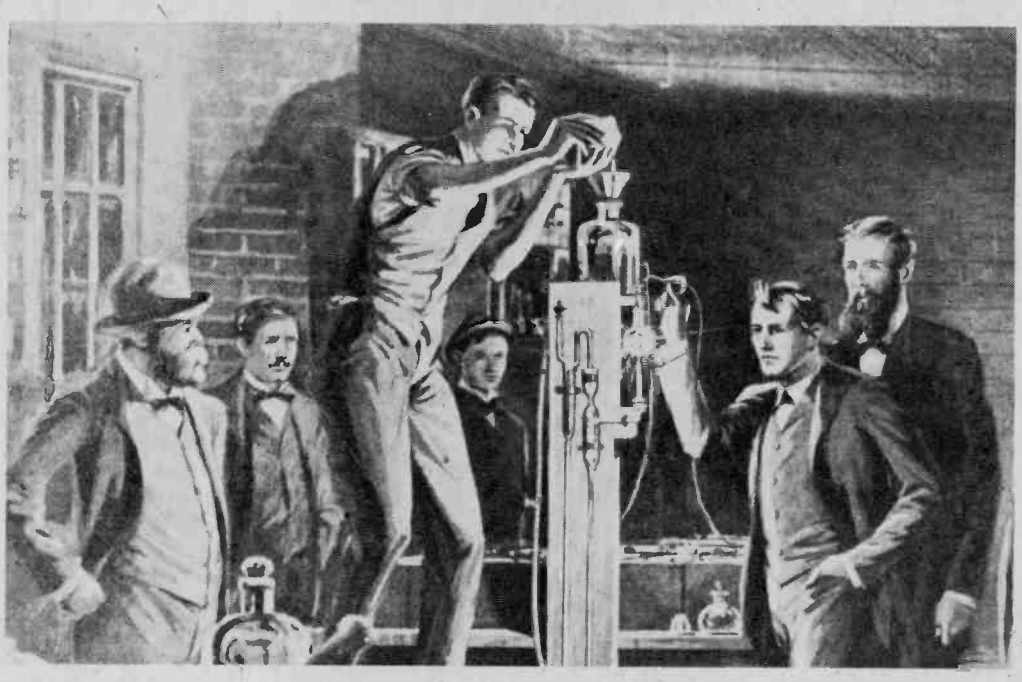
Need parts? Hobby Mart: page 89.



PARTS LIST FOR SOLAR SWINGER

C1—365-uF variable capacitor
C2—5-uF electrolytic capacitor, 15-volts
D1—1N34A germanium diode
J1—any jack to fit headphones
L1—ferrite antenna coil (Radio Shack 270-1430 or equiv.)
Q1, Q2—2SA52 transistor (RCA SK-3003, GE-2, Radio Shack 276-2004)
R1, R3—10,000-ohm resistor, ¼-watt
R2—220,000-ohm resistor, ¼-watt
R4—15,000-ohm resistor, ¼-watt
SB1—two solar cells (Radio Shack 276-120 or equiv.)
Misc.—headphones of 1000-2000-ohms; ¾ bolt and nut; tube base; old tubes; wooden plate; etc.

in search of New Edisons



U.S. Department of the Interior, Edison National Historic Site.

THOMAS ALVA EDISON was one of a kind, and the hero of every kid of the 1930s who made rotten-egg smells, and burned holes in his bedroom curtains with a chemistry set. All over the country, knee-pants test tube shakers dreamed of one day making great scientific discoveries for the betterment of mankind. And indeed some of them did just that, as witness the development of laser technology, plastics, television, and computer science, to mention but a few of the more obvious examples. Scientific progress continues to be made, of course, but something is clearly missing. It's the unique kind of *inspired motivation* that characterized Edison and other scientific greats of the past.

A year-long "Centennial of Light," an international celebration to commemorate the 100th anniversary of Thomas Edison's invention of the incandescent electric light bulb on October 21, 1879, has a second and equally important purpose: To inspire the youth of today and of the future in the belief that there *are* solutions to many of today's global problems. The solutions need only to be sought and found, through scientific developments as well as through social, political, and economic advances.

Thomas Edison, a highly principled inventor-businessman, is the ideal inspirational symbol. As Robert I. Smith, chairman of Public Service Electric and Gas Company, and head of the International Committee for the Centennial of Light paraphrases an Edison biography, "Although Edison led no armies, conquered no countries, enslaved no people, his life and his inventions have influenced the course of history more than any other person in recorded civilization."

The light bulb was but one of more than 1,000 inventions patented by Edison. Other outstanding inventions included: An entire system of electric generation and distribution, the phonograph, the motion picture camera, and equipment that made telephone and telegraph systems commercially practicable. Edison's scientific genius had direct bearing, long after his death, on the development of the modern electronics world as we know it, including invention of radio, television and modern cinematography.

The Centennial of Light, kicked off in September 1978, will go on throughout 1979. Major elements of the planning are designed to attract students and educators. For example, symposiums will bring selected high school students and teachers to Florida's Disneyworld in February, and university students and professors will go to San Francisco in April.

Science Fairs will be encouraged in elementary and high schools throughout the country. Educational materials and scholarship programs will emphasize the need to encourage young people to pursue scientific knowledge. Other plans in the works include: The showing of special films, television, and radio programs, traveling exhibits, displays and lectures, and even parades.

Among those already planning special programs, events and activities for the Centennial are: The American Association for the Advancement of Science, the Smithsonian Institution of History and Technology, the United States Park Service, the Edison National Historic Site in West Orange, N.J. (the site of Edison's research laboratory), Menlo Park, New Jersey, the city in which Edison conducted his successful experiments with the incandescent lamp, the New Jersey Histori-

The celebration of the centennial of electric illumination will recall Edison's light and hopefully shed some on the process of invention for the youth of today

by Jorma Hyypia

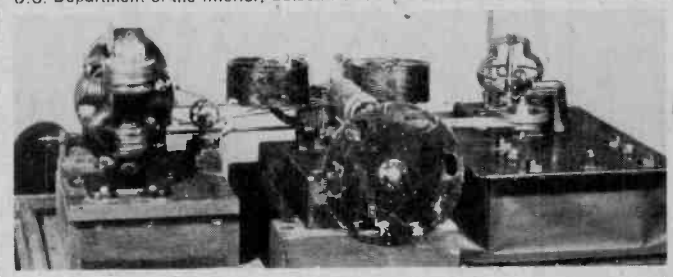
cal Commission, Fort Myers, Florida, site of Edison's winter home and former site of his "Fort Myers Lab", the Electric Power Research Institute, the Edison Electric Institute, and Rutgers University, which is initiating a 20-year project to organize and publish all of Edison's scientific papers.

One major focus of Centennial activities will be Dearborn, Michigan, where 50 years ago Henry Ford dedicated Greenfield Village and the Ford Museum to American values and ingenuity, and to the man he considered to be the greatest genius the world has ever known. Ford removed the 82-year-old inventor's first laboratory board-by-board and nail-by-nail from its original site in Menlo Park, and even transplanted, along with the reconstructed building, the actual earth from the building's front yard! Edison's wry comment on seeing the rebuilt lab: "Wonderful, only our floor was never as clean as this."

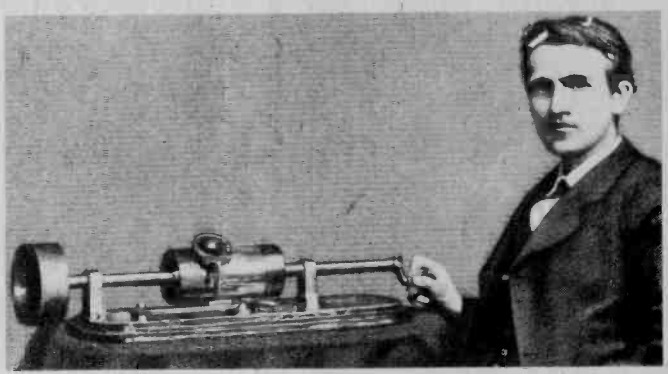
On October 29, 1929, Edison reenacted the entire process, the "Miracle of the Millenium," by re-inventing the electric light at Greenfield Village. By his side was Francis Jehl, just as he had been a half century earlier. Dignitaries watching the second invention of the light bulb included: Herbert Hoover, Madame Curie, George Eastman, Harvey Firestone and Cyrus Eaton.

Here, Edison poses with one of his later models of the incandescent lamp. Note the extra neck on the bulb for bleeding out air.

U.S. Department of the Interior, Edison National Historic Site.



Edison's 1889 Strip Kinetograph, the first motion picture camera using strip film. Note that the film moved horizontally 20-40 fps.



Greenfield Village & Henry Ford Museum

An engraving made by J. J. Cade after the photograph taken of Edison and his phonograph by the famous Matthew Brady. This model used foil as recording medium.

Another center of activity will be West Orange, New Jersey, where Edison lived and worked for many years. The National Park Service now maintains and conducts tours through the laboratory buildings and through Glenmont, Edison's home. Plans call for a series of special celebrations, complete with invited dignitaries.

Many U.S. and overseas electronics corporations will celebrate the Centennial of Light and Thomas Edison. This is rightly so, because these companies represent the breadth of activities with which the inventor was involved. Each organization grew, one way or another, from the work of this man, his patents, his improvements, his methods of scientific inquiry, and his formulation of modern day research. The list of corporations reads like an electronics industry Who's Who and includes such household names as: American Telephone and Telegraph, Allis-Chalmers, General Electric, GTE Sylvania, RCA, Westinghouse Electric, many well-known electric power companies, and even the Japan Atomic Energy Commission.

Is it possible for a man or woman having Edison-like inventive genius to make his or her mark these days as an independent thinker and doer? Or does the pace and sophistication (equate that with high cost) of modern research demand that scientific brains congregate in corporate laboratories, or find refuge in university laboratories, there to plead for research grants year in and year out? Is it possible to be a truly "free" inventor, and still survive? In short, would a latter-day Edison be an anachronism in modern society?

The issues could be debated endlessly, and this is not the place to start. I might make this one personal observation. Many years ago, when I left a plush chemical research laboratory (rife with intra-company politics) to work in a far more primitive laboratory in a smaller company, I received this sage counsel from a more experienced researcher: "A good scientist can do good work anywhere, even in a garage." And perhaps even the reverse is true today: "A mediocre scientist, not approaching being a genius, can succeed in a glamorous corporate research environment." ■

IT'S SIMPLY BASIC

Use this low-memory inventory to keep track of your music

by Larry Friedman, WB2AHN

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

IN LAST ISSUE'S PROGRAM *Inventory* we showed how a disk system is used for massive data storage and fast retrieval. The program is typical of its kind for single-drive disk systems in that all the data from the disk is taken into the computer's memory, manipulated and processed, and then the new "data file" is transmitted back to the disk. While this arrangement allows for data updating and selective error correction it requires relatively enormous computer memory (RAM), even when using a disk system which requires no additional memory for its own operating system (such as the PerCom LFD-400).

Less RAM. Now many of us computer hobbyists can't afford the amount of memory normally required by a disk inventory program. But, if we eliminate both selective error correction and deletion of unwanted data we sharply reduce the amount of RAM required for data handling.

In fact, this month's program, *Music Library*, requires only enough RAM to process six data variables and the error correction loop. The whole *bit* (pun intended), including the program itself can be shoehorned into 4K of RAM.

Music Library will keep track of your records and tapes, and allow you to easily locate a long-lost treasure. Designed for SWTPCo version 2.0 BASIC in conjunction with the basic PerCom LFD-400 disk system, *Music Library* will run in about 4K of memory, and one single diskette will accommodate about 7000 individual entries, or in excess of 2300 complete entries consisting of artist, album (or tape) and song. The exact number will be determined by the length of each individual entry.

Updating. Once you have selected the starting disk sector (line 0115), the program will automatically and continuously write your data entries onto the disk. This is accomplished at line 1080. The UPDATE command automatically locates the end of your previous data and simply adds on the new data without requiring any additional memory in the computer. This is because the program does not use an array table (large list of variables, which takes large quantities of RAM).

To keep the program reasonably short it does not provide for removal of an entry (this requires a considerable amount of RAM). But, it does have ERROR-CORRECTION should you make a mistake while entering data. The ERROR CORRECTION system is intermingled with the start mode (lines 1000-1090). It is somewhat unusual in that it employs the "negative reaction" technique, meaning it won't write to the disk until you confirm there is no error *by not* typing the word "error." (Yes, it is difficult to follow on the first five read-throughs.)

On a program run the computer will only output the information that it has, it won't fill with blank spaces by attempting to print information it doesn't have stored on the disk. (See lines 2050, 2055).

If you utilize this program on a different computer system make certain the fundamental BASIC "conditional GoTo command" (IF-THEN) is tailored for your system. For example, in line 4030 the statement reads IF C$= N$ Z=1. Your computer might require the statement to read IF C$=N$ THEN Z=1. (This byte-saving type of statement has been used throughout the program. Multiple statement lines have also been used to save RAM.)

The program can be easily modified to personalize the system for your particular needs. ■

MUSIC LIBRARY

```
0100 REM "MUSIC LIBRARY" BY LARRY FRIEDMAN
0101 REM FOR ELEMENTARY ELECTRONICS MAGAZINE
0102 REM
0103 REM WRITTEN FOR SWTP 8K BASIC VERSION 2.0,
0104 REM AND PERCOM LFD-400 DISK SYSTEM
0105 REM ***************************************
0110 INPUT "NEED INSTRUCTIONS? (Y/N) ";I$:IF I$="Y" THEN 210
0115 INPUT "SECTOR START";C
0117 REM #10 DENOTES THE FILE NAME USED FOR THE PERCOM DISK SYSTEM
0120 OPEN #10,C
0130 DATA START,ARTIST,ALBUM,SONG,LIST,UPDATE
4057 PRINT "ALBUM: ";B$
4060 GOTO 4020
4070 IF Z=1 THEN 150
4080 PRINT "NO SONG UNDER NAME: ";N$:GOTO 150
5000 RESTORE #10
5020 PRINT "ARTIST";TAB(18);"ALBUM";TAB(36);"SONG"
5030 READ #10,A$,B$,C$\150
5040 PRINT A$;TAB(18);B$;TAB(36);C$
5050 GOTO 5030
6000 READ #10,A$,B$,C$\1020
6010 GOTO 6000
9999 END

READY
```

```
0140 RESTORE #10
0150 PRINT :INPUT "COMMAND",C$:RESTORE
0155 IF C$="EXIT" CLOSE#10:END
0160 FOR X=1 TO 6
0170 READ L$
0180 IF L$=C$ THEN 200
0190 NEXT X
0195 PRINT "ILLEGAL COMMAND":GOTO 150
0200 ON X GOTO 1000,2000,3000,4000,5000,6000
0210 PRINT :PRINT
0220 PRINT "COMMAND          FUNCTION"
0230 PRINT "-------          --------"
0240 PRINT "START            TO ENTER INITIAL DATA ENTRIES"
0250 PRINT "ARTIST           TO LOCATE ALBUM AND SONG BY ARTIST"
0260 PRINT "ALBUM            TO LOCATE ARTIST BY ALBUM"
0270 PRINT "SONG             TO LOCATE ARTIST AND ALBUM BY SONG"
0280 PRINT "LIST             FOR COMPLETE LISTING OF ALL FILES"
0290 PRINT "UPDATE           TO ADD TO LIST  (SEE 'START')"
0300 PRINT "EXIT             TO LEAVE PROGRAM"
0310 GOTO 115
1000 PRINT :PRINT "ENTER ARTIST, ALBUM, AND SONG."
1010 PRINT "TYPE 'LEAVE' TO EXIT 'START' MODE"
1015 RESTORE #10
1020 PRINT
1030 PRINT :INPUT "ARTIST",A$:IF A$="LEAVE" P=6:GOTO 1080
1035 IF A$<>"ERROR" THEN 1075
1036  D$=""
1037 GOTO 1030
1040 INPUT "ALBUM",B$
1050 INPUT "SONG",C$
1055 REM D$, E$, AND F$ ARE USED FOR ERROR CORRECTION LOOPING
1060  D$=A$:E$=B$:F$=C$
1070 GOTO 1030
1075 IF D$="" THEN 1040
1080 PRINT #10;D$;E$;F$:IF P=6 P=0:GOTO 150
1090 GOTO 1040
2000 INPUT "NAME OF ARTIST",N$:X=0
2010 RESTORE #10
2020 READ #10,A$,B$,C$\2070
2030 IF A$=N$ X=1:GOTO 2050
2040 GOTO 2020
2050 IF B$="" THEN 2055
2052 PRINT "ALBUM: ";B$
2055 IF C$="" THEN 2060
2057 PRINT "SONG: ";C$
2060 GOTO 2020
2070 IF X=1 THEN 150
2080 PRINT "NO ARTIST LISTED UNDER NAME: ";N$:GOTO 150
3000 INPUT "ALBUM NAME ",N$:Y=0
3010 RESTORE #10
3020 READ #10,A$,B$,C$\3070
3030 IF B$=N$ Y=1:GOTO 3050
3040 GOTO 3020
3050 IF A$="" THEN 3060
3055 PRINT "ARTIST: ";A$
3060 GOTO 3020
3070 IF Y=1 THEN 150
3080 PRINT "NO ALBUM LISTED UNDER NAME: ";N$:GOTO 150
4000 INPUT "SONG",N$:Z=0
4010 RESTORE #10
4020 READ #10,A$,B$,C$\4070
4030 IF C$=N$ Z=1:GOTO 4050
4040 GOTO 4020
4050 IF A$="" THEN 4055
4052 PRINT "ARTIST: ";A$
4055 IF B$="" THEN 4060
```

SAMPLE RUN OF "MUSIC LIBRARY" SHOWING TYPICAL DATA ENTRIES

```
READY
>RUN
NEED INSTRUCTIONS? (Y/N) ? Y


COMMAND          FUNCTION
-------          --------
START            TO ENTER INITIAL DATA ENTRIES
ARTIST           TO LOCATE ALBUM AND SONG BY ARTIST
ALBUM            TO LOCATE ARTIST BY ALBUM
SONG             TO LOCATE ARTIST AND ALBUM BY SONG
LIST             FOR COMPLETE LISTING OF ALL FILES
UPDATE           TO ADD TO LIST  (SEE 'START')
EXIT             TO LEAVE PROGRAM
SECTOR START? 1100

COMMAND? START

ENTER ARTIST, ALBUM, AND SONG.
TYPE 'LEAVE' TO EXIT 'START' MODE


ARTIST? TOMMY DORSEY
ALBUM? BIG BAND
SONG? TREES

ARTIST? TOMMY DORSEY
ALBUM? BIG BAND
SONG? MARIE

ARTIST? LED ZEPPELIN
ALBUM?
SONG? BLACK DOG

ARTIST? STEVE MILLEF
ALBUM?
SONG?

ARTIST? ERROR

ARTIST? STEVE MILLER
ALBUM? BOOK OF DREAMS
SONG?

ARTIST? STEVE MILLER
ALBUM?
SONG? JET AIRLINER

ARTIST? LEAVE

COMMAND? LIST
ARTIST           ALBUM            SONG
TOMMY DORSEY     BIG BAND         TREES
```

(Continued on page 86)

Programs are written in SWTP type 2.0 8K basic, and might require some modification for use with other BASIC interpreters. Programs for this column are checked and debugged using a SWTP 6800 computer with 12K memory, a Micro-Term ACT-1 CRT terminal, an ASR 33 TTY, and a National Multiplex CC8 recorder. Printout will fit single line TTY or two lines on most CRT terminals.

WINDSHIELD WASHER WATCHER

You'll never get caught high and dry again

by Martin Weinstein
WB8LBV

EVER HAD THE ANNOYING experience of having the car in front of yours on the highway begin to kick up dirty water on your windshield, and when you went for the washer button, nothing happened? Well, chin up, bunkie, the Washer Watcher is just for you. It not only warns you when the tank is empty, it warns you when you're nearing refill time, *before* it's too late. This handy device can also be an engine saver for those of you who have water-injected turbocharger setups on your car.

The heart of the unit is National Semiconductor's LM1830 fluid detector, which responds to the conductivity of fluids across its probe leads.

How It Works. The LM1830 generates an AC oscillator signal (in order to prevent electrolytic coating of the probes, thereby reducing their efficiency) which is coupled to the probes by a 0.05-uF capacitor. When the conductive fluid in the tank reaches a low enough level, the resistance between the probes rises past the 13,000-ohm reference level (set internally within the IC), and the oscillator signal is coupled to the amplifier segment of the IC. The amplified 6,000 Hz signal is then fed to an LED which indicates the low fluid condition.

Construction. The circuit can be assembled quickly and easily on solderless breadboard stock. We used Continental Specialties Corp.'s Experimenter 350. Component layout is not critical, but you can use the layout shown in the photograph if you're not feeling terribly creative.

The probe assembly in our model was made by drilling three holes in a triangular pattern in a large rubber stopper. After doing this, insert the metal probes (we used knitting needles). Measure the diameter of the narrow end of the stopper, and then cut a hole in the top of the fluid reservoir just slightly larger than the stopper's narrowest diameter, thus allowing a snug fit. Solder a wire to each probe, and connect them to the appropriate pins on the IC. Do not cement the probes into position on the stopper yet, because you still have to calibrate.

Calibration and Operation. The longest probe, which connects to a ground anywhere in the engine compartment that's handy, should be pushed down through the stopper so that it's just touching the bottom of the reservoir.

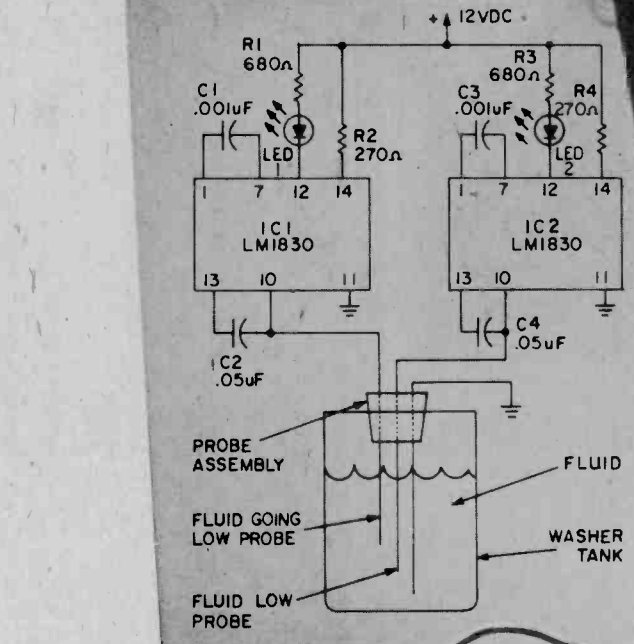
The "refill" probe may be inserted to any length, depending upon how much margin you wish to have between the first and last warnings.

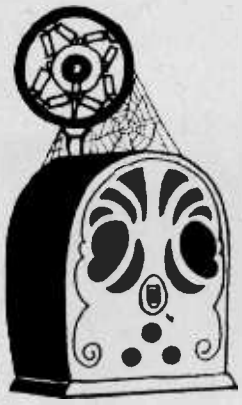
Remember, water varies from area to area, and the type of solvent you use in your washer reservoir, and the resulting mixture, can affect the calibration. Before you cement the probes and stopper in place, check the operation of the unit by referencing the warning lights with visual observations. Try to keep the solvent/water mixture the same each time you refill, in order to keep the unit calibrated.

When you're satisfied with the unit's calibration, cement the probes into the stopper, both on the top and bottom, and then cement the stopper into the hole in the reservoir. Silicon bathtub sealer should do the job very nicely. The next time you take a trip, let the Washer Watcher take some of the grief out of driving for you. ■

PARTS LIST FOR WASHER WATCHER

C1, C3—0.001-uF ceramic disc capacitor
C2, C4—0.05-uF ceramic capacitor
IC1, IC2—LM1830 National Semiconductor
LED1, LED2—light emitting diode
R1, R3—680-ohm, ½-watt resistor
R2, R4—270-ohm, ½-watt resistor





ANTIQUE RADIO CORNER

Some timely topics for the old time radio fan

by James A. Fred

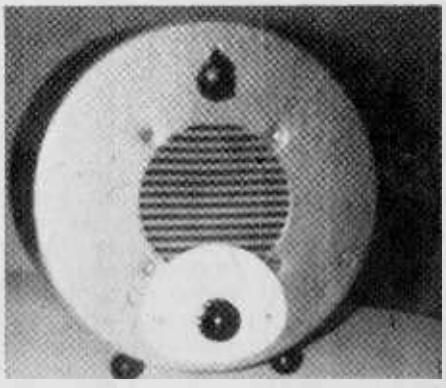
WITHIN THE PAST FEW WEEKS I have received letters from two collectors who have found cathedral radio cabinets in near mint condition, but the radio chassis were missing. Now this seems strange to me because all the cathedral radios I've found that needed restoration had defective cabinets. The speaker grill and grill cloth are the most likely items to be damaged. There is usually veneer coming off in several places. I even have a radio whose front has come loose from the sides. To get back to the letters it seems like a good idea to set up a system to find chassis for these cabinets. The Philco cabinet had no model number, but from the drawing he sent I believe it to be a model 33B or an 84B. The only information I have on the Sears cabinet is that it is Beehive or Cathedral shaped. If any reader has a chassis or speaker to fit either cabinet and he writes to me in care of ELEMENTARY ELECTRONICS magazine I will pass the information on to the cabinet owners.

I just received word that Antique Radio Press will no longer publish *Antique Radio Topics*. After January 1, 1979 it will be published by Puett Electronics, P.O. Box 28572, Dallas TX 75228. If you are interested in subscribing or want a sample copy write to Puett Electronics.

Parts for Sale. Antique Radio Parts, P.O. Box 42, Rossville, IN 46065 will publish two antique radio parts catalogs in 1979. The catalog will list tubes, parts, and services available to collectors of old radios and wireless equipment. To receive both catalogs send 25¢ in coin plus two long, self-addressed envelopes to the above address. If you live outside the United States send International reply coupons or 40¢ U.S. coins. The Postal Service will not accept envelopes for mailing back to them with foreign stamps. I know because I have received stamped, self-addressed envelopes from both Canada and Mexico and have been unable to use them. Another problem I have is receiving letters with requests for help that do not contain return postage. This is especially true with requests from foreign countries. Airmail in most cases costs 31¢ per ½ ounce. International reply coupons can be purchased in First Class Post Offices, also International Money Orders. These two items can be used to send funds to any country that is a member of the International Postal Union.

African Antique. Some time ago I received an interesting story and a photo of a round, metal table model radio from Ken Greenberg of Skokie, IL. The radio shown in one of the photos was purchased in the early 1950's. It was made by the Berec Battery Export Company in London, England for use in Africa. It was primarily used in Rhodesia and was sold to the natives for a small sum of money in an attempt to educate them via radio.

Mr. Greenberg's radio covers the medium and shortwave bands and operates on a power pack consisting of 1.5- and 90-volt batteries. It is a very rugged, moisture proofed radio that played surprisingly well when its attached wire antenna was extended. The radio uses a 1R5, 1S5, 1T4, and a 3S4 tube. It has a two-speed vernier dial drive. The cabinet is deep drawn from aluminum.

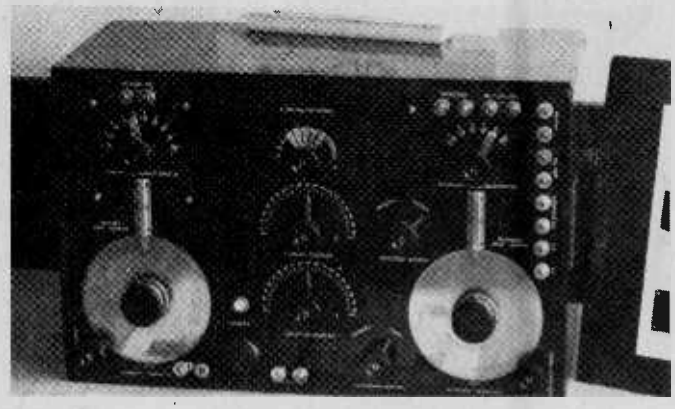


This is the heavy duty, battery powered round radio (referred to in the text) that was made for use in Rhodesia in the '50s.

Radio/Phonographs. There seems to be a group of collectors who are looking for the radio/phonographs that were made between 1926 and 1931. Most collectors don't have room for these large console radios so the price hasn't shot up as has the older, smaller battery operated radios. I received a letter recently from a collector who is looking for several of these old radio/phonographs. I was surprised to learn that one model of RCA had a Radiola model 17 radio along with a wind-up, 78 RPM, single play turntable in a highboy console cabinet. Likewise Wells-Gardner built a radio/phonograph for Lyon & Healy (a large Chicago music store) that had an AC operated radio in a lowboy phonograph cabinet with a hand-wound record turntable. The above named radio phonos all had electric pickups to recover the sound from the records. I recall a Majestic highboy that had both an electric turntable and an electric pick-up. This set was the model that used a five gang tuning capacitor and used type 26's, 27's, 45's and a "B" supply setting in the bottom of the cabinet. For a future column I'll try to find some photographs and more information on these early radio/phonograph combinations.

An Old Acquaintance. One of the oldest names in radio may disappear from the scene this year. In the latter part of 1978 Dart Industries purchased the stock of the P. R. Mallory and Co., Inc., Dart Industries was especially interested in the battery division. The Duracell has found wide acceptance among the consumers of America.

P. R. Mallory started the company in 1916, the year in which I was born. In 1929 it moved to Indianapolis, IN and a major thrust was made into the radio parts replacement market. Major lines were capacitors, resistors, volume controls, vibrators, battery chargers, telephone plugs and jacks, auto radio



This is an I-P-500 Crystal Detector Receiver made in 1918 that was a prize winner in the old equipment contest at the AWA Conference in 1978.

power supplies, and some years later became a major battery manufacturer. I started my first radio repair shop in 1935 and for many years used Mallory parts exclusively. I remember when the Delco Radio Division of General Motors Corp. was buying 10,000 Mallory vibrators per day to keep Delco auto radio lines operating.

In recent years Mallory Distributor Products Company has been selling semi-conductors, security alarm systems, recording tape, and other modern products as well as their more traditional lines of replacement parts. Only time will tell if the Mallory name survives in the future of electronics.

New English Magazine. A new magazine titled *Sounds Vintage* is being published in Great Britain. *Sounds Vintage* is published bi-monthly and is written expressly for those persons interested in wireless and vintage sound. Among the areas covered are vintage wireless equipment, gramaphones and cylinder players, disc record players, vintage amplifiers, and pre-war literature. In the future there will be stories of wireless pioneers, and of companies involved in the manufacture of radio and wireless equipment.

The price will be £6.80 U.K. (English Pounds—send an International Money Order), postage paid by air mail, for a one year subscription of 6 copies. Write to: *Sounds Vintage,* 28 Chestwood Close, Billericay, Essex, England.

More On Test Equipment. Many antique radio collectors neglect one of the most interesting facets of the hobby. These items are electrical meters and test equipment. I first became interested in radio in 1931 and have earned a living since 1935 in the radio-electronic field. I have always been interested in electrical meters and have built most kinds of simple test instruments. I built my first VOM (Volt-Ohm Meter) in 1934 and my first tube tester in 1935. Since then I've built capacitor testers, signal generators, VTVM's (Vacuum Tube Voltmeters) oscilloscopes, etc. I have built from scratch and from kits of parts, i.e., Heathkits and Eico kits.

Most collectors aren't interested in test equipment either because it is hard to find, is too expensive, or they aren't interested in electronic repairing of their own equipment. At the ARCA conference in King of Prussia, PA several collectors had test equipment for sale at very reasonable prices. I saw several tube testers made in the early 30's. These testers would check 201A's, 199's, etc., which all collectors use. There were also individual test meters priced as low as 50¢ each which still worked well and only needed cosmetic repairs. In my stock I probably have more than 350 meters ranging in age from the 1920's to the 1960's. If you are interested the old brands to look for are Hoyt Jewell, Weston, Sterling, Beede, and Readrite. These meters were the more popular ones made for radio use. Other meters made for electrical and automotive use were Roller-Smith, Westinghouse, General Electric, and Splitdorf. The above named meters are the ones to look for in flea markets and garage sales.

Another group of meters were called pocket meters, or "Watch Case" meters and were intended for home use. This type meter was usually 2⅓ inches in diameter by a half-inch thick. The case was brass, nickleplated, and if the meter had only one range it would have one short lead wire and a pointed contact on the case. Most Watch Case meters were made to test filament and "B" batteries used with the 1920's battery radios. I know of several collectors who collect the brass, nickleplated meters. You can usually find these too at flea markets and garage sales.

A reprint of the Radiola III instruction booklet is now available along with the Radiola IIIA booklet that has been on sale for some time. You can get either booklet for $2.00 postpaid from Antique Radio Press, P.O. Box 42, Rossville, IN 46065.

Safeguarding Your Collection. I want to emphasize one more time the importance of having a complete list of all your antique radio equipment put into a safe place (not in your home). I recommend a safety deposit box in a bank or similar institution. I have written on this subject before, but apparently most collectors don't want to do this. Periodically I hear or read about a collector who was "ripped off" by a thief.

The latest happening I have heard about took place on the west coast. There is a collector out there who had 13,000 vacuum tubes. There were many tubes made between 1920 and 1930, some were made before 1920, and thousands were made after 1930. Fortunately he had the foresight to call in a prominent west coast antique radio appraiser who had seen the tubes and other collectibles the man had and had filed the proper paper work to prove these tubes existed. The collector was insured and his monthly premium was quite a lot of money. The insurance investigator was unhappy, as were the local police because the collector had promised to install a burglar alarm, but hadn't done so. After the insurance company investigator interviewed the appraiser by telephone the claim was approved to be paid.

(Continued on page 92)

An early spark telegraph transmitter also entered in the old equipment contest at AWA Conference. The Rolling - pin shaped glass tube holds the spark gap apparatus.

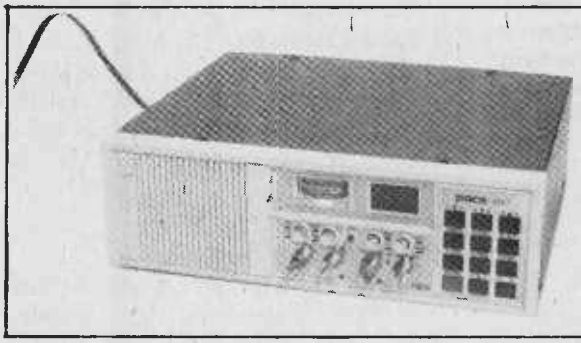
Kathi's CB Carousel

by Kathi Martin, KGK 3916

Kathi puts the Pace 8117 computerized CB through its paces

For something like two years computerized CB transceivers have been the big talk at equipment shows. The trouble is, that's just what its all been—talk. Why, the last time I looked and listened it was one of the *heavies* in the computer and calculator marketplace that was going to turn CB on its ear with a computerized CB. With the notable exception of SBE's excellent Key/Com 1000 (you can read about it in this issue's CB XCVR Checkout), which was developed from their model 55 marine VHF transceiver, the traditional CB manufacturers have ignored computer control for CB sets. With all the developments in VHF/UHF scanners you'd think some of the technology would rub off on some of the other CB biggies, but up to now it hasn't. Now, however, SBE has some heavy competition in the field—the Pace 8117 by Pathcom. A real honest-to-goodness computerized CB transceiver.

The Pace 8117 is basically a base station with provision for operation off a 13.8-VDC power source (the DC cable is not supplied). The rig features the usual 40-channel coverage, PA and remote speaker jacks, an LED digital channel display, S/RF-output meter, RF gain control, Delta tuning, and *the computer.*



A CB rig with a touch-pad? Right! Because the Pace 8117 is controlled by an on-board microprocessor—meaning micro-computer. For more information circle number 64 on the reader service coupon.

The Computer. The computer is programmed by a 4 by 3 (12 position) touch pad such as you would find on a touch-tone telephone. Ten of the buttons are dual function—numerals and commands—so there are effectively twenty-two operating keys which program the computer.

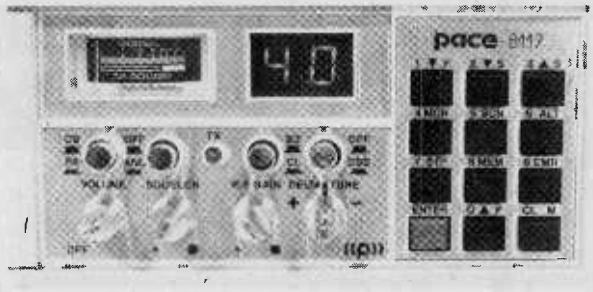
The instant power is applied the computer tunes the rig to channel 19. If you want to change channels there are fast and slow *up/down* selectors that step through each channel. If you want to go directly to a particular channel you can do that too. Now none of these features really requires an on-board microprocessor; they simply come with the computer, which provides a user-selected 10-channel scan mode, a continuous scan of all 40-channels without stop, a 40-channel scan and latch onto either a busy (BZ) or clear (CLR) channel, and a programmable monitor that allows you to receive on one channel and monitor another on a sampling for one-half second every 10-seconds.

Two front panel switches determine what happens when the computerized scan or monitor finds what you're looking for. One switch, labled BZ and CLR, determines whether a scan stops on a busy or clear channel. A switch labled CSS provides a continuous 40-channel scan without a stop. If the scan stops (latches) to a channel in the BZ or CLR mode it remains on that channel until the user resumes scanning by pressing the appropirate pad button.

Programmed Scan. Here's how you might utilize the computer. Assume you have four active "assistance" channels in your area: 9, 10, 11, and 19. You could program only these channels into the 10-channel memory and the computer would scan only these four channels, stopping on the first one to become active. If you had to shift immediately to channel 9, let's assume you have just received an emergency call on 19, you could do it by simply pressing the 9 EMR (9 emergency) pad button. You can start, stop, or resume the scan

(Continued on page 88)

CIRCLE 64 ON READER SERVICE COUPON



Dual purpose touch switches provide 22 alphanumeric functions. The numerals are for keying in the channel numbers, the "alpha" designations are the computer functions: for example, CL M means clear memory; MEM means program memory; ENTER means enter channel number into memory or monitor, STP means stop, the way you exit a computer mode. It looks complicated at first glance, but a short evening's practice is all it takes to make you a "computer programmer." The panel Switch BZ/CL determines whether the scan stops on a busy or clear channel. The CSS switch provides continuous 40 channel scanning with no stops. This is truly a super unit for the active CBer.

CB XCVR CHECKOUT

- DAK MARK V
- GENERAL ELECTRIC 3-5875
- MOTOROLA CB-555
- SBE KEY/COM 1000

☐ ELEMENTARY ELECTRONICS has been able to obtain some the latest 40-channel CB transceivers for review, and presents the test reports here. These units are not prototypes, but are "stock standard," the same as the transceivers that you can buy over the counter. If you don't find the particular unit you are interested in reported on here, check for the 1979 edition of CB BUYERS GUIDE, soon to be on the newsstands.

• DAK MARK V

$119.95 (M. H. Scott)

General Description: A 40-channel AM transceiver for mobile and P.A. operation. Delta fine tuning ±2.5 kHz is provided. Power supply is 12 to 13.8 VDC with negative or positive ground. Overall dimensions are 2¼-in. H x 7⅛-in. W x 9-in. D. There are front panel controls for: channel selection, volume, squelch, RF gain, and Delta tune. Switches for: PA/CB, Noise blanker, ANL, channel indicator dimmer; and tone. Standard accessories include a micro-

CIRCLE 53 ON READER SERVICE COUPON

phone, mobile mount, DC power cable.

Receiver Section Test:

Input sensitivity	0.4 μV
Adjacent channel rejection	56 dB
AGC action	7 dB
Input level for S9 meter indication	40 μV

Transmitter Section Test:

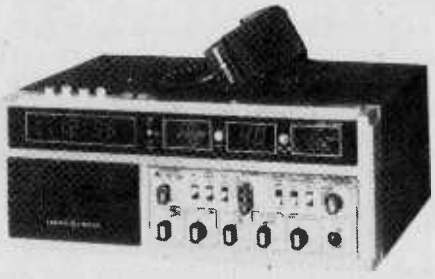
AM RF output	3.8 watts
Modulation to 85%	yes
Relative sensitivity for 85% mod.	—43 dB
Modulation limited to 100%	yes

Editorial Remarks: The Mark V has a 6 dB per unit S-meter, double conversion, jacks for P.A. and remote speakers, L.E.D. digital channel indicator S/RF-output meter. ■

• GENERAL ELECTRIC 3-5875

$469.95 (General Electric)

General Description: A 40-channel AM/SSB transceiver for mobile, P.A., base operation. Fine tuning ±2.2 kHz is provided. Power supply



CIRCLE 62 ON READER SERVICE COUPON

is 12 to 13.8 VDC with negative or positive ground and 120 VAC. There are front panel controls for: channel selection, volume, squelch. Fine and coarse clarifier, tone, MIC power, RF gain, SWR CAL and L.E.D. dim. Switches for power, AM/SSB modes, ANL, noise blanker, CB/PA, MOD/SWR meter, antenna A/B, speech compressor and clock/timer set. Standard accessories include a microphone, mobile mount, DC power cable and A.C. power cord.

Receiver Section Test:

Input sensitivity	0.4 μV
Adjacent channel rejection	57 dB
AGC action	9 dB
SSB opposite sideband rejection	50+ dB
Input level for S9 meter indication	50 μV

Transmitter Section Test:

AM RF output	3.5 watts
SSB RF output	11.5 watts P.E.P.
Modulation to 85%	yes
Relative sensitivity for 85% mod.	—30 to —45 dB
Modulation limited to 100%	yes

Editorial Remarks: The 3-5875 has a relative reading S-meter, double conversion, jacks for P.A. and remote speakers, L.E.D. digital channel indicator, speech compressor, Modulation/SWR and S/RF-output meters, and connections and switching for two antennas. Has digital clock/timer. ■

• MOTOROLA CB555

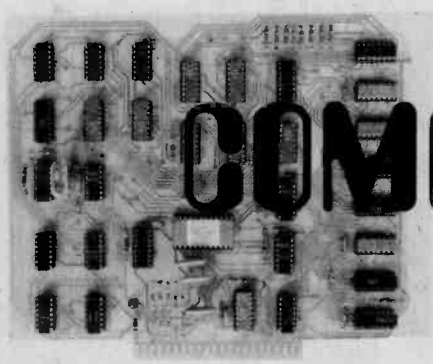
$409.95 (Motorola, Inc.)

General Description: A 40-channel AM/SSB transceiver for mobile, P.A. base operation. Fine tuning ±1.1 kHz is provided. Power supply is 12 to 13.8 VDC with negative ground and 120 VAC. Features L.E.D. digital clock that works on AC only. Overall dimensions are 4-7/16-in. H x 11⅞-in. W x 11-in. D. There are front panel controls for: channel selection, volume, squelch, RF gain, clarifier, mike gain, SWR cal. Switches for:

CIRCLE 66 ON READER SERVICE COUPON

AM/LSB/USB, S/RF/SWR meter mode, PA/CB/Extend (Extend is a Noise Blanker), ON/OFF/AUTO for

(Continued from page 94)



COMPUTER READOUT

by Tom Williams

Tell a computer how to tell itself what to do

MOST COMPUTERS CAN BE MANAGED quite nicely by learning one or more of the popular high-level languages like BASIC or PASCAL. That does not, however, prevent us from being a trifle curious about what is really going on inside the machine. One can drive a car quite well without any idea of how the engine actually works, and one cannot repair a car without devoting more attention and study to its functioning than most of us can afford. Many people, however, get a degree of satisfaction from appreciating the basic concepts of how it works. The same can be said of computers and the people who use them.

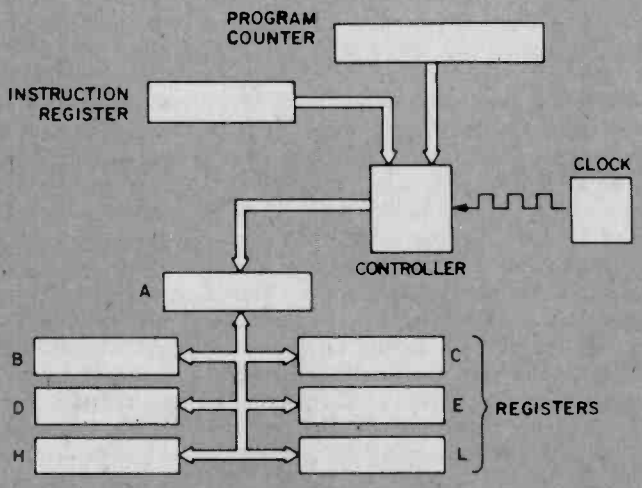
It is a well-known fact that a digital computer consists of an input/output device, central processor and memory, and that it does all its work by manipulating 1's and 0's which are represented by *on* or *off* conditions of electronic switches. But how is all this activity organized and how does the machine accomplish all its complex computations at such rapid speed using only *on* and *off* states?

Communication. To answer this question, we must take a quick look at how the central processing unit, or CPU, communicates with computer memory and then a more detailed look at what goes on inside the CPU. The simplest way to think of the CPU is as a mailman who goes from one numbered mailbox to another in succession. The mailboxes are locations in computer memory which contain program instructions or data for the CPU. The numbers of the mailboxes are the *memory addresses* and it is to these addresses that the CPU refers as it steps through a program.

For instance, when the CPU looks at an address, it may find an instruction telling it to go to the next address and read the contents of that location into one of its *registers*. CPU registers are special memory locations inside the CPU that are used for temporarily storing and manipulating data. Because of its function, this type of memory is often referred to as "scratchpad memory."

Figure 1

The important internal components of the 8080 central processing unit (CPU) are shown in this block diagram. The data is transfered along the wide lines according to the instruction in the instruction register. The clock keeps it all in perfect timing.



Going to the third address in line, the CPU may find a similar instruction which tells it to take the contents of the fourth location and store them in another CPU register. At this point, the CPU has two different numbers stored in two of its internal registers. The next instruction the central processor sees may be a command to add these two numbers together, that is, to add the contents of one register to the contents of another. The final instruction might then tell the CPU to take this result and store it in another specified location out in computer memory, or to output it to an output port where it could be read by a terminal device.

Our simple example has shown that a computer program consists of two things: *Instructions* to the CPU to perform certain operations, and *data*, or information that the CPU needs to carry out these instructions. The latter may come in various forms and we will discuss only a few of them here.

Architecture. Looking into the CPU, that microscopic silicon wonder, we find that it contains a number of distinct internal components. The ones we will discuss here are the registers, the program counter and the controller. The number, size and arrangement of these internal components is known as the CPU's *architecture*. For the purposes of this article, we will refer to the architecture of the popular 8080 8-bit microprocessor.

Since the length of a data word for the 8080 is 8 bits, or one byte, each internal register will be able to store one byte. Two exceptions to this are a couple of specialized registers called the stack pointer and the program counter. These registers must store memory address information, and since addresses in the 8080 can be up to 16 bits in length, these two registers must be able to store two bytes.

We will not discuss the stack pointer at this time, but the program counter will be of central importance. You will notice I listed the program counter as a CPU component in its own right because of its importance, but it is really a specialized register.

Let us imagine our simplified 8080 as illustrated in figure 1. We see the different registers with connections between some of them so that data can be easily transfered among them. Also illustrated is the controller with the clock input. Other CPU components include the arithmetic logic unit, the address buffer, and the instruction decoder.

What makes the whole thing go? That is the function of the system clock, which is usually connected externally to the CPU. It is a crystal oscillator

which produces a rapid series of pulses which are used as a timing reference by the entire system. It might be more useful to think of it as a metronome rather than a clock, as some functions require a different number of clock pulses to be performed than others. Every operation of the machine, however, uses this reference to time the sequence of its operations. In an 8080-based system, the clock frequency is typically 2MHz—which may do something to explain the speed with which a computer computes.

Operation. Let us now perform an actual addition of two numbers while examining what is taking place inside the CPU. To do this, it will be necessary to have an addition program contained in the computer's memory. As mentioned above, such a program will consist of instructions and data. The instructions are binary codes that cause the CPU to perform certain operations on the data. There is a limited number of instructions any given CPU can perform, and the list of these instructions is known as the *instruction* set for that CPU.

A computer program is a list of appropriate instructions, also known as *opcodes*, and their *operands*, or data the CPU needs to carry out the instructions, stored in an orderly manner in memory.

To execute the program, the *program counter goes* to the address of each instruction in turn, loads that instruction into the instruction register, and then goes to the address of the next instruction. The instruction in the instruction register is decoded by the instruction decoder and executed and the process is repeated until a programmer's error is encountered and the machine gets confused.

When writing programs such as these in machine language, the individual CPU's architecture is a major consideration. The nature of the machine's instruction set is based upon its architecture, and in order to program for a different CPU, a different instruction set must be learned. High level languages like BASIC and PASCAL allow us to communicate in English-like statements of the problem. The interpreter or compiler translates the program into machine instructions the CPU can understand.

For our purposes, let us assume that our addition program has either been entered in machine language by a programmer or been translated by a compiler. At any rate, it now resides in memory as absolute machine code—the stuff our CPU can digest. Also, for our purposes, we will not use a terminal (input/output can really get complicated) and assume that the two numbers to be added are contained in the program.

Instruction. While there are perhaps more elegant and efficient ways to write this program, it will serve to illustrate some of the things the computer does. To the CPU, our program would look like this:

1. 00100001
2. 10000000
3. 00100000
4. 00000110
5. 00000101
6. 00111110
7. 00000010
8. 10000000
9. 01110111
10. 01110110

This is, of course, incomprehensible to a human reader, especially since practical programs are many hundreds of times longer than this. For this reason, those bytes which are instructions and not data can be described by humans with short abbreviations called *mnemonics*. Mnemonics apply only to instructions in the instruction set and numeric data must be represented for humans by another form of notation than binary, usually octal (base 8) or hexadecimal (base 16). We won't discuss these here, however, and I will use decimal notation to indicate numbers the computer must deal with.

Figure 3
ASSEMBLER SOURCE LISTING

Opcode	Operand	Comment
LXI H	200 040	Put address in H & L
MVI B	005	Put & in register B
MVI A	002	Put 2 in register A
ADD B		Add B to A
MOVM A		Put A into memory location
HLT		Halt

This is an assembler source code listing for our addition program. The assembler reads the letters and numbers and then translates them into binary numbers.

Remember that each 8-bit byte of code above resides in a separate location in memory and that each such location is specified by a unique address. For the 8080, addresses can be numbered from 0 to 65,535 decimal.

If we were to translate this program into readable form, we could see that it is telling the CPU to first load the H and L registers with the numbers in the next two memory locations. The first goes into the L register and the second into the H register (this reverse order is an 8080 convention and not true for all CPU's). This number will later be used by the computer to refer to an address elsewhere in memory.

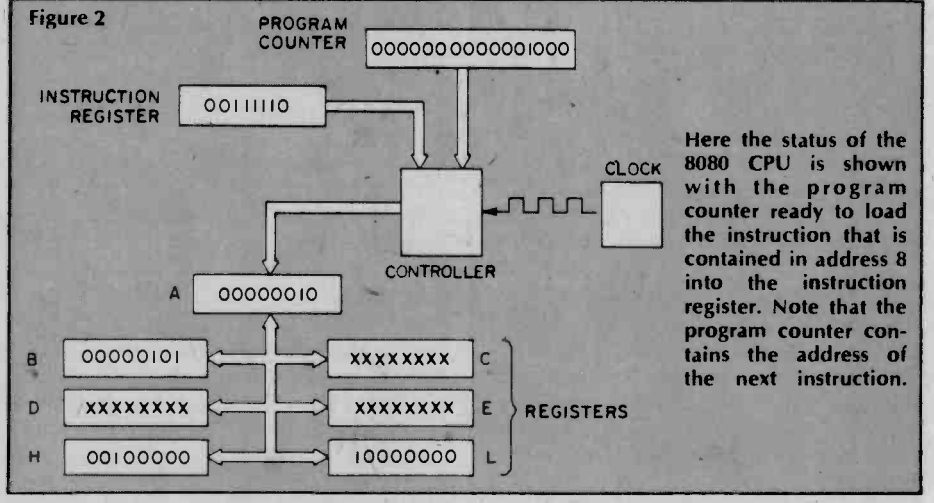
The next *instruction* (not the next byte) is at address number 4 in our program. It tells the computer to put the following number (here, the number 5) into the B register. The next instruction similarly tells it to put the contents of the next memory location into the A register. At this point in the program, the computer registers look like figure 2. Note that the program counter contains the address of the *next* instruction to be put into the instruction register.

That instruction is the ADD B instruction that tells the CPU to add the contents of register B to the contents of register A. The result will be the new contents of register A, but the data in register B will not be destroyed.

Answers. The question now is what to do with the answer. In our case, we have chosen to store it in a location in

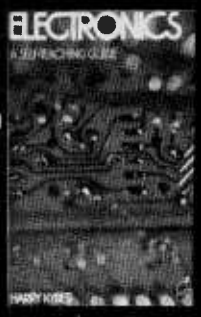
(Continued on page 87)

Figure 2



Here the status of the 8080 CPU is shown with the program counter ready to load the instruction that is contained in address 8 into the instruction register. Note that the program counter contains the address of the next instruction.

e/e BASIC COURSE IN ELECTRICITY & ELECTRONICS



One of the keys to hobby construction fun is a firm understanding of transistor function and operation. This article will tell you all you need to know to use transistors in your latest brainstorm. The easy-learning format makes understanding transistors a snap even if you've had trouble with them before.

This article is based on material appearing in *ELECTRONICS, A Self-Teaching Guide* by Harry Kybett. John Wiley & Sons, Inc., Publishers.

INTRODUCTION TO THE TRANSISTOR

Using transistors in your projects is easy once you understand how they work. This article will give you the basics of modern transistor theory enabling you to use these tiny dynamos in your construction projects.

THE TRANSISTOR AS A SWITCH

The transistor is undoubtedly the most important modern electronic component. It has made great and profound changes in electronics and in our daily lives since its discovery in 1948.

In this chapter the transistor will be introduced as an electronic component which acts similarly to a simple mechanical switch, since it is actually used as a switch in much modern electronic equipment. The transistor can be made to conduct or not conduct and electric current—which is exactly what a mechanical switch does.

An experiment in this chapter will help you to build a simple one-transistor switching circuit. This circuit can be easily set up on a home workbench, and it will enhance your learning if you obtain the few components required and actually perform the experiment of building and operating the circuit.

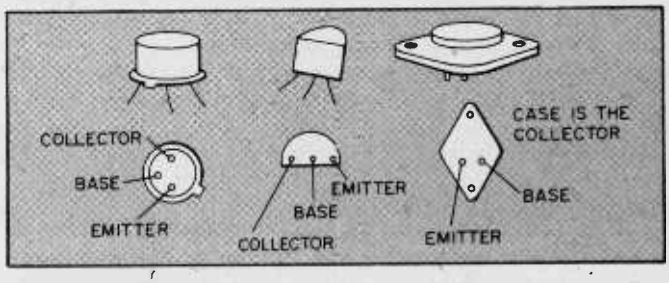
From this basic idea we will progress to simple circuits which use several transistors to accomplish the same end. This affords an easy introduction to why the transistor is used, and to how it is used in computers and other modern circuits.

When you complete this chapter you will be able to:

- describe the basic construction of a transistor;
- specify what transistor switching action is;
- differentiate between the two most common types of transistors;
- tell which currents flow through a transistor;
- specify the relationship between base and collector current in a transistor;
- calculate the current gain for a transistor;
- explain how a transistor can be ON or OFF;
- compare the transistor to a simple mechanical switch;
- do simple transistor current calculation.

THE BASIC TRANSISTOR

The diagrams below show several common transistors in use today. For each transistor, the lower diagram shows how the leads are designated and how to identify them in most cases.

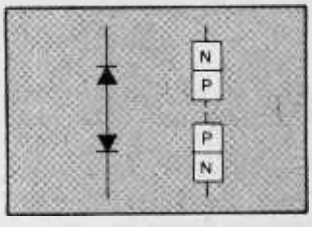


QUESTIONS

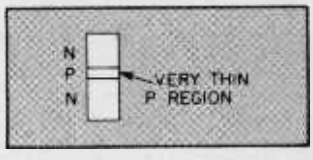
1. How many leads are there on most transistors? ....
2. Where there are only two leads, what takes the place of the third lead? .....
3. What are the three leads or connections called? ....

ANSWERS

1. Three
2. The case can be used instead, as the diagram on the right. (This is limited to power transistors.)
3. Emitter, base, and collector.



In its simplest form a transistor can be considered as two diodes, connected back to back, as in this drawing.



However, in the construction process one very important modification is made. Instead of two separate P regions as shown above only one very thin region is used.

Which has the thicker P region, the transistor shown above or two diodes connected back to back?
Two diodes. The transistor has a very thin P region.

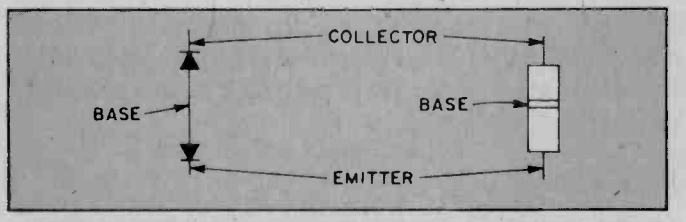
Two separate diodes wired back to back will not behave like a transistor. Why this difference in construction should make the transistor act like a transistor and not like two diodes will not be covered, as this is semiconductor physics and not electronics.

What is the main construction difference between two diodes connected back to back and a transistor?

. . . . . .

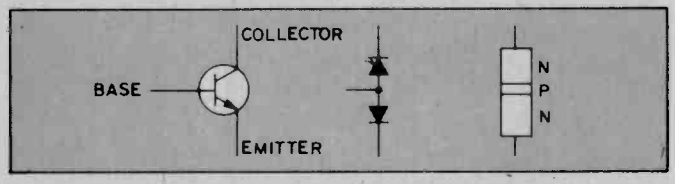
the very thin P region used in the transistor

The three terminals of a transistor—the base, the emitter, and the collector—are connected as shown below.



The two diodes are usually called the **base-emitter diode,** and the **base-collector diode.**

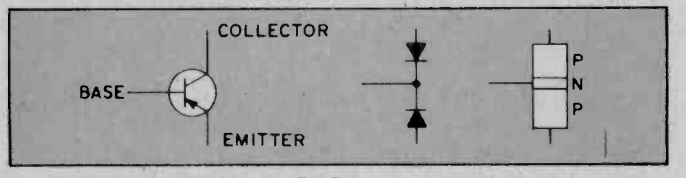
The symbol used in circuit diagrams for the transistor is shown on the following diagram, with the two diodes and the junctions shown for comparison.



Because of the way the semiconductor materials are arranged, this is known as an NPN transistor. Which transistor terminal has the arrowhead? . . . . . .

the emitter

It is also possible to make transistors with a PNP configuration, as shown below.



Both types, NPN and PNP, are made from either silicon or germanium.

QUESTIONS

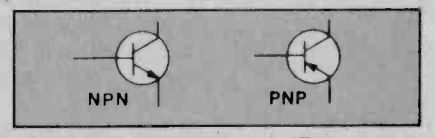
4. Draw a circuit symbol for both an NPN and a PNP transistor. (Use a separate sheet of paper for your diagrams.)

5. Which of these might be silicon? . . . . . .

6. Are silicon and germanium ever combined in a transistor? (Hint: What was said about diodes?) . . . . . .

ANSWERS

4.



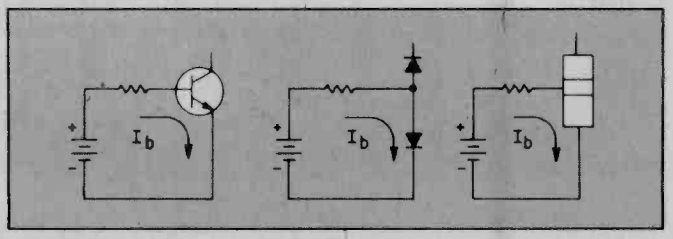
5. Either or both could be silicon. (Either or both could also be germanium.)

6. Silicon and germanium are **never** mixed in any semiconductor.

HOW THE CURRENT FLOWS

If a battery is connected as shown below to an NPN transistor, then a current will flow as shown.

This current, flowing through the base-emitter diode, is called **base current** and is given the symbol *Ib*.

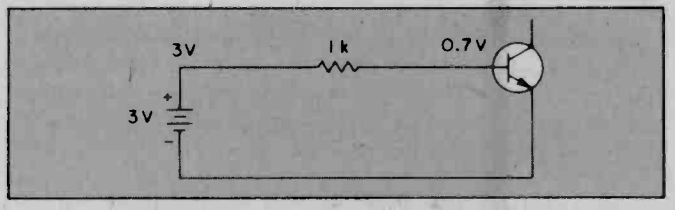


Would base current flow if the battery were reversed? Base current would not flow as the diode would be back biased.

In the circuit below, the base current can be calculated using ohm's law, where

$$I = \frac{E}{R}, \quad E = IR, \text{ and } R = \frac{E}{I}$$

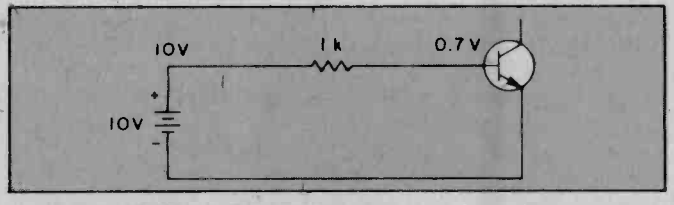
Find the base current in this circuit. (Hint: Do not ignore the 0.7 V drop across the base-emitter diode.)



Your calculations should look something like this.

$$Ib = \frac{(Vs - 0.7\text{ V})}{R} = \frac{(3 - 0.7)}{1\text{ k}\Omega} = \frac{2.2\text{ V}}{1\text{ k}\Omega} = 2.3\text{ mA}$$

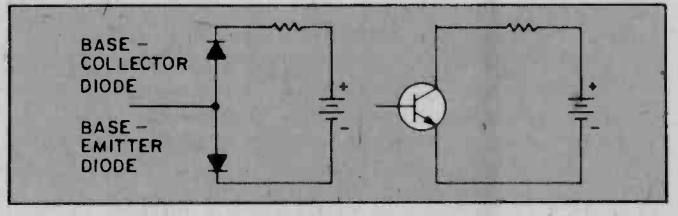
In the circuit below, as the 10 V battery is much higher than the 0.7 V diode drop, we can consider the base-emitter diode to be a perfect diode, and thus assume the voltage drop is 0 V.



Calculate the base current.

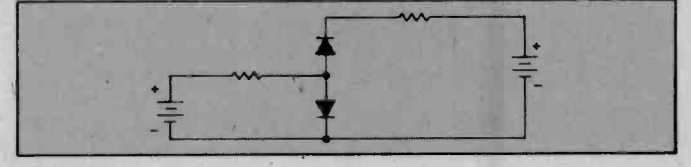
$$Ib = \frac{(10 - 0)}{1\text{ k}\Omega} = \frac{10}{1\text{ k}\Omega} = 10\text{ mA}$$

Look at the circuit below.



Will current flow in this circuit? Why or why not?

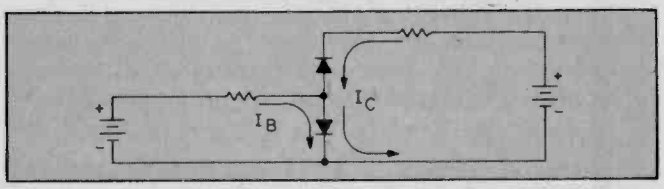
It will not flow as the base-collector diode is reverse biased.



Now, we will put both of the circuits together. Note that we have two batteries, one in each of the base and collector circuits.

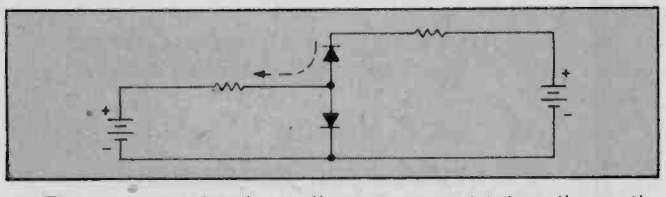
When both the base and the collector circuits, as in the diagram above, are connected, it demonstrates the outstanding characteristic of the transistor, which is sometimes called *transistor action: If base current flows in a transistor, collector current will also flow.*

Examine the current paths in the diagram below.



Base current (Ib) flows through the base-emitter diode and causes the collector current (Ic) to flow through the base-collector diode.

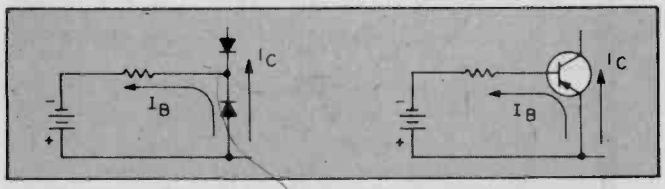
No current flows from the collector to the base, as shown by the dotted line below.



The reason why the collector current takes the path shown in the first of these two diagrams, rather than the dotted line path, is beyond the scope of this book. This is the domain of semiconductor physics and is not needed in electronic circuit design and analysis at this time.

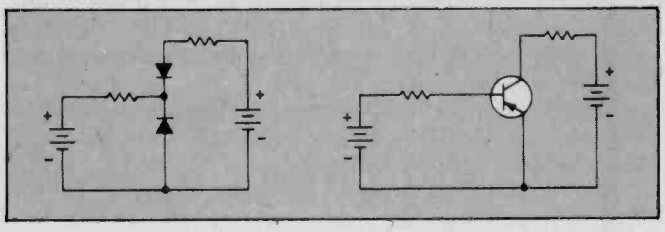
Up to now we have been using the NPN transistor, solely for the purposes of illustration. A PNP transistor could have been used. There is no difference in how the two types work or behave. What is said about one is equally true for the other.

There is, however, one important circuit difference which is illustrated below. This is caused by the fact that the PNP is made with the diodes in the reverse direction from the NPN.



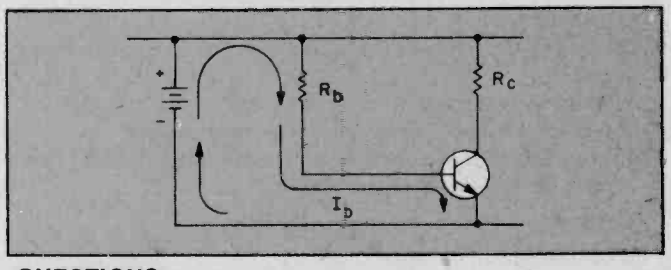
Note how the battery polarity is reversed and the current flows in the opposite directions through the diodes.

The two figures below show the battery connections to produce currents for both circuits. In both diagrams the current flow is counterclockwise.



As stated earlier, there is absolutely no difference between NPN and PNP transistors. Both are used equally in electronic circuits; one is not favored over the other. Base current causes collector current to flow in both. To avoid confusion, the rest of this discussion will be conducted using NPNs only as examples. And from now on, we will use the circuit symbols only.

Consider the action of the circuit below. It uses only one battery to provide the base and the collector current. The path of the base current only is shown in the diagram.



QUESTIONS

7. Name the components through which the base current flows. .....

8. Into which terminal of the transistor does the base current flow? .....

9. Out of which transistor terminal does the base current flow? .....

10. Through which terminals of the transistor does no base current flow? .....

ANSWERS

7. the battery, the resistor *Rb,* and the transistor

8. base

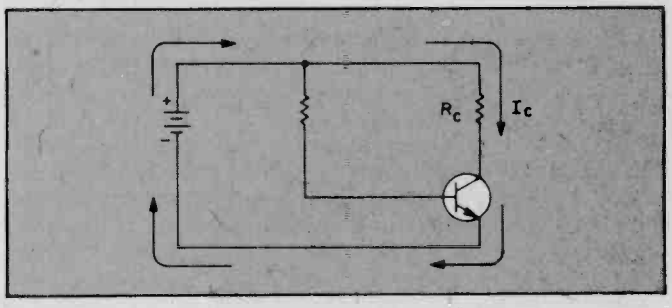
9. emitter

10. collector

Can you remember the outstanding physical characteristic of the transistor? When base current flows in the preceding circuit, what other current will flow, and which components will it flow through?

Collector current will flow. It will flow through the resistor *Rc* and the transistor.

The path of the collector current is shown in the diagram below.



QUESTIONS

11. List the components through which the collector current flows. .....

12. What causes the collector current to flow? .....

ANSWERS

11. the resistor *Rc,* the transistor, and the battery

12. base current (Collector current cannot ever flow if

base current is not flowing first.)

It is a peculiar property of the transistor that the *ratio of collector current to base current is constant.* The collector current is always much larger than the base current. The constant ratio of the two currents is called the *current gain* of the transistor and it is a number much larger than 1.

Current gain is given the symbol β, called beta. Typical value's β range from 10 to 300. 100 is a good typical value from many transistors, and we will use this number for convenience in our calculations.

QUESTIONS

13. What is the ratio of collector current to base current called? .....
14. What is the symbol used for this? .....
15. Which is larger—base or collector current? .....
16. Look back at the circuit before question 7. Will current be greater in *Rb* or in *Rc*? .....

ANSWERS

13. current gain
14. β
15. Collector current is larger.
16. The current is greater in *Rc*, since it is the collector current.

The mathematical formula for current gain is as follows.

$$\beta = \frac{Ic}{Ib}$$

where:

Ib = base current *Ic* = collector current

From this you can see that if no base current flows, no collector current will flow. And if more base current flows more collector current will flow. This is what is meant when we say the "base current controls the collector current."

Suppose the base current is 1 mA and the collector current is 150 mA. What is the current gain of the transistor? .....

150

Current gain is a physical property of the transistor. Its value can be taken from the manufacturer's published data sheets or it can be determined experimentally by the user.

In general β is a different number from one transistor type to the next, but it remains constant for a given transistor. Transistors of the same type have β values within a narrow range of each other.

One of the most often performed calculations in transistor work is determining the values of either collector or base current, when β and the other current are known.

For example, suppose a transistor has 500 mA of collector current flowing and it is known to have a β value of 100. Find the base current. To do this, use the formula as shown below.

$$\beta = \frac{Ic}{Ib}$$

$$Ib = \frac{IC}{\beta} = \frac{500}{100} = 5 \text{ mA}$$

Now you do these simple examples.

QUESTIONS

17. *Ic* = 2 A, β = 20. Find *Ib*. .....
18. *Ib* = 1 mA, β = 100. Find *Ic*. .....
19. *Ib* = 10 μA, β = 250. Find *Ic*. .....
20. *Ib* = 0.1 mA, *Ic* = 7.5 mA. Find β. .....

ANSWERS

17. 0.1 A, or 100 mA
18. 100 mA
19. 2500 μA, or 2.5 mA
20. 75

This set of questions will serve as a summary of the first part of this chapter. You should be able to answer all the questions. Use a separate sheet of paper for your diagram and calculations.

QUESTIONS

21. Draw the circuit in frame 13, and show the paths of *Ib* and *Ic*.
22. Which current controls the other? .....
23. Which is the larger current, *Ib* or *Ic*? .....
24. *Ib* = 6 μA, β = 250. Find *Ic*. .....
25. *Ic* = 300 mA, β = 50. Find *Ib*. .....

ANSWERS

21. Refer to frame 13 to see if the figure is correct.
22. *Ib* (base current) controls *Ic* (collector current).
23. *Ic*
24. 1.5 mA
25. 6 mA

THE TRANSISTOR EXPERIMENT

The object of the following experiment is to find β of a particular transistor by measuring several values of base current with their corresponding values of collector current. These values of collector current will be divided by the values of the base current to obtain β. The value of β will be almost the same for all the measured values of current. This will show that β is a constant for a transistor.

As long as the circuit is set up, measure the collector voltage for each current value. This will demonstrate experimentally some points to be made in future frames. Observe how the collector voltage *Vc* drops toward 0 V as the currents are increased.

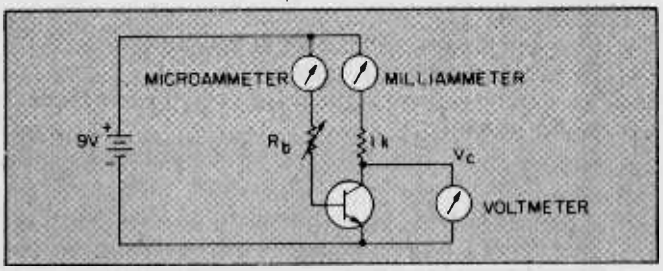
If you do not have the facilities for setting up the circuit and measuring the values, just read through the experiment to find out how it would be done. If you do have the facilities, you will need the following equipment and supplies.

1 9-V transistor radio battery (or a lab power supply)
1 current meter, maximum reading 100 μA
1 current meter (maximum reading 10 mA)
1 voltmeter, maximum reading 10 V
1 resistor substitution box, or a 1 MΩ potentiometer, or assorted resistors with values in the table
1 1-kΩ resistor
1 transistor, preferably NPN

Almost any small commercially available transistor will do for this experiment. The measurements given in this book were obtained using a 2N3643. If only a PNP is available, then simply reverse the battery voltage and proceed as described.

Finally you will need several clip leads to join the components together. If you have adequate facilities, soldered joints can be used.

Set up the circuit shown in the figure below. Follow this procedure.



(1) Set *Rb* to its highest value.
(2) Measure and record *Ib* (in the table on page 55)
(3) Measure and record *Ic*.
(4) Measure and record *Vc*.
(5) Lower the value of *Rb* enough to produce a different reading of *Ib*.
(6) Measuer and record *Ib*, *Ic*, and *Vc*.
(7) Lower *Rb* again and get a new *Ib*.
(8) Measure and record all the values again.
(9) Continue this until $Vc = 0$ V.
(10) Further reductions in the value of *R2* will increase *Ib*, but will not increase *Ic* or *Vc*.

Check the figures in your table to make sure you got a consistent pattern. Then compare your measurements with the ones given.

Rb	*Ib*	*Ic*	*Vc*

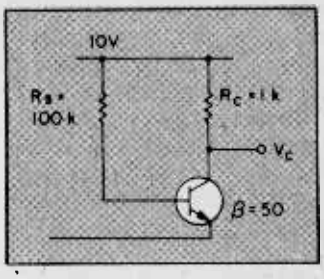
The figures in this table were obtained in an experiment conducted with considerable care. Precision resistors were used, and a commercial 2N3643 transistor was used. With ordinary 10% or 20% tolerance resistors and a transistor chosen at random, different figures will obviously be obtained. So if your figures are not as precise as those here, do not worry.

Rb	*Ib*	*Ic*	*Vc*
1 MΩ	9 uA	0.9 mA	8.1 volts
680 kΩ	13	1.3	7.7
470	19	1.9	7.1
330	27.3	2.8	6.2
270	33.3	3.3	5.7
220	40	4.1	5.0
200	45	4.5	4.5
180	50	5	4.0
160	56	5.6	3.4
150	60	6	3
120	75	7.5	1.5
110	82	8.0	1.0
100	90	9	0.3

In the experiment which produced this table, $\beta = 100$. You can see this by forming the ratio *Ic*/*Ib* for almost every pair of current values.

For each value of *Ib* and its corresponding value of *Ic* in the experiment, calculate the value of β. The values wil' vary slightly but will be close to an average. (Excessively low and high values of *Ib* may produce values of β which will be quite different. Ignore these for now.)

Did you get a consistent β? Was it close to the manufacturer's specifications for your transistor?



In the experiment you measured the voltage level at the collector—*Vc*—and recorded your measurements. Let's examine how to determine the voltage at the collector, when measurement isn't feasible. This will also show how the collector voltage can be determined without measurement.

Apply these steps to the circuit above.

26. Determine *Ic*.
27. Determine the voltage drop across the collector resistor *Rc*. Call this *Vr*.
28. Subtract *Vr* from the supply voltage to get the collector voltage.

Let us go through the first step together.

26. To find *Ic*, we must first find *Ib*.

$$Ib = \frac{10\text{ V}}{100\text{ k}\Omega} = 0.1\text{ mA}$$

$$Ic = \beta \times Ib = 50 \times 0.1\text{ mA} = 5\text{ mA}$$

Now do the next two steps. Use a separate sheet of paper for your calculations.

27. To find *Vr*:
$Vr = Rc \times Ic = 1\text{ k}\Omega \times 5\text{ mA} = 5\text{ V}$
28. To find *Vc*:
$Vc = Vs - Vr = 10\text{ V} - 5\text{ V} = 5\text{ V}$

Use the same circuit, but use a value $\beta = 75$. Again find:

QUESTIONS

29. *Ic* .....
30. *Vr* .....
31. *Vc* .....

ANSWERS

29. $Ib = \frac{10\text{ V}}{100\text{ mA}} = 0.1\text{ mA}$; $Ic = 75 \times 0.1\text{ mA} = 7.5\text{ mA}$
30. $Vr = 1\text{ k}\Omega \times 7.5\text{ mA} = 7.5\text{ V}$
31. $Vc = 10\text{ V} - 7.5\text{ V} = 2.5\text{ V}$

Use the same circuit again, but with these values: $Rb = 250\text{ k}\Omega$ and $\beta = 75$. Again find:

QUESTIONS

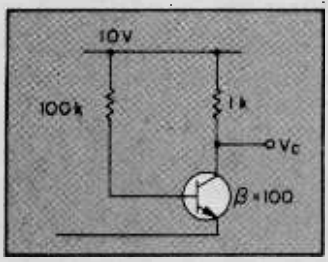
32. *Ic* .....
33. *Vr* .....
34. *Vc* .....

ANSWERS

32. $Ib = \frac{10\text{ V}}{250\text{ k}\Omega} = \frac{1}{25}\text{ mA}$; $Ic = 75 \times \frac{1}{25}\text{ mA} = 3\text{ mA}$
33. $Vr = 1\text{ k}\Omega \times 3\text{ mA} = 3\text{ V}$
34. $Vc = 10\text{ V} - 3\text{ V} = 7\text{ V}$

Write down your values for:

35. *Ib* = ...
Ic = ...
36. *Vr* = ...
37. *Vc* = ...



From the preceding problems you can see that *Vc* can be set to any desired value by choosing a transistor with an appropriate value of β, or by choosing the correct value of *Rb*.

Consider now this special example. The object is to find *Vc*. Go through the steps of the previous few examples.

You should have these values.

35. $Ib = \frac{10\text{ V}}{100\text{ k}\Omega} = 0.1\text{ mA}$

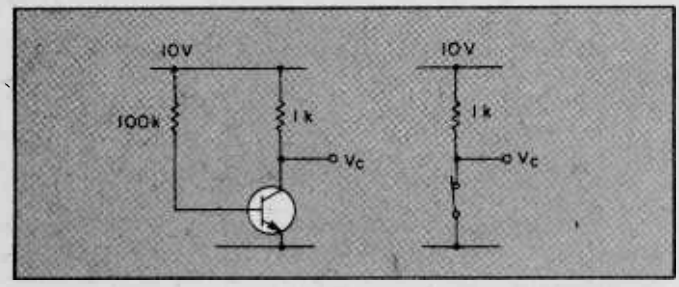
$Ic = 100 \times 0.1\text{ mA} = 10\text{ mA}$

36. $Vr = 1\text{ k}\Omega = 10\text{ mA} \times 10\text{ V}$

37. $Vc = 10\text{ V} - 10\text{ V} = 0\text{ V}$.

Here the base current is just sufficient to produce a collector voltage of 0 V. This is a very important condition with many practical applications.

Look at the two drawings below and compare their voltages at the point labeled *Vc*.



Consider a transistor which has sufficient base current and collector current to set its collector voltage to 0 V. Obviously it can be compared to a closed mechanical switch. As the switch is said to be ON, then the transistor is also said to be "turned on" or just ON.

QUESTIONS

38. From the above, what can a turned on transistor be compared to? .....

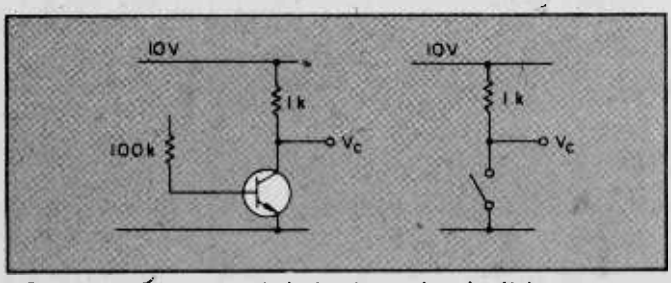
39. What is the collector voltage of an ON transistor? .....

ANSWERS

38. a closed mechanical switch

39. 0 V

Now compare these two circuit drawings.



Since the base circuit is broken—that is, it is not complete—there is no base current flowing.

QUESTIONS

40. How much collector current is flowing? .....

41. What is the collector voltage? .....

42. What is the voltage at the point *Vc* in the mechanical switch circuit? .....

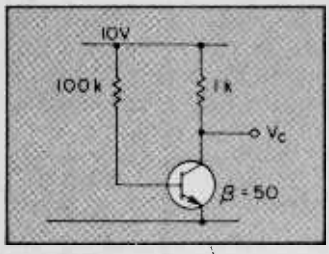
ANSWERS

40. None.

41. Since there is no current flowing through the 1 kΩ resistor, there is no voltage drop across it. So the collector will be at 10 V.

42. 10 V, since there is no current flowing through the 1 kΩ resistor.

From the preceding section, it is obvious that a transistor with no collector current can be considered similar to an open mechanical switch. For this reason a transistor with no collector current and its collector voltage level at the supply voltage level is said to be "turned off" or just OFF.



Now work through this example and compare the results to the examples above. Again the object here is to find *Vc*.

43. *Ib* = ...

Ic = ...

44. *Vr* = ...

45. *Vc* = ...

ANSWERS

43. $Ib = \frac{10\text{ V}}{100\text{ k}\Omega} = 0.1\text{ mA}$

$IC = 50 \times 0.1\text{ mA} = 5\text{ mA}$

44. $Vr = 1\text{ k}\Omega \times 5\text{ mA} = 5\text{ V}$

45. $Vc = 10\text{ V} - 5\text{ V} = 5\text{ V}$

Note the output voltage this time is exactly half the supply voltage. This condition is very important in AC electronics and will be returned to in the AC section.

SUMMARY

At this point it is useful to compare the properties of a mechanical switch and a transistor.

State	Transistor	Mechanical switch
Open or OFF	No current flow. Full supply voltage across collector and emitter.	No current flow. Full supply voltage across terminals.
Closed or ON	Full circuit current flows as collector current. No voltage drop between collector and emitter	Full circuit or load current flows through the switch. No voltage drop across the switch terminals.

The terms ON and OFF are used in digital electronics to describe the two transistor conditions just encoun-

(Continued on page 86)

Lab Test Elementary Electronics For Yourself

Get switched on

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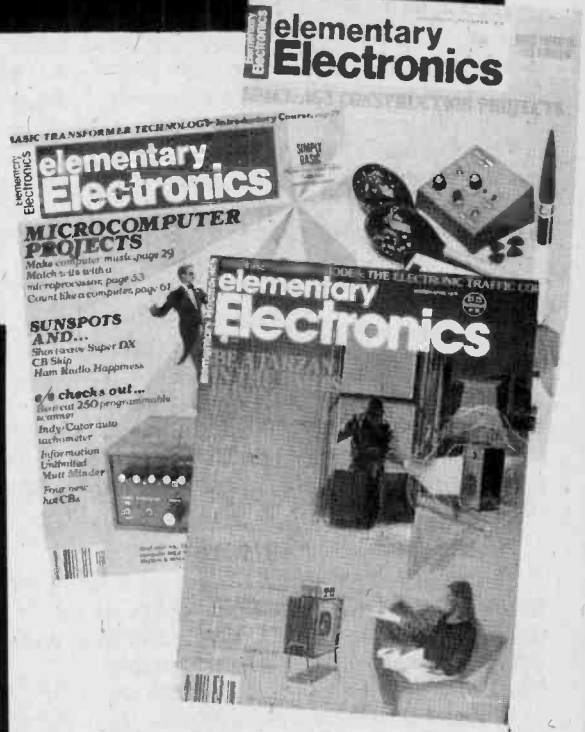

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Palomar Loop

(Continued from page 56)

ize the Palomar's nulling. But if you are limited for BCB DXing to a receiver's built-in loopstick antenna, or a piece of wire lying on the floor or stapled to the moulding, then the Palomar will pay off in almost unbelievable performance: you will actually dig out signals you never knew existed.

The Palomar loop antenna system works best in a frame house; brick and stucco will reduce maximum performance, and it might be necessary to position the antenna near a window facing the direction from which you want to receive signals. Aluminum siding generally acts as an almost total shield if the siding is grounded according to the electrical code, and the loop antenna might not offer any improvement in reception unless located in a window. Our tests in an aluminum sided home indicated poor reception when the siding totally surrounded the loop. When there was a discontinuity in the siding, such as a fiberglass or shingle front, good to excellent reception was attained, though nulling in some directions was not sufficiently deep. Further, reception in a basement which was partially below ground, with the siding starting above the basement ceiling—actually 3-feet above ground—was very good.

The equipment at the time this article was prepared—was available directly from Palomar Engineers, Box 455, Escondido, CA. 92025. The loop amplifier is priced at $67.50 (less 2U6 type 9-volt battery). Plug-in loops are priced at $47.50 each. Make certain you specify the BCB antenna for 550-1600 kHz coverage. (Add $2 shipping and handling for U.S. and Canada to total order.) For additional information circle No. 52 on the reader's service coupon. ■

Basic Course

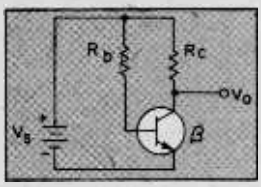
(Continued from page 84)

tered, and their similarity to a mechanical switch is made use of in many digital situations. We will not get into the details of digital electronics in this book, beyond examining the simple transistor switch in the next chapter.

SELF-TEST

The questions below will test your understanding of this chapter. Use a separate sheet of paper for your diagrams or calculations. Compare your answers with the answers provided following the test.

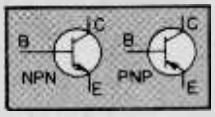
1. Draw the symbols for an NPN and PNP transistor. Label the terminals of each.
2. In the figure below, draw the paths taken by the base and collector currents.

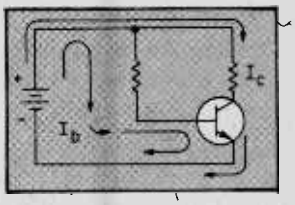


3. What causes the collector current to flow? .....
4. What is meant by the term *current gain*? What symbol is used for this?
   What is its algebraic formula? .....
5. In the figure in question 2, $Rb = 27\ k\Omega$ and $Vs = 3$ V. Find *Ib*. .....
6. Repeat question 5 with $Rb = 220\ k\Omega$ and $Vs = 10$ V. Find *Ib*. .....
7. Using the same figure, find *Vo* when $Rb = 100\ k\Omega$, $Vs = 10$ V, $Rc = 1\ k\Omega$, and $\beta = 50$. .....
   .....
8. Repeat question 7 with these values: $Rb = 200\ k\Omega$, $Vs = 10$ V, $Rc = 1\ k\Omega$, and $\beta = 50$. .....
   .....
9. Now use these values: $Rb = 47\ k\Omega$, $Vs = 10$ V, Rc = 500 ohms, and $\beta = 65$. .....
   .....
10. Now use these values: $Rb = 68\ k\Omega$, Vs = 10 V, $Rc =$ 820 ohms, and $\beta = 75$. .....
    .....

Answers to Self-Test

If your answers do not agree with those given below, go back and review the appropriate sections.

1. 

2. 

3. Base current.
4. Current gain is the ratio of collector current to base current. It is given the symbol β. $\beta = Ic/Ib$.
5. $Ib = \frac{(Vs - 0.7)}{Rb} = \frac{(3\ V - 0.7\ V)}{27\ k\Omega} = \frac{2.3\ V}{27\ k\Omega} = 85\ uA$
6. $Ib = \frac{10\ V}{220\ k\Omega} = 45.45\ uA$
7. 5 V
8. 7.73 V
9. 3.1 V
10. 1 V

■

Simply Basic

(Continued from page 71)

```
TOMMY DORSEY      BIG BAND              MARIE
LED ZEPPELIN                            BLACK DOG
STEVE MILLER      BOOK OF DREAMS
STEVE MILLER                            JET AIRLINER

COMMAND? ARTIST
NAME OF ARTIST? STEVE MILLER
ALBUM: BOOK OF DREAMS
SONG: JET AIRLINER

COMMAND? ALBUM
ALBUM NAME ? BOOK OF DREAMS
ARTIST: STEVE MILLER

COMMAND? ALBUM
ALBUM NAME ? BIG BAND
ARTIST: TOMMY DORSEY
ARTIST: TOMMY DORSEY

COMMAND? SONG
SONG ? MARIE
ARTIST: TOMMY DORSEY
ALBUM: BIG BAND

COMMAND? EXIT

READY
```

■

SHOOTING AHEAD IN ELECTRONICS

If you want to go further in your exploration of transistors, you can order the book from which this article was excerpted, *ELECTRONICS*, by Harry Kybett. Write to Self-Teaching Guides Department, John Wiley & Sons, Inc., Publishers, 605 Third Avenue, New York, NY 10016. The price is $7.25 postpaid. If you want more information about the popular Self-Teaching Guide series, just ask, and they'll send you some. Be sure to mention you saw it in ELEMENTARY ELECTRONICS.

Computer Readout

(Continued from page 78)

memory for future reference by the computer. The MOVM,A instruction, at position 9 in our program, causes the contents of the A register to be moved to that location in memory *who address is stored in the H and L registers!*

The final instruction is the halt instruction (HLT) which stops program execution. If it were not there, the program counter would merrily continue to step through all available memory—sometimes with intriguing results.

This program could be located anywhere in available memory that did not interfere with other machine operations. Our address designations merely reflect the sequential order of the program. To load it, we must first load the program counter with the starting address, then press RUN. The machine then takes over, driven and timed by the system clock.

It should be noted that our example was an addition routine. This was because practically all the computer does *is* add, with binary subtraction being merely a modified form of addition.

For example, multiplication can be thought of as the successive addition of one number a certain number of times. One illustrative but inefficient way to do this in machine code for 5 × 8 would be to clear the B register and put 5 into the A register. We then add 8 to the B register 5 times each time we add 8 to the B register, we subtract 1 from register A. There is an instruction that looks for a zero condition in the A register. When this is the case, we have added 8 five times, or multiplied 5 × 8.

For programmers wishing to use machine instructions, it is not necessary to memorize all the binary number associated with the machine instructions. There are programs called *assemblers* which allow one to write a program using the written mnemonics and numbers. The assembler then reads this written program called a *source listing*, and translates the letters and numbers into the binary information for direct use by the computer. An assembler code source listing of our addition program would look like that in figure 3.

When this is read by the assembler, the comments are ignored and everything else is translated into the binary code as shown above at a starting address specified by the programmer.

The kind of machine programming we have discussed in this article is important to programmers wishing to write especially efficient or special-purpose programs. For the rest of us, it is perhaps interesting to realize that every time a BASIC program says A=7+2, something like that described above takes place in the machine . . . at 2 million cycles per second. ■

Hi-Fi Reports

(Continued from page 32)

perior to the bulk of the units available.

While the KD-5070 is described as an automatic turntable it will not play a stack of L.P.s, but it will deal with individual albums at the touch of a button. The controls provide automatic indexing for 7-, 10-, and 12-inch records. At the end of each play the tone arm returns to the rest and power turns off, unless the repeat play button is used. The tonearm can be operated manually if desired.

The vertical tracking force is adjustable in 0.1-gram increments from 0 to 3 grams and there is a calibrated antiskate adjustment. The turntable speed is unaffected by line-voltage variations between 90 and 140 volts. The 33-RPM pitch control could be varied +5.4 percent and −7 percent, and the 45-RPM pitch control could be adjusted +3 percent and −5 percent. Wow and flutter measured 0.05 percent with peaks to 0.12 percent. Output cable capacitance is a nominal 90-pF. The listening panel felt that the sound quality of first rate cartridges was noticeably improved with this turntable.

Everyone who has tried the KD-5070 has been impressed with its ease-of-operation. With the automatic features all you do is put a record on the spindle and push the start button. You never have to touch the tonearm. It's great if you need a turntable that can be used by children. The KD-5070 carries a suggested retail price of $285.00.

Sony is giving everyone a chance (for $4,400) to be the first on their block to have a pulse code modulation, digital audio processor. It is said to virtually eliminate tape hiss, distortion and wow and flutter, and to provide 85 dB of dynamic range with the peaks clearly recorded. For more information circle 61 on the reader service coupon.

Heath is offering a new 125-watt-per-channel rack-mounting power amplifier kit with a mail order price of $359.95 (Model AA-1600). An optional oak-finished case is available for $27.95. Circle number 1.

Sansui claims to have the fastest responding preamplifier (model CA-F1) in the west (and east), with a 50-V μSec slew rate and 0.06-μSec rise time. The aux, tuner and tape inputs are claimed to have a 5- to 600,000-Hz. frequency response and a 100-dB signal-to-noise ratio. $495. Circle number 57 for more information about the CA-F1. ■

Hey, Look Me Over

(Continued from page 18)

CIRCLE 56 ON READER SERVICE COUPON

teries are not included. Get all the specs direct from YAESU Electronics Corporation, 15954 Downey Avenue, P.O. Box 498, Paramount, CA 90723. ■

Signal Snare

(Continued from page 47)

tween the drain of Q1 and ground. The station signal should diminsh. This indicates that the RF reflex portion of the circuit is operating correctly. The capacitor shunts the RF to ground, but does not affect the audio amplification as it has a high impedance to the audio frequencies.

Check the audio amplifier portion of the reflex circuit by tuning in a station and then removing the headphones from J2. Temporarily connect a 100-ohm, ½-watt resistor in place of the headphones to J2. Connect the headphones with a pair of clip leads across the output of D1 (across C6), and compare the signal level with the previous level at J2. The level at D1 should be lower than that of J2 to verify that the audio is being amplified by Q1. ■

Images

(Continued from page 64)

comes time to upgrade your present equipment, the first thing to consider is dual conversion. With this system two different IFs are used. A shortwave signal might, for example, be first converted to 3100 kHz. Thus a station's image would be a full 6200 kHz below its real frequency.

If you can't afford a dual conversion receiver, at least one that doesn't overload, try for some amplification before the IF. Even one stage of amplification at the original frequency will reduce image problems. Two stages are even better, but more expensive than a quality synthesized frequency receiver. ■

Kathi's CB Carousel

(Continued from page 75)

at any time. On the other hand, if you're just looking for action you could simply have the computer continuously scan all 40-channels searching for a busy or unused channel.

Since the computer also tunes the transmitter to the received channel, though it will not scan in the transmit mode, protection is provided against an invalid entry. Should you try to enter a channel number greater than 40, or a three digit number, the computer automatically reverts to channel 19.

Channel programming for both the memory and monitor modes is volatile, meaning it vanishes when the power is turned off. If you want to retain the programming simply turn the volume control down but not off. Once the memory is "lost" it has to be reprogrammed.

Performance. As far as the computer is concerned you get everything that's claimed. It works well, and certainly provides a convenient way to keep up with all 40-channel action. There are a few operating or programming hang-ups that takes some practice to unravel, but they are just about what you'll find on an ordinary VHF scanner. Basically, there are no hang-ups once you get used to the programming procedure.

As for the receiver and transmitter, performance is what I've come to expect from the better quality transceivers. The receiver sensitivity measured 0.4 μV for a 10-dB S+N/N (signal plus noise to noise ratio). Adjacent channel rejection measured 65 dB (considerably better than the factory claimed 50+ dB), while the AGC action was a superb 3 dB between the test limits of 2 μV and 10,000 μV.

The transmitter delivered exactly 4 watts output to a 50-ohm load. A −30-dB microphone sensitivity produced 100% modulation, which was limited to 100%. The S-meter was calibrated for an S9 indication with a 100 μV input.

All in all, an impressive package, which is probably representative of the way future computerized CB rigs are likely to go. The Pace 8117 sells for $249.95. For additional information circle No. 64 on the reader service coupon. ■

Redco RFC-50

(Continued from page 50)

ample, the display indicates 27,9651 with the *resolution* selector at the "100" setting, meaning that you must multiply the reading by 100. 27.9651 times 100 becomes 27.965100, or 27.9651 MHz.

Now suppose that you require greater resolution. Using our last example, you would set the *resolution* to "10" (meaning kHz) and the reading might indicate 7.96515. You know the figure that vanished when displaced to the left was a 2, hence the frequency is 27.965150, or 27.96515 MHz. The error is again in the digits column; 9 Hz maximum plus the instrument's normal error, which is specified as 9 parts in 10^{-6}.

Our tests indicated reliable readings to about 46 MHz; we would say the upper limit should be the specified 40 MHz. The minimum input signal for a reliable reading in the RF range of 50 kHz to 40 MHz feeding the direct front panel input was nominally 30 mV, somewhat more sensitive than the specified 100 mV. Because of normal component tolerances, we would assume the manufacturer's claim of 100 mV to be typical.

The input power rating of the sampling circuit is 100-watts P.E.P. Our tests were limited to the maximum rating of our test transmitter which is 250-watts P.E.P., and all worked well up to 250 watts. We must assume the REDCO 1000-P.E.P. rating is correct. At the low end, we found flea power as low as 2-watts through the in-line connection gave reliable performance.

While the in-line connection has no effect at the lower frequencies, in the range of 27 to 30 MHz it produces an SWR of nominally 1.3:1. This has no real effect on the average antenna system or the associated transmitter's performance, but you should be aware of the fact your SWR indicator (meter) will read slightly higher than usual.

Is it Accurate? Accuracy is always a relative term, for it depends on what is used as the standard of reference. In this instance, we used a Hewlett-Packard frequency counter, which is generally employed for our transmitter tests. The REDCO RFC-50 indicated within 20 Hz of the HP's reading. Considering that the HP counter can indicate 0.001 Hz, the RFC-50's frequency reading was essentially accurate; certainly as accurate as the average hobbyist will ever need or be able to afford. As to long-term accuracy, that depends, as do all other counters without a TXO (temperature controlled oscillator), on the ambient environment, and the quality of the counter's crystal and components.

Summing Up. Overall, the REDCO RFC-50 performs well as an in-line Amateur or CB) frequency indicator.

The REDCO RFC-50 Communications Frequency Counter is priced at $179.95 complete with AC and DC power cords. For additional information, circle number 68 on reader service coupon. ■

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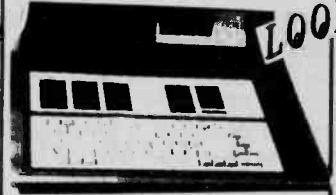

This Honeywell No. 74100903-001 ASC11 encoded microswitch data entry format keyboard. Comes with fully populated I.C. boards. Some 100 I.C.'s, 7100 & 71400 series, or some are dot matrix I.C.,s, LSI chips TMC 4907 - a 4 mhz crystal, a Mostek MK2002, plugs into a wire wrap board of 120 sockets. Also 2-large heat sinks, 4-2N3055 xistors, 2-2N3668, 4-jumper cables with dip plugs attached, 30 lamps No. 382 & other stuff. Power required for keyboard +5VDC, to 12VDC regulated. Pin out supplied for keyboard only. Keyboard in console is a complete assembly ASC11 encoded & is easily removed to fit or use as is. The additional circuitry was used to drive status indicators; Format, program level, check & display etc. Console size: 19" wd.x16"dp.x8" hg. rear, front slopes to 2 3/4"hg. Removed from equipment. Good to excellent condition.

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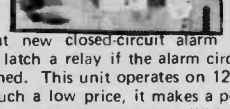

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☐ 60 DISC CAPACITORS, asst values long leads (#437)	1.29	120 for 1.30
☐ 20 TRANSISTOR ELECTRO'S, asst up and ax (#453)	1.29	40 for 1.30
☐ 75 HALF WATTERS, resistors, color coded, asst (#454)	1.29	150 for 1.30
☐ 35 SILVER MICAS, red becks, axial, asst. (#455)	1.29	70 for 1.30
☐ 4 PUSH BUTTON, SPST, PANEL, N.C. 125V 1A (5289)	1.29	8 for 1.30
☐ 100 GERMANIUM DIODES, axial leads, u test (#642)	1.29	200 for 1.30
☐ 100 STABISTORS, Regulator, sensing and computer. Axial, ex. yield (#3140)	1.29	200 for 1.30
☐ 100 PRINTED CIRCUIT ½ WATT RESISTORS, asst (#1060)	1.29	200 for 1.30
☐ 12 TRANSISTOR SOCKETS, asst npn and pnp types (#651)	1.29	24 for 1.30
☐ 50-3 AMP SILICON RECTIFIERS, axial, asst V (#865)	1.29	100 for 1.30
☐ 50 POLYSTYRENE CAPS, plastic coated, prec. (#1052)	1.29	100 for 1.30
☐ 10 NE-2 bulbs, for 110vac projects, hobby, etc (#1222)	1.29	20 for 1.30
☐ 10 PROXIMITY REED SWITCHES (#1258)	1.29	20 for 1.30
☐ 6 2N915 UHF TO-18 TRANSISTORS (#1423)	1.29	12 for 1.30
☐ 30 MOLEX CONNECTORS, nylon, asst. sizes (#5642)	1.29	60 for 1.30
☐ 6 CALCULATOR AC ADAPTOR JACK, standard threads 3 terminals (#2316)	1.29	12 for 1.30
☐ 50 ONE AMP ZENER DIODES, asst. axial, u test (#1964)	1.29	100 for 1.30
☐ 5-PA-263 THREE WATT PC BOARDS, for amps (#2013)	1.29	10 for 1.30
☐ 6 MINI MOTORS, 1½ VDC, for many hobby projects (#2551)	1.29	12 for 1.30
☐ 50-1N4000 RECTIFIERS, asst to 800V, u test (#2594)	1.29	100 for 1.30
☐ 20-UPRIGHT ELECTROS, asst'd values & capacitance. (#3226A	1.29	40 for 1.30
☐ 1-UHF TUNER, solid state, standard type (#2927)	1.29	2 for 1.30
☐ 6 ITS A SNAP, 9 VDC BAT-clip, red n black lead (#2852)	1.29	12 for 1.30
☐ 8 1400 VOLT "RED BALL" RECTIFIERS, axial 1 AMP (#2590)	1.29	16 for 1.30
☐ 20 1N4148 SWITCHING DIODES, 4 nsec. axial (#3000)	1.29	40 for 1.30
☐ 6 10 AMP QUADRACS, w/trigger diode up 600V (#3620)	1.29	12 for 1.30
☐ 5 MICRO SWITCHES, push, asst types (#3011)	1.29	10 for 1.30
☐ 40 SQUARE DISC STYLE CHOKES, color codad (#3203)	1.29	80 for 1.30
☐ 30 TRANSISTORS TO92 2N4400 series, u test (#3291)	1.29	60 for 1.30
☐ 6 TRANSISTORS TRANSFORMERS, audio, inter, etc mini (#3295)	1.29	12 for 1.30
☐ 15 PRINTED CKT TRIMMER POTS, asst values, etc (#3346)	1.29	30 for 1.30
☐ 7-2N3055 HOBBY NPN TRANSISTORS, TO-3 (U3771)	1.29	14 for 1.30
☐ 10-PNP 30 WATT TO-5 TRANSISTORS, hobby (#3772)	1.29	20 for 1.30
☐ 50 TUBE SOCKETS, 4, 5, 6, 7 pin tubes, asst (#3839)	1.29	100 for 1.30
☐ 1-10 AMP POWER TAB QUADRAC, 200 PRV, TO220, 2/trigger (#1590)	1.29	2 for 1.30
☐ 10-BULLET RECTIFIERS, 1.5 amp, 200V, axial (#84)	1.29	20 for 1.30
☐ 6-READOUTS, MAN-3, common cath, LED, the claw, RED (#3338)	1.29	12 for 1.30
☐ 8-LEDS, asst. sizes and shapes, red, green, yellow, amber (#3869)	1.29	16 for 1.30
☐ 1 PHOTO FLASH ELECTRO. CAP, 600 MF @ 360V (#3897)	1.29	2 for 1.30
☐ 2-CIRCUIT BREAKERS, glass sealed, axial, rated @ 1 amp (#3905)	1.29	4 for 1.30
☐ MICRO MINI TOGGLE, SPST, 2 pos, on-off, 125V @ 3 amps (#3936)	1.29	2 for 1.30
☐ 5 SLIDE VOLUME CONTROLS, asst. of popular values, for HiFi. (#2318)	1.29	10 for 1.30
☐ 15 COAX LEDs, single lead, pin head style, Color: Red (# 1788)	1.29	30 for 1.30
☐ 60 TERMINAL STRIPS, form two lugs up, Solder type. (#35A334)	1.29	120 for 1.30
☐ 60 CERAMIC CAPS, incl. NPO's, neg. coef. N750's asst. values. (#35B90)	1.29	120 for 1.30
☐ 10 TV/FM SPLICERS, for 300 ohm shielded twin lead. Bakelite. (#5547)	1.29	20 for 1.30
☐ 10-1SV ZENERS, 400mw, axial, glass case (#5404)	1.29	20 for 1.30

☐ 12-1.5V LAMP AND SOCKET SET, 200ma, T2 style (#3956)	1.29	24 for 1.30
☐ 10-RCA PHONO JACKS, chassis mount, teflon base (#5119)	1.29	20 for 1.30
☐ 15-THERMISTORS, asst. types, styles, & values (#2048)	1.29	30 for 1.30
☐ 4-5-DIGIT 7—SEGMENT READOUTS, in flat pak case (#5616)	1.29	8 for 1.30
☐ 4-¼" BLOCK TRIM POTS, 5K (#2536)	1.29	8 for 1.30
☐ 1 "FOTO-FET" N CHANNEL, Cryotalonics, J-Sealed Effect Transistors (#1169)	1.29	2 for 1.30
☐ 1-VOLTAGE REGULATOR, TO202 case, 12V 600MA (#1900)	1.29	2 for 1.30
☐ 1-3 DIGITS ON A CHIP, LED, red, DL-33 (#1887)	1.29	2 for 1.30
☐ 3-MM5262 2K DYNAMIC RAM, specify type (#3459)	1.29	6 for 1.30
☐ 10-2N711 HIGH SPEED SWITCHING TRANSISTORS, TO18, npn (#3374)	1.29	20 for 1.30
☐ 2-15W HI POWER TRANSISTORS, 220V, npn, TO66 (#2797)	1.29	4 for 1.30
☐ 3-24 PIN IC SOCKETS (#2168)	1.29	6 for 1.30
☐ 1-MM5312 DIGITAL CLOCK CHIP, 100% (#1525)	1.29	2 for 1.30
☐ 2-MM5725 4 FUNCTION CALCULATOR CHIP, 100% (#2036)	1.29	4 for 1.30
☐ 1-MM5202 ERASABLE PROM, 100% (#3459)	1.29	2 for 1.30
☐ 3-10 AMP 25V BRIDGE RECT, comb style (#2447)	1.29	6 for 1.30
☐ 10-2N3565 RF TRANSISTORS, TO106, 2N5133 (#3372)	1.29	20 for 1.30
☐ 6-LINEAR SWITCHING TRANSISTORS, 2N2905, pnp, TO5 (#3375)	1.29	12 for 1.30
☐ 50-2 AMP CYLINDRICAL RECT, up to 1K, u-test (#4006)	1.29	100 for 1.30
☐ 6 OPEN-FACE READOUTS, LED, red, some segs missing mostly duals (#3952)	1.29	12 for 1.30
☐ 10-2N2222 (or equiv.), TO-18 metal case (#1992)	1.29	20 for 1.30
☐ 10-DATA ENTRY SWITCHES, SPST, 1 amp, norm open 125V (#5321)	1.29	20 for 1.30
☐ 8-TRANSISTOR RADIO EARPHONES, 8 ohms imped (#2946)	1.29	16 for 1.30
☐ 15-FLUORESCENT OVERFLOW READOUT TUBES, w/leads (#3288)	1.29	30 for 1.30
☐ 2-ALUMINUM HEAT SINKS, for TO-220 (#5339)	1.29	4 for 1.30
☐ 1-2N5001 80V TRANSISTORS STUD (#2800)	1.29	2 for 1.30
☐ 3 MICROPROCESSOR/SUPPORT CHIPS, asst. MM5780-90 ser, 24-28pin (#5639A)	1.29	6 for 1.30
☐ 6 CLOCK/CALCULATOR CHIPS, asst. MM5378, 75, 5737 etc. (#5638A)	1.29	12 for 1.30
☐ 25 DTL FAIRCHILD IC's, gates and flip flops, Dip, 100% (#3709)	1.29	50 for 1.30
☐ 8-TRANSISTOR RADIO EARPHONES, 8 ohms imped (#2946)	1.29	16 for 1.30
☐ 1-24 VOLT 50 MIL TRANSFORMER, 115V input, open frame, 1" x 1" x 3/4" (#5631)	1.29	2 for 1.30
☐ 10-2N3704 TRANSISTORS, silicon, TO-92 case, hfe-300 100% (#5625)	1.29	20 for 1.30
☐ 10-2N3705 TRANSISTORS, silicon, TO-92 case, hfe-150, 100% (#5626)	1.29	20 for 1.30
☐ 10 D33021 TRANSISTORS, low power, silicon, hfe-60, TO-92 (#5627)	1.29	20 for 1.30
☐ 1 ALLEN BRADLEY POT, 10K, 2-1 4 watte, type-J, 2" x ¼" shaft (#1748)	1.29	2 for 1.30
☐ 50 ASST. RED LEDS, 20% or better, various styles and types (#5624)	1.29	100 for 1.30
☐ 10 G.E. POWER TAB TRANSISTORS, D40N1, N2, some NS, TO-220 (#5629)	1.29	20 for 1.30
☐ 2-¼" BLOCK TRIM POTS, 200K (#2535)	1.29	4 for 1.30
☐ 1-12VDC SMIL REED RELAY, spst, N.O. 2200 ohms, 7/8" x 5/16" x 5/16" (#5515)	1.29	2 for 1.30
☐ 50 TEMP. COEFFICIENT VOLTAGE REF. DIODES, asst. volt, +50% (#5647)	1.29	100 for 1.30
☐ 12 SKINNY TRIM POTS, PRECISION, asst. styles, value+ 50% yield (#3389)	1.29	24 for 1.30
☐ 60pc-PRECUT, PRETINNED WIRE, various lengths and colors (#1971)	1.29	120 for 1.30
☐ 60-MINI RESISTORS, for PC appl, vart. 1/8W, color coded (#2235)	1.29	120 for 1.30
☐ 20-NYLON GEARS, hi-quality, asst. sizes (#3446)	1.29	40 for 1.30
☐ 10-5K POTS, audio taper, plastic snap-in mounting (#5124)	1.29	20 for 1.30
☐ 10-1&2 MEG DUAL POTS, audio taper, "snap-in" mnt (#5125)	1.29	20 for 1.30
☐ 50-1 AMP ZENERS, wide asst. of values, untested (#1964)	1.29	100 for 1.30
☐ 12-SCR'S & TRIACS, 10 AMP, asst. values, untested (#2087)	1.29	24 for 1.30
☐ 3-QUADRACS, 10 AMP, 100% prime, 50-100-200 V, TO-220 (#5048)	1.29	6 for 1.30
☐ 20-MINI RECTIFIERS, 1½ AMPS, 25V, epoxy, axial (#5374)	1.29	40 for 1.30
☐ 10-1N4007 1000V MINI RECTIFIER, epoxy case, axial leads (#2383)	1.29	20 for 1.30
☐ 75 MOLEX CONNECTOR Type M1938-4, mates 14 to 40 pin sockets (#1609)	1.29	150 for 1.30
☐ 50 IF TRANSFORMERS, asst sizes (#35A9)	1.29	100 for 1.30
☐ 10-T.V. CHEATER CORD JACKS (#5519)	1.29	20 for 1.30
☐ 10-1 AMP 200V MINI RECTIFIER, 1N4003, epoxy, axial (#2379)	1.29	20 for 1.30
☐ 4-1.5V SILVER OXIDE WATCH BATTERIES, specify; RW 15, 18, 32 or 10L120 (#5063)	1.29	8 for 1.30
☐ 3-LCD WATCH READOUTS, 3½" digits, 7 seg. dim 1½ x 1" (#5066)	1.29	6 for 1.30
☐ 20-IC DICE CHIP, complete circuitry, asst. sizes (#5065)	1.29	40 for 1.30
☐ 10-INSTRUMENT KNOBS, asst. styles and colors, ¼" shaft (#5121)	1.29	20 for 1.30
☐ 4 MIKE HOLDERS, for CB's and other mobile rigs (563-1	1.29	8 for 1.30
☐ 5-TANTALUM ELECTROS, TEARDROP style, 2.2uf @ 25V (#5205)	1.29	10 for 1.30
☐ 2-INLINE FUSE HOLDERS, complete w/5 amp fuse (#5213)	1.29	4 for 1.30
☐ 30-4" CABLE TIES, non-slip white plastic (#5217)	1.29	60 for 1.30
☐ 30pc-HEAT SHRINK, asst. sizes, 50% shrinkage (#5246)	1.29	60 for 1.30
☐ 2-5.1V, 5%, 10W, STUD ZENER, DO-4case (#5287)	1.29	4 for 1.30

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☐	1942	MED YELLOW STUBBY
☐	1802	MICRO SINGLE PIN RED
☐	2793	JUMBO Amber
☐	2135	JUMBO RED
☐	2138	JUMBO GREEN
☐	2137	MICRO RED
☐	2790	JUMBO RED CLEAR

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CIRCLE 16 ON READER SERVICE COUPON

ELEMENTARY ELECTRONICS HOBBY MART

Antique Radio Corner

(Continued from page 74)

Hot Tubes. This happening brings up several questions to be discussed. Number one, what would a thief do with more than 13,000 radio-TV tubes? One knowledgeable collector felt that they were smuggled into Mexico. Why would they do this? Since there are only a few known radio collectors in Mexico they would no doubt be sent to other countries where radio collecting is becoming popular.

Number two, why haven't more radio collectors installed burglar alarms? Anyone handy with tools can buy equipment from radio catalogs to protect his home, museum, or work shop. Very often insurance companies give lower rates to persons with approved alarm systems.

Number three, why haven't radio collectors made a list of every radio, tube speaker, etc. in their collection and put it into a safe (away from home) location? Using file cards list the name, manufacturer, year built, number of tubes, condition, amount paid, approximate present value, and any other fact that would help establish its value. Most insurance companies will cooperate by sending a representative to your location and will verify each item.

Fourth and last (for this discussion), why haven't radio collectors had the larger, more valuable items in their collections appraised? There are a large number of antique appraisers, but most know very little about old radio equipment. Radios are a special branch of the antiques field. What the antique radio collectors need is a "Blue Book" of antique radio values similar to the one used by used car dealers. A book of radio values would stabilize the radio collecting hobby. Everyone having such a book would know what his radios were worth as well as what other collectors radios, (that he might consider buying) are worth. The Antique Wireless Association has made a small beginning by listing prices for radios that have been sold or auctioned at their meetings.

To my knowledge there is only one appraiser for old radios now active. There are discussions going on at this time with the thought of establishing a nation wide "Antique Radio Appraisers Association." Well qualified collectors living in various parts of the United States would become members of the staff. This way any collector desiring an appraisal could find an appraiser within a few hundred miles.

Any reader who would like to comment on the insurance and appraisal discussion is welcome to write to me in care of ELEMENTARY ELECTRONICS magazine. ■

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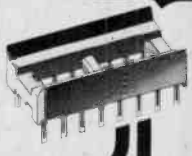
14 PIN	.12	24 PIN	.24
16 PIN	.14	28 PIN	.28
18 PIN	.18	40 PIN	.40
20 PIN	.20		



GENERAL INSTRUMENT

1 Amp Rectifiers (Epoxy) Stock level	Part No.		Price	1.5 Amp Single Phase Silicon Bridge Rectifiers Stock level	Part No.		Price
1.1Million	1N4001	50V	.029	320000	W06M	600V	.34
.6Million	1N4002	100V	.039	110000	W08M	800V	.39
1.4Million	1N4003	200V	.045				
1.9Million	1N4004	400V	.049				
.9Million	1N4005	600V	.055				
.4Million	1N4006	800V	.065				
1.7Million	1N4007	1000V	.07				

SWITCHING DIODES	Part No.	Price
	1N914 (100V 4NS)	.027
	1N4148 (100V 4NS)	.027

Zilog

		Z80-CTC	$10.90
		Z80A-CTC	$13.10
		Z80-DMA	~~40.00~~ $32.20
Z80-CPU	~~14.95~~ $13.60	Z80-SIO/0	~~59.00~~ $45.00
Z80A-CPU	~~24.95~~ $16.20	Z80A-SIO/0	~~68.00~~ $50.00
Z80-PIO	~~7.95~~ $10.90	Z80-SIO/1	~~59.00~~ $45.00
Z80A-PIO	~~11.95~~ $13.10	Z80A-SIO/1	~~68.00~~ $50.00

CMOS's

CD4000BE	.17	CD4042BE	.59	CD4515BE	$1.95
CD4001BE	.17	CD4043BE	.57	CD4516BE	.69
CD4002BE	.17	CD4044BE	.55	CD4518BE	.79
CD4006BE	.87	CD4046BE	.99	CD4519BE	.47
CD4007BE	.17	CD4049BE	.33	CD4520BE	.69
CD4008BE	.75	CD4050BE	.33	CD4522BE	.99
CD4009BE	.39	CD4051BE	.54	CD4526BE	.99
CD4010BE	.39	CD4052BE	.54	CD4527BE	$1.09
CD4011BE	.17	CD4053BE	.54	CD4528BE	.69
CD4012BE	.17	CD4060BE	.99	CD4531BE	.74
CD4013BE	.32	CD4066BE	.44	CD4532BE	$1.19
CD4014BE	.73	CD4068BE	.21	CD4539BE	.99
CD4015BE	.69	CD4069BE	.21	CD4543BE	$1.39
CD4016BE	.35	CD4070BE	.29	CD4555BE	.65
CD4017BE	.62	CD4071BE	.21	CD4556BE	.65
CD4018BE	.69	CD4072BE	.21	CD4581BE	$2.25
CD4019BE	.39	CD4073BE	.21	CD4582BE	.79
CD4020BE	.69	CD4075BE	.21	CD4584BE	.60
CD4021BE	.69	CD4076BE	.79	CD4585BE	.90
CD4022BE	.69	CD4077BE	.25	40014PC	.59
CD4023BE	.17	CD4078BE	.21	40085PC	$1.09
CD4024BE	.49	CD4081BE	.21	40097PC	.60
CD4025BE	.17	CD4082BE	.21	40098PC	.60
CD4026BE	$1.39	CD4085BE	.69	40160PC	.89
CD4027BE	.39	CD4086BE	.69	40161PC	.99
CD4028BE	.57	CD4093BE	.40	40162PC	.89
CD4029BE	.74	CD4104BE	$2.25	40163PC	.99
CD4030BE	.35	CD4502BE	.85	40174PC	.89
CD4033BE	$1.45	CD4508BE	$2.25	40175PC	.89
CD4034BE	$2.25	CD4510BE	.88	40192PC	$1.19
CD4035BE	.64	CD4511BE	.99	40193PC	$1.19
CD4040BE	.74	CD4512BE	.59	40194PC	$1.10
CD4041BE	.74	CD4514BE	$1.95	40195PC	$1.10

LINEAR I.C.'S

LM324N	.49	Quad Op Amp
LM339N	.49	Quad Comparator
LM555N-8	.29	Timer
LM556N-14	.59	Dual Timer
LM723CN	.34	Voltage Regulator
LM723CH	.39	Voltage Regulator
LM741CH	.37	Op Amp
LM741CN-8	.24	Op Amp
LM1458N-8	.39	Dual Op Amp

VOLTAGE REGULATORS

PART NO.	UNIT PRICE	DESCRIPTION
LM323K	$5.50	3 Amp 5 Volt Regulator
78H05KC	$5.75	5 Amp 5 Volt Positive Regulator TO3
7800UC Series TO-220/LM340T	.79	Positive Voltage Regulators (Plastic) 1 Amp 5, 6, 8, 12, 15, 18, 24 Volts
78M00HC Series TO-5/LM340H	$1.50	Positive Voltage Regulator 1/2 Amp 5, 6, 8, 12, 15, 18, 24 Volts
7800KC Series TO-3/LM340K	$1.60	Positive Voltage Regulator 1 Amp 5, 6, 8, 12, 15, 18, 24 Volts
78L00AWC Series TO-92	.29	Positive Voltage Regulator 100 MA 2.6, 5, 6.2, 8.2, 12, 15 Volts
7900UC Series TO-220/LM320T	$1.10	Negative Voltage Regulator 1 Amp 5, 6, 8, 12, 15, 18, 24 Volts
79M00HC Series TO-5/LM320H	$1.50	Negative Voltage Regulator 1/2 Amp 5, 6, 8, 12, 15, 20, 24 Volts
7900KC Series TO-3/LM320K	$1.95	Negative Voltage Regulator 1 Amp 5, 6, 8, 12, 15, 18, 24 Volts
78MGT2C	$1.25	Dual In Line Adjustable 4 Terminal Positive Voltage Regulator
78GUI TO-220	$1.45	1 Amp Adjustable Positive Voltage Regulator
78S40PC	$2.50	Switching Regulator

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CPU's

Stock level	Part No.	Price
4600	8080A	~~5.95~~ 5.50
16000	6800	~~8.95~~ 7.95

INTERFACE SUPPORT CIRCUITS

Stock level	Part No.	Price
4000	8212	1.98
1400	8214	~~4.95~~ 3.95
2800	8216	1.98
1500	8224	2.75
4000	8226	1.98
1700	8228	4.75
700	8238	4.75
5800	8251	~~5.95~~ 4.95
550	8253	14.95
11000	8255	5.95
400	8257	9.95
800	8259	14.95
3300	6810	~~3.95~~ 3.50
2200	6820	~~4.95~~ 3.95
4200	6821	~~4.95~~ 3.95
3000	6850	~~5.95~~ 4.95
1200	6852	~~5.95~~ 4.95

MOS Static RAM's

Stock level	Part No.	Price
11400	2114	$7.50
	4K (1K x 4) 300NS	
74000	2102LFPC	$1.19
	1K 350NS (Low Power)	
19700	2114	$6.95
	4K (1K x 4) 450NS	

MOS Dynamic RAM's

Stock level	Part No.	Price
16000	4K 4027	$2.95
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CIRCLE 4 ON READER SERVICE COUPON

Solar Swinger

(Continued from page 67)

work cloth under the wooden base to protect the soft wood from scratches and dents.

Cut a 1½" hole about ¼" deep for the tube base. The ¼" indentation will take a large pasteboard washer to bolt the tube socket into position. Finish drilling out the 1-inch hole for the tube prongs to fit comfortably inside. Depending upon the size of the tuning capacitor, lay it upon the bottom area and drill a large hole to enclose the whole body. Do not drill clear through the board but leave about ¼" at the top side for the mounting area of the tuning capacitor.

The tuning capacitor and the headphones are the only components mounted outside of the tube envelope. A small ¼" hole is drilled in the center and at the rear of the base towards the tube socket. The headphone and antenna wires will feed through this area to the tube socket pins. Cut a groove into the wood area between the capacitor and tube socket hole. The capacitor's two small connecting wires will lay flat in this groove.

If needed, sand down the top of the wooden base area with fine sandpaper. Stain, varnish or spray paint the top side. Choose a light color spray paint, such as white or yellow, to give the base and component parts a contrasting appearance. Spray on at least three coats of paint and let it dry between each coat to produce a slick, enamel appearance. Let the wood base dry overnight before mounting any parts.

Final Touchup. After the base appears dry mount the variable capacitor and connect two pieces of hookup wire from it to tie into the tube socket. Next, mount the small tube socket. Temporarily, place a piece of masking tape over the socket and wooden base plate. Lay the base upside down (over a shoebox) to wire up the remaining components. Feed the earphone cable through the rear hole and connect to terminals 4 and 6 of the tube socket. Feed a short piece of hookup wire through the same hole to serve as an external antenna connection. Solder this wire to terminal 2. Now solder the capacitor's two wires to terminals 2 and 1. Once again, check over the entire wiring procedure. Solar Swinger should be ready to roll (and rock).

Connect the antenna wire to the outside antenna—or you can try to pick up local stations with a 12-ft. piece of wire laying around the baseboard of a wall. You should be able to pick up local stations at each end of the broadcast band. If a ferrite, adjustable antenna coil is used, adjust the core until the stations are loudest at each end of the band. Turn Solar Swinger's solar cell toward the sunlight or operate under a table lamp.

After all adjustments are made, spread silicone cement over the tuning capacitor wires. Cut out a large pasteboard or plastic washer and place it over the tube pins. Use the ¾-inch machine screw and bolt the tube socket into position. To keep the earphone wires from pulling out, apply silicone cement in the small hole. Place four rubber grommets or metal spacers on each corner for feet, and cement in place. Let the radio lay upside down until the silicone cement sets up.

The glass envelope should be mounted last and glued to the tube base with black silicone cement. Place a thin layer of rubber cement around the top, just inside the tube base. Hold the envelope in a straight upright position and set it down in the fresh cement. Now apply rubber silicone mement to the outside of the glass and base area. Wipe off all surplus with a paper towel and make a neat joint with your fingers. Let the envelope and the base dry overnight.

Many of our Solar Swinger's parts may be found in the junk box. In fact, low priced transistors are used in the directly coupled audio circuit. If you are starting out cold and purchasing all new parts, you may pick up a 2 transistor AM radio kit from Radio-Shack (#28-214) for $6.95. Most all the parts needed for the Solar Swinger can be robbed from this kit.

Solar Swinger—a great conversation piece and a sunny savings over the high cost of batteries! ■

CB Xcvr Checkout

(Continued from page 76)

clock alert operation. Standard accessories include a microphone, and an AC power cord.

Receiver Section Test:

Input sensitivity	0.5 μV
Adjacent channel rejection	64 dB
AGC action	1.5 dB
SSB opposite sideband rejection	50+ dB
Input level for S6 meter indication	350 μV

(Reading compresses above S6)

Transmitter Section Test:

AM RF output	3.8 watts
SSB RF output	11 watts P.E.P.
Modulation to 85%	yes
Relative sensitivity for 85% mod.	—25 dB
Modulation limited to 100%	yes

Editorial Remarks: The CB555 has a relative reading S-meter, jacks for P.A. and remote speakers, L.E.D. digital channel indicator, S/RF/SWR meter, CLOCK "alert" which will automatically turn the unit on at a predesignated time, and shut it off one hour later. ■

• SBE Key/Com 1000

$259.95 (SBE, Inc.)

General Description: A 40-channel AM transceiver for mobile, P.A., marine operation. Delta tuning ±1.5 kHz is provided. Power supply is 12 to 13.8 VDC with negative or positive ground. Overall dimensions are 2.1-in. H x 5.9-in. W x 8.8-in. D. There are front panel controls for: volume, squelch, RF gain, variable

CIRCLE 69
ON READER SERVICE COUPON

noise limiter, and Delta tune. Switches for: CB/PA, noise blanker, panel lamp dimmer. Eleven keyboard switches for channel selection and control. Standard accessories include a microphone, mobile mount, DC power cable.

Receiver Section Test:

Input sensitivity	0.3 μV
Adjacent channel rejection	56 dB
AGC action	13 dB
Input level for S9 meter indication	80 μV

Transmitter Section Test:

AM RF output	3.6 watts
Modulation to 85%	yes
Relative sensitivity for 85% mod.	—31 dB
Modulation limited to 100%	yes

Editorial Remarks: The Key/Com 1000 has a 5 dB per unit S-meter, double conversion, jacks for P.A. and remote speakers, L.E.D. digital channel indicator, on-board microprocessor providing 40 channel SCAN, 10 channel memory SCAN, alternate channel operation and SCAN, 10-second check of priority channel, S/RF-output meter, and separate power connection for microprocessor memory. ■

LITERATURE LIBRARY

322. A new 20-page, full-color TRS-80 Microcomputer Catalog has just been issued by *Radio Shack*. The catalog includes complete, current information on the TRS-80 Microcomputer, its peripherals and accessories with plain-language descriptions, application ideas and detailed specifications.

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

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

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

345. For CBers from *Hy-Gain Electronics Corp.* there is a 50-page, 4-color catalog (base, mobile and marine transceivers, antennas, and accessories). Colorful literature illustrating two models of monitor-scanners is also available.

323. *Lafayette Radio's* 1979 catalog offers almost everything in hi-fi, CB, ham and many electronic parts. A product index will help you find anything from auto equipment accessories to wire wrapping tools.

381. *Fordham Radio's* handy catalog covers test instruments, tools, parts, home and car audio products, scanners and lots more. Get your free copy today!

385. Amateur Radio buffs and beginners will want the latest *Ham Radio Communications Bookstore* catalog. It's packed with items you should be reading today!

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.

372. Just what the experimenter needs can be found in *Olson's* bargain flyer—parts, assemblies, semiconductors, components, and more. Even more interesting are the prices.

379. There's everything in the area of musical synthesizers for drums, strings, other instruments and full orchestras, as well as audio gear, video display modules, and a computer in *PAIA Electronics'* catalog.

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.

384. *The B&K-Precision* test instruments are described in a new compact catalog all experimenters should have! Start stepping up your test bench capabilities.

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

302. Big catalogs are coming back. *Burstein-Applebee* will send you theirs. It's a parts bonanza every experimenter would want to see. Latest catalog is over 200 pages.

303. *Graymark's* catalog reveals a host of products and kits every experimenter would like to have. Unusual binary clock is a winner. A *must* catalog for the beginner.

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

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

374. *Radatron's* Catalog 1006 lists many projects from a self-contained portable lab station for an electricity-electronics course to many texts, lab manuals, and applied activities.

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

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

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

308. Your guide to equipment for radio communication is an informative product booklet offered by *R. L. Drake Co.* Hams and SWLers alike should scan this 20-page shopper's guide.

310. New and used personal computer machines, and peripherals you never dreamed existed, or were available are in the *Newman Computer Exchange* catalog. Get yours today.

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

312. *E.D.I. (Electronic Distributors, Inc.)* carries everything from semi-conductors to transformer/relays to video cameras. In prices ranging from 19¢ to $500, products appear from over 125 electronic parts manufacturers. The catalog is updated 3 times a year.

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

314. Cover the Ham bands from 80 to 10-meters with one classy rig—*Swan Electronics'* 100-W 100 MX mobile transceiver. Get the details direct from *Swan*.

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

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

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

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

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

328. 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. Hard to find parts fill each page, so get a copy of the catalog from *McGee* today!

329. *Semiconductor Supermart* is a new 1979 catalog listing project builders' parts, popular CB gear, and test equipment. It features semiconductors—all from *Circuit Specialists*.

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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.

362. *B&F Enterprises'* Truckload Sale catalog offers 10% off all merchandise: (military or industrial surplus) speaker kits, TV games, computer terminals, tools, TV components, lenses, and more.

364. If you're a component buyer or specifier, you'll want this catalog of surplus bargains: industrial, military, and commercial electronic parts, all from *Allied Action*.

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MILLIONS in Mail! Free Secrets. Transworld-3, Box 6226, Toledo, OH 43614.

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Get "How to Write A Classified Ad That Pulls." Includes Certificate worth $2.00 towards a classified ad in this publication. Send $1.50 (plus 25¢ postage) to R. S. Wayner, Davis Publications, Inc., Dept. CL, 380 Lexington Avenue, New York, NY 10017.

PLEASE Be sure to include your zip code when ordering merchandise from classified advertisements. You'll receive faster delivery.

GUARANTEED big money making program Abraxas Ent., P.O. Box 6072, Evansville, IN 47712.

EXCITING Second Income Working At Home. Free Details. Write: C. T. & S. Enterprises, Box 2442-D, Loves Park, IL 61132.

HOMEWORKERS Needed! $600 weekly addressing, mailing. Ideal for students. Box 1874, Htfd., CT 06144.

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"THREE Steps to Success." Send sase: Mailing Systems, G.P.O. Box 2420, N.Y., NY 10001.

REAL Estate Appraising. Fantastic profits! AAR, Box 6125-B, Hayward, CA 94544.

$500 CASH ADVANCE; stuff 1000 envelopes. Information; self-addressed stamped envelope. Freedom 02-11, Box 1060, Orange Park, FL 32073.

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SINGLE? Widowed? Divorced? Nationwide introductions! Identity, Box 315-DC, Royal Oak, MI 48068.

STOP forgetting important dates. For complete information send $1.00 (Refundable) to KAZ Enterprises, P.O. Box 19563, Indianapolis, IN 46219.

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DATES GALORE! Meet singles-anywhere. Call DATELINE, toll-free (800) 451-3245.

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JAPANESE Girls Make Wonderful Wives. We have large number of listings. Many interested in marriage. Only $1.00 brings application, photos, names, descriptions, questionaire, Etc. Japan International, Box 156 AA, Carnelian Bay, CA 95711.

BEAUTIFUL Mexican-Oriental girls Needing American Boy-Friends. Free Details "actual" photos. World, Box 3876-DC, San Diego, CA 92103.

FREE: 1,000 LADIES PHOTOS. World's largest Matrimonial Catalog. Postage/Handling $1.00. Intercontact, Box 12, Toronto, Canada M4A 2M8.

JAPANESE introductions! Girls' photographs, descriptions, brochure, details, $1.00 INTER-PACIFIC, Box 304-SC, Birmingham, MI 48012.

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TV TUBES 36¢ each. Send for Free 48 page color catalog. Cornell, 4217-W University, San Diego, California 92105.

TUBES Oldies, latest. Supplies, components, schematics. Catalog free. (Stamp appreciated). Steinmetz, 7519-EE Maplewood, Hammond, IN 46324.

SAVE 50% build your own speaker system. Write McGee Radio Electronics, 1901 McGee Street, Kansas City, MO 64108.

LINEAR Amplifiers 3.5-30 MHZ. Schematics, Detailed Instructions For Base BL-200, Mobils BL-100 and BL-200. All, $6.00. Bomar's, Box 541, Pendleton, SC 29670.

BUILD Distance Crystal Sets. 10 plans—25¢; Handbook "18 Different"—50¢; "20 Different—50¢. Kit catalog—50¢. Laboratories, 1477-G, Garden Grove, CA 02642.

POLICE Scanners, Crystals, Antennas, Radar Detectors, CB's. HPR, Box 19224, Denver, CO 80219.

FOUR crystal radio plans and crystal diode; $1.00. Henley, 502 No. Armstrong, Pleasant Hill, MO 64080.

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WATCH and clock repairing books, tools, materials. Free Catalog. North American, Box 77, EE53, Fox River Grove, IL 60021.

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Ask Hank, He Knows!

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

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

Never Stopped Publishing

Where is White's Radio Log?
—P. D., Powell River, B.C.

Keep looking! White's Radio Log is a part of COMMUNICATIONS WORLD which is now published once a year. The 1979 edition hit the newsstands in late January. If you can't find a copy, send $1.75 plus 25 cents for postage and handling to:

COMMUNICATIONS WORLD
Single Copy Sales Dept.
380 Lexington Avenue
New York, NY 10017

Don't hesitate, they sell out pretty quick.

Charter Reader

Your November-December 1978 issue announced the 15th anniversary of ELEMENTARY ELECTRONICS. *I still have your first 1963 issue and continue to find it very interesting. This premier edition gave me my first knowledge of electronics magazines. I would just like to mention that although I haven't written for information, I still find the answered questions very informative. Thanks for having this column in the magazine.*

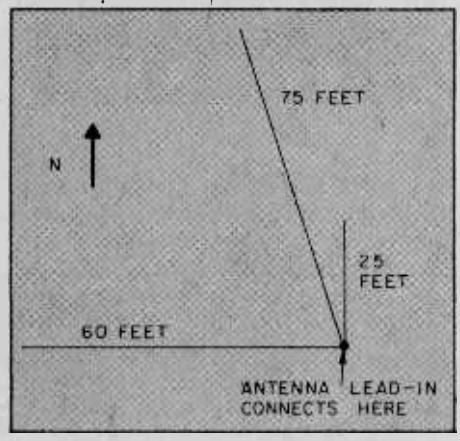
B. R., Bracebridge, Ontario

And a happy anniversary to you! You are a charter reader as I am. We've come a good many years and saw the development of solid-state at the hobby level. I think you'll find the next five years to be more revolutionary than the first 15 years.

Watta Setup!

I'm enclosing a diagram of my DXing antenna layout. Can you give me your opinion of the antenna system I use?
—A. E., Milton, FL

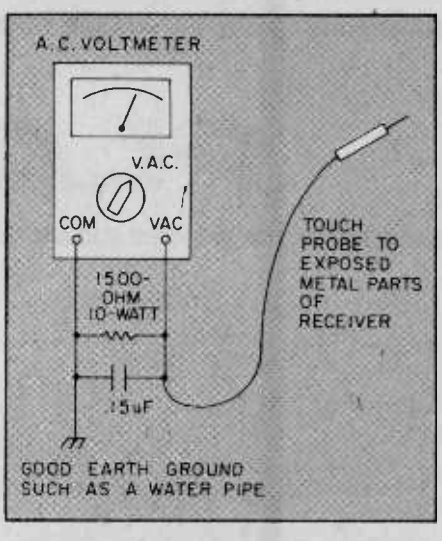
Terrific! You should be able to hear Castro snore. I do believe that the 25-foot length is not needed. I suggest that you should be able to switch out the different legs of the antenna to eliminate background noise while zeroing in on weak signals.



You'll Laugh Yourself to Death

I get an electric "tickle" from the metal cabinet of my receiver? Is this safe?
—J. F., Cleveland, TN

I'd say "No," to that. But check it yourself to be absoultely sure. Use an AC voltmeter having 5000-ohms/volt or more sensitivity in the following manner: Connect a 1500-ohm, 10-watt resistor paralleled by a .15 μF disc capacitor between a known good earth ground (water pipe, conduit, etc.) and the exposed metal parts on the receiver, one at a time. Do this with the receiver plugged into an AC outlet and the receiver turned on. Measure the AC voltage across the combination 1500-ohm resistor and .15-μF capacitor. Reverse the AC plug and repeat the voltage measurements for each exposed metalic part. For receivers manufactured after January 1, 1973, the voltage must not exceed 0.75 VRMS. This corresponds to 0.5 mA AC "tickle" charge and is not excessive or dangerous. If your receiver exceeds this value, look for the fault or short. Sets built



prior to 1973 may test high as 7.5 VRMS. Legally, this is okay, but by "current" standards it is unsafe.

Parts Seeker

Hank, I picked up a copy of the magazine 99 IC PROJECTS *and I want to get into them right away. Unfortunately, it's tough buying semiconductors in Columbia Falls, Montana. So give me a basic list of parts suppliers that I should contact.*
—D. J., Columbia Falls, MT

Here are a few parts and equipment suppliers in alphabetical order:

1. Aldelco, 228 E. Babylon Turnpike, Merrick, NY 11566.
2. AP Products, Box 110, 72 Corin Dr., Painesville, OH 44077.
3. Continental Specialties Corp., 70 Fulton Terrace, Box 1942, New Haven, CT 06509.
4. Cornell, 4219 E. University Ave., San Diego, CA 92105.
5. Digi-Key Corp., P.O. Box 677, Thief River Falls, MN 56701.
6. ETCO Electronics, Dept. 024, North Country Shopping Center, Plattsburg, NY 12901.
7. Jamesco Electronics, 1021 Howard Ave., San Carlos, CA 94070.
8. Lafayette Radio, 111 Jericho Turnpike, Syosset, NY.
9. Poly Paks, P.O. Box 942-N9, Lynnfield, MA 01940.
10. Radio Shack, One Tandy Center, Ft. Worth, TX 76102.

You find many other good sources of parts and equipment in the Hobby Mart section of ELEMENTARY ELECTRONICS. Check the ads out and write for catalogs.

Lend a Hand

Here's another list of our friends who need your help. Lend a hand, boys!

Δ Lafayette HE-30 receiver, operator's manual and schematic diagram; George Kopp, 3411 Woodbine Ave., Cincinnati, OH 45211.

Δ Viking Model 87 reel-to-reel tape deck, needs accompanying electronics; Charles D. Jennison, 48 Cócheco St., Dover, NH 03820.

Δ Hallicrafters S-40A receiver, needs operator's manual and service equipment; J.O. Bois, 407 Sumner St., Santa Cruz, CA 95062. ■

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