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Why the smallest digital scanner is also one of the smartest.

We started with very fast, sophisticated microprocessors. Then we made some highly complex circuitry very simple to operate. Just one touch tells the new M400 to monitor any active police, fire, weather and emergency frequency in your area. That's a lot of return for practically no effort. And it makes the M400 perfect for your home or car.

scan modes — whichever is best for you. We've also set aside a priority channel so you can monitor your favorite frequency every second. There's even a digital quartz clock and elapsed timer. And the control panel is backlighted for the best possible visibility — day or night.

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We've preprogrammed 545 channels with commonly used public service frequencies. Then we coded the touch sensitive keyboard with symbols for police, fire, marine, mobile telephone and weather. So all you have to do is touch the symbol for the type of activity and band you want to monitor. The M400 does the rest. If you want to search for unknown frequencies, the M400 lets you do that, too. And for those channels you want to store and hear again, you have 30 programmable channels to use. Plus you can use either manual or

Take all the action with you.

With the new Regency Touch M400, you can have all the action, no matter where you are. It's the most complete scanner made primarily for mobile* use. And it works just great at home. So get the small scanner that's very smart. At your Authorized Regency Scanner Dealer.

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*Use of mobile scanners prohibited in certain locales.

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CIRCLE 9 ON READER SERVICE COUPON

Science & Electronics

January/February 1981
Volume 21, No. 1

elementary Electronics

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Cover Photo by Ray Solowinski
Guitar courtesy of Stuyvesant Music Inc.

ISSN: 0013-595X

ELEMENTARY ELECTRONICS / SCIENCE AND ELECTRONICS is published bi-monthly by Davis Publications, Inc. Editorial and Executive offices: 380 Lexington Ave., New York, NY 10017; all subscription orders and mail regarding subscriptions should be sent to P.O. Box 2630, Greenwich, CT 06835. In U.S.A. and possessions, one-year subscription (six issues) $7.50; two-year subscription (12 issues) $14.50, three years (18 issues) $21.50; and four years $28.00. Elsewhere, add $1.00 postage for each year. For change of address, please advise 6 to 8 weeks before moving. Send us your current mailing label with new address. Advertising offices: East Coast: 380 Lexington Ave., New York, N.Y. 10017, (212) 557-9100; Midwest; 360 N. Michigan, Suite 1022, Chicago, IL 60601, (312) 527-0330; West Coast: J. E. Publishers' Rep. Co., 8732 Sunset Blvd., Los Angeles, CA 90069, (213) 659-3810. Controlled Circulation. Postage paid at New York, New York, and Sparta, Illinois.

NEW PRODUCTS PARADE

SHOWCASE OF NEW PRODUCTS

260 VOM Variation

A new version of the 260 VOM from Simpson features reversed, recessed, insulated panel connectors with matching safety-engineered test leads. This design feature reduces the possibility of a shock hazard in the event that a connector is inadvertently pulled out of the instrument jack. In addition, the double-fused protection network is conveniently located in the accessible battery-and-fuse compartment. An Off/Transit position on the function switch protects the meter movement during transit. This position shunts the meter movement and opens the internal connections to the common and positive jacks. The Model 260-7 measures AC/DC voltage, current, resistance, dB and output voltage (the AC component of a mixture of AC and DC voltage) with 27 of the most popular ranges and DC sensitivity of 20,000 ohms per volt. The taut-band meter movement is varistor protected against overloads. The 260-7 uses only 2 batteries, one 9-V battery and one 1.5-V D cell. The basic 260-7 is priced at $103. Options include a mirror scale, Simpson's additional relay overload protection and rolltop case. Accessories include probes for measuring temperature, low power, ohms and high voltage, and protective cases. For complete specifications, write to Simpson Electric Company, 853 Dundee Avenue, Elgin, IL 60120.

Watt Saver

Dr. Watt is an electrical energy conserving device utilizing patented NASA technology to cut the power required for induction motors from 10 to 60 percent. With application to most home appliances and machinery, Dr. Watt will yield consumers an average yearly savings of 30 percent on their original investment. In addition, Dr. Watt qualifies for a 15 percent energy tax credit as specified by the IRS. Not only will Dr. Watt

(Continued on page 8)

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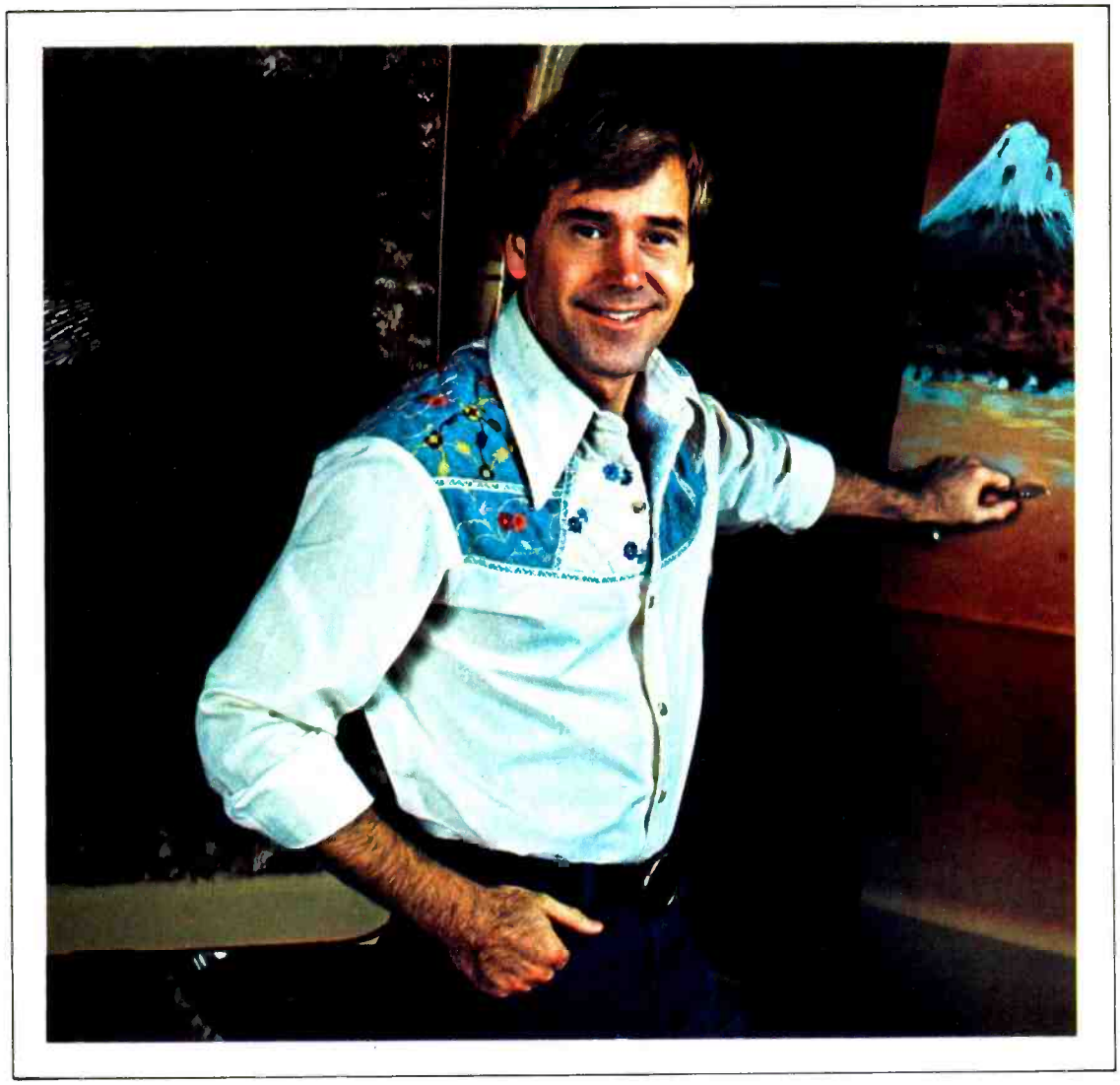
ON READER SERVICE
COUPON

You gotta shop around.



When you do, you'll probably pick CIE. You can't afford to settle for less when it comes to something like electronics training that could affect your whole life.

When you shop around for tires, you look for a bargain. After all, if it's the same brand, better price—why not save money?

Education's different. There's no such thing as "same brand." No two schools are alike. And, once you've made your choice, the training you get stays with you for the rest of your life.

So, shop around for your training. Not for the bargain. For the best. Thorough, professional training to help give you pride and confidence.

* * *

If you talked to some of our graduates, chances are you'd find a lot of them shopped around for their training. They pretty much knew what was available. And they picked CIE as number one.

Why you should shop around yourself.

We hope you'll shop around. Because, frankly, CIE isn't for everyone.

There are other options for the hobbyist. If you're the ambitious type—with serious career goals in electronics—take a close look at what we've planned for you at CIE.

What you should look for first.

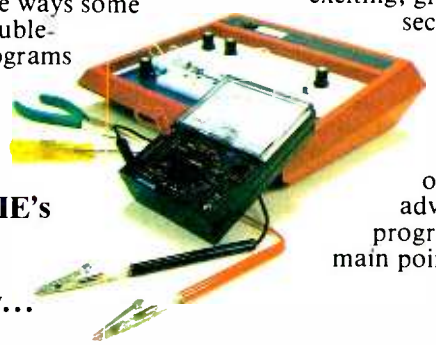
Part of what makes electronics so interesting is it's based on scientific discoveries—on ideas! So the first thing to look for is a program that starts with ideas and builds on them!

That's what happens with CIE's Auto-Programmed® Lessons. Each lesson takes one or two principles and helps you master them—before you start using them!

How practical is the training?

This is the next big important question. After all, your career will be built on what you can do—and on how well you do it.

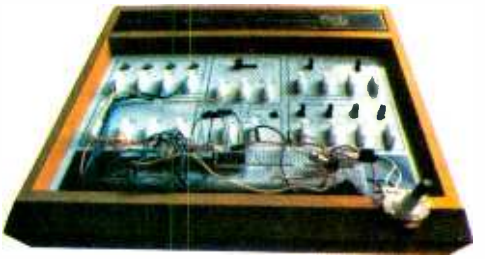
Here are ways some of CIE's trouble-shooting programs help you get your "hands-on" training...



With CIE's Personal Training Laboratory... you learn and review the basics—perform dozens of experiments. Plus, you use a 3-in-1 precision Multimeter to learn testing, checking, analyzing!

When you build your own 5 MHz Triggered-Sweep, Solid-State Oscilloscope you take your first real professional step. You use it as a doctor uses an X-ray machine— to "read" waveform patterns... lock them in...study, understand and interpret them!

When you get your Digital Learning Laboratory you'll be into digital theory—essential training today for anyone who wants to keep pace with the state of the art of electronics in the eighties. With CIE's Digital Lab, you'll be applying in dozens of fascinating ways the theory you've learned. For example, you'll compare analog and digital devices. You'll learn to make binary to decimal conversions and to work with semiconductor devices and circuits. You'll see how digital equipment is vital in today's exciting, growing fields such as security where digital theory provides the brains for space-age alarm and protective devices.



Of course, CIE offers even more advanced training programs, too. But the main point is simply this:

All this training takes effort. But you'll enjoy it. And it's a real plus for a troubleshooting career!

Do you prepare for your FCC License?

Avoid regrets later. Check this out before you enroll in any program.

More than half of CIE's courses prepare you for the government-administered FCC License exam. In continuing surveys, nearly 4 out of 5 CIE graduates who take the exam get their Licenses!

Associate Degree

Now, CIE offers an Associate in Applied Science Degree in Electronics Engineering Technology. In fact, all or most of every CIE Career Course is directly creditable towards the Associate Degree.

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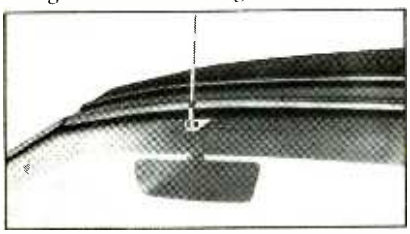
CB antennas

By Scott Larkin

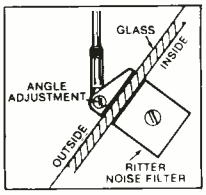
The Avanti Moonfantom

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



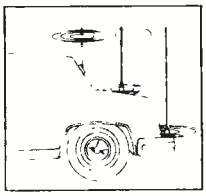
Amazing patent pending design puts coax and pick-up inside where it's safe from the elements.

Just take a look at the following:



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

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



Uniform radiation pattern with no dead spots.

New On-Glass Unique Design – The Moonfantom is a ½ wave antenna that requires no ground plane. Can be conveniently mounted on glass in a matter of minutes! There are no holes to drill. No car body patching at resale time. New dual adhesive system assures a secure hold with the strength of a 3/8" bolt. Can be easily removed at resale time.

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

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

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NEW PRODUCTS PARADE

(Continued from page 3)

save energy, and therefore, cost to the consumer, it will also extend the motor's life by allowing it to run cooler. Simply plug any induction motor (½ horsepower or less) powered appliance into Dr. Watt, and then plug Dr. Watt into a wall socket, and the device will measure and deliver only that power which is required to do the job. Washers, gas dryers, refrigerators, air conditioners, attic fans, furnaces, freezers, sewing machines, table saws, drill presses, electric typewriters and many other appliances will run more efficiently as the result of Dr. Watt. Dr. Watt is available for $39.95 (Ohio residents add 4.5 percent sales tax) plus $2.95 postage and handling from EnerCon Inc., 30044 Lakeland Blvd., Wickliffe, OH 44092.

Satellite Receiver

A new 24-channel satellite receiver, Model TV-4300, is priced at $995 and is available from International Crystal. The high performance receiver tunes all channels within the 3.7-4.2 GHz band.

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Standard dual audio output is provided at 6.2 and 6.8 MHz. Other frequencies are available. The TV-4300 is a full packaged and assembled receiver complete with built in LNA power supply, built in AFC, tuner, control circuitry and power cable. All ouptut levels are compatible with video monitor and VTR input. For complete information, write to International Crystal Manufacturing Co., Inc., 10 North Lee, Oklahoma City, OK 73102.

Indoor Scanner Antenna

Antenna Incorporated's All Band Persuader Scanner Indoor Base Station Antenna (Model 60502) approaches the high performance of an outdoor scanner antenna with a unit that can be installed inside the home or apartment. It is ideal for installation in apartments, condominiums, office buildings and

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homes where an outdoor base station antenna cannot be installed, and easily outperforms the short telescopic antennas supplied with most scanners. The All Band Persuader consists of a 7-ft. wire which is attached vertically to a wall inside the home or apartment, a small black box on the baseboard (a self-adhesive pad is provided), a short 2-ft. wire is connected to a convenient ground and a 10-ft. interconnect cable with pin plug is connected to the antenna receptacle of the scanner. The antenna operates on all frequencies between 25-900 MHz and carries a suggested retail price of $11.95. For further information, write to Antenna Incorporated, 26301 Richmond Road, Cleveland, OH 44146.

Trucker's CB

"The professional drivers' choice" is the billing given to a new President Citizens Band radio. Designated the AR 711, the rig was designed and built precisely to the specifications of truckers and other professional users. The features built into the AR 711 are: a noise-cancelling microphone with an extra-long coil which extends to 10 feet, a 4-in. external speaker with mounting bracket and 5-ft. cable, instant select Channel 9 and 19 switches, automotive protective knobs and Hi-Cut tone switch. The AR 711 also carries the President two-year full warranty. Other features include Mike Gain, RF Gain, ANL/NB, "S"/RF Meter, Digital Channel Indicator, TX and RX Indica-

(Continued on page 10)

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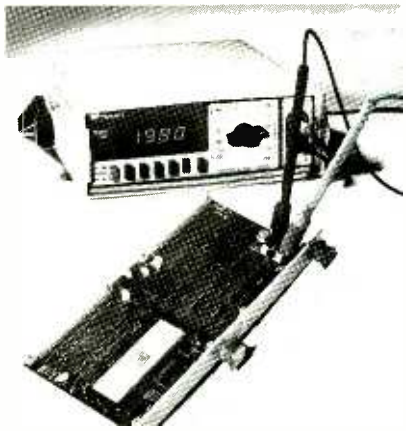
NEW PRODUCTS PARADE

(Continued from page 8)

tors, Positive/Negative Ground, Automatic Modulation Control, PA and External Speaker Jacks and Plug-in DC Power Cord, among others. The President AR 711 carries a suggested retail price of $139.95. For more information, write to American Radio Corp., 6330 Castleplace Drive, Indianapolis, IN 46250.

3½ Digit Multimeter

The Triplett Model 4000, 3½ digit multimeter offers a wide angle LED digital display for easy viewing and pushbutton function selectors. Single range selector



switch and just two input jacks serve all function selectors. A single range selector switch and just two input jacks serve all functions and ranges—31 ranges are available. Ranges included are: 200 mV to 1000 VDC VAC 200 uA to 2000 mA AC DC current; 200 ohms to 20 megohm low power and high power resistance. Input impedance is 10 megohms on all ranges and accuracy is ±0.2 to ±0.5% depending upon the range selected. The easy-to-read LEDs are 0.43-in. high and provide polarity and over-range indication. The 48-in. long insulated safety test leads with screw-on insulated alligator clips, combination carrying handle/bench stand, plus a three-wire detachable long line cord are also furnished. Power requirements are 50/60 Hz, 120 or 240 VAC with internal change. Optional accessories include miniature clip leads for high density circuits and a 30 amp DC current shunt. The Triplett Model 4000 sells for $235. For further information, contact Triplett Corporation, One Triplett Drive, Bluffton, OH.

QRP Rig

A new model has been added to the Ten-Tec "Argonaut" QRPp line, the Model 515. Featuring a new super-sensitive receiver front-end, the 515 has 0.35 uV sensitivity, 4-pole crystal lattice filter with 2.4 kHz bandwidth, a unique op-

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tional combination CW filter and variable notch filter in and outboard cabinet, and a new heterodyne VFO with a new permeability-tuned oscillator which provides increased calibration accuracy. Argonaut's band coverage (80-10M) has the 10-meter band split into new 500 kHz segments and crystals included for 28 and 28.5 kHz segments (others optional). Other features include: offset tuning with LED indicator, resonate control, direct frequency readout, QSK instant CW break-in, adjustable sidetone level and pitch, S SWR meter, low distortion audio and built-in speaker. The broadband transmitter section features a new design no-tune final for instant band change, 5 watts input, new LED output indicator set for 2-watts voice operation, TVI filter, automatic 750 Hz CW offset, automatic sideband selection (reversible), and PTT. Sells for $429.95. For full information, see your Amateur Radio dealer or write Ten-Tec, Inc., Highway 411 East, Sevierville, TN 37862.

TRS-80 CLOAD at Disk Speed

Personal Micro Computers, Inc., has announced a device to input prerecorded programs into the

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TRS-80 Model I, Level II computers at 16 times normal speed. Standard cassettes can now be loaded at 8000 baud (that's one kilobyte per second) using a modified CTR-41 recorder and the Fastload Cassette Interface. Any cassette program previously "saved" at normal speed (500 baud) can now be loaded at high

(Continued from page 12)

INTRODUCING SONY'S NEW DIGITAL DIRECT ACCESS RECEIVER!

A Whole New Breed Of Radio

Innovative design. Advanced technology. Digital key-touch tuning. The ICF-2001. It's a whole new breed of radio. A receiver that supplants the conventional multi-band concept, receiving a wide amplitude-modulated frequency range–shortwave, mediumwave and most longwave broadcasts. Plus FM, SSB and CW. Even more important, the 2001 replaces the ordinary tuning knob and dial with a direct-access tuning keyboard and a Liquid Crystal Display (LCD) for digital frequency readout. Which make the unit as easy to use as a pocket calculator. Instant, direct-access tuning modes and six memory-station presets assure maximum ease of use. And the quartz-crystal, frequency-synthesized circuitry behind them assures outstanding reception. Reception of local broadcasts and exciting news, music, sports, entertainment and information from around the world. You'll get the inside, local news stories from foreign countries... exclusive coverage of world sports events... plus everything from informal "ham" to marine communications. All at your fingertips.

Key-Touch Tuning
To tune a station manually, you simply punch in the station frequency numerals on the direct-access, digital tuning keyboard. Press the "Execute" key and the command is entered, the station is received and LCD readout confirms tuning. If you punch in an incorrect frequency by mistake, the ICF-2001 tells you to "Try Again" by flashing those words on the display. The instant, fingertip tuning provides total accuracy and convenience. And the LCD digital frequency display confirms the exact, drift-free signal reception.

Automatic Scanning
In auto-scan mode, the tuner can be set for continuous scanning of a given frequency range, which you set by means of upper and lower limit keys designated "L_1" and "L_2." You may want to scan an entire frequency range. For instance, the 76 to 108 MHz FM spectrum. If you want scanning to stop at any strong signal–one that reads "4" or "5" on the LED signal-strength indicator– switch on "Scan Auto Stop." For continuous scanning, leave the switch off, and just press the "Start/Stop" key to listen to a station or resume scanning.

Manual Tuning
Like the auto-scanning mode, manual tuning is useful for quick signal searching when you don't know particular station frequencies within a given range. You simply press the "Up" or "Down" key, and the tuner does the searching for you. And if you press the "Fast" key at the same time, the scanning rate increases for especially rapid station location. When you hear a broadcast you want to receive, just release the keys for instant reception, presssing the "Up" or "Down" key again if necessary for exact tuning.

Memory Presets
After you've tuned a station using punch-in, key-touch tuning or either scanning mode, you can enter it in the 2001's memory for instant, one-touch preset reception. Which means no retuning hard-to-find foreign broadcasts. Plus instant access to your favorite local stations for music and news. Six preset buttons allow up to six stations–in any wave range–to be memorized. And there's LCD digital readout of the memory buttons being used on each band. What's more, the upper and lower limit keys can be used as memory presets when they're not being used for scanning, allowing a total of eight frequencies to be memorized for instant, one-touch reception.

Frequency Synthesis
The 2001's direct-access tuning and outstanding reception quality are made possible by the unit's all-band quartz-crystal, PLL frequency synthesis. Instead of the conventional analog tuning system, with its variable tuning capacitor, the 2001 incorporates an LSI and a quartz-crystal reference oscillator. Which means that the local-oscillator frequencies used in superheterodyning are locked to the "synthesized" quartz reference frequencies. The result is the utmost in tuning stability, without a trace of tuning drift. In addition, dual-conversion superheterodyning for AM assures exceptionally clean, clear reception across the entire 150-to-29,999kHz spectrum.

Features

- FM/AM/SSB/CW/wide spectrum coverage
- Dual-conversion superheterodyne circuitry of AM assures high sensitivity and interference rejection
- Quartz-crystal, phase-locked-loop frequency synthesis for all bands assures the utmost tuning stability, without a trace of tuning drift
- Direct-access, digital tuning keyboard and LCD digital frequency readout for quick, key-touch station selection–maximum accuracy and ease of use
- Manual tuning and automatic scanning for effortless signal searching, easy DXing
- 6-station presets, plus 2 auxiliary presets, for instant reception of memorized stations on any band–plus LCD memory indication.
- 5-step LED signal-strength indicator
- Local/Normal/DX sensitivity selector for AM
- SSB/CW compensator for low-distortion reception
- Telescopic antenna, plus external antenna included
- 4" speaker for full, rich sound
- Slide-bar bass and treble controls
- Sleep timer–with LCD readout–can be set in 10-minute increments for up to 90 minutes of play before automatic radio shut-off

Only $299.95

Plus $5.00 S&H (Cont'l U.S.A. Only)

PHONE: (312) 848-6777

SPECTRONICS, INC. — 1009 GARFIELD ST., OAK PARK, ILL.-60304

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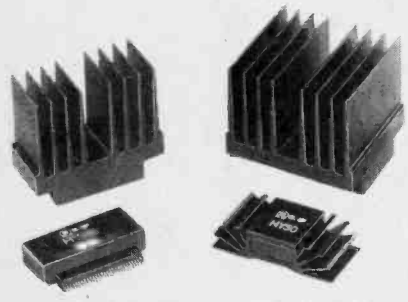
NEW PRODUCTS PARADE

(Continued from page 10)

speed. For short programs Fastload is faster than disk because of disk start up time and longer programs load in seconds instead of minutes. The Fastload does not require transferring all programs to another media first. Fastload is more reliable for reading cassettes at high speed than CLOAD is at its low speed. Fastload is also capable of searching at high speed for BASIC programs by a single character designation or for system programs by a name of up to six characters in length. To use the Fastload, the user has only to initialize with a system command after turning on the TRS-80. Thereafter, the command LOAD, normally reserved for disk programs, can be used under Level II BASIC and will permit under disk BASIC by calling it with a system command. The price for Fastload Cassette Interface is $188.00. The modified CTR-41 recorder is $95.00. Units are available from dealers or by mail order from Personal Micro Computers, Inc., 475 Ellis Street, Mountain View, CA 94043.

Encapsulated Audio Modules

A line of mono and stereo preamplifier modules, plus five power amplifiers, has been introduced by Gladstone Electronics. The ILP preamplifier modules contain complete circuitry for tone controls, accurate phono equalization, plus inputs for tuner, mike, auxiliary, and tape monitor. Performance specifications are: DC response to 100 kHz, less than 0.005% distortion and a signal/noise ratio of better than 90 dB. The power amplifiers are designed with excellent thermal stability; they have built-in heatsinks and full protection against shorts and open circuits. Only five connections are required to install the power amplifier modules: input, positive voltage, negative voltage, output and ground. Power amplifier specifications: frequency response of 10 Hz to 45 kHz (within 3 dB), signal/noise ratio of 100 dB, and they will operate into loads from 4 to 16 ohms. Both types of module are totally encapsulated, and they are both provided with plug-in edge connectors for ease of installation.



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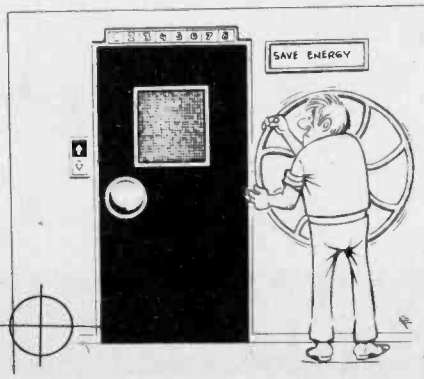
Ham Speech Clipper

Heath's new, fully-assembled SSB Speech Clipper may be used with a number of their Amateur radio transceivers and transmitters. The HDP-1220 BW Clipper is designed for use with the SB-100/101/102 and HW-100/101 transceivers, and the SB-400/401 transmitters. The HDP-1220 is said to increase average SSB output by 66 percent, to a little below key-down CW output. The HDP-1220 installs in the IF strip of the rig to produce true RF processing. A specially-designed IC gives harmonics, symmetrical clipping, and a built-in SSB filter keeps both audio and signal narrow and clean. The HDP-1220 Speech Clipper comes fully assembled, and can be installed in just 15 to 30 minutes using only three cables (included). No non-reversible modifications need be made to the transceiver or transmitter. Mail order priced at $149.95 FOB Benton Harbor, MI, the HDP-1220 Speech Clipper is featured in the latest free Heathkit catalog, along with a complete line of Amateur gear and nearly 400 other electronic kits. For a free copy write: Heath Company, Dept. 350-170, Benton Harbor, MI 49022, or visit any Heathkit Electronic Center. ■

CIRCLE 1 ON READER SERVICE COUPON



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

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

Why?

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

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

Super Sidekick

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

+3B

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

RK 56

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

TELEX® TURNER®

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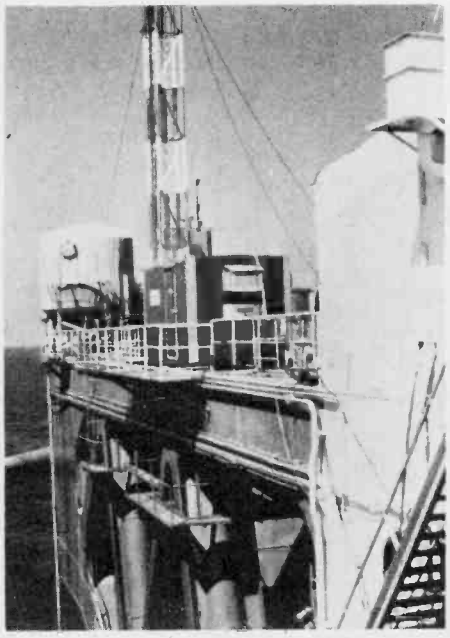
SCIENCE NEWS

PROGRESS IN ELECTRONICS

Microcomputer Digs Oil

With sophisticated minicomputers to choose from, why pick a microcomputer to monitor drilling instrumentation on an offshore oil rig? The answer is quite simple—reliability!

Each morning, Occidental Petroleum in Houston receives a drilling report prepared by an Apple II personal computer. The report comes from Transworld 61, the largest semisubmersible oil rig in the world, in the Gulf of Mexico, 100 miles south of New Orleans. The Apple II, selected by Geotech, Inc., of New Orleans, collects and analyzes drilling data from instruments and sensors throughout the rig.



This is Transworld 61, the world's largest semisubmersible oil rig. On the oil rig's platform is the instrumentation laboratory (center) of Geotech, Inc., New Orleans. The laboratory contains an Apple II personal computer which monitors drilling data from instruments and sensors.

Sensors on the mud pumps—used to drive the drill bit—monitor flow rate, mud temperature, and density. Other sensors measure drill pressure and drill location, as well as pressure build up in the drill-hole area, which could lead to blowouts. In addition to continual tracking of this subsurface data, the computer also monitors instruments in the laboratory on the rig's platform: gas-liquid chromatographs, PH meters and ion measuring devices.

Most measurements are accepted directly by the computer using its built in analog inputs. However, Geotech has added an Applesoft BASIC language card to the Apple II, a printer controller, a real-time clock and an interface to some of the specialized laboratory instruments.

The computer runs 24 hours a day, 7 days a week, as does the oil rig. Downtime can cost $3,000 an hour, so reliability is crucial. In the hostile environment of the off-shore rig, computers have tended to die out. The line frequency may not always be 60 Hertz, and line voltage can vary plus or minus 20 volts. The Apple microcomputer, however, has resisted power problems and has been consistently dependable.

Out of 21 rigs similarly equipped with Apple systems, only one has failed in 15 months of operation. Even during a hurricane, when workers deserted the rig, the computer—powered by battery and with a telemetry link—continued to report rig stresses and strains, as engineers in Houston looked on.

The Town that Teaches

About 200 years ago, the first pioneers arrived in Lee's Summit, Missouri. Today the pioneers are back again. But this time, they have founded a different kind of town. It's called Safety Town, and its purpose is to educate children about safety.

The miniature town comes complete with sidewalks and streets, a traffic light at the main intersection, traffic signs and lots of small buildings—a Dairy Queen store, a church and factories. The "pioneers" who built it are the Lee's Summit Council of the Telephone Pioneers at Western Electric's Kansas City Works.

Safety Town is based on the concept that children learn and retain more habits prior to age six than at any other time in their lives. The program is designed for four and five year old children about to enter kindergarten or first grade.

"When the children leave after 20 hours in Safety Town, they will have a good background in safety," explained Dorothy Chlad, president of

the National Safety Town Committee. "They will know about traffic, bus and home safety, fire prevention and more. But, parents must remember that all Safety Town can do is introduce safety to children. The basic concepts have to be reinforced at home, at all times."

"Our involvement began in June

Green Light Go. That's just one of the rules Carl Saderstrom explains to his mother, Merrily, in Safety Town, where small children learn about road safety.

or July of 1978," said Joe McMillan, a director at the Kansas City Works and a member of the Lee's Summit Safety Town Committee. "Western Electric provided the design for the houses, helped build them and made the architectural sketch."

About a dozen Western Electric Pioneers were responsible for designing and building Safety Town. They also installed the town's traffic signs and traffic light. Actually, the electrical engineering is the same as a full size town.

Aqueduct to Predict Earthquakes

Geophysicists from the University of Southern California want to use the Los Angeles aqueduct system to study and predict earthquakes. Transforming the aqueduct system into a highly accurate tiltmeter—an instrument for measuring the earth's deformations (tilts) that usually precede and accompany earthquakes—would be fairly simple, according to Peter Leary, one of the USC geophysicists. Inexpensive sensors to measure changing water levels—which the investigators believe reflect tilt—must be added.

The self-contained sensors will be set into the roof of the ten foot square, concrete-walled aqueduct at intervals along a 50 mile segment in the Antelope Valley. Geophysicists have chosen the segment that extends from the town of Mojave southwest of the Fairmont reservoir.

Based on their analysis of DWP water-level measurements since 1969, the investigators have found that different aqueduct sections have different water level histories. For instance, between 1978 and 1979, water levels in the Antelope Valley fell about a third of a foot, while levels in the northern 60 miles of the aqueduct remained unchanged. The former decline corresponds to a downward tilt of the Antelope Valley. Coincidentally, the United States Geological Survey elevation and gravity surveys have shown subsiding in the same region during the same time span.

Without a doubt, the aqueduct is potentially a powerful tiltmeter; it is practically a scientific instrument as it stands. If this aqueduct system works effectively as a tiltmeter, there may be other aqueducts in the world that could be made to work in the same way at very low costs. ■

SPEAKING SOFTLY

BY MICHAEL KAYE

LOOKING AT THE BEST IN SOFTWARE

WE ARE ON our way to a clearing in a forest just outside of town where we'll witness a duel. The early morning sun sparkles on the grass, our cursors are at the ready; the tension mounts; Seated at our keyboards, the margins having been paced off . . . "Let the duel begin!"

Maybe calling it a duel is a bit strong. Inasmuch as we'll be witnessing a challenge between two word processors, why don't we call it a "write-out" instead of a "shoot out"—or maybe a "write-off."

The Contestants. I'm going to put Radio Shack's SCRIPSIT and Michael Shrayer's "Electric Pencil," two of the most popular word processing software packages available for the microcomputer user, head to head for comparison. And, just to make things a little juicier for you, I'll let you in on a little secret . . . I'm using both of them to write this article—but not at once.

I use "Electric Pencil" to do most of my writing; it's easier for me to edit on the run with it. The cursor control commands are easy to use; and, most importantly, it is easy to insert, delete, and move text around. In order to execute these functions, all that you have to do is hold down the SHIFT key and another LETTER key to invoke a particular function. There isn't much to it once you learn what all of the commands are.

The command set for SCRIPSIT is more sophisticated and complex than the set for "Pencil" but I find that it slows me down. I wish that the command syntax that SCRIPSIT uses wasn't so unwieldy. There are some cases where you have to hit two or three keys at the same time and in a certain order to do the same job that can be done with one keystroke in "Electric Pencil."

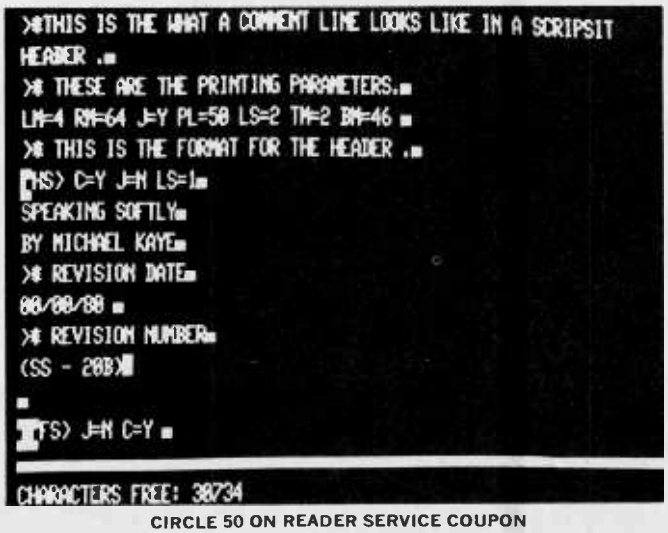
But let's not come down too hard on Radio Shack. There are occasions when it might be nice to have eight fingers on each hand. SCRIPSIT tries to do an awful lot of things with a limited amount of keyboard space to play on, so the keys have multiple roles.

Different Menus. Each of the programs has a different "Menu" format when it comes to performing certain tasks such as loading text and specifying print parameters. "Pencil's" menu is accessed by typing a SHIFT and "K" at the same time. The menu appears on the screen and you select the appropriate function.

SCRIPSIT doesn't have any such an animal. Hitting the BREAK key will put you in the command mode. And you can access commands while the text is in front of you. But you had better know what the commands are first, as you won't have a menu to remind you as to what the selections are; and there are quite a few of them. SCRIPSIT's command set is more versatile, but as I said earlier, it takes practice to use it easily.

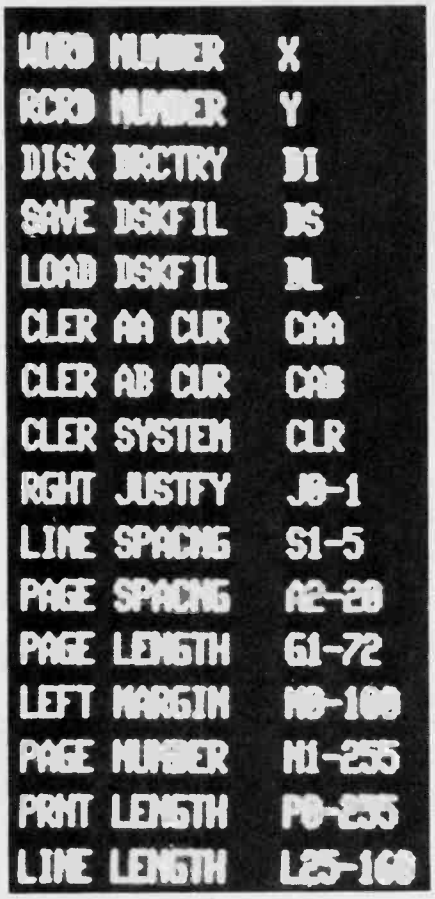
Radio Shack has taken steps to alleviate the complexity of SCRIPSIT. For instance, they give you a nifty set of little labels that you can apply to the keys; albeit carefully, that help the keyboard gymnastics run more smoothly. They go one better than that with the inclusion of a "Teacher" magnetically sequestered on three audio cassettes, who will guide you through the opening moments and settle you into a familiarity with SCRIPSIT. They have included a card that has an abreviated instruction set so that you don't have to continually refer to the manual. The manual is adequate for the task, but I would like to see a more detailed version that relies less on the cassettes. The documentation that is supplied with "Pencil" is not as copious as that for SCRIPSIT; the instruction set is spelled out quite clearly and then you're off and typing.

Now, lest you think that I think that "Pencil" is the only game in town, let me blow the fog away on that one. While "Pencil" is easy to use on the way in, SCRIPSIT is terrific on the way out. The print formatting, pagination, and other printout routines are miles ahead of "Pencil." One of the things I like most about SCRIPSIT is that you can specify the printout parameters for each piece you are



Radio Shack's word processing program, SCRIPSIT, gives the user access to all information needed to take advantage of it.

CIRCLE 50 ON READER SERVICE COUPON



The Electric Pencil from Michael Shrayer Software is a simple but efficient word processing program. Its command set is simpler than that of SCRIPSIT, but the user must guard against typing too quickly or risk the losing of letters from line to line.

CIRCLE 51 ON READER SERVICE COUPON

working on as part of the text. You tell the computer what the "measurements" are just once at the beginning, and then off you go. When you print out with "Pencil," you have to specify the measurements each time. Unlike "Pencil," SCRIPSIT also allows you to leave little notes to yourself in the form of comment lines which are similar to remark statements in a BASIC program—they are embedded in the text but are not printed out.

"Pencil" has some kinky edges that I could do without; the most annoying of these being that it is possible to type faster than the program can handle things, especially on insertion of text, and you sometimes lose letters while you type. Also, when a word is dropped down to the next line because it exceeds the line width of 64 characters, you'll lose letters. This doesn't happen with SCRIPSIT; you can barrel right along and it won't miss anything.

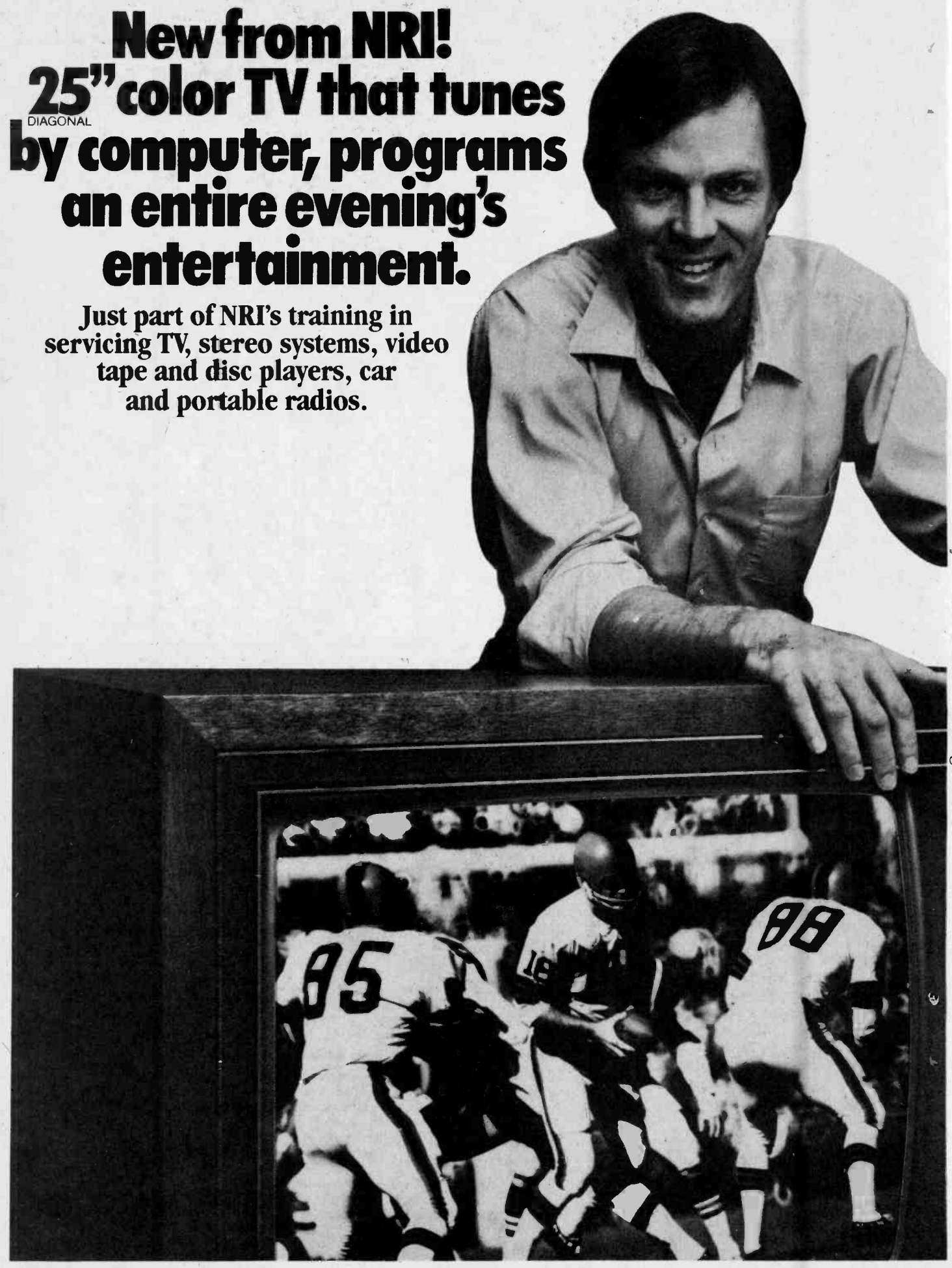
Minor Flaws. Both programs leave something to be desired when it comes to file handling and bookkeeping because there is no way to get into the DOS without exiting the program. For instance, there is no way in either program to know how much disk space you have left. You find out when the programs come back with a Disk Space Full message.

Depending on what operating system you are using, this can have disastrous results, I have had several disks "eaten" as a result. With "Pencil" you can at least find out what you have on the disk, but only if the files stored are "Pencil" files. SCRIPSIT must be brought to a screeching halt entirely if you want to know anything about what is on the disk.

Each program seems to have something that the other left out. Whether this was by design or an accident is a question for the computer gods to answer. Being a mere mortal, I decided to use both systems. This may seem a little extravagant; but if you are shelling out upwards of three grand for a word processing system (depending on your taste in printers), then an extra $100 or so is not a lot of money to spend on software. Both programs are available in tape and disk formats. I suggest that you try 'em both out at appropriate locations and then select the one you're most comfortable with. ■

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.

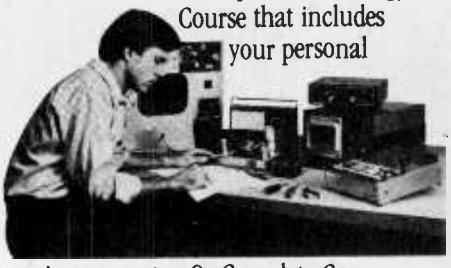
Complete, Effective Training Includes Video Systems

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

DX CENTRAL REPORTING

A WORLD OF SWL INFO

BY DON JENSEN

☐ There are few other areas where radio has as much of an impact on listeners as it does in the Arab World.

In North Africa and the Middle East radio plays the key role in forming public opinion because of the importance of the spoken word to largely illiterate people.

An estimated 70 percent of the Arabic-speaking radio audience cannot read. Literacy is so low in that part of the world that people listen to the ubiquitous transistor radio far more than they read newspapers. Furthermore, spoken Arabic, for all its harsh sound to Western ears, is a poetic, emotional language. Listeners often are moved by the tone and style of the radio commentators, rather than by the meanings of the broadcasts.

An ambassador from one of the Arab countries has said, "We Arabs are slaves of our beautiful language. Our voice is frail when we call for unity and roaring when we preach disunity."

A Powerful Medium. Radio has the power to "move" people, but Arabs also understand that much of what is broadcast is propaganda. In fact, one phrase for lies is *kalam izaat,* —Arabic for "radio talk."

Not knowing Arabic, most North Americans SWLers will miss much of the radio infighting that goes on between Arab countries. Still, it is possible to learn much about what is going on in this volatile part of the world by listening to their English language programs.

One of the easiest stations to tune in this part of the world is Radio Cairo. Egypt's programming in English is easily heard during the evening hours. Try about 0200 GMT on 9,475 kHz or 12,050 kHz.

There are several outlets with English programming located in the Persian (or Arabian) Gulf area.

One is Radio Kuwait, about 2000 GMT on 11,665 kHz. Another is the Dubai Radio and Colour TV Station, which has been testing at various times and on various frequencies as this is being written. One frequency to try is 21,700 kHz. Others you may tune are 9,640 kHz and 17,750 kHz.

The Broadcasting Service of the Kingdom of Saudi Arabia can be heard around 2030 GMT in English, transmitting on 11,855 kHz.

Somewhat harder to hear is Iraq's Radio Baghdad. You can try for this one at about 2200 GMT on 9,745 kHz, for English programming.

Another Arab World station is Radio San'a in the Yemen Arab Republic. Listen for this opening in Arabic at 0300 GMT on 9,780 kHz.

Radio Lebanon has been moving around a bit, but reports have them on 15,375 kHz with English programming at 0230 GMT.

That should give you a few DXing targets to hunt for in the radio-active Arab World.

New on the Air. I mentioned DXing clubs as an unbeatable source for information about shortwave listening and other aspects of the listening hobby.

The major DX clubs in our continent are affiliated with the Association of North American Radio Clubs (ANARC).

ANARC publishes a list of its member clubs and their addresses. If you'd ilke a copy, so you may contact one or several about possible membership, data on what they offer and the cost, send a stamped self-addressed envelope to ANARC Club List, Association of North American Radio Clubs, 557 North Madison Avenue, Pasadena, Calif. 91101. If you live in Canada send an envelope addressed to you and one International Reply Coupon.

A reader, who asked his name not be used, sent DX CENTRAL a query some weeks ago. He had joined the International Shortwave Club in Great Britain, but had not received that club's bulletins for months. He added that his letters of inquiry to the club had gone unanswered

"Can you get any info on the ISWC?" he asked.

I've contacted several good sources in England and unfortunately the story seems the same.

"Repeated attempts at getting any response (from ISWC's president) have all been to no avail and letters written have remained unanswered."

"It seems that ISWC is defunct, at least for the moment," an English contact reports.

I'm pleased to note, however, that the clubs affiliated with the Association of North American Radio Clubs, which I just mentioned, have a good record for stability and longevity. ■

DX GLOSSARY

DX, DXer, DXing—distant broadcasting stations; one who listens to these stations as a hobby; the hobby itself.

FM—Frequency modulation.

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

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

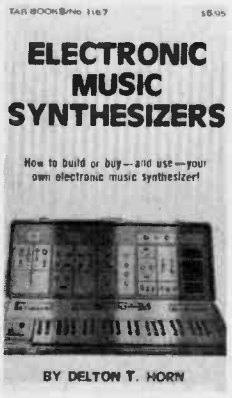
Medium wave—broadcast band in the 540 to 1600 kHz range; normal AM radio broadcasting frequencies.

SW, SWL—Shortwave, shortwave listener.

COVER TO COVER

YOUR ELECTRONIC BOOKSHELF

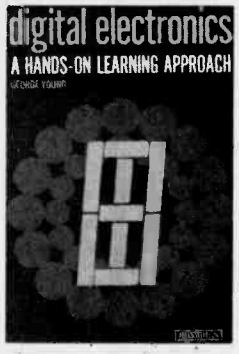
Moogography. Anyone fascinated by the musical possibilities of electronic synthesizers, or who wants to experiment with this exciting new way of making music, will *Electronic Music Synthesizer* by Delton T. Horn has all the answers. It's filled with data on synthesizers in general, and on individual models, candidly explaining the advantages and disadvantages of each one. Such musical workhorses as the Moog (Minimoog and Polymoog), ARP 2600, Oddessy, PAIA, Oberheim, RMI and EML Synkey synthesizers are presented in full detail. Also included is a chapter on accessories and on the various components that can, with the help of this book, produce almost any sound one can hear. Author Horn includes a full section on how to build keyboards, an op amp organ, the digital Poly-Syngan, oscillators, drones, filters, tunable noise stage, modulators, voltage control. For anyone who wants a book that provides solid, practical help in choosing and using, or building, a synthesizer, this informative manual is the good choice. Published by Tab Books, Blue Ridge Summit, PA 17214. Circle No. 62 on the Reader Service Coupon.



Soft cover
168 pages
$5.95

Everything you ever wanted to know about synthesizers.

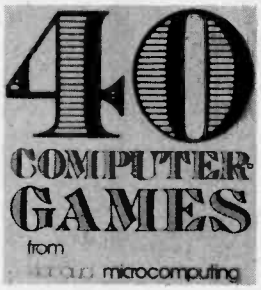
Dig it! A Hands-On Approach. Discovering and understanding the new technology of digital circuitry is made a great deal easier with the help of *Digital Electronics: A Hands-On Learning Approach* by George Young. This text, which gives a comprehensive view of digital circuits and electronics, approaches the subject of ICs in an unusual fashion; it gives little in theory but a great deal of practical information. Starting from the basic diode, Young tells the reader about gates, flip-flops, pulse generators and other more advanced digital circuits. He even has sections on the type of power supplies to use, troubleshooting methods and how to fabricate a printed circuit board. Step by step instructions given for all the experiments, which give the reader a real feel for ICs, are straight forward and easy to understand. Published by Hayden Book Company, Inc., 50 Essex St., Rochelle Park, NJ 07662. Circle No. 61 on the Reader Service Coupon.



Soft cover
202 pages

$8.95
Digital circuitry by the numbers.

RUN for Fun! You'll find 40 exciting computer games in a new book called—of all things—*40 Computer Games,* edited by Emily A. Gibbs and Jim Perry. These games are written in different languages for various computer systems. There is something for everyone, even TI-59 owners. There are nine game categories, including gambling, board games, space adventures, card games and more. Published by



Soft cover
148 pages
$7.95

Dozens of games for the computerist.

COVER TO COVER

(Continued from page 23)

Wayne Green, Inc., Peterborough, NH 03458. Circle No. 63 on the Reader Service Coupon.

Way to Go. Contrary to popular belief, it ain't no fun to cut against the grain. Thus, *The ARRL Operating Manual,* edited by Robert Halprin, K1XA, furnishes all the basics—and then some—of making the most

Soft cover
157 pages
$5.00

All the latest info on Amateur operations.

effective use of your Amateur radio station to achieve maximum satisfaction and enjoyment. Up-to-date trends in contesting, DX, traffic/emergency matter, OSCAR, UHF-VHF and FM and interfacing home computers are packed between the covers. The text takes into consideration the entering Amateur and the re-entering old timers who've let some time lapse between contacts. Published by the American Radio Relay League, Inc., 225 Main St., Newington, CT 06111. Circle No. 66 on the Reader Service Coupon.

CB Antenna Tips. When it comes to Citizens Band antennas, many consumers are baffled by all the sizes and styles on the market. If they don't have enough electronics background to make a decision on their own, they turn to a sales clerk for assistance, who may be just as baffled by it all as the customer. If you would like a free copy of the Buyers' Guide, visit a Shakespeare dealer in your area or write to Jim Waring, Shakespeare Company, The Antenna Group, P.O. Box 246, Columbia, SC 29202. Circle No. 65 on the Reader Service Coupon. ■

SCANNER TIPS

MONITOR THE AIRWAVES

BY ROBERT GROVE

Checking Relative Performance

I have two scanners of different manufacture. One picks up police calls for miles around, while I can only hear very close stations on the other. How come?

—B.T., Stamford, CT

There are several possibilities for this poor performance. Are you using identical antennas? An outside antenna would certainly have greater range and signal capture. Are both scanners in exactly the same position? If you live in a mobile home, the metal shielding can severely reduce signal levels available to the set's tiny whip antenna. If you can't use an outside antenna the scanner should be placed as close to the window as possible.

If you are using an outside antenna on the poor performer, try switching the antenna with the other unit to test the antenna system. It could have a shorted circuit, a broken conductor, or a loose or corroded connection.

Has your scanner ever been aligned? If it is "used" and of unknown history, or if someone has tinkered with its innards, this could cause the problem.

Antenna Height

I am installing an outside antenna for my scanner. How high should it be?

—D.L., Rock Falls, IL

Generally speaking, once your outside antenna has a clear "view" of the horizon, it is high enough. Be sure that it is not near wiring or large metal surfaces, other antennas, or lost in the trees.

If you are on flat terrain, you would have to increase your antenna height by a factor of two to four times to make an audible difference in receive signal strength. In the mountains, (especially in a valley) it's a different story. The higher you can elevate your antenna, the better will be your reception. The same rule holds true with your television antenna; TV channels occupy the same portion of the radio spectrum as scanner communications.

SCANNER TIPS is edited from questions submitted to Columnist Robert Grove and answered by the Technical Advisor Corps of the Scanner Association of North America (SCAN). To get your scanner questions answered, write to SCIENCE & ELECTRONICS, 380 Lexington Ave., New York, NY 10017. If you would like more information about SCAN, write to them at Suite 1212, 111 East Wacker Drive, Chicago, IL 60601. ■

ACCUTUNE

Perfect Pitch Every Time With This Electronic Tuner

BY ANTHONY J. CARISTI

TUNING A GUITAR is a time consuming and difficult task, especially if you don't have perfect pitch or your ears have been blasted to near deafness by loud music. But here is a project, which is simple to build, that allows you to tune your guitar without listening to it.

Precise Device. Accutune is a precision tuner with an accuracy of ± 1Hz. It allows the guitarist to strum and twang away at a precisely tuned instrument and eliminates the necessity of tuning each string from the tone generated on a previously adjusted lower string. This latter method could result in an improperly tuned guitar.

Accutune is self-contained and is powered by a 9-volt transistor battery. A six position rotary switch on the unit selects the desired frequency for each of the instrument's strings.

To operate the unit, plug your guitar's cable into the phono jack of the unit, select the desired string and adjust the guitar for a meter reading of center scale. Accutune also features a battery monitor circuit that checks the battery's terminal voltage.

When the battery has insufficient energy to properly operate the unit, LED1 lights, alerting the user that the battery needs replacement. This feature ensures proper voltage and as a result, proper tuning indications. Although this may sound complex, the theory behind Accutune is very simple.

Harmonics Ignored! All musical instruments, generate tones that are rich in harmonics. To measure the fundamental frequency of an electrical guitar tone, its fundamental frequency must be amplified and harmonic content reduced so that a sinusoidal waveform is generated. This allows the circuit's frequency sensitive section to only respond to the fundamental frequency while ignoring the harmonics.

This is done by sections D and A of U2, which are operational amplifiers connected as an active bandpass filter. This is a multiple feedback circuit utilizing both negative and positive feedback to amplify the desired frequency while attenuating all others outside the passband. The passband of the filter can be adjusted to the desired frequency by

selecting the proper resisitve component. The circuit's center frequency selection is determined by a set of six potentiometers and resistors. These parts are labelled R9 through R20. They are chosen by S2A.

U3 is a specialized frequency-to-voltage integrated circuit designed to deliver a DC voltage at its output proportional to the frequency of the input signal. This chip's output voltage level is determined by the resistance value connected between pins three and four to ground and the capacitance connected to pin two.

As with U2D and U2A, the resistance connected to U3 pins three and four is determined by the front panel selector switch and a set of six potentiometers and resistors. These parts are labelled R22 through R33 and S2B.

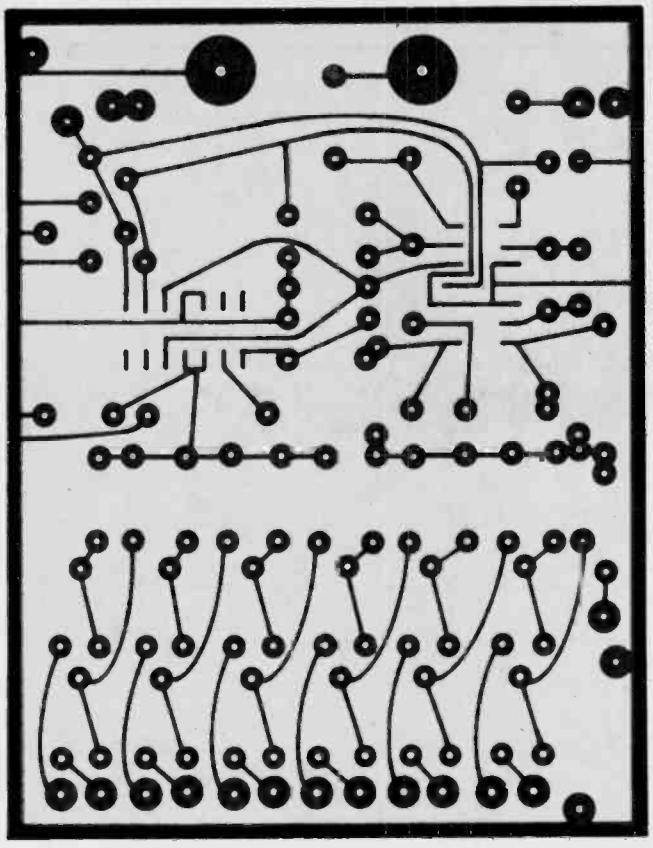
To provide an expanded meter scale for increased meter sensitivity, U2B is used as an operational amplifier with a gain of three and a DC voltage applied to its negative input. U2B drives a milli-ammeter through R 38 providing a meter scale representing a ±10% center scale frequency range. This sensitivity is sufficient to indicate a change of 1 Hz in the guitar.

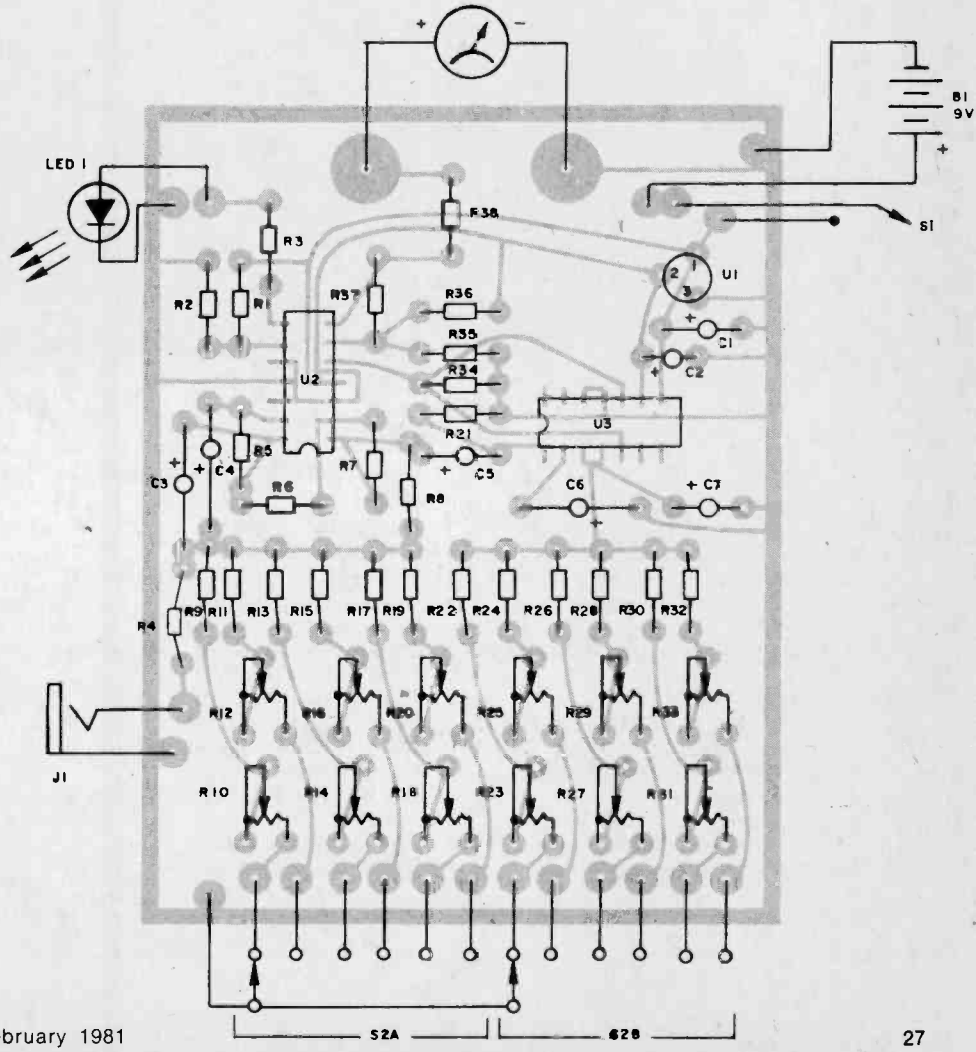
Pins and U2. Section U2C is connected as a voltage comparator to monitor the terminal voltage of the battery. A reference voltage of +5-volts is fed to pin 10 and a portion of the battery voltage is fed to negative input pin nine. When the battery is fresh, its terminal voltage is sufficient to keep pin nine at a higher potential than pin 10.

The output U2C is thus zero and LED1 is extinguished. As the battery voltage decreases with use, a point will be reached where the voltage at pin nine is no longer higher than that at pin 10. The output then switches to battery voltage, illuminating LED1.

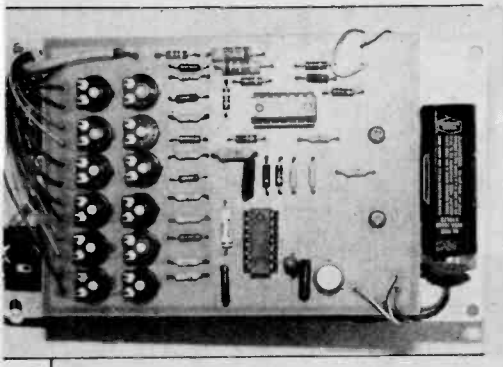
To ensure the continued accuracy of Accutune, 5-volt regulator U1 provides a constant voltage to U3 and U2B. Thus, the circuit will maintain its calibrated accuracy despite the constantly changing terminal voltage of the battery.

M1's Back. The entire circuit of Accutune, except the front panel components, is contained on a printed circuit board mounted on the back of M1. The meter used has a center to center stud distance of 1-inch and this distance is reflected in the foil layout.





The upper illustration shows the foil side of Accutune's PC board. Unless you are an expert at making your own, you should order the kit or a pre etched circuit board from Niccum. The lower illustration is a parts overlay showing completed project. When you install the components, note polarity.



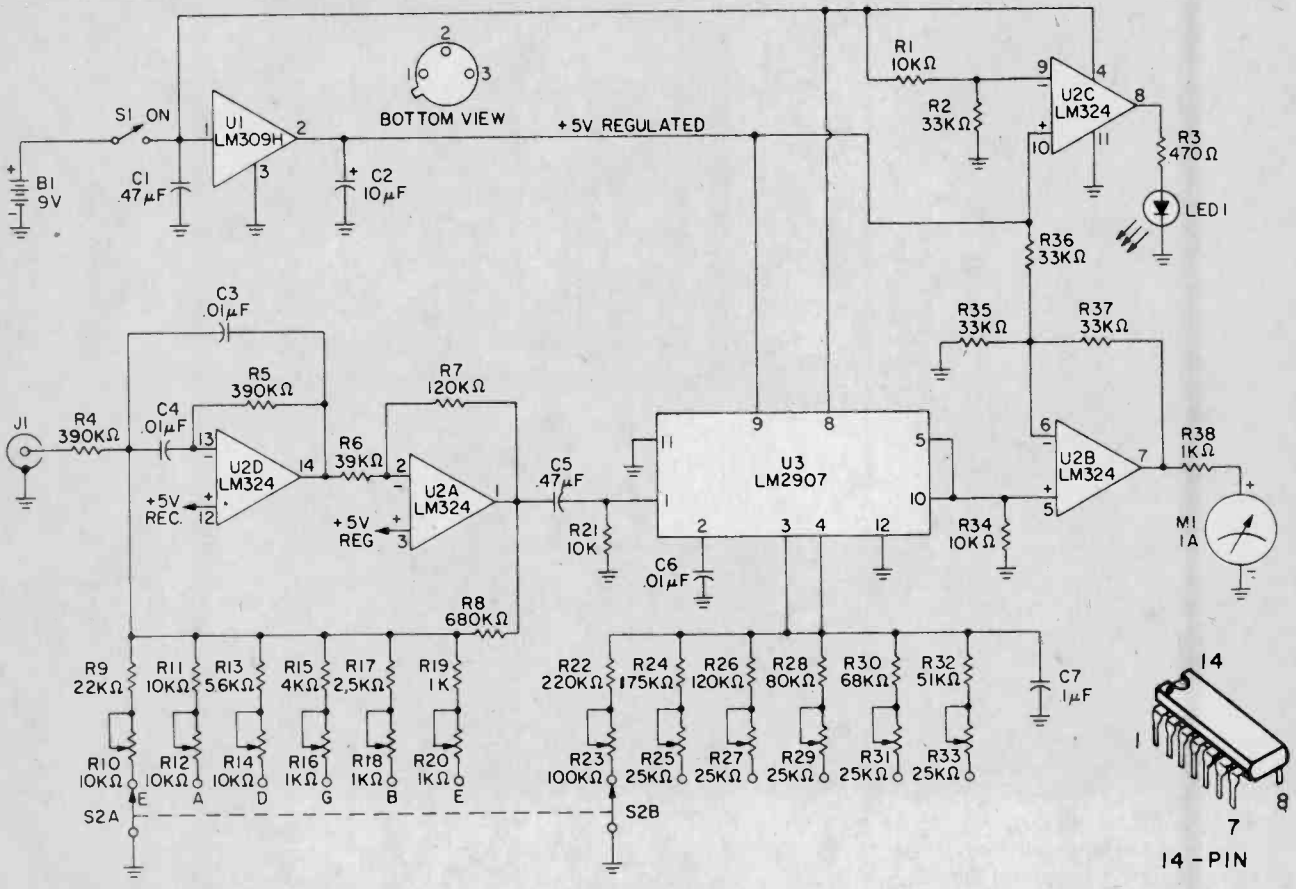
Be sure to measure the center to center distance between the meter studs before making your printed circuit board.

Use sockets for U2 and U3, rather than soldering them to the printed circuit board. It is extremely difficult to remove a multi-pin integrated circuit from a printed circuit board once it has been soldered in place.

No Substitutions! Do not substitute ceramic capacitors for C3, C4, and C6. These parts are used in the frequency sensitive sections of the circuit and should be stable components to preserve the calibrated accuracy of the

(Continued on page 86)

Twelve potentiometers are the heart of Accutune. Each potentiometer must be tuned for a discrete frequency. If there is a problem in getting a center scale reading, then change the value of the resistor that is in series with the problem potentiometer.

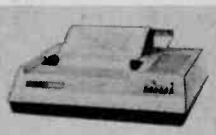


PARTS LIST FOR ACCUTUNE

B1—9-volt transistor battery
C1, C5—.47 uF, 50 volt ceramic capacitor
C2—10 uF, 25 volt ceramic capacitor
C3, C4, C6—.01 uF, 100 volt mylar capacitor
C7—.1 uF, 50 volt ceramic capacitor
J1—Phono Jack
LED1—Red light emitting diode, Radio Shack 276-026 or equivalent
M1—1 mA DC Milliammeter
ALL RESISTORS ARE ¼-WATT, 10% UNLESS OTHERWISE NOTED
R1, R11, R21, R34—10,000-ohm resistor
R2—33,000-ohm resistor
R3—470-ohm resistor
R4, R5—390,000-ohm resistor
R6—39,000-ohm resistor
R7—120,000-ohm resistor
R8—680,000-ohm resistor
R9—220,000-ohm resistor
R10, R12, R14—10,000-ohm potentiometer
R13—5,600-ohm resistor
R15—4,000-ohm resistor
R16, R18, R20—10,000-ohm, potentiometer
R17—2,500-ohm resistor
R19—1,000-ohm resistor
R22—220,000-ohm resistor*
R23—100,000-ohm potentiometer
R24—175,000-ohm resistor*
R25, R27, R29, R31, R33—25,000-ohm potentiometer
R26—120,000-ohm resistor*
R28—80,000-ohm resistor*
R30—68,000-ohm resistor*
R32—51,000-ohm resistor*
R35, R36, R37—33,000-ohm resistor*
R38—1,000-ohm resistor*
S1—SPST switch
S2—Two pole six position rotary switch
U1—LM309H voltage regulator integrated circuit
U2—LM324 operational amplifier integrated circuit
U3—LM2907 frequency to voltage integrated circuit
*See text
Misc.—Cabinet with metal face plate, screws, solder, knob, printed circuit board, wires, hardware, etc.

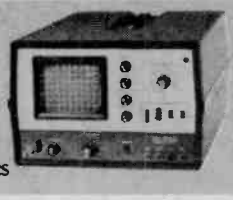
Note: A complete parts kit including PC board and all components is available from Niccum Electronics, Rte. 3, Box 271B, Stroud, OK 74079. Price for the complete kit is $39.50; please include $2.00 P&H. A pre-etched and labeled PC board is only $6.50.

All-In-One Computer



Computer Peripherals

Amateur Antenna Tuner



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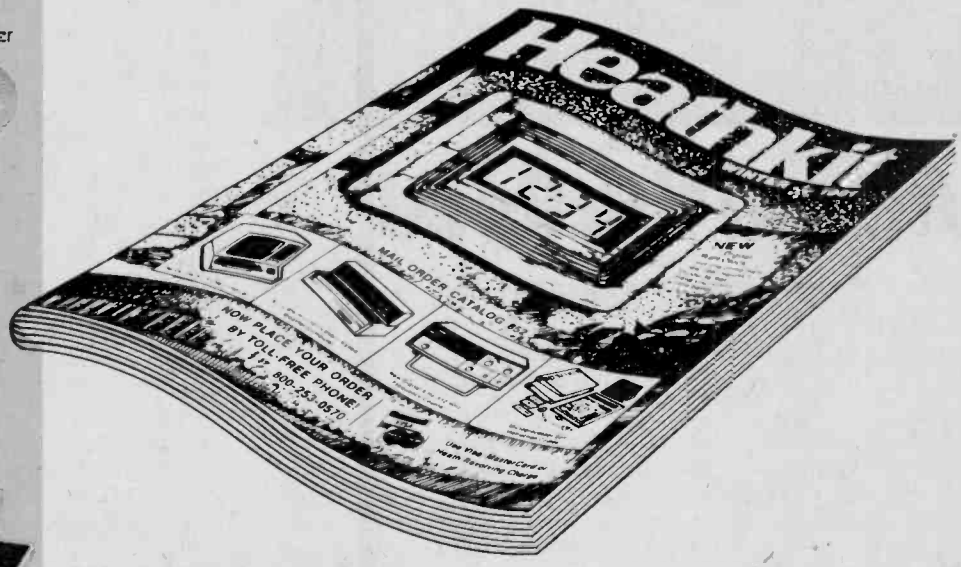
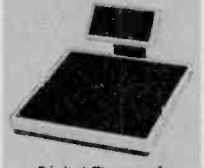
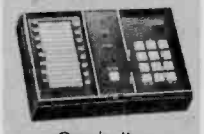


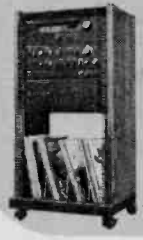


Digital Electronic Scale

Car Thermometer



One-button Phone Dialer



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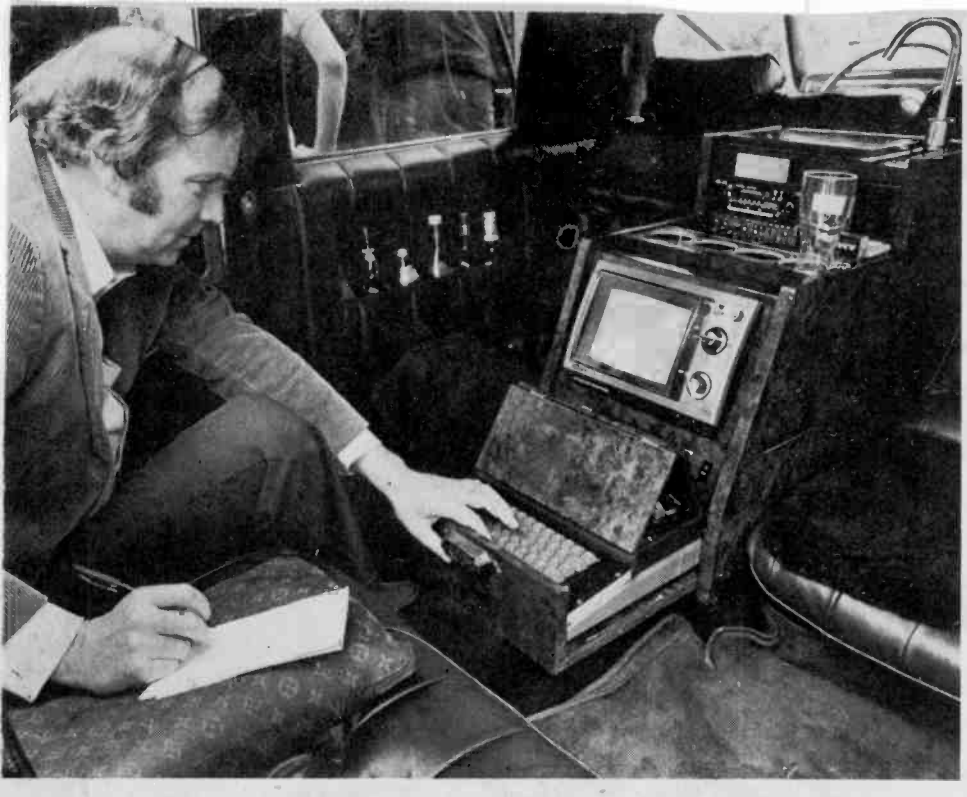


Computer on the Road

An Apple II business microcomputer turns this Cadillac limo into a rolling office

BY PAUL MARGOLIS

TIME IS MONEY; and the time a busy executive spends tied up in traffic is a frustrating waste. Mr. William Kelly, president of SAI Electronics of Farmingdale, N.Y. is now able to put formerly wasted commuting time to good use, thanks to an Apple II microcomputer system in his Cadillac limousine.

Originally Mr. Kelly had envisioned his custom-built, stretched Cadillac as the means of making his daily four-hour commute as painless as possible. To that end it was equipped with such amenities as a color TV, bar, refrigerator, plush upholstery and a mobile telephone to keep him in touch with his office.

The idea of installing a computer actually came about quite accidentally. Mr. Kelly had taken the Cadillac to Berliner Electronics in New Hyde Park, N.Y. to have a sophisticated electronics package added to the factory equipment. This was to include a 200-watt stereo system with ten speakers, a remote starting system to enable the engine to be started from up to a quarter-mile away, a microwave burglar alarm system and a video system complete with a camera to record events on the spot.

While making arrangements to install all of this equipment, Bob Berliner, owner of the Berliner Electronics chain of electronics and computer centers on Long Island, suggested, "Why not put in a computer, too? That way you could keep track of your business no matter where you were." Kelly thought the idea was fantastic, and an Apple II was added to the already impressive list of equipment to be installed.

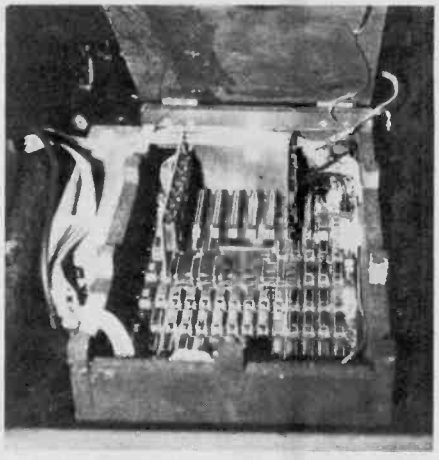
Design Innovations. Much innovative design work went into installing the computer in the car. First there was the problem of where to put the machine and its two disk drives. The area under the right front seat was stripped to the steel flooring and a housing was built to hold the Apple's central processing unit. The two disk drives were stacked one atop the other above the CPU. Fortunately the Apple II is designed to function in an environment having ambient temperatures ranging from below freezing to well over 100° F., so the machine needed no special heating or cooling provisions, other than convection slots built into the equipment housing and racks.

Supplying AC voltage to close tolerances posed another problem, as microcomputers require highly stable voltage to function properly. The AC power system with which the car was equipped at the factory was adequate for small appliances, but it wouldn't do for a computer. The staff of Berliner Electronics ended up assembling an AC supply that could meet the demands of the Apple II and its peripherals.

Ready to Roll. After a week and a half of work, everything was installed, the upholstery was put back in place—and the Cadillac was fitted out with a microcomputer system that would do credit to many business offices. The keyboard and CRT display screen are hidden away behind finely crafted walnut cabinetwork fitted into the rear console. Opening the wooden doors gives access to the powerful 6502-based Apple II with its 48K of RAM memory, provision for 232 Kbytes of data storage on disk and a 16-color high resolution graphics capability. The disk software with the system includes an on-line data base business management program and three languages in ROM (Applesoft BASIC, Floating Point BASIC and Assembly Language).

When he's on the road commuting or traveling between his several business establishments, all Kelly has to do is call his office to inquire about a particular account. Then he can access all the details about it from the data in his rolling computer system and make whatever additions or deletions are necessary. In this way he has an up-to-the-minute picture of his inventory, customer accounts and bills due and paid.

In today's straitened economy, the businessman needs every advantage he can get. Installing an Apple II microcomputer system turned Mr. Kelly's Cadillac into a mobile extension of his office, thereby enabling him to keep abreast of every aspect of his business at all times. ■



A special housing had to be built under the Cadillac's front seat to hold the Central Processing Unit and two disk drives of the Apple II microcomputer. The design of the Apple II allowed for its mounting in an unventilated area of the Caddy.

DIGITAL CLARINET

Play music by the numbers with your digital clarinet.

BY WALTER SIKONOWIZ

TO MAKE A FINE instrument such as a violin or bassoon, a craftsman must meticulously carve, cut, form and finish for hundreds of hours. It takes decades to master the instrument.

The time has now come where you can build a fine instrument and master its musical intricacies in a few hours. Appealing? Then the Digital Clarinet is waiting for you to pick it up and play away to your heart's content.

The Digital Clarinet is a high quality ultra-miniature instrument that's fun to build and play. Its sophisticated digital circuit is as far beyond other similar projects as a Stradivarius eclipses the simple kazoo.

Each note in the unit's three octave range is generated with enormous stability and accuracy; frequency drift, the plague of analog systems, is not a problem. Since this project's output signal is a modulated square wave, the generated frequencies have the range and tonal characteristics of a woodwind instrument—hence the name: Digital Clarinet.

Double Features. The Digital Clarinet provides two keying modes: Sustained and Percussive. After a key is struck in the sustained mode, the sound output rises to maximum and remains there as long as that key is down. Once the key is released, the note gradually decays. Percussive keying yields a note that rises to a set volume and fades to nothing regardless of how long the key is pressed. Also a note's attack and decay times can be controlled with a pair of potentiometers. These controls yield strange effects.

The Circuit. To understand the circuit, let's examine the block diagram (Fig. 1). The unit's master oscillator, integrated circuit U1, operates at a frequency of 250,030 Hz. U1's square wave output signal drives top-octave generator U2. Twelve discrete frequencies (or notes), $C_5^{\#}$ (554.3 Hz) to C_6 (1046.5 Hz), are generated by U2. These notes are equally spaced to conform with standard chromatic scale. Since only one note at a time is utilized, the 12 top octave notes are routed to the multiplexer circuitry from U3.

To make our selection, we need a one-octave (12-key) keyboard. Encoder chip U4 provides the necessary logic to interface the keyswitches with the rest of the circuit. U4 debounces all the keyswitches and provides a set of four latched outputs driving the address lines of multiplexer U3.

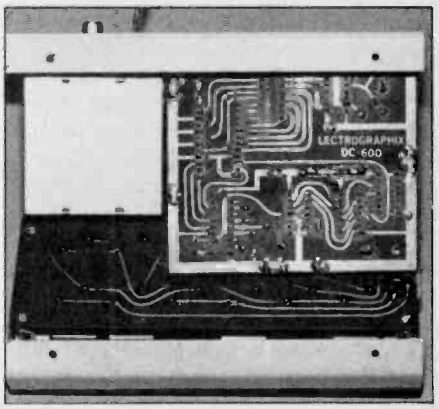
When pressed, each key produces a binary-coded address that selects a unique signal. *Note*: U4's address outputs are latched so the circuit remembers the old note until a new one is selected. Should two keys be depressed at once, U4 responds only to the first one which is pressed.

Multiplexer Times Two. We'll return to encoder U4, but right now let's note that the output of multiplexer U3 is routed to the input of frequency divider U7. Two square wave outputs with frequencies ½ and ¼ as great as the input are generated from U7. Another multiplexer, U6, is used to select between U3's output (the top octave) and U7's outputs (the middle and low octaves). U6's selection is determined by signals from clocked latch U5, which is controlled by two octave-shift keys. If neither octave-shift key is pressed, multiplexer U6 selects f/4 (signals in the lowest octave). Signals in the middle or top octave (f/2 and f respectively) can be selected by pressing the appropriate octave-shift key before striking a switch on the Digital Clarinet's main keyboard. *Note*: Address signals for multiplexer U6 (as with U3) are latched.

Latch circuit U5 memorizes the octave-shift keys that are closed when the Key Down signal at pin 12 of U4 goes high. U5 retains this octave-selection information until the next note is struck, at which time it updates the information. (It should be apparent that ocatve selection must precede note selection.)

The Digital Clarinet's frequency range extends from $C_3^{\#}$ (138.59 Hz) to C_6 (1046.5 Hz). This compares favorably to the range of a regular wind-powered clarinet.

The Key Down signal mentioned above goes high for the entire time any switch of the 12-note keyboard is pressed. Envelope generator U8, under control of the Key Down signal, generates an appropriate envelope voltage. In the sustained mode, this envelope voltage rises to its maximum value after Key Down goes high. It remains at maximum until the key switch is re-



Small in size but big in sound, the Digital Clarinet is easy to wire and operate.

leased and Key Down drops low, at which time the envelope decays to zero. Since decay is initiated by release of the key switch, latching is used to preserve the note and octave information that would be lost after key release.

In the percussive mode, the envelope signal rises after Key Down goes high, but decays after reaching its peak even if Key Down is high. Regardless of the keying mode used, the output note's attack and decay times are determined by the envelope voltage's rising and falling speed.

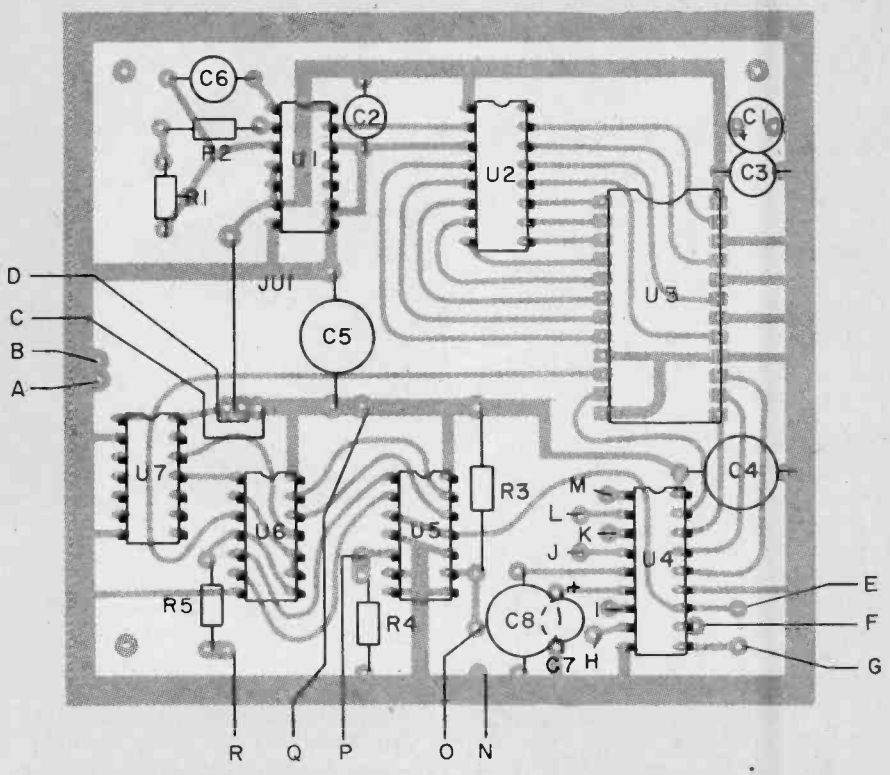
Amplitude modulator U9 multiplies the envelope voltage with multiplexer U6's square wave output to yield a musical note. The note's instantaneous loudness is directly proportional to the envelope voltage.

ICs You See. Circuit power is supplied by eight AA cells arranged to provide a dual supply of +6 and −6 volts. Oscillator U1 is a 4047 CMOS multi-vibrator, which can easily be tuned to proper pitch via trimmer potentiometer R1. The 4047 has excellent stability with changing temperature and voltage. For this reason it was used in lieu of more expensive crystal oscillator circuitry.

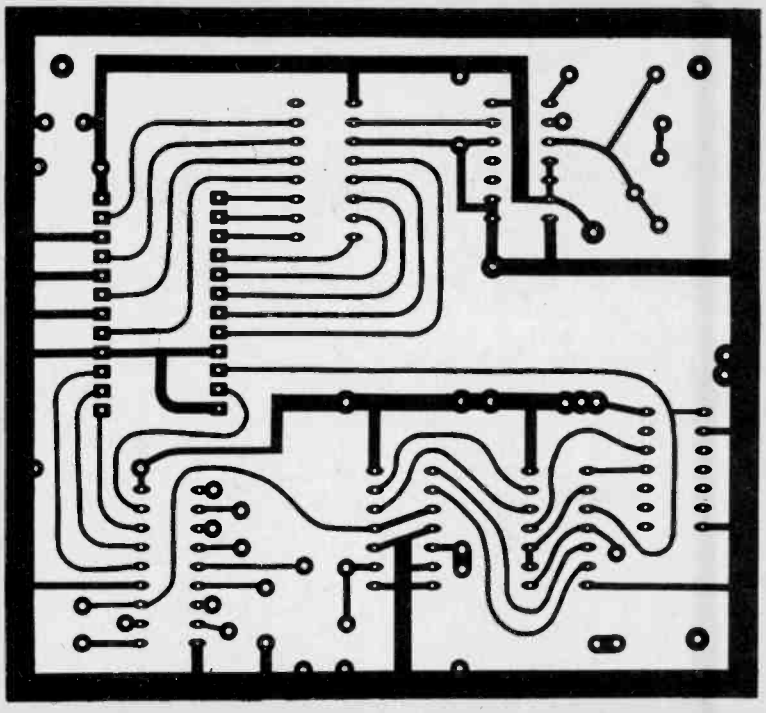
Top-octave generator U2, a Mostek 50240, is fairly expensive. It is recommended that you be especially careful when handling it to avoid damage from static discharge. Note how the keyswitches (S5 through S16) connect to encoder U4 in a matrix arrangement. Each keyswitch connects to one horizontal and one vertical line of the encoder matrix (Fig. 2).

Frequency divider U7 is a common 4024 CMOS binary divider. Mutliplexer U6 (4016) selects the appropriate signals from U3 and U7, routing them to amplitude modulator U9, a 3080 transconductance amplifier. This resembles a standard operational amplifier except its gain is a function of the current injected into pin 5 and its ouput is a high-impedance current source. Trimmer potentiometer R13 is used to null out the offset voltage of U9 and C15 rolls off U9's high-frequency response. Potentiometer R17 is a volume control. The signal at J1 has a maximum amplitude of 500 millivolts and can be fed into the high-level (Tuner, Aux or Line) inputs of any amplifier.

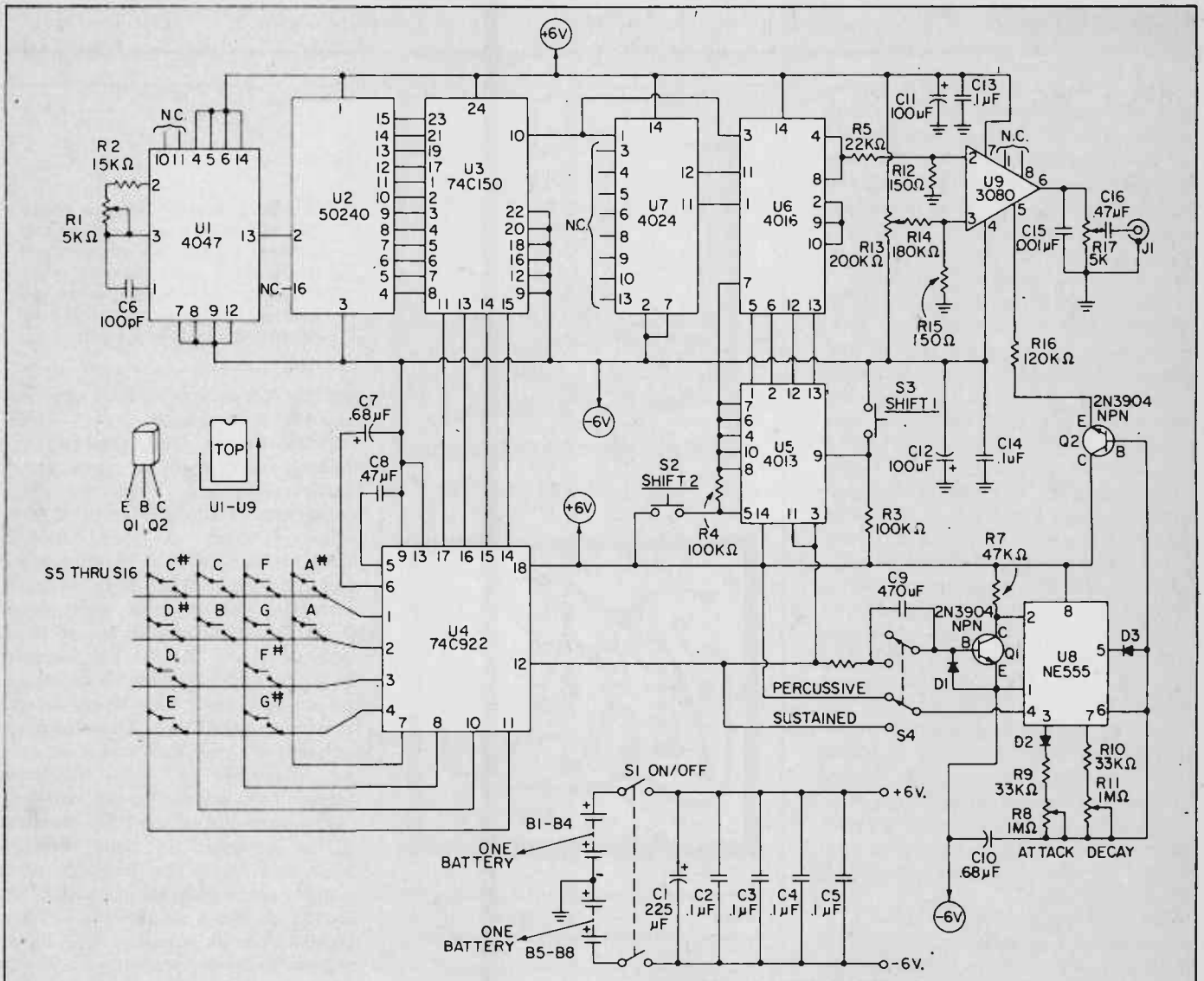
Latch U5 is a type 4013 dual flip-flop. Pressing S3 shifts the scale up one octave; pressing S2 yields a two-octave shift. Pressing both simultaneously gives the same effect as pressing



The parts overlay shows components on top of the printed circuit board. Note that all of the electronic components fit handily on board, making for easy assembly. When soldering integrated circuits, always note the position of the IC on the circuit board.



This is the foil side down of one of the printed circuit boards for the Digital Clarinet. Requiring seven integrated circuits, the project looks complex but is very simple to wire. Other than the integrated circuits, there are relatively few components to wire up.



PARTS LIST FOR DIGITAL CLARINET

B1 thru B8—(8) 1.5V AA penlite cells
C1—225 uF, 16V electrolytic capacitor
C2, C3, C4, C5, C13, C14—.1 uF ceramic disc capacitor
C6—100 pF polystyrene capacitor
C7, C10—.68 uF, 20V tantalum capacitor
C8—.047 uF, 100V mylar capacitor
C9—470 pF, polystyrene capacitor
C11, C12—100 uF, 16V electrolytic capacitor
C15—.001 uF, mylar capacitor
C16—.47 uF, 16V mylar capacitor
D1, D2, D3—1N914 silicon diode
J1—RCA jack
JU1—Jumper wire
Q1, Q2—2N3904 NPN transistor
All Resistors 5%, ½-Watt Unless Noted
R1—5,000-ohm, trimmer potentiometer
R2—15,000-ohm resistor
R3, R4, R6—100,000-ohm resistor
R5—22,000-ohm resistor
R7—47,000-ohm resistor
R8, R11—1,000,000-ohm linear-taper potentiometer
R9, R10—33,000-ohm resistor
R12, R15—150-ohm resistor
R13—200,000-ohm trimmer potentiometer
R14—180,000-ohm resistor
R16—120,000-ohm resistor
R17—5,000-ohm audio-taper potentiometer
S1, S4—DPDT switch
S2, S3—normally open pushbutton switch
S5 thru S16—normally open pushbutton switch (computer style)
U1—4047 CMOS multivibrator (RCA)
U2—50240 top-octave generator (Mostek)
U3—74C150 16:1 multiplexer (National)
U4—75C922 keyboard encoder (National)
U5—4013 CMOS D-type flip-flop
U6—4016 CMOS quad analog gate
U7—4024 CMOS binary divider
U8—Signetics NE555 timer (see text)
U9—LA3080 operational transconductance amplifier (RCA)
Misc.—PC 1,2—Printed circuit boards, aluminum box, aluminum minibox, IC sockets, wire, knobs, screws and nuts, solder, etc.

Note: An etched and drilled set of epoxy-composition printed-circuit boards, stock no. DC-60, is available from LECTROGRAPHIX, P.O. Box 537, Auburn, New York, 13021. Cost is $12.50 postpaid for a set (one analog and one digital board) in the continental USA and Canada. All others please include an extra $2.00 handling charge. Checks and money orders must be payable in US funds only.

S2 by itself.

Only Old Friends. Envelope generator U8 is our old friend, the 555 timer. However, use only a Signetics NE555 (note the "NE" prefix) rather than a National device ("LM" prefix). In the majority of circuits, these units are directly interchangeable, but in this circuit proper sustained-mode operation **will be obtained only** with the Signetics NE555 device.

Switch S4 selects either the percussive or sustained modes and transistor Q1 simply inverts the triggering signal applied to U8. Emitter follower Q2 reads the voltage on timing capacitor C10 and injects a proportionate current into pin 5 of U9 (via R16) to control the 3080's gain.

Don't Buzz! Ground. Construction of the Digital Clarinet is not overly complex, but there are a few points that you must strictly adhere to for best

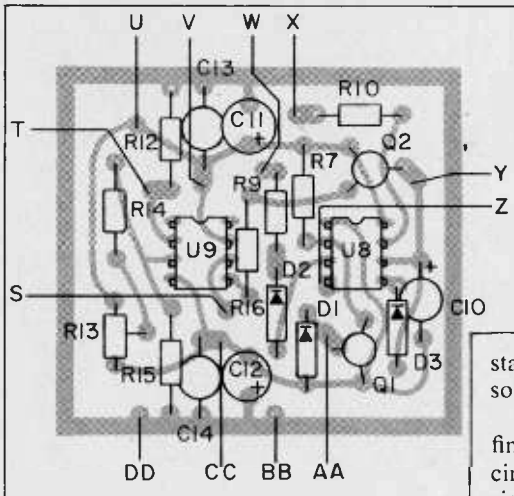
results. First, use an aluminum cabinet and make sure it is connected to system ground. This is easily accomplished at the point where J1 mounts in the chassis wall. A metallic enclosure of this sort is necessary because it minimizes any audio interference (a background buzz) produced by the fast, high-amplitude digital signals in this project.

Printed-circuit construction is highly recommended. Either make your own, if you have the necessary skill or purchase pre-fabricated boards from the manufacturer given in the parts list. The circuit has been segregated into two boards: One to hold the digital circuitry and one for the analog stages. This separation is important because the analog board must be shielded from the digital board to prevent audio interference. Fortunately, shielding is easily accomplished by mounting the analog board together with C15, C16, J1 and volume control R17 inside an aluminum minibox. The minibox should be mounted inside the aluminum cabinet housing the Digital Clarinet and the box should be electrically connected to system ground. Wires running to and from the analog PC board can be routed through grommeted holes in the minibox's walls. Using this system, a prototype was constructed; we obtained dead silence between notes and not a trace of digital hash.

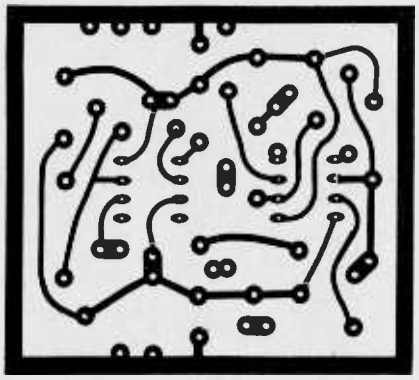
What A Figure. By viewing Fig. 2, it can be seen that certain components do not mount on either board. Specifically, R6 and C9 mount directly on the lugs of S4, while C15 is soldered across the outermost lugs of R17. **Note:** The border around PC1 is at a potential of −6 volts, while PC2's border is at ground potential. Bear this in mind and don't get confused. Be sure to include jumper (JU1) when wiring up the digital board.

When fabricating the keyboard, the use of computer-style keyswitches is recommended. They have a very light, smooth action and are extremely easy to key. We set it up so keyswitches with black tops can signal sharp notes and white topped keys can retrieve non-sharp notes. The notes of the scale in ascending order are: C♯, D, D♯, E, F, F♯, G, G♯, A, A♯, B, C. This is a cyclic pattern, so the 13th note is C♯ (with twice the frequency of the starting note).

In the prototype, keys are arranged in two ranks with the upper row running from C♯ to F♯ and the lower one from G to C. As an alternative to this arrangement, you might consider cannibalizing the keyboard from a toy piano. There are many options, but stay away from calculator keyboards. With few exceptions, these are too small for comfortable keying.



This parts overlay shows a circuit that is quite a bit crowded. It's bit more so than the other printed that is quite a bit crowded. It's a circuit board. Be careful when you wire up various jumpers and connectors. It's easy to get mixed up.



Unless you are an expert at making PC boards from scratch, we suggest that you order an etched set from Lectrographix Inc.

You will not find all the ICs required by this project in your local electronics shop or with some of the better known mailorder retailers. The 50240, 74C922 and 3080 are carried by Circuit Specialists (Box 3047, Scottsdale, AZ, 85257). The 74C150 is available from Digi-Key Corp. (Box 677, Thief River Falls, MN, 56701). All remaining ICs are common items; they can be easily purchased.

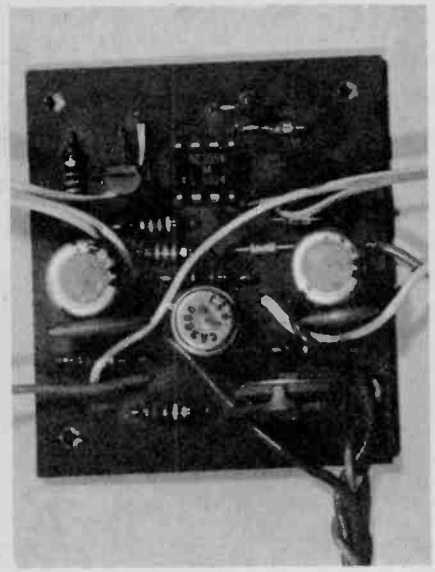
Solder At 25. As always, use resin-core solder and a 25 Watt or less soldering iron when soldering components. Polarized devices must be properly oriented. This applies specifically to all the semiconductors, C1, C7, C10, C11, and C12. Since most of the ICs are MOS devices, therefore **susceptible to damage** from static discharge, IC sockets are strongly recommended. Install the ICs in their sockets only **after** soldering is completed.

Check, Please. Once construction is finished, you're ready to check out the circuit's operation. Feed the output signal from J1 via shielded cable to the high-level input of your amplifier. (CAUTION: low-level amplifier inputs intended for use with magnetic phono cartridges will overload when driven by the Digital Clarinet.) Set S4 to the sustained mode. Adjust R8 for minimum attack time (minimum resistance) and set R11 for a long decay interval (maximum resistance). Trimmer potentiometers R1 and R13 should be set to the midpoints of their adjustment ranges. Turn on the power.

Tap each one of the twelve switches of the keyboard in their chromatic order and verify the presence of an output note, which should decay after key release. Each note should be lower-pitched than its successor and higher-pitched than its predecessor. If not, check for a keyboard wiring error. Next, press S3 and then strike a note on the keyboard. The pitch should be one octave higher. Press S2 and hit the same keyswitch as before. This time the pitch should be shifted two octaves higher. If not, check for wiring errors or faulty components in the circuitry associated with U5 and U6.

Assuming all has gone well to this point, switch S4 to the percussive mode and strike a note on the keyboard. The output note should rise and decay in volume even though your finger continues to press the keyswitch. If not, check the following for wiring errors or faulty components: R6, C9 and S4.

Natural Decay. With these preliminary tests completed, experiment with various settings of the attack and decay potentiometers. Natural musical sounds generally take more time to decay than to attack. On this instrument, however, you can reverse things for a very strange effect. When percussive keying is used, though, keep the attack time short for best results.



Shielded in an aluminum box, a PC board controls mode or sound of musical note.

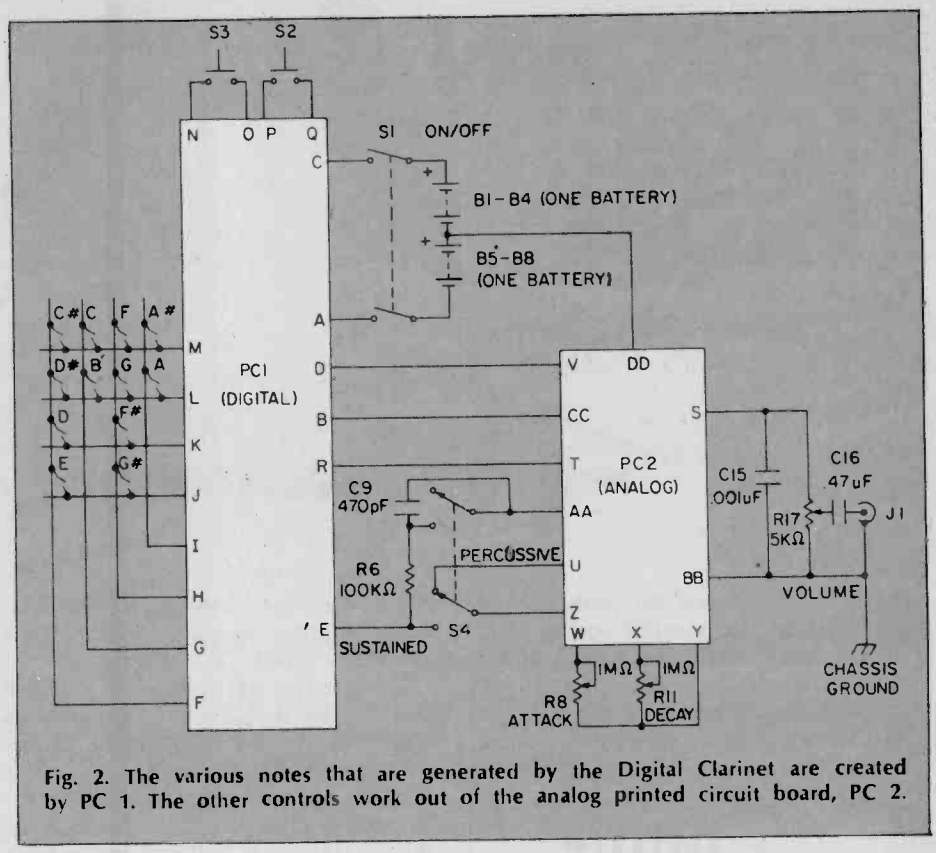


Fig. 2. The various notes that are generated by the Digital Clarinet are created by PC 1. The other controls work out of the analog printed circuit board, PC 2.

Listen carefully to your Digital Clarinet's output note as you key the instrument. If a slight thumping is apparent with very short attack or decay times, it can be cancelled out by adjusting R13.

Those of you who own frequency counters can tune the circuit by adjusting R1 to obtain exactly 250,030 Hz at U1's output (pin 13). Lacking a counter, you can tune the instrument by ear against a pitch reference such as a tuning fork. Remember that this instrument's range extends from 138.59 to 1046.5 Hz and any pitch reference within this three octave interval can be used for tuning purposes. Correct tuning will be found within the mid-portion of R1's range of adjustment.

Although the Digital Clarinet may not be appropriate for Carnegie Hall or your local church, it is great for messing around in your home. Plug it into your stereo and let your fingers fly away at the keys.

So go to it. Although you may not be able to play the clarinet as well as Benny Goodman, there's no reason why you can't swing away to an old Goodman tune with your Digital Clarinet. ■

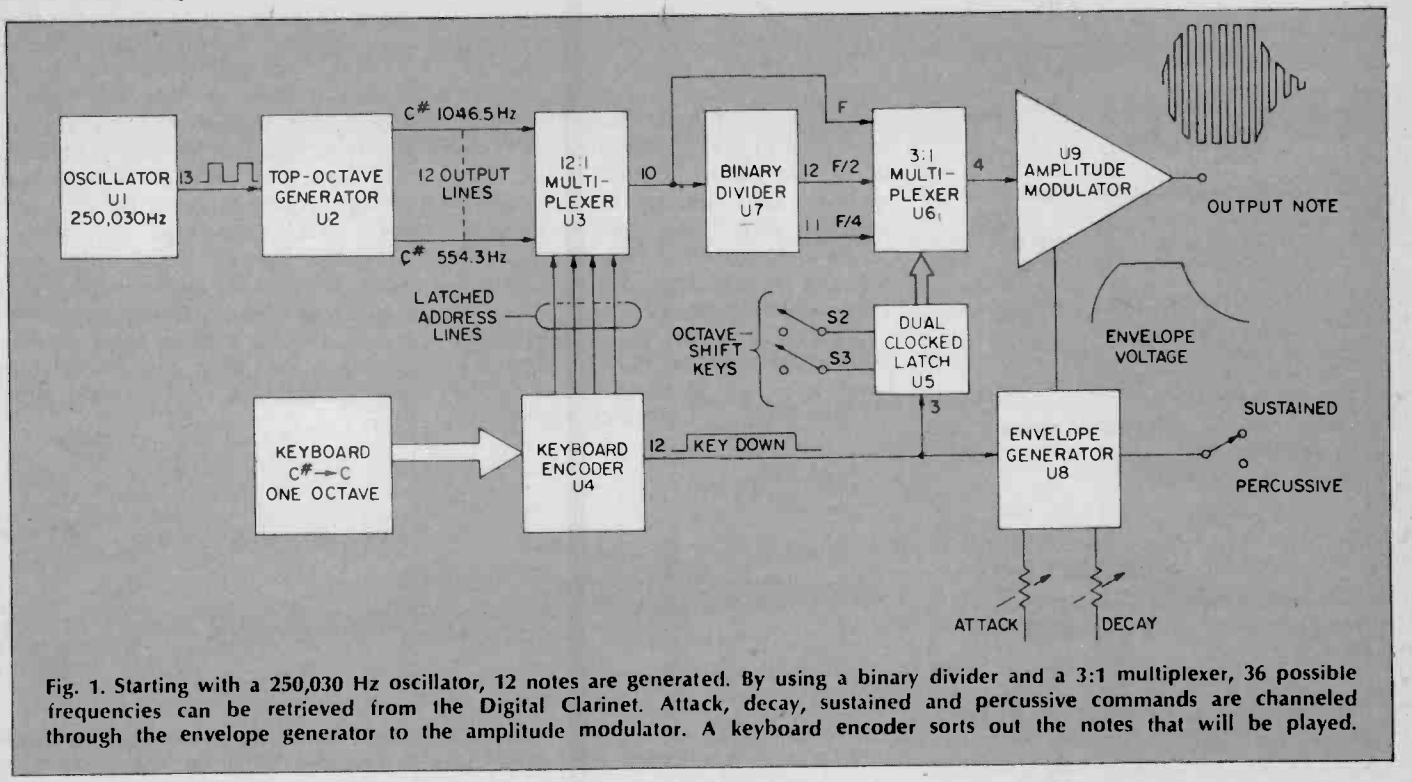
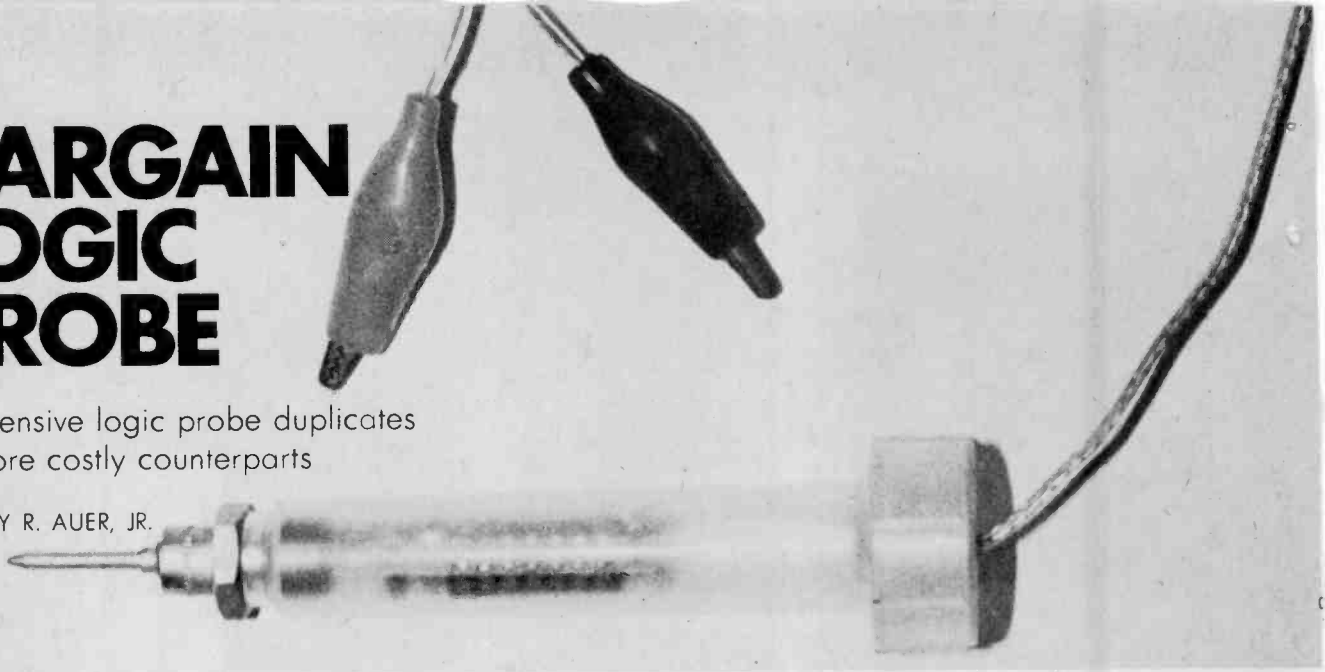


Fig. 1. Starting with a 250,030 Hz oscillator, 12 notes are generated. By using a binary divider and a 3:1 multiplexer, 36 possible frequencies can be retrieved from the Digital Clarinet. Attack, decay, sustained and percussive commands are channeled through the envelope generator to the amplitude modulator. A keyboard encoder sorts out the notes that will be played.

BARGAIN LOGIC PROBE

Inexpensive logic probe duplicates its more costly counterparts

BY ROY R. AUER, JR.



WHEN WE ARE DEALING with varying voltages, that is called analog data. In the digital world we do not find a variable signal. It is either on or off, just as a switch would be either on or off. Another way of saying this is high or low, or 1 or 0. Each high or low bit is put together to make up a basic character or Byte. Sometimes these Bytes are called words.

If we have 1001, then we can call that a 4 bit Byte. That is the smallest Byte ever to be encountered in the computer world. It can be used where the data accuracy is not critical and the amount of data is small. To illustrate this, if 1001 were sent and interference generated a pulse at the moment of the third bit, then we have been left with false data of 1011. Its meaning would be completely different. To increase accuracy and handle more data, we could go to 8 bit Bytes. Such as 10101010. A logic probe allows us to look at a particular point in the circuit to determine if a low (0) or high (1) is present.

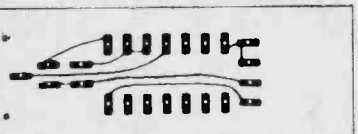
For most of our electronic experiments, we don't need expensive logic probes costing upwards of $40. Here is a cheap unit which can signal high level (1), low level (0), and oscillation. No pulse detection feature was included thus keeping the size small and the price low, around $2. The probe is designed for TTL signal levels and can be used for 5 volt CMOS circuits although loading may occur.

Theory of operation: Bargain Logic Probe uses only one IC, a 74L04 hex inverter shown in the schematic. The input to inverter A normally floats high, making its output low so as to light L1. The output of inverter B is high so L2 is off. If you now make the input of inverter A zero volts, L1 will turn off and L2 will illuminate. When oscillation is present at the input, both L1 and L2 will light at some intermediate brightness depending on the duty cycle of the signal being observed.

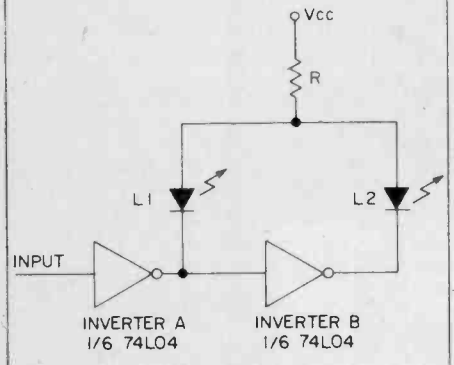
Using a 74L04 is important, the "L" series only requires the driving signal to sink 180 μA max, much below the 7400 series 1.6 mA max or even the 74LS00 series 400 μA requirement.

Construction: A full scale PC board layout is shown in addition to the parts layout on the component side. I slid the entire PC board inside a used syringe cover (available at hospitals for free), and attached a readily available test probe tip. Using different color L.E.D.s to signal high or low will help to quickly distinguish the signal level. Power is supplied by the circuit under test, and runs around 10 mA. Note, voltage requirements for the "L" series are 5 ±.25 V nominal.

So far, Bargain Logic Probe works great. It fits in my pocket and gives me a quick handle on circuit performance. It can also be used to show oscillator output in low power transmitter stages, SW converters & receiver local oscillators. ■

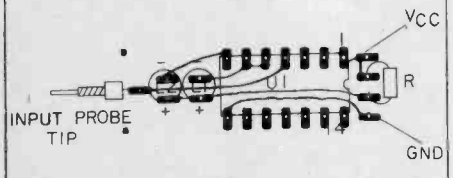


Here's the extra-small printed circuit board template for Bargain Logic Probe.

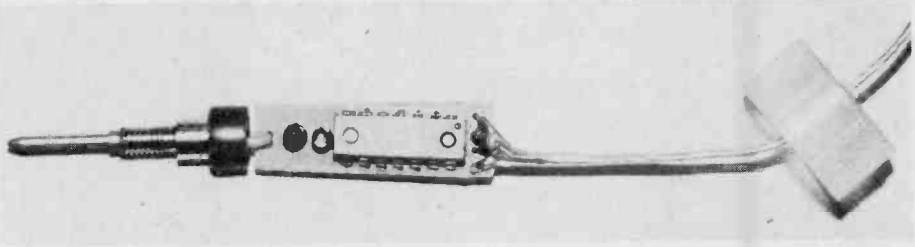


PARTS LIST

L1—light emitting diode, red
L2—light emitting diode, yellow
R—1,000 ohm, ¼-watt resistor, 5%
U1—74L04 hex inverter
Misc.—probe tip, syringe cover, pc board, alligator clips, wire.



This will give you a good idea of parts layout on PC board. There are few parts.



This photo of the Bargain Logic Probe will give you some idea of the simplicity of the unit. It's small, but there aren't very many components. When done, just cap it up.

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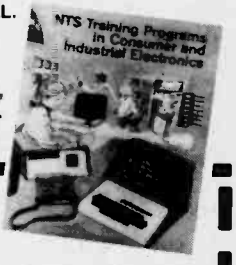

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IT'S SIMPLY BASIC

Organize Your Life With This Program

BY LARRY FRIEDMAN

BY POPULAR REQUEST, we bring you a calendar planning program written in Heath H-8 Disk BASIC. *The Organizer,* a data manipulative program capable of handling unlimited amounts of entries and files, is designed to keep track of events by date, month or category heading. However, this calendar program has a "twist"—a new command which allows the user to selectively print data using a VMO (Vector Merge Option). The command SERIES lets the user print data based on MONTH and HEADING. It is possible to print all events occurring in the same month with the same topic heading.

The program is constructed in BLOCK fashion. Sections are arranged by the thousand. For example, lines concerning file searches by DATE can be found in lines 3000-3260. This is SECTION 3 of the main program. To find out what section any part of the program is located in, see line 210. The first command, NEW FILE, is located at line 1000, and each additional command starts at an even thousand.

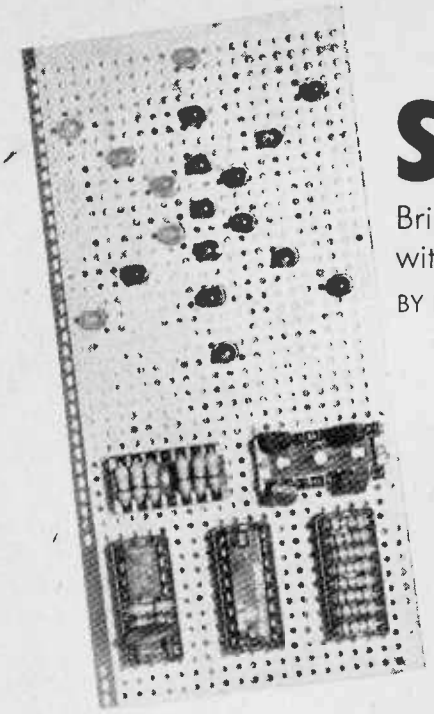
A new function used in this program is the LOGICAL AND statement. An example of this can be found at line 3060. AND is a logical statement which determines if all members of a set (in this example, A = M, B = D, and C = Y) are "TRUE." In line 3060, the computer will only advance to line 3100 if A = M, B = D, and C = Y. Examples of other logical operators are NOT and OR.

The Organizer uses the Heath function for the end-of-file test, CIN(file#). Other computers may use statements such as EOF(File #) or a slash-bar after the input statement (i.e. 1000 INPUT A,B,C/1400 tells the computer to advance to line 1400 when the file has been completely read) instead of CIN(File #).

Although the program contains many lines, the data table is very small, so the program should be able to run on most systems. Necessary modifications for use on other systems are minimal, and these mostly concern statements using Heath Disk BASIC. ■

```
LISTING OF "THE ORGANIZER" BY LARRY FRIEDMAN


00100 REM *
00110 REM *              "THE ORGANIZER"
00120 REM *             BY LARRY FRIEDMAN
00130 REM *    FOR SCIENCE AND ELECTRONICS MAGAZINE
00150 REM *    FOR HEATHKIT H-8 WITH HDOS VER. 1.5
00160 REM *    EXTENDED BENTON HARBOR BASIC VER. 11B.02.00
00170 REM *
00185 DIM X$(7)
00210 DATA NEW FILE,OLD FILE,DATE,HEADING,MONTH,SERIES,END
00220 FOR I=1 TO 7
00230 READ X$(I)
00240 NEXT I
00250 INPUT "COMMAND    (TYPE 'LIST' FOR INSTRUCTIONS) =>";C$
00260 IF C$="LIST" THEN 400
00270 FOR I=1 TO 7
00280 IF X$(I)=C$ THEN 600
00290 NEXT I
00300 PRINT CHR$(34);C$;CHR$(34);" IS NOT A VALID COMMAND"
00310 GOTO 250
00400 PRINT
00410 PRINT "COMMAND TABLE"
00420 PRINT "-------------"
00430 PRINT "NEW FILE          USED TO ENTER DATA FILES"
00440 PRINT "OLD FILE          USED TO APPEND OLD FILES"
00450 PRINT "DATE              FILE SEARCH BY DATE"
00460 PRINT "MONTH             FILE SEARCH BY MONTH"
00470 PRINT "HEADING           FILE SEARCH BY HEADING"
00480 PRINT "SERIES            FILE SEARCH BY HEADING AND MONTH"
00490 PRINT "END               EXIT PROGRAM AND CLOSE FILES."
00500 PRINT
00510 GOTO 250
00600 ON I GOTO 1000,2000,3000,4000,5000,6000,7000
01000 OPEN "MLIST.DAT" FOR WRITE AS FILE #1
01010 PRINT "NEW FILE MODE"
01015 IF V2$<>"OFM" THEN 1020
01016 V2$=""
01020 PRINT "ENTER INFORMATION AS FOLLOWS:"
01030 PRINT "<LINE 1> DATE -IN FORM MM,DD,YY- (I.E.- 11,15,80)"
01040 PRINT "<LINE 2> GENERAL INFORMTION"
01050 PRINT "<LINE 3> SUBJECT HEADING (I.E. 'REPORTS DUE', ETC.)"
01060 PRINT
01080 PRINT
01100 PRINT "###"
01110 INPUT "<LINE 1> ";A,B,C
01120 LINE INPUT "<LINE 2> ";C$
01125 LINE INPUT "<LINE 3> "$D$
01130 PRINT
01140 INPUT "TYPE C<ONTINUE>, Q<UIT>, OR R<EDO> =>"$V$
01150 IF V$="C" THEN 1200
01160 IF V$="Q" THEN 1300
01170 IF V$<>"R" THEN 1140
01180 PRINT "O.K.  RETYPE ENTRY."
01190 GOTO 1110
01200 PRINT #1,A;",";B;",";C;",";C$;",";D$;","
01210 GOTO 1100
01300 PRINT #1,A$",";B;",";C;",";C$;",";D$
01310 PRINT
01315 CLOSE #1
01316 IF V1$="OFM" THEN 2500
01320 GOTO 250
02000 PRINT "OLD FILE MODE"
02010 V1$="OFM"
02020 V2$="OFM"
02030 PRINT
02040 OPEN "MLIST.DAT" FOR READ AS FILE #1
02050 OPEN "DLIST.DAT" FOR WRITE AS FILE #2
02060 IF CIN(1)<1 THEN 2300
02070 INPUT #1,A,B,C,C$,D$
02080 PRINT #2,A;",";B;",";C;",";C$;",";D$
02090 GOTO 2060
02300 CLOSE #1
02310 CLOSE #2
02320 GOTO 1000
02500 OPEN "DLIST.DAT" FOR READ AS FILE #2
02510 OPEN "MLIST.DAT" FOR READ AS FILE #1
02520 OPEN "TLIST.DAT" FOR WRITE AS FILE #3
02530 IF CIN(1)<1 THEN 2600
02540 INPUT #1,A,B,C,C$,D$
02550 PRINT #3,A;",";B;",";C;",";C$;",";D$;","
02560 GOTO 2530
02600 INPUT #2,A,B,C,C$,D$
02610 IF CIN(2)<1 THEN 2700
02620 PRINT #3,A;",";B;",";C;",";C$;",";D$;","
02630 GOTO 2600
02700 PRINT #3,A;",";B;",";C;",";C$;",";D$
02710 CLOSE #1
02720 CLOSE #2
02730 CLOSE #3
02740 OPEN "MLIST.DAT" FOR WRITE AS FILE #1
02750 OPEN "TLIST.DAT" FOR READ AS FILE #2
02760 INPUT #2,A,B,C,C$,D$
02770 IF CIN(2)<1 THEN 2800
02780 PRINT #1,A;",";B;",";C;",";C$;",";D$;","
02790 GOTO 2760
02800 PRINT #1,A;",";B;",";C;",";C$;",";D$
02810 PRINT
02820 CLOSE #1
02830 CLOSE #2
02840 GOTO 250
03000 PRINT "DATE MODE"
03010 PRINT
03020 INPUT "ENTER DATE AS MM,DD,YY  =>";M,D,Y
03030 OPEN "MLIST.DAT" FOR READ AS FILE #1
03040 IF CIN(1)<1 THEN 3200
03050 INPUT #1,A,B,C,C$,D$
03060 IF A=M AND B=D AND C=Y THEN 3100
03070 GOTO 3040
03100 Q=1
03110 PRINT
03120 PRINT A;"/";B;"/";C
03130 PRINT C$
03140 PRINT D$
03150 PRINT
03160 GOTO 3040
03200 IF Q<>0 THEN 3250
03210 PRINT "NO LISTINGS FOR THAT DATE."
```

(Continued on page 84)



Star-nament

Brighten up your holiday season with this simple project

BY ROY R. AUER, JR.

THE HOLIDAY SEASON is upon us, with all its tinsel and colored lights. In this spirit, here is a quick project that is sure to dazzle your family and friends and add life to your holiday decorations and trappings.

It's a tree ornament, but one with a big difference; it's all electronic and it gives the illusion of an exploding and imploding six point star.

A block diagram of the circuit is shown in Fig. 1, consisting of three parts: oscillator, counter, and display. The oscillator is a LM 555 integrated circuit set up as a multivibrator.

The pulses from this oscillator are sent to a decade up-counter chip, the CMOS 4017, whose ten output lines go high in sequence. These output lines are directed to four encoding and driving transistors that illuminate the display LEDs in the desired sequence.

For the circuit, the values of R1, R2, and C1 may be changed if it is desired to run Star-nament at a different rate (see schematic). Transistors Q1-Q4 can be any high beta NPN type with a 50mA collector capacity.

Only $10! I wire-wrapped my project, using a perfboard and IC sockets. The entire job took two hours. Total cost ran about $10 and could be substantially reduced if you have a few parts lying about.

Layout is not critical except for the positions of the LEDs. Variations from the suggested pattern may or may not be visually pleasing, i.e. with the positive LED lead being connected to the positive supply through the current limiting resistor. Failure to properly orient the LED will cause it not to light.

The power supply for the ornament can range from 5-12 VDC with six to nine the best. A 9-volt rectangular cell will run the project for about five to six hours, but lantern batteries should operate the display for a much longer time, since current drain is 40 mA at 6 volts for Star-nament.

To operate, connect the power supply to Star-nament and it will begin to repetitively expand and contract. If you leave some space at the bottom or top of the perfboard, a standard Christmas tree ornament hook can be used to suspend the ornament from a branch.

If that doesn't work, try a paper clip bent to the appropriate shape. An alternative would be to mount the project at the very top of the tree instead of the usual metalic star or pinnacle-type ornament. Also different color LEDs can be used to give your Star-nament a flashier look. ■

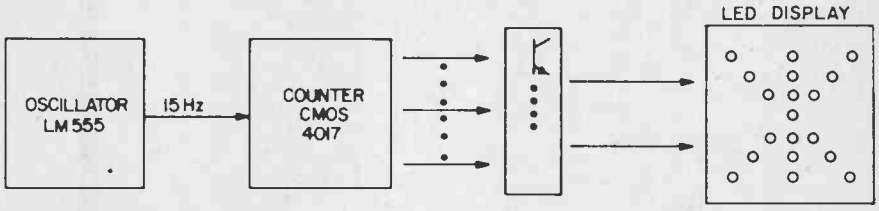
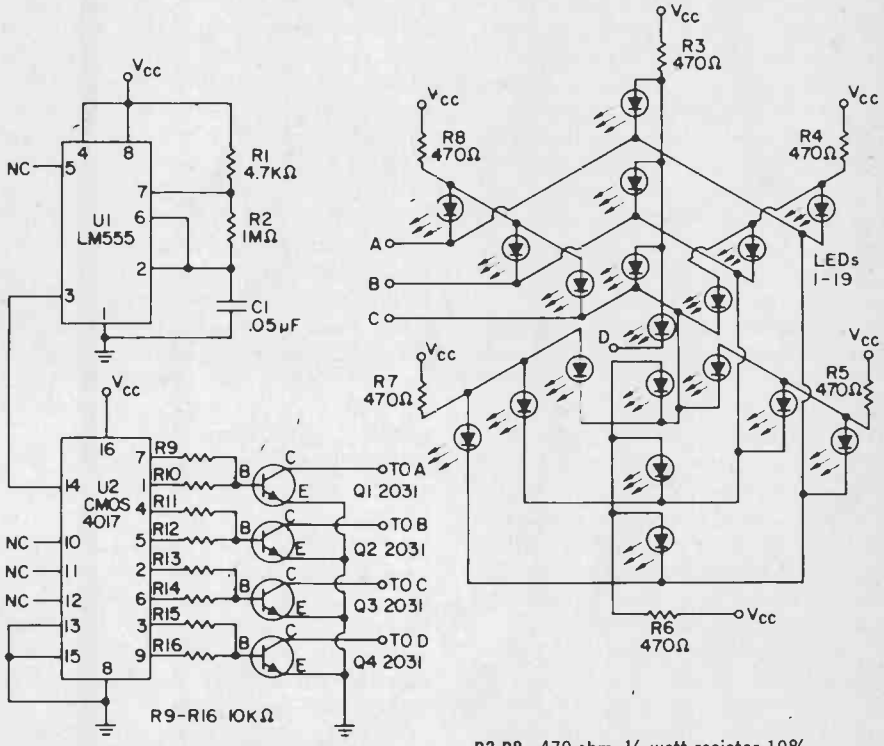


Fig. 1. Only two integrated circuits are used to create this colorful flashing display. A counter, an oscillator and 19 LEDs are all that are really needed. An inexpensive project, Star-nment adds life to any holiday. This project can be constructed by using either wire winding techniques or by purchasing the PC board from Niccum Electronics.



PARTS LIST FOR STAR-NAMENT

C1—.05-uF 15 V capacitor
LED1-LED19—Red light emitting diode
Q1-Q4—Radio Shack 2031 NPN-transistor
R1—4,700-ohm, ¼-watt resistor, 10%
R2—1,000,000-ohm ¼-watt resistor, 10%
R3-R8—470-ohm, ¼-watt resistor 10%
R9-R16—10,000-ohm, ¼-watt resistor, 10%
U1—LM 555 timer integrated circuit
U2—CMOS 4017 decade up counter integrated circuit
Misc.—Sockets, perfboard, wire, battery, battery clip, hardware, etc.

Note: A complete parts kit including a pre-etched PC board and all components is available from Niccum Electronics, Rte. 3, Box 271B, Stroud, OK 74079. Price for the complete kit is $12.50; a pre-etched PC board is only $4.00. Please include $1.00 for postage and handling.

Speaker Of The Future

Innovative design offers high efficiency and great sound at low cost.

BY KEITH BROWNSTONE

AN INNOVATIVE CONCEPT in loudspeaker design is changing audiophiles' minds about what a stereo speaker should be. Poly-Planar speakers, from Electronic Research Associates, Inc. (ERA), combine highly efficient sound reproduction qualities with extreme ruggedness, space-saving design, and versatility of operation. The engineers at ERA have virtually reinvented the loudspeaker to create a line of patented speakers that are slim and lightweight, and sound great.

The Speaker Reinvented. Conventional loudspeakers use a moving cone to reproduce sound. Low frequency sounds are produced by increasing the size of the cone and the magnet required to drive it; all of which makes for a bulky and heavy arrangement. In the Poly-Planar speakers, a flat surface is substituted for the cone; thus permitting an increase in sound producing surface without having to resort to the bulk and depth of conventional speakers.

This design means, for example, that a Poly-Planar 12-inch woofer can be 1 1/16 inches thick and weigh 19 ounces —and give much the same performance as a conventional speaker eight inches thick and weighing 10 pounds! And this is a high-fidelity speaker with a 40 Hz to 20 kHz response range!

Loudspeaker design remained relatively static for the 50 years following the development of the dynamic loudspeaker in the mid-1920's. Materials and the quality of sound reproduction improved, but the basic principles remained the same: a loosely supported rigid diaphragm, or "piston," produces sound by its mechanical motion. This piston was traditionally a paper cone whose diameter varied with the frequency it was expected to reproduce.

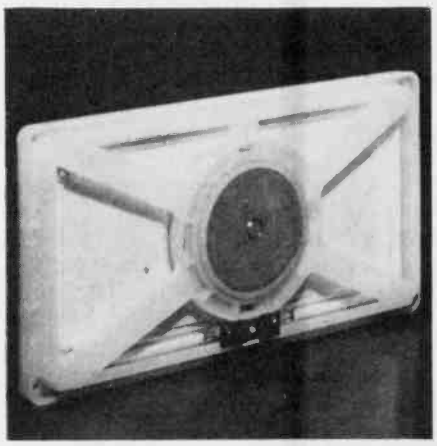
There are, unfortunately, a number of drawbacks to this design. Molded paper cones are unstable; they can flex and distort sound. And transverse distortion can occur through the cone material itself. Finally, the applications of speakers with paper cones are limited because paper will deteriorate under conditions of moisture, extremes of temperature or vibration.

Poly-Planar Evolution. In the mid-1960's, audio experimenters set about finding ways of circumventing the shortcomings of conventional dynamic loudspeakers. They substituted a flat panel made of a cellular material like polystyrene for the paper cone and were able to use a smaller magnet, thereby substantially reducing speaker weight and depth.

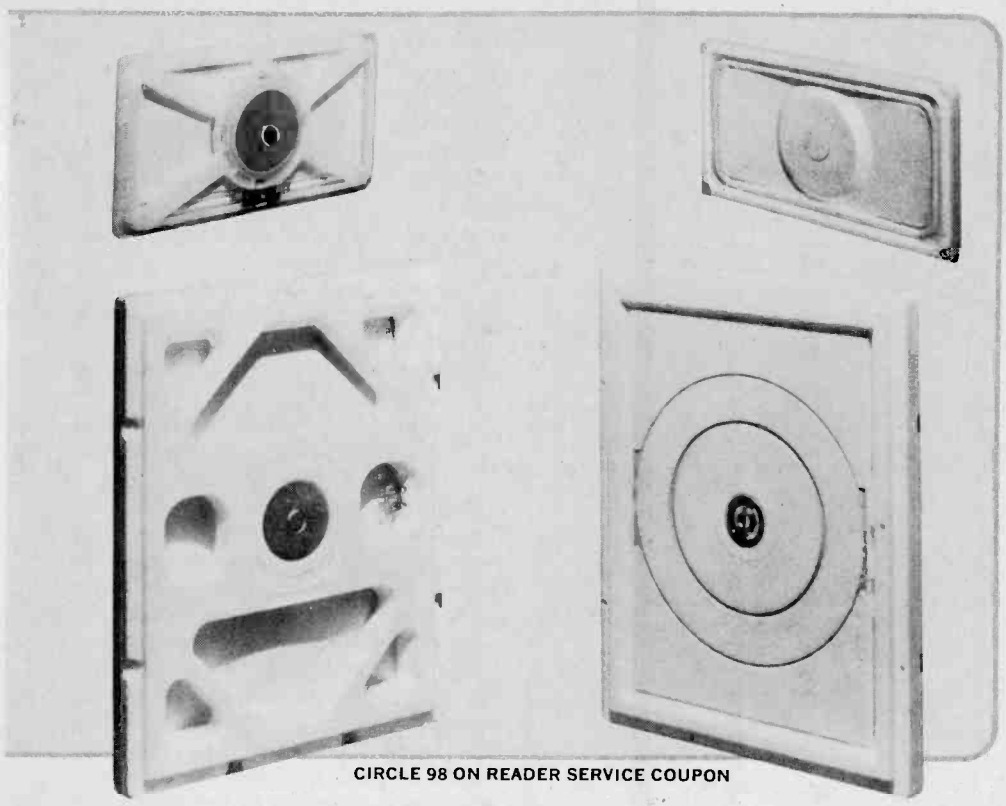
Several companies manufactured these slim "wafer" or acoustic panel-type speakers during the 1970's. Unfortunately, these early models, innovative though they were, lacked the sound quality and tonal response of conventional speakers. One major American speaker company lost its corporate shirt on acoustic panel speakers.

The engineers at ERA studied these pioneering acoustic panel speakers, improved on them and came out with a patented line of speakers having sound reproduction qualities that challenge conventional cone speakers. Poly-Planar speakers use a single magnetic driver mounted in the center of a polystyrene panel. This serves to produce low, mid-range and high tones. Channels inscribed in the diaphragm of the speakers act as the "pistons," projecting the sound according to its frequency. At low frequencies, the entire panel moves; as the frequency rises, increasingly smaller portions of the panel vibrate in response.

Mechanical Crossover. An acoustical-mechanical series of crossover networks



These photos show the slim, compact lines of the Poly-Planar speakers for car stereo.



CIRCLE 98 ON READER SERVICE COUPON

duplicates the effects of conventional multi-speaker configurations. The actual vibrating structure is also made of a similar polystyrene material, so as to form a perfect acoustical match with the frame.

One of the greatest advantages offered by this configuration is a markedly increased acoustical output for the weight of magnet used. Thus, ½ watt of power into a Poly-Planar speaker can produce a 100 dB Sound Pressure Level (SPL). In most applications, the need for a separate power booster is entirely eliminated.

Since the Poly-Planar relies on the panel configuration rather than on electrical crossover networks to distribute the sound, phase distortion is largely eliminated. This use of mechanical crossover networks integral with the speaker itself ensures clear, crisp sound without distortion.

Poly-Planar construction also eliminates speaker baffles; components of conventional speakers that hamper sound dispersion. The sound from a Poly-Planar is directed straight forward; the entire front surface of the speaker serves as a radiating area.

Ruggedness and Tone Quality. While the Poly-Planar speakers compare favorably to conventional speakers in nearly every area, two features of their design put them in a class by themselves: versatility and ruggedness. The small, slim dimensions of the Poly-Planars, and their ability to be used in applications where no conventional speaker could live, make the Poly-Planar the only choice in many circumstances. In outdoor applications where tonal quality is of paramount importance, the Poly-Planar has no peer. These rugged, totally weatherproof speakers are used in the Rose Garden of the White House, and the National Park Service uses them in outdoor displays.

One of the most unusual environments in which Poly-Planars are proving themselves is in the Paris sewer system. There they are used to broadcast the lectures of guides taking tourists through this unique subterranean landmark.

Poly-Planar speakers excel in other, more mundane applications where their ruggedness, size and tonal qualities combine to make them the first—indeed, often the only—choice for the job. For vans and off-the-road vehicles, Poly-Planars are practically the only speakers that can withstand the abuse of an automotive environment and still function perfectly. They enjoy such a high reputation for reliability that Cessna and Beech, two well-known aircraft manufacturers, have installed Poly-Planars as cockpit speakers for intercom and communications receiver functions.

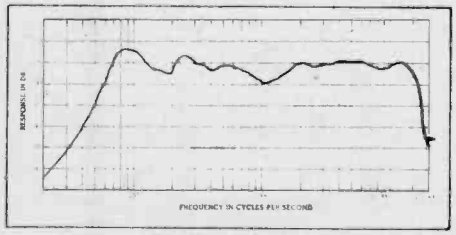
Poly-Planars Ahoy. ERA Acoustics has recently expanded its speaker line to include a number of Poly-Planars designed specifically for marine use. These speakers are entirely weatherproof and are designed to withstand the very worst that a marine environment can offer. A number of yacht builders such as Chris-Craft, Hatteras Yachts and Pacemaker Yachts have selected Poly-Planars for hi-fi, intercom and auxiliary communications speaker installations. A further testimony to the Poly-Planars' serviceability comes from the U.S. Navy, which uses the speakers in crews' entertainment applications aboard warships.

In household installations, Poly-Planar speakers lend themselves to a great variety of architectural schemes. It is possible to mount the speakers in walls or ceilings, as they require only an inch or two of depth. There are even speaker configurations that are designed for use in conjunction with mirrors or other hanging wall decorations.

For excellent sound quality, rugged, weatherproof construction and adaptability to nearly every speaker application, Poly-Planars are unsurpassed.

For additional information on the Poly-Planar speaker line, write Electronic Research Associates, Inc., 311 East Park St., Moonachie, NJ 07004, or circle No. 98 on the Reader Service Coupon. ■

Rigorous testing on the bench and in anechoic chambers like this one ensures quality.



This diagram shows frequency response of the poly-Planars from 40 Hz to 20 kHz.

Calculator Power Supply

Build this handy, multi-voltage power source for your calculator

BY MIKE IHM

WHEN WAS THE LAST TIME the batteries in your calculator went dead? Perhaps the night before an important school assignment was due. Or when you were balancing your bank account and found out that you would have to do all of the calculations on paper-again! Such heartbreaking events can be frustrating, and take up much of your valuable time.

Of course, we can do arithmetic manually or in our heads, but it is faster and easier to use a calculator. As one can see, if the batteries are dead and no external power supply is available, the calculator is of no value. This is why the inexpensive power supply described here will be useful.

Batteries are not cheap. It costs roughly one dollar for two AA batteries, or for one 9 volt transistor battery. Supplying approximately 0.3 watts of power, a battery will last for about five hours. This amounts to about one third of a cent per minute to operate. What about cost per year? Here is an example: Say that someone uses his calculator five minutes per day on the average for an entire year. Calculating the battery cost over a year, we discover that we have spent over $6 for batteries. Six dollars could buy another calculator or pay for part (or all) of the power supply. The cost of batteries may seem trivial, but by eliminating the need for batteries, money is saved.

The power supply described in this article, will save money, and it can be used to power other devices. Cost of the power supply will run from five to fifteen dollars depending on cost and availability of parts. In fact, the calculator supply could be made completely from parts found in your junk box!

Ratings. The design of the power supply is flexible. You can change the design to fit your needs more fully; for example, different voltage outputs, current, regulation, etc. The prototype has the following ratings:

1. 3 volt regulated output
2. 9 volt regulated output (via Jumper 1)
3. Maximum current output of 150mA
4. Uses a transformer, from an adaptor, that has this approximate rating: 12 volt @ 200mA

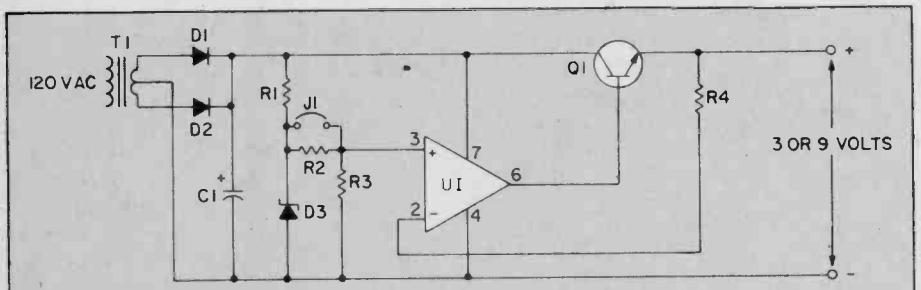
As mentioned before, you can alter these ratings to fit your needs. The phototype will regulate to at least ten percent or better. Its zener diode has a zener break down of about 9 volts.

Before building your power supply, define what it's going to be used for; i.e., the calculators voltage and ampere ratings. Another good question; is the transformer available, at reasonable cost. Once these questions are answered, it is time to proceed to the design and construction of your power supply.

Theory. Basically this power supply is a simple voltage regulator with a filtered and rectified input of about twelve volts. The block diagram in Fig. 1, gives a clear picture of how the circuits interact.

The transformer that will be used, should have a voltage rating of at least three to four volts higher than the regulated output voltage. The voltage output of the transformer is dependent on the load current. If the transformer has a high output current rating, the output voltage will be higher. Remember, ripple may play a part in how you choose your transformer. The current rating of the transformer should be at least fif-

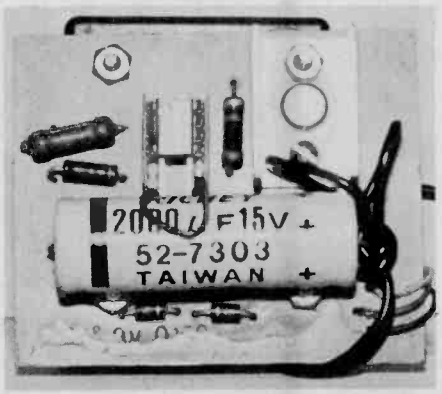
(Continued on page 80)



PARTS LIST FOR CALCULATOR POWER SUPPLY

C1—2,000uF capacitor
D1, D2—1N4001 diode rectifiers
D3—9-volt zener diode
Q1—NPN 2N1893 or similar
R1—200-ohm resistor
R2—43,000-ohm resistor
R3—25,000-ohm resistor
R4—10,000-ohm resistor
T1—12-volt center tapped transformer, 200mA
U1—741 Op Amp IC

Misc.—22-gauge wire, adaptor case, IC socket, 4-40 machine screws and nuts, heat sink and P.C. board.

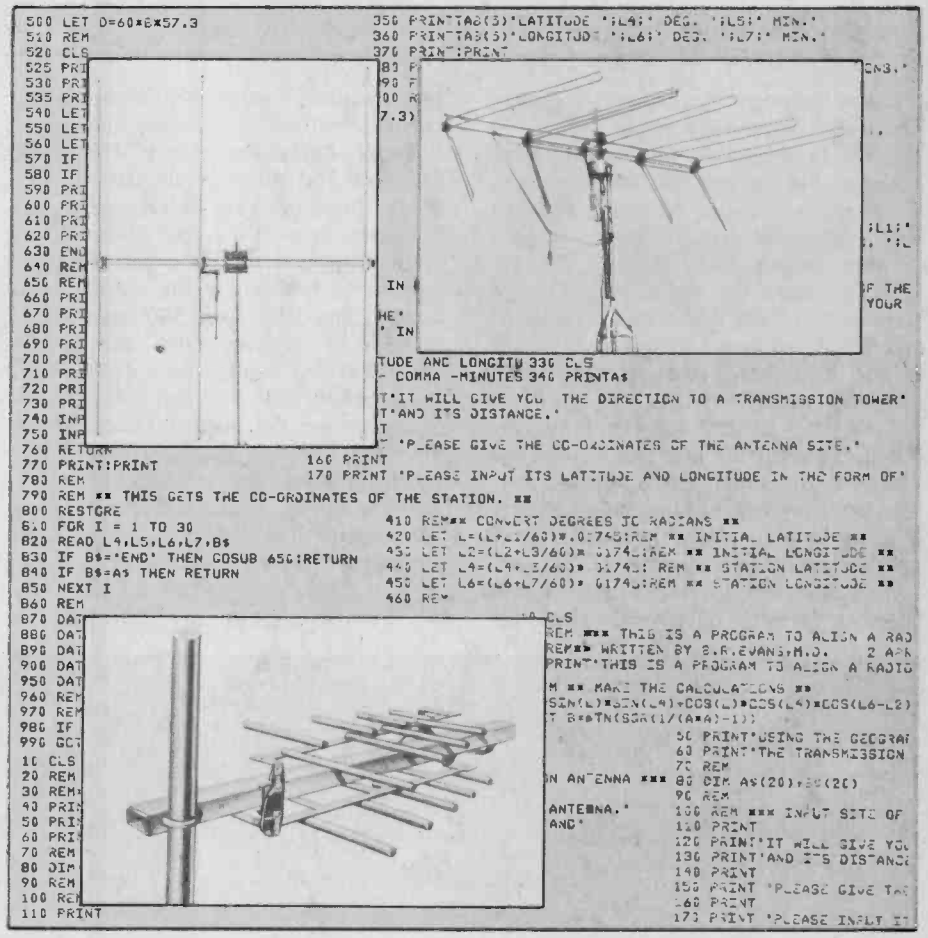


The Calculator Power Supply is designed so that the circuitry can be mounted flexibly.

ANTENNA AIMING PROGRAM

Use your computer to pinpoint stations with this basic program.

BY BRUCE R. EVANS, M.D.



THE MOST OBVIOUS FEATURE of a computer is its ability to function as a highly sophisticated programmable calculator. Naturally, there are many of the latter on the market but none are as versatile as a microcomputer or as easy to program—i.e., there is no BASIC for calculators.

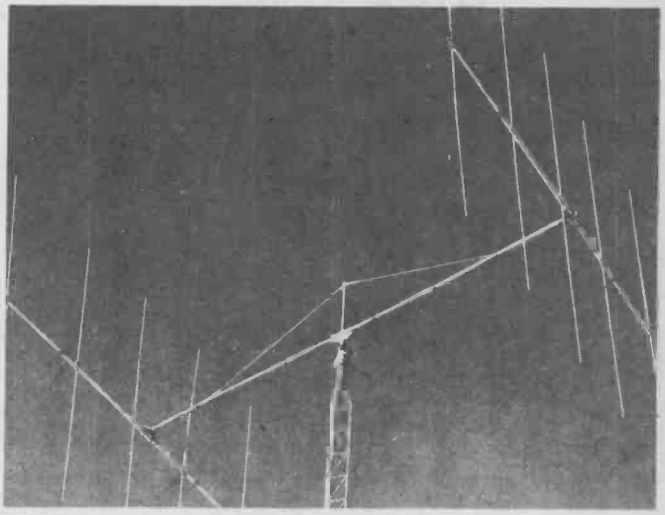
One such use for your microcomputer is calculating direction and distance. This problem arises when one attempts to aim an antenna, whether for a TV, an FM receiver or an SW antenna. Radio Shack's Level II BASIC has enough trigonometric functions to allow you to use your computer to do all the math necessary to make this alignment.

Inputting The Coordinates. The program asks you to input the coordinates of the site of your receiving antenna. I could have programmed these as a constant, but this way allows you an unlimited number of sites. The coordinates are repeated back to you for verification and then you are asked the name of the station at which you are aiming your antenna. This can be frequency numbers, call letters or, as in my case, the name of the airport at which the transmission tower is located.

If the name of the transmitter is not included in the DATA lines, you are asked to input the coordinates. Again, the figures are repeated on the screen for verification. Then the computer makes the calculations and gives you the distance to the transmitter and the direction in which to aim your receiving antenna.

Formula Guidelines. There are two limitations inherent in the formula used, and in Radio Shack's math routines. The first is that you can not enter two points that are on the same meridian of longitude—i.e. within three minutes of each other. The second limitation is that if you calculate the directions to and from the transmitter, the angles are not exactly reciprocals. This seems to be a function of the math subroutines in this version of BASIC, since the same calculations using another version don't have this problem. However, the difference is only one or two degrees, maximum. I am sure that no one can aim an antenna that precisely.

Before running the program, fill the DATA statements with the names and coordinates of the transmission antennas in your vicinity. You must enter these in the order of degrees of latitude, minutes of latitude, degrees of longitude, minutes of longitude and the name of the station in quotation marks. You may enter as many sites as you want; just remember the correct order.



Large beam antennas like this one must be aimed precisely to get the best results from them. A rotor helps tuning accuracy, and the program aids, too.

commas between the data and quotation marks around the name.

Seconds of latitude and longitude are not used, but the program will run using the common practice of giving minutes with a decimal fraction such as 44.5 minutes instead of 44 minutes, 30 seconds. I wrote the program to locate stations in North and Central America and the Caribbean. Coordinates south of the Equator or east of the Prime Meridian will give errors.

Lines 150 to 250 let you input the coordinates of the antenna site. Line 310 lets you enter the name of your "target" transmitter. Line 390 is merely a delay loop to allow the data to stay on the screen long enough to be verified. Lines 410 to 450 are necessary in most versions of BASIC, since the trig functions require that the angles be given in radians rather than degrees.

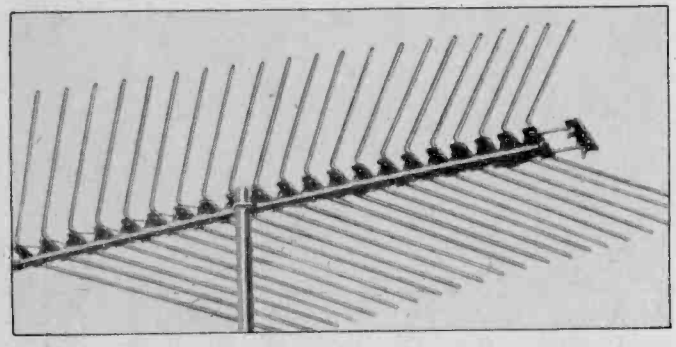
Super Calculator. Lines 489, 490, 540 and 550 do the calculations. Try doing these on your hand calculator! However, be very careful when keying in the program that you get the right number of brackets in the correct positions. Lines 500 and 560 return the answer to degrees and should be omitted if you omitted lines 410 to 450.

Lines 570, 580, 980 and 990 are necessary to get the correct quadrants of direction. The last two are rather awkwardly placed but I couldn't find a neater solution. Perhaps you can! Lines 530 and 610 use Radio Shack's unique method of formatting print. If you are using another version of BASIC, you will have to change this. Lines 670 to 760 are similar to lines 150 to 250 but get the coordinates of an unlisted station. Subroutine 790 to 850 searches the DATA statements for the station.

It is much better programming practice to exit from lines 830 or 840 with an EXIT command, since this closes the loop off; but Level II BASIC lacks this command for some reason. I have mentioned the DATA statements and their format earlier. I want to point out the 0,0,0,0, END in line 950.

I have included many REM statements to help you understand the program and to aid you in making any modifications. Most of these can be removed if you need to save memory space. However, don't remove 650 or 790 as both are the destinations of earlier GOSUB instructions. ■

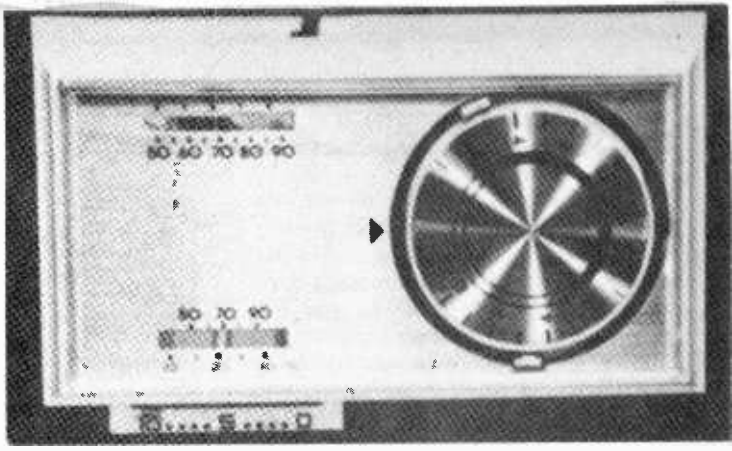
```
10 CLS
20 REM *** THIS IS A PROGRAM TO ALIGN A RADIO OR TELEVISION ANTENNA ***
30 REM** WRITTEN BY B.R.EVANS,M.D.    2 APRIL 1980 **
40 PRINT'THIS IS A PROGRAM TO ALIGN A RADIO OR TELEVISION ANTENNA.'
50 PRINT'USING THE GEOGRAPHIC CO-ORDIATES OF THRE ANTENNA AND'
60 PRINT'THE TRANSMISSION TOWER.'
70 REM
80 DIM A$(20),B$(20)
90 REM
100 REM *** INPUT SITE OF ANTENNA.
110 PRINT
120 PRINT'IT WILL GIVE YOU  THE DIRECTION TO A TRANSMISSION TOWER'
130 PRINT'AND ITS DISTANCE.'
140 PRINT
150 PRINT 'PLEASE GIVE THE CO-ORDINATES OF THE ANTENNA SITE.'
160 PRINT
170 PRINT 'PLEASE INPUT ITS LATITUDE AND LONGITUDE IN THE FORM OF'
180 PRINT''DEGREES - COMMA - MINUTES.''
190 PRINTTAB(15)'(EG. 12,34)'
200 PRINT
210 INPUT 'LATITUDE  > ';L,L1
220 INPUT 'LONGITUDE > ';L2,L3
230 CLS
240 PRINTTAB(5)'LATITUDE ';L;' DEG. ';L1;' MIN.'
250 PRINTTAB(5) 'LONGITUDE ';L2;' DEG. ';L3;' MIN.'
260 PRINT:PRINT
270 REM
280 PRINT'NOW PLEASE ENTER THE NAME OF THE STATION'
290 PRINT'AT WHICH YOU WANT TO POINT YOUR ANTENNA.'
300 PRINT:PRINT
310 INPUT ' > ';A$
320 GOSUB 790
330 CLS
340 PRINTA$
350 PRINTTAB(5)'LATITUDE ';L4;' DEG. ';L5;' MIN.'
360 PRINTTAB(5)'LONGITUDE ';L6;' DEG. ';L7;' MIN.'
370 PRINT:PRINT
380 PRINTTAB(5)'PLEASE WAIT WHILE I MAKE THE CALCULATIONS.'
390 FOR I= 1 TO 1000:NEXT
400 REM

410 REM** CONVERT DEGREES TO RADIANS **
420 LET L=(L+L1/60)*.01745:REM ** INITIAL LATITUDE **
430 LET L2=(L2+L3/60)*.01745:REM ** INITIAL LONGITUDE **
440 LET L4=(L4+L5/60)*.01745: REM ** STATION LATITUDE **
450 LET L6=(L6+L7/60)*.01745:REM ** STATION LONGITUDE **
460 REM
470 REM ** MAKE THE CALCULATIONS **
480 A=SIN(L)*SIN(L4)+COS(L)*COS(L4)*COS(L6-L2)
490 LET B=ATN(SQR(1/(A*A)-1))
500 LET D=60*B*57.3
510 REM
520 CLS
525 PRINT'DISTANCE TO '$A$;' IS ';
530 PRINT USING '####.##';D;
535 PRINT 'NAUTICAL MILES.'
540 LET A1=(SIN(L4)-SIN(L)*COS((D/60)/57.3))/(SIN((D/60)/57.3)*COS(L))
550 LET C=ATN(SQR(1/(A1*A1)-1))
560 LET C1=C*57.3
570 IF L2<L6 THEN GOTO 980
580 IF L4<L THEN LET C1=180-C1
590 PRINT
600 PRINT 'AIM YOUR ANTENNA - - -';
610 PRINT USING '###.##';C1;
620 PRINT'  DEGREES.'
630 END
640 REM
650 REM ** INPUT DATA FOR A STATION NOT IN DATA **
660 PRINT:PRINT:PRINT
670 PRINT TAB(5) 'SORRY, I DON'T HAVE THE'
680 PRINT TAB(5) 'CO-ORDINATES OF '$A$;' IN MY DATA.'
690 PRINT:PRINT
700 PRINT TAB(5) 'PLEASE INPUT ITS LATITUDE AND LONGITUDE IN'
710 PRINT TAB(5) 'THE FORM OF 'DEGREES - COMMA -MINUTES.''
720 PRINT TAB(5) '(EG.12,34)'
730 PRINT:PRINT
740 INPUT 'LATITUDE > ';L4,L5
750 INPUT 'LONGITUDE > ';L6,L7
760 RETURN
770 PRINT:PRINT
780 REM
790 REM ** THIS GETS THE CO-ORDINATES OF THE STATION. **
800 RESTORE
810 FOR I = 1 TO 30
820 READ L4,L5,L6,L7,B$
830 IF B$='END' THEN GOSUB 650:RETURN
840 IF B$=A$ THEN RETURN
850 NEXT I
860 REM
870 DATA 43,53,78,51,'OSHAWA',44,22,79,42,'BARRIE'
880 DATA 45,53,78,51,'OTTAWA',44,07,77,34,'TRENTON'
890 DATA 45,21,80,03,'PARRY SOUND',42,58,81,15,'LONDON'
900 DATA 44,36,79,26,'ORILLIA',44,14,76,30,'KINGSTON'
950 DATA 0,0,0,0,'END'
960 REM
970 REM
980 IF L>L4 THEN LET C1=C1+180 ELSE LET C1=360-C1
990 GOTO 590
```



Log periodic antennas like this one from Jerrold are designed to pull in hard-to-get UHF stations from distances of up to 80 miles.

This close-up photo of the Alliance heavy-duty rotor shows the kind of mechanism necessary to keep antennas aimed properly, despite wind, weather.

MULTIPLE SET-BACK THERMOSTATS



Cool your heating bills with a set-back thermostat

BY HERB FRIEDMAN

IN TODAY'S WORLD of spiraling energy costs, any relief would be welcome. However, to many people, saving energy usually means driving less or puting on a sweater or two. But there is no reason why you should have to sacrifice anything.

There are many ways to save energy. They include: calking doors and windows, installing storm windows and doors, adding insulation in the attic (and in the walls, if possible), keeping your furnace in tune and cutting the night-time temperature by at least 5°.

Next to ceiling insulation, the largest savings generally comes from reducing your home's temperature. Cutback savings can often run up to 30% of your heating bill if you reduce your dwelling's temperature 5° to 10° for at least 12 hours.

With the price of oil hovering around $1 a gallon, this translates into savings of $200 to $300 for the average oil-heated home. The savings will always be more with electric heat, however, the savings with natural gas heat will increase regularly and surpass that of oil as natural gas deregulation takes effect.

Magic, Twice A Day. To get those magical 12 hours, install a multi-setback thermostat that allows you to cut back heating your home twice a day. For example, if the adult and adolescent members of a family are not home during the day, the thermostat could be cut back from 8 a.m. to 4 p.m.

If the night cut back is from 10 p.m. to 5 a.m., the total heating cut back is 15 hours; more than half a day. The fuel savings can be impressive, particularly if you can use a 10° cut back. If the home is occupied during the daytime, savings will be less.

A screwdriver is all it takes to install a new multi-setback thermostat since its clock no longer requires a power supply. The thermostat is powered by an internal NiCa battery that is recharged by a current through two thermostat switching wires (see Fig. 1).

A typical heating system is controlled through a low voltage relay switching system. The thermostat's contacts close a transformer relay circuit and the relay's contacts close the furnace's circuit. When the thermostat contacts are open, the thermostat's clock battery charger circuit draws enough current through the transformer relay circuit to recharge a NiCa battery for the clock motor, but not enough to cause the relay to close.

So what we have is a transformer relay power source charging the battery whenever the thermostat is open. When the thermostat closes the charging is interrupted, but the battery is sufficiently charged to operate the clock motor. Because a very low trickle charge is applied to the battery, there is no possibility of overcharging even if the thermostat contact remains open for weeks.

Resolve Any Problems. Upgrading a home's heating system with a multi-setback thermostat usually involves just replacing the existing thermostat with a clock model. There are instances when circuit problems must be resolved. Perhaps the largest problem is that most clock thermostats have switching contacts rated 15-30 VAC, which is different than older systems.

Many older heating systems, particularly hot-water circulators, switch the 120 volt powerline to the motors and/or burners. Many gas furnaces have powerpile or millivolt thermostat control, which does not provide recharging power for the thermostat's battery.

NOTE: Installing a powerpile setback thermostat is a *dangerous* procedure. Unless you know exactly what you are doing, do not try it yourself. Have a licensed electrician come in and do the job so you can benefit from the savings of a setback thermostat.

To install the thermostat, first determine what it is switching. Remove the cover of the existing thermostat and look at the wires. If they look like bell wires, #18 or thinner, it's probably a low voltage switching system. If you see standard electrical wire, #16, #14 or even #12, it's most likely 120 volts.

Set the control of the thermostat so the contacts are open and measure the voltage across the wires. If you measure 14-30 VAC you can substitute a multi-setback thermostat in place of the existing one.

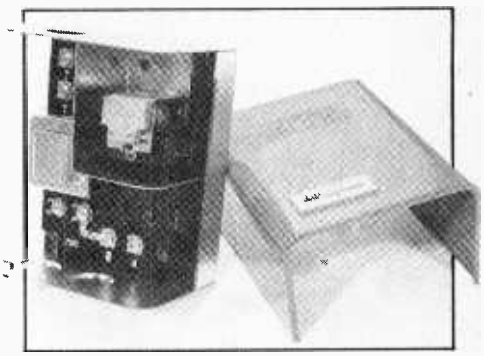
If you measure an extremely low voltage (for powerpile thermostats) or 120 volts you will need an intermediate relay (costing $20). A typical relay controller is the Honeywell model RA89 (See Fig. 2). This relay brings the voltage to 14-30 VAC.

The relay controller can be installed anywhere, though the easiest place is usually near the main furnace pull-box or safety switch, which is mounted somewhere on the furnace.

If your thermostat has three connecting wires or a combination heating/air conditioning sub-base, it's best to get some professional advice before you tackle the job. (Some three-wire systems are no more difficult than those of two wires.)

Have Lots Of Setbacks. There are two common types of multi-setback thermostats: one provides for one or two setback cycles every 24 hours, the other provides up to 12 cycles through user installed plugs. A typical do-it-yourself thermostat kit is the Robertshaw; it is supplied with a connecting back-up plate and an adaptor plate.

The adaptor covers vertically mounted electrical wall boxes. If the wall box is horizontal, because the original ther-



A step down transformer relay is necessary for all line voltage heating systems.

mostat was a horizontal mount, the adaptor isn't needed because the connecting back-up plate is for horizontal boxes. (*Note:* Many thermostats have no adaptor plates available and you must change the box and plaster the hole or make your own adaptor.)

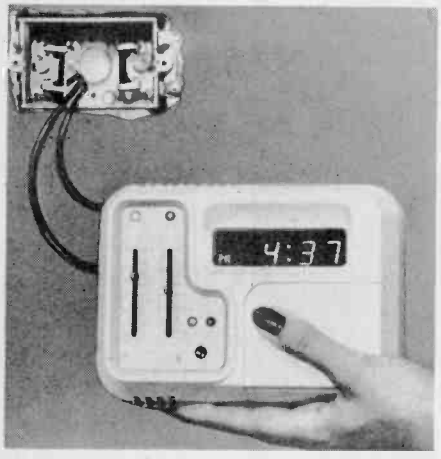
After you decide the thermostat type you prefer, install the relay controller. It's a simple device in a metal cabinet consisting of a transformer and relay. Connections are made directly to screw terminals.

Mount the relay as close as possible to the furnace's safety switch/wiring box, as shown. (*CAUTION:* Make sure you turn off the electricity going to the furnace before doing any work.)

Next, remove the existing thermostat, taking extra care with the wires; after many years the insulation could be brittle. Remove the thermostat a bit at a time if installed on a mounting plate. Don't try to pry the plate off the wall along with the thermostat; it all comes apart easily if you search out the screws.

Mercury Is The Contact. If your clock thermostat has mercury contacts rather than magnetic or other mechanical contacts, make sure the mounting plate is level. When you're certain the plate is level, secure the mounting screws and connect the furnace wires to the appropriate screw-terminals on the plate.

The thermostat you removed could have had its wires connected to terminals on the unit, however, most modern set-back thermostats have no wire connections. Attach the wires to the thermostat's plate. When the thermostat is secured to the plate, spring contacts in the thermostat's back contact the plate's connections. The thermostat to plate connections are secured when the thermostat's screws are tightened.



It's really quite simple to hook most heating systems up to a set-back thermostat.

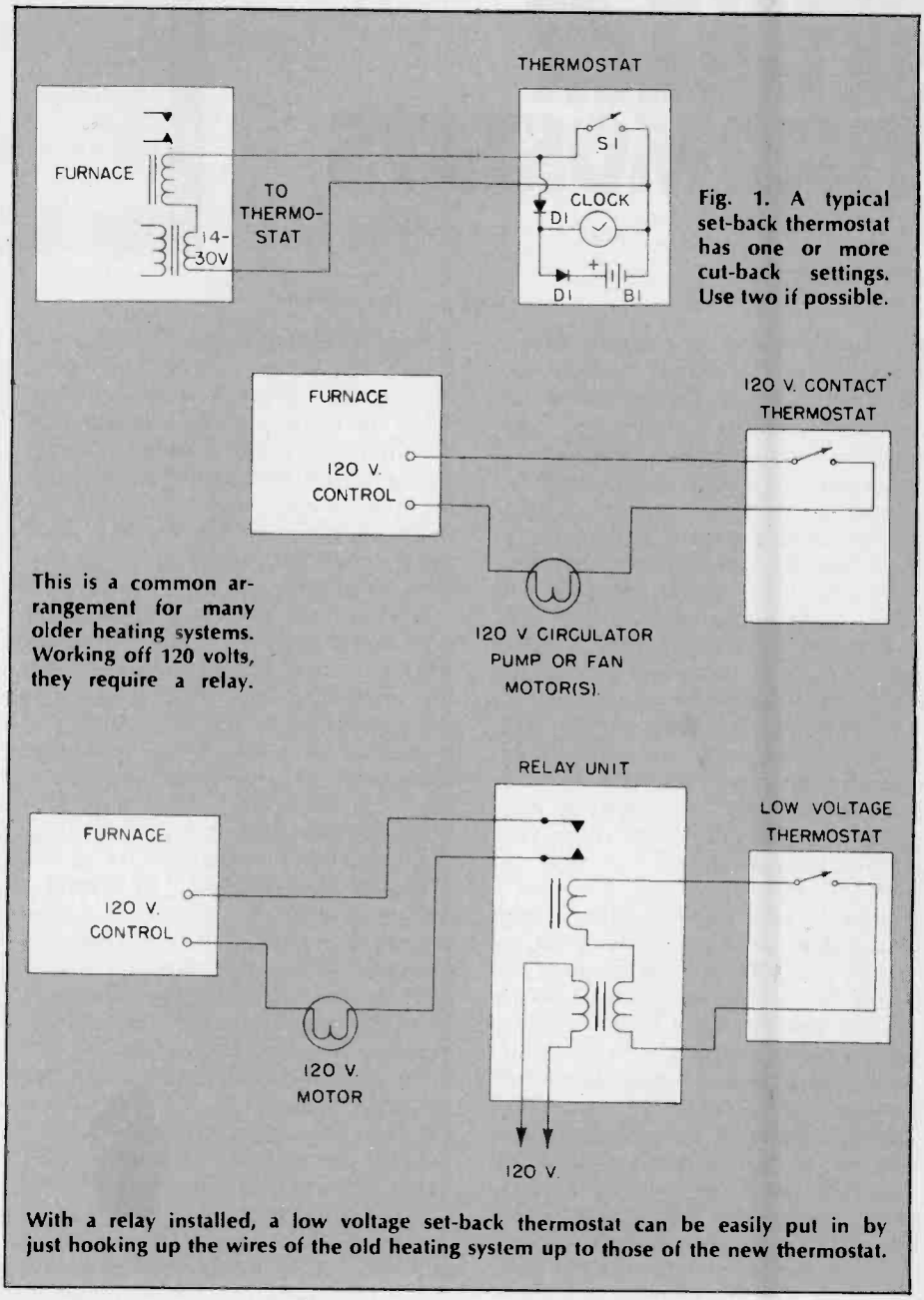


Fig. 1. A typical set-back thermostat has one or more cut-back settings. Use two if possible.

This is a common arrangement for many older heating systems. Working off 120 volts, they require a relay.

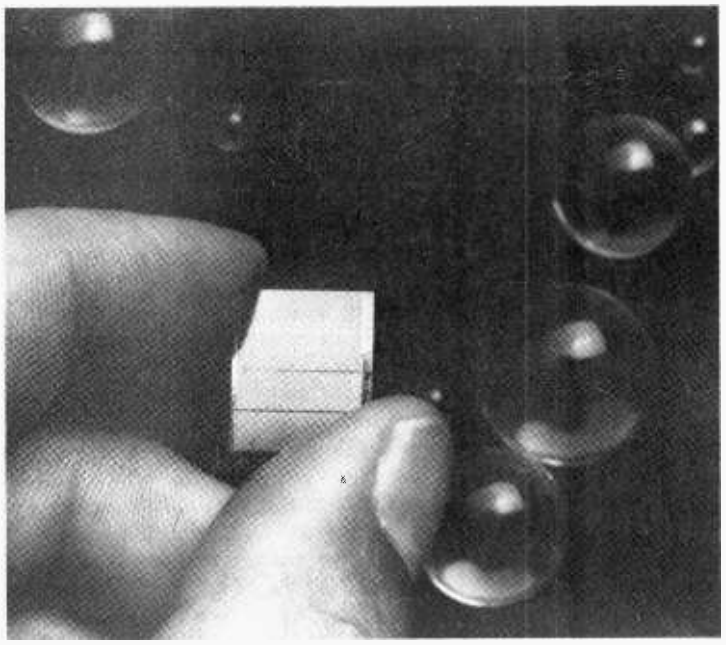
With a relay installed, a low voltage set-back thermostat can be easily put in by just hooking up the wires of the old heating system up to those of the new thermostat.

Set the timer stops or plugs to the desired switching times, install the thermostat cover and apply power to the clock by turning on the electricity to the furnace. Follow the instructions provided with the clock to get an operating charge on the battery, then set the clock to run and move the dial or clock hand to the correct time. A 30 minute battery charge is necessary to initially get the system up and running.

It's Best In L.A. The total cost of the thermostat will run between $30 and $95. As a general rule, you should save at least twice the basic cost in the first heating season.

Some representative savings, by Honeywell, for a 10° twice a day heating setback, are: Minneapolis, 18%; Los Angeles, 30%; New York, 24%; Boston, 21%; Louisville, 24%. You can figure about half these savings for a 10° single night time setback. Whatever the savings work out for you, remember that the longer you keep the temperature low, the greater the savings.

The greatest thing about this sort of thermostat is that you will only feel the difference in your wallet and as a consequence will be setting back your household energy consumption. ■



BUBBLE MEMORY

This revolutionary data storage will burst on the microcomputer scene in the next few years

BY MICHAEL SARA

THE TWO TYPES OF MEMORY technology most familiar to hobbyists and other small computer users are semiconductor and magnetic. RAMs, ROMs, EPROMs, and EAROMs fall under the former category; tape and disk storage are included in the latter. Most computerists have at least a passing knowledge of each.

There is, however, another class of memory that is beginning to emerge. This type of storage has a data access time, a cost per bit and a storage capacity that lie somewhere between those of the two familiar forms of memory. The new technology is called "magnetic bubble memory," and it's catching on fast.

Rising Bubbles. Bubbles have already made a name for themselves by finding application in word processing systems and telephone switching networks. Many of you have literally heard the results of bubbles in action. The taped messages in the phone system most likely are "filed" by a bubble memory. Also, a telephone's time-of-day message is often harbored in a bubble. ("Good morning! At the tone the time will be ten (pause) thirty-two (pause) and forty seconds. (pause) Beep.")

Although still in its infancy, magnetic bubble storage is expected to account for $50 million in revenue by 1981. By 1984, bubble technology should garner $230 million; by 1986, a whopping $688 million. Today about one-third of all bubble memory units are used by the military and aerospace industries. By 1983, it is predicted, fully one-half of bubble memories will be used in telephone systems, mostly in switching networks.

Although the price tag on these devices is somewhat high today, manufacturing costs are declining and, in the next couple of years, the price of magnetic bubble storage will dramatically decrease. You can, therefore, expect bubbles to burst on the small computer scene very soon.

Early Developments. Magnetic bubble technology began in the Bell laboratories in 1967. Andrew H. Bobeck observed that small cylindrical magnetic domains form in thin films of synthetic ferrites of garnets when an external magnetic field is applied perpendicularly to the film's plane. He also showed that a varying field can move these domains laterally through the film.

A rectangular solid sheet of garnet material magnetizes readily at right angles to its surface, but not parallel to the surface. In the absence of a magnetic bias field (HB), the material remains in a state of magnetic equilibrium; that is, the positive charge in the substance equals the negative charge, so that the net magnetic moment of the material is zero (Fig. 1). Magnetic balance is maintained even if the magnetic bias field strength is increased a bit. This state is designated HB_1, and magnetic domains appear in serpentine, or strip, form within the crystal while HB_1 bias is applied.

Bubble memory storage is compact and easy to handle. Many units, such as this Fujitsu are just plugged into various hardware.

A second tier is reached when the magnetic bias field intensity is increased further. Here, the magnetic regions contract into cylinders (circles, if viewed from above). The diameters of the cylinders range from 2 to 20 micrometers, as a function of the material used and the strength of the applied bias. It is this HB_2 state that magnetic bubbles are created and maintained, as shown in Fig. 2.

If the field intensity is further increased and maintained (HB_3), the bubbles disappear.

Obviously, bubbles are most stable under HB_2 conditions, and such a magnetic bias field is supplied by a permanent magnet sandwiching the garnet bubble crystal. This also accounts for the non-volatility of the bubble memory. (A voltaile memory loses its data when power is removed. RAMs are volatile memories. Non-volatile memories such as tapes and disks, retain their data even upon loss of power.)

A bubble or group of bubbles in isolation has only academic value. To make them useful as storage elements, they must be manipulated under controlled conditions. Bubbles can be made to move by applying a rotating magnetic field (a magnetic gradient) to the bubble structure, as shown in Fig. 3. When a surrounding pair of orthogonal

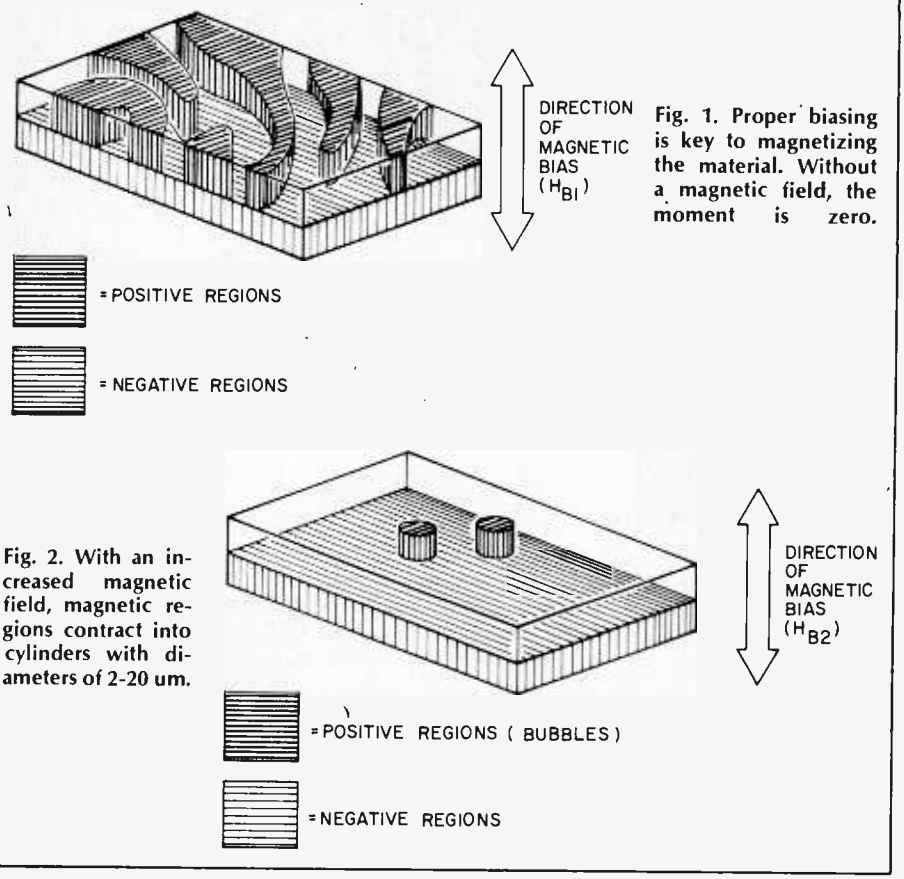


Fig. 1. Proper biasing is key to magnetizing the material. Without a magnetic field, the moment is zero.

Fig. 2. With an increased magnetic field, magnetic regions contract into cylinders with diameters of 2-20 um.

field coils is energized, the bubbles move simultaneously, in order, through predetermined paths in the crystal structure.

These patterns, which usually take the form of chevrons, are thin film deposits on the surface of the garnet crystal. Upon application of 2-phase alternating current, a rotating field is created in the plane of the permalloy chevrons. The bubbles move along the path defined by the chevrons as a function of magnetic polarity (Fig. 4). Thus, a type of serial shift register is created where logic 0 and logic 1 are defined as the absence or the presence of a bubble, respectively.

Microcomputers First. It is expected that bubble memory systems will be used in microcomputer applications before they are used in large computers. Immediate applications exist for high-density bubble memory systems in smaller computers, while large computers will probably have to wait through most of the 1980's.

The microcomputer applications for which bubble memories are presently well-suited include data terminals, word processing systems, industrial control systems, and telecommunication systems. These often require peripheral read/write memories storing from 128 Kbytes to around 2 Mbytes (the capacity range of most tape and diskette data storage peripherals).

With magnetic bubble memories, such storage can easily be built into the basic microcomputer system. Moreover, since they are solid-state, bubble memories can increase system reliability because of drastically reduced maintenance requirements.

Mass memory storage systems such as tapes and disks are electromechanical, and are usually designed to operate in moderate environments. In contrast, bubble memories exhibit the high reliability associated with semiconductor systems. This reliability extends to the storage medium, too, because unlike tapes and disks, the magnetic bubble medium is sealed against contamination from the outside.

Data Storage Configurations. The magnetic bubble memory was originally configured to store data in a long-loop serial shift register manner. It turns out, however, that this scheme suffers from a few significant disadvantages. On the one hand, in order for any particular bit to be read, it must first circulate throughout the entire data loop. This takes time, a valuable commodity in data access. On the other hand, a single fault in the shift register architecture spells disaster for the entire bubble chip. The processing yield for the shift register technique is, therefore low, resulting in commensurately higher prices placed on the devices.

Major/Minor Loop. Another, more efficient, organization, called the major/minor loop structure, is a serial-parallel-serial technique in which data is serially generated in the major loop and moved over to the minor loops to finally be transferred, *en bloc* and in parallel, to the minor loops for ultimate storage. This is shown in Fig. 5.

The major/minor loop approach results in faster access times and, very importantly, it allows the inclusion of redundant minor loops. Redundancy permits defective loops (determined during quality control procedures) to be eliminated from the memory map of the device. The bottom line is a fast, efficient and reliable chip.

As efficient as the major/minor loop structure is, however, it has two important drawbacks. First, there is a problem associated with a too slow read operation; the other involves the spacing between the minor loops, which also affects speed. Block-replicate organization remedies both problems.

In block-replicate organization, the major loop is split into an input track on one end of the minor loops, and an output track on the other end (Fig. 6). At the output end, each minor loop has its own replicate/transfer gate. During a read in this structure, the loops rotate to the bit position that corresponds to the desired data block. That block is then replicated onto the output

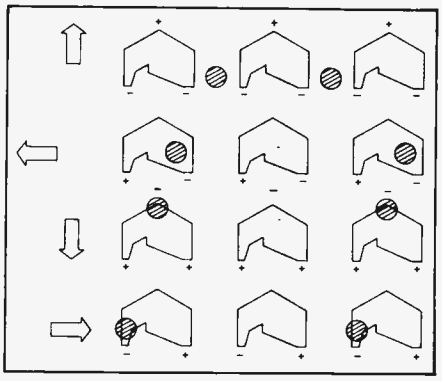


Fig. 3. By applying a rotating magnetic field, bubbles can be made to move. To be useful bubbles must be totally manipulated.

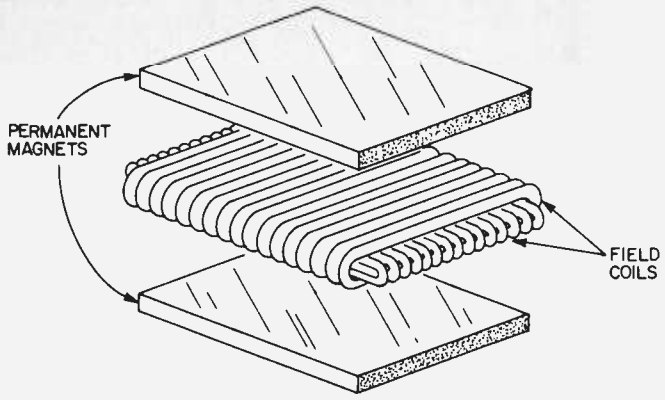


Fig. 4. Field coils and permanent determine the direction of the bubbles as they move. Thus, a serial shift register is created.

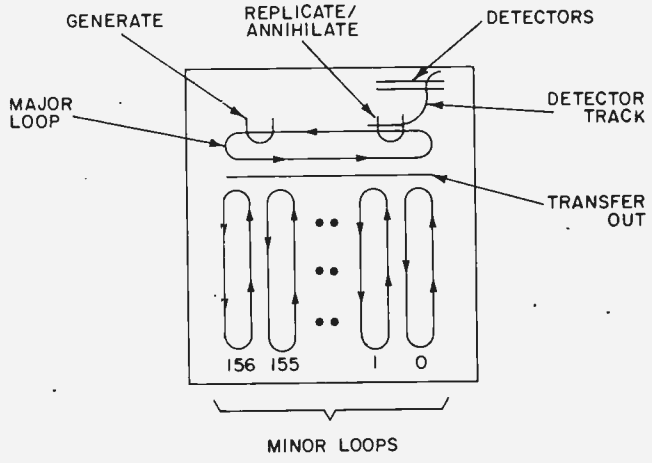


Fig. 5. This is a block diagram of the major/minor loop organization of Texas Instruments' TIB0203 92 kbit bubble memory. For reading, data is transferred from the minor to the major loops.

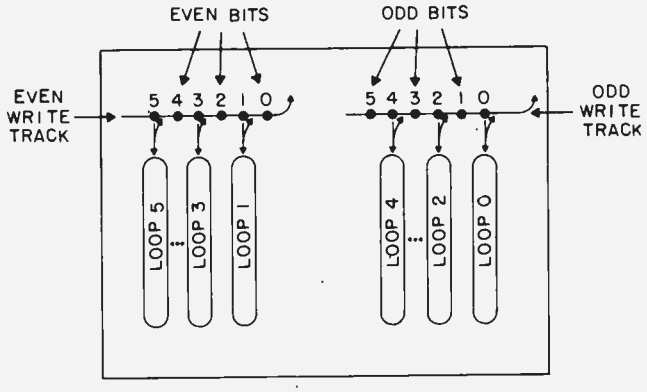


Fig. 6. The data storage area is divided into odd and even storage banks.

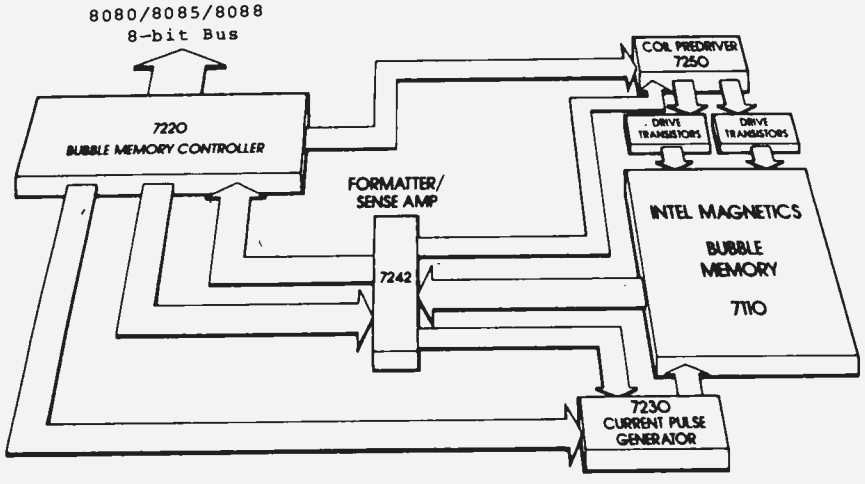


Fig. 7. Support large scale integration (LSI) circuits available with the Intel 7110 megabit bubble memory chip turn the memory module into a complete storage system.

track without the data ever leaving the minor loops. This replicated set of data then moves along the track to the detectors, and is read and destroyed—thus speeding up the read operations.

The second problem, that of the spacing between the minor loops, is also solved with the block-replicate method. The ends of these loops are separated by one bit position, so there is a space between each valid data bit that moves onto the major loop or is replicated in the output track. In a simple major/minor loop structure, these spaces must be read and ignored by the bubble memory controller. This cuts cutting the achievable data rate in half.

The cure for this problem involves splitting the data-storage area into odd and even banks. Each bank has its own generator and input track, but the generators are connected in series so that they create identical data on both tracks. Data moves along each track into position over the minor loops, but the odd bank has an extra bubble position, so when the first bit is opposite loop 0 in the even bank, the second bit is opposite loop 1 in the odd bank. Then, when the data are shifted into the minor loops, every other bubble generated enters a loop.

The remaining bubbles—odd numbered bits from the even bank and even numbered bits from the odd bank—are shifted off the end of the track and destroyed. Because data is now generated in every bit position, the data rate equals the shift rate—twice as fast as in the simple major/minor loop structure. A further variation on the odd/even approach can make the data rate twice the shift rate.

Hardware Support. One of the major enigmas that faced manufacturers of bubble memory chips was that of developing hardware support for a working magnetic bubble memory system. Intel Magnetics (Santa Clara, CA) was recently successful in producing and marketing a megabit bubble memory system, including the heretofore elusive support electronics.

Intel's 7110 bubble memory system is typical of the great strides that high technology has taken during the past decade. The 7110 bubble memory system establishes the new storage medium as a viable element in the computer memory hierarchy.

The 7110 bubble memory device itself is organized with block-replicate architecture. The device stores 2048 pages of 512 bits each, formed by combining two 256-bit registers with serial

(Continued on page 81)

INSTALLING THE HYGAIN THUNDERBIRD TH5DX TRIBAND YAGI ANTENNA

The world comes to you with this far-reaching yagi antenna

CIRCLE 90 ON READER SERVICE COUPON

THE ADVANTAGES OF communicating on the 10 meter band are declining as sunspot activity ebbs.

The 10 meter band is superior to both the 15 and 20 meter bands since it has a greater number of channels, requires smaller antenna, is suitable for low power operation and receives less man-made interference than the other two bands.

However, the 15 and 20 meter bands provide consistant short, medium and long range propagation for most of the day; openings on 10 meters will decline and reach a low point five or six years after sunspot activity peaks.

Therefore, high frequency amateur radio operators may desire use of all three bands. How? Use a triband Yagi antenna. Although cubical quad antennas offer superior gain, front to back ratios for the same given number of elements and low angle of radiation, they are difficult to build and maintain. One of the best Yagi antennas is the HyGain Thunderbird TH5DX five-element tribander.

There are approximately 450 pieces to the TH5DX. The boom is 18 feet long. The longest element measures 31 feet 5 inches and the antenna has a turning radius of 17 feet 9 inches. The assembled antenna weighs 50 pounds.

It's A Trap! The antenna can be easily installed with simple tools, however, the construction of the antenna will take many hours. Since the TH5DX is a trap and a triband antenna, the location and length of the elements are critical. Carefully measure all dimensions before installing the elements.

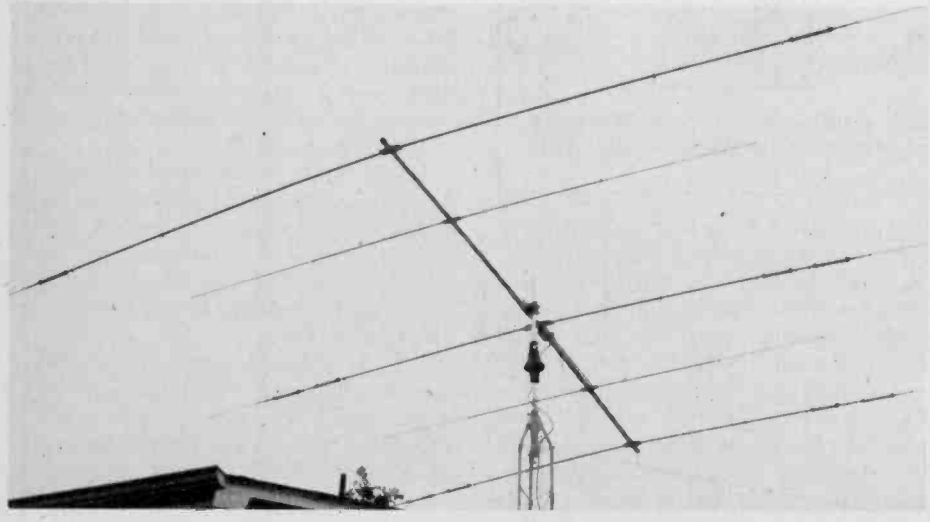
The antenna can be constructed on its tower (or supporting structure) or on the ground. The tower used in our installation was a Rohn 25 G top mast section and was mounted on the roof of a split level home.

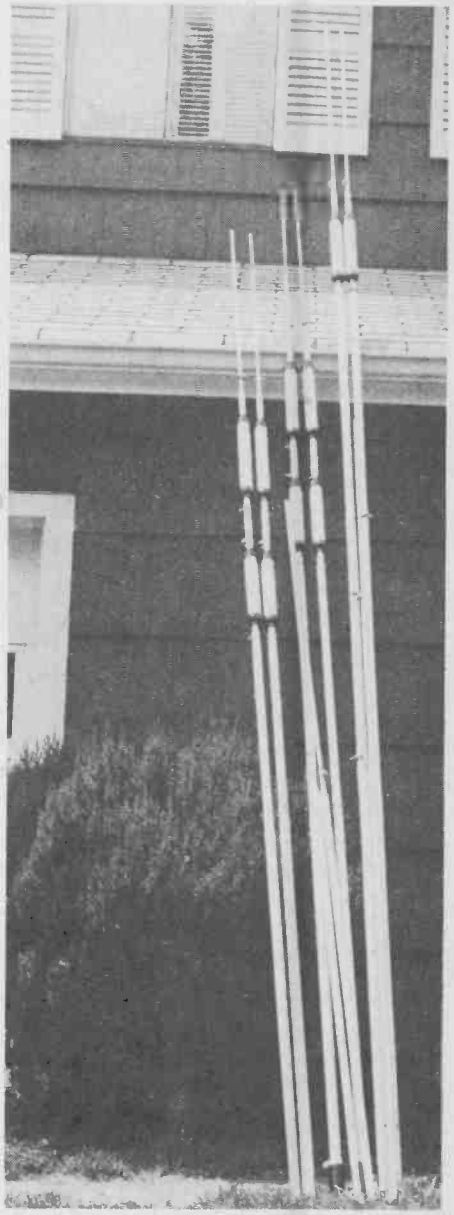
The two-inch boom stock and aluminum mast brackets easily bolted together. (As was suggested, all compression clamps were pre-assembled.) However, instead of building and mounting the entire antenna, we chose to build half-element sections on the ground to assemble on the roof.

The antenna was constructed by first mounting the boom to the antenna mast. We encountered some difficulty in locating a 2-inch or better mast and eventually resorted to using galvanized fence post stock. All the boom bracket elements were fitted in place, working from end to end. This made the element assembly easy and safe.

The boom bracket elements are carefully designed and constructed. They are held together with four ¼-20 weather resistant steel screws. After the elements are aligned, they are locked into position by ¼-20 anchor bolts.

Got A Match? Impedance matching is achieved with a beta match. Although this type of matching has more elements than the standard gamma match.





Putting in the Thunderbird antenna is not a small job. With a boom of 18 feet, this project is meant only for serious listeners.

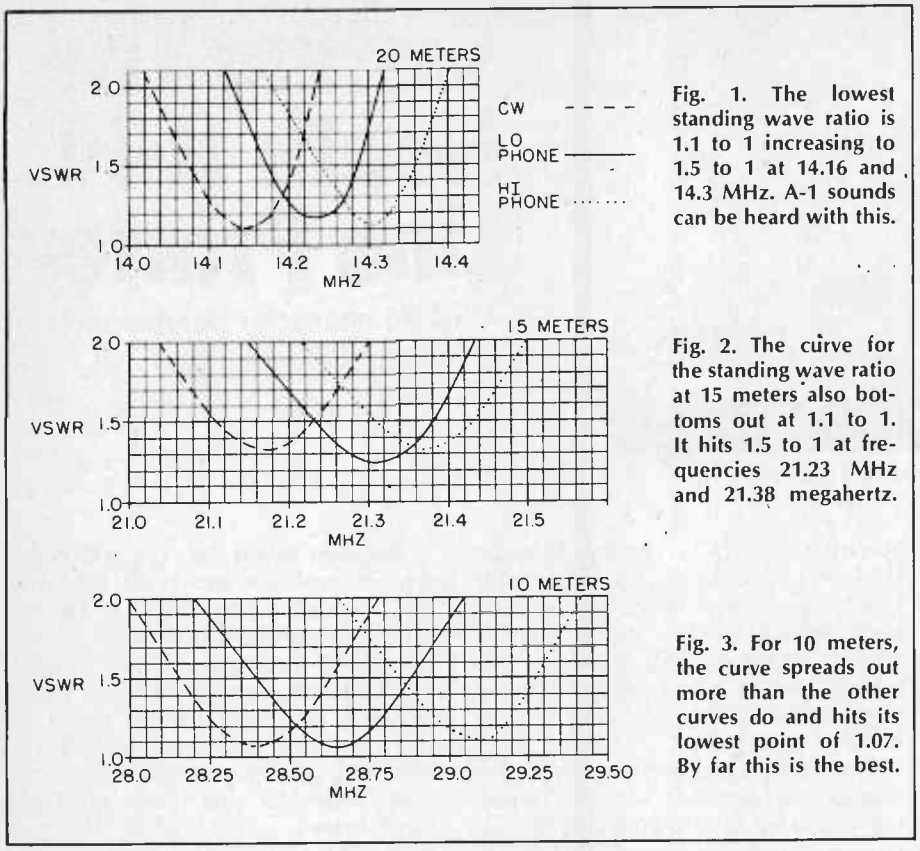


Fig. 1. The lowest standing wave ratio is 1.1 to 1 increasing to 1.5 to 1 at 14.16 and 14.3 MHz. A-1 sounds can be heard with this.

Fig. 2. The curve for the standing wave ratio at 15 meters also bottoms out at 1.1 to 1. It hits 1.5 to 1 at frequencies 21.23 MHz and 21.38 megahertz.

Fig. 3. For 10 meters, the curve spreads out more than the other curves do and hits its lowest point of 1.07. By far this is the best.

its construction and alignment are simplified when the dimensions of the text are followed. Rather than winding an RF choke for matching, a HyGain BN 86 ferrite ballun was used.

Connections to the driven element of the antenna were made with six-inch lengths of braid that were tinned after a hole was inserted in the braid to accept mounting bolts.

Coax cable was used to feed the antenna and both the beam and coax were weather-proofed with silicon sealant to prevent deterioration. It took 12 hours to install the antenna on the premounted tower. A good amount of time was spent in checking dimensions and lifting components on to the roof.

The TH5DX Thunderbird triband beam appears to be mechanically sound. The elements seem well balanced. Heavy gauge aluminum was used in the mast and elements. A wind of 80 miles per hour produces a 164 pound load across the antenna mast and rotor. Maximum wind survival is estimated to be 100 miles per hour. However, the boom and a few elements sagged after being placed on the tower.

Yagi beam antennas are designed to reflect energy from a dipole-like driven element through a series of parasitic elements (reflector and director elements) that are spacially related to absorb energy through induction or radiation. The reflector element is always the longest element and constitutes the back of the beam.

Attenuates And Amplifies. An antenna of this type makes a transmitter more powerful by amplifing incoming signals and attenuating signals from unwanted directions. These properties cause loss of uniform radiation. Most of the radiation is pumped out in front of the antenna towards the director elements.

The antenna's main lobe has a finite width and is measured between the two half-power points. Unfortunately, most Yagi beams have significant side lobes that reduce antenna amplification and directivity. Triband operation is obtained in a Yagi (or any type of antenna) with traps.

A trap is a high impedance inductor-capacitor combination. It serves as a transmission line that prevents the RF energy from moving along the entire length of the beam at higher frequencies. Since the TH5DX is a triband beam, two traps are necessary: one for 10 meters and a second for 15 meters to prevent the entire element length from radiating on these bands.

On 20 meters, the resonance of these traps does not hinder the RF energy from moving down the element in transmision line fashion.

On the TH5DX, all traps are prealigned, securely made and weather-proofed. Unfortunately, traps decrease the bandwidth of the antenna. Careful design, high impedance circuits and use of proper spacing can optimize the bandwidth of a multiband antenna.

Since there are three active elements on 20 and 15 meters and four active elements on 10 meters, the driven element and second director have two traps (one for 15 and one for 20). There are no traps for the 10 meter reflector since it is cut exactly.

Our beam was set up for low phone operation, which means a resonance of 14.4, 21.32, and 28.650 MHz. Front to back ratios were measured by observing the differences in incoming signal with the antenna rotated 180 degrees and the changes in signal strength as noted by local ground wave contacts.

Check It Out. Voltage standing wave ratio checks were made with a DAIWA voltage standing wave ratio bridge. The front to back ratios and standing wave ratios were found to be a function of the beam position since the beam was mounted close to metal objects.

In spite of these limitations, the characteristics of our Thunderbird TH5DX exceeded the graphs given by HyGain (Fig. 1-3). On 20 meters, our lowest standing wave ratio was 1.1 to 1 at resonance with the standing wave ratio increasing to 1.5 to 1 at 14.3 megahertz and 14.16 megahertz.

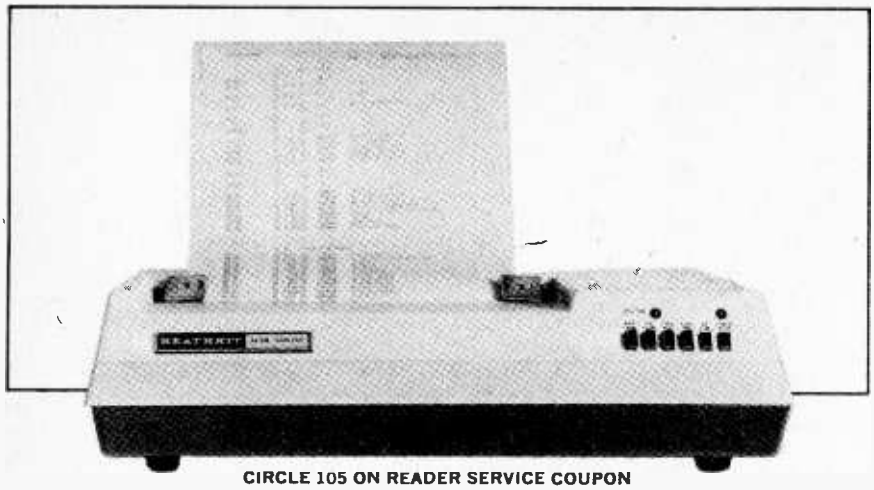
The TH5DX coupled to a Heathkit SB 104A fulfilled our expectations; on clear channel frequencies, excellent results were obtained on all three bands. Six continents were reached with our receiver hooked up to the TH5DX.

What Good Bands. On 15 meters, DK5 BD/ST 2 Khartoum, the Sudan, answered our initial CQ. On 10 meters, TF3/IRA and GM4 HJQ were worked in quick succession under spotty band conditions. ZL1 BD in Hamilton, New Zealand, gave us a 5-8 on 20 meters. An impressive number of contacts were obtained on the three bands.

For the TH5DX, adequate grounding requires number 10 copper or number eight aluminum wire through ground clamps (on the main mast) and an eight foot electrode.

The Thunderbird TH5DX from HyGain is a superb triband trap antenna for $289.95. It offers the amateur a gain of 8.5 dB and an average front to back ratio of 25 dB. It can handle a maximum of 2 kW peak effective power without difficulty.

Its voltage standing wave ratios at resonance are less than 1.4 to 1 with a good bandwidth. The half power beam width is 56 degrees. With these stats, this HyGain antenna lives up to its specifications and reputation. For additional information, circle number 90 on the Reader's Service Coupon. ■



CIRCLE 105 ON READER SERVICE COUPON

Testing The Heath H-14 Line Printer

A full 96 character dot-matrix printer for the hobbyist

WHEN YOU FIRST operate a microcomputer, the excitement begins to build within you, growing each day as more and more meaningful programs are generated and run. That's why the sudden thrill of first operating a line printer is immeasurable. SCIENCE & ELECTRONICS assembled, wired, tested and operated the Heathkit H-14 Line Printer for its readers, but if you want to share the thrill—get your own H-14!

The H-14 brings performance and convenience in reading, editing, debugging and modifying your computer programs. In fact, programs can now be run—such as mailing lists and labels—that are not practical to program without a line printer.

Dot Facts. The Heathkit H-14 Line Printer uses a 5x7 dot-matrix to display the full 96 character ASCII upper and lower case. Printout is on sprocket-fed paper width adjustable from 2.5 to 9.5 inches with a form height of 11 inches. The printout results from impact on a nylon inked ribbon with line spacing either 6 or 8 lines per inch, depending on the software.

Character printing speed is approximately 1.75 seconds for a full line, on 60-Hz power line. The maximum instantaneous printing rate is 165 cps. For a long run, the printhead tends to heat up, so the printhead temperature is monitored after each line. Should the heat become too high, the printhead speed is limited by slowing or stopping the printing. Under test conditions used by the Editors, the H-14 did not stop or appear to slow down because of printhead heating, even after printing seven continuous pages of tight copy.

Interface Facts. Cables supplied with the H-14 provided direct connect to the Heath H-89, or the H-8, H-17, and H-19 computer systems. The H-14 accepts RS-232 signals or 20 mA current loop on passive (preferred) or active operation. The H-14 operates at Baud rates of 110 to 4800 (seven selectable rates). It is compatible with any computer having RS-232 serial interface with handshaking. All functions are microprocessor controlled. There's much more on the specs, but let's go on with the review.

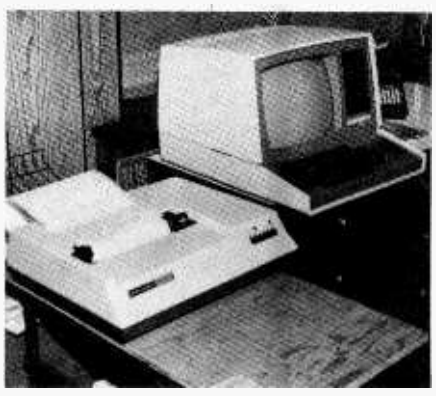
Putting It Together. We followed the step-by-step procedure, carefully rereading each step after completing the action described. The assembly of the 10 by 4¾-inch printed circuit board went smoothly, although it seemed to take most of the time. Another circuit board 2 by 5 inches was assembled quickly. Point to point wiring on the chassis and chassis assembly also went fast. The Heath-supplied cable harness eliminated hours of point-to-point wiring time. All in all, assembly was enjoyable and moved along nicely.

How It Printed. Once we overcame our lack of understanding of the software involved, the H-14 Line Printer worked fine. We preferred to print in wide character format. After some use, we also noticed characters not printing evenly spaced. The trouble here is the stretching of the print head string. The string functions very much like a dial cord as it pulls the print head across the paper surface. After a few hours of use the string stretched. So, as part of normal H-14 servicing, the print head string should be tightened once or twice until all the "stretch" is out of it. We found that the plastic cover for the unit did not sit well on the base because of a slight warp. This was corrected by keeping a few books (three pounds) on the cover for a few days—the warp vanished. The paper feed step motor does not have the punch it needs to lift new paper from floor level to table height. We overcame this fault by keeping a supply of paper under the leveling tray that collects the printed sheets.

Software Headache. The HDOS system manual for the H-89 Computer and accompanying BASIC (Benton Harbor and Microsoft) gives no detailed step-by-step procedure for programming the line printer into action. It's all in the Heath manuals if you can dig it out. To spare you this delay so your H-14 can get on line, we've made some notes for you. Just follow the steps below:

- INIT (Initialize) a new disk from Distribution Diskette. The new disk can now be used to store programs and files but it cannot operate the H-89 Computer. Note: The H-89 can also run Heath CP/M, which is a standard ORG-O CP/M. More operating systems are to be introduced by Heath.
- SYSGEN (System Generate) the new disc after it has been INIT. After SYSGEN, the disk may be used to operate the H-89. At the prompt CAT/S, you will see a list of programs SYSGENed onto the new diskette with their flags shown. Note: this list is much longer than just CAT since files flagged with an "S" will not be listed

(Continued on page 86)



The H-14 can be connected to the H-89, H-8, H-17 or H-19 computer systems. The H-17 operates at Baud rates of 110 to 4800.

Speech Synthesis On a Single IC

Unlimited vocabulary and low cost make this new vortrax chip a best bet for speech synthesis

BY MARTY WEINSTEIN

INEXPENSIVE ELECTRONIC SYNTHESIZED speech has been around for quite a while. However, an unlimited vocabulary speech synthesizer has now been condensed into a single 22-pin CMOS DIP integrated circuit by Votrax and Silicon Systems Incorporated.

There are nearly a dozen companies currently manufacturing different types of speech synthesizers, but the new SC-01 Speech Synthesizer IC is a vastly superior device. Unlimited vocabulary, low cost and power requirements, small size and automatic inflection, are a few of SC-01's advantages. It also creates speech in a unique way.

Say Ahhh. When your doctor tells you to "say ahhh," you are generating one of the 45 or more different sounds that are used to create words in English. These sounds are called phonemes. Speech produced by generating a connected series of phonemes is called phonetically created speech.

The Votrax SC-01 produces these 45 phonemes, plus 16 alternative phonemes (differing only in their duration) plus three pause phonemes to allow for proper phrasing.

This total of 64 sounds can be selected by a six bit code (since $2^6 = 64$). The SC-01 uses an eight bit data word; the remaining two bits control the speech output's pitch level. (We raise the pitch (or frequency) of our voice toward the end of a question and lower it when we make a definitive statement or give a command.)

The Votrax SC-01 is the first commercial IC speech synthesizer that uses phonetics in creating speech. Others (such as those from Texas Instruments and National Semiconductor) reproduce (not generate) speech.

Linear Predictive Coding (LPC) is one popular data-condensing technique and it's used in TI's Speak & Spell. But LPC requires that spoken words be analyzed by a powerful computer to produce the code stored in the LPC speech synthesizers' memory. The result is a fairly substantial memory requirement and a limited vocabulary.

However, phonetic speech can be readily generated and a system's vocabulary can be modified quickly, easily and inexpensively.

Less Bytes With SC-01. The simplicity of phonetically created speech is illustrated by the word cat. A data coding approach like LPC might require 64 eight-bit bytes of data to reproduce the word; the Votrax SC-01 requires only three, the phonemes K-AE-T. The SC-01 requires 10-15 bytes of data to produce a second of speech, while approaches like LPC require 250.

The SC-01 and a memory are all you need for a talking circuit (assuming the memory has the right speech data on it). Most other schemes require a microprocessor.

If you have a computer and the SC-01 is properly connected to the output part, it can say H-AE1-EH3-V-PA1-UH1-N-UH3-AH2-Y-S-S-A1-AY-Y or "Have a nice day" with just 15 lines (bytes) of memory. You can even make it sound like it's pouting by clever use of the two pitch data bits.

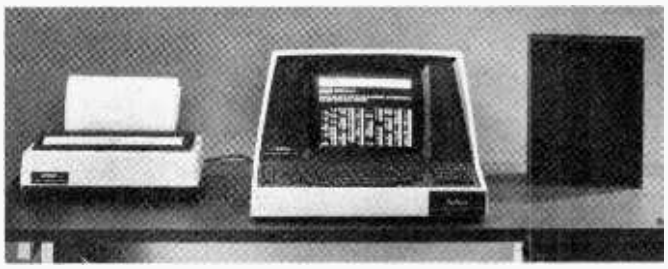
A technical difficulty in producing intelligible synthetic speech is the transition between phonemes. An abrupt transition from one phoneme to the next can make synthesized speech very difficult to discern.

Votrax circumvented the problem by incorporating on-chip circuitry that automatically looks at adjacent phonemes and decides how to make the best transition between them. An abrupt transition is provided for sounds like "P," a more gradual transition for vowel sounds and soft consonants like "S."

The duration of each phoneme has been predetermined and is stored on the SC-01 chip; the shortest phoneme is about 40 milliseconds, the longest about 250. A variation in pitch for each phoneme occurs automatically via on-chip circuitry.

The SC-01 first gets instructions in the form of a phoneme command word (six phoneme selection bits plus two pitch selection bits) and a simultaneous strobe input pulse. Then an on-chip phoneme duration timer is reset as phoneme production begins. (See Fig. 1)

When the duration timer has reached the end of the predetermined duration of the phoneme being produced, the SC-01 requests the next phoneme by setting the logic state of its Acknowledge/Request pin high. When the next phoneme has been received, the Acknowledge/Request pin is switched to a



Hooked into a system with a speaker and the appropriate amplifier, Vortrax is ready to sing any tune that you could program into it.

logic low state acknowledging the phoneme command.

The SC-01 is packaged in a standard 22-pin DIP IC, although other types can easily be made available to manufacturers who desire this chip (Fig. 2).

It Adds Speech And $. With the SC-01 doing the talking, a manufacturer can add speech to his product for $6-$15; this means $30 to $75 in retail price to the consumer.

A few technical conveniences in the SC-01 make it attractive to manufacturers. They include a 5-volt input compatibility, which allows it to work with TTL and other 5-volt logic ICs; on-chip input latches and a separate strobe line, meaning it's easy to add to microprocessor-based circuits and systems; a single positive supply with a wide range of supply voltages and only 7 mA current drain, making it very compatible with all kinds of battery-operated devices; and an on-chip master clock circuit, requiring only a capacitor.

You can provide your own input clock, either to get normal speech or strange effects from *basso profundo* to chattering chipmunks, with lots of strange sounds in between.

A SC-01 and a 64-key keyboard (with an encoder, of course) can be rigged up to type phonemes instead of letters to create words. That's a fine approach for an experimenter, but for a company trying to get a pinball machine to say "Nice shot wizard" this approach would involve a lot of very expensive engineering development time.

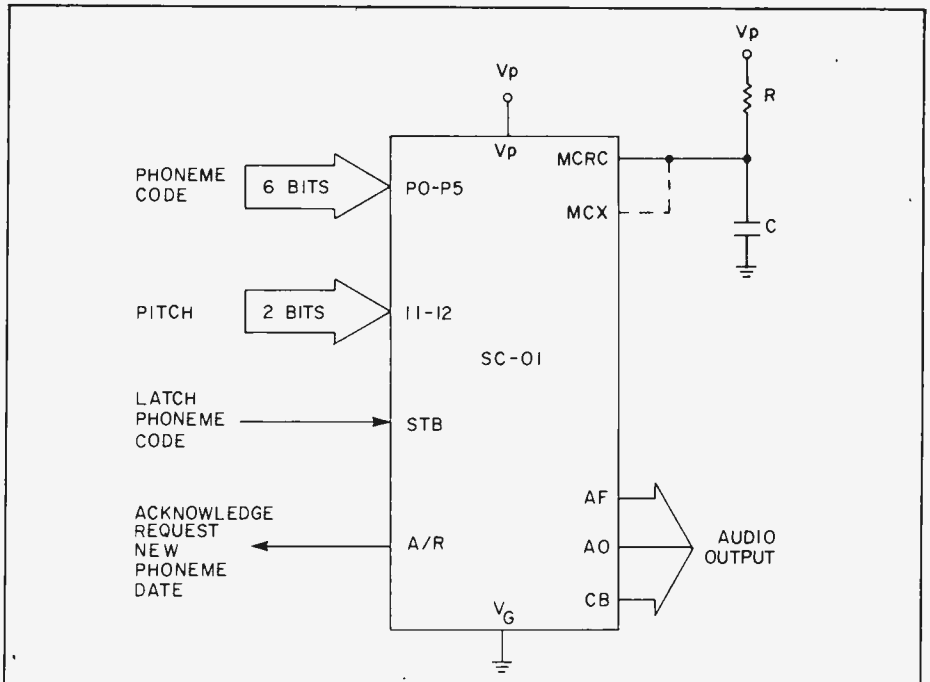


Fig. 1. This flow diagram of the Vortrax SC-01 chip illustrates the complexity of this talking IC. Phoneme, pitch, latch and other codes are used to get a good audio output.

Speech By The Rules. Votrax recognized this problem more than three years ago and began working on the rules (algorithms) you must follow to convert English text into its corresponding phonemes.

Instead of publishing a phonetic dictionary or conversion guide, Votrax created a highly sophisticated computer program that is a tremendous tool for phonetic speech system designers. (See Tables 1A-C and 2)

The Votrax CDS-1 is a Vocabulary Development System that translates English text into phonemes. It uses a typewriter-like tabletop computer terminal (with a video display), a line printer and a speaker.

When the user types his English text into the system, the phonetic transcription appears in numeric and symbol form, either on the display or paper.

Unfortunately SC-01 is available only

TABLE 1A

Phoneme Code	Phoneme Symbol	Duration (ms)	Example Word
00	EH3	59	jacket
01	EH2	71	enlist
02	EH1	121	heavy
03	PA0	47	no sound
04	DT	47	butter
05	A2	71	made
06	A1	103	made
07	ZH	90	azure
08	AH2	71	honest
09	I3	55	inhibit
0A	I2	80	inhibit
0B	I1	121	inhibit
0C	M	103	mat
0D	N	80	sun
0E	B	71	bag
0F	V	71	van
10	CH*	71	chip
11	SH	121	shop
12	Z	71	zoo
13	AW1	146	lawful
14	NG	121	thing

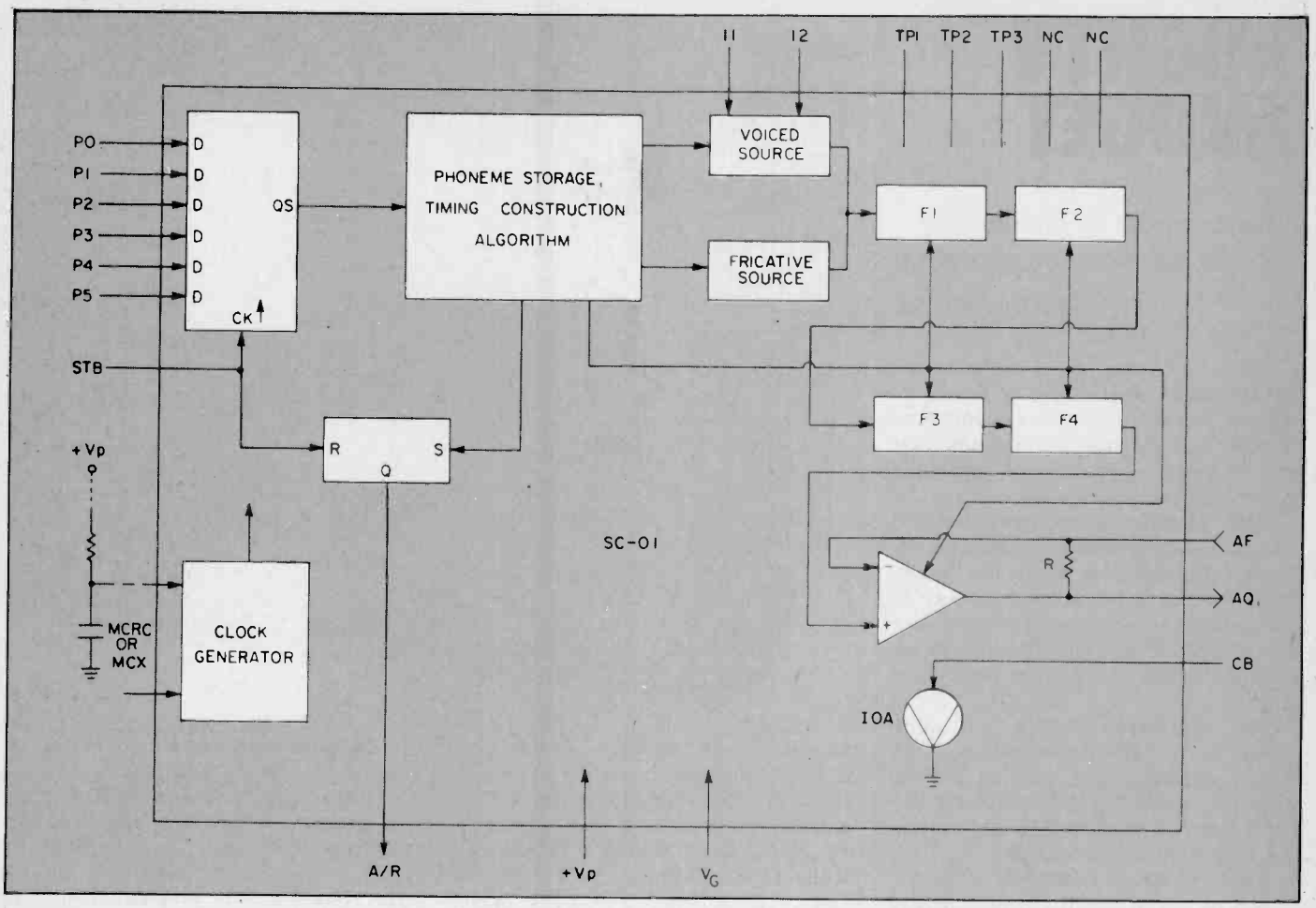
TABLE 1B

Phoneme Code	Phoneme Symbol	Duration (ms)	Example Word
15	AH1	146	father
16	OO1	103	looking
17	OO	185	book
18	L	103	land
19	K	80	trick
1A	J*	47	judge
1B	H	71	hello
1C	G	71	get
1D	F	103	fast
1E	D	55	paid
1F	S	90	pass
20	A	185	day
21	AY	65	day
22	Y1	80	yard
23	UH3	47	mission
24	AH	250	mop
25	P	103	past
26	O	185	cold
27	I	185	pin
28	U	185	move
29	Y	103	any

*T must precede CH to produce J sound.
D must precede J to produce CH sound.

TABLE 1C

Phoneme Code	Phoneme Symbol	Duration (ms)	Example Word
2A	T	71	tap
2B	R	90	red
2C	E	185	meet
2D	W	80	win
2E	AE	185	dad
2F	AE1	103	after
30	AW2	90	salty
31	UH2	71	about
32	UH1	103	uncle
33	UH	185	cup
34	O2	80	for
35	O1	121	aboard
36	IU	59	you
37	U1	90	you
38	THV	80	the
39	TH	71	thin
3A	ER	146	bird
3B	EH	185	get
3C	E1	121	be
3D	AW	250	call
3E	PA1	185	no sound
3F	STOP	47	no sound



The above block diagram illustrates the various interconnections in the Vortrax SC-01 speech synthesizer chip. Through a very complicated process, electronic commands are sorted, amplified and given tonal characteristics. The chip emits a versatile voice.

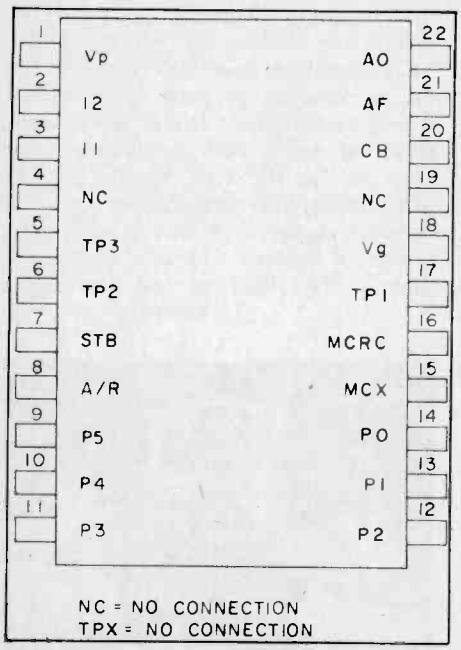


Fig. 2. This shows the placement of each pin in the Vortrax SC-01. P0-P5 are the phoneme command points. I1-I2 give the electronic word tones or inflections. Input STB controls latching. AF, AO and CB are audio outputs. MCX and MCRC are timing controls. A/R acknowledges receipt of phoneme data.

to purchasers of at least 25,000 units. You would have to spend between $250,000 and $500,000 to use one unit.

It's hard to predict when the SC-01 will be available to the hobbyist. Votrax does business with companies, not individuals, as a rule and company spokesmen were reluctant to predict when parts would become available to the hobbyist.

The first SC-01s available to hobbyists might be priced from $20-$50 each and available in six to 12 months. In one or two years, it should become more generally available for $20-$25.

Machines That Talk Back. There are many ways a chip like SC-01 can be used. A talking dashboard could reduce accidents by helping drivers keep their eyes on the road. Talking books using a data cassette and a speech synthesizer can put more talk on each tape. Your bedroom clock can not only tell time, it can tell you to get up.

One good thing about talking circuits is that they use less energy than LEDs or video and they are about the same size or smaller. But the best thing about the Votrax IC is that it opens the doors to many exciting and different projects that before were only dreams and fanciful thoughts. ■

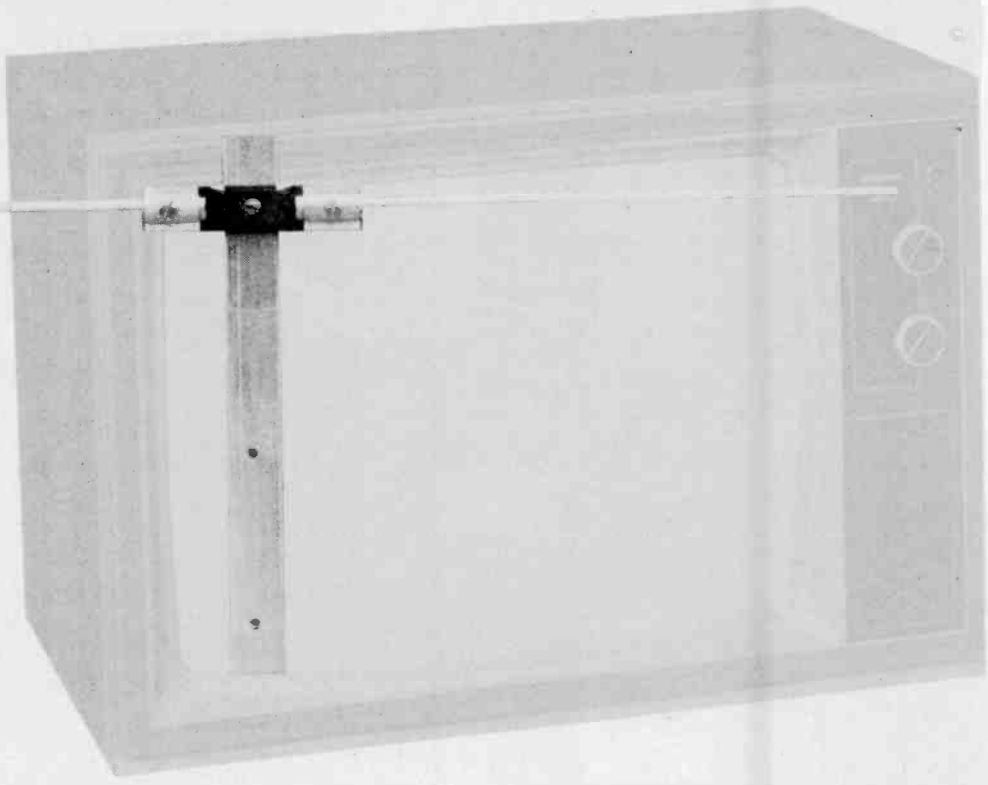
TABLE 2. PHONEME CATEGORIES ACCORDING TO PRODUCTION FEATURES

Voiced					'Voiced' Fricat.	'Voiced' Stop	Fricat. Stop	Fricative	Nasal	No Sound
E	EH	AE	UH	OO1	Z	B	T	S	M	PA0
E1	EH1	AE1	UH1	R	ZH	D	DT	SH	N	PA1
Y	EH2	AH	UH2	ER	J	G	K	CH	NG	STOP
Y1	EH3	AH1	UH3	L	V		P	TH		
I	A	AH2	O	IU	THV			F		
I1	A1	AW	O1	U				H		
I2	A2	AW1	O2	U1						
I3	AY	AW2	W	W						

MIGHTY MIDGET

This compact TV antenna boosts metropolitan reception

BY ROBERT GROVE



TELEVISION RECEPTION in some urban and suburban areas is only fair. Rabbit ears do not provide sufficient gain or directional pattern. A somewhat better antenna is necessary.

The "Mighty Midget" was designed for just such applications. Its one-element construction is inherently broadband making it useful on a variety of channels. It is also less directional than a multielement antenna, resulting in acceptable performance from more than one direction.

The prototype antenna was comprised of two telescoping whips. They were adjusted while viewing several channels, recording the optimum element lengths for each. The table shows the results of this approach.

This TV dipole is actually a modification of the Windom antenna applied at VHF. The Windom was a popular amateur radio antenna in the early days of shortwave radio communications. A center-fed dipole has a characteristic impedance at its feedpoint of 72 ohms. Lorn Windom fed his antenna 14% *off*-center (36% from one end). His antenna showed a higher impedance on even-multiple harmonic frequencies, and could be fed with 300 ohm transmission line with very little mismatch. Thus, we use standard, low cost 300 ohm line to transmit the TV signal from Mighty Midget to our TV set. The antenna location is chosen for a perfect TV picture.

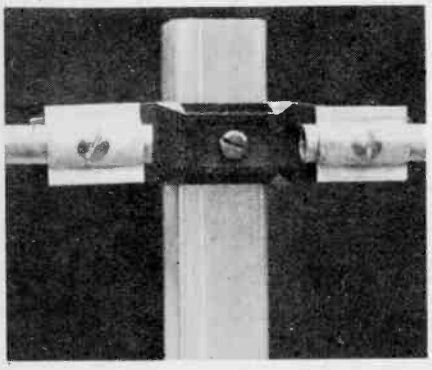
Our Mighty Midget has one advantage over Windom's design: Because of the high frequencies involved, our antenna has very thick elements compared with their lengths. This results in wideband performance.

EXPERIMENTAL LENGTHS OF ELEMENTS

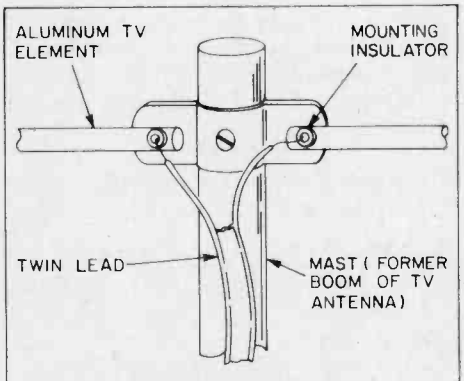
TV Channel	Optimum dipole elements "A" "B"
2	48" + 48"
4	36" + 12"
5	48" + 31"
6	22" + 16"
7	46" + 5"
10	48" + 36"
12	48" + 36"

Construction: The parts for this antenna are readily available: A broken or discarded TV antenna. All that will be needed are two elements: one 48" and one 36" long. The mounting insulator also will be needed to support the elements. The original boom may be used as a short mast; it is already contoured to fit the insulators holding the aluminum elements. The other elements are broken off and discarded. The remaining insulators may be left on or removed at your discretion. If a long rear element is still salvageable, much of your work is already done for you. The 48" x 36" lengths may be achieved by squeezing down on each element at the appropriate point with a pair of cutters. The end of the element is then bent up and down until

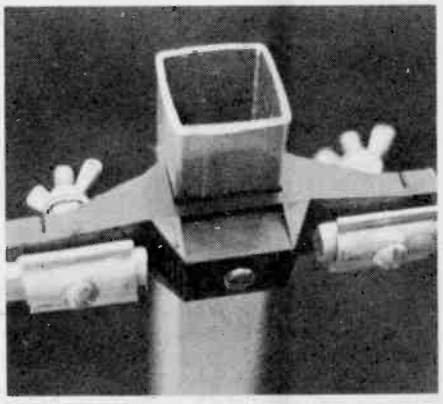
(Continued on page 85)



The Mighty Midget has hefty construction and will take any sort of battering. With three heavy bolts, it's hard to damage.



A connector on each side of the mast is used for holding the 300-ohm TV cable.



Sturdy wing nuts are utilized to hold and allow for easy removal of the TV wire.

SEMICONDUCTOR SURVEY

The RCA Bimos: combines bipolar and MOSFET advantages

BY ED NOLL

THE RCA BIMOS OPERATIONAL amplifier, series CA080 through CA083, utilizes a MOSFET input and composite bipolar/MOS output. Such devices combine the advantages of both MOSFET field-effect and bipolar transistors. The MOSFET input transistors are gate-protected with safety diodes and provide a high input impedance with a very low input bias and offset currents, and their input impedance is typically 10^{12} ohms.

The output system uses a combination of bipolar and MOSFET output transistors which provide a wide output voltage swing and high output current capability. Power consumption is low and the unity gain bandwidth extends up to 5 MHz. The slew rate is fast, giving it the ability to follow a high-amplitude and high-frequency fast signal change.

BiMos Applications. The operational amplifiers can be used as inverting and non-inverting amplifiers, IC pre-amplifiers, active filters, sample and hold ampliers, as well as current amplifiers. The CA080 and CA081 are single amplifiers, while the CA082 and CA083 are dual amplifiers. The CA080 is externally phase-compensated while the other three types are not. All except the CA082 have provision for external offset nulling.

The CA080E is mounted in an 8-lead mini-dip case, as shown in Fig. 1. Inverting input is at pin 2; non-inverting input at pin 3. Output is derived at pin 6. Supply voltages are connected to pins 4 and 7. A low value phase-compensating capacitor can be connected between pins 1 and 8. Such a capacitor reduces instability and provides better high-frequency performance. Phase compensation also prevents self-oscillation in certain circuit applications.

An adjustable nulling or bias-equalization control system can be connected between pins 1 and 5. In a critical application this adjustment provides proper DC level conditions throughout the amplifier. In most instances the circuit is adjusted for an exact zero level no-signal output.

CA080E Circuits. Several practical circuits were built up on a solderless circuit board, beginning with the voltage-follower or unity-gain amplifier configuration of Fig. 2. The two ways you are likely to find such a circuit displayed on a schematic diagram are given. Example A is helpful in planning your wiring for a solderless circuit board. The circuit shown in 2B is used more often, saves space and simplifies organization of schematic diagrams. Often the only terminals indicated would be pins 2, 3 and 6.

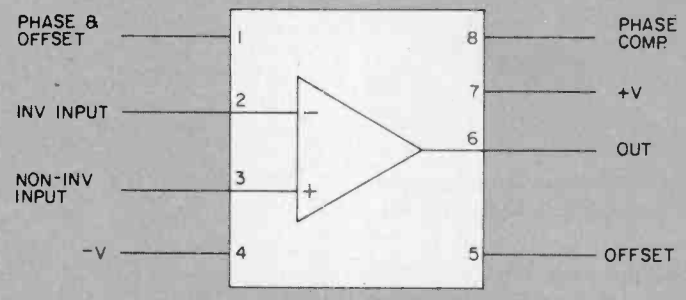


Fig. 1. The CA080E configuration is mounted in an eight-lead mini-dip case, with inverting at pin 2, non-inverting at pin 3.

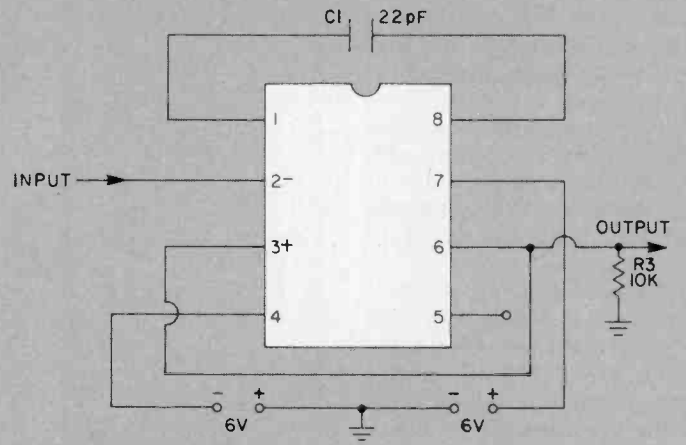


Fig. 2A is most useful in solderless breadboard construction applications, where compactness of the circuitry is not paramount.

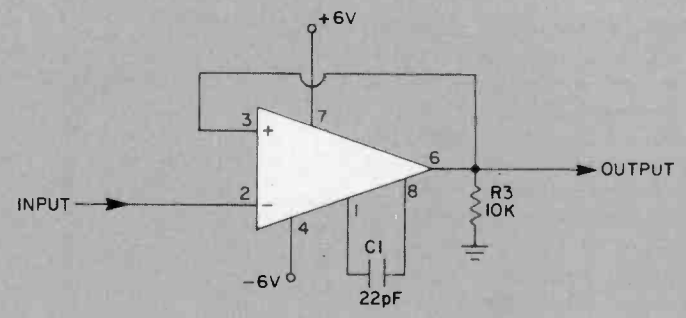
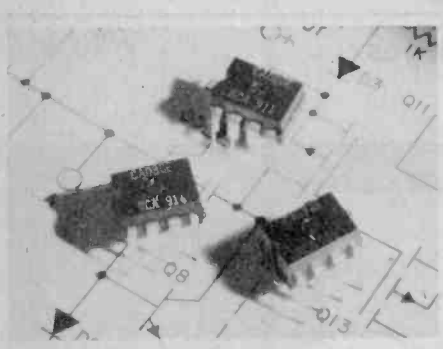


Fig. 2B is the amplifier circuit design most commonly used with the RCA BiMos. It saves space, is more flexible in organization.

The input impedance is very high and signal can be derived from a very high-impedance source. This signal applied to the inverting input (minus), pin 2, appears at the output inverted but of the same amplitude. The output, however, can drive a much lower impedance (typically a 2K to 10K load-



These RCA CA080 series chips combine the advantages of bipolar and MOSFET ICs.

ing). Unity-gain performance can be extended up to the high frequency limit of the device.

Signal source can be an audio oscillator or even a pulse generator.

A phase-compensating capacitor of 10pF to 22pF can be used. If you wish to check out its application, remove the signal from the input and then disconnect the capacitor from between pins 1 and 8. The circuit will go into self-oscillation with this design.

Inverting Amplifier. The inverting amplifier of Fig. 3 has a gain of 10 according to the ratio:

$$VG = R2/R1 = 10K/1K = 10$$

Again a split-voltage supply was used using two 6-volt batteries. Remember, if you see the circuit of 3B in a schematic diagram, that the ground point is between the two batteries, as shown more exactly in 3A.

Substitute different values for resistor R2 and note the influence on the output voltage.

Single Voltage Operation. The same amplifier connected for single voltage supply operation is shown in Fig. 4. Note that the two equal value resistors R3 and R4 are needed to supply the proper bias to the non-inverting input of the operational amplifier. Performance was similar to that of the circuit of Fig. 3.

Non-Inverting Amplifier. Performance as a non-inverting amplifier was checked using the arrangement of Fig. 5. Note that the input signal is now applied to the non-inverting input (plus), pin 3. Performance was the same as for the previous two amplifiers with the exception that the input and output voltages are now of the same phase, rather than reversed.

The feedback path is again between the output back to the inverting input of the amplifier. Gain is again determined by the external circuit values of resistors R1 and R2 (R2/R1). ■

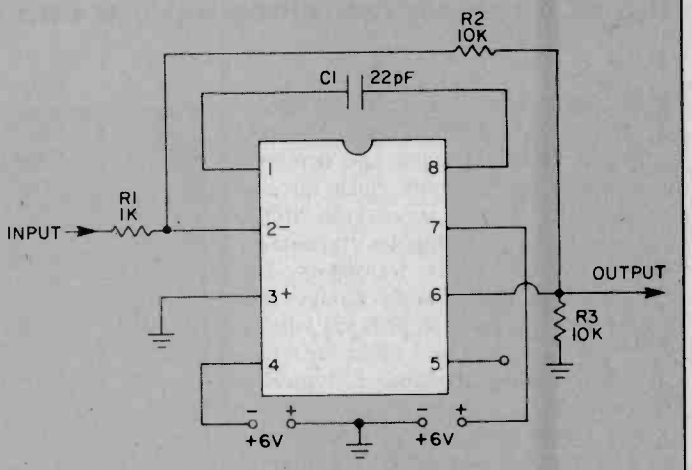


Fig. 3A. A split-voltage supply is used to power this 10 gain inverter. The RCA CAO80-3 chip series is available from: Advanced Computer Products, Box 17329, Irvine, CA 92713.

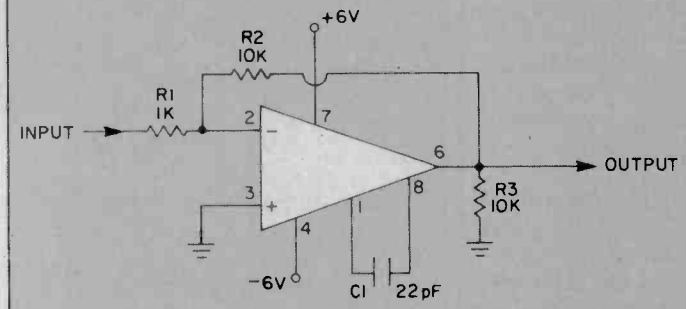


Fig. 3B. Gain is determined by placing resistors R1 and R2 between the input and output.

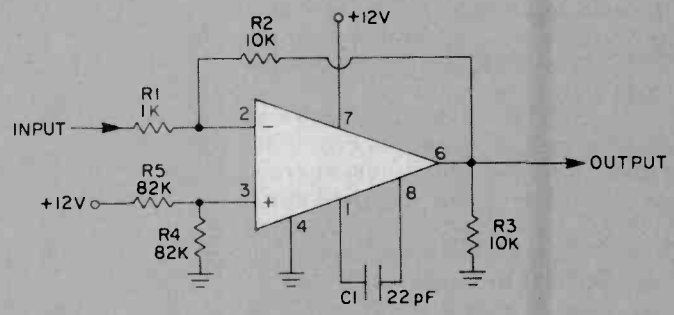


Fig. 4. Two equal valued resistors, R1 and R2 are needed to supply proper biasing to the input.

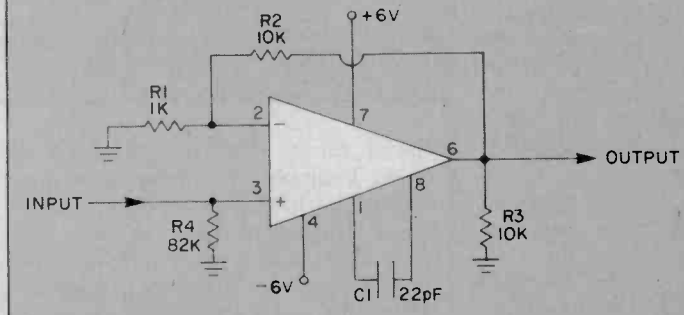
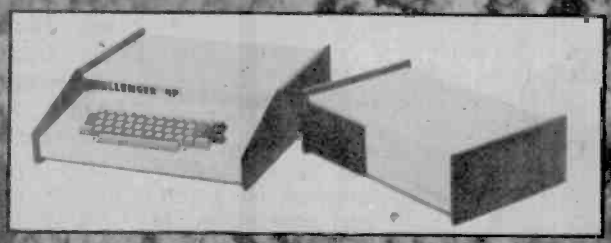


Fig. 5. Note that input signal is now applied to the non-inverting input + pin 3 on IC chip.

COOLING A MICROCOMPUTER



Eliminate glitches caused by overheating

by DR. BRUCE R. EVANS

U.S. Geological Survey

YOU HAVE BEEN USING your word processor for several hours with no problems, when suddenly the letters on the screen begin to change in an erratic manner. You have just finished balancing your checkbook and for relaxation you start to play Star Trek, but it inexplicably bombs. You have spent three hours debugging your new BASIC program, but then you find you can't load it on to cassette. What do all these problems have in common? They all are symptoms of overheating.

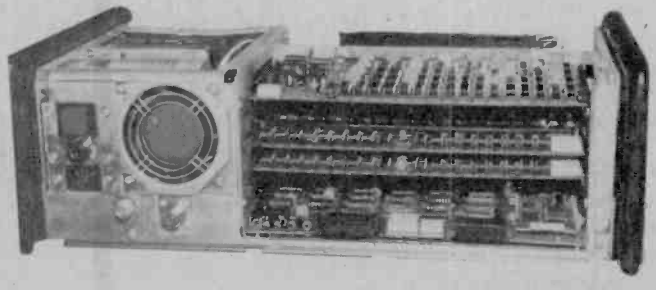
Why does overheating occur? There are three reasons, all of which boil down to manufacturing costs. Computer manufacturers try to save money by supplying unregulated voltages to the S-100 bus, so each board plugged in must have its own voltage regulator. This saves money on the power supply, but it means that later you have to pay extra to have regulators installed on each board. It also means that the power supply can be cooled with a smaller—i.e. cheaper—fan. Unfortunately, it also means that heat is produced in the memory area while the cooling is directed at the power supply.

The second reason for overheating is related to the drastic drop in the price of memory. Originally, 4K of RAM was considered adequate, but now it is economically possible for even hobbyists to have 48K or more of memory. Much of this consists of static RAM chips, which draw at least double the power of dynamic ones. My static memory heat sinks could keep my den warm in a blizzard!

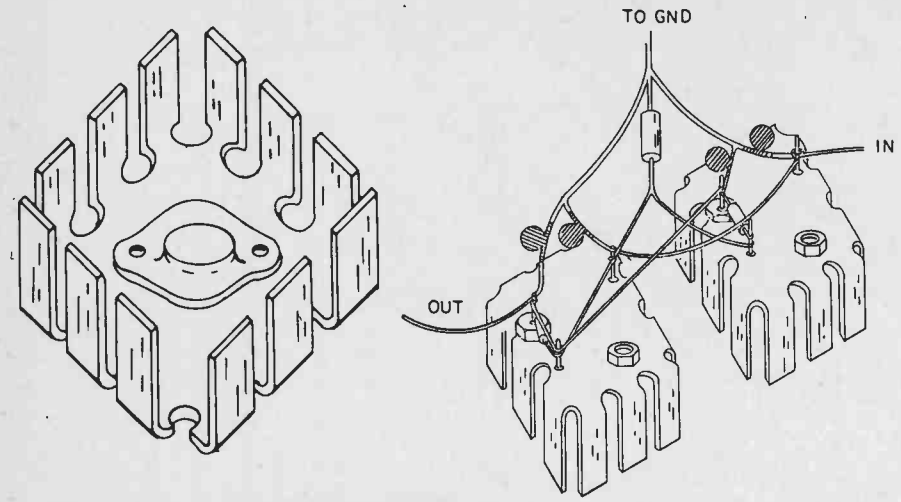
The final reason for overheating is the proliferation of accessory boards such as disk controllers and I/O boards. All this hardware generates heat and at the same time, by filling the motherboard slots, leaves less room for the air to circulate.

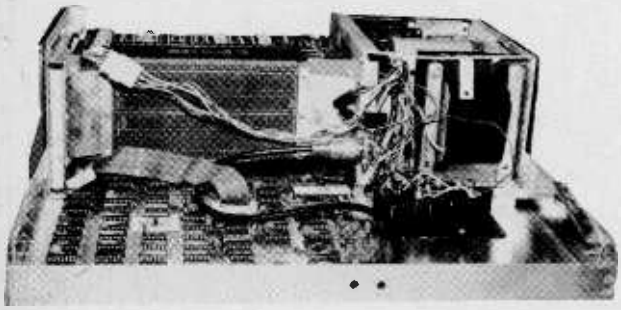
There are many ways to lessen the problem. Unfortunately, the manufacturers usually don't bother to mention them in their manuals, preferring to pretend that the problem doesn't exist. I shall start with the simple ways of reducing excess heat.

The Easy Solutions. The first and easiest way is to spread the boards out to make use of the full space available. This is particularly important if the boards are mounted horizontally, as in my SOL-20. Be sure to place the hottest board on the top so it is not roasting another one above it. This method is easy and costs nothing. Don't worry that the spacing out will increase noise on the bus, because digital circuitry has an inherent high noise tolerance. If



The first thing that should be attempted if a microcomputer has overheating problems is separating the various microprocessor mounting boards to allow air circulation.





Above left is the metal form of the heat-sink and transistor mounting for a voltage preregulator. At right is the completed unit; below, the preregulator is mounted at the rear of SOL-20.

necessary, you can actively terminate your bus system; but if you get a lot of noise when you scatter your boards, the probable cause is one or more bad sockets. Who doesn't have a dud that he is too lazy to re-solder?

Second, you should remove any unused boards. However, remember to turn off the power supply before inserting or removing them. This, of course, means that you cannot add boards if your programs expand, so think ahead. If possible, plan your memory addressing so that you can remove the static boards first, since they have the greatest current drain.

I have no experience with the newer boards with bank select features, but I would remove them too if you don't need them, since, even if they are not be addressed, they will still draw power to maintain the data.

Third, you can drill extra ventilation holes in the cabinet. This is usually not very esthetic but it works and it's cheap. Be sure that nothing can fall or be sucked into the holes, and screen them if necessary.

My final cheap solution is to replace the heat sinks on the boards with more efficient ones. Unfortunately, there is seldom room to do this.

Improving Air Flow. The next group of suggestions involve improving the air flow. Here again I start with the cheapest. By using an external fan, you can cool the memory boards directly. It is an easy and surprisingly effective method, but it does mean that the cover must be left off the computer, and it makes things noisy and drafty for the operator.

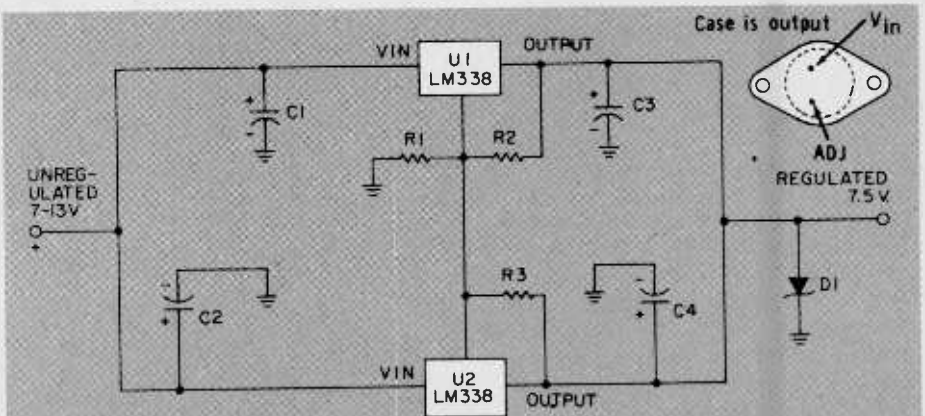
Before going further, you should check the airflow in the chassis both with and without the cover on. Use a smoking match or candle. You may get quite a surprise; quite likely you'll find that most of the cooling is applied to the power supply, with the memory area left to bake. You may also find that the air flow works only if the cover is in place; otherwise the fan just draws air from the room and blows it out the back of computer.

If you find that the fan does in fact cool the memory area, you can consider replacing it with a more efficient one. Often, however, a bigger fan won't fit. If it will, check the flow rate, since bigger isn't necessarily more efficient. Check the power drain and noise level, too. This information should be available from your dealer.

Preregulated Power. My final suggestion is to preregulate the power supply before it reaches the bus. This will help since the voltage applied to the bus varies widely, causing the on-board regulators to work to their limits and so produce more heat. The unregulated +8 volts can actually vary from 7 to 13 volts, and the ±16-volt lines can vary by 7 volts or more. I chose to preregulate only the +5-volt supply, as it is the main culprit (the only one on a static board). Naturally, heat will still be produced by the preregulators, but you can heat sink them properly and place them well away from the memory area where heat can be dissipated safely.

Caveat Preregulator. Several words of caution are in order at this point. You will probably void your warranty by making modifications, so be sure you

(Continued on page 81)



PARTS LIST FOR PREREGULATOR

C1-C4—1-uF tantalum capacitor
D1—9.1-volt Zener diode
R1—620-ohm, ½-watt resistor (see note in text)
R2, R3—270-ohm, ½-watt resistor
U1, U2—National Semiconductor LM338 variable voltage regulator
Misc.—Heat sinks, wire, solder

Antique Radio Corner

Rewinding transformers and a plea for the future

BY JAMES A. FRED

☐ There is a lot of interest in collecing antique advertising items that are related to radios and their accessories. Among these items are cloth banners, lighted and animated signs, metal signs, cardboard cutouts, magazine and newspaper advertising, ash trays, newspaper electrotypes, lamps and paperweights.

Nostalgic Radio Paraphenalia. I have a lighted RCA Tube sign that causes so much radio interference that I must turn it off during listening tests on radios. I have seen several beautiful animated signs that are amazing, considering their age. Many metal signs have survived, and there is one present day collector who is offering a replica of an old De Forest radio sign. Most of the cardboard signs have been destroyed because of their fragility.

The best place to find these old signs are in flea markets and antique shows. Several enterprising flea market vendors have removed radio advertising pages from 1920's magazines and are selling them for $5.00 each.

Atwater Kent had advertising table lamps and lead pencils with his name on them. His early battery radios had a wire holder for a pencil, which made it handy if the set owner wanted to log the stations he received. The listener could also record the three tuning dial numbers in case he wanted to find a station again.

Newspaper electrotypes are also interesting collectibles. Being made of wood and metal, most have survived. I've found several in flea markets that either have the name of a radio, a microphone, a radio, or perhaps a group of people looking at a radio set.

You will find other items now and then such as paperweights. Most are made of a rectangle of glass about three inches by six inches long with an adertisement mounted on the bottom. You may also find glass ash trays or embossed metal ash trays. Once you have started to search for advertising objects you will be surprised at how many you can find.

One of the biggest problems radio collectors have is finding transformers. In an old radio receiver there are several varieties of transformers. There are audio, both interstage and output, and power transformers.

Winding Your Own. We have discussed the audio transformer several times during the past five years. The problem is now more acute than ever, with audios nearly non existant. Stancor A-53 interstage transformers are nearly impossible to find. The price of anything that uses copper wire is increasing all the time. There are a few technicians who will rewind audios, but they are hard to find. Taking everything into account, the audio transformer situation is very bad.

Power transformers are another story. There are many of these transformers sitting on radio parts jobbers' shelves, but they have increased in price several times while they've been gathering dust in corners.

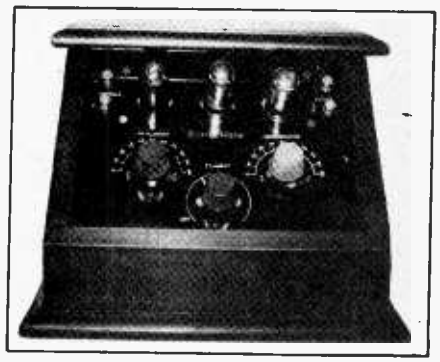
One problem with those transformers is that while they have the high voltage winding we need and the 5-volt rectifier filament winding, they have a 6.3-volt winding we cannot use on the pre 1932 radio sets. Any radio made before 1932-33 had either a 1.5,- 2.5,- or 5-volt filament tubes. Finding any kind of a transformer with a 1.5- or 2.5-volt winding is very difficult. A burned out transformer can be rewound, but a professional rewind job will cost $25.00 to $50.00 or more.

Unless you have an extremely interesting or valuable radio, this is a lot of money to spend. For instance, if you had a Scott or a Silver-Marshall it would be worthwhile to have the transformer rewound.

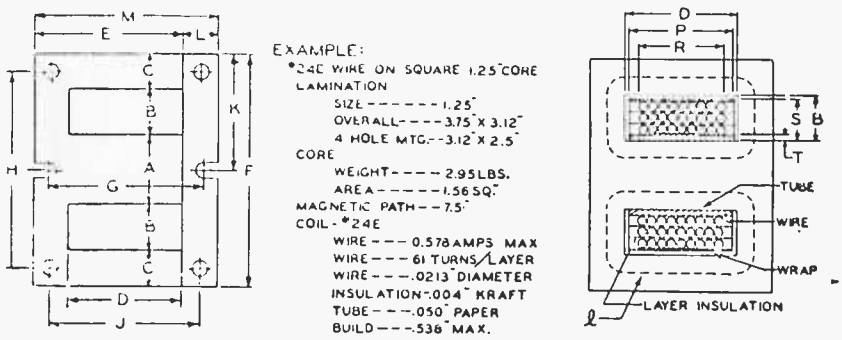
Transformer design is tricky and requires technical knowledge as well as complete specifications on copper wire and silicon steel for the core. But since most collectors aren't engineers (and neither am I) I am going to share my 45 years of experience in the radio electronics business with you. You may not be able to design power transformers from scratch, but you will be able to restore, modify and adapt transformers to fit your equipment.

Transformer Basics. Basically, a transformer consists of iron or steel laminations and copper wire. If you want to absorb the theory behind transformers you can find it in any electronic textbook. What I am going to tell you is good, practical information usually not found in books.

The wattage rating of a transformer depends on the cross sectional area of the center leg of the transformer core. The majority of transformers you will encounter will have the core made up of thin steel laminations shaped like an



A beautiful three tube Echophone would be a great addition to any collection.



As noted in the text, many transformers have an E shaped and an I shaped piece of steel that forms the transformer body. Insulated copper wire surrounds the center post.

"E" and an "I." The forms are stacked alternately to make a pile of laminations high enough so that the cross sectional area of the center leg of the "E" will equal one square inch of each 50 watts that the transformer is rated at.

This applies to transformers made from 1928 to about 1950. More recent transformers have higher grades of steel laminations which allow higher ratings. Since we are confining our discussion to radios built before 1945, we will use the figure of 50 watts per square inch of cross sectional area.

Wire Size. Another important fact to consider is the size wire necessary to supply the current needed for your radio. To determine this you will need a tube manual and a circuit diagram of the radio. Magnet wire is numbered to designate the different sizes.

Whenever you buy wire, you ask for the wire size number instead of its diameter. The cross sectional area is the quantity that determines its current carrying capacity. Of course, you must use insulated wire in a transformer. To estimate the current carrying capacity of a wire you can divide the cross sectional area in circular mills by 500. In other words your wire will carry 1 ampere for each 500 circular mills. This is the amount of current the old-time engineers figured the wire would carry without excessive heat.

Suppose you have an old radio with the following tubes:

3 Type 226s drawing 1.05 amps. each at 1.5 volts
2 Type 227s drawing 1.75 amps. each at 2.5 volts
2 Type 271As drawing .25A each at 5 volts
1 Type 80 drawing 2 amps. at 5 volts

This makes a total of 8 amperes, so you will need a center-tapped high volt- Even though the 71As require 5 volts, as does the Type 80, you cannot use the same winding for both of these tubes simultaneously.

In addition to the filament voltages, you wil lneed a center-tapped high voltage winding. This voltage is rectified by a Type 80 full wave rectifier to provide the high B + voltage needed in the radio.

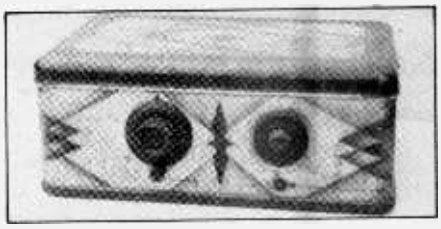
There is one more quantity we need to know before we can go ahead and rework a transformer for the radio set. We need to know how many turns of wire to use for each volt the transformer will deliver. This quantity is called "turns per volt." More about this later.

We now have all the information we need to attack the transformer problem from a practical standpoint. Let us suppose that we have a radio with the tubes listed previously. We have a transformer on hand that has the proper high voltage winding, a 5-volt at 2 amperes winding for the rectifier tube but only a 6.3-volt at 4 amperes filament winding. Can we remove the 6.3-volt winding and replace it with a 5.- 2.5.- and a 1.5-volt winding? The 6.3-volt winding will provide over 25 watts of power, but we only need 16 watts. This would mean that we could successfully convert the 6.3-volt winding to the three windings we need.

Calculating Losses. Of course, we know that there are losses in every electrical and mechanical device. In a transformer the losses add up to about 10 percent and include core losses, hysteresis losses and the IR drop in the wire. So we should add about 10 percent to the number of turns we figure we will need for each winding. This is the reason the no-load voltage of a winding is usually 10 percent higher than the rated voltage.

Before dismantling a good transformer, carefully measure the voltage of all the windings. The primary winding usually has black leads and connects to the power line. The 5-volt leads are green, the 6.3-volt leads are yellow, the high voltage center tap is red with a yellow tracer and the other two high voltage leads are red.

You may find transformers that were made before color coded wires became standard so be careful. Remember, the 115 volt line voltage can be lethal; and the high voltage winding is even more dangerous, going as high as 800 volts. It always zaps you when you are careless and least expecting it.

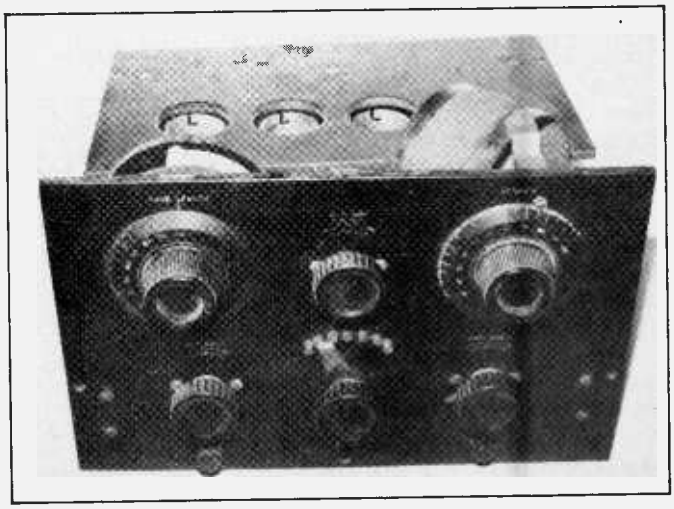


There is quite an unusual paint job on this old Atwater Kent model 37 radio receiver.

Mutilated Radios. There is nothing that makes me so unhappy as finding a piece of mutilated antique radio equipment. Last summer I attended an auction sale of the estate of a deceased electrical/electronic collector. If the merchandise had been good when he acquired it, he had reduced a lot of it to junk by that time.

Worst of all, from my viewpoint, were a number of radios and accessory equipment that had been modified.

Think Ahead. If you don't mind my getting up on a soapbox I have one comment to make: DON'T!. I repeat DON'T ever cut up, or otherwise mutilate a piece of antique radio or wireless gear. I know that you bought it and can do with it as you please, but keep in mind the future generations of young people who will never have any knowledge of early radio equipment except what is now in the hands of present day collectors. Try to leave your radios in as good or better shape than they were when you found them. As a collector, I believe we all have an obligation to future generations to do this. ■

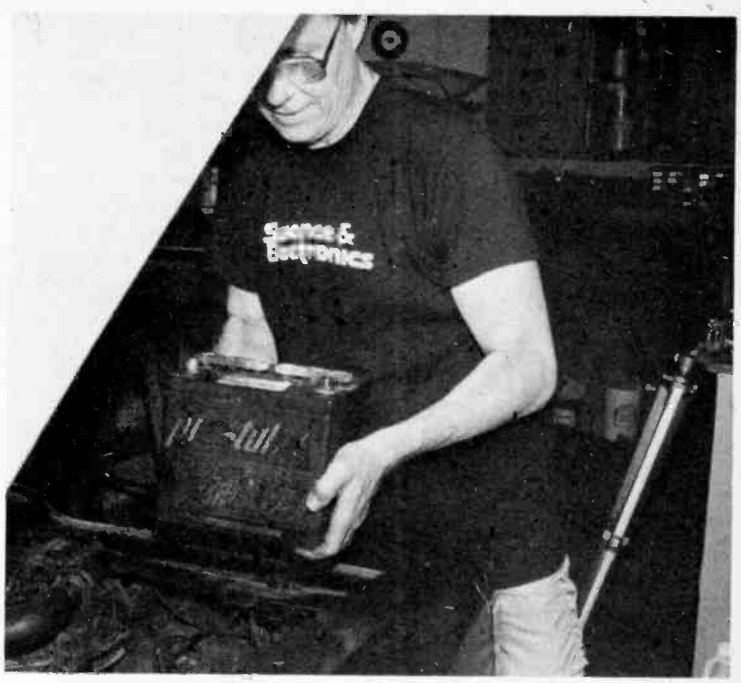


The Federal model is quite a beauty. This model is quite rare because it was originally intended to be mounted in a lowboy cabinet with a phonograph. It's a real find.

Installing a Battery Pan Replacement

A simple but crucial repair for your car's electrical system

BY JULIAN S. MARTIN



MY NEIGHBOR RETURNED home from a shopping trip in his 1975 Ford with a troubled look and a blush on his wife's face. Only after he parked in my driveway and said, "You gotta help me!", did I learn the full story. With the hood up I saw the battery tied down in place with some material that resembled pantyhose. That was the blushed look. There were some scratches and pit marks on the positive terminal. That was what the troubled look was all about!

What happened was simple to deduce, between my friend's babbling and an eyeball inspection. I removed the battery and found the original battery tray was corroded away, with edges broken off. Slots where the battery tie-down rods fitted were rusted away. My neighbor had hit a bump coming out of a parking lot, the battery broke loose from the tie down rods, the battery tray collapsed and the battery slid off. The positive terminal touched metal alongside the fender causing the motor to stall. Fortunately, the short was brief and no further damage occurred.

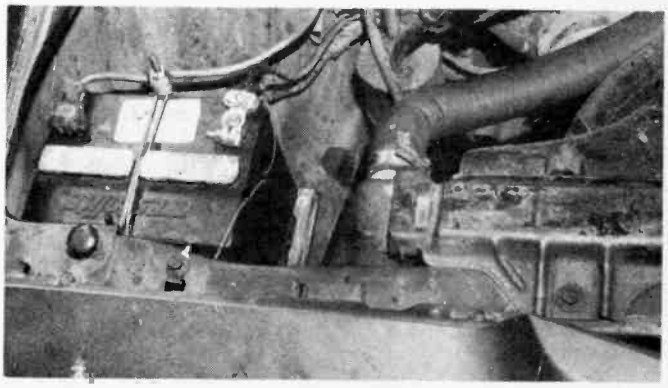
Go to work. First off, the old battery tray was removed. It took some doing because the original self-tapping bolts were frozen in place. Hammer and cold chisel could not break the heads off because limited space prevented the swing of a hammer. So, we drilled out the bolts, and removed the battery tray. No trouble getting in a replacement battery tray. Even two of the original holes lined up with the slots on tray. Two new mounting holes were drilled and the tray was mounted.

The new battery tray did not seat the battery snuggly because a universal anything fits nothing. Two wood blocks bolted in place with No. 6 machine screws gave the battery a snug seat in the tray. The original tiedown rods were used again because they were serviceable. However, the tie-down rod that rested on top of the battery was not, so we fashioned some 3/16 in. steel rod to replace the unusable part.

Battery maintenance procedures by the car owner could have prevented this mishap. Don't leave this to the garage mechanic without your checking the work. Since we had the battery out, we cleaned the top and sides, and steel-brushed the terminal posts. When the battery was mounted, we discovered that the negative terminal battery clamp was defective. So we replaced it and, remembering an old radio trick, added a No. 12 wire to the clamp which I connected to the body frame. Naturally, an electrolyte specific gravity check was made, and water was added.

My friend is smiling now, and his wife is still blushing. But, the old Ford is rolling again, and, my friend claims that the ignition noise on the radio is all but gone. ■

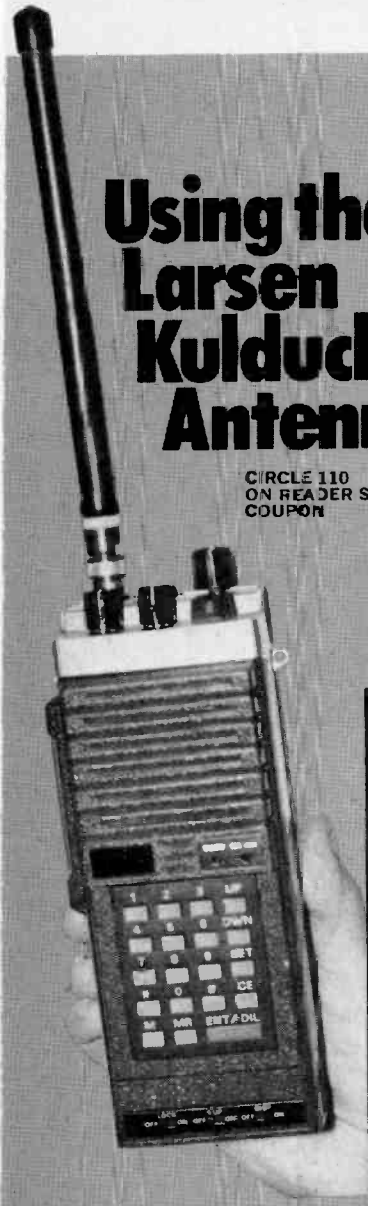
Putting in a battery pan is easy but do it right. Make sure the pan is level and secure.



Cleaning off your battery is a good idea when you replace your old rusting pan. If you need a new battery pan, the battery posts and connectors probably require cleaning.

Using the Larsen Kulduckie Antenna

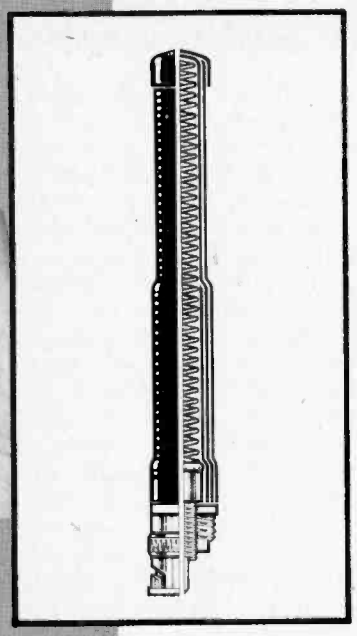
CIRCLE 110 ON READER SERVICE COUPON



Boost the output of your two-meter handheld with this rugged detachable antenna

YOU'VE ALL HEARD claims made by manufacturers that their products will outperform the competition hands down. And you've all just smiled, most likely, and thought, "tell me another." Well, here's one claim of superior performance that turned out to be a modest and retiring understatement. For, when Larsen Electronics suggested that their new Kulduckie flexible antenna for two meter handheld transceivers was noticeably more efficient than the average two-meter rubber duckie antenna we just figured, "well, here's another promotional puff. We get them all the time." But, as you'll find out if you read on, things turned out considerably, and pleasantly, differently.

First Surprise. The first hint of something different came upon a visual examination of the Kulduckie. Compared to a standard rubber duckie, it's a little unusual. It has a stepped configuration, much like a two-stage ballistic missile. Moreover, while it will bend, it's a lot stiffer than most rubber duckies. And its "rubber" coating is a lot shinier than is usual. Also, it is a bit longer than the other similar antennas.



By using air wound copper wire, Poly-Olifin shrinktubing as insulation and many other clever features, Larsen Electronics has built a superb antenna.

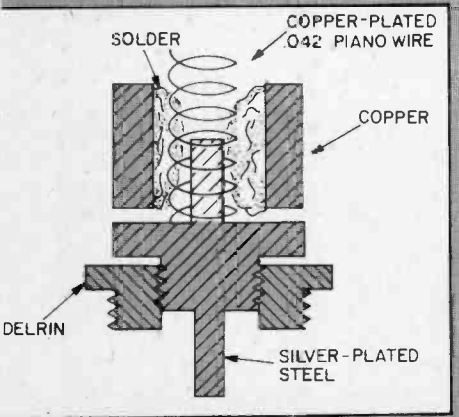
Second Surprise. When we plugged it into our Yaesu FT-207R test rig, we expected to see a small increment of improvement in our transmitted signal. After all, the antenna is slightly longer than our reference rubber duckie. Therefore, it has a bit more radiating area. But actual measurements were something else again. For the Larsen Kulduckie outperformed our reference duckie by somewhere over 20% in transmitter radiated power. That is an average measurement, using our field strength meter. In actual operation, the Kulduckie accessed repeaters that the reference rubber duckie never even touched. In on-the-air tests, every contact we tried switching off with confirmed that the Kulduckie made a substantial improvement in signal strength. We were quieter into every repeater we tried the unit with.

Third Surprise. For those of you who have used the Yaesu FT-207R, you know that it does draw a bit of power when in the high power transmit position. A shade over 800-mA, to be exact. Well, following up a tip from a friend who knows the Yaesu very well, we measured current drain in transmit using the Larsen Kulduckie.

So How Come? Well, we sat down to figure out just why the Larsen antenna does such a good job. The increase in efficiency as far as power output is concerned is easy enough to explain. It works better because it's made better. It uses air wound .042 wire for the radiating element, and the wire is plated with a high-conductivity copper alloy. The wire is carefully flood-soldered to the base connector. Furthermore, while many rubber duckies use plain PVC as the insulator-coating material, PVC is not the greatest insulator at VHF frequencies. Larsen uses Poly-Olifin shrinktubing as its insulator, thereby achieving a lower dielectric loss, hence a greater radiating efficiency because less RF energy is lost in internal heat. The Poly-Olifin is later dipped in PVC for a durable finish, but the PVC is never in contact with the radiating element. Contact areas are silver-plated, and to demonstrate the special care that goes into the construction, the cap assembly is never allowed to come into contact with the radiating element.

All this is very interesting, we know, but does it explain not only the increase in transmit efficiency, but also the reduction in transmitter power consumption? Well, partially. The greatest concensus of opinion among our technical staff here is that besides being more efficient, the Kulduckie also presents a load to the transmitter final that is closer to the ideal 50-ohms. Because the final is loaded properly, it operates more efficiently.

So, if you want the best of both worlds, and especially if you want to inject new life into your old hand-held, pick up one of the new Larsen KD series Kulduckies, for $12.50. Larsen Electronics is located at 11611 N.E. 50th Ave., P.O. Box 1686, Vancouver, WA 98688. For more information circle number 110 on the Readers Service Card. ■



View of Kulduckie's base shows care in Larsen's manufacturing process.

AM/FM Receiver Alignment

A simplified approach to an important adjustment procedure

BY ANTHONY J. CARISTI

THE WORDS "RECEIVER ALIGNMENT" often conjure up a mysterious and complicated procedure which can be performed only by an expert. While it it true that receiver alignment should not be attempted by anyone who does not have the necessary skills and equipment, it is not a very difficult procedure if you have some basic guidelines. This article will explain the various procedures for aligning AM, FM, and AM/FM receivers using a minimum of equipment.

Before getting into the mechanics of receiver alignment, it is important that the service technicians understand the basic operation of the receiver, and why proper alignment is necessary. To this end, a discussion of the modern superheterodyne receiver will follow.

Receiver Fundamentals. Virtually every AM and FM receiver manufactured today is a superheterodyne receiver. They utilize a built-in RF oscillator and mixer circuit to convert the received signal to a lower frequency called an intermediate frequency (IF). In a given AM or FM receiver, the IF remains the same frequency regardless of which radio station is being received.

The basic advantage of this type of circuit is that the greatest part of the RF gain, and bandpass characteristic of the receiver, is provided by the IF stages, and is a constant for all received frequencies. Thus, the manufacturer of the receiver can precisely determine the sensitivity and selectivity of the receiver. Proper alignment ensures that the receiver performs exactly the way the manufacturer intended. Refer to Fig. 1, which is a simplified schematic diagram of the RF and IF sections of a typical modern day AM receiver.

In Fig. 1, simplified AM radio schematic, you will note a combination mixer-oscillator stage, and two stages of IF amplification. This circuit is typical of a minimum cost AM receiver which has a two gang tuning capacitor and no RF amplifier. Such a circuit might be used in the common pocket-sized AM transistor radio. More expensive receivers will use a similar circuit with the addition of a transistor stage for RF amplification.

In the circuit of Fig. 1, the received signal is picked up by the loopstick antenna and is fed to the base of Q1. This transistor stage is used as a combination local oscillator and mixer, and is actually a Hartly oscillator with the received signal being placed in series with the base drive of the oscillator. The frequency of oscillation is determined by C3, C4, and T1. At the same time C1, C2 and the loopstick antenna are tuned to the received signal frequency. The output of T2 contains several frequencies: the radio station frequency, the local oscillator frequency and two new frequencies equal to the sum and difference of the local oscillator and received frequency.

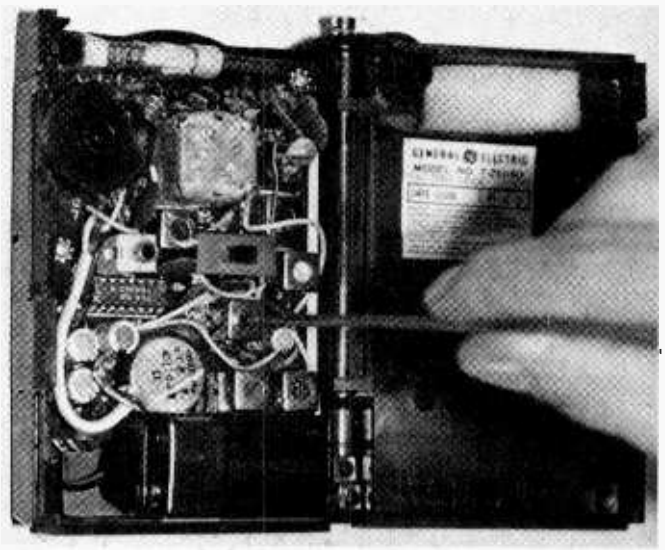
It is the function of the two IF stages, Q2 and Q3, to amplify the difference frequency (IF) and reject all others. This is accomplished by tuning all IF transformers, T2, T3, and T4, to the specified frequency. For most AM receivers, this is 455 KHz. The tuning of these transformers is performed during alignment of the receiver.

FM Circuitry. Fig. 2 is a simplified schematic of a typical FM receiver. In this diagram you will note the similarity with the AM receiver schematic of Fig. 1. This basic difference, aside from the higher operating frequency, is that the FM receiver employs an RF amplifier stage, Q1.

Most FM recevers have at least one RF amplifier, since it is the nature of FM transmission that weaker signals than AM are usually encountered. Good FM reception requires a solid signal in the IF amplifier, so that effective limiting takes place. Note also the requirement of a three gang variable capacitor instead of the two gang as appears in Fig. 1. The additional cost and size of this capacitor is one reason why most AM receivers have no RF amplifier stage.

Although the IF amplifier stages of the AM receiver and FM receiver appear to be similar, there is a substantial difference in the way in which they are designed. The bandwidth of an AM radio station is just 10 KHz, and the receiver must be designed to have an IF bandwidth no greater than this. Such a narrow bandwidth is easily controlled by the design of the IF transformers which, when tuned to the same frequency such as 455 KHz, will provide the desired bandwidth of 10 KHz.

In the case of FM reception, and especially Stereo Multiplex FM, good reception requires a recever with at least 150 KHz bandwidth. It is the nature of FM to have significant side-



In simple cases of misalignment, adjustment of the IF transformers is often sufficient. Tuning these transformers and paying close attention to the dial placement can bring a set back onto frequency without the use of other test equipment.

bands on either side of the carrier frequency, as far away as 75 KHz. Such a wide bandwidth in the IF stages of an FM receiver cannot be attained by tuning each stage to the same frequency. What is done is to stagger tune each stage, so that the resultant overall response has the required bandwidth. Note that each IF transformer in Fig. 2 has separate tuning slugs for primary and secondary which permit stagger tuned alignment.

Because of the problem of attaining proper alignment in the IF stages of an FM receiver, the more expensive designs utilize special filter circuits which are tuned at the factory and require no adjustments in the field. You will find that many modern stereo receivers are designed this way. However, these types of receiver still require alignment of the RF and local oscillator sections of the unit as you would expect.

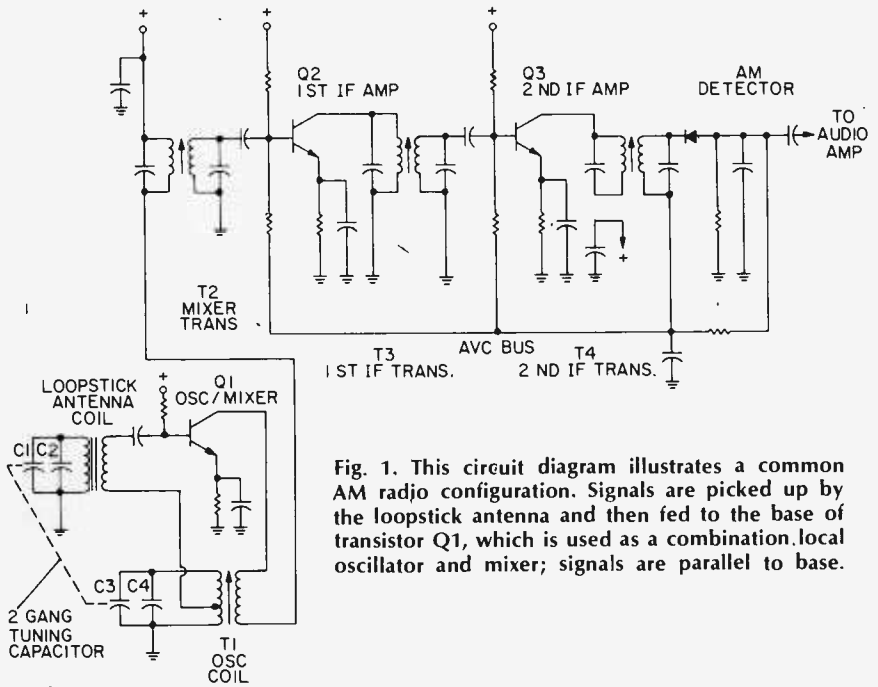


Fig. 1. This circuit diagram illustrates a common AM radio configuration. Signals are picked up by the loopstick antenna and then fed to the base of transistor Q1, which is used as a combination local oscillator and mixer; signals are parallel to base.

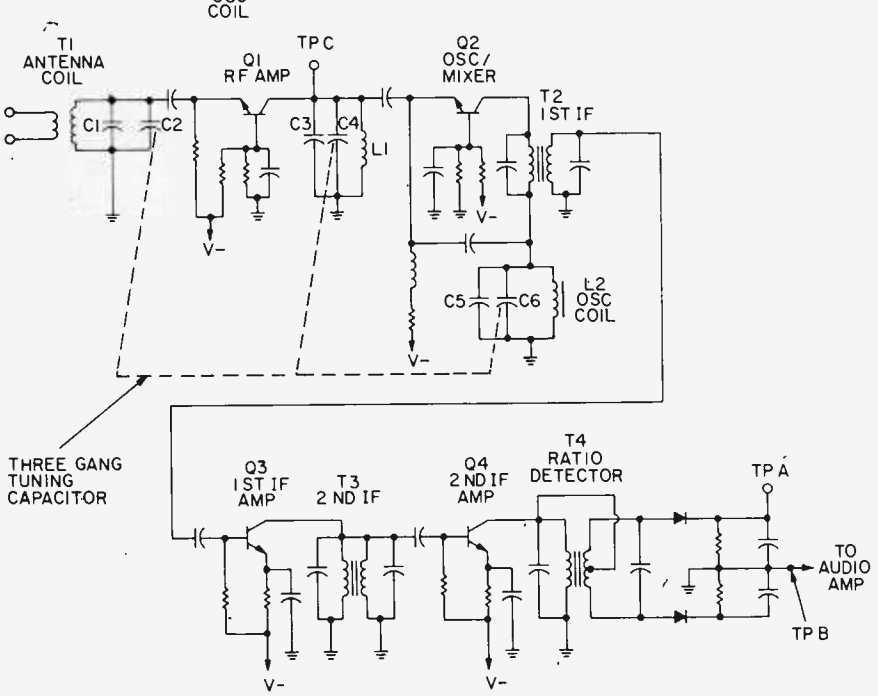


Fig. 2. While there are similarities between FM and AM circuitry, the most obvious difference shown in this FM circuit schematic is an RF amplifier stage to boost signals.

AM Receiver Alignment. Alignment of an AM receiver is a relatively simple procedure, and can actually be performed by using existing radio stations as a signal source instead of a signal generator. However, if a signal generator is available, it is always best to use it as described in the following paragraphs.

When performing the alignment of an AM receiver, connect a few loops of wire across the output cable of the signal generator and loosely couple the loops to the AM antenna coil. Use the smallest RF output from the generator that will produce a reliable meter reading. For a tuning indicator you can connect a VTVM or VOM set to measure AC volts across the voice coil of the speaker.

An alternate method is to measure the DC voltage level on the AVC (Automatic Volume Control) line of the receiver. This requires a high impedance DC voltmeter such as a VTVM.

The alignment procedure will, of course, depend upon the number and type of adjustments in the specific receiver under test. If possible, obtain the manufacturer's alignment procedure. In the absence of such information you can use the following procedure.

IF Alignment. The first adjustment to be performed is the IF alignment. Set the signal generator at 455 KHz. with about 30% to 90% amplitude modulation. Loosely couple the output of the generator to the antenna coil of the receiver and listen for the audio modulation in the receiver speaker as the RF generator is varied about 455 KHz. If you do not obtain any audio around this frequency, the IF of the receiver may be another frequency, such as 262 KHz.

Once you have determined the proper frequency, set the generator at 455 KHz. or whatever the specified intermediate frequency may be. Connect the VOM across the voice coil of the receiver and adjust the IF transformers (T2, T3, and T4 in Fig. 1) for the maximum reading of the meter.

As you progress with the IF alignment, you may find that you can lower the RF output of the signal generator to prevent overload of the receiver. When you are satisfied that all IF transformers are tuned so that no further

increase in meter reading can be attained, the IF alignment is complete.

The next set of adjustments will align the upper and lower settings of the tuning capacitor. This is accomplished in two steps, which will have to be repeated several times, since the adjustments have some interaction with each other.

The initial adjustments are made at the high end of the broadcast band. Set the tuning dial to a silent point (where no radio station is received) near 1600 KHz. Set the RF signal generator to the same frequency. Adjust the two trimmer capacitors (C2 and C4 in Fig. 1 for maximum meter reading.

Then set the tuning dial of the receiver to a silent point around 600 KHz. and set the signal generator to the same frequency. Adjust the oscillator tuning coil (T1 in Fig. 1) for maximum meter reading.

Repeat the adjustments for 1600 KHz and 600 KHz as described above until no further improvement can be made. Once you have done this, the AM alignment will be completed.

FM Receiver Alignment. Proper FM alignment requires the use of a sweep generator and oscilloscope, unless the receiver under test has a fixed tuned IF section which is permanently aligned at the factory. The generator may be coupled to the antenna terminals of the receiver using the circuit of Fig. 3, which matches the 50-ohm impedance of the generator to the 300-ohm input impedance of the FM receiver.

Some receivers may have highly selective front ends which make injection of the 10.7 MHz IF through the RF stages difficult. In these receivers you may couple the output of the signal generator to the input of the first IF amplifier stage through a 10-pf capacitor. This point is shown in Fig. 2 as test point C. Use only sufficient signal strength to achieve a usable display on the oscilloscope. Fig. 4 is a typical connection diagram of the receiver, generator and oscilloscope.

The first section of the FM receiver to be aligned is the IF amplifier. Set the signal generator to a center frequency of 10.7 MHz. and a sweep width of about 450 KHz. An FM sweep generator should have a marker system which allows you to identify the important frequencies of interest, such as 10.6, 10.7, and 10.8 MHz. These markers indicate the desired bandwidth of the IF amplifier.

Connect the Y input of the oscilloscope to test point A of Fig. 2, and adjust the scope controls to obtain a display similar to Fig. 5. Adjust all IF transformers (T2, T3, & T4 in Fig. 2) so that the amplitude of the display is maximum, while preserving the symmetry of the waveshape at about 10.7 MHz. Bear in mind that low cost FM receivers will have a waveshape similar to that of waveform A, while high quality receivers will have the preferred waveshape B of Fig. 5.

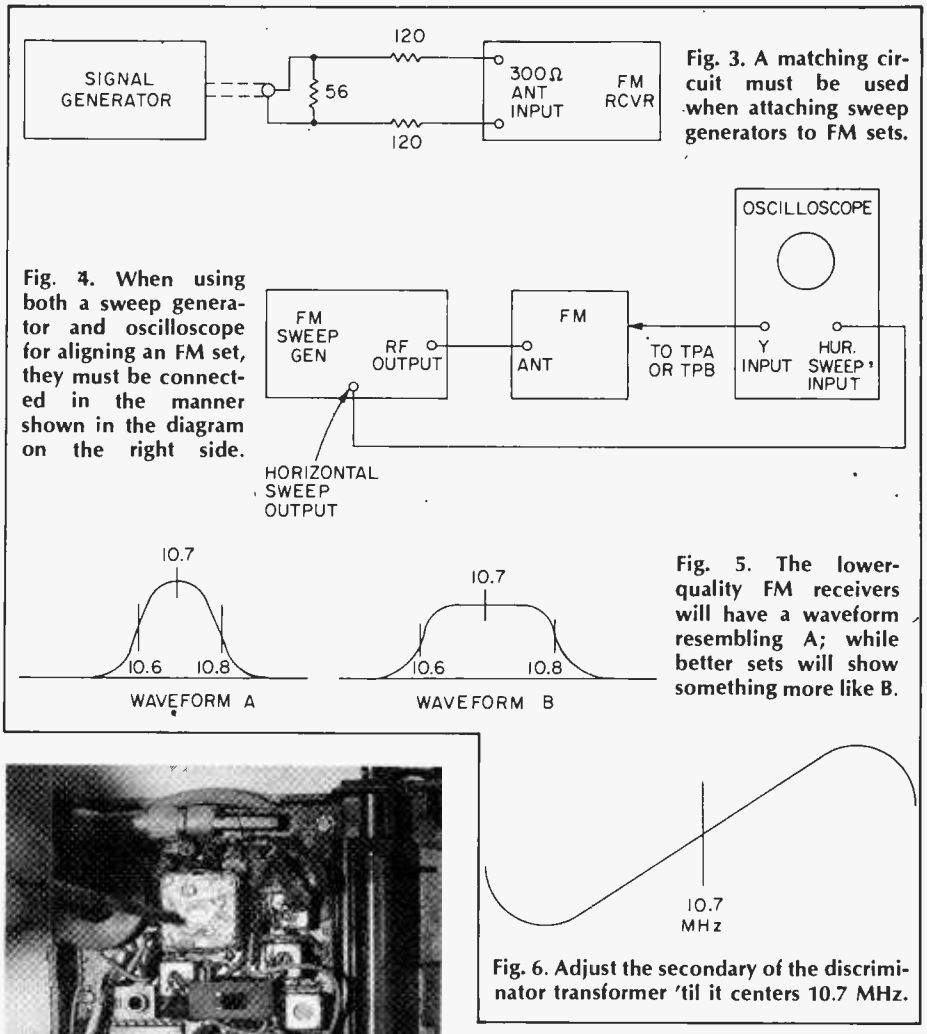


Fig. 3. A matching circuit must be used when attaching sweep generators to FM sets.

Fig. 4. When using both a sweep generator and oscilloscope for aligning an FM set, they must be connected in the manner shown in the diagram on the right side.

Fig. 5. The lower-quality FM receivers will have a waveform resembling A; while better sets will show something more like B.

Fig. 6. Adjust the secondary of the discriminator transformer 'til it centers 10.7 MHz.

Adjusting the FM trimming controls is a preliminary step to curing misalignment.

The next step is the adjustment of the Ratio Detector or Discriminator. Connect the Y input of the oscilloscope to test point B of Fig. 2, and adjust the secondary of the Ratio Detector or Discriminator transformer (T4 of Fig. 2) to place the 10.7 MHz marker at the center of the S curve, as shown in Fig. 6. Readjust the primary of the same transformer for maximum amplitude and straightness of the line between the positive and negative peaks. This completes the alignment of the IF section of the receiver.

Trimmer Adjustments. The final adjustments to the FM receiver are made to the trimmer capacitors, which are connected in parallel with the main FM variable capacitors. These are shown in Fig. 2 as C1, C3 and C5. Note that some FM receivers, especially the higher quality ones, may have four such trimmer capacitors. These adjustments are made with the FM tuning dial set to near the high end of the range, (108 MHz).

Set the FM dial to a silent point near 108 MHz. Set the signal generator to the same frequency as the dial setting, and couple the output of the generator to the antenna terminals of the receiver as shown in Fig. 3. Connect a DC voltmeter to test point A as shown in Fig. 2, and use only enough signal output from the generator to attain a reliable meter reading. Adjust C1, C3, and C5 as shown in Fig. 2 for maximum meter reading.

(Continued on page 81)

CB SPECTRUM

Noise Cancelling Mikes—by Turner

BY KATHI MARTIN KGK3916

ALL THE YEARS that I've been involved in CB I have preached CLEAN talk power. Time after time I've shown in this column that when the signal gets drowned out by noise, none of the powermikes or other gadgets and gizmos are really worth anything with new, 100% modulation-limited transceivers. They invariably overload the modulator, so what comes out is a mushy, distorted modulation that is virtually unreadable when the signal sinks into the noise.

Adding extra microphone gain through a powermike only drives the modulator into greater compression. But everything has its limits. The compressor is intended for a barebones mike (with no extra amplification); when hit with the extra level from a powermike the average transceiver compressor overloads and generates distortion. When the received signal is strong, the distortion sounds "full and rich," as if the signal is all *talk power*. But when the signal falls into the noise level, the distortion actually interferes with signal's readability.

Older Sets Benefit. Many of the older—particularly tube-type—transceivers can use the extra output of a power mike. However, few late model 23-channel rigs—and *no* 40-channel models—get any benefit from a powermike. A powermike can only make things worse or leave them as they are. It leaves things alone when the powermike's gain is reduced to that of an unamplified mike; but if you're not going to use a powermike's amplification, why pay for something you're not going to use?

Ambient Noise. Another part of the problem is *ambient noise*. A modern rig is sensitive enough for a flea's whisper; so if it's that sensitive it will also pick up ambient noise that will mask voice modulation. While ambient noise might not be a problem at a base station where the only ambient sound is that of dust settling on the carpet, it is a problem for mobiles, particularly when driving with the windows open.

All sorts of exterior noises and wind roar are sensed by the mike; and they tend to obscure the message conveyed by the modulation. Yet it's out on the road where CB is most needed—and where clean modulation should be a first consideration—that the high mike gain used in modern transceivers works against effective communications.

How then do we get the most *effective* modulation without doing a rebuilding of the transceiver? By using a mike that attenuates the unwanted noises and sounds: a mike that's called a Noise Cancelling Microphone, such as the Turner AMM-46 and RK-56.

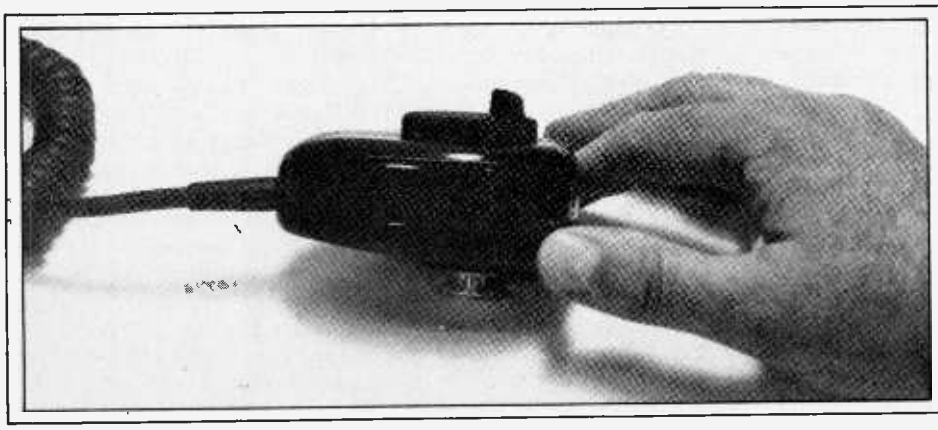
The Turner AMM-66. The mike that makes the difference is the Turner AMM-66, which is specifically designed for close talking. Unlike standard mikes, which usually break up when hit by a strong voice level right up against the windscreen, the AMM-66 Noise Cancelling Microphone is designed to be used right up close. In fact, there's a small projection on the windscreen that keeps the mike off the lips—that's how close it's supposed to be used. The frequency response of the mike is tailored for close talking—it doesn't "blow out" with a rumbling bass—and the element cavity attenuates sounds (noises) which aren't aimed directly into the mike. Not only is the sound cleaner, but ambient noises are attenuated.

True, when the signal using a noise cancelling mike is received wall-to-wall, with the S-meter pinned to the right, it sounds somewhat *thin*. This is because we've been conditioned to think of the distorted mush common to most transmissions as "talk power." Actually, "talk power" means a signal that can be read under the most possible conditions. And for this you need a clean, undistorted signal. (Out where the signal has to fight its way past the noise, it's the clean signal that gets through.)

Noise cancelling mikes such as those from Turner are universal in the sense they can be used with any rig. The AMM-46 and RK-56 are both dual impedance (500K ohms, nominally 500 ohms); you just select the appropriate color-coded wires. Both contain a SPDT PTT switch that can accommodate just about any standard Push-To-Talk wire connections. (You just supply the necessary mike plug.)

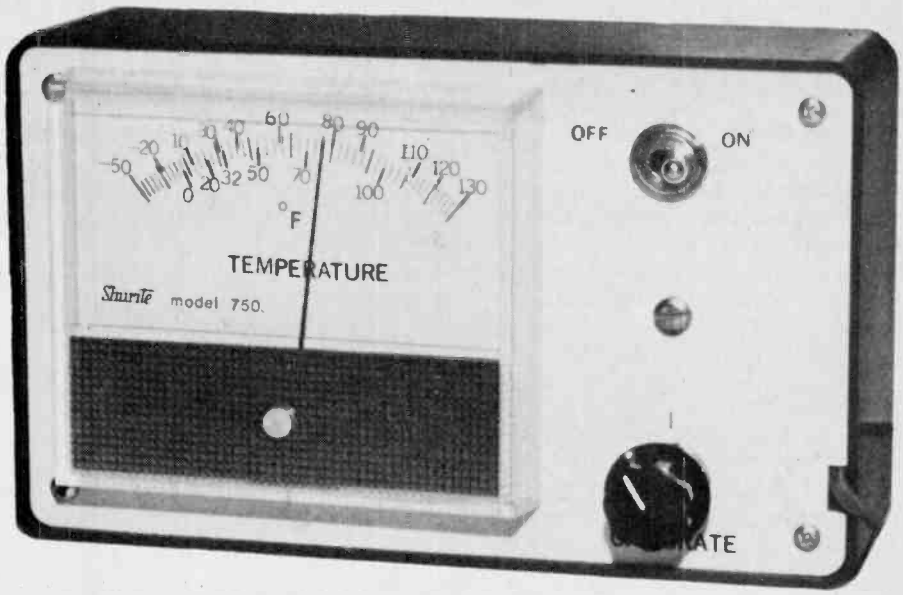
The AMM-46 is intended for the technically skilled: all that's supplied for a wiring aid is a schematic. The RK-56, which is housed in a "police style" case, is specifically intended for CB installation by the novice. It is supplied with a wiring guide for virtually every CB transceiver I have heard of, and many I never knew existed. You just hook up your transceiver according to the wiring booklet that's included and match the color coded wires to the plug connections listed.

For more information on Turner Noise Cancelling Microphones, circle No. 55 on the Reader Service Coupon. ■



Noise cancelling mikes, such as the Turner AMM-66, can be used with any CB rig. These mikes are the most effective way to reduce all the unwanted sounds and noises that come across your set. Powermikes do not get rid of the noise; all they can do is to amplify it. The Turner AMM-66 is designed to be used up close; other mikes will break up when a strong voice is close to the windscreen. Great thing about the Turner mike is that there are two models: AMM-66 and RK-56. AMM-66 is designed for the technically skilled and the RK-56 is housed in a police styled case so its installation can be done by most any CB novice.

CIRCLE 55 ON READER SERVICE COUPON



SITRAT

Build this highly accurate electronic thermometer

BY THOMAS R. FOX

SITRAT IS AN ELCTRONIC thermometer that requires six components and a battery. The parts are readily available. You may already have them in your junk box. All you need to build the SITRAT is one NPN silicon transistor a potentiometer, 2 resistors, a zener diode, a battery and a 0-1 milliampere panel meter. There's a good chance you can salvage the meter from some previous project. Maybe that neutrino monitor you designed that was to estimate the rate of energy conversion of a Quasar! If you purchase a brand new panel meter it should set you back between five and nine dollars. Other parts combined, if purchased new, should cost less than three bucks.

The author's prototype model of SITRAT is just as accurate with a weak battery as with a brand new one.

The Circuit. In the circuit diagram, the current flowing through the meter is the transistor's collector current. Collector current increases when the transistor's temperature does. This means that the meter's needle goes up when the temperature does. That's basically all the theory you need, to understand how SITRAT works!

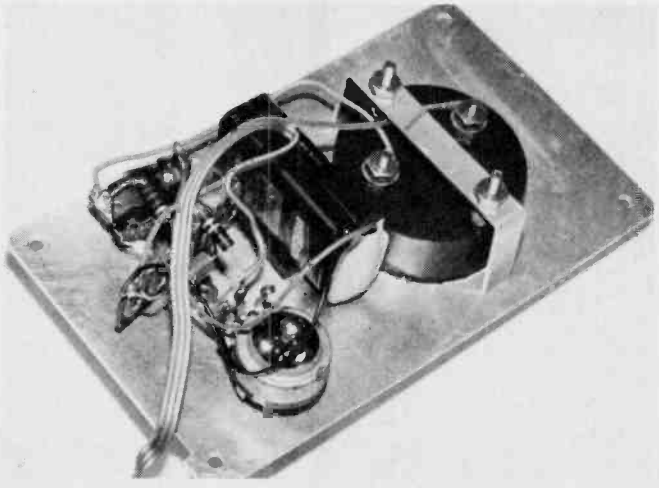
For those who desire a little more insight into this thermometer, notice that the base current flows through R1. Since R1 is a potentiometer we can set the transistor's base current to some specific value by just turning R1's knob. By definition, a transistor's collector current is just its base current times its DC current gain, usually abbreviated β_{DC}. Collector current is equal to the DC current gain times the base current plus I_{CEO}, which is the collector cut off current with the base open. However, I_{CEO} is negligible in silicon transistors so we don't even mention it here. This means, if we squirt a tiny current into the transistor's base, out of the collector comes β_{DC} times the current we squirted into the base.

Let's suppose we have a transistor with a DC current gain, at room temperature of 100. We apply 10 microamperes to its base. We get 10 microamperes × 100 = 1000 microamperes = 1 milliamperes at the collector. Let's warm the transistor to 100°F. At this temperature, the current gain has risen to 110. Collector current is now 10 microamps × 110 = 1100 microamps = 1.1 milliamps. These calculations assume base current always remains the same. In real life, base current will increase due to a temperature increase, causing an even greater increase in collector current. The base current increases with temperature because the base-to-emitter voltage, V_{BE}, decreases with increasing temperature. The reason that a decrease in V_{BE} causes an increase in the base current is easy to visualize. R1 see 9 V_{BE}. As V_{BE} decreases, the voltage across R1 increases. As the R1 voltage increases, its current also increases. The current that flows through R1 is the same current that flows through the base. In fact, it is the base current.

A simple voltage regulator circuit consists of R3 and zener diode D1. This voltage regulator provides a constant voltage source for Q1's base bias circuit. Voltage regulation insures that the battery's voltage won't affect I_B and thus the meter's current.

Picking The Transistor. You can use any NPN silcon transistor you find laying around in SITRAT—even that free one that came with that surplus company's "bonus pack." The author has determined the DC current gain at room temperature for 10 different transistors picked at random. The list below includes two unmarked surplus transistors.

You may have noticed that the author chose the transistor with the least DC current gain to use in his prototype.



Inside view of SITRAT. Note component simplicity. There is no need for printed circuit board here! The ball-bearing potentiometer is very classy—but you can use a regular one meg pot in this circuit.

TABLE ONE

Transistor	DC Current Gain
2N5088	710
HEPS002	110
2N5089	625
2N3860	200
2N2222A	153
RS2031	167
2N5129	47
2N2897	55
Surplus "A"	100
Surplus "B"	140

The reason he did this is that he found that when the transistors are placed in the circuit (see schematic), it appeared that the lower the current gain, the more sensitive the thermometer. Since the author was seeking a relatively sensitive thermometer he chose the lowest gain transistor he tested. However, you can use any transistor you have, although the author does not recommend those extremely high gain transistors, say with gains over 500. If the thermometer doesn't seem as sensitive as you would like, just plug a different transistor into the circuit. If you have a data sheet available, choose one with a relatively small β_{DC}, which is the DC current gain.

Construction. Because of its extreme simplicity, the actual construction is a no-sweat job. Use a 2 lug terminal strip to mount R2, R3 and D1 and use point-to-point wiring between them and R1, S1 and M1, which are all mounted on the front panel. See line drawing and the photo. In the parts list, R2 is listed as a 100K resistor. If you use a high gain transistor, R2 may have to be increased to 470K or even 680K.

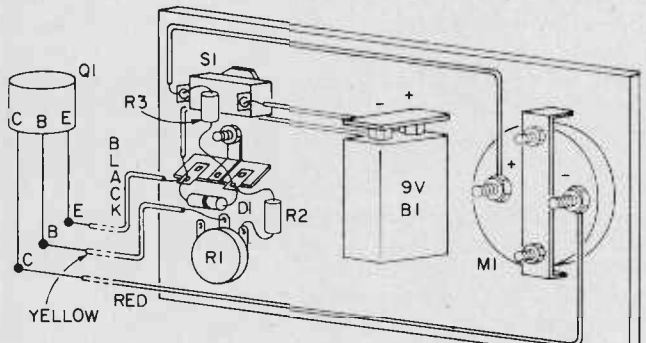
For details on making the transistor probe, see line drawings on this and the next page. First cut a 3-conductor cable, shown in drawing. Strip away the outer cable and push spaghetti sleeving up the three inner leads as shown. Next, using a heat sink such as an alligator clip, solder the cable's wires to the transistor leads, as in detail. Make sure you record on a sheet of paper which wire (usually color coded) is connected to each lead of the transistor (emitter, base, collector)—this is done to avoid any possibility of error when connecting the probe's cable to the rest of the circuit. Next, spray the bare leads, connections and transistor with acrylic plastic. After the acrylic dries, pull up the sleeving over the connections and leads as shown in the drawing. To completely waterproof the probe, take Epoxy Putty or E-POX-E RIBBON and encase the transistor assembly in it. Try to fashion a reasonable looking, pointed probe, by using your fingers. See Figure 8. For that final, semi-professional touch, wet your hands and roll the rough-looking probe between them like dough. You should be able to fashion a smooth, cylindrical probe out of the putty, as in drawing. This completes the actual construction

Data For Meter Dial. The first step here is to 'make like a scientist' and take a number of meter readings when the transistor probe is placed in different temperature water baths.

Obtain a small plastic container. You also will need a fairly accurate thermometer. This thermometer will be kept submerged in the pail. The pail itself will be about half filled with water. For good accuracy, you will have to take at least 10 different readings, each reading at a different temperature.

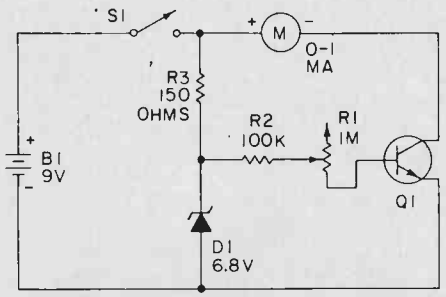
Start out with exactly 120°F water. This can be easily done by first filling the pail with hot water—say 125-135°F—and then waiting until it cools to exactly 120°. Be sure you have the probe in the water for at least a few minutes before you make any adjustments or take any readings. Once you have exactly 120° water, set R1 so that the meter reads exactly .9 milliamperes. If you wish, place a drop of Plastic Rubber or similar glue at the pot's shaft so it can't be turned by mistake or accident. Mark this point down as .9 ma at 120°F. Next, replace the 120° water with some slightly cooler water. Be sure you stir the water. After a minute or two, again take both SITRAT's and the thermometer's readings. Also mark the information down. Similarly, you should take at least six more readings at different temperatures. Make sure each of the six separate temperatures differ by at least 5°F. Another reading should be taken at the freezing point of water. To take this reading, empty the bucket and then half fill it with small ice cubes or compacted snow. Then, pour cold water into the bucket until it is about ⅔ full. Finally, place the probe in the middle of the bucket and stir the icy mixture frequently. Wait several minutes or until the meter's needle stops moving. Then mark down 32°F and next to it place the meter's reading—for example 32°F @ .3 ma. (Notice that in Table 2, which is the reading the author recorded, 32° corresponds to exactly .32 ma. This is entirely a coin-

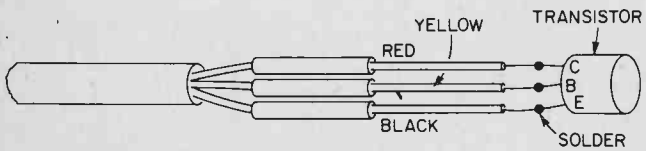
SITRAT line drawing shows simple placement of the few components. Cable to the probe can be almost any length; no electrical problems to worry about. A quick kit!



PARTS LIST FOR SITRAT

B1—9-VDC transistor radio battery
D1—6.8-volt zener diode, ½ watt
M—0 1-mA panel meter
Q1—any type NPN silicon transistor (see text)
R1—1,000,000-ohm potentiometer
R2—100,000-ohm, ¼ watt resistor, 10%
R3—150 ohm, ¼ watt resistor, 10%
S1—SPST switch
Misc.—2 lug terminal strip, an appropriate length of a 3 conductor cable, spaghetti sleeving, acrylic plastic spray, E-POX-E Ribbon or Epoxy Putty, Dry Transfer Lettering, graph paper, suitable case, small plastic pail, good quality thermometer, wire, solder, hardware, etc.





NOTE: BE SURE TO MARK DOWN WHICH WIRE IS CONNECTED TO EACH LEAD OF THE TRANSISTOR. FOR EXAMPLE; RED TO COLLECTOR, YELLOW TO BASE, BLACK TO EMITTER

This is the only tricky part of SITRAT. Follow the directions in the text carefully, and you will not have a single bit of trouble.

cidence!) You should also take at least one reading below freezing. To do this, make a mixture of salt and ice cubes and place both the probe and thermometer in it. Record both the thermometer's and SITRAT's reading and jot it down in the table.

Table 2 lists the readings from the author's prototype. While the general appearance of your table should be similar, your actual readings will differ, except for the .9 ma at 120°F reading which should be identical. (Quickie Quiz: Do you know why this reading is identical to the author's and will always to be the same for all transistors regardless of DC current gain? HINT: Read this section over.)

TABLE 2
MEASUREMENTS TAKEN WITH AUTHOR'S PROTOTYPE OF SITRAT

Temperature of Water Bath (°F)	Current (milliamperes)
120°	.9
108	.8
98	.735
91	.67
85	.63
77	.58
68	.52
61	.48
54	.445
40	.36
32	.32
9	.22

NOTE: This Table is to be used as a guide ONLY. Your readings will differ, perhaps substantially.

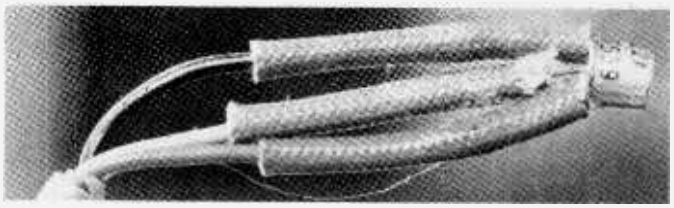


Photo of probe just before encapsulating in putty. Don't forget to use the insulator sleeves, and spray with acrylic, as the text directs you to.

We have the data. Now what? If we tried to label a meter's dial directly from our data we would have a funny looking thermometer indeed. Only the various temperatures measured would appear on the dial.

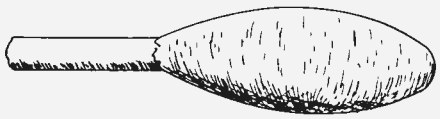
A far better way is to obtain a sheet of graph paper. Then mark the vertical axis with milliamperes (0, .1, .2 . . . . . 9, 1.0) and the horizontal axis with temperature measured in degrees Fahrenheit. See chart below. Now plot the data points you obtained (as in Table 2) on the graph paper, as in the chart. Then draw a SMOOTH curve through the points. To draw this smooth curve use a 'french curve' or if you are careful, you can draw it free hand. Refer to chart. Notice that this curve has been extended quite a bit above and below the known data points. This procedure enables you to use SITRAT over a greater range of temperatures than you actually measured. This procedure is known as extrapolation.

So now you have a beautiful curve. What now? If you are acquainted with curves on graph paper, simply read off the current readings that correspond to every temperature that is divisible by 10 (e.g. 120, 110, 100, 90 etc.) and mark the information down in a table. We assume, that you aren't acquainted with this technique. For this reason, we will describe it.

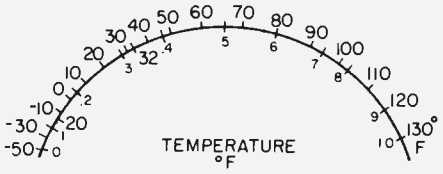
First you should determine the maximum temperature your SITRAT will measure. To find this 'maximum' temperature draw a horizontal line (this line is marked (a) in the chart) parallel to the temperature axis starting at the 1.0 ma marking on the current axis. Determine the point where this line intersects the curve, then draw a straight line directly down (parallel to the current axis). This line is labeled (b) in the chart. Mark down where this vertical line intersects the temperature axis —this will be the maximum temperature your SITRAT will measure. Note that the author's prototype can measure a maximum temperature of 130°F.

Now to find how low a temperature your SITRAT can measure. Finding the minimum temperature is a bit simpler. First, make sure you have continued extrapolating the smooth curve until it hits the horizontal axis (0 ma point). Mark down the temperature where this extrapolated curve hits the horizontal axis. In the chart, this point is −50°F. This is the lowest temperature your SITRAT can measure and

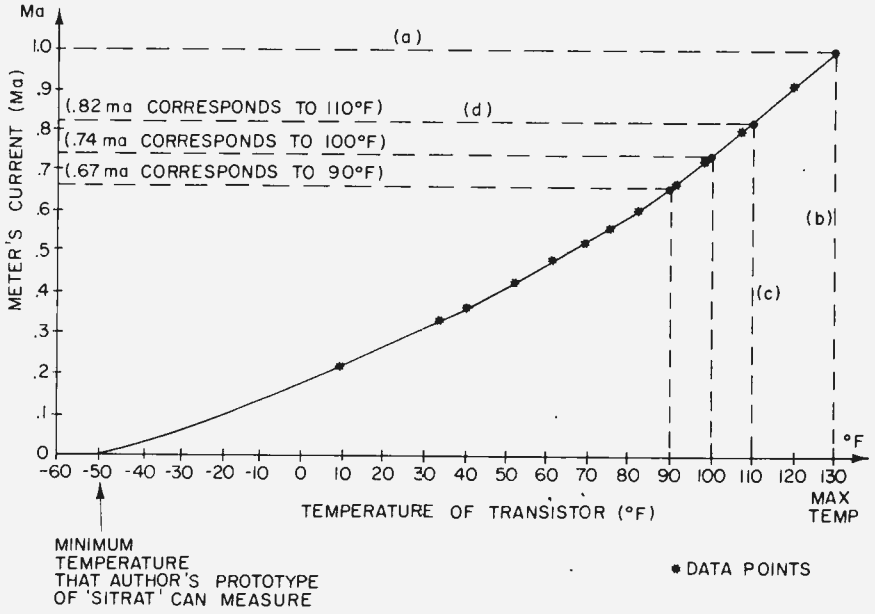
(Continued on page 84)



Drawing of the probe after is has been coated with the epoxy putty. The idea is to mold the putty until it is fairly smooth all around he transistor and leads. Make sure that there are no holes or openings.



The dial plate of milliammeter, converted to degrees Fahrenheit. Of all the aspects of assembling SITRAT, this is the most time consuming, since you will have to calibrate dial according to your own specific components. Follow text with real care!

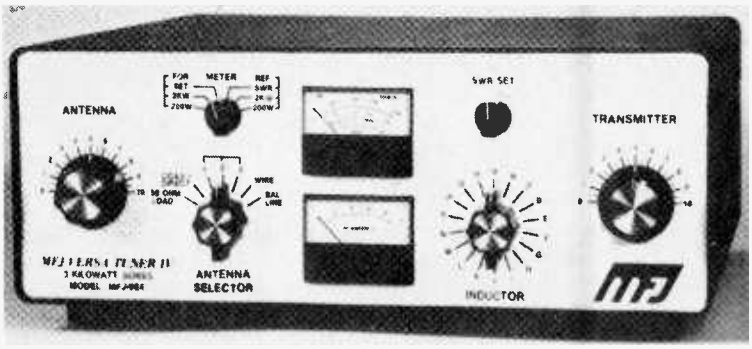


This is the graph that you will need to calibrate the temperature reading meter scale. Make a couple of trial runs on graph paper until you get the knack of drawing smoothly.

S&E LAB TESTS THE...

MFJ Versa Tuner IV

This tuner assures perfect antenna matches up to 2 KW



CIRCLE 100 ON READER SERVICE COUPON

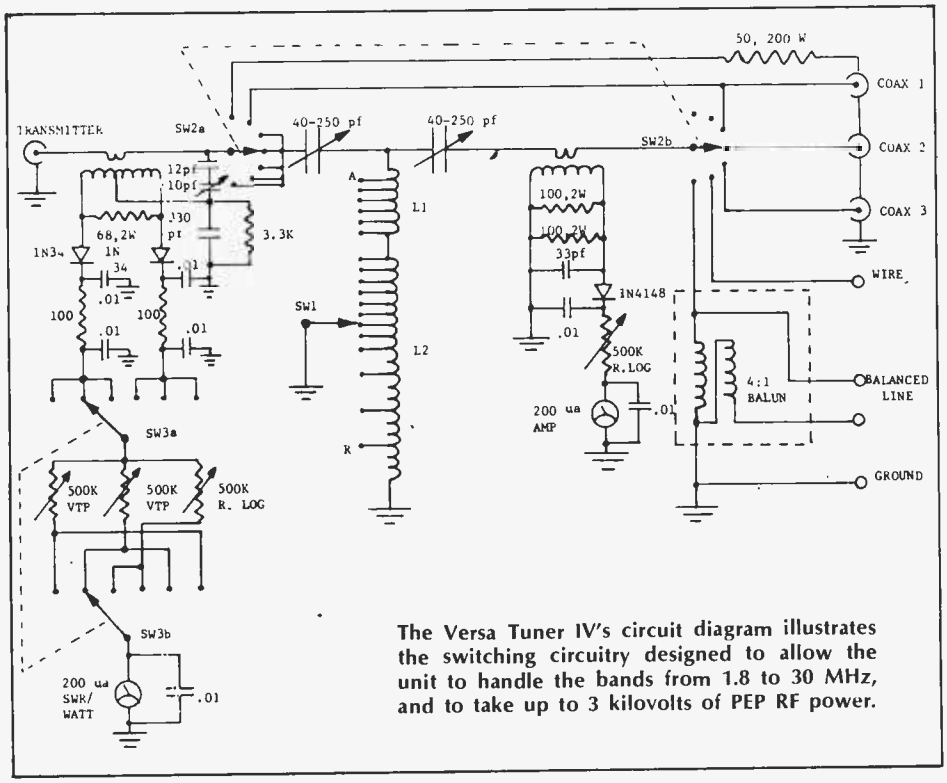
THERE ARE A LOT of antenna tuners around for medium power transmitters running about 200 or 300 watts, and some of them offer a pretty impressive array of features. But what about the guy who runs a 2000 watts Single Sideband, and wants a full-featured antenna tuner too? Well, here's a tuner that fits the bill. The MFJ-984 Versa Tuner IV will handle 3-KV PEP RF power. It has three standard outputs for coaxial (unbalanced line), a long wire terminal, and a built-in balun transformer so that the unit can be used with balanced feedlines. There's a dummy load which allows test operation at powers up to 200 watts for periods of two minutes. There's the usual SWR (Standing Wave Ratio) meter, but in this case calibrated for 0-200 watts and 0-2000 watts both forward and reflected power. There's also a unique RF ammeter which is user adjustable (it is factory-adjusted to 0-10 amperes), and which gives a foolproof indication of power going into the antenna. And, for some operators, best of all, the Versa Tuner IV covers 1.8 to 30-MHz, which means that it will tune the neglected 160-meter amateur band.

Tuning Procedures. Tune-up is straightforward. ANTENNA and TRANSMITTER matching capacitors are set to mid-scale. The INDUCTOR switch is set to "A" and then with the rig in receive is rotated until received noise and signals are maximized. Then the capacitors are rotated to peak noise even further. Using low power, no more than 50 watts, the TRANSMITTER and ANTENNA capacitors are adjusted for lowest SWR, first roughly, and then in smaller increments. If a low ratio cannot be achieved (somewhere around 1.1:1), then the inductance is increased or decreased, repeating the capacitor adjustments until the proper combination is found.

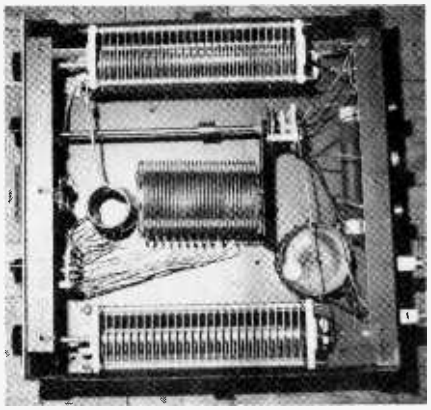
Beating the Game. As many of you know, adjusting an antenna tuner is a bit like rolling dice. The controls are all interdependent, and more than one setting can occur at which the appearance of a low SWR is indicated. This is where the RF ammeter in the MFJ-984 is invaluable. The proper setting is always the one at which the highest antenna current flows. Since the RF ammeter indicates RF current, the control setting which produces the highest reading of the RF ammeter consistent with the lowest SWR indication is the proper one. By the way, if a 0-10 ampere RF ammeter range is not sufficient for your power output, you can recalibrate it yourself for higher ranges.

Operation. We used the tuner under a wide range of conditions. We always observed the manufacturer's warnings about not using the tuner with the top cover removed, since at high power the RF voltages inside can be very high—and dangerous. We always tuned up with low power, and then fine-tuned with high power. We found the unit was rated conservatively, and performed its job extremely well. Coils and switches are very high quality—switches

(Continued on page 85)



The Versa Tuner IV's circuit diagram illustrates the switching circuitry designed to allow the unit to handle the bands from 1.8 to 30 MHz, and to take up to 3 kilovolts of PEP RF power.



This inside view of the Versa Tuner IV shows rugged coils that let unit take 2KW.

DXing THE FRENCH RADIO EMPIRE

Tune in to the far-reaching voices of French influence

BY C. M. STANBURY II

A NEW SWBC STATION which received major publicity at the end of 1979 was "Africa No. 1" in the Republic of Gabon. This French-backed, strategically situated relay served to focus DX attention on the French government's vast international network. Monitoring this global chain will provide both exotic loggings and a sometimes surprising look at a potential super propaganda power.

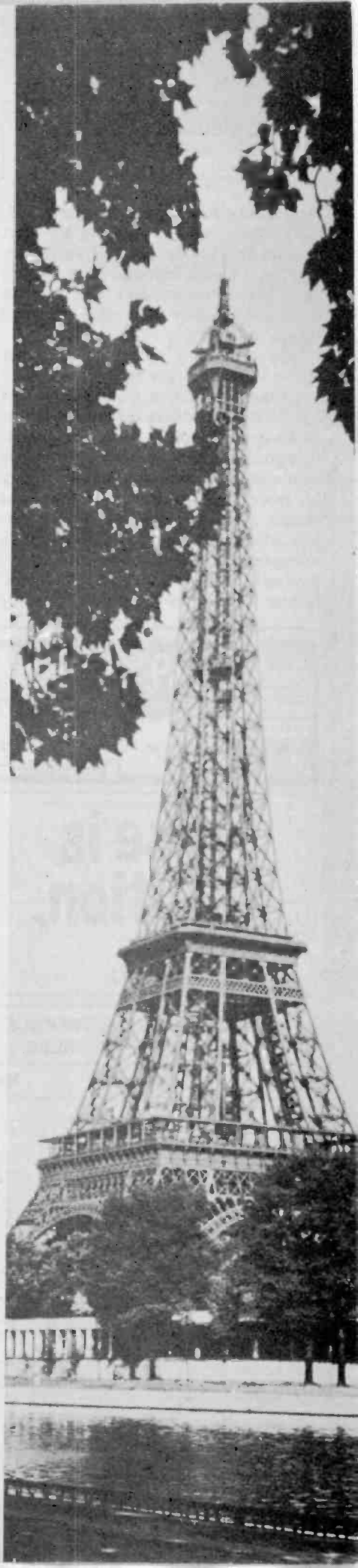
France & Gabon. Although Radio France International, the official shortwave voice of the French government, has no English beamed to North America, their "France Calling Africa" transmission at 1200-1300 EST (1100-1200 during the summer months) is widely heard in the U.S. and Canada. As we write this, it is already aired on some 10 different frequencies from France. In the very near future, it will also be relayed by Africa No. 1—either on some of the frequencies presently listed or on additional channels.

Although Africa No. 1 is nominally run by an international corporation, with the majority of its shares owned by the Gabonaise government, this station was primarily financed by the French government who, through yet another "corporation," owns at least 30% of Africa No. 1 stock. The relay of Radio France International has already been announced and time will also be sold to religious organizations. Thus Africa No. 1 follows the pattern of many West European relay bases. Their principle backer cannot be held responsible for all the programs aired, nor can they be embarrassed by any complications the host country might cause.

Still In Europe. Not only did France pioneer this sort of arrangement, but it has also carried it to some very strange lengths through another corporate structure, Radio Monte Carlo—with studios in the principality of Monaco—which is wholly owned by the French government. Furthermore, their transmitters are on French soil; at a military base. Because of this, some SWLs argue that Monaco, when logged via RMC, should not count as a separate country.

On the other hand, Radio Monte Carlo has never relayed Radio France International. All its time is nominally for sale. At the moment RMC's major customer is an American-based religious organization, Trans World Radio, which previously operated a relay for Radio Nederland on the island of Bon-

(Continued on page 80)



FRENCH SW FREQUENCIES AT A GLANCE

kHz	STATION	TIME (EST) & NOTES
640	FR3, Guadeloupe	Early evenings
666	FR3, New Caledonia	Early AM
738	FR3, Tahiti	Early AM
1375	FR3, St. Pierre	Early evenings
1467	R. Monte Carlo/TWR	2300-0100
3315	FR3, Martinique	Early evenings
3385	FR3, French Guiana	0400 S/On & Early evenings
6135	FR3, Tahiti	0300
7170	FR3, New Caledonia	0300
9495	R. Monte Carlo/TWR	0130
11705	R. Monte Carlo/TWR	Alternate frequency
11710	FR3, New Caledonia	0200
11845	R. France International	English at 1200-1300 (1100-1200 during summer)
15170	FR3, Tahiti	2200 (English at 1400)
15300	R. France International	See 11845. Also on 15360, 15425, 17795, 17850, 17860, 21505, 21620 & 21675 kHz.

Calculator Power

(Continued from page 46)

teen hundredths of an ampere (150-mA), which will be adequate for most calculators. Try to get a transformer that has a higher current rating (in this case 200mA or greater) and at least three volts higher than the regulated output voltage.

One can apply this data to other power supply designs as well. It is very important to pick a transformer that has a current rating beyond what is necessary to supply a particular circuit. It is good practice to use a transformer with a current rating ten percent higher or more. The transformer that was chosen in this project was from a battery eliminator (adaptor) and has a voltage rating of twelve volts and a current rating of about 200mA. The transformer was left in the plastic case for protection purposes.

The block diagram shows in simple form how the inexpensive power supply works. As they say, a picture is worth a thousand words! The schematic shows how the circuit works in detail.

The pass regulator is an NPN transistor with a high current rating. This component should be able to easily handle the output current. The transistor should have a heat sink.

The 741 operational amplifier (U1), acting as the error detector/amp, has its negative input (pin 2) coming from the emitter of the transistor through a 10,000 ohm resistor. Its positive input (pin 3) comes from the reference voltage; either a 9 volt reference (via Jumper 1) or a 3 volt reference via a 43,000 ohm dropping resistor. The reference voltage originates across the zener diode.

Now, the output voltage regulation, or swing, for a variable load is approximately 10%. This is good enough for most calculators.

Construction. The printed circuit board layout is not included in this article because of design changes and other variations. It is a good project to practice printed circuit board designing, and to get the feel of fabricating PC boards. The prototype was designed so that the board could be piggybacked onto the adaptor's case. Thus, mounting schemes will dictate your PC board layout and design.

The board was mounted using 4-40 machine screws. These screws were placed through four holes that were drilled in the adaptor's plastic case and through the PC board.

The transformer was left inside the plastic case and the secondary wires were sent to the externally mounted PC board. In this way, the 120 VAC is isolated inside the plastic case and thus there is no chance of getting a shock. The rest of the construction is left up to the hobbyist. ■

ELEMENTARY ELECTRONICS INDEX TO ADVERTISERS

• DXing French Radio

(Continued from page 79)

aire off the South American coast. A former RMC customer was Radio Omega, which previously shared a transmitter site with that mysterious right wing clandestine, Radio Free Russia. That is, however, the only known link between Radio Monte Carlo and clandestine broadcasting.

Trans World Radio programs from "Monaco" are currently heard in North America on 9495 kHz—a frequency which is not usually allocated for broadcast purposes—beginning at 0130 EST. If you don't hear them there, try around 11705 kHz.

Radio Monte Carlo is involved in further corporate complexities on the strategic island of Cyprus in the eastern Mediterranean. There, it nominally owns half interest in a second MW relay station (1233 kHz). The rest of the stock is owned by yet another French government corporation. Again, its principle customer is Trans World Radio, which uses it for broadcasts to the Middle East. Unfortunately, this station is very difficult to hear on our continent. Finally, in Europe, the French government owns a long wave commercial broadcast station known as "Europe No. 1" at Saarbrucken, West Germany. The French obtained Europe No. 1's license during the early 1950s while Saarland was administered separately from West Germany. This one operates on 182 kHz where it is interfered with by an East German station, Radio DDR.

The Americas. FR3's station on St. Pierre 1375 kHz recently boosted power to 20 kw. When plans for this power increase were first announced, some elements of the Canadian press speculated that separatist-prone Quebec was the real target. However the new power really doesn't seem to be enough to make the story plausible. Truth is, 20kw turns out to be the power now used by many FR3 MW transmitters. Not that St. Pierre isn't a good DX target. During early evenings, the 1375 kHz signal can often be logged throughout eastern and central North America by Skilled DXers. But what a DXer and an ordinary listener can hear are two different things. Most likely that new transmitter is for the benefit of the French fishing fleet in the Gulf of St. Lawrence.

Also during the early evening hours (as well as at 0400 EST sign-on), SWLs should try for the FR3 station at Cayenne, French Guiana on 3385 kHz. This is another location at which a Radio France International relay is supposedly in the works, but a quasi-commercial "Caribbean No. 1" seems more likely. Indeed it seems the intricacy of the French shortwave empire lends itself to all sorts of speculation. FR3's station at Fort de France, Martinique is listed on 3315 kHz and the one at Pointe a Pitre, Guadeloupe is sometimes heard by DXers on 640 kHz if and when they can get by interference from Havana's Radio Liberacion, KFI, Los Angeles and others. ■

Microcomputer Cooling

(Continued from page 66)

are beyond its limits. Check the minimum input voltages for the particular voltage regulators in your system. Most 5-volt regulators on the memory boards require an input voltage of 7 volts, but a few require 7.5 volts. Also check for unusual voltage requirements on your boards.

My 16K dynamic RAM boards require 8 volts of unregulated power to pull up the phantom line when it is disabled. I think that this was simply a design problem of not being able to run a regulated 5-volt line to the particular IC input. As the board specifications state that only 7.5 volts is necessary to run the board, I assumed that this particular anomaly could cope with preregulation of the bus.

I chose National Semiconductor's LM 338 variable voltage regulator, because it has good heat protection, good internal electrical protection and required a minimum of external components. It is guaranteed to supply 5 amps with peaks of 7 amps, and it will probably deliver ten if necessary. Finally, I have found their technical staff ready and willing to help an amateur—an uncommon situation these days!

I have used two regulators in parallel to double the current supplied. If you are going to improve the power supply, there is no sense doing just the minimum. That is what caused the problem in the first place.

Resistors R2 and R3 were set at 270 ohms, even though the applications sheet suggested 240 ohms, since I had the former but not the latter in my junk box. It is seldom necessary to be exact in this situation.

Final Adjustment. I determined R1 by trial and error using a potentiometer until I had the correct output voltage. (Note: I used a 620-ohm ½-watt resistor but, for best results, temporarily solder in a 2,000-ohm potentiometer and adjust it for the required output voltage and then replace it with an equivalent ½-watt resistor.)

If you are mathematically inclined, you can calculate this but such calculations assume that all the components are precisely the values claimed. Capacitors C1, C2, C3 and C4 are all 1-mfd tantalum. I used these since they are more reliable than mica and faster than electrolytics. C1 and C2 are optional, but they do reduce ripple in the input. Almost any value of capacitor would have done, but generally bigger means better. C3 and C4 absorb noise on the power line.

The voltage and capacitance values that I picked are too low to make protection diodes necessary but if you use much bigger capacitors it is possible to damage the regulators with inadvertant voltage spikes. Consult the spec sheets if you modify my design. Finally, if you are the sort who always takes precautions, you can put the over-voltage protection Zener diode D1 in. However, the voltage is roughly regulated before the preregulator and terminally regulated on the board, so a failure in your preregulator should not be fatal.

The photos show the two regulators mounted on heat sinks and that I mounted the two heat sinks inside the cabinet. Figures 1 and 2 give more detail. The finished product is then wired into the system between the power supply and the cables to the S-100 bus.

I hope that you will find these solutions, particularly the last, useful. I have had no problems at all since preregulating the voltage. ■

AM/FM Alignment

(Continued from page 73)

As a final check, set the receiver dial to a silent point near the low end of the range, 88 MHz, and set the generator frequency to the same frequency. Now, by varying the generator about 88 MHz while watching the DC voltmeter, you can determine how accurate the FM dial is. If necessary, you may adjust the oscillator coil L2, or slip the dial pointer so that the dial reading agrees with the signal generator frequency.

Keep in mind that if you do make this adjustment you will have to go back to 108 MHz and readjust the trimmer capacitors again. In addition, if you are working on an AM/FM receiver slipping the dial pointer will also require a realignment of the RF section of the AM receiver. For these reasons it is not recommended that the dial be slipped unless it already has been placed far out of calibration through some previous servicing procedure. ■

Bubble Memory

(Continued from page 55)

output channels. Each page is processed as 64 eight-bit bytes.

In a system operation, a page or burst of pages—up to the entire 2048—can be read or written at one system request. Pages are located so that after reading or writing one page, the next page is immediately available. The device can also be started and stopped between sequential pages to give controlled rapid access.

Based on a shift rate of 50 MHz, the average random access time of the 7110 is 40 milliseconds (ms); the maximum data rate is 100 kHz. A page-read or -write requires 327 shift cycles, so that the read/write time is 6.5 ms, and the average data rate is 78 kHz.

A block diagram of a basic 7110 system is shown in Fig. 7. Outside interface is provided by the 7220 bubble memory controller. The 7220 makes the system look like a peripheral to the microprocessor system bus.

The controller chip is a 40-pin device built with HMOS technology. It provides bus interface, generates all memory system timing and control, maintains memory address information and interprets and executes user requests for data transfers.

The 7242 formatter/sense amplifier is a dual-channel unit that interfaces with both channels of the bubble memory. It is a 20-pin device built with NMOS technology. It senses the low-level bubble signals, handles redundant loops, and buffers data. It also contains the burst error detection and correction circuits for each channel.

7110 Current Supply. The 22-pin 7230 current pulse generator, a Schottky bipolar TTL device, supplies the relatively high peak currents required by the bubble memory. It also contains a power-down circuit to shut off the current sources whenever the device is deselected. It has power-failure detect circuitry to shut down the bubble memory in an orderly manner.

High currents with peaks beyond the capacity of standard ICs are required to drive the coils. Therefore, the 7250 coil predriver interfaces with the bubble memory controller to driver transistors, such as quad bipolar transistor packs, or quad VMOS FET transistor packs. This CMOS device comes in a 16-pin package.

Today, the bubble memory chip set will cost you $3500, but by the end of 1982, the price will probably be one-tenth of that. ■

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Simply BASIC

(Continued from page 42)

```
03250 PRINT
03259 CLOSE #1
03260 GOTO 250
04000 PPINT "HEADING MODE"
04010 PRINT
04020 LINE INPUT "HEADING FOR FILE SEARCH  =>";H$
04030 PRINT
04040 OPEN "MLIST.DAT" FOR READ AS FILE #1
04050 IF CIN(1)<1 THEN 4500
04060 INPUT #1,A,B,C,C$,D$
04070 IF D$=H$ THEN 4200
04080 GOTO 4050
04200 Q=1
04205 PRINT
04210 PRINT A;"/";B;"/";C
04220 PRINT C$
04230 PRINT
04240 GOTO 4050
04500 PRINT
04510 IF Q<>0 THEN 4530
04520 PRINT "SORRY, NO LISTINGS UNDER THAT HEADING."
04530 Q=0
04535 CLOSE #1
04540 GOTO 250
05000 PRINT "MONTH MODE"
05010 PRINT
05030 INPUT "ENTER NUMBER OF MONTH AND YEAR (EX. 11,80) =>";M,Y
05035 PRINT
05040 OPEN "MLIST.DAT" FOR READ AS FILE #1
05050 IF CIN(1)<1 THEN 5500
05060 INPUT #1,A,B,C,C$,D$
05070 IF A=M AND C=Y THEN 5200
05080 GOTO 5050
05200 Q=1
05210 PRINT A;"/";B;"/";C
05220 PRINT C$
05230 PRINT D$
05240 PRINT
05250 GOTO 5050
05500 PRINT
05510 IF Q<>0 THEN 5590
05520 PRINT "SORRY, NO LISTINGS FOR THAT MONTH."
05590 CLOSE #1
05595 GOTO 250
06000 PRINT "SERIES MODE"
06010 PRINT
06020 INPUT "ENTER MONTH AND YEAR AS MM,YY =>";M,Y
06030 LINE INPUT "ENTER SUBJECT HEADING =>";S$
06040 OPEN "MLIST.DAT" FOR READ AS FILE #1
06050 IF CIN(1)<1 THEN 6300
06060 INPUT #1,A,B,C,C$,D$
06070 IF A=M AND C=Y AND D$=S$ THEN 6200
06080 GOTO 6050
06200 Q=1
06210 PRINT
06220 PRINT A;"/";B;"/";C
06230 PRINT C$
06240 PRINT
06250 GOTO 6050
06300 IF Q<>0 THEN 6350
06310 PRINT "SORRY, NO FILE ENTRIES COMPATIBLE WITH REQUESTED"
06320 PRINT "INFORMATION."
06330 PRINT
06350 CLOSE #1
06355 GOTO 250
07000 CLOSE #1
07010 CLOSE #2
07020 END
*
```

Sitrat

(Continued from page 77)

corresponds to 0 ma on your meter. When your SITRAT is complete, you will have labeled the 1.0 ma mark on the meter's dial with the maximum temperature and the 0 ma point with the minimum temperature.

Next, draw a vertical line directly up from the temperature axis at the 110° mark. This line is labeled (c) on the chart. Determine the point on the curve this line meets, then draw a horizontal line (labeled d) to the current axis and make a note of the current reading. The author marked this point as .82 ma at 110°F. He did the same for the following temperatures; 100, 90, 80, 70, 60, 50, 40, 30, 20, 10, 0, −10, −20, −30 and the minimum temperature (−50). All the information is given in Table 3. The reader should construct a table similar to Table 3. However, the exact numbers will differ (except for the 120°F, .9 ma point) from Table 3. This is due to the fact that no two transistors (even two 2N5129) have exactly the same characteristics.

Alternative Method. If graphs and curves aren't your bag, you can still build SITRAT. All you have to do is take measurements at *exactly* 10 degree intervals. While this isn't easy, it can be done. Your table should be similar to Table 3, although it probably won't go much below 10°F because of the difficulty of easily obtaining temperatures below this value.

Drawing The Meter's Dial. After you construct the final table (which should be similar to the author's Table 3), the final step is to label the meter's dial plate. Remove the meter's clear faceplate. For meter's with plastic faceplates, this is done by gently prying it off with your fingers. Better meters have two small screws holding it in place. Use a pencil eraser and remove the *'D.C. MILLIAMPERES'* label as well as all numbers.

Applications. This thermometer has many applications. Remote-reading outdoor thermometer and freezer thermometer are just a few of the possibilities. To catch lots of fish, find the species water temperature. Drop the probe to the water depth indicating that temperature. Then, drop your fishing line to the same depth. While the author hasn't tested SITRAT for cable's longer than 15 feet, the reader should experience no problem with very long cables.

Final Comments. Your SITRAT is unique. No one has another one exactly like it. The reason for this should be obvious now. The transistor you used is one of a kind. The higher the transistor gain, the less sensitive your SITRAT will be. However, this isn't necessarily bad. The less sensitive your SITRAT the greater the range of temperatures it will measure.

Your SITRAT's accuracy depends upon how carefully you labelled the meter's dial plate. The quality of panel meter you use is also a factor. SITRAT's accuracy is diminished at bitter cold temperatures; below about −20°F.

While SITRAT is about as cheap an electronic thermometer it is possible to build, you actually substitute your time for dollars. There is no such a thing as a free lunch. However, most of the time used in completing SITRAT is fun time. You will soon dream up applications that the author has never even thought of. ■

TABLE 3

Temperature (°F)	Current (milliamperes)
130°F (Max.)	1.0 ma
120	.9
110	.82
100	.74
90	.67
80	.60
70	.54
60	.475
50	.42
40	.365
32	.32
30	.31
20	.265
10	.22
0	.18
−10	.145
−20	.11
−30	.07
−50 (Min.)	.00

NOTE: Table 3 was derived by the author from measurements taken with his prototype of SITRAT. Your Table will be similar, although it will differ in actual readings as well as the minimum and maximum temperature.

Mighty Midget

(Continued from page 62)

the excess length snaps off. It probably will be necessary to drill a hole for a screw in each element where it is secured to the insulator.

If you have to start from scratch using parts from several elements, the mouting rivets will have to be drilled out of the elements and insulators. Use the original holes for inserting mounting screws which can double as terminals for lead-in attachment. It is recommended that washers be used under the head of the screws to tightly hold the lead-in wire. A bolt through the center hole will secure dipole insulators to the mast.

Erecting the Antenna: After the dipole is finished, check to make sure all screws are tight, and that the lead-in wires are securely attached. It is a good idea to coat the connections on your lead-in with silicon rubber bathtub sealant to prolong life and inhibit corrosion from bad weather.

A standard mounting kit of hardware is available from discount stores and radio hobby outlets like Radio Shack and Lafayette. Before permanently locking the mast in position, experimentally rotate the dipole in different directions to optimize reception on channels that are watched most often. Run the lead-in as short as possible to the TV set, twisting it at a rate of one turn per yard to minimize noise pickup. Use standoff insulators to separate the twin lead from metallic surfaces and to maintain some tension on the line, so that it doesn't flap on a windy day. ■

Versa Tuner IV

(Continued from page 78)

have a 2-KV dialectric strength. Capacitors are excellent—they have a 6-KV breakdown voltage. We never experienced arcing, nor did overheating pose a problem even at the highest power. The 4:1 balun transformer worked fine. The Versa Tuner IV was able to match a very wide range of loads.

This is a fine piece of equipment. With all its features, at $299.95, the MFJ-984 is a good bargain, and an excellent addition to any high-powered ham shack. MFJ is at P.O. Box 494, Mississippi State, MS 39762. For more information circle number 100 on the Readers Service Coupon. ■

Accutune

(Continued on page 28)

unit. As an option for greatest calibration stability, you may substitute metal film resistors for those resistors identified with an asterisk (*)

The LED may be permanently attached to the front panel by using a small amount of epoxy. Avoid bending the leads of the LED and solder two different colored flexible wires to it.

Convenient, Yet Stylish. A convenient place to install the 9-volt battery is above the meter, attached to the front panel. You may wish to fabricate a small battery clip out of sheet metal and fasten it to the panel with screws or epoxy. Secure the battery to the front panel so that it does not dangle.

It is best to calibrate Accutune with an accurate audio frequency generator and an oscilloscope (or VOM). If these instruments are not available to you, go to your local electronics repair shop and have them calibrate it for you. completes the alignment of the unit's bandpass amplifier.

A Set Back. Set the audio oscillator back to 165 Hz and the rotary switch to lower E. Adjust R23 for a meter reading of exactly center scale. Do the same for the other five notes by adjusting the proper potentiometer and setting the audio oscillator and rotary switch to their appropriate positions.

To calibrate, connect the audio generator's output to Accutune's input jack using a standard phono plug. Set the generator's frequency to 165 Hz and its amplitude to 20 millivolts RMS. If the audio generator's amplitude control does not permit you to set such a voltage, connect a 10,000-ohm and a 470-ohm resistor voltage divider across the audio oscillator's output, set it to 0.5-volts RMS and use the voltage across the 470-ohm resistor to drive Accutune.

Turn on Accutune's power switch, set the rotary switch to lower E and examine the waveform at pin one of U2. Adjust R10 for the maximum amplitude of the 165 Hz signal, which should be about 0.15-volts RMS. In a similar manner set the audio oscillator to each of the remaining frequencies.

GUITAR STRING	FUNDAMENTAL FREQUENCY
E	164.8 HERTZ
A	220.0 HERTZ
D	293.7 HERTZ
G	392.0 HERTZ
B	493.9 HERTZ
E	659.3 HERTZ

Set the rotary switch to a certain note and adjust the proper potentiometer for a maximum amplitude of the waveform at pin 1 of U2.

To operate the unit, plug the guitar cable in to the front panel jack of Accutune and turn on the power switch. Set the guitar's volume controls to maximum output and set the rotary switch to lower E. Pluck the lowest string of the guitar. Adjust the tuning of the guitar until the meter reads exactly center scale. (You may have to pluck the string several times before the adjustment is complete.) Set the rotary switch to each of the remaining positions and adjust each string in a similar manner. Be sure to turn off the power switch when finished tuning.

For those of you who have a fledgling rock band and use an electric organ or piano to tune up, Accutune can be calibrated to the keyboard. First, plug Accutune into the keyboard and set the volume at minimum. Slowly increase the volume until you get a reading.

Hit a low A. Adjust the A potentiometers until you get a dead center reading. Do the same for the other notes. Accutune can pick up the musical hash of other instruments (different harmonics) and be calibrated to the pitch of your choice.

Now that Accutune is completed, you can put it to use. With Accutune in hand, you will never again have to fret about those screechy or klunker notes you may have once plucked. ■

H-14 Printer

(Continued from page 58)

under the normal catalog recall, CAT. To save valuable sector space on the disk it would be wise to erase programs or files not needed. For example, the file SYSHELP.DOC is not needed, so it can be erased. The same is true for other files such as ATH84.DVD, ATH85.DVD, and ND.DVD. Others you may want to erase are: ONECOPY, FLAGS, etc., which are not necessary for most operations. They can be restored on the disk using the ONECOPY program from your copied distribution diskette.

- At the prompt, type COPY LP:= LPHRD-DVD and this will enable the line printer to function.
- SET Commands—do it now, or printer will not print as you would want it to on command; type the following: SET HELP. Then follow instruction for setting the SYO, TT, and LP. The terminal readout explains it all. If you need additional help, refer to page 1-25 in the HDOS manual for the H-89.
- ONECOPY Benton Harbor Basic

onto the disk. Now you can write a program that will print on the H-14. Here is a sample program:

```
10 REM Test Program for H-14
20 OPEN "LP" for write as file #1
30 FOR I = 1 to 10
40 PRINT #1, I
50 NEXT I
60 CLOSE #1
70 END
```

Now, be sure your line printer is switched ON and ON LINE. Type RUN and hit the carriage return. Your printer will come to life. To store the test program on the diskette, type:

SAVE "TEST"

Now, revert back to the system HDOS control by typing BYE (Benton Harbor). Then type after the HDOS system prompt, the following:

COPY LP:=TEST.BAS

The result will be a printout of the entire program, line numbers and all.

Comments. It may seem that we are a bit critical of the Heathkit H-14 Line Printer, but we all like it very much. To cover all the good points of this product, such as its "paper out" and "paper jammed" signals, would take several more pages and this article would sound like an editorial "puff." Instead, we focused in on a few rough spots to make your future experience on the H-14 smooth.

The H-14 sells for $595.00 F.O.B. Benton Harbor, MI. A fully wired version that's pretested sells for $895.00. The printer comes with a one-inch high stack of edge-punched, fan-folded paper. We suggest you order an additional 31-pound supply direct from Heath for only $30 (Heath catalog number HCS-2). Once you get your H-14 on line, you'll be as enthusiastic as we are, and, possibly, find that computer programming takes on new excitement with gratifying rewards. (Heath Co.'s address is Benton Harbor, Michigan 49022.) Please circle number 105 on the Readers Service Coupon for more information. ■

LITERATURE LIBRARY

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

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

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

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

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

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

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

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

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

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

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

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

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

362. A new catalog packed full of military, commercial and industrial surplus electronics for every hobbyist is offered by *B&F Industries.* 44 pages of bargains.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

404. *Spectronics, Inc.* offers a complete line of equipment for the shortwave listener. Their catalog lists receivers, a complete SWL library and numerous other accessories, all at discount prices.

405. The *Kester Solder Company* is offering a book on soldering techniques and a handy guide to the various types of solders and their applications. Both are valuable items for the electronics hobbyist working with conductive metals.

406. The 1980 catalog from *Advanced Computer Products, Inc.* is billed as "the world's most complete catalog of electronics, computers, hardware, software and intelligent computer products and gadgets." A copy of this catalog is yours for $2.

407. *Poly Paks Inc.* carries a diversified line of electronic equipment at bargain prices. They cover computer products, electronic games, tools for the hobbyist and professional, and much more.

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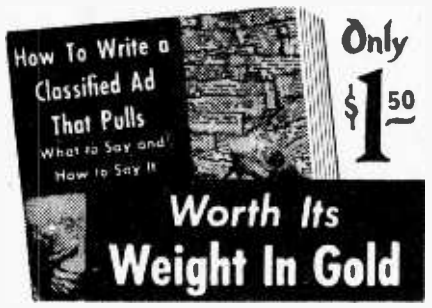

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New York, NY 10017

Tough to Hear

I have a Bearcat Scanner. My outside antenna is 30 feet above the ground. Base stations come in well but mobile transmissions are weak. I live in a mountainous area. Will a preamplifier be the answer?

—J.H., Blaireville, GA

I doubt it! We're talking about signal loss due to terrain. If the signal can't get to you, there's nothing to amplify.

Club It!

Is SCAN a scam?

—W.N., Tallahassee, FL

SCAN is a club for scanner owners who want to get more out of their listening hobby by sharing information and experiences with other scanner owners. Annual dues are ten dollars. You can get all the facts by writing directly to SCAN, Suite 1212, 111 East Wacker Drive, Chicago, IL 60601.

VHF-UHF 300 DX

I hear signals from an airport 250 miles away from time to time. I know it can't be F2 layer skip and E layer skip. Am I just lucky, or what?

—W.A., San Diego, CA

That kind of DX is always luck. What you are experiencing is tropospheric bending. Usually you can hear stations from 150 to 300 miles away. This bending is caused by the weather, so you should be on the lookout for cold fronts, especially when there is a possibility of a cold front overrunning a warm front causing a temperature inversion. When smog alerts are out, start DXing for tropospheric bending.

Glass Capacitor

I'm making my own glass plate capacitor for a very high voltage circuit. Can you tell me the dielectric constant for plate glass. Also, what thickness should I use?

—G.H., Waco, TX

The dielectric constant for plate (window) glass averages out to 7.6. The thickness used should be ⅛-in. which is "picture frame" glass. Use several layers of this glass for overall coverage of a large area. It sounds like you're making a super Tesla Coil. Be careful, you'll be working with very high voltages and current storage capacity that can kill a man or a small horse.

Color Code

Hank, I have a tip for you. Beginners have a time learning the RMA color code, as did my younger son. I put colored dots on my calculator just above the pushbutton keys. The instructions for use are simple: for the first two bands, push the keys with matching colors in sequence, then identify the third band with a numbered key and depress the zero key an equivalent number of times. The three color bands are read off on the LED readout in ohms. Since we seldom see a black third band, I did not instruct my son about it until he fully understood what he was doing. Now, he never uses the color-coded calculator because he has a visual print of the keyboard in his memory.

—L.G., Empalme, Mexico

Great idea. I took an inexpensive calculator and color-coded it. I showed it to a friend who teaches electronics in the local high school, and he flipped over it. Now his students are using your idea. Thanks much.

Faster than Slow

Okay, I heard about MSTV, which I assume is "Medium-scan television." That's all I know. Can you tell me more, Hank?

—J.A., Carrington, ND

Medium-scan television activity is centered around 29,150 kHz. Details on MSTV can be learned by listening to the International Slow-Scan TV Network each Saturday at 1800 GMT on14,230 kHz. Or, send a self-addressed, stamped envelope to Dr. Don Miller, W9NTP, Box 95, Waldron, IN 46182. Some of the facts known to me are: MSTV offers limited motion pictures at a rate of 3.75 fields per second at a bandwidth of 35 kHz. Seems like an ideal set up for a computer game telecast with the viewers as players.

Island SWLer

SWLs in Hawaii are scarce because there aren't any clubs of sort over here. I'd like to hear from some SWLs in Hawaii and get to know them so I can trade experiences with them and to know that I'm not alone. I am 13 years old and I have been a SWL since 1979. I logged about 40 countries, and received QSLs from Radio Australia, Radio Canada International, Far East Network, Radio South Africa, and N.H.K. Japan.

—Eugene Park,
2253 Kanealii Ave.,
Honolulu, Hawaii 96813

I sure hope you tie up with some active SWLers because sharing experiences is the best way to gain knowledge in your hobby.

Ground by any Other Name

Why do the British call ground earth?

—H.K., Marion, OH

I noticed the British talk funny when I first tanked up on petrol. Yes, their ground is our earth, which to me is another name for a common buss. Which reminds me of another reader who installed a braided wire throughout his furniture-type audio rack and interconnected all the metal chassis grounds to this copper braid. He then connected the braid to the AC line's "green" ground terminal. That was the end of AC hum.

Disc—oh!

What is the difference between a "direct disc" and a "digital disc?"

—C.E., Reno, NV

A "direct-to-disc" recording is a technique whereby live performances by artists are recorded directly on to the master disc. No tape recording is utilized. The entire performance must be recorded continuously. It is impossible to over dub on errors. "Digital-to-disc" recording process uses a digital master tape on which the sound is broken down into its digital counterparts greatly reducing the effect tape has on a recorded performance like reduced dynamic range and increased noise level. Overdubbing is possible, and second, third and higher generation tapes are indistinguishable from each other with respect to effect in performance and increasing noise level.

First Transistor Radio

I received a note from a reader who has a Regency pocket transistor radio, circa 1954, which is claimed to be the first of its kind. The unit is in mint condition mainly because it requires a difficult-to-find 22.5 VDC battery—which he claims put it out of contention. In our March/April 1980 issue of ELEMENTARY ELECTRONICS, we claimed the Regency unit to be the first, not the first with a 9 VDC battery. I wonder who came up with the first 9 VDC transistor battery radio to fit in a pocket? ■

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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.

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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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