INSIDE RCA'S VIDEODISC PLAYER

Build a digital LED VU meter
Pirate broadcast stations
Computer control for your robot

What's new in home video
Selectric-to-computer interface
Dolby's new N-R system for hi-fi

LEARN ABOUT MICROPROCESSORS

Single-board assembly language
Computers lead the way
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When you’re shopping for digitals, be sure to check out these Triplett Digital Multimeters. They’re loaded with extras that extend multimeter life and make your job a lot easier and safer.

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8610B 600 MHz 9-Digit Frequency Counter
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A. 2010A — $84.00*, B. 2015A — $99.00*, C. 8610A — $99.00*, D. 5020A — $115.00*, E. 8000B — $199.00**, F. 2035A — $79.00*, G. 2037A — $99.95*
Introducing the Bearcat 350, the first scanner that shows you broadcasting frequencies in plain and simple English.

The new Bearcat 350 easily qualifies as the most advanced scanner in the history of scanner radios.

Besides being the most sophisticated Bearcat Scanning monitor, it is also the world's first alpha-numeric scanner. Simply put, for the first time you have the option of scanning frequencies by numbers or names.

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To enter the same frequency source using words or abbreviations simply press the alpha-numeric key again. Your unit is ready to be programmed by frequency name.

"Type" in the word or abbreviation for the frequency source. Press the "enter" button again. Your Bearcat 350 is ready to receive frequencies by number or name. It's as easy as that.

More than words.

Even without the alpha-numeric capabilities, the Bearcat 350 would be an unbelievable advancement in no-crystal scanning.

Its complex synthesized technology gives it the capability of receiving every local public frequency automatically. You will be able to receive low, high, UHF, UHF-T public service bands, the 2-meter and 70 CM amateur (Ham) bands, plus the AM aircraft band.

The Bearcat 350 scans up to 50 channels in five banks—10 channels per bank.

Impressive extras.

It took Bearcat Scanners, the leader in scanner radios, to give you these impressive features in the Bearcat 350: patented selective scan delay, direct channel access, scan speed control, automatic squelch, patented track tuning circuitry and front mounted speaker. And look at these extras: two digital display panels, AC/DC operation, counter on each channel to determine which are most active, priority, and attractive die cast metal cabinet. See your Bearcat Scanner dealer today. Ask about the incredible Bearcat 350. Your perception of scanner radios will never be the same again.
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CANON ENTERING VIDEO

This leader in 35mm still photography will field its own line of video equipment and is expected to be just one of many film-photography companies to put its name on electronic photography gear for the consumer. Canon announced it would offer a portable videocassette recorder and a color video camera on the Japanese market this June. The camera will be a compact Canon-made unit using a 1/3-inch pickup tube and 3:1 zoom lens. The VCR will be built for Canon by Funai Electric. At pre-stime, it wasn’t known whether the Canon name would appear on such equipment in the United States. Currently another name in photography—Technicolor—has exclusive rights to the Funai-built mini-VCR (which uses a tiny cassette of quarter-inch tape) in this country.

VCR-CAMERA COMBINATIONS

Canon says its ultimate goal is a hand-held combination solid-state camera and mini-VCR, which seems to be the goal of just about every other manufacturer in the field of electronic photography. The third Japanese manufacturer to demonstrate the prototype of such a combination is Matsushita, which showed a 4.6-pound unit using a cassette about the size of a standard audio cassette, capable of two hours of recording. Matsushita's Micro Video System (MVS) is not compatible with the two previous developmental entries—Sony’s Video Movie and Hitachi's Mag Camera.

In Japan, there were indications that serious talks looking toward all-in-one camera-recorder standarization were about to begin. They would include the three companies which have already demonstrated their proposed entries, along with other manufacturers interested in the field. That presumably would affect Fuji Photo Film, which says it is ready to mass-produce mini-cassettes for portable combinations. Fuji proposed a cassette similar in proportions to the audio cassette, and said it had developed two types of tape for it—metal “MV,” capable of two hours' playing time, and evaporated-metal “VV,” which could record and play up to four hours. Both tapes are believed to be 9-microns thick. Fuji said that although metal tape costs about three times as much as oxide tape manufactured for audio applications, the differential wouldn’t be that great in video.

CHEAP VCR's

Almost simultaneously with RCA’s introduction of the under-$500 videodisc player, lower-priced VCR's have started to appear in force. Sanyo continues to have the cheapest unit—a single-speed Beta which lists at $699 but often sells for $100 less. But now Panasonic, Quasar, Magnavox, and others in the VHS camp—including RCA—have introduced low-end “no-frills” recorders which are being sold at around $649 or less, although their list prices frequently are considerably higher. Sears, Ward, and J.C. Penney all have dropped catalog prices of VCR's (to $685, $790 and $688, respectively), and the same units are frequently advertised at considerably lower prices in sales catalogs and retail stores. Lower-priced VCR's probably are coming, and a stripped-down version at a suggested list of about $500 wouldn’t be surprising before year’s end.

VIDEODISC LINEUP

Manufacturers of 87% of the color TV sets sold in the United States are now committed to the videodisc-player market, along with a few companies not currently in the color-TV business. Companies representing 59% of the color-TV market have embraced the RCA-developed CED system. 15% the JVC-Matsushita VHD system, 13.2% the Philips-MCA LV optical system, with 12.8% uncommitted or unknown.

Here’s the latest lineup of companies committed to videodisc players and the formats that they have chosen: CED—RCA, Zenith, Sears, Montgomery Ward, Sanyo, Hitachi, J.C. Penney, Sharp, Toshiba, and Radio Shack. VHD—GE, Quasar, Panasonic, JVC, and Sansui (the last is tentative and indicates it may switch to CED). LV—Magnavox, Sylvania, Philco, Gold Star, Advent, Pioneer, Fisher, and Samsung.

1,125-LINE TV

Having filed with the FCC for consideration of standards for high-definition television, CBS is exploring all proposed systems in its search for “movie-quality” TV as a new deluxe service for broadcast stations, direct satellite-transmissions and cable TV. It demonstrated a 1,125-line system developed by Japan’s NHK to an SMPTE conference in San Francisco, and was planning demonstrations of other systems at pre-stime. The NHK system was shown using special Matsushita 32-inch picture tubes which had an 8:5 aspect ratio. The system required a 30-MHz bandwidth for a single channel. Another system, developed by CBS, uses computer techniques to conserve bandwidth.
The world famous Super Case. Complete with 48 of the most popular and professional problem-solving tools. From screwdrivers and nutdrivers to pliers, wrenches, crimping tools and more. A super variety and super value. All unconditionally warranted from Vaco, of course. The Super Case and all the other fine Vaco tools can be seen in our new 1981 catalog. It's free, just write. Say you want to take a good look at VACO.

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Negative-feedback inventor inducted into hall of Fame

In a ceremony at Arlington, VA February 18, retired Bell Labs engineer Harold S. Black was inducted into the National Inventors Hall of Fame in the U.S. Patent Office.

HAROLD S. BLACK

Though Black developed the idea of negative feedback in 1927, it did not reach consumer-audio equipment until years later. But it was used in long-distance telephone transmission as early as 1928. Seventy amplifiers using negative feedback were used for a field test of the system in 1931, in Morristown, NJ. In 1936, Philadelphia and New York were linked with a commercial long-distance system using negative-feedback amplifiers.

Besides its standard audio use, negative feedback is now applied in medical technology, computers, chemical control systems, spacecraft-guidance systems, and numerous other fields. "I have seen hundreds of thousands of uses," Black said recently.

Dr. Black holds 11 fellowships and 19 memberships in professional societies. He has received 62 U.S. patents and 271 foreign ones, and has written 42 technical papers. His awards include the John Potts Memorial Award of the Audio Engineering Society.

Radio service dealers to convene in Florida

The National Electronics Convention and Trade Show is being held in Tarpon Springs, FL (near Tampa/St. Petersburg) August third to sixth, 1981. The convention is co-sponsored by the National Electronic Service Dealers Association (Nesda), the International Society of Certified Electronics Technicians (ISCTE) and the Florida Electronic Service Association (FESA).

Early registration will be profitable to the delegates. Registrations prior to April 30 will cost $90 per person, plus $80 for each additional family member. Between April 30 and June 30, the rate is $100 per person and $80 for each additional family member. After June 30, rates are $110 for one and $90 for additional family members. Persons 16 years old and under may attend the convention for $50 each.

For the registration fee to a convention-goer may participate in a technical school, the "Magic of Electronics" trade show, the instructors' conference, a seminar on cable television, and golf and tennis tournaments, along with meals and cocktail parties. There will also be time for sight-seeing around the noted local attractions, such as Busch Gardens and DisneyWorld.

For those who wish to attend only the Monday and Tuesday instructors' schools, there is a special rate of $50. Fee for the management school is $20 for one, $30 for two from the same company, and $50 for each non-member.

The theme of the convention is "The Magic of Electronics." This year a seminar on cable television will also be featured.

For additional information and convention registration pleasure write to Nesda, 2708 West Berry, Ft. Worth, Texas 76109.

Can the consumer bring back quality production in USA?

The American consumer, by exercising vigorously his right to complain about poor quality, can bring about an improvement in product quality. Dr. Norihiko Nakayama, president of Fujitsu America, told a seminar of management executives in New York recently.

"In my opinion," Dr. Nakayama declared, "Americans should refuse to settle for inferior goods." If a tool breaks, he said, take it back to the store. If the store won't give satisfaction, go to the manufacturer. And there are other avenues for protest. A consumer can write to an administrative publisher.

Those statements were made during a seminar: "Using Japanese Quality Control and Productivity Techniques in U.S. Industry," sponsored by the American Management Association and the Technology Transfer Institute.

Dr. Nakayama hinted that the Japanese consumers' attitude may be an important reason for the quality which is one of the factors in the success of Japanese imports. In his home country, customer complaints are taken seriously, he says: "To the Japanese, keeping the customer is important, and so is the company's reputation."

Radar helps steel industry

NEW IMPROVED RCA RADAR helps steel technicians control the loading of materials into blast furnaces. The newer furnaces have rotating tops that make it possible to control the distribution of the iron ore, coke, and limestone used in making steel. That new scanning radar not only measures the height of the load accurately, but also gives information on its profile, thus detecting unevenness in the loading.

Henry C. Johnson of RCA Labs is shown adjusting the new radar, which is an improvement on an older one that gave height, but not profile, information. The coiled coaxial cable above his head is a delay line designed to act as a calibration unit in improving the accuracy of the system.

Random House to distribute classroom computer items

The Radio Shack division of Tandy Corp has named Random House an authorized distributor for Radio Shack TRS-80 computer products for classroom use. Random House is a large publisher of classroom materials for schools.

The agreement is called by Charles A Phillips of Radio Shack, "...an important step in Radio Shack's strategy to better address the growing market for microcomputers and instructional software in the schools."

Besides offering Radio Shack's computer products through its educational sales force, Random House is undertaking an extensive development effort to produce software for teaching and administrative applications in schools.

The Radio Shack/Random House arrangement is not exclusive, Mr. Phillips said; at least one other agreement with an educational publisher is being negotiated.

continued on page 12
Facts from Fluke on low-cost DMM's

For a measurement like this, every millivolt matters.

In digital multimeters, accuracy and resolution go hand in hand. After all, an extra millivolt of resolution means nothing unless you can trust its accuracy. For critical measurements like checking avionics, calibrating medical systems, or simply verifying the performance of your circuit, it takes a precision DMM to fill the bill. The new 4½-digit Fluke 8050A delivers 0.03% basic dc accuracy and 0.005% of full scale resolution. Measure ac and dc voltages with 10 µV of sensitivity. Or resolve 10 nA of current and 10 milliohms of resistance. All guaranteed for one full year. That's the kind of performance you demand in a bench/portable DMM. And it's from Fluke, the leader in DMM's with a thirty year reputation for reliable, high-quality precision instrumentation.

Of course, there's more to the 8050A story. With our hybrid True RMS converter you get honest, accurate ac answers to 50 kHz without missing any significant distortion components. A dB function features 16 selectable reference impedances. And the relative mode lets you make offset measurements in all instrument functions.

You'll also find all the other dependable Fluke features on the new 8050A. Conductance for those high resistance and leakage measurements to 100,000 Megohms. Extensive overload protection and safety features. A full line of accessories. And a low price of only $369 U.S.

For all the facts on the new 8050A's accuracy and reliability, call toll free 800-426-0361; use the coupon below; or contact your Fluke stocking distributor, sales office or representative.

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Please send all the facts on Fluke low-cost DMM's.

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For technical data circle no. 39
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You learn by doing. No ivory-tower, strictly theoretical course here. You actually design and build modern electronic circuits, run tests, and verify specs. You learn how various systems interact, design your own circuits to perform specific tasks, learn to look for better ways and new ideas.

The NRI Circuit Designer is a totally unique instrument with full breadboarding capability, built-in multiple power supplies and a multi-function signal generator for circuit testing. Fast, simple connections let you build up prototype...
circuits, immediately check them out for function or faults. It handles both linear and digital integrated circuits as well as discrete components such as transistors and diodes. Six practical lab units carry you through both the theoretical and practical world of electronic circuit design.

Professional Working Instruments
Your course also includes the choice of the professionals...the 6-function, 26-digit Beckman digital multimeter for fast, accurate voltage, current, and resistance measurements. It features accurate LCD readout and full portability. You also get the famous Texas Instruments TI-30 scientific calculator to speed and simplify circuit analysis and design. It's a true

engineering instrument that includes trigonometric functions as well as square root, logarithms, and memory. Together with your Circuit Designer, they work to give you a sound basis of practical experience.

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Although the NRI Electronic Design Technology program carries you through advanced electronics, the unique NRI lesson concept simplifies and speeds learning. Especially written for individual instruction, each lesson covers its subject fully and thoroughly. But extraneous material is eliminated, language is clear and to the point. Organization is logical and effective.

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You need absolutely no electronic experience to be successful with this modern course. If you're a high school graduate with some algebra, you should handle it without any trouble. We even include, at no extra charge, the NRI Math Refresher Module, designed to help you brush up on your math and teach you any new concepts you may need from basic algebra through phasors and circuit analysis.

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There's so much to tell you about this exciting new course for the electronic 80's, we can't do it all here. Send the postage-paid card for our free, 100-page catalog with all the facts about this and other NRI electronics courses. We'll rush it right to you without obligation. Look it over and discover for yourself why only NRI can prepare you so well for your future. If card has been removed, please write to us.

NRI SCHOOLS
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We'll train you for the good jobs.
Standard & Poor's software for Radio Shack TRS-80

Standard & Poor's, the firm of financial experts best known as publisher of The Wall Street Journal, has prepared a complete stock analysis and portfolio-management package for microcomputer enthusiasts who are also investors.

Available for use on the Radio Shack TRS-80 microcomputer, Standard & Poor's STOCKPAK provides for evaluating and managing a stock portfolio of up to 100 securities, with as many as 30 transactions on each issue. It also makes it possible to analyze 900 New York, American exchange, and over-the-counter common stocks, and generate reports to guide investment decisions.

The STOCKPAK system is designed for use with Radio Shack's Model I or Model III TRS-8032K business-computer systems. It includes four program diskettes and a comprehensive user's manual.

The first program diskette is the Portfolio-Management System, which provides for the maintenance and control of a portfolio, or a simulation capability for any group of securities to be evaluated.

A second diskette contains the Screen and Select System, with which the user can apply a variety of investment criteria to the 900-stock data base, identifying securities to meet such requirements as price/earnings ratios of less than 10, selling below a given price, and more. Stocks selected and criteria statements can be stored for instant recall.

Diskette three is a Report Writer System which creates reports of stocks meeting user-selected criteria, along with additional information from the data base.

The fourth diskette is a Demo Data Base which contains the 900 common stock data base of the most widely traded stocks and includes 30 financial items on each of the companies.

The STOCKPAK system for the TRS-80 is available from Radio Shack stores and other outlets for $49.95. A monthly updating of the data base is available from Standard & Poor's, if desired, at an annual subscription fee of $200.

Computer voice processing to make big jump in '80's

Talking to your computer instead of typing instructions on a terminal, and listening to it instead of reading a printout, will become fairly common in industrial operations and financial transactions during the first half of the 1980's. During the second half, voice processing will come to the forefront in office systems and consumer products. So says an International Business Research Report, issued by Frost & Sullivan Inc. of New York City and London.

Using voice as computer input is not only more appealing because of its "naturalness," but saves time by freeing hands and eyes. At present, there are several problems: Vocabulary of most systems is limited—generally they are scheduled to respond to discrete commands, not continuous speech. The vast majority of present systems respond to only one operator, whose speech they have been trained to understand. Independent systems, which recognize the voices of different operators, are rare. (F&S believes that a sufficiently low-cost, large-vocabulary system that can accept continuous speech will be available within the next few years.)

Voice response—the other half of voice processing—is a technique that converts computer-generated digital data into human or synthetic speech, depending on whether the vocabulary has been tape-recorded or electronically synthesized. It has already been used to a limited extent, as in a Simpson-Sears experiment with linkage of telephone customer orders to a computer, military testing of voice-response equipment for instructing flight crews, and a General Motors assembly-line installation. Within a year, Texas Instruments plans to introduce a speech synthesizer with a 2,000-word vocabulary, says Frost & Sullivan.

Foundation gives $500,000 for computer education

The Foundation for Computer Education, based in Cupertino, CA, has just made its fourth set of awards, amounting to $150,000, to 26 educational systems. That brings the value of grants given to educational institutions and individuals to $500,000 since October 1979.

These grants of computer equipment are given for projects intended to improve education through the use of small, low-cost computers. The projects range from basic word-attack skills for kindergarten through third grade, to genetics and molecular biology at the university level.

Some 87 projects have been approved and have received awards of computer equipment. The 87 recipients are eligible for a grand prize—to be given to the institution or individual demonstrating the outstanding example of a program leading to improved education with small computers.

The non-profit organization was chartered as the Apple Education Foundation in 1979, and was joined since by Bell & Howell as a major supporter, and assisted by a number of computer or computer-related firms that donated equipment or services. The systems awarded include Apple II personal computers, Apple being still the principal sponsor of the foundation.

The systems given the educational groups range in value from something over $2,000 to about $7,000, the bulk of them between $4,000 and $6,000.

STANDARD & POOR'S STOCKPAK system used with a Radio Shack TRS-80 microcomputer.
Now, a mini-scope with the features most wanted by field engineers!

B&K-PRECISION'S new Model 1420 is a good example of what can materialize when a company listens well. This new 15MHz dual-trace mini-scope was designed by B&K-PRECISION engineers from a clean sheet of paper to respond to the special needs of field engineers...a mini-scope with lab-scope features.

So small in size (4.5"x8.5"x12"), the 1420 easily fits into a standard attaché case with plenty of additional storage room for a DMM, tools and accessories. For use in any environment, the 1420 can be powered from an AC line, 10 to 16VDC or an optional internal battery pack. Unlike some competitive mini-scopes, adding a battery pack will not add to the size of the slim 1420.

The rugged 1420 features dual-trace operation and an honest 15MHz response. In addition, its smooth roll-off provides useful response to 20MHz.

An efficient rectangular CRT displays waveforms with high brightness for good readability under all field service conditions.

Too many field-service mini-scopes sacrifice features and performance for compact size, handicapping the field engineer. The new generation 1420 has overcome these problems. In spite of its small size, the 1420 has eighteen sweep ranges that span from 1 µS/div. to 0.5S/div. in a 1-2-5 sequence; variable between ranges. Sweep magnification is X10, extending the maximum sweep rate to 100nS/div. For use with computer terminals or video circuits, a video sync separator is built in. For added ease of use, automatic selection of chop and alternate sweep modes is provided, as is front-panel X-Y operation.

The new 1420 mini-scope comes complete with two 10:1/probes and is available now from your local B&K-PRECISION distributor. Available options include carrying case and probe pouch.

To receive a free 16-page color brochure describing the 1420 and the complete B&K-PRECISION oscilloscope line, call toll-free, (800) 621-4627 (312) 889-9087 in Illinois.
The State Of The Art Moves Ahead

The electronics industry never stands still. Not a single working day passes that engineers and scientists are not busy researching and analyzing in an attempt to advance the state of the art a notch or two. Very often, we are not aware of that massive effort until we see the results brought to the marketplace.

Two recent conferences—the International Electron Devices Meeting held in Washington, DC, and the International Solid-State Circuits Conference held in New York—provided a look at the semiconductor industries' view of where the state of the art is today and where it will be tomorrow (the next few years). Since semiconductors are often viewed as the heart of modern electronics, by watching the advances made in the semiconductor field we begin to realize the advances being made in the industry as a whole.

Although many topics were discussed at the conferences, one stands out as a measure of the state of the art. VLSI (Very Large Scale Integration) will be the next generation of IC's to reach us. Those IC's will pack more circuitry into less area, consume less power, and operate faster than ever before. To say the least, those IC's will be very sophisticated and extremely powerful from a designer’s point of view.

To produce the new IC's, new fabrication processes are required. Called electron beam and X-ray lithography, the processes produce circuit patterns on the silicon wafers with smaller line widths. Currently, IC's are being produced with line widths of 3 micrometers. Experimental IC's are being fabricated with line widths down to 1 micrometer and industry analysts are predicting line widths down to 0.5 micrometer in the not-too-distant future.

What does that mean in terms of actual IC's? Matsushita has fabricated a 64K static RAM. Packed onto a 5.44 x 5.8 mm chip, this RAM contains over 402,000 components. Both Nippon Telegraph & Telephone and a joint effort by NEC and Toshiba has produced 256K-bit dynamic RAM's. The NEC/Toshiba device uses 1.5-micrometer lines while the NTT device is 20% smaller, using 1-micrometer lines.

On the microprocessor front, Intel has unveiled a three-IC set that comprises a 32-bit micromainframe (that's Intel's word). It's been dubbed a micromainframe because it has the computing power of a mainframe computer and processing power can be increased by adding CPU's without changing software. Intel has also developed a virtual memory capability that permits 1 gigabyte of address space. That's 1000 megabytes. I remember being thrilled when I finally expanded my home computer to 64K of RAM. Speed is also increasing. Zilog plans to introduce two updated versions of their 16-bit CPU, the Z8003 and Z8004, that will run at 10MHz. That would make them the fastest CPU's available.

This should give you a pretty good idea of what is happening behind the scenes and what the future may bring. If you have any comments or predictions, please send them to me and we'll publish as many of the best ones as we have room for.

ART KLEIMAN
Managing Editor
Road test the remarkable Touch Test 20. Now, with its 20 key test functions at your fingertips, (plus the ability to measure 10 electrical parameters and 44 ranges) you can take one lab to the field instead of a cumbersome collection of individual testers.

Another bright idea. The Touch Test 20 is the only DMM with light pressure touch function selection. No more dials to fiddle with. Instead, an LED shows the function you choose. And when you switch, you get an audible bleep and a visual blip to let you know.

**Operation: a snap.** A light touch chooses the function. An LED shows it.

**Functional. Not gimmicky.** We believe that in DMM design, form should follow function. For example, it’s rare that a DMM is used hand-held. Usually it’s placed so the operator’s hands are free to manipulate the test leads and the equipment being tested. That’s why we developed the Touch Test 20 — to fit where and how it would be used. The result is the most innovative portable/bench-type multimeter in the industry today.

**Small wonder.** The Touch Test 20 is designed specifically for mainline electronics measurement and testing. It checks AC and DC voltage, AC and DC current as well as resistance. Analyzes temperature in Celsius and Fahrenheit. Measures conductance and capacitance. It also performs diode/transistor and continuity tests. All with the accuracy that’s synonymous with the name Non-Linear Systems.

**Shop-proven. Field-proven.** The Touch Test 20 is ideal for bench-top use. The large, 0.55-inch LED numbers make it easy to read. And its dial-free, light touch selection system prevents the unit from skittering across the tabletop. Light and versatile, it’s the perfect, portable road lab, too.

The Touch Test 20 comes with test leads, temperature probe and resistor/capacitor test adapter. It features automatic polarity and overload indication plus in-circuit test capabilities. The Touch Test 20 is available in two models — rechargeable battery or line operated. All parts and labor are guaranteed for a full year. And each model is available with optional accessories like a leather carrying case with shoulder strap and belt loop, to help you get the job done.

**Touch Test 20 at a glance**

**Measurements**

<table>
<thead>
<tr>
<th>Feature</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>AC Voltage</td>
<td>10 µV to 750 VRMS, 6 ranges</td>
</tr>
<tr>
<td>DC Voltage</td>
<td>10 µV to 1000 VDC, 6 ranges</td>
</tr>
<tr>
<td>AC Current</td>
<td>10 µA to 10 A, 4 ranges</td>
</tr>
<tr>
<td>DC Current</td>
<td>0.1 µA to 10 A, 7 ranges</td>
</tr>
<tr>
<td>Resistance</td>
<td>10 mΩ to 20 mΩ, 7 ranges</td>
</tr>
<tr>
<td>Temperature</td>
<td>-40°F to 150°F, 2 ranges</td>
</tr>
<tr>
<td>Conductance</td>
<td>0.01 nS to 200 nS (equivalent to 5 megohms to 100,000 megohms) 2 ranges</td>
</tr>
<tr>
<td>Capacitance</td>
<td>1 pF to 200 pF, 6 ranges</td>
</tr>
</tbody>
</table>

**Tests**

- Diode: Diode and transistor junctions in conducting and non-conducting directions
- Continuity: Audible signal

**Size**

2.9" H x 6.4" W x 7.5" D

**Weight**

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**Price**

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CIRCLE 41 ON FREE INFORMATION CARD
OTHER SATELLITES ON THE WAY

Two more satellites—carrying up to 612 new transponders—will be in orbit over the U.S. by mid-1985—and that doesn’t include the proposed Comsat DBS plan. The quadrupling of satellite facilities will come as a result of the FCC’s recent decision to expand its “open skies” policy. As part of the same ruling, the Commission is moving toward a “short-spacing” of birds, permitting them to fly at intervals of about 3° instead of the current 4° apart.

The new birds will be operated by GTE, Hughes Communications, Inc., and Southern Pacific Communications, each of which will launch two new satellites and build a third as a ground spare, ready for launch in case of a problem with the orbiting bird. In addition, companies already in the space game, such as AT&T, RCA Americom, and Western Union will be permitted to put more satellites in orbit.

Overall, the new satellite facilities will cost more than $2 billion. Many of the birds will be used for video service, although some of the new satellite operators are expected to concentrate on data communications, teleconferencing, and other non-video services.

The FCC hopes to come to a decision this year about spacing of satellite orbits, to avoid interference while making the most efficient use of spectrum space. The FCC is also examining related matters, such as future satellite usage of 12/20 GHz and higher bands.

NEW CABLE PROGRAMMING

The cable-TV industry continues to find itself on the receiving end of new entertainment services—many of them unveiled during the semi-annual industry conventions. At a recent industry gathering, more than half-a-dozen satellite-fed program services were announced, along with several augmentations of current program packages. Many of the new services will be on the bird shortly—with some of them, such as Showtime’s expansion to a 24-hours-on-weekends service already in operation.

Culture is the main ingredient in several of the new program packages, including the previously announced CBS Cable service which is due to go on the Westar bird by June. “Alpha,” a joint effort by ABC Video Enterprises and Warner Amex Satellite Entertainment, should be underway by the time you read this aboard Satcom I, using the same transponder as WASE’s “Nickelodeon.” Alpha will feature performing- and visual-arts programs.

Bluebird, another new program service, will offer many shows from British Broadcasting Corp. (the type now seen on public-TV channels) along with other original cultural programs. Bluebird channel is operated by an affiliate of New York’s Rockefeller Center and is currently negotiating with several satellite companies for transponder space.

A number of other specialized services via satellite are also in the works. For example, an “adult” movie channel (mostly R-rated, exploitation movies) is being offered by Satori’s “Private Screenings” service from midnight to 6 a.m. aboard Westar. Bravo, another of the culture channels, will introduce an evening newscast at 8 p.m., concentrating on cultural events taking place in selected cities nationwide. Times Mirror Satellite programming will launch a home shopping service, offering catalog-type information and giving cable customers (and other satellite viewers) the opportunity to order merchandise via a special video catalog.

EUROPEAN MOVIES AND TV SHOWS

More European TV programs and movies are taking to the skies over America, thanks to two recent deals by major satellite-program delivery services. Satellite Program Network, which is establishing its second network SPN-11 on Westar III Transponder 9, is turning over three hours every night to Telefrance-USA. The shows will run from 9 p.m. to midnight (eastern time) and include a regular cycle of shows: Sunday, family programs; Monday, French TV shows; Wednesday, “great French films;” Friday “French Life Today” and European TV specials. The other nights will offer reruns of the previous evening’s shows. The Telefrance-USA package is dubbed into English and is aimed at the U.S. audience.

On Satcom I Transponder 9, USA network has begun carrying The English Channel, a series of culturally oriented programs which includes documentaries, music, drama and entertainment, much of it produced by British independent TV stations.

Meanwhile many new program suppliers are slipping programs aboard satellites, filling in the gaps between the major program services now carried aloft. For example, “Telehorse” will be beamed daily aboard Westar by Hughes TV network. The shows will be scrambled and will cover races from various Chicago-area racetracks, sent exclusively to Las Vegas betting parlors so gamblers can watch events on which they are wagering. Over on an HBO transponder on Satcom, a few moments in the morning will be turned over each month to a cable-TV industry publisher, who will present information about the business; that will be aimed primarily at cable-TV executives.

GARY H. ARLEN
CONTRIBUTING EDITOR
Here's the easy way to join the microprocessor revolution.

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CABLE TELEVISION

Is cable television a friend or foe? With so many choices of programming—HBO, C-SPAN, BRAVO, ESPN, QUBE, etc.—it would seem imminent that a potential viewer will have a veritable video smorgasbord at his fingertips. But will he? Superficially, it would seem logical that there would be an unlimited variety of "top shelf" entertainment available, 24 hours a day.

Don't bet on it!

In the past, the three major TV networks—ABC, CBS, and NBC—were the only rivals in the vast national telecasting market. With only three suppliers of programming competing for their share of the 140,000,000 TV viewers, a substantial slice of the pie was nearly guaranteed to all. That convenient and powerful system was extremely attractive to advertisers—the only source of income in commercial TV. Coupled with the expertise of the American Research Board (ARB) and the Nielsen ratings system, demographics dictated to the advertisers exactly where their target audience was. It was scientific, lucrative, and efficient. In fact, it was a near-perfect medium in which to expose, sell, and saturate a market.

Advertising on TV is sold on a "cost per thousand" (viewers) basis. The more viewers of a program (and the commercial), the more money is charged per commercial spot run. When 140,000,000 viewers are divided by only three networks, simple arithmetic shows that a higher potential gross income can be realized than when there are 30 or more national "networks" vying for the audience.

It doesn't require a genius to extrapolate in what direction TV programming will go when the audience, and the revenues to produce network programming, is diluted to one-tenth or less of its current standing. To maintain the present quality of programming (and many think that it is already decadent), networks will be forced to increase their "cost per thousand" rates to a point where advertisers will be forced to seek alternative media to reach their targets more effectively.

Ultimately, the demise of networks and their affiliated local-TV-station outlets will become inevitable. Then we will all be forced to pay top dollars for mediocre programming on a cable system comprised of 30, 40, or 50 channels of second- and third-rate programming.

Our only hope may be that, after a few years of "all-pay TV," someone will come up with the idea of supplying first-rate entertainment free to anyone who can receive a TV signal via wireless techniques, and which will be sponsored by advertisers in exchange for commercial announcements within the programs that they sponsor. Eureka! We will have re-invented commercial TV! But will it be too late?

MYLES H. MARKS,
Technical Director WIIIC-TV (NBC Affiliate)

Mr. Richard Johnson's comments in the letters department of your February 1981 issue stir me. Perhaps Mr. Johnson is so involved in his work that he can only see the trees and cannot concern himself with the forest. Not being familiar with El Cajon-San Diego TV services, I can't comment on them, but I can comment on the cable TV in Reno. If Teleprompter TV is a "mom & pop" operation, it certainly has expanded.

Your best guide through the solid state jungle...

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As I understand it, from the San Francisco Bay area to it is one system.

But perhaps Mr. Johnson means that the systems in El Cajon, CA, Wellington, NV, and Hawthorne, NV, are "mom and pops" and number three systems, while Telepromter is only one system.

The January 1981 issue of Saturday Review has another comment: "Can PBS Survive Cable?", by Peter Caranicas. That is a very interesting article. But perhaps again CBS cable is a "mom and pop" operation. Sure.

It is my present personal opinion that Mr. Johnson is so anxious to get the cable-industry view across to the public that he doesn't pay any attention to the facts.

As a viewer of several years, and an electronics hobbyist of some more years, the future is of great concern to me. We have viewed the great variety of TV around the large population centers. And, as at present, we have also been in other locations where only one channel was available. In Reno, three stations broadcast the three networks only, and cable opens up the programming with three more channels—two independent, and PBS. I believe that is a necessary service.

However, what with the increasing costs, I am uncertain about how long it will last. When we first subscribed, the price was under $5.00 a month; now it is $7.50, with indications that the company wants more. Fortunately, competition is on the scene, and the price increase has not yet happened—and, strangely, the reception has improved tremendously.

With our economic system the way it is, perhaps enough viewers will not be able to afford the increasing costs of cable TV, and thus broadcasting will continue.

J.T. KING
Reno, NV

BALLY ARCADE USER GROUP

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THE CURSOR GROUP.
Fred Cornett, President

MODULATION

In the "Letters," department (January 1981), Mr. Davis states: "White is 12.5% carrier level, not zero modulation, which is the blanking level. Maximum modulation (87.5%) occurs at white, not sync, which is +40%.

Much of that statement is incorrect. That is not unusual in articles I have read about TV modulation down through the years. So let's try to set the matter to rest.

In this particular case, I believe we have an IEEE gratitude that's causing the confusion. That scale is very useful around a TV studio, and other spots, for measuring levels; and, of course, for transmitter-modulation measurements, if used properly.

When modulating a TV transmitter, it sees only the overall signal, which means the whole composite signal (sync plus video). We cannot speak of +40% sync or minus that. The blanking level is not zero modulation; it is simple zero on the IEEE scale (no relation). Tip of sync is 100% modulation, as Jack Darr stated. Sync is transmitted at 25% and is not 40%. The scale reads 40 units—not 40%. The

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The total units on the scale for transmitter measurements must be 160 units—two divisions above 100 units, which appear on the scale. Zero carrier should be set at that point. Zero carrier is displayed on the scope, by chopping the signal after it is detected from the transmitter, either by a mercury relay or electronic means.

That signal is generally not available to the studio engineer, so he never sees it. That probably causes much of the confusion. If we set the carrier at two divisions above 100, we wind up with a total of 160 divisions; thus, if sync is set at 40 divisions, we end up with 25% sync (measured from zero carrier to tip of sync), which is correct. 100% modulation of video is never reached. It is set by FCC rules. A 12.5% protection area is provided, for two reasons. Firstly, to avoid white-picture saturation due to characteristic curve distortion; second, to eliminate over-modulation (carrier chatter), which would cause problems with intercarrier receivers.

A word about power output may be useful. We must consider video as a subtractive process. As we fill in the white-picture area, our power output decreases. TV and AM transmitters act quite differently. In AM, an average signal does not change the power input (DC Input). The output power does change, due to the modulation in added fashion. But in a TV transmitter, the power output changes in a drastic fashion. The difference here is that the DC input power changes in TV and consequently the output power changes, too. The TV transmitter power is at a maximum only with an all-black picture (with sync-only modulated). As we apply video, the power decreases in accordance with the white content of the picture. At all-white picture, the power is minimum. In a typical 50 kW transmitter, the plate current can change from 6 amps to 11 amps using 6800 volts. Quite a power change, eh? Those figures might make a ham operator drool.

C. M. ROGERS.
Valley Center, KS

THE HP-85
With reference to Mr. Gilder’s report on the HP-85 in your December 1980 issue: There are a couple of minor errors. Firstly, the beeper can be programmed for both duration and pitch. The standard pack of programs, supplied with each machine, includes a rendition of the William Tell Overture using the beeper.

Second, if a binary routine, included with a tape from the user’s library, or available in the printer/plotter ROM, is used, the entire graphics image can be stored as a single string. The graphics screen can thus be used for storage, adding 6K to the available memory.

BOB STAINER
Cape St. James, B.C. Canada

KEEPING AIRWAVES PUBLIC
I was interested in your editorial (December 1980) on keeping the airwaves public; but the fact is, as you know very well, the airwaves haven’t all been free to the public for at least the last 50 years. I cite as an example the scrambled telephone messages which have been transmitted on our shortwave bands as far back as the mid ’30’s. Those messages were—and as far as
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NEW
I know still are—scrambled for the sake of privacy, but are nonetheless transmitted on our public airwaves.

That, to my way of thinking, is just as wrong as the thing you are complaining about. I have always felt that it wasn’t right. Messages broadcast over our “free” airwaves should be available for all to listen to without special “secret” deciphering equipment. Yet, for some reason, I have never seen or heard of any complaints about scrambled broadcasts over the public airwaves in any radio magazine.

But something that is of much more concern to me than that is some of the FCC’s proposals of butchering up the AM broadcast band even worse than it has already been messed up—like narrowing the bandwidth to 9 kHz and eliminating the so-called clear-channel stations. After all, the original idea was that frequencies between 550 kHz and 1700 kHz were for long-distance communication. Local broadcasting can as well be done at much higher frequencies. But that is not what is being done and as a result the AM band has become so cluttered up with stations that it is only good for local coverage.

That is certainly not in the public interest. On the other hand, I, for one, do not believe that the 70-UHF channels will be used for TV entertainment in years to come—if ever.

JOHN R. SIMPSON
Tampa, FL

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Global Specialties 2001 Function Generator

GLOBAL SPECIALTIES CORPORATION (70 FULTON TERRACE, NEW HAVEN, CT 06509) HAS INTRODUCED THE MODEL 2001 FUNCTION GENERATOR. THIS VERSATILE INSTRUMENT PRODUCES FOUR DIFFERENT OUTPUT WAVEFORMS: A SINUSOIDAL, A SQUAREWAVE, A TRAPEZOIDAL, AND A TTL-LEVEL SQUAREWAVE. THE MODEL 2001 COVERS FREQUENCIES FROM 1.000 TO 200.000 HERZ IN FIVE OVERLAPPING PUSHBUTON-SELECTABLE RANGES. A VERNIER CALIBRATOR IS CALIBRATED FROM 0.1 TO 1.0. THE FREQUENCY OF THE OUTPUT WAVEFORM IS THE DIAL MEASUREMENT MULTIPLIED BY WHATEver RANGE PUSHBUTON IS SELECTED (100.000, 1.000, 10.000, 100.000, OR 1.000 HERZ). FOR EXAMPLE, DIAL 0.5 AND PUSH THE 1-KHZ BUTTON AND YOU GET 500.000 HERZ. THE DIAL IS ACCURATE TO WITHIN ±5% OF THE SETTING.

A VARIABLE OUTPUT-LEVEL CONTROL IS USED TO CONTROL THE LEVEL AT TWO OUTPUT JACKS MARKED "IN" AND "LO." THE HIGH OUTPUT DELIVERS FROM 0.1 TO 10.0 VOLTS P-P (OR MORE THAN 40 DB) INTO 600 OHMS. THE LOW OUTPUT IS −40 DB DOWN, OR FROM 1 TO 100 MILLIVOLTS INTO AN OPEN CIRCUIT OR 0.5 TO 50 MILLIVOLTS INTO 600 OHMS. THE MODEL 2001 HOLDS THE OUTPUT CONSTANT WITHIN 0.5 DB OVER ITS ENTIRE FREQUENCY RANGE.

THE TTL SQUAREWAVE OUTPUT IS AT THE DIAL FREQUENCY AND CAPABLE OF DRIVING UP TO 10 TTL LOADS WITH RISETIMES AND FALLTIMES OF LESS THAN 25 NANOSECONDS. THE AMPLITUDE IS 0 OR 5 VOLTS, AND IS NOT ADJUSTABLE BY THE LEVEL CONTROL. THE TTL SIGNAL IS ALWAYS IN PHASE WITH THE OTHER OUTPUTS (OTHER OUTPUTS CAN BE USED SIMULTANEOUSLY).

THE SINUSOIDAL OUTPUT HAS LESS THAN 2% DISTORTION. THE SQUAREWAVE WAVEFORM IS WITHIN ±1% LINEARITY ERROR; THE SQUAREWAVE HAS RISETIMES AND FALLTIMES OF LESS THAN 100 NANOSECONDS. ALL THOSE OUTPUTS CAN BE SWEEPED OVER ANY DESIRED FREQUENCY BAND. AN AC VOLTAGE OF UP TO ±10 VOLTS CAN BE FED INTO THE SWEEP IN JACKS. THAT CAN BE USED TO CHECK THE FREQUENCY RESPONSE OF A FILTER, FOR EXAMPLE. THE MANUFACTURER RECOMMENDS USING A TRAPEZOIDAL WAVE AND DRIVING THE SCOPE'S HORIZONTAL SWEET WITH THE SAME TYPE OF WAVE. SINCE THE TRAPEZOIDAL WAVE IS LINEAR WITH TIME, THE SCOPE SHOWS A LINEAR DISPLAY OF THE FREQUENCY-RESPONSE CHARACTERISTICS OF THE FILTER. ANY PEAKS, REGENERATION, LACK OF SYMMETRY, OR OTHER FAULTS WILL SHOW UP INSTANTLY.

THE OPERATOR'S MANUAL CONTAINS FULL INSTRUCTIONS FOR THIS. TO SHOW THE RESPONSE OF A 5-KHZ BANDPASS FILTER, FOR EXAMPLE, SET THE FREQUENCY DIAL AT 0.55 AND PRESS THE 10-KHZ RANGE PUSHBUTON. SETTING THE SWEEP VOLTAGE AT 9.7 VOLTS (P-P) WILL CAUSE THE MODEL 2001 TO SWEEP FROM 1 KHZ TO 10 KHZ.

IF AN OFFSET SIGNAL-VOLTAGE IS NEEDED (ONE THAT IS NOT SYMMETRICAL ABOUT ZERO), PRESS THE DC OFFSET PUSHBUTON. THE LEVEL CONTROL NOW BECOMES AN OFFSET CONTROL. FOR INSTANCE, YOU CAN CREATE A SQUAREWAVE THAT GOES FROM 0 VOLT TO ±5 VOLT, OR FROM 0 VOLT TO −5 VOLT. IF THE SCOPE IS SET TO DC INPUT, THAT ALSO VARIES THE POSITION OF THE TRACE ON THE SCREEN.

AN INSTRUMENT LIKE THIS ONE CAN BE VERY HELPFUL IN ALL KINDS OF AUDIO TESTING. THE TRIANGLE WAVEFORM, FOR EXAMPLE, IS IDEAL FOR LOCATING PROBLEMS.

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clipping in any stage from input to output. You can detect the slightest clipping tendency by noting the flattening of the triangle wave’s sharp peaks. Nonlinearity shows up instantly as a curvature of the rising and falling ramps. Faults such as these show up very easily with these tests.

The instruction manual details all modes of operation and shows control settings, waveforms, and a handy chart showing the scope patterns produced by many typical defects. Full calibration data is in the back of the book, if needed. The Model 2001 is a handy instrument with many possible uses. It sells for $186.00.

R-E

**Sencore Model DVM56 Microranger DMM**

*WITH THE AVAILABILITY OF LOW-COST MICROPROCESSOR IC'S IT WAS JUST A MATTER OF TIME BEFORE THEY WOULD BE USED IN ELECTRONIC TEST EQUIPMENT. ONE OF THE MOST RECENT ADDITIONS TO THE FIELD IS THE MODEL DVM56 MICRORANGER FROM SENCORE (3200 SENCORE DR., SIOUX FALLS, SD 57107). ACCORDING TO THE COMPANY'S SERVICE MANUAL THE MODEL DVM56 WAS DESIGNED TO FREE THE TECHNICIAN OR ENGINEER FROM THE NEED TO SWITCH RANGES MANUALLY, INTERPOLATE READINGS, OR HAVE TO FIGURE OUT WHERE THE DECIMAL POINT SHOULD BE, MAKING SERVICING FASTER. THE MODEL DVM56 DOES ALL OF THOSE THINGS AUTOMATICALLY.*

Physically, the model DVM56 is somewhat larger as compared to more conventional DMM’s. The unit measures 4 X 8 X 11½ inches. The front panel measures approximately 4 X 8 inches. The unit is solidly built and its large size gives you an idea of the amount of circuitry packed inside the cabinet.

The model DVM56 measures AC and DC current up to two amperes. Resistance measurements from 0.01 ohm to 99.99 megohms can be made in either the high- or low-power mode. The low-power mode is used for in-circuit testing of solid-state devices as there is insufficient voltage to forward-bias a junction. AC voltage is measured in three modes over three ranges: peak-to-peak (two kilovolts maximum), average RMS, and true RMS (.0001 mV to 999.9 volts for both RMS modes). DC-voltage measurements up to 10 kilovolts are possible with the model TP222 10-kilovolt probe (included). Without the probe, DC voltages from 0.1 mV to 1000 kilovolts can be measured.

There are two decibel ranges. The dBm range uses the standard reference of 1 milliwatt into 600 ohms (0.7746 volts RMS). If any other reference is desired, the dBP range is used. To “program” a reference into the model DVM56, simply press the OHMS & DBP ZERO button while measuring the reference. All further dB readings will be referenced to the programmed reading.

Another feature is the ability to select the resolution for a particular application. By pressing one of the three pushbuttons on the front panel, the user can select 3-digit, 4-digit, or 4½-digit resolution. As the instruction booklet points out, the 4½-digit readout will most likely be most important when using the DVM56 in calibrating procedures. For most applications, 3 digits will suffice. Certainly, 4 digits exceed the capabilities of most DMM’s.

There is also a RANGE HOLD button. Since the model DVM56 will actually switch through as many as three basic ranges of voltages, it will be useful to be able to perform multiple measurements using the same range. For instance, if you are servicing a piece of electronic equipment where all the voltages will be in the kilovolt range, there seems to be little reason to allow the model DVM56 to start off in the MILLIVOLT range, autorange to the VOLT range, and finally up to the KILOVOLT range. When you want to use one range, press the RANGE HOLD button while a reading is displayed, will keep the meter in that range until you want to use the autoranging feature again. That feature works the same way for all functions (voltage, resistance & current).

Another unusual feature is PEAK & NULL. As most technicians and engineers are already aware, DMM’s are unable to take the place of analog meters when it comes to adjusting traps or tuned circuits where an exact minimum or maximum reading is needed. This feature will do a fantastic job of pushing peaking and nulling. Two small LED indicators (labeled with + and − signs and direction indicators) on the front panel are used to indicate a peak or null.

ended on page 36
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CIRCLE 31 ON FREE INFORMATION CARD
In use, the operator selects the desired function, depresses the PEAK & NULL button, connects the test leads to the circuit to be adjusted, and watches the two red lamps on the panel. When both lamps glow (and one or the other of them goes out when you adjust the coil or other device) the circuit is in perfect adjustment. The markings indicate which way you must adjust to obtain a peak or null.

Large (0.5-inch) LED's are used in the display and are easy to read at a distance. A bail-type handle also serves as a handy tilting stand for bench use, and the construction of the cabinet is rugged enough to withstand hard usage.

Front-panel banana jacks let you use any test leads you may already own. Three high-quality leads are supplied. Two of the leads (black and red) have alligator-clip terminations, while the third (red) has a probe.

As already mentioned, the unit comes with a 10-kilovolt transient-protector probe (model TP222). The probe allows the model DVM56 to make DC-voltage measurements up to 10 kilovolts. Sencore recommends that the probe be used whenever DC voltage measurements are made, as it increases the meter's input impedance, resulting in less circuit loading. That means, of course, a more accurate reading. The isolation resistor in the probe also tends to decouple the leads from the circuit, and that results in less capacitive loading.

Although readings obtained using the probe were good, there were some drawbacks. In use, the probe, which is five inches long, is slipped onto the end of the standard probe, which is also five inches long. That results in a rather clumsy, 10-inch-long test probe. Additionally, the probe must be removed for all ranges other than DC volts.

The model DVM56's case has feet for stability when used on a flat surface. Other case features include a provision for cord storage, a clip for the 10-kilovolt probe, and a spare-fuse compartment. There is also a 1-s-volt accessory jack for use with the optional LA220 AC amplifier. A slide-out chart at the bottom edge of the case (just under the front panel) has complete instructions for using the unit.

One of the few problems noted in use is the delay in obtaining readings once the test probes have been attached to the circuit. The instructions list the "thinking time" for the microprocessor as two seconds, maximum. However, you will have to get used to that delay first, as most good technicians place a probe on a connection and look at the meter with the expectation of seeing a reading immediately. The two seconds may seem like an eternity to a fast technician. The delay is shortened when using the RANGE HOLD function, as the unit will not have to cycle through the ranges. However, it seems as though the time is lengthened when using the TP222 probe. When you consider that you would have to reach up and change the ranges of a normal meter, perhaps the wait is justified. To be sure, you can get used to it.

The model DVM56 sells for $795.

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Alliance Model HD-73 Heavy-Duty Antenna Rotator

Alliance, manufacturer of the famous Tenn-Rotator TV antenna rotators since the early 1950's, has released a heavy-duty antenna rotator designed for amateur and CB use. The model HD-73 comes well packaged with a control unit, a rotator motor, accessory hardware, and a manual. The six-conductor cable required for installation is not included.

Before purchasing any rotator, you should determine whether it will be adequate for your antenna. Wind loading and vertical-weight bearing are probably the two most important considerations. Because the rotator is affixed to the uppermost part of the antenna mast or tower, an additional vertical support is required to attach the antenna to the rotator. The longer that vertical support is, the greater the stress on the rotator because of leverage from

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wind loading. When vertically polarized beam antennas are used, that problem is aggravated. No metal vertical part of the antenna support should be closer than one-quarter wavelength to the lowest tips of the antenna elements. Assuming that a two-meter beam is used, a nonmetallic support between the antenna boom and rotator should be about three feet long.

In CB installations the nonmetallic support above the rotator theoretically should be at least 18 feet long! Obviously, that length is rarely (if ever) met in the field, but it could be a consideration for those operators who want the best radiation pattern possible from a vertically polarized antenna. Horizontally polarized antennas present no such problem, and can be mounted as close to the rotator as is practical.

The model HD-73 rotator weighs approximately 10 lbs. when mounted, and is housed in heavy-duty aluminum. It is designed for wind loading in excess of 100 miles-per-hour (1.7 square-feet-per-wind-load area) and is water resistant. The rotator provides 400 inch/pounds of starting torque, and 1800 inch/pounds of brake torque to resist windmilling.

The motor is designed to operate from only 20 VAC (provided by the control unit) in order to comply with safety limits mandated by Underwriters' Laboratories, Inc.

An improved braking action reduces torque stresses on the antenna system. There is very little play noticeable in the bearings. Those bearings fill two complete raceways to help equalize the weight load on the rotator. The system can accommodate up to 1000 lbs. of balanced vertical load.

The support bracket is designed for in-tower centering without having to use shims. Four bolts are provided for mounting the unit without spacers; in addition, a drilling template is supplied.

Alternatively, the rotator can be mast-mounted. No-slip support brackets are supplied that have a good "bite," and can accommodate a mast pipe of 1½-2 inches O.D.

The control unit is powered from 120 VAC at 0.8 amps. It is housed in a plastic cabinet and features a large, brightly illuminated azimuth-indicating meter that is lighted by a replaceable bayonet-base panel bulb.

Calibration is shown in 10-degree increments, as well as in compass points. In our tests, resolution of the indicator was very good—within a few degrees. A front-panel calibration control definitely helps to trim up the accuracy.

The motor is activated by pressing a bar on the control unit, either to the left or the right to correspond with the desired beam rotation. Dual speeds are featured: FAST (approximately 1 rpm) and SLOW (approximately ½ rpm). Overload protection is provided by both a fuse and a thermal switch. Overheating is a problem, and it is recommended that the model HD-73 not be used for extended periods of rotation. The transformer is small and becomes quite warm with only moderate use. The control unit is switched off when not in use.

Contact sparking of the controlling wiper switch was visible and audible during some rotator activation. Subsequent inspection revealed that the open contacts are large enough.
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CIRCLE 15 ON FREE INFORMATION CARD
EQUIPMENT REPORTS
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to accommodate the current. The sparks may be disconcerting but do not appear to pose any hazard.

Cable installation is simple. A chart directs the user as to which type of cable to order for the length of control line needed. Screw-type terminal blocks are included on both the control unit and rotator housing to accommodate the six-conductor cable.

The manual is one of the best we've seen. It is fully illustrated, and includes theory, instructions, a troubleshooting guide, a schematic diagram, an exploded diagram of the rotator, and a complete parts list. We judge the Alliance model HD-73 heavy-duty antenna rotator to be a reliable system for most nondemanding amateur and CB installations. It sells for $154.95, from the Alliance Manufacturing Co., 22790 Lake Park Blvd., Alliance, OH 44601.

The majority of metal locators can be divided into three basic types: BFO, induction balance, and transmitter-receiver. The new Radio Shack 1400 One Tandy Center, Ft. Worth, TX 76102, model 63-3001 metal locator is the latter type.

The unit is equipped with a telescoping aluminum shaft that may be adjusted in length to suit the user. The extendable shaft is long enough for average-height users. A tall adult might have to stoop over slightly to get the search head close enough to the ground for sensitive searching.

The locator requires 6 "AA" cells (not supplied). The battery compartment is easily accessible through a sliding cover. No assembly is required and the unit is ready to go as soon as it is unboxed.

The search head is made of plastic and it is water resistant. But it is not immersion-proof, so don't plan on using the unit to probe for objects below the water line. The tilt of the search head is adjustable to suit the user.

Two coils located in the search head are used to locate buried or hidden objects. The coils are arranged so that the signal from the transmitting (search) coil cannot be detected by the receiving coil. When the search head passes over an object, an electromagnetic field between the coils changes shape, and the receiving coil can then detect the signal from the transmitting coil.

Some materials (non-ferrous) cause the field to diverge (spread out), while dissimilar substances cause the field to converge (squeezing together). Those dissimilar fields are used to analyze a target, or to discriminate against trash in the ground. The search coil is Faraday-shielded to minimize capacitive effects.

Two controls are used to adjust the detector for best sensitivity. One of those controls selects between ferrous and non-ferrous materials; the other is used for peaking. Indication is provided both by a visual panel meter and a speaker. A third control sets the speaker volume. The meter is tilted for a comfortable viewing angle. For noisy environments, or where quiet operation is preferred, an earphone (included) can be used. Using the earphone turns off the speaker.

A shielded four-conductor retractable mike cable connects the search head and the control compartment. It is mounted internally through the center of the heavy-gauge, seamless aluminum tubing shaft. The shaft itself is securely attached to the control compartment.

A phenolic printed-circuit board contains five transistors and two diodes. It is etched well and neatly laid out. The board is very roomy and is easy to service should service ever be required. Unfortunately, no circuit diagram is provided.

In order to extend battery life, we followed the manual's instructions and bought Radio Shack's alkaline batteries. The detector wouldn't work at all. A close inspection revealed the cause. The center-post terminals of the Radio Shack alkaline batteries are too short to touch the contacts in the battery compartment. Use standard "AA" cells, or make sure that the batteries you buy have center posts long enough to make contact with the battery holder.

Once the unit was operating, we proceeded to adjust it as recommended in the manual. The manual provides a number of valuable tips. Read it, then read it again! Metal locators are tricky to use; practice is necessary!

There was some capacitance effect; non-
Video Review magazine tests a lot of sophisticated video products. They get to see virtually every make and type of color TV receiver, which makes their selection of Magnavox as their standard TV receiver pretty impressive.

"We thought the Magnavox picture quality and resolution were superb." Ever since Video Review began testing products, says the magazine, "we've been looking for a top quality, 19-inch TV set that might serve as a standard of reference for all of the other products we test... video cameras, video cassette recorders, video cassettes.

"We thought the Magnavox picture quality and resolution were superb, and that off-the-air sensitivity was also extremely good.

"Major VHF channels were received with uniformly accurate color fidelity. This receiver produced superior color pictures even when using its own indoor VHF and UHF antennas."

"The special tuning features and remote control capabilities of the Magnavox receiver are awesome."

"The tuning system is purely electronic and totally digital," they continue. "There is a fine tune switch and a memory lock button. If any channel is received mistuned, the user simply fine tunes up or down in frequency by holding the button, and when perfect tuning has been achieved, the button is released and the memory lock button is depressed once."

"Nearby is Magnavox's Video-matic feature. Depressing this button activates the electronic eye for automatic brightness adjustment, color adjustment circuits and automatic fine tune."

"...unusually good for any receiver."

Overall, Video Review rated the Magnavox 9.5 or better (out of a possible 10) on Video Quality, Reception Sensitivity, Color Fidelity, and Video Resolution and Fidelity. As they put it, "...unusually good for any receiver."

We can only add that once you see a Magnavox color TV at your Magnavox dealer, we think you'll agree.

For Magnavox color TV specifications, write Magnavox Consumer Electronics Company, Dept. 700, P.O. Box 6950, Knoxville, Tennessee 37914.

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LEARNING ABOUT MICROPROCESSORS

How do microprocessors do what they do? Use an assembly language computer to find out.

JORMA HYYPIÄ

THE MOST ENJOYABLE WAY TO LEARN THE ESSENTIALS of computer programming is to play with a hobby-type computer that permits communicating with the machine in "plain English" by means of a typewriter-style keyboard. However, that way you learn little or nothing about the way computer magic is actually created by the complex patterns of electrical signals whizzing around through those mysterious "black-centipede" integrated circuits that cling to the PC boards inside every computer. To truly understand the more esoteric, fascinating fundamentals of microcomputer operation, you need to work with a training-type computer or with a hobby computer that uses assembly-language programming.

Comparing hobby computers that use the BASIC programming language with assembly-language training-computers is a little like trying to equate competitive Frisbee throwing with chess mastery. It can't be done because each requires the development of uniquely different special skills. So before plunking down several hundred dollars for a bona-fide trainer, know what it can and can't do. For
example, you should understand that it is not suitable for game playing and other conventional entertainment applications, or for balancing checking accounts. It is for serious study, either in an academic environment, or at home, through some sort of self-education program.

The five computers discussed in this article are reliable, thoroughly tested machines. They are anything but carbon copies of each other, since each offers unique options you should consider carefully before making a purchase. The E&L MMD-I computer is an outstanding example of a basic teaching and control computer. The SYM-I has found widespread use in computer-control applications. The ELF II, available in kit form, is the least expensive way for a soldering-iron hacker to get into assembly-language computing while still having the option of expanding the system by adding an ASCII-keyboard.

Computer knowledgeable readers may be puzzled by the inclusion of the COSMAC VIP, which is marketed as a home-entertainment computer. Its inclusion in this article is justified because it provides a comfortable middle ground for those who might be fearful of an all-out intellectual plunge into computer fundamentals. The VIP can be used to explore some of the more esoteric aspects of computer operation and programming; but it can also be used for highly entertaining game-playing when there is need of a temporary respite from study.

Finally, for those who want an easy-to-understand but thorough, course in computer fundamentals, there's the Heathkit ET-3400 and its associated learning program. Any one of those computers is ideal for an electronics hobbyist who invents computerizable gadgets, because it can be used as a control device as well as a learning aid.

All other factors being equal, you may wish to choose a training computer that uses the same microprocessor used in the high-level language computer you already own or plan to buy. That way your training will relate more directly with your other computer activities. For example, the SYM-I uses the 6502 microprocessor developed by MOS Technology that is also found in such popular computers as Apple II, Challenger 1P, Superboard II, and PET. The popular 8080A microprocessor, originally from Intel, used in the MMD-I is also found in Computcolor II and in the Heathkit H8 computer. The VIP uses RCA's own 1802 microprocessor, which is also in ELF II. Heathkit's ET-3400 features a 6800 microprocessor designed by Motorola. The Z-80 microprocessor developed by Zilog, used in the Exidy Sorcerer and Radio Shack's TRS-80, is, unfortunately, available only on fairly high-priced single-board computers.

Some general information

All of the computers discussed here are programmed in what's known as machine language. While programs written in machine language may take a bit more effort on the part of the programmer, they are worth it: They run more quickly and occupy less memory than programs written in BASIC— which you may already be familiar with from using hobby-type computers.

Machine language uses numbers, rather than words, to generate the binary code—ones and zeroes—that is used by the microprocessor as instructions and data.

Machine code (instructions in machine language) is generally expressed using one of two counting systems—octal or hexadecimal.

In our normal, non-programming, lives we use a counting system based on the number ten (0, 1, 2, 3, 4, 5, 6, 7, 8, 9). After "9," we move over one position and start counting (10, 11, 12, etc.). The octal system uses the base eight. In octal, you count "0, 1, 2, 3, 4, 5, 6, 7, 10, 11, 12, ...". The number eight is represented by "10", nine by "11", and so on.

The hexadecimal system uses the base 16. In it, you count "1, 2, 3, 4, 5, 6, 7, 8, 9, A, B, C, D, E, F, 10, 11, ...". The first six letters of the alphabet are used to represent single-digit numbers above nine— in hexadecimal, that is. Confusing as that may seem, it soon becomes second nature.

Hexadecimal (or hex, for short) is particularly convenient for working with eight-bit microprocessors because with just two digits you can express any value that requires eight bits or fewer.

In practice, you'll probably write your programs in assembly language. Assembly language uses abbreviations, called mnemonics, to give the programmer a kind of shorthand with which to work. Each mnemonic represents a computer instruction and has a corresponding op code—a hex or octal number that can be fed into the computer through a simple keypad.

After hand-assembly your programs using mnemonics, you'll translate the mnemonics to op-codes in hex or octal, and enter them into the computer.

Before you purchase your training-type computer, watch the prices carefully if you want to obtain full value for your dollars. In general, a training computer should cost substantially less than a good high-level language computer of comparable quality. However, you can pay a great deal more for the trainer of your choice than for one of the least expensive hobby jobs. It is impractical to specify prices in this article because market conditions could make them change by the time you read it. But, more important, what you pay depends on the extras you want, or need, to buy to make the computer of your choice fully operable.

Four of the five computers described here use simple LED readouts, but the ELF requires the purchase of an RF modulator so you can use a regular TV set as your display device. Although the ELF II has an LED readout, it too can be used with a TV set and RF modulator.

It is very important that you consider carefully the completeness and intelligibility of the instructional literature that comes with any computer. If it is inadequate, or simply hard to understand, you'll find yourself spending more money on books. And right there you have one of the most persuasive arguments for taking a good look at E&L's MMD-I if you want the best in self-education opportunities. The Bugbook literature that comes with it is without peer, especially because the text is intimately related to the MMD-I itself.

Mini-Micro Designer (MMD-I)

This trainer, which is widely used as an educational aid in computer schools here and abroad, and also as a control computer for industrial operations, makes use of an 8080 A microprocessor and octal notation. For any serious student/hobbyist, that computer stands out as the Rolls-Royce for both self-education and control applications. It comes complete with a power supply, for instant plug-in operation, and commands a premium price.

The basic unit comes with an octal keyboard, 24 discrete LED's that serve as readouts to tell you what is going on inside the computer, and a handy solderless breadboard on which to plug in simple electronic components for experimentation. Since those components are not soldered, you can disassemble an experiment quickly to clear the board for the next. If you intend to do a great deal of experimentation, the use of a second, outboard, solderless breadboard is strongly recommended since replacement of the built-in breadboard is difficult if it should be damaged.

You get 256 bytes—8-bit words—of RAM (Random Access Memory) for programming, plus another 256 bytes of ROM (Read Only Memory) that control computer operations. The odds are that you will soon want to expand that basic setup by adding a memory interface upper-deck (see Fig. 1) that provides up to 2048 additional bytes of RAM plus the circuitry needed to interface the computer with a cassette tape-recorder and/or Teletype equipment. Beyond that, you can expand the memory all the way to 64K (65,536 bytes) if you have the need and can afford the cost.

To derive the greatest learning benefits
from the MMD-1 and Bugbooks, plan to invest in at least some of the many outboard units that can be purchased factory-assembled or at lower cost, in kit form. But perhaps the best choice is a "student station" that incorporates many of the outboards into a single peripheral unit, and comes with an extra solderless-breadboard plus more than a score of extra IC's and other components for use in experiments.

The MMD-1 comes with a keyboard executive (KEX) PROM (Programmable Read Only Memory) to handle the assembly-language instructions. You should start with that IC, plus an associated load/dump (L/D) IC because they relate best to the Bugbook text. Later you may wish to trade those PROM's for replacements, a combined KEX/L/D and a Monitor PROM, so that you can single-step through any program in running sequence, not merely through consecutive memory locations.

After completing the self-training course in microcomputer use, you can continue to use the MMD-1 as an experimental tool and/or control device. For example, it could be used to operate a model railroad system automatically.

**SYM-1**

The SYM-1, shown in Fig. 2, is an extremely versatile machine constructed on a single 8 x 11-inch printed circuit board. It uses the 6502 microprocessor and is programmed in hex. The board includes a 28-key control pad for data entry, a six-digit 7-segment LED read-out display, 4K bytes of ROM that contain the operating system and 1K of static RAM.

The board also contains five programmable interval timers, four relay drivers/ input buffers, 15 bi-directional TTL-level lines, and 51 I/O lines (expandable to 71). Interfaces include a dual-baudrate cassette recorder interface with remote control and RS-232 (serial) and TTY (parallel current-loop) interfaces.

On-board memory is expandable to 4K bytes (and even more, off-board) and there is provision for up to 28K bytes of user-programmable ROM.

Software options include an 8K Microsoft BASIC and a resident assembler/editor/loader, both in ROM. There is also a Keyboard Terminal Module that, together with an inexpensive RF adaptor and your TV set, gives you a complete computer system with keyboard entry and video display.

The SYM-1 requires only a five-volt power supply. You can either provide your own or buy one specifically designed for the SYM.

One feature of the SYM-1 that should not be ignored is that fact that is closely related to the recently discontinued KIM-1, a single-board computer that enjoyed great popularity among hobbyists and for which an enormous amount of software has been written. The SYM-1 is KIM-1-compatible: Not only does it use the same microprocessor as the KIM, but one of the two cassette formats it uses for program storage is the same as the KIM's and it uses the same hardware interface busses as the KIM. What this boils down to is that any software written and/or recorded for the KIM will also run on the SYM-1!

In addition to the SYM-1's copious documentation (two thick manuals—Reference and Programming) the SYM-1 user has at his disposal sources of information such as The First Book of KIM by Butterfield, Ockers and Rehnke (Hayden Book Company).

The SYM-1 is not the least complex computer described here, but it is worthy of consideration by anyone who has committed himself to learning how microcomputers work and to making the most of the capabilities of his machine.

**ELF II**

This computer, which makes use of RCA's 1802 microprocessor, comes factory-assembled or as an easy-to-build kit that can be put together in one evening. Quality components are used throughout. The PC board, for example, is of highest grade, double-sided with plated-through holes. Sockets are provided for three of the 17 integrated circuits, and I picked up additional sockets for the other IC's for less than five dollars. I think that the slight extra expenditure for sockets is a good investment since they totally eliminate the chance of damaging IC's with soldering-iron heat, and because troubleshooting by component-substitution becomes a cinch. The kit-assembly instructions are very clear.

The kit costs under $100, and you can buy a power supply for about five dollars extra. Another five spent on Tom Pittman's Short Course on Microprocessor & Computer Programming would be no waste. You can also buy the ELF II fully assembled and tested, complete with power supply, RCA 1802 User's Manual, and the Short Course.

The ELF II features a full hex keyboard, two-digit hex output display, stable crystal-clock for timing purposes, and 256 bytes of RAM that is expandable to 64K. Included in the kit is an RCA 1851 video-IC that permits display of your programs on any video monitor, or on a regular TV set by use of an inexpensive RF-modulator.

Most of the left-half of the PC board (see Fig. 3) is unused, but is ready for the addition of all kinds of add-ons as your needs and desires grow along with your increasing familiarity with the ELF II. Its 5-slot, plug-in, expansion bus permits you to add such features as: Giant Board kit with cassette IO, a Kluge (prototyping) Board that accepts up to 36 IC's, 4K RAM boards, an ASCII keyboard, a light pen, a color graphics & music system and a video-display board.

Software available includes: Tiny BASIC, an assembler, a disassembler, the Elf-Bug monitor, and a text editor. There is also a recently introduced full BASIC that requires 8K of RAM plus ASCII and video-display boards.
ship on your TV screen, and suggestions about where to obtain additional literature.

COSMAC VIP

That computer, shown in Fig. 4, uses RCA’s own 1802 microprocessor and must be connected to a computer video monitor or to a conventional TV set by means of an RF-modulator. The modulator can be used with the add-on color board and a color TV if you want full-color pictures.

![Fig. 4—The COSMAC VIP from RCA must be connected to a video monitor or, using an RF modulator, a conventional TV.](image)

The VIP comes with 20 interesting game programs that you can key into the computer with the hex keyboard, and then store on cassette tape for more convenient future use. Since the computer is not intended as a trainer, RCA provides no self-instruction material other than the programming manual. However, you can learn much about assembly-language programs just by studying the game programs in the manual in context with mnemonic code and other technical data also provided.

Several add-on modules are available. For example, a color board (VP590) greatly enhances games by displaying them in full color on your TV set. You can develop your own color programs with full control of both foreground and background colors. Conversion of the basic VIP board to color is easy. Just remove three IC’s from the main PC board and transplant one of them to the plug-in color board. You must also reprogram the CHIP-8 control program used with black-and-white image programming into a more powerful CHIP-8X program for color.

For the ultimate in game-playing fun, also install a plug-in Simple Sound Board (VP595). If you have an early VIP model you may have to add several IC’s and resistors to make the sound board operative. If your sound board puts out only a continuous tone that can’t be shut off except with the main power switch, look for the missing components.

For more serious electronic music-making, try the Super Sound Board (VP550) that features two independent sound-generating systems so that you can obtain stereo music on your hi-fi audio equipment. There’s independent control of note frequency, duration, and amplitude for each channel, and you can program both melody line and harmony. It’s even possible to add an optional drum synthesizer.

The instruction manual provides a short course in music writing, and shows how to convert any sheet music into computer language so that the music can be played through a home hi-fi system. You need know nothing about writing or reading music, and you don’t even have to know how to play a kazoo to make electronic music, or to create all sorts of weird sounds, including “outer space” type music.

My only problem with the Super Sound Board came with writing the required PIN-8 machine-language program that drives the system. More than 3,500 digits on a reference sheet must be keyed into the computer memory correctly or the program “bombs out” and you have to start all over again. For that reason, be sure to make a copy of your freshly keyed-in program on cassette tape before you attempt to run it! That way, if it bombs, you can quickly put the defective program back into memory for debugging. It’s a lot less painful than starting all over again from the beginning. If you still have trouble, try to borrow a demonstration tape from your VIP dealer, or make a copy in his store. But that’s the easy way out.

Heath ET-3400

For those interested in working with the 6800 microprocessor, Heathkit’s ET-3400 (Fig. 5), available either in kit form or assembled, fills the bill.

![Fig. 5—A BUILT-IN solderless breadboard is among the features of the ET-3400 computer trainer from Heath.](image)

It has its own power supply and comes with 256 bytes of RAM (expandable to 512 bytes) and a 1K monitor program in ROM. Programming is done in hex using a built-in keypad and data is displayed by six 7-segment LED’s.

One nice feature of that computer trainer is a built-in solderless breadboard for prototyping and interfacing, and for memory circuits that can be connected to the microprocessor. Associated with the breadboarding section is an 8-position DIP switch for inputting binary data to circuits built on it, and eight discrete LED’s to indicate logic states within those circuits.

Heath also has an accessory, the ETA-3400, that connects to the trainer by means of a 40-wire ribbon cable. The unit comes with 1K of RAM and can be expanded to 4K. It has an RS-232 serial interface for connection to a teletype or video terminal, and an audio cassette interface that permits programs to be stored.

Also included with the ETA-3400 is a Tiny BASIC interpreter in ROM. Working from a terminal, you can program in BASIC and, from within a BASIC program, call machine-language routines that were written using the trainer.

To round things out, Heath offers a Microprocessor Self-Instruction Program (course) that uses the ET-3400 as a teaching tool.

As was stated at the beginning, working with a training-computer or other assembly-language machine is very different from keyboard/video chatting with a high-level language computer that tells you when you’ve made a mistake, and that may even suggest where to look for the trouble. Not so with training computers. So you’ll have to apply yourself a lot harder, but that’s the way you’ll learn about microprocessors.

Learning the inner secrets may not be as tough as learning chess, but it will be no Frisbee-flying either. Still interested? Then it’s your move!
It sure doesn't work like a VCR. Look what happens between picking the signal off the disc and converting it into something that will produce a picture on your TV

CHESTER H. LAWRENCE

IN THE OVERVIEW OF THE RCA VIDEODISC system presented last month, we pointed out that the output signal from the pickup arm was composed of several separate signals. This month we will follow the video and see how it is processed by the videodisc player circuitry.

Figure 1 is a block diagram of the video-processing circuitry. Since the signal from the pickup arm includes a 260-kHz servo signal that could interfere with the demodulation of the video carrier, the composite signal from the pickup arm is first fed through a 260-kHz trap that removes the servo signal, thus eliminating this source of possible interference.

Another potential source of trouble is the relatively low-frequency 716-kHz sound carrier. It can cause modulation of the spacing between the stylus and signal on the disc. The phase modulation of the video carrier that results can result in an undesirable 716-kHz visual beat (sound beat) in the video picture on the TV screen.

To keep this from happening, the NLAC (Non-Linear Aperature Correction circuit) shown in Fig. 1 separates the sound-beat information, phase inverts it and adds it to the original signal. In effect, this cancels the sound-beat signal before it can appear in the video FM signal.

After passing through the NLAC, the video carrier is fed through a 2- to 9-MHz bandpass filter network and then on to the video demodulator. In the video demodulator, the video carrier is demodulated to develop the composite video signal that is fed to the comb filter.

The defect detector is also a part of the video demodulator. It is activated whenever a defect in the video carrier is spotted. When the defect detector is activated its output is applied to the comb filter. It causes the comb filter to automatically insert the corresponding portion of the previous horizontal line of information into the output signal whenever a defect is spotted. In this way, momentary defects in the video
carrier do not appear as visible noise impulses on the picture displayed on the TV screen. Instead the previous horizontal line fills the gap. The fault circuit can fill up to three horizontal lines with color information before any visible degradation in the signal performance becomes noticeable to the viewer.

The comb filter is primarily used to separate the chrominance and luminance signals. Efficient chrominance/luminance separation is rather important, because the RCA videodisc system uses a "buried" subcarrier system that places the chrominance information at a subcarrier frequency of 1.53-MHz. This frequency is approximately at the midpoint of the luminance bandpass.

The chrominance information, however, is frequency interleaved with the luminance. As a result, the energy content of the chrominance signal is spaced at 1/2 the horizontal-rate difference from the luminance signals. This is why the comb filter can effectively separate these signals.

Non-linear aperture correction

The signal from the pickup arm is a composite of several signals. These include the 5-MHz video FM carrier, a 716-kHz audio FM carrier, a 260-kHz servo-sensor signal and a 5-MHz ±716-kHz beat signal. The servo-sensor signal is eliminated by a trap in the bandpass filter that passes frequencies between 0.5 and 9 MHz. But this filter and trap cannot eliminate the 5-MHz ±716-kHz beat signal. If this signal is not eliminated undesirable sound beats appear on the screen of the TV being used to watch the videodisc picture.

Figure 2 shows the circuitry that corrects for the 716-MHz soundbeat signal. The video FM carrier is applied to the base of Q101, the NLAC buffer, after passing through the bandpass filter. The buffered signal from Q101's emitter is then fed through RC network C106, R108, and C104 to the base of Q103, the NLAC amplifier. This signal contains the audio carrier and the video carrier plus an in-phase soundbeat.

At the same time the signals from Q101's emitter are also fed through capacitor C105, diode CR102 and capacitor C108 to Q102's collector. Diode CR102 mixes the video and audio carrier signals and generates a 5-MHz ±716-kHz soundbeat signal that is 180° out of phase with the beat signal amplified by Q101. The in-phase audio and video carriers are also there after mixing.

Since the signal from Q101's emitter is also coupled to the base of Q102; diode CR101, which is connected from Q102's emitter to ground through C107, conducts out of phase with diode CR102. This produces a soundbeat signal that 180° out of phase with the soundbeat signal from diode CR102. This signal is inverted by Q102 and along with the signal from CR102 appears at Q102's collector.

In Q103's base circuit, the 180° phase-shifted 716-kHz soundbeat is added to the in-phase 716-kHz soundbeat from Q101's emitter. This cancels the soundbeat information in the video carrier signal, which is then amplified by NLAC amplifier Q103 and NLAC driver Q104. The output signal is coupled from the emitter of Q104 and supplied to the video demodulator circuit.

Video FM demodulator

The video FM carrier output from the NLAC circuit, after having been corrected for sound-beat information, is supplied through a 2- to 9-MHz bandpass filter to pin 3 of video demodulator IC U201 (see Fig. 3). The incoming FM video carrier is first amplitude limited by a limiter circuit and then coupled to one input of a phase-lock-loop detector. The other detector input is a 5.3-MHz VCO signal. Its center frequency is set by C215. This capacitor is connected between pins 5 and 6 of the integrated circuit. A filter network is coupled to pins 5 and 6 of the integrated circuit to filter the PLL (Phase Lock Loop) feedback signal.

The modulation on the video FM carrier causes the frequency of the

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FIG. 2—SOUNDBEAT CORRECTION CIRCUIT eliminates a signal that would cause undesirable beats to appear in the picture on the TV screen when the videodisc is played.
carrier to vary. The PLL detector generates a difference signal that is proportional to the instantaneous phase difference between the carrier and VCO reference. This difference signal (or error signal) controls the frequency of the 5.3-MHz VCO to maintain phase lock between the carrier and the VCO. Since the VCO frequency is forced to track the carrier, the error signal, that controls the VCO, is the original video information.

Demodulated video output exits the integrated circuit at pin 7. Here it is filtered and then coupled to the base of phase equalizer transistor Q201 through VIDEO LEVEL ADJUST control R202. After being phase equalized by Q201, the signal is reinstated into the integrated circuit at pin 9 where it passes through a gated inverting amplifier and leaves the IC at pin 11.

Before demodulation, the amplitude-limited video carrier signal is applied to a defect-detection circuit in U201. It compares the incoming video FM carrier with the VCO. The defect-detector circuit generates a logic HI whenever video-carrier loss is detected. The logic HI defect-detector input is fed through an inverting amplifier to produce a logic LO output during a defect. The logic LO defect-detector output pulse at pin 13 is coupled to the comb-filter circuit to gate on the defect-correction circuitry.

During LOAD/UNLOAD, RAPID ACCESS FORWARD and REVERSE, and PAUSE, the output of the video FM demodulator is "squelched" to prevent noise from appearing on the TV receiver screen. This is done by applying a NOT SQUELCH signal (SQ) to pin 8 of the integrated circuit. Internally, the squelch circuitry controls both the inverting amplifier that provides the composite video-output signal to the comb filter, and the defect pulse-inverter circuit. The squelch action on the defect-inverter circuit prevents the defect gate output from going to a logic LO when the carrier disappears because the stylus has been lifted off the disc. If the defect-detection output was not disabled, the comb-filter circuit would continue to recycle the previous horizontal line of information.

When the NOT SQUELCH line returns to logic HI, the video demodulator is allowed to operate. However, noise generated by lack of video carrier does not appear in the demodulator output signal at pin 11. Internal positive-going defect-detector pulses, generated when the PLL detector is unlocked hold a charge of about 2 volts on C221 connected to pin 10.

As the stylus begins picking up good signals and the demodulator PLL locks, the defect pulses cease, allowing the voltage on C221 to discharge to 1 volt through the time constant of C221 and R212. At this point, the internal squelch circuitry is deactivated allowing the video-demodulator output amplifier to resume normal operation.

The time constant of C221 and R212 allows enough time for adequate video carrier to be recovered. This provides nondistorted video information to the display when returning to the PLAY mode. Once the squelch system un-squelches, the squelch circuit no longer responds to defect pulses. Therefore, the system can only be squelched by pulling pin 8 LO via the NOT SQUELCH line.

Comb filter/defect corrector

Figure 4 is a simplified diagram of the video-processing operation. You'll note that the composite video from the video demodulator is fed to one input of an electronic DEFECT SWITCH. This is built into the comb-filter IC. At the same time, delayed video is fed to the other input of the DEFECT SWITCH.

The defect gate pulse from the video demodulator automatically switches the input to the comb filter from the composite video output from the video demodulator to the delayed video input from the comb filter delay line, whenever the defect pulse appears.

When the video carrier is recovered, the defect gate pulse goes HI, switching the comb-filter input back to the normal composite video output from the video demodulator.

In addition to supplying the delayed
video signal, the comb filter also separates the luminance and the buried subcarrier chrominance information. The combined chrominance is then bandpass filtered to separate the vertical detail and DAXI (Digital Auxiliary Information) code used to develop the time indication) from the combined chrominance signal.

The comb filter uses a 9.2-MHz clock that is developed from the 1.53-MHz clock signal generated by the video converter. This 1.53-MHz signal is also fed through two phase-shifting transistors to provide the clock signal needed by the system control circuits.

As shown in greater detail in Fig. 5, composite video from the video demodulator is applied to pin 4 of U301, the comb-filter defect corrector. The defect gate pulse from the demodulator is applied to pin 2. Delayed video information from the comb filter’s output appears at pin 15 and is applied through R304 the delayed video adjust control to the base of Q301 the video amplifier. The signal is amplified by Q301 and returned to the defect switch through pin 10.

During normal operation the input to the delay line consists of the composite video output from the video demodulator. Whenever the video-carrier signal is lost, the defect gate pulse on pin 2 of U301 goes to Logic 1.0. This switches the defect switch so it now supplies the delayed video signal.

If the video carrier is lost for an extended period, the horizontal line of information that occurred before the video-carrier loss is recirculated through the delay line and back to the defect switch several times.

At the same time the composite video is fed to the delay line, it is also coupled to two separate amplifier channels. One of these is the luminance pass channel. This signal is amplified and its gain controlled by R328 the LUMINANCE ADJUST control.

The amplified signal is then fed to one input of an internal adder circuit. The other input to this adder circuit is fed from the output of the delay line. Since adjacent lines of luminance information contain essentially the same information, the adder’s output will be the sum of the luminance signals. However, since the chrominance signals have a 180° phase shift from one line to the next, these signals will cancel, removing chrominance information from the adder’s output. As a result, the signal at pin 18 contains only combed luminance information. All of the chrominance signal has now been eliminated.

The incoming composite video from the defect switch also passes through the chrominance pass channel. The chrominance pass-channel amplifier is an inverting amplifier whose gain is controlled by R329, the CHROMANCE ADJUST control.

The inverted signal from this amplifier is then fed to one input of another internal adder circuit. The other input of this adder is the delayed composite video. Because of the inversion in the amplifier, the chrominance information that appears at the inputs to the adder are now in phase and a combed chrominance output appears at pin 1 that is twice the value of the incoming chrominance.

At the same time the inversion results in the luminance signal being out of phase with the delayed signal and the luminance signals cancel in the adder. Therefore, the luminance has been removed from the chrominance output at pin 1.

The delay line that is used in the comb filter is driven by a 9.2-MHz clock. Its output is divided by six and then applied to a phase comparator that compares the phase of the divide-by-six clock signal with the 1.53-MHz clock signal from the video converter. The phase comparator output is then applied to the 9.2-MHz clock voltage-controlled oscillator to insure that the clock signal is usually six times the 1.53-MHz clock rate.

After being processed by the comb filter, the combed chrominance information from pin 1 of U301 is passed through Q305, the CHROMA BUFFER as shown in Fig. 6. The chroma signal is then fed through R317, the VDO LEVEL ADJUST (Vertical Detail Output) control to Q303 the VDO BUFFER transistor. Q303’s output is then split into three. One path is through a filter network that passes only vertical-detail output signals. These signals are coupled to an adder, where they are combined with the combed luminance.

Another output from Q303 is applied through VDO driver Q302 and contains the DAXI code that is coupled to the system control circuit.

The third combed chrominance signal from Q301 is applied to a bandpass filter that passes only frequencies between 1 and 2 MHz. This signal contains the chrominance information (1.53 MHz ±500 kHz). The output of this bandpass filter is fed to R312, the CHROMA LEVEL ADJUST control. Its arm is connected to the CHROMA DRIVER transistor, Q304. The resulting 1.53-MHz chroma subcarrier is then coupled to the video converter IC.

The combined luminance information taken from pin 18 of U301 is coupled to Q306 the LUMINANCE BUFFER. And from there it goes through a filter network to one input of an adder circuit. The other input to this adder contains the signal that has been separated from the combed chrominance output. These two signals are added to develop complete combed luminance.

Now that we’ve taken a trip through the video-processing circuitry of the RCA videodisc player there are important circuits still to be described. We will examine more of them next month.

R-E
JAMES A. GUPTON JR.

WITH THE UNICORN-1 ROBOT OPERATING under radio control, what now? Why, computer control, of course! This part will deal with that subject, although, because of its complexity, only in general terms.

For those of you already involved with computers—micro or otherwise—much of what will be discussed here may seem elementary. For those who have not yet been exposed to that fascinating area of electronics we will try to keep things as simple as possible.

What will be covered here will be the concepts involved in having the actions of a robot determined by an electronic device rather than by a human operator. That’s where much of the challenge of computer control comes in.

A human can exercise his judgment—without necessarily having to think about it—and change the robot’s actions to meet the circumstances. The computer also has to exercise judgment, but before it can do that it must be taught—or programmed—how to make judgments; that involves a great deal of highly detailed programming.

For those of you who are unfamiliar with computers, it is not enough just to connect a computer to the robot and say, “Go ahead . . . do your stuff.” Every action must be pre-planned, and, more important, every consequence of every action must be considered and the appropriate reaction prepared.

That is one reason why we will not present specific programs for robot control but will, instead, talk about the way those programs will have to function.

Methods of computer-control

To put it broadly, there are three ways that a computer can be used to control the robot’s actions.

The first, and simplest, would substitute a computer, located outside the robot, for the command consoles described earlier in this series. That computer would be linked to the robot either by cable or by radio.

The program for that system would be fairly simple and would allow the operator to type in a command, to which the robot would respond. For example, entering “GO” or “G” would cause the robot to move forward; “TURN LEFT” or “L” would cause it to turn to the left, and so on.

That elementary program could be modified to operate with a speech-recognition device—several of which are available for a couple of hundred dollars—to allow the robot to respond to the spoken
word. The vocabulary would be limited (but adequate) but the commands would have to be given to the external computer, not to the robot directly.

The second system would be a program, or series of programs, that would command the robot to perform a predefined sequence of actions.

For example, the robot might be instructed to move forward for ten seconds, stop, raise its right arm in a salute, beep its horn, and then turn around and return to its starting position.

Such programs could become very elaborate, but have a major drawback. Unless the robot is equipped to respond to its environment (and, so far, it isn’t) any unknown factor that enters the picture could have serious consequences.

Using the program above as an example, suppose that, unknown to you, the robot is facing a brick wall, five feet in front of it. Shortly after the robot begins to carry out the instructions given to it by the computer, it will run smack into that wall! Not only will that interfere with the rest of the program, but it can also cause damage to the robot and, possibly, the wall. Or, maybe, instead of a brick wall, there’s a person or a piece of furniture in the way. The overall damage—and its consequences—could be considerably more serious.

In any case where the robot is operating without human intervention, provision must be made for the program to be overridden!

Any program of that nature must contain some means for the human supervisor to stop or alter the robot’s actions at any time. That is one reason that the “drop-dead” circuit was included on the latch board (Part 9)—one command would activate that circuit and cause the robot to stop in its tracks, should any unforeseen circumstance arise.

The third method of computer control, and the most fascinating, involves the robot having its own, on-board, computer. The precautions given for the second method also hold here. We’ll talk about that method in more detail shortly.

Interfacing

Whichever method is chosen, the robot must be equipped to respond to (and, perhaps, “talk back” to) the computer. Fortunately, the circuits already being used by the robot are designed with that in mind.

There are two formats that computers can use to output data or to receive it: parallel and serial. The parallel format is always used by the computer internally.

The unit of information that the computer uses for communication is called a byte. A byte is made up of eight bits (binary digits)—each one either at a logical “high” or logic “low” state—and the computer operates on all eight bits at once. Frequently, when a computer is used to operate a printer, the parallel format is used and eight lines are used to connect to the printer—one for each bit of the byte.

On the other hand, sometimes it is convenient—or even necessary—to transmit computer data using only a single line (by telephone, for example). In that case, the serial format is used. The computer takes each byte and sends it out bit-by-bit, one after the other, indicating the beginning and end of each byte. At the other end, the eight bits are received in the order in which they were sent; when they have all arrived, they are used in parallel. Both of those systems are illustrated in Fig. 83. The device that performs the parallel-to-serial and the serial-to-parallel conversions is known as a UART (Universal Asynchronous Receiver/Transmitter). UARTs would be used if commands were transmitted to the robot by radio.

If you connect your computer to the robot by means of a cable from the computer’s parallel port, it would be a good idea to use twice as many lines as necessary (16) and ground every other one. That will help keep electrical noise from getting mixed in with the data.

(For more information on how computers operate see “Your Own Computer” in the October 1980 issue of Radio-Electronics and the article on assembly language computers on page 45 of this issue.)

The decoder-, latch-, and relay-driver boards in the Unicorn-1 use parallel data. Using the same technique as used with the 7402 IC’s on the decoder board, any two bits of an eight-bit word (byte) can be N0R’d or NAND’ed to produce a single control bit for the relay-driver board. If you’re knowledgeable, more complex and versatile encoding/decoding schemes can be used.

Which computer?

There are two classes of computers that must be considered: those for external use and those that can be mounted on-board the robot.

Almost any computer that has at least one parallel port can be used for the first purpose and it is not our intention to single out one manufacturer’s over the other. If you are contemplating buying a computer, refer to the articles mentioned above.

The important thing is that the computer be equipped with a parallel port and that it be flexible enough to meet your needs—present and anticipated. For example, if you are considering using voice control, make certain that there is a speech-recognition board available for your computer.

It should be noted that some computers—such as the Radio Shack TRS-80 and the Commodore PET—do not have parallel ports as such, but that their expansion connectors—frequently used to connect to printers—are actually just that. The thing to look for is eight data lines, usually designated “D9” through “D17.” If you have those, you have your parallel port.

You will also want a cassette and/or disk interface to allow you to save programs that you have written for the robot.

One thing you should avoid are inexpensive computers that are actually glorified video games. They generally will not have the facilities you need and it will prove difficult (or impossible) to add them.

The other possibility is a single-board computer that can be mounted in the robot. In addition to a parallel port and cassette interface, that computer must also have a hexadecimal (“hex”) keypad for programming, and some kind of LED display, if it is not going to be used together with an external computer. An example of how such a computer would be interfaced to the robot is shown in Fig. 84.

A good computer for the purpose is the KIM-I. Unfortunately, that computer was recently discontinued; but you may still be able to find one here and there. Other possibilities include the SYM-I (a sort of super KIM), the ELF-II or the Explorer/85 (keypad version). Again, refer to the article on page 45. Both the ELF-II and the Explorer/85 are manufactured by Netronics, 333 Litchfield Road, New Milford, CT 06776. The SYM-I is produced by Synertek Systems Corporation, P.O. Box 552, Santa Clara, CA 95052.

Bear in mind that some of those computers may require a power supply other than 5- or 12-volts DC. In that case a power inverter (see Fig. 85) can be used to turn the robot’s 12-volt supply into 117 VAC, which the computer’s power sup-
ply can then convert readily to its own requirements.

Finally, if you already own a computer but intend to install another in the robot, it would be a good idea to make sure that both computers use the same-type, or compatible, microprocessors. The KIM-1 and SYM-I use the 6502, which is also found in the Apple II, OSI Challenger and the PET, and the Z-80 in the TRS-80 is compatible with the Explorer/85's 8085.

The 1802, used in the ELF II and in RCA's VIP, is not normally found in larger computers, but that does not mean that an 1802-based single-board computer should not be used in the robot.

The fact that both of your computers use the same microprocessor means that both of them speak the same language, at the microprocessor level. That, in turn, means that you can use your larger computer to develop and debug (troubleshoot) programs to run on the robot's computer and to download (transfer from the larger to the smaller computer) those programs, either directly or, if the cassette interfaces are of the same type, from tape.

The programming itself will also be easier, since—assuming that your programs are in machine language and not in BASIC—you will be able to use an assembler, making your work go more quickly and also making it easier to follow the flow of the program.

Programming

As you may have gathered by now, it would be impossible to present computer programs for robot-control, there being so many variables involved.

If you are working with an external computer, you will probably want to work in BASIC or another high-level language, using the OUT command, or its equivalent, to transfer data to the robot.

As mentioned above, the on-board computer will almost certainly have to be programmed in machine language. It's more difficult to work with than BASIC, but it does have advantages. Programs take up much less memory space, and also run more efficiently. You may even want to write your "big-computer" programs entirely in machine language through the use of an assembler.

This section has of necessity, been sketchy after all, even books on the subject have not been able to cover the matter completely.

If you are going to use a computer with your robot, we recommend that you do as much supplementary reading as you can. Personal-computer magazines such as Byte magazine and Interface Age have had special issues dealing with robots, and the subject comes up frequently there and in other computer publications. Another good source of information that is often overlooked is your local library.

Todd Loofbourrow's book, How to Build a Computer-Controlled Robot (Hayden Publishing Company) contains a number of robot-control programs written for the KIM-1 (or SYM-I) as well as a number of more generalized flowcharts. Much of the information presented there may be adaptable to your robot.

A very good—although rather technical—article on "An Interactive Programming Language for Control of Robots" by Li Chen-Wang appeared in the September 1977 issue of Dr. Dobb's Journal of Computer Calisthenics & Orthodontia. It involves a robotic simulation on a computer's video display and its principles could be adapted to control a "flesh-and-blood" robot. (That issue, #18, Volume II, No. 8, is available in limited quantities from: Dr. Dobb's Journal, 1263 El Camino Real, Box E, Menlo Park, CA 94025 for $2.50, postpaid, second class.) It's worth looking into for readers already familiar with computer programming.

In the next part of the Unicorn-I series we will take a look at sensors. We will discuss sensors in general, and show you some specific examples that can allow your robot—and the computer that controls it—to respond to the world around it.

We would like to hear about how you're doing with your version of Unicorn-I. Write (and send photographs) to: ROBOT UPDATE, Radio-Electronics, 200 Park Avenue South, New York, NY 10003.

"Charlie's OK at fixing computers. He seldom does any damage that an electronic technician can't repair."
THE EMPHASIS IN HOME ENTERTAINMENT products seems to be shifting, at least for the moment, from high-fidelity components to video and its many related products. Both in the United States and in Japan, new video products and advances in video technology abound. In this article, I will present a few of the newsworthy developments that have come to my attention in recent weeks.

Having just returned from a visit to the Japan Electronics Show held in Tokyo, and personal visits to many of Sony Corporation's factories, much of the news presented here originated in the Orient. It has been my experience, though, that even if the products seen in Japan are not yet sold in the U.S., with a few exceptions they will all be sold here within the next six months to one year. New ideas and products originated by Japanese manufacturers are most often test-marketed in their own domestic market and then exported to the rest of the world.

Jitterless VCR still-pictures

Many VCR's, both VHS and Beta format, have, for some time, featured a "freeze-frame" mode that stops playback of a video tape so the helical-scan head drum repeats a single picture over and over again, presenting what appears to be a still picture on the face of the associated TV screen. Unfortunately, most of these "still frame" systems present a picture that, at its best, is somewhat blurred and at its worst is marred by wide bands of noise streaking across the picture horizontally or diagonally.

To understand why this happens, it is necessary to review the way video signals are recorded on video cassette recorders (VCR's). The system used is called an azimuth recording system. In the NTSC system of television transmission, the TV picture consists of two fields for each frame. There are 60 fields per second or 30 complete frames per second. A VCR uses multiple heads to record the video signal. In the Betamax system, for example, the two video heads are located 180° apart, around the perimeter of the fast-spinning head drum. One head, tilted at one angle, is designated as a "plus" azimuth head, while the other head is set at different, opposite, angle and is designated as a "minus" azimuth. One head normally records one field and the other head records the signal of the adjacent field which, together with the first recording, equals one complete frame. This system, one of Betamax's distinguishing characteristics, prevents the video signal of one track from interfering with that of the adjacent track.

With this type of arrangement, when the VCR is put in the "still-frame" mode (the horizontal motion of the tape is stopped and only the head drum revolves), the video head straddles two tracks at once, as shown in Fig. 1. That is, the head scans part of the A-1 field's...
picture as well as B-1 field’s picture. The “still” picture produced is actually a combination of two fields, or one complete frame. As can be seen in Fig. 2, when there is a fast moving object in the scene being reproduced, such as the rapidly moving end of the golf club in the diagram of Fig. 2, the resulting picture becomes quite blurred. It can no longer be regarded as a true “still” picture.

Sony Corporation, at the Electronics Show in Japan, introduced a new model Betamax VCR, the SL-39. They claim it is the first home video recorder that can produce still-frame pictures that are as good as those used in broadcast equipment. The new capability is the result of what Sony calls their Double-Azimuth Head.

The diagram at the left, in Fig. 3, shows the ordinary head/drum arrangement, in which the “A” side has a “plus” azimuth head while the “B” side of the drum incorporates a “minus” azimuth head. In the diagram at the right, however, one of the video heads (the one that would normally be designated as having the “minus” azimuth) also has a “plus” azimuth (hence the name Double-Azimuth Head).

When the VCR is placed in the “still frame” mode, the signal is read or scanned by the normal “plus” azimuth head as well as by the “plus” azimuth section of the double azimuth head. During this mode of operation, the “minus” azimuth portion of the head is inactive. As shown in Fig. 4, when the tape is stopped, only the signal that was recorded on the “plus” azimuth track is scanned. This means that the B1 field (in Fig. 1) is not traced at all. In playback, the A1 field is played back twice during the still mode of operation. All this results in a completely motionless picture. To get slow-motion that is equally noise and jitter free, Sony has combined this new still-frame approach with normal playback. Thus, in the slow-motion mode, still frame is followed by normal playback, which, in turn is followed by another still picture, etc.

Other video innovations

The Tokyo Electronics Show also saw the introduction of new VCR’s and receivers that can handle any of the world’s major broadcast video systems, new lightweight video cameras, and what may well become the central component in the home entertainment system of the future, a TV monitor color screen called Profeel, also introduced by Sony Corporation.

Profeel, as presently offered to the Japanese domestic consumer, consists of three different sized high-quality color monitor components ranging from a giant 27-inch screen (measured diagonally) down to a 16-inch version. Since the monitors contain only the electronics needed to produce the high-quality color picture and its associated audio tracks (there is no TV-RF/IF section), the tuner section of a VCR is used with the Profeel monitors. Optionally, the viewer can buy a separate Profeel component tuner at a cost (in Japan) of approximately $300.00. In Japan many of the broadcast programs already transmit stereo audio along with the TV picture. The stereo audio signals coming from the VCR or the component tuner can be fed directly to a component high-fidelity system or the matching Profeel speaker systems available as part of the program. The whole idea suggests that someday in the future, video will become component-oriented in much the same way that audio equipment did in the 1960’s and 1970’s. When you think about that, it makes a lot of sense, since we are seeing more and more video-related items that need to be interfaced with a television monitor but do not require the RF and IF circuitry contained in a full TV receiver.

Panasonic (National, in Japan), Sharp, and Sony all offered three-system video-cassette decks. The three systems referred to have nothing to do with the VCR format, but rather relate to the three systems of standards used in TV broadcasting around the world. Thus, Sony’s version of this new VCR, the SL-77, can record and play back in the PAL and SECAM modes used in Europe and elsewhere, and can play back (without being able to record) prerecorded video cassettes using the American and Japanese NTSC system. To deliver that
added versatility, the machine requires about 50% more parts than a conventional VCR and, at Japanese prices, will cost about $200.00 more than similarly featured one-system machines. Sharp’s model VC-6500E, a VHS-format unit, is similarly priced and also handles all three video formats. There were universal TV receivers in a variety of screen sizes and prices that are also switchable and can handle all three of the world’s major TV standards, as well as a variety of different electric line voltages and frequencies.

Status of videodiscs

Some manufacturer-exhibitors at the Tokyo Electronics Show exhibited more than one type of videodisc—presumably to illustrate their technical and manufacturing capabilities. Toshiba, in fact, showed not only the optical Philips/Magnavox/Pioneer type of player and a JVC/Panasonic/GE VHD capacitance type, but even had on hand a player that could handle the U.S.-originated RCA SelectaVision (CED) discs.

A few weeks after the Tokyo Electronics Show closed in Japan, there was important news about the looming videodisc battle right here in the United States. Late in October, 1980 General Electric Company, Matsushita Electric Company of Japan, (MEI), Victor Company of Japan (JVC) and Thorn EMI of Great Britain announced formation of three jointly-owned companies to launch the VHD videodisc system in the U.S. in late 1981. The joint ventures consist of a program distribution and artistic production company, VHD Programs, Inc., a videodisc manufacturing company, VHD Disc Manufacturing Co., and a disc player manufacturing company, VHD Electronics Inc.

According to executives of all the companies involved, the VHD system combines the advantages of both the laser-optical system and the capacitive-groove type systems with which it will compete. Its 10.2-inch diameter disc, developed by JVC, features fast and slow motion, fast forward and reverse, still-frame mode, and random access, with one hour’s playing time on each side. Since the big question about VHD’s ability to compete with other systems had been the question of available programming or software, the entry of Thorn EMI into the group is a significant development.

Already negotiations are underway with 20th Century-Fox, Warner Home Video, Columbia, MGM/CBS and other major studios. The initial VHD library, subject to final negotiations, will include at least 160 current, all-time favorites, and future motion pictures from major studios and independents. VHD Programs, Inc. is also negotiating licensing agreements to distribute VHD disc programs to the home video market with Walt Disney Productions, Filmways and a number of independent production companies, including Time-Life films.

The projected VHD player reproduces full-color video programs in two-channel stereo sound. The user will also be able to select a videodisc with a different language on each of the two sound tracks. The VHD player rotates the disc at 900 revolutions per minute (as compared with 1800 rpm for the laser-optical disc and 450 rpm for the RCA SelectaVision discs). An optional random access feature will permit viewers to program more than 10 separate segments for playback in a preselected order and speed selected for each segment. By adding an optional digital audio processor to the basic player, digital audio sound for high fidelity enthusiasts becomes available.

In the mastering process of the VHD system, information is recorded onto a photo-sensitized glass master disc by focusing a minute laser beam directly onto its surface. The laser beam is split in two, with one part used to record program information while the other is used to record a special tracking signal. A metallic disc produced from the glass disc is used for the remainder of the manufacturing process, similar to the procedure that is used in audio-record stamping.

The VHD diamond capacitance-playback stylus used in playing these discs has an electrode that detects the capacitance variations between the disc and the stylus. The stylus is able to detect both the main signal and the tracking signal simultaneously and is therefore able to track effectively even though there are no grooves in the VHD disc itself.

Listen fast—or slow

The hand-held remote control unit shown in Fig. 5 should be familiar to most readers who have seen or own one of the new VCR’s equipped with the special-effects features shown on the face of the controller. What may not be so familiar is the VSC logo that has been affixed to the top of the unit. It stands for Variable Speech Control Company, a small San Francisco-based outfit that has come up with audio circuitry that meets the new requirements of the VCR’s. Now, thanks to the development of a new custom IC, it becomes cost-effective for manufacturers to include what VSC calls their “speed listening feature.” While viewers are now able to double the viewing speed (or, in some cases, increase it even more) on a home VCR, they have had to content themselves with either turning off the audio tracks or listening to unintelligible “Donald Duck”-like speech that normally occurs at increased speeds. As explained by Mr. Marvin Flaks, president of VSC Corporation, the human brain can easily process verbal information at speeds of 250 to 300 words per minute, or about twice the average speaking rate. At this speed, comprehension may actually increase, as concentration intensifies. The VSC feature simply allows you to listen to the increased audio rate by restoring the pitch or frequency range of the audio tracks to their normal range.

Among the companies that have already licensed VSC technology are Sony, Panasonic, JVC, General Electric and Aiwa. The feature also lends itself to use in hand-held audio-cassette decks, car tape decks, telephone-answering machines, and, possibly, videodisc players that also feature fast-play modes.

That’s a quick look at what’s new and what’s coming soon in home video. One thing you can be sure of is that there will be many more innovations as manufacturers try to keep up with each other, and with the public’s demand for more sophisticated equipment.
ANYONE FAMILIAR WITH RECORDING, BE IT THE HOME RECORDIST OR THE PRO, RECOGNIZES THE NEED FOR AN ACCURATE VU METER TO FACILITATE SETTING AUDIO LEVELS. AN ACCURATE VU METER ALLOWS US TO MAXIMIZE THE S/N RATIO WHILE MINIMIZING THE DISTORTION CAUSED BY CLIPPING IN AMPLIFIER STAGES OR SATURATION OF THE TAPER.

IN THE PAST, THE ANALOG, OR MECHANICAL, VU METER WAS USED. THOSE METERS WERE (AND ARE) AVAILABLE WITH VARYING DEGREES OF ACCURACY FOR VARYING AMOUNTS OF MONEY. AS WITH MOST OTHER THINGS, HIGHER ACCURACY MEANS HIGHER COST. THE VU METER RESPONDS, MORE OR LESS, TO THE AVERAGE LEVEL OF THE AUDIO; ALTHOUGH IT CAN RESPOND QUICKLY, IT IS NOT A PEAK-READING OR RESPONDING METER.

IN AN ATTEMPT TO OVERCOME SOME OF THE SHORTCOMINGS OF THE ANALOG VU METERS, AN ALL-ELECTRONIC VU METER HAS BEEN DESIGNED AROUND THE EXAR XR-2276 IC. THIS BAR-GRAph GENERATOR IC IS ONE OF A SERIES OF RECENT DEVELOPMENTS BY IC MANUFACTURERS INTENDED FOR THE MARKET PREVIOUSLY DOMINATED BY MECHANICAL METERS.

UP UNTIL ABOUT TWO YEARS AGO, ANYONE WISHING TO CONSTRUCT A "MOVING LED" OR "BAR-GRAph" DISPLAY HAD TO ASSEMBLE A SERIES OF COMPARATORS AND RESISTIVE VOLTAGEx DIVIDERS TO MONITOR THE ANALOG INPUT AND LIGHT A SERIES OF LED'S. WITH THE INTRODUCTION BY TEXAS INSTRUMENTS, NATIONAL SEMICONDUCTOR, AND EXAR INTEGRATED SYSTEMS OF A SERIES OF IC's, THE TASK HAS BEEN GREATLY SIMPLIFIED.

ALL OF THOSE IC's ARE GENERALLY THE SAME; THEY USE A VOLTAGE-DIVIDER NETWORK WITH TEN OR TWELVE VOLTAGE TAPS, TEN OR TWELVE COMPARATORS, A STABLE INTERNAL REFERENCE VOLTAGE, AND AN ANALOG INPUT SIGNAL BUFFER. EACH VOLTAGE TAP IS APPLIED TO ONE INPUT OF EACH COMPARATOR, WHILE THE OTHER INPUTS ARE TIED TOGETHER AND FED FROM THE OUTPUT OF THE ANALOG SIGNAL BUFFER. AS THE INPUT SIGNAL INCREASES, SUCCEEDING STAGES OF COMPARATORS TRIP, SUPPLYING DRIVE CURRENT TO THEIR CORRESPONDING LED. IF THE LED's ARE ARRANGED IN LINE, WE HAVE A BAR-GRAph DISPLAY; OR, IN THE VARIATION USED WITH THE VU METER, WE MAY ImitATE A CONVENTIONAL METER DIAl.

THE RESISTORS IN THE VOLTAGE DIVIDER MAY BE SELECTED TO PRODUCE A LINEAR RESPONSE (E.G., 1 VOLT BETWEEN ANY TRIP POINT AND THE PREVIOUS OR NEXT TRIP POINT), A LOGARITHMIC RESPONSE (E.G., 3 DB BETWEEN ANY TRIP POINT AND THE PREVIOUS OR NEXT TRIP POINT), OR A SPECIALIZED LOGARITHMIC SCALE SUCH AS THE VU METER WITH ITS INHERENT EXPANDED SCALE AROUND THE 0 VU POINT. AT THE PRESENT TIME, ONLY EXAR IS MANUFACTURING AN IC SUITABLE FOR USE IN A VU METER.

THE XR-2276 HAS ALL THE CIRCUITRY NECESSARY TO DETERMINE THE LEVEL OF THE INCOMING SIGNAL AND DISPLAY IT INSTANTANEOUSLY. THIS PEAK-READING ABILITY HELPS PREVENT PRE-AMP OR TAPE OVERLOAD FROM RAPID, SHORT-DURATION PEAKS IN THE PROGRAM MATERIAL TO WHICH A NORMAL VU METER WOULDN'T RESPOND. INSTEAD OF USING THE CONVENTIONAL MOVING NEEDLE, THE XR-2276 DRIVES A SERIES OF LED's ARRANGED IN A MANNER SIMILAR TO THE VU METER SCALE WITH WHICH MOST PEOPLE ARE FAMILIAR.

CIRCUIT DESCRIPTION

REFERING TO FIG. 1, THE INPUT SIGNAL IS APPLIED TO RESISTIVE DIVIDER R1 THROUGH R8; THE APPROPRIATE TAP IS SELECTED WITH DIP SWITCH S1 THROUGH S7. THE SIGNAL IS THEN AMPLIFIED BY IC1; R11 IS A VERNIER GAIN ADJUSTMENT TO SUPPLEMENT S1 THROUGH S7. IC2 FUNCTIONS AS A FULL-WAVE PRECISION RECTIFIER.

THE SIGNAL IS NEXT APPLIED TO IC3 WHICH MAY BE CONFIGURED FOR DIFFERENT RESPONSE CHARACTERISTICS: 1) A LOW-PASS FILTER WHICH GIVES THE METER AN AVERAGING RESPONSE; 2) PEAK-AND-HOLD RESPONSE WHICH WILL SHOW SHORT-DURATION PEAKS AND HOLD THEM LONG ENOUGH TO BE SEEN; OR 3) FAST OR PEAK-RESPONDING WITHOUT "HOLD." THE LAST VARIATION INCLUDES A JUMPER THAT ALLOWS THE USER TO DETERMINE QUANTITATIVELY THE AMPLITUDE AND DURATION OF AUDIO PEAKS BY THE BRIGHTNESS OF THE LED's WHILE THE FIRST TWO VARIATIONS CONFORM MORE TO STANDARD RESPONSE TIMES FOR VU AND
peak-reading audio-level meters. (You can wire a SPST switch in place of the jumper to allow switch-selectable response.)

The audio signal finally arrives at IC4, the XR-2276, where it is converted into one-(or more)-of-twelve digital output signals. The output of that device goes to the driver-transistor arrays (IC5 and IC6) and then to the LED's.

The power supply is an unregulated split supply delivering approximately + and −15 volts.

There are several variations and options available to the constructor. Those options concern the input attenuator, the LED drive circuitry, and the power supply. See Figs. 2 and 3 for details.

Construction

Nearly all components are mounted on PC boards. The display and associated circuits for each VU meter are mounted on two boards—the foil patterns are in Figs. 4 and 5. The pattern for the power-supply board is in Fig. 6. The components used, and the wiring of the boards, will be determined by the options and variations that you select. The two boards used for the circuitry and display panel are mounted with their foil sides facing each other and interconnected with short sections of No. 20 or 22 solid wire. You can use pieces clipped off resistor leads for this purpose. There are twelve jumpers across the top of the boards and others on each side. Figure 7 is an interior view of a stereo VU meter with the Option-E (120-volt AC) power supply. That combination is Version 2. See parts list.

The appropriate components are mounted on the power-supply board which should then be connected to two signal processing and display boards.

The LED's protrude through the meter dial which can be fabricated by gluing a facsimile of Fig. 8 to stiff cardboard and punching ⅛-inch holes at the crosshairs. Alternately, you can order a ready-made meter dial. (See parts list.) Next, the bezel is mounted in the enclosure's front panel. The easiest way to hold it in place is to run a hot soldering iron tip along the adjoining surfaces of the bezel and front panel to weld the two pieces together. Be careful—don't use too much heat.
FIG. 2—OPTIONS FOR HOME recording use. In circuit at a, the stepped attenuator and switch have been replaced by a multi-turn trimmer resistor originally used in controlling the gain of IC1. Use the modified LED drive circuitry at b if you can get along with lower brightness from the indicators.

FIG. 3—POWER SUPPLY VARIATIONS. Option C is used when you have a convenient external source of 24-to-30 volts DC. IC7 and Q1 provide the dual-polarity output voltages. Use the arrangement at b (Option E) when you want to power the instrument from 117-volt AC lines.

FIG. 4—FOIL PATTERN for the rear PC board. This board is 2.7 inches wide and 2 inches high.

FIG. 5—PC PATTERN for the front board. The LED indicators are arranged so they protrude through holes in an arc in the meter dial.

FIG. 6—FOIL PATTERN for the power-supply PC board. It is used for both versions of the supply circuit.

FIG. 7—INTERIOR VIEW of the prototype stereo VU meter. Note how the two circuit boards, meter face, and front panel go together.
KIT OF PARTS

A complete kit of parts for the different version of the VU meter is available from: BFA Electronics, P.O. Box 212, Northfield, OH 44067. Ohio residents please add applicable sales tax.

VU-1: Includes Boards 1 and 2 (front and back boards) and, optionally, Board 3, depending on power source; also 1 bezel, 1 meter dial and all parts needed for PC boards, case not included. Request either Option C, D, or E.* Order: VU-1-C @ $27.00 or VU-1-D @ $24.00 or VU-1-E @ $31.00. Add $2.00 postage and handling.

VU-2: Includes 2 pieces each of Boards 1 and 2 and 1 Board 3, 2 bezels, 2 meter dials, all appropriate parts for all P.C. Boards (parts for Board 3 will be for Option E) and a plastic case. (Case has no holes—user must machine it as required). Order: VU-2 @ $74.55. Add $2.50 postage and handling.

VU-3: Includes 2 pieces each of Boards 1 and 2 and 1 of Board 3. $10.00. Add $1.00 postage and handling.

*Option C: 24-30 volts DC operation
Option D: ± 15 volt DC supply already available
Option E: 120 volts AC operation

Finally, mount the coupled PC boards on the front panel with the LED's and meter dial extending into the bezel. Use spacers and No. 4-40 nuts and bolts as shown in Fig. 9.

Figures 10 and 11 show the layout of parts on the rear and front circuit boards, respectively, when using the circuit as shown in Fig. 1. Figure 12 shows the component side of the front board.

Applying the options

If you eliminate the switchable attenuator and substitute an adjustable trimmer resistor as in Fig. 2-a, refer to the
FIG. 13—COMPONENT LAYOUT GUIDES for the front panel when using Options A and B. Note that the LED polarity has been reversed in Option B.

STIFF WIRES OR EXCESS RESISTOR LEADS TO FRONT BOARD

FIG. 14—THIS PARTS LAYOUT is used for the rear board when Option B is taken. Note that IC’s 5 and 6 have been completely eliminated and replaced by resistors R19 to R30.

FIG. 15—PARTS FOR THE POWER SUPPLY are positioned on the board as shown when using a 24-to-30-volt DC external supply.

PARTS LIST

All resistors 5%, ¼ watt unless otherwise specified

R1—10,000 ohms
R2—12,000 ohms
R3—3000 ohms
R4—2000 ohms
R5—1200 ohms
R6—1300 ohms
R7—430 ohms
R8—200 ohms
R9—470,000 ohms
R10—5100 ohms
R11—100,000 ohm, single or multi-turn trimmer (Bourns 3352W-1-104, 3299W-1-104 or equivalent)
R12—36,000 ohms
R13—10,000 ohms, 1%, 1/10 watt
R14—680 ohms, 1%, 1/10 watt
R15—470,000 ohms
R16—39,200 ohms, 1%, 1/10 watt
R17—62,000 ohms
R18—1000 ohms
R19—R30—560 ohms
R31, R32—47,000 ohms’
R33—1000 ohms’
R34—68,000 ohms
R35—100,000 ohms
R36—3300 ohms

Semiconductors

LED1—LED12—H-P 5082-4684 or equivalent T-1 LED
D1, D2—1N914
Rect1—50-volt, 1 A bridge rectifier**
Q1**—2N6111 (National) or equivalent
IC1-IC3—CA3140E (RCA)
IC4—XR2276P (Exar)
IC5, IC6—ULN 2003A (Sprague, TI, SigNetics)
IC7**—LM741CN (National) or equivalent

Capacitors

C1—0.1 µF, 100 volts Mylar
C2-C4, C6, C7**—0.01 µF, 25-volt ceramic disc
C5—0.47 µF, 10 volts, Mylar
C11**—100 µF, 25-volt aluminum electrolytic
C10**—1000 µF, 25-volt aluminum electrolytic
S1—57-position DIP switch
S8—SPDT switch
T1**—20-volt, 1-amp CT transformer (Stancor P8604 or equivalent)
F1**—1A-amp 3AG fuse
* Used only with DC input option
** Used only with 117 VAC option

Note: The quantities shown above are for a single-channel unit. With the exception of the power-supply components, two of each will be required for a stereo meter.

“Option A” section of Fig. 13. It shows how attenuator resistors R2 through R8 are eliminated and replaced by R11 and a few jumpers. Refer to Fig. 11 for the locations of all other components on this board.

If you can get along with lower brightness from the LED indicators, do not install IC5 and IC6 on the rear board. In their places install resistors R19 through R30 across the IC terminal pads as in Fig. 14. Refer to the (continued on page 90)
IN PART 1 OF THIS ARTICLE ON CONVERTING AN IBM SELECTRIC terminal/printer for use with a microcomputer, we covered the hardware end of the project, a four-IC interface board that is connected to the parallel- or expansion port of the computer—wherever eight-bit parallel data can be output. Now we'll consider the software needed to drive the interface (and the printer).

We stated earlier that the software would provide both the translation from ASCII and the time delay needed by the different functions. The software will vary from one computer to the next, unless they are alike in every respect. The differences are the ORG (starting address) of the assembly-language or machine-language program, the CPU register in which the character is stored, up to the time of printing, and other minor differences. The timing can remain the same for any processor running at 2 MHz or thereabouts; for faster or slower machines, the values of the timing words will need changing.

The software is presented in two versions, shown in Table 1 and Table 2. The 8080 assembly-language version in Table 1 can be used with any 8080 or Z-80 system, bearing in mind only the timing, ORG, and register differences that may have to be changed. The computer's I/O port assignments must also be considered.

The BASIC program (Table 2) is specifically for the TRS-80, Model I, and simply POKE's the numerical data into memory as a means of loading the driver. The BASIC version, needless to say, is easier to load from a disc than would be a machine-language program on tape. After it has been POKE-ed, the program will be accessed by the LPRINT command each time a character is to be printed. To do that some of the DOS (Disk Operating System) must be altered. The program takes care of all those matters.

Both programs accomplish the same purpose. Whenever a character is to be output, (either printable or control) the CPU's accumulator must be freed temporarily of any other tasks. The contents of the various registers are all "pushed" onto the stack for later recovery. At the last possible moment, the character will be passed from the register in which it is contained (such as the B register under North Star DOS and the C register under CP/M) to the accumulator, from where it will be output to the printer port. The correct code for the character will have been found in the lookup table, which will be explained in a moment.

The software has a unique feature which saves some time, and also some wear and tear on the mechanism: it saves the
TABLE 1

<table>
<thead>
<tr>
<th>Line</th>
<th>Instruction</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1000</td>
<td>REM PROGRAM TO POKE SELECTRIC DRIVER INTO MEMORY</td>
<td></td>
</tr>
<tr>
<td>1819</td>
<td>ON ERROR GOTO 1838</td>
<td></td>
</tr>
<tr>
<td>1829</td>
<td>PRINT</td>
<td></td>
</tr>
<tr>
<td>1839</td>
<td>INPUT &quot;SYSTEM SIZE (16, 32 OR 48)&quot;; M$</td>
<td></td>
</tr>
<tr>
<td>1849</td>
<td>M = VAL(M$)</td>
<td></td>
</tr>
<tr>
<td>1859</td>
<td>IF M &lt; 16 AND M &lt; 32 AND M &lt; 48 THEN 1030</td>
<td></td>
</tr>
<tr>
<td>1869</td>
<td>D = D - M</td>
<td></td>
</tr>
<tr>
<td>1879</td>
<td>M = M + 16</td>
<td></td>
</tr>
<tr>
<td>1889</td>
<td>POKE 16422, 0</td>
<td></td>
</tr>
<tr>
<td>1899</td>
<td>POKE 16457, 255</td>
<td></td>
</tr>
<tr>
<td>1909</td>
<td>POKE 16456, 1256 - 1</td>
<td></td>
</tr>
<tr>
<td>1919</td>
<td>IF MV32763 THEN M = 65536!</td>
<td></td>
</tr>
<tr>
<td>1929</td>
<td>REM &quot;&quot;&quot;&quot; INDICATES SINGLE PRECISION VARIABLE</td>
<td></td>
</tr>
<tr>
<td>1949</td>
<td>ON ERROR GOTO 1200</td>
<td></td>
</tr>
<tr>
<td>1959</td>
<td>READ B</td>
<td></td>
</tr>
<tr>
<td>1969</td>
<td>IF B THEN B = ABS(B) + D</td>
<td></td>
</tr>
<tr>
<td>1979</td>
<td>POKE M.B</td>
<td></td>
</tr>
<tr>
<td>1989</td>
<td>M = M + 1</td>
<td></td>
</tr>
<tr>
<td>1999</td>
<td>GOTO 1158</td>
<td></td>
</tr>
<tr>
<td>2009</td>
<td>PRINT</td>
<td></td>
</tr>
<tr>
<td>2109</td>
<td>NEW</td>
<td></td>
</tr>
<tr>
<td>2119</td>
<td>REM PROGRAM DATA</td>
<td></td>
</tr>
<tr>
<td>2129</td>
<td>DATA 245, 197, 213, 229, 121, 230, 127, 6, 1, 254</td>
<td></td>
</tr>
</tbody>
</table>

TABLE 2

<table>
<thead>
<tr>
<th>Line</th>
<th>Instruction</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1249</td>
<td>DATA 8282.71, -127.6, 32.33, 8.96, 254</td>
<td></td>
</tr>
<tr>
<td>1259</td>
<td>DATA 9282.74, -127.6, 254.128, 282.74</td>
<td></td>
</tr>
<tr>
<td>1269</td>
<td>DATA -127.6, 16, 214, 32, 207, 21, -127, 218, 97</td>
<td></td>
</tr>
<tr>
<td>1279</td>
<td>DATA -127, 39.22, 0.33, 113, -127, 25.78, 33</td>
<td></td>
</tr>
<tr>
<td>1289</td>
<td>DATA 112, -127, 7.88, 278.54, 119, 163, 282.71</td>
<td></td>
</tr>
<tr>
<td>1299</td>
<td>DATA -127, 128.56, 225.55, 17.8, 13.25, 182</td>
<td></td>
</tr>
<tr>
<td>1309</td>
<td>DATA -127.33, 6.5, 118, -127, 176.58, 232</td>
<td></td>
</tr>
<tr>
<td>1319</td>
<td>DATA 55, 17.8, 205, 182, -127, 58.12, -127</td>
<td></td>
</tr>
<tr>
<td>1329</td>
<td>DATA 58, 232.55, 235.25, 182, -127, 225.25, 193</td>
<td></td>
</tr>
<tr>
<td>1339</td>
<td>DATA 241, 201, 122, 179.20, 227.27, 8.27, 195</td>
<td></td>
</tr>
<tr>
<td>1349</td>
<td>DATA 182, -127, 8</td>
<td></td>
</tr>
<tr>
<td>1359</td>
<td>REM TABLE DATA</td>
<td></td>
</tr>
<tr>
<td>1369</td>
<td>DATA 255, 213, 254, 249, 245, 253, 149</td>
<td></td>
</tr>
<tr>
<td>1379</td>
<td>DATA 248, 241, 252, 198, 148, 128, 214, 137</td>
<td></td>
</tr>
<tr>
<td>1389</td>
<td>DATA 177, 169, 182, 190, 185, 179, 188, 187</td>
<td></td>
</tr>
<tr>
<td>1399</td>
<td>DATA 166, 176, 285, 141, 215, 134, 151, 261</td>
<td></td>
</tr>
<tr>
<td>1409</td>
<td>DATA 246, 228, 224, 236, 237, 235, 286, 287</td>
<td></td>
</tr>
<tr>
<td>1419</td>
<td>DATA 225, 212, 199, 228, 233, 223, 238, 217</td>
<td></td>
</tr>
<tr>
<td>1429</td>
<td>DATA 197, 196, 221, 289, 231, 238, 222, 286</td>
<td></td>
</tr>
<tr>
<td>1439</td>
<td>DATA 239, 193, 247, 8.24, 0.8, 192</td>
<td></td>
</tr>
<tr>
<td>1449</td>
<td>DATA 0.8, 156, 172, 173, 165, 142, 143</td>
<td></td>
</tr>
<tr>
<td>1459</td>
<td>DATA 161, 148, 135, 164, 169, 156, 165, 153</td>
<td></td>
</tr>
<tr>
<td>1469</td>
<td>DATA 133, 132, 157, 145, 167, 174, 158, 144</td>
<td></td>
</tr>
<tr>
<td>1479</td>
<td>DATA 175, 129, 183, 0, 0, 0, 0</td>
<td></td>
</tr>
</tbody>
</table>
That completes the appropriate time period, after which the shift bit is zero if it was lower case. Before printing the next character, the program checks to see if the “case” has changed. Since the shift mechanism stays locked, either in upper or lower case, it is only necessary to send the shift bit again when the case changes.

If a shift bit is required, it is sent first and held for a certain time period, after which the rest of the character follows. After the character has been sent, and the data held for an appropriate length of time, a “zero” is output to the port. That completes the print cycle for each printable or control character. The contents of the stack are now “popped” back into the appropriate registers and control returns to the operating system.

Whether you use the 8080 assembly-language version or the TRS-80 disk BASIC version, great care should be exercised in entering the programs; they modify the DOS, and just one wrong byte can prevent the entire system from working.

### Changing typiing elements

It should be noted that the portion dealing with the translation table can be modified as needed. For some balls and/or character sets many changes may have to be made. For example, IBM ball (IBM calls them “typing elements”) 185 is a desirable type for use with BASIC programs. Several tables changes are necessary to use that ball. It has upper-case letters where the lower-case letters would normally be; the codes for upper-case letters must be changed, in the table, to be the same as those for lower case. The codes for the additional characters, for which that ball was recommended, must be added to the table in the correct places. To illustrate how simple those changes are, see Table 3, a simple BASIC program that will make the necessary changes in Table 2 in a few seconds. The table is changed in memory by that routine and you can then save the changed version, or simply run the “change” program whenever using the second ball.

Once you have mastered the tilt/rotate patterns, and understand the method of assigning numbers to each character, you should have no particular problem in doing that for your own system. The programs as presented are correct in most details for balls used in normal typing.

The use of the lookup table is described for those who may be unfamiliar with them. The “codes” are the numeric value that must be output for each character. In the ASCII table, characters come in a certain order. The table in the program is made up of the new values for the corresponding characters, and the actual ASCII code is used to access the table codes. The twenty-third ASCII character, then, will direct the program to the twenty-third code in the translation table. That code may or may not be the same as the ASCII value, but in any event it is the table code that is finally sent to the printer. If you change to a ball with characters located differently, you simply determine where in the table to make the change, and change the code for those characters.

Table 4 illustrates the correspondence between the ASCII table and the translated code. That code is only correct for the assignments we made to the tilt/rotate and other lines, as shown at the beginning of the assembly-language program. You can make up your own code if the data lines are assigned differently, or if you use a ball that does not have characters positioned as did ours, which were an IBM 134 and 185.

One more peculiarity of that software needs pointing out for those who use other machines and are not familiar with the TRS-80 (for which the sample programs were written). In those listings, the character to be output is handled by an STA instruction rather than an OUT instruction. That was done because the TRS-80 is a character-based system, and the character can be sent at any time, but, rather, is treated as a memory location, into which successive characters are written. That part of the program can easily be changed for computers using more conventional I/O standards.

Our converted Selectrics have been satisfying in many ways. The low price of the finished product was more than worth it, and anyone who loves to tinker with hardware cannot help but enjoy such an activity. As stated earlier, those machines are not fast, and 100 to 150 words per minute (comparable to a Telepyper) is inadequate for many of the purposes a computer might be used for. Nevertheless, these converted terminals are a good alternative for anyone trying to save money on hardware, particularly if word processing is to be the major consideration.
Although their schedules are subject to change without notice, when you can find them these stations offer an interesting alternative to standard broadcast fare.

ROBERT B. GROVE

IN OUR JUNE, 1980 ISSUE WE EXPLORED the fascination of monitoring "spy" numbers stations. At this writing, the riddle as to the origin of those mysterious transmissions is still unresolved.

But the numbers stations are not the only unlicensed signals on the airwaves. Pirate and clandestine broadcasters populate the radio spectrum from medium-frequency wavelengths (200-1600 kHz) through shortwave. Even listeners to the FM and TV bands encounter those phantom signals occasionally.

Who are the perpetrators, and what are their motivations? To answer those questions, we must first separate the pirates and clandestines into their own categories.

The pirates

Operating a radio transmitter without a license is hardly new in the United States. Many CB'ers have been doing it for years! So have hams who would rather not spend the time and energy needed to take the amateur radio examination or learn the required Morse code.

Pirate broadcasting began early this century when radio regulations were very loosely structured and enforcement was virtually non-existent. Perhaps the best documented pirate station was that of David Thomas, owner of unlicensed station WUMS ("Was Unlicensed Marine Station").

Originally built to operate on 1235 kHz, WUMS' homemade transmitter was switched to 2004 and 1560 kHz in 1938. Messages were sent to Ohio River vessels in the ferry service, and the station broadcast entertainment as well.

In 1939 WUMS was hauled into Federal Court on charges of operating an amateur radio station without a license. Since WUMS was obviously not in the amateur service—not operating in the amateur-frequency bands—the charges were dropped.

In 1948, following a series of transmissions monitored by stations as far away as China, WUMS was cited again by the FCC. After the Commission reportedly spent some $10,000 for prosecution, the case was once again thrown out of court.

After more than 50 years of virtually continuous operation, WUMS has finally gone off the air for good after establishing a world's record for perpetual piracy! Its transmitter has been accepted by the Smithsonian Institution, joining the company of names like Edison and Marconi, to be enshrined with other artifacts of our nation's memorabilia.

Needless to say, unlicensed pirate stations drive the FCC bonkers. Schedules are erratic, locations are rarely given, and transmission times are often short. The United States is not as saturated

COMMUNICATIONS
with those stations as is Great Britain, unofficially the home of pirate broadcasting. Long wave, medium wave, shortwave, FM, and even TV pirates flood the airwaves over the Isles. A large number of them are in Ireland, such as Radio Dublin, Weekend Muzick Radio, Radio Nautilus International, European Music Radio, Radio Zenith, Radio Condor International, and many more.

Holland is the home of Radio Dolfijn International, and AIR is in Glasgow, Scotland. For additional entertainment there is the Voice of the Pyramids, Voice of Venus, Radio Confusion—the list is endless.

But the United States is certainly not devoid of illicit broadcast activity. One of the most famous in recent history is the Voice of the Voyager, a pirate broadcaster in Minneapolis who constantly gave a Houston, TX mailing address over the air. To compound the obfuscation, return mail was sent to listeners from Ann Arbor, MI. That one gave the FCC fits, and took the cooperative efforts of all 13 FCC field stations to locate it finally, and shut it down!

Even as early as 1933, stations attempted to avoid prosecution by transmitting from international waters. RXKR operated aboard the motor vessel City of Panama off the coast of southern California. Basking in the balmy breezes of the Pacific, RXKR conducted its programming right in the middle of the standard broadcast band.

FRED. IDENTIFICATION AND SCHEDULE (Time: Universal Coordinated)

<table>
<thead>
<tr>
<th>FREQ. (kHz)</th>
<th>IDENTIFICATION AND SCHEDULE</th>
</tr>
</thead>
<tbody>
<tr>
<td>1128</td>
<td>Mersey Alternative Radio</td>
</tr>
<tr>
<td>1187</td>
<td>Alternative Radio 2200-0200 Sat. eve./Sun.</td>
</tr>
<tr>
<td>1271</td>
<td>Radio City 1100-1500 Sat./Sun.</td>
</tr>
<tr>
<td>1320</td>
<td>Radio Jackie 0800-1700 Sat./Sun. (going to court; longest record for operating on land in Britain)</td>
</tr>
<tr>
<td>1463</td>
<td>Radio Condor International 0900-1400 Sun. Also 6243, 11463 kHz; Ireland.</td>
</tr>
<tr>
<td>1620</td>
<td>PRN; New England</td>
</tr>
<tr>
<td>2460</td>
<td>Radio Watergate International/RWI Abscam. East coast, 0500 weekends; 35 watts. Operator &quot;Jack Cass, Mr. Personality.&quot; Also on 2340, 2630 kHz.</td>
</tr>
<tr>
<td>2390</td>
<td>Radio Nautilus International 0400 winter months; &quot;Danny King&quot; 35 watts.</td>
</tr>
<tr>
<td>3240</td>
<td>Voice of the Pyramids; not yet active. Also 4670, 5825, 6240, 6250, 7470, 9330, 11850, 15020, 15030, 11615 kHz.</td>
</tr>
<tr>
<td>3405</td>
<td>WHY Radio 0700. 90 watts.</td>
</tr>
<tr>
<td>3885</td>
<td>WBLO 2330 and 1500. Also 4020-kHz Sun.</td>
</tr>
<tr>
<td>4004</td>
<td>Radio Indiana 0400-0530. Also 6990, 7315, 7360 kHz, 21600 kHz at 2200. &quot;Voice of Indiana&quot;; Johnson Vellant II transmitter, 200 watts into 60 foot longwire.</td>
</tr>
<tr>
<td>5930</td>
<td>Radio Dublin (c/o Disk-It, Finglas Village, Dublin 11, Ireland.) Also 6210, 6250, 6275, 6310, 6350 kHz.</td>
</tr>
<tr>
<td>6204</td>
<td>Radio Iris; Holland.</td>
</tr>
<tr>
<td>6235</td>
<td>ABC International; Radio Zenith; European Music Radio; Radio Zodiac 49. Sundays.</td>
</tr>
<tr>
<td>6260</td>
<td>Radio Cill Dara International (Ireland); Sun. 1000-1300. Radio Cavendish (Scotland); Sun. 0800 (also 7320 kHz).</td>
</tr>
<tr>
<td>6265</td>
<td>Radio Krypton; Sun. 1200-1300.</td>
</tr>
<tr>
<td>6279</td>
<td>Syncom International; Sat./Sun. 0100-0600; Sun. 0800-1100. Also 6248, 7430 kHz. 21522 kHz; Fri./ Sat. 2300-0100.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>FREQ. (kHz)</th>
<th>IDENTIFICATION AND SCHEDULE</th>
</tr>
</thead>
<tbody>
<tr>
<td>6420</td>
<td>KVHF Sun. 0945</td>
</tr>
<tr>
<td>6955</td>
<td>Radio Nautilus International 0300</td>
</tr>
<tr>
<td>6960</td>
<td>Voice of Venus 0330</td>
</tr>
<tr>
<td>6965</td>
<td>WARG/WONS 0400-0500 &quot;Your Free East Broadcaster.&quot; Also 6980, 6988 kHz.</td>
</tr>
<tr>
<td>7050</td>
<td>XR705 0600.</td>
</tr>
<tr>
<td>7053</td>
<td>Voice of Alpha 66; 0115-0149 (Miami)</td>
</tr>
<tr>
<td>7082</td>
<td>Radio Abdala (Miami) 0100-0200</td>
</tr>
<tr>
<td>7090</td>
<td>Radio Libertad Cubana/Radio Rebelde (Miami); &quot;Commandante David.&quot; 0100-0330</td>
</tr>
<tr>
<td>7325</td>
<td>Radio Zodiac; European Music Radio Sun. 0630-0845</td>
</tr>
<tr>
<td>7340</td>
<td>Weekend Muzick Radio</td>
</tr>
<tr>
<td>7342</td>
<td>Radio Impact 0600-0800. Also 7325 kHz.</td>
</tr>
<tr>
<td>7365</td>
<td>Radio Confusion 0003</td>
</tr>
<tr>
<td>7400</td>
<td>The Voice of the Cuban Patriotic Junta. 0200</td>
</tr>
<tr>
<td>7420</td>
<td>The Voice of Revolutionary Vinco</td>
</tr>
<tr>
<td>7570</td>
<td>The Voice of the Burmese People. 1130</td>
</tr>
<tr>
<td>9615</td>
<td>Radio Noticias del Continente (TIRL); (Costa Rica)</td>
</tr>
<tr>
<td>9585</td>
<td>Voice of the Communist Party of Turkey. 0555-0629</td>
</tr>
<tr>
<td>9730</td>
<td>Voice of the Egyptian People; 1900-2000 (Anti-Begin; anti-Sadat)</td>
</tr>
<tr>
<td>11615</td>
<td>La Voz de la Resistencia Chilena; 0100-0137. Also 7246, 7195 kHz</td>
</tr>
<tr>
<td>15045</td>
<td>Radio Free Grenada; ostensibly broadcasts coded messages as obituaries weekends at 2230</td>
</tr>
</tbody>
</table>
Daytona Beach, FL. Run by two local disc jockeys, the Commission threatened them with heavy fines if they resumed operation. Capitulating against those odds, they now operate a legal FM cable service and stay out of trouble!

Why pirate?
Just what is it that motivates someone to start a pirate broadcasting operation? Frustration with the cumbersome licensing procedure? Indignation against authority? A keen sense of the thrill of the chase? Perhaps all of those and more. Let's ask Mr. "Guy Wire", operator of Radio Liberation in the quaint Plaquemines parish town of "Putrid," LA.

Q. Why did you decide to put a pirate station on the air?
A. Why not? It seemed like it would be fun ... it was my way of thumbing my nose at FCC censorship.

Q. What kind of programming did you do?
A. We had a staff of about 20; we got our idea of taping on cassette from Radio Havana. We were probably heard in all the states east of the Mississippi. Programs included "The Pol Pot Exile Show," rebroadcasts of The Voice of Free Grenada, some Spanish-language programming, and even an entire evening of barking dogs!

Needless to say, the FCC had fun with that one. When they finally located the neighborhood, the FCC engineers had considerable trouble finding "Guy Wire" who had spotted the suspicious vehicle and burried his transmitter!

Eventually, at the urging of his parents, the culprit exhumed the corpse of the illegitimate transmitter and put on one last demonstration for the FCC officials.

Threatened with a $10,000 fine, "Guy Wire" promised never to repeat his escapade.

In the United States, a spokesman for pirate stations is Al Muick. An informative copy of his "Free Radio Campaign" newsletter is available postpaid for $1 by writing: Free Radio Campaign, RD#2, Box 542, Wescosville, PA 18106.

Not all is in fun
As amused as we may become with the antics of some pirates, many transmissions have a definite purpose. During World War II, a British pirate attempted to damage Nazi morale by broadcasting stories that Field Marshal Rommel was a homosexual!

And that takes us to the second group of unlicensed broadcasters.

The clandestines
Some stations prefer to maintain their anonymity because of the nature of their broadcasting contents. Often politically-motivated, their transmissions are intended to persuade listeners to take drastic action against the ruling authority.

One of those, Radio Noticias del Continente (TIRL) is in Costa Rica and probably Cuban supported. It is suspected that the station was formerly called Radio Sandino, an anti-Somoza operation.

Also Communist-inspired, Radio Magallanes espouses its anti-Chilean messages, and the Voice of the Communist Party of Turkey lets its will be known.

The revolutionaries
Few American pirates or clandestines are Anti-American. Most are merely critical of certain government policies, often using the airwaves to voice their disenchantment.

But there are a few prominent anti-Castro broadcasters, sending their counter-revolutionary messages from, not surprisingly, south Florida.

Judging from the length of time those stations have been active, coupled with their blatant admission of location (mostly Miami or Key West), it would appear that the Federal Communications Commission is not particularly concerned with their presence. That may be in part due to the recent appearance of a powerful Radio Moscow relay station, beamed toward the United States from Cuba, on 600 kHz.

All of the anti-Castro Miami stations operate at the low end of the amateur 40-meter band, causing considerable grief for legitimate users. The Voice of Alpha 66 can be heard on 7053, usually between 0115 and 0150 hours daily. Radio Libertad Cubana (Radio Rebelde) is nearby on 7090 kHz, featuring the unique programming of Comandante David, usually between 0100 and 0330. Radio Abdala is just a fraction of a dial turn away at 7082 kHz, operating from 0100-0200.

Recently, nationwide publicity was given to a "raid" on one of the stations, the identity of which was not disclosed by FCC officials. A day or two later, another group, the Bay of Pigs Veterans Association's Radio Giron issued a news release claiming to be the operation that was shut down. Since no one had ever heard of Radio Giron, considerable question was raised as to the validity of the claim.

Was the Radio Giron statement issued to satisfy public demand to know which operation had been shut down? Was the FCC news release an unfortunate snafu which should have never been issued? Was the entire incident contrived, ostensibly to satisfy the many hams who had reported the illegal interference in their coveted 40-meter band?

At this writing, the south Florida clandestines are still alive and well, broadcasting their anti-Castro messages with apparent impunity.

Operating frequencies and schedules
Here we present an extensive list of the more frequently reported pirate and clandestine broadcasters. Because of the tenuous nature of their operation, frequencies and schedules change frequently. We cannot be held responsible for the accuracy of this list, but the basic ranges of times and frequencies are typical. Most of the broadcasters are in the British Isles, and many are reported by American and European listeners.

It would seem that the best time to look for the pirates is from 0900-1400 hours, and the best frequency ranges are 6235-6290 and 7325-7370 kHz. They are invariably low power, so some persistence and patience will be necessary.

Is pirate radio a wave of the future? Yes! says Al Muick of Free Radio Campaign. Especially in England where at least three new stations are expected to be operational shortly.

Radio Europe (Radio del Mare) will be afloat in the English Channel serving the Dutch and Belgian listeners of Radio Mi Amigo. According to Muick, the operator of this endeavor is "Ferry Eder."

Another operation will be conducted in the shortwave bands by ex-ABC England personnel. All three operations are expected to utilize medium-wave and VHF as well.

Pirate/clandestine radio is alive and well. Next time you casually tune across your shortwave dial and happen to discover a weak signal arguing with the establishment, the chances are good that you are listening to a fresh breath of individuality adrift in a sea of drivel. Let us know what you hear!

The author would like to thank John Santosuosso and Al Muick for their contributions in preparing this article.
NEW DOLBY NOISE REDUCTION SYSTEM

Dolby B is certainly the best known noise reduction system on the market, but it isn’t the only one. New Dolby C is Dolby Laboratories’ answer to the competition.

LEONARD FELDMAN
CONTRIBUTING HI-FI EDITOR

AFTER MORE THAN TEN YEARS OF BEING the acknowledged leader in the field of noise-reduction systems for use in consumer-type cassette tape recorders, Dolby Laboratories, under the direction of Dr. Ray Dolby, has announced a new noise-reduction technique, to be known as Dolby C. (Dolby A is the professional noise-reduction system used by many recording studios, and Dolby B the well known consumer-product system.)

Before the development of Dolby-B noise-reduction and its commercial acceptance in the early 1970’s, about the best signal-to-noise ratio that you could expect from even the best cassette tape decks was perhaps 40 or 45 dB. Adding a full 10 dB of noise-reduction or hiss reduction above 5 kHz was considered to be (and still is) one of the most important contributions to the high-fidelity field by any single inventor.

Virtually every important manufacturer of high-fidelity component stereo cassette decks signed license agreements with Dolby Laboratories and incorporated Dolby-B noise-reduction circuitry in its products. Today, it would be difficult, if not impossible, for a manufacturer to sell a stereo cassette deck priced above $150.00 if it did not incorporate Dolby B or an equivalent system.

But Dolby B, while certainly the best known electronic noise-reduction system in use today, is not the only one. Since its introduction we have seen a variety of noise-reduction systems developed. Many of them offer greater decreases in audible tape noise reduction than Dolby B. Among those are the well known linear companding (compression-expansion) system developed by dbx, Inc. In addition to increasing the available dynamic range on cassettes by applying 2 dB:1 dB compression during recording and the reciprocal, 1 dB:2 dB expansion during playback, the dbx system delivers more than 30 dB of noise reduction in the process.

Nakamichi, the well known maker of high-quality cassette decks, in cooperation with Telefunken of West Germany has come up with a two-band noise-reduction system that calls High-Com II. It is a variation of Telefunken’s professional noise-reduction system and, though frequency-selective, it provides approximately 20 dB of noise reduction at mid- and high frequencies.

Meanwhile, in Japan, Sanyo and Toshiba have developed their own noise-reduction systems: Super-D and ADRES respectively. Each one offers considerably more noise-reduction capability than Dolby B. Here, in the U.S., CBS Records has hinted that it has developed a noise-reduction system that not only provides more noise reduction than Dolby, but produces recordings that sound good even when played without any special circuitry or decoding device.

Other noise-reduction systems that are directly competitive with Dolby B include ANRS, developed by JVC and, more recently, Super ANRS. In addition to providing noise reduction, those systems also deal with the problem of high-frequency tape saturation.

Many audiophiles were beginning to wonder whether Dolby would come up with a new noise-reduction system to compete with all of the newer systems that have been gaining increased acceptance and popularity. Instead, about two years ago Dolby Laboratories came up with a headroom-extension system that they called Dolby HX. That circuit varied instantaneous recording bias and equalization to provide better headroom when recording high-level, high-frequency signals. When such signals occur in the program material, the bias is automatically lowered. When mid- or low-frequency signals predominate, the bias is increased to provide the best recording conditions for those frequencies. And because dynamic alteration of record-bias levels changes the overall flatness of frequency response, recording equalization is dynamically varied as well.

Very few companies use Dolby HX in their cassette decks. Some have expressed fears that the instantaneous lowering of bias during moments when high-frequency, high-level, passages
are recorded would have an adverse effect upon the distortion of low and mid-frequency signal content being recorded at the same instant. Accordingly, many companies have not used Dolby HX despite the fact that all Dolby licensees were offered the new innovation without having to pay additional royalty fees.

Now, Dolby has come up with a new noise-reduction system. It was demonstrated at the Winter Consumer Electronics Show in Las Vegas. Rumors concerning that new system were widely circulated long before Dolby disclosed its details. Back in October 1980, while attending the Tokyo Audio Fair, I learned that the rumors were true and that the new noise-reduction system would be called Dolby C. Many Japanese licensees of Dolby are already working on cassette decks that contain the new noise-reduction circuitry and will introduce those models by mid-1981.

How Dolby C works

In many respects, Dolby C-type noise reduction works like Dolby A and Dolby B. Like those earlier systems, C-type noise-reduction is a dual-path system that reduces noise using a low-level side-chain (a level-sensing mechanism in the Dolby system). In addition, the sliding-band technology of the B-type noise-reduction system is used in the new system, although the band of frequencies over which noise reduction takes place has been extended two octaves downward, as illustrated in the comparison graphs of Fig. 1. Dolby C-type noise reduction required other new developments to achieve its 20 dB of noise reduction while, like Dolby A and Dolby B, still retaining freedom from side effects like "breathing" and "pumping."

According to Dolby Laboratories, the Dolby C noise-reduction system solves the problem of achieving high levels of compression (during recording) and expansion (during playback), without introducing undesirable side effects, by using two processing stages in series. Each stage supplies 10 dB of compression during recording and the same amount of expansion during playback decoding. Furthermore, each circuit operates at its own independent level.

One stage, identified as the high-level stage in Fig. 2, is sensitive to signals at about the same levels as in Dolby-B noise reduction, while the second stage, a lower-level stage, operates on signals of lower amplitude. Since the two stages are in series, their net effect is to multiply the signals, which is the same as adding or subtracting decibels. In that way, a total of 20 dB of compression and expansion is obtained, and that is the equivalent of 20 dB of noise reduction.

Because of the independent-stage arrangement, the program signal is never subjected to the problems associated with a single 20-dB compression or expansion stage. The in-

THE NEW NAKAMICHI 700ZXL computing cassette deck and its accessory NR-100 Dolby C noise reduction processor.
dependent and cumulative action of the two compression/expansion stages can best be understood by referring to Fig. 3. Dolby maintains that the two-level, two-stage configuration provides more accurate control of the program signal than is possible with a single compander circuit.

To execute the two-level, two-stage configuration for Dolby-C noise reduction, two conventional IC’s are used, according to Dolby Labs. That means that a Dolby-C noise-reduction system can initially be built using readily available parts. In the future it is expected that integrated-circuit manufacturers will produce a single, dedicated, Dolby-C integrated circuit to make it easy to add that system to new products. One of the two stages of Dolby C can easily be configured to provide the well-known Dolby-B noise-reduction characteristic at the push of a front-panel switch, for example, so that cassette decks incorporating C-type noise reduction can also deliver Dolby-B noise reduction for compatibility with existing Dolby-B-type recordings as well as the new Dolby-C recordings.

Overall compatibility

An important consideration in the development of Dolby C was the compatibility of recordings made with the new system. Just as Dolby B had to be compatible with recordings that had no noise-reduction encoding in them (consumer noise reduction did not exist, for all practical purposes, at the time that Dolby-B was first introduced), Dolby-C noise reduction has been designed on the premise that Dolby B is now in universal use. As a result, recordings made with Dolby-C noise reduction will be listenable on high-fidelity cassette machines equipped with B-type noise reduction.

Of course, reproduction will not be perfect under those conditions, just as the reproduction of Dolby-B recordings on machines not equipped with any Dolby circuitry is not perfect. They are listenable, however, especially if the amplifier’s treble control is adjusted to compensate for the Dolby effect. Dolby maintains that Dolby-C recordings would even be tolerable when played back on lower-fidelity portable cassette units not equipped with any type of noise-reduction circuitry. Accordingly, Dolby Laboratories will develop professional-grade C-type noise-reduction encoders for use in cassette duplication.

Other features of Dolby C

Besides the two stages of companding, Dolby-C noise reduction incorporates several other circuit innovations. Two of those circuit innovations, designated in Fig 2 as the anti-saturation and spectral-skewing networks, introduce precisely calculated frequency-response modifications during recording and compensate for them during playback.

Those response modifications are introduced as a further safeguard against audible side effects. Specific benefits of those additional circuits include the reduction of encode-decode errors and a reduction of upper-middle and high-frequency tape saturation and attendant side effects, such as high-frequency losses and intermodulation distortion.

While the new system uses readily available components including Dolby-IC processors, the complexity of the C-type noise-reduction system is said to be between two and three times that of a conventional B-type circuit. Furthermore, according to Dolby, to take full advantage of the noise-reduction capabilities of the Dolby-C system, the recorder using it must have a very high level of mechanical and electrical performance and sophistication, including low-noise circuitry surrounding the noise-reduction processor itself. Because of those cost and quality considerations, it is likely that the new system will appear first as a supplement to standard Dolby B in high-performance, higher-priced cassette decks. In the future, the use of Dolby-C circuitry may be simplified somewhat by the development of specific-purpose Dolby-C IC’s. When that happens, we may see some lower- or mid-priced cassette decks incorporating the new noise-reduction system.

As was the case with Dolby HX, Dolby Labs will provide C-type noise reduction to its licensees under their existing Dolby license agreements without imposing an additional royalty for using the new system.

It is evident that Dolby, the first developer of noise-reduction systems for consumer tape recorders, is not about to resign from its position of supremacy in the highly competitive noise-reduction field just because others have come up with noise-reduction schemes that are claimed to be superior to the one originally developed by Dolby!
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MAY 1981 75
Here's a look at negative-ion generators, and other tidbits,

EARL "DOC" SAVAGE, K4DS, HOBBY EDITOR

In June 1980, I passed along a request from Russ Lane for some information about building a negative-ion generator. Thanks for your responses.

For the uninitiated, there are those who maintain that exposure to air that contains negative ions promotes physical and mental well-being. I simply don't know whether it does or doesn't, so I can only say, "To each his own!"

In any case, there is general agreement that breathing ozone (O₃) for an extended period is unhealthy. Further, an ion generator will produce ozone if it is not adjusted properly. So, if you build your own, be sure to have all the information you will need and make the adjustments that prevent ozone formation.

Negative ions are introduced into the atmosphere when a negatively charged object "leaks" them into the air. To get an appreciable quantity of ions, you need several thousand volts—at least 5,000.

There are four convenient methods of producing the required high voltage. One is to begin with 110 volts AC or more from a transformer and add on a long series of voltage-doubler circuits. Another is to use a "firing transformer" designed to produce an arc (normally to ignite an oil furnace).

Very little current is needed to produce ions. Safety precautions with either of the above methods include placing a very high resistance between the supply and the charged object in order to limit the current in case you accidentally come into contact with it.

Two ways that are more satisfactory for producing high voltage require a little more circuitry. They are to use either an automobile ignition coil or a TV flyback transformer to change a low input-voltage into 5- to 20-thousand volts. For increased efficiency, the low voltage should be interrupted DC (square wave) rather than AC. That is usually done with heavy-duty switching transistors driven by a square-wave generator (a 555 IC) or by a feedback winding added to the flyback transformer.

There are two advantages to those last two methods. One is that the current is automatically limited. The other is that those systems are more readily adjusted to prevent ozone formation.

Of course, the final high-voltage must be rectified; the usual approach is to use a solid-state diode designed for TV high-voltage supplies. The negative output lead is connected to the "charged object."

Unit charges (electrons) disperse over the surface of an object with a concentration proportional to the radius of curvature at any given point. What that means is that the electrons collect around sharp angles and points (see Fig. 1). So, if you want them to leak off into the air, your object must have one or more sharp points. Then, with a good high voltage, the electrons "spray off" the charged object and ionize the air molecules.

That shape factor is the reason why builders of ion generators often use one (or more) sewing needles as the charged object. The negative output of the high-voltage supply is simply connected to the needle.

Because of the shape factor, you should be careful when you hook-up and route the high-voltage lead. Avoid leaving wire ends sticking out. Watch for sharp projections that may be left on a solder blob. Avoid sharp bends in the wires—use gentle curves when changing direction. After all, you want to lose as few electrons as possible before reaching the needle(s).

There you have the basics for building your own negative-ion generator. Special thanks to Dennis Doonan (Racine, W1), Istvan Mohos (Phoenix, AZ), Richard Kaufman (New York, NY) and others who came up with much of the foregoing information.

Magazine index

How often does this happen to you? You remember an article with information that you need but you can't remember what issue it was in—maybe not even the year it appeared or in what magazine. You tackle the annual indexes if you have them or worse yet, the table of contents in each individual issue.

That process can be a real headache; it can take from hours to days. And that is only when you can remember the article—what about those articles that you have forgotten?

I have some magazine files that go back more than 25 years. Searching for something vaguely recalled used to be a chore, but not any longer—my TRS-80 does the searching for me.

What does your microcomputer do for you besides play games? Put your computer to work keeping and searching a master index—one or more depending upon your needs.

An 8K or 16K computer can hold a surprisingly large index if you are careful about how you arrange the data. That is especially true if you use your imagination to create a coding system that will reduce memory requirements. Here's an example:

Identify Unmarked IC's
Radio-Electronics
P. 45, Jan 80

Can become
ICIDXMARK/RE0450180

Of course you should use your own system, but it is obvious that the second entry takes less memory but conveys the same information.

Well . . . yes, it did take time to create the index files for the several magazines—especially for the ones that go back a number of years. Once done however, it takes only a few minutes every month or two to stay current.

Now my searches are quick and complete. The reference mentioned above will turn up in a long list if I key in "IC" and on a much shorter one under "ICID."

Don't let your computer just play around—put it to work. And if you don't have one yet, here is one more reason to get one.

Help!

Pat Hazen of New Orleans is asking for help in designing an alarm circuit to substitute for an output-meter indicator in a detection device. He is speaking specifically of the gas detector in the July 1976 issue of Radio-Electronics.

Fig. 1

Electron Concentration Near Point
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PanaVise Products, Inc. (2850 East 29th Street, Long Beach, CA 90806) has a comprehensive catalog of their heads, bases, mounts, and accessories. With all the possible combinations, they have a holder/vise for almost any application.

An extensive listing of general and computer-related parts, equipment, and accessories is to be found in the Advanced Computer Products, Inc. catalog (PO Box 17329, Irvine, CA 92713).

Digi-Key Corp. (PO Box 677, Thief River Falls, MN 56701) has a catalog with a very broad listing of parts for the builder. The chances are good that Digi-Key has what you may need, including books. You can get their catalog by calling, toll-free, 1-800-346-5144.

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POWER ETCHING SYSTEM & ETCHING SOLUTION HEATER, GC Cat. No. 22-392 includes an etching tank, pump, and heater, and is designed to handle two single-or double-sided boards up to 8 x 10 inches in size at the same time.

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The basic tank system, GC Cat. No. 22-394, includes a 1.25-gallon molded polyethylene tank with lid, agitating pump, hose, wire base PCB board holder, and instructions. The base can be mounted on a bench, left portable, or mounted as a bench wall. The pump keeps acid agitating for faster, more even etching. PCB boards fit into a submersible rack, with handles, that keeps boards separate and hands away from the acid. The tank lid can also be used as an auxiliary lab tray.

The Etching Solution Heater, GC Cat. No. 22-392, greatly reduces etching time. The heater attaches easily to the tank and its thermostat quickly adjusts to solution temperature.

The price of the basic tank system is $55.98; the heater costs $10.25.—GC Electronics, 400 South Wyman St., Rockford, IL 61101.

TIMED LIGHT CONTROL, the Night Sentry, is designed to give your home a "lived-in" look while you're away. This wall-model, solid-state light timer provides automatic control of indoor or outdoor light fixtures—including porch, post, kitchen, bathroom, and bedroom lights—using a microprocessor. Its "memory" permits automatic self-programming; you use it as a conventional light switch and after 24 hours of use, your pattern of light-use will be repeated daily.

The Night Sentry can be programmed in a matter of seconds, and up to 48 on-off settings per 24-hour period are possible. It can be installed in minutes with only a screwdriver. The suggested retail price for the Night Sentry is $25.00.—Dynascan Corporation, 6460 W. Cortland St., Chicago, IL 60635.

DUAL-TRACE OSCILLOSCOPE, model HM312, offers precise, drift-free performance over varying conditions. Both vertical amplifiers have a bandwidth of DC to 20 MHz, with a maximum sensitivity of 5 mV-per-cm. Full X-Y operation is available by switching channel 2 into the horizontal-deflection system.

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The model HM312 will trigger on as little as a 4-mm signal up to 30 MHz. Triggering is auto or variable level, with the source being channel 1, 2, or external. A TV-frame sync filter is also provided. Sweep speeds range from 0.2 seconds to 40 nanoseconds. All of the critical DC voltages are regulated.

The input-line transformer can be connected to operate from 110 to 237 volts AC, 50 to 60 Hz. There is a built-in 1-kHz, 0.2-volt (± 1%) square-wave generator that is used for checking probe compensation.

The model HM312 comes in an all-metal case (9.3 x 8.3 x 15 inches) that is particularly suited for lab and field use. There is a handy carry handle and retractable tilt-up stand that pulls down from under the unit. The price of the model HM312 is $610.00.—Hamag, Inc., 191 Main St., Port Washington, NY 11050.

DMM, model 467, is a hand-portable combination of digital and analog LCD displays to analyse both steady and pulsing signals, plus differential + and — peak-holding capability and fast-pulse detection and indication.

In the differential mode, the model 467 can make percent modulation and signal-tracking measurements. In the pulse-detection mode, it can give visual and/or audible indication of pulse presence and logic states. Other standard features include 25 AC/DC voltage, current and resistance ranges, true RMS AC voltage and current measurements, 0.1% DC accuracy on the...
The model 467 is cordless and gives up to a year of service on a single 9-volt alkaline battery. It measures 2 X 5.6 X 4.6 inches, weighs 1½ pounds, and comes with a 9-volt battery. U.L.-approved test leads with screw-on alligator clips, and an instruction manual. The price is $239.00.—Simpson Electric Company, 853 Dundee Ave., Elgin, IL.

AC POWER-LINE TESTER KIT, model 3600-K, features a new hand-size battery-operated 3¾-digit AC power-line tester, a model 10-L clamp-on AC ammeter, a model 101 line separator, man-made leather top opening hand-and-shoulder carrying case, two 4½ foot long test leads, and a 9-volt battery.

The digital 3600 AC power-line tester has a single-selector switch for AC volt ranges, 0-200 volts and 0-600 volts. Accuracy is ± 0.5% of reading. AC-current range (requires the use of the model 10-L clamp-on ammeter) is 0-20-200 amps. AC-Continuity detection and gives up to 3% of reading.

The model 10-L clamp-on AC ammeter adapter is used to make current measurements without circuit interruption when clamped around a single conductor, and 0-20-200 amps may be read directly as AC amperes on the model-3600 display. If conductors cannot be separated, the Triplett model 101 line separator is provided in the kit to make fast and accurate measurements.

A large, easy-to-read 0.5-inch, 3¾-digit liquid-crystal display with low-battery alert and over-range indication, is provided. The model-3600 tester is compact and weighs 10 ounces with its 9-volt battery. Typical battery life is 500 hours in usage and the display indicates when eight hours of battery life remain. It also has auto-zeroing, inherent protection (up to 600 volts on all ranges) from overloads without damage, and meets ANSI C39.1 specifications. The price is $150.—Triplett Corporation, One Triplett Drive, Bluffton, OH 45817.

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SUPER ISOLATOR, model ISO-11, is designed to curb problems in microprocessor installations resulting from severe AC powerline spikes, surges, and hash—those unexplained crashes, memory losses, or other glitches. (Disks, printer, and processor often interact, aggravating such problems.)

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The model ISO-11 features two individually dual-pl filtered AC socket banks (six sockets in all). Heavy-duty spike/surge suppression is incorporated in the design. Equipment interactions are eliminated; and disruptive and damaging line spikes and hash are controlled.

The model ISO-11 is priced at $85.95.—Electronic Specialists, Inc., 171 South Main Street, Natlick, MA 01760.

PROGRAMMABLE DMM, model 192, "smart" DMM offering 0.005% accuracy, 1 μV sensitivity, 8½-digit resolution, front-panel math functions, and data-storage capability. Additional features include fast averaging (150 ms per range change), one-button zero, a speed of over 25 readings per second at 4½-digit resolution (or 20 readings per second at 5½-digit resolution), and high-input impedance of 10¹⁰ ohms up to the 20-volt range.

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An optional AC-volts function, which uses AC averaging, is priced at $175.00. For an additional $395.00, the user may opt for full IEEE-488 interfacing.

The model 192’s math programs include scale factor and offset modifications, Y=x+b, percentage deviation from a entered nominal value, storage of minimum/maximum values (also serving as a peak-hold memory), and hi/lo pass limits. There is also a choice of multiple or single-input connectors. Separate inputs for DC volts, AC volts, and ohms on the front-panel enhance system accuracy by allowing the optimum cable type to be used for each function. A rear-input adapter allows multiple and single rear inputs when used with the IEEE-488 option.

The model 192 also is a high-performance, low-cost datalogger, due to its data-storage feature. Ten different readings may be programmed from the front panel, allowing up to 100 readings to be stored over a period of up to four days. The model 192 is priced at $995.00.—Keithley Instruments, Inc., 28775 Aurora Road, Cleveland OH 44139.

What's News

Quality service instruments to be available locally

The John Fluke Mfg. Co., long known as a leading builder of high-class electronic instrumentation, has announced a new plan of broad marketing and distribution to meet the needs of service technicians, and hobbyists, as well as educational and personal users.

In the first six months of the program, Fluke will have at least 400 local dealers throughout the country, ranging from electronics distributors to automotive stores and hobby shops. The program will make a complete line of high-quality handheld and bench low-cost digital multimeters available locally. The user will be able to inspect the meters at the store and purchase them locally, while still being assured of any needed service from Fluke. Fluke is the first large instrument manufacturer to mount such a program.

The program is being initiated with the Fluke Series D, a group of five digital multimeters, with prices ranging from $125 to $299, meter accuracy from 0.5 percent to 0.1 percent, and a corresponding range of meter functions.

Now Midland Precision Series 5001 mobile CB has superb 21-404 extension speaker as a bonus!

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STEREO HEADPHONE, model 60A, offers high quality sound at an affordable price. It features individual volume and balance controls, a sensitive cushions and a 10-foot coiled connecting cord with a 3-circuit phone plug. It's packaged in a 3-color display carton. Suggested retail price of model 60A is $14.95. —BPC Electronics, 855 Conklin St., Farmingdale, NY 11735.

FM STEREO ANTENNA, the Stereo-Captor model FM-4400, is an indoor antenna featuring a built-in amplifier that boosts and cleans up weak FM signals, therefore adding more stations in most areas. Operating on 110-117 VAC, the unit eliminates multi-path distortion and optimizes signal-to-noise ratio for clear reception. It also has a bi-directional signal element that turns 90 degrees to receive FM stations in all directions for maximum capture area. Measuring 19 in. wide by 3½ in. deep, this compact unit is housed in a deep brown enclosure and can sit on a shelf or on top of a stereo receiver. Coaxial cable and transformer are included. Price is $71.95. —Winegard Co., 3000 Kirkwood St., Burlington, I.A 52601.

CASSETTE DECK, model KX-500, has Dolby and metal tape capability and features fast, efficient flux-out head cleaners. The four-position tape selector is combined with a variable bias-adjust control to optimize the performance of each tape.

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RECORD MUTE switch, phase control, two microphone jacks with built-in preamps, a headphone jack, and LED recording and pause indicators. With Dolby on and chrome, ferri-chrome or metal tape in use, the frequency response is 30 to 16,000 Hz and the signal-to-noise ratio is 64 dB. The Model KX-500 is priced at $225. —Kenwood Electronics, Inc., Dept. P., 1315 E. Watsoncenter Rd., Carson, CA 90745.

RECORD CLEANER, the Cecil Watts Record and Stylus Care Kit, is a three-piece starter kit designed to introduce the user to this basic non-liquid system of record care. The principle behind the record cleaning device is that it is used in a semi-dry or slightly moist state and therefore does not leave a film or residue on the record that can result in a lack of stylus contact and subsequent distortion. The kit includes Parasitik Disc Preener, Parasitik Anti-Static Fluid and Watts Stylus Cleaner. Price is $13.95. —Empire Scientific Corp., 1055 Stewart Ave., Garden City, NY 11530.

AM/FM STEREO, Concept model CD-82, is both an AM/FM stereo and cassette player featuring automatic reverse and has normal bias as well as metal tape capabilities. Other features are a line-output preamplifier that makes the unit compatible with most power amplifiers, and a stereo headphone capability that helps provide clearer reception in low-signal areas. The model CD-82 is also compatible with a variety of equalizers and boosters. Price is $299. —J.J.L, 737 West Artesia Blvd., Compton, CA 90220.

CASSETTE DECK, RT-30, is a metal-capable DC-controlled motorized deck and features a 12-LED Sharpscan peak level display, damped eject, and an automatic program search system. Specifications of this model include a signal-to-noise ratio of 66 dB (Dolby on over 5 kHz), a frequency response of 30 to 14,000 Hz for normal, 30 to 15,000 Hz for Dolby, and 30 to 17,000 Hz for metal tapes. Suggested retail price is $199.95. —Sharp Electronics Corp., 10 Keystone Pl., Paramus, NJ 07652.

SPEAKER SYSTEM, model B450T10, is a 3-way wedge-shaped system designed for use in autos, recreational vehicles, boats, and homes. It can sit on any flat surface or can be built over a 6 x 9-inch mounting hole. Each speaker includes a 4-inch air suspension woofer with a 10-ounce magnet, 2-inch midrange, and a 1/2-inch tweeter.

Manufacturer's specifications include a power rating of 50 watts, impedance of 4 to 8 ohms and a frequency response of 65 to 20,000 Hz. The model B450T10 includes a built-in amplifier, is also available. The B450T10 series speakers are housed in aluminum die cast enclosures.

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sures that measure 8" x 5 x 7 inches. Comes with adjustable mounting brackets, mounting hardware, 5-feet heavy-duty hook-up wires and installation instructions. The B450T10 sells for $198, the B450T10SP sells for $238. —International Components Corp., 105 Maxx Rd., Melville, NY 11747.

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As shown in Fig. 1, your voice—or even a whisper—is amplified up to 1000 times by the 741 op-amp. That op-amp requires a dual-polarity power supply (positive and negative voltages of equal magnitude). Thus, it needs two 9-volt batteries. If you look carefully you'll notice that two batteries are used for the 741 and that one of them is shared with the 555 IC.

If additional amplification is desired, as many op-amps as you feel are necessary can be added. Another option would be to use one of the many IC's that contain two or more op-amps.

The 555 acts as the tone generator, and it's configured in the astable mode. Its pin-3, square-wave output is transformed into a triangle wave by R1 and C2. The pitch of your "voice" is controlled by R1.

Now we get to the heart of the circuit: Q1. Transistor Q1 can be a 2N1086, 2N1091, or any other equivalent NPN germanium-type such as a Radio Shack 276-2001. Sounds picked up by the microphone are amplified by the 741 and that IC's output drives the transistor to

saturation. When the transistor is in the saturated state, the triangle wave is able to reach the speaker, and your new "voice" is heard.

Unwanted noise may occasionally trigger your "voice" due to the high gain of the 741 op-amp. If this gets to be a problem there are several simple solutions you can try. One would be to use a higher-impedance microphone. Another would be to substitute a higher value for resistor R3. A potentiometer may also be used so that the value can be adjusted to fit the ambient conditions. On-off switch S1 is a DPDT type.

Any technique can be used in building this circuit. I hope that the device will be useful or fun for you—or both!—J. Paul Sturgis

NEW IDEAS

This column is devoted to new ideas, circuits, device applications, construction techniques, helpful hints, etc. All published entries, upon publication, will earn $25. In addition, Panavise will donate their model 324 Electronic Work Center, having a value of $49.95. It combines their circuit-board holder, tray base mount, and solder station (see photo below). Selections will be made at the sole discretion of the editorial staff of Radio-Electronics.

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If all else fails, look for a leaky transistor. Here's what they're all about.

JACK DARR, SERVICE EDITOR

Don't try to measure transistor leakage with anything but a good transistor tester. You can *not* identify a leaky transistor with a VOM. Leakage in silicon transistors may be as little as 10-15 microamperes and still upset circuit operation. I've seen it happen. The older germanium-types have a normal leakage higher than that, but we see very few of those in signal circuits any more.

There are a few good transistor testers on the market. I have one that's been around for a while, a Sencore CG-151. It reads actual leakage on an analog meter. It also tests FET's. I've heard that FET's can be very tricky with leakage, though I haven't run into that as yet.

Leakage causes problems in any circuit. Not long ago, a friend and I found a puzzling problem in a very complex DC voltage-regulator circuit in an imported set. The trouble turned out to be a leaky control transistor in an error-amp circuit. That fouled up the regulator stage, and as a result there was no regulation to speak of. The key clue here, as in all cases like it, is that the circuit simply does not work as it should! Resistors, supply voltages, etc. seem to be OK but the set still does not work. So, the active device—the transistor—would be a suspect. One good check, if you have a duplicate of the suspicious device, is to replace it and recheck the operation. Since it's usually necessary to take the transistor out to get a definitive leakage test (with no shunts), you may as well try a new one anyhow. If no substitute is available, test the original. If it shows leakage, you'd better order a replacement.

I've noticed that quite a few of the new sets are coming out with fairly complex voltage-regulator circuits. Those circuits include not only the regulator itself, but the error-amps, etc. Some also include a "start-up" circuit that develops a pulse of DC to kick the horizontal oscillator into action. If you find one with poor regulator action, or anything else that isn't normal, suspect the possibility of leakage in one of the transistors.

Here's another oddball that came in the last batch of letters. The symptom was an odd horizontal line that floated up and down, and varied in width. Checking through the circuit to see where the vertical blanking was, I found that it came through a blanker transistor. I suggested that the transistor be checked for possible leakage since the variable nature of the symptom made that quite a possibility.

The triplets

A great many solid-state sets use the RGB circuit. There are three video output stages, one for each color: red, green, and blue. In most sets, those stages are identical triplets. This is one time when plug-in transistors or small modules can be very helpful. If you see odd one-color symptoms, try interchanging two of the three output stages/transistors. If the problem is in the blue, for instance, swap the red and blue output stages and see if you now have the same problem in the red. If so, that output stage is bad; leakage here may be the cause.

A letter came in a while back concerning a "blue smear" around objects, especially light-colored ones. I suggested swapping two of the three output transistors, with the idea that a leaky blue output transistor might be causing a "blue blooming". (I did tell him to check the convergence first, but that wasn't it!)

Transistors can do some strange and interesting things. I've had one on my bench for a long time that was removed from the third IF stage of a Zenith. On the curve tracer, at room temperature, it makes a beautiful "set of fingers." Cool it off a bit with a short puff of freeze spray, and the pattern collapses. Warm it up by holding your fingers on it, and the pattern comes back. Warm it up a bit more by holding a soldering iron near it, and the pattern collapses again. The transistor will work only over a very narrow range of temperatures. Leakages are often temperature-sensitive so freeze spray and a

continued on page 88
By Netronics

ASCII/BAUDOT, STAND ALONE

Computer Terminals

COMPLETE for only $149.95

The Netronics ASCII/BAUDOT Computer Terminal Kit is a microprocessor-controlled, stand-alone keyboard/terminal requiring no computer memory or software. It allows the use of existing typewriter and printer character sets, 16-line terminal display format with selectable baud rate, RS232C or 20 ma. output, full cursor control and 75 ohm video output. The keyboard follows the standard typewriter configuration and generates the entire 128 character ASCII upper/lower case set with 96 printable characters. Features include onboard regulators, selectable parity, shift lock key, alpha lock key, jumper, a drive capability of one TTYT load, and the ability to more directly with almost any computer, including the new Explorer/85 and ELF products by Netronics.

The Computer Terminal requires no I/O mapping and includes 1 of memory, character generator, 3 key decoder, processor controller, controller circuit, parallel ASCII/BAUDOT to serial conversion and serial to video processing. With onboard memory, character generator, and keyboard controller circuit, the computer can be used in any environment for high-speed text processing.

VIDEO DISPLAY SPECIFICATIONS

The heart of the Netronics Computer Terminal is the microprocessor-controlled, ASCII/BAUDOT Video Display Board (VDB) or BAUDOT signal source. The VDB converts the parallel data to serial data which can be used alone or with the RS232C or 20 ma. current loop output, which can be connected to the serial I/O on your computer or other interface, i.e., modem.

When connected to a computer, the computer must echo the character received. This 8-bit received data word, or data which is transferred from the information, is provided to data to video display with a 213 video output set on a TV screen (using an RF modulator) or on a video monitor. The VDB generates the cursor, horizontal and vertical sync pulses and performs the housekeeping relative to the screen.
heat gun can be valuable tools in finding a bad transistor. 

I'm reminded of something I got from my friend Bob Lucas. After telling some horror stories like the ones above in an article for TESA News, he ended by asking:

"Remember when transistors first came out? They told us they'd never short, open, or get intermittent, and would last forever! I wonder when the engineers are going to get around to making these immortal transistors?"

So do I, Bob, and so do we all!

**MORE BROADMOOR**

Robert L. Grow of Philadelphia, PA has found a new address for Broadmoor parts. World Wide Systems, 342 W. Touhy Ave., Chicago, IL 60645 has bought up the company and has whatever parts are left. The telephone number is (312) 982-9340. Bob says, "Thanks!" to Sams, who spent half a day digging up that information.

**HORIZONTAL SHADING**

This Quasar CTS-942 came in with no high-voltage output and bad horizontal transistor and damper diode. Now I get a picture, but it is shaded from left to right. It starts out dim and brighter as it goes to the right. When the set is turned on, the horizontal waveform is normal, but after warmup the peak is distorted. Also, there is excess current on the +99.5-volt DC supply; it is 1 amp but it should only be 0.5 amp. The vertical sync is erratic but that may not be related. Got anything on the crystal ball?—J.F., Furlong, CA

The crystal ball shows one thing: a horizontal-frequency sawtooth signal is managing to get into the video circuit! That causes the shading. I remember at least one set with that symptom; one of the flyback-derived DC-voltage supplies had an open filter capacitor. Check all of the DC-voltage supply lines with an oscilloscope and look for that sawtooth pulse. Any kind of pulse you find on a DC supply line is wrong! Get rid of it by checking the filtering.

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**EQUIPMENT REPORTS**

Continued from page 42

metallic objects with a moisture content give a slight "metallic" reading due to their capacitive conductivity. A metal locator of this type is very sensitive to small objects. As a stud finder, it does a creditable job detecting nails behind wallboard. Coins were readily detectable with the unit held three or four inches above ground. Buried objects may be detected at slightly greater depths due to the ionization of the surrounding soil. Maximum depth penetration on large masses is about three feet. That is handy if you happen to stumble on a buried locomotive.

Most competitive transmitter-receiver metal locators are substantially more expensive than the model 63-3001. Considering its low cost, it is a good value and will provide endless hours of fun at the beach or playground. Beer cans and pop-tops are available by the thousands. Who knows, you might even find something of value!

The model 63-3001 Metal Locator sells for $39.95 at your Radio Shack dealer.

---

**service questions**

O000OPS!

In your diagram of the Hitachi NP4-SX chassis in the Dec 1980 issue of Radio- Electronics, TR-901 is shorted gate to anode That wouldn't help.—C.H., Tinton Falls, NJ

Thanks; you're right, and we're sorry. A line has been added from the junction of R906/C322 to the TR901's gate; this should be deleted. Correct that on your copy of the article, people.
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WITH THE VOCAL ZAPPER

---

Option B" section of Fig. 13 for the other changes. Note that the LED polarity has been reversed; the anodes have been jumpered together and returned to a common ground.

The VU meter can be operated from either an external source of 24 to 30 volts DC as shown in Fig. 3-a or a 20 volt center-tapped as in Fig. 3-b. When using the external supply, a 741 op-amp and 2N6111 power transistor are used as the voltage splitter and regulator to develop the dual-polarity voltages (+ and - 12 to 15 volts DC). The component layout for that version of the power supply is shown in Fig. 15. Figure 16 shows the location of the bridge rectifier and filter capacitors when using the power-supply option in Fig. 3-b.

Operation
After inspecting the PC Boards for mistakes, omissions, solder bridges, and the like, apply power and supply an input signal. The signal can come from the LINE output or TAPE output jacks of the stereo system or tapped from the input jacks of the tape deck, or, in the case of an audio console, a spare LINE output. If a signal generator is available, apply a signal to the system and increase its level until the tape deck's VU meters indicate 0 VU. Set one and only one rocker switch (S1-S7) for an 0 VU reading (i.e., the 0 VU LED just starts to light). Use R11 as a vernier to "fine-tune" that adjustment. If the VU meter is being used to establish the point where a power amplifier starts to clip, perform the setup as before, while monitoring the speaker output with the VU meter and an oscilloscope. When clipping is seen, set the appropriate rocker switch and adjust R11 as before. See Table 1 for power levels versus switch setting. If Option A is used (simple potentiometer for input attenuator; no switches), simply rotate the control for the appropriate reading with any given input, as explained above.

When recording, levels should generally be kept below 0 VU with occasional peaks above 0 VU. The more peaks that occur above 0 VU, the greater the distortion. The user's needs and equipment will dictate the acceptable amount of program material allowed to exceed 0 VU.

---

TABLE 1

<table>
<thead>
<tr>
<th>Switch Setting</th>
<th>0 VU Point</th>
<th>Approximate Voltage Level for 0 VU Reading</th>
<th>Corresponding Power Developed into Various Load Impedances</th>
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<tr>
<td></td>
<td></td>
<td></td>
<td>600Ω</td>
</tr>
<tr>
<td>S1</td>
<td>-10dB</td>
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<td>0.167mW</td>
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<tr>
<td>S2</td>
<td>0 dB</td>
<td>0.77V</td>
<td>1.00w</td>
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<tr>
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<td>+4dB</td>
<td>1.23V</td>
<td>2.50w</td>
</tr>
<tr>
<td>S4</td>
<td>+8dB</td>
<td>1.85V</td>
<td>6.70w</td>
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<tr>
<td>S5</td>
<td>+12dB</td>
<td>3.06V</td>
<td>15.80w</td>
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<tr>
<td>S6</td>
<td>+22dB</td>
<td>9.75V</td>
<td>158.0w</td>
</tr>
<tr>
<td>S7</td>
<td>+32dB</td>
<td>30.8V</td>
<td>158.0w</td>
</tr>
</tbody>
</table>
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<th>Value</th>
<th>Part No.</th>
<th>Price</th>
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#### CAPACITOR CORNER

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<td>50 VOLT</td>
<td>0.000001uF</td>
<td>ASST. 6</td>
</tr>
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CIRCLE 37 ON FREE INFORMATION CARD

96

RADIO-ELECTRONICS

LOW COST PARTS

FLASHER LED
Littorin LED FRL-4403
designed and sold with built-in
transistor. 1/2 watt power dissipation
11.50 each

COMPUTER GRADE
CAPACITORS
NEW
1,700mfd
2 1/2 x 4 3/4
6,040mfd
2 3/4 x 3 1/2
11,500mfd 16 VDC-51.00
2 1/4 x 3 1/2
22,000mfd 15 VDC-5.00
2 1/2 x 3 1/2

1/2 RPM MOTOR
NEW SYNCHRON
TIMING MOTOR
110 VAC 60 CY
$7.50 ea.

TRANSFORMERS
120 volt primaries

3 VOLTS at 200 ma $1.25
8 VOLTS at 100 ma $1.25
12 V CT at 500 ma $2.50
16.8 V at 3 AMPs $5.50
30 VCT at 3.5 AMPs $5.50

SPECIALS

7-17vdc
S.S. BUZZER

24/4 EDGE CONNECTOR
tin solderable 154, 256

$5.00 each

151/2" long
Dual gate N-FET
3 SK 45

SEND FOR FREE CATALOG!

LM 1889
TV, VIDEO MODULATOR
$2.50

40 MFD 350 VOLTS
$1.00

2 1/2 INCH X 1/4 INCH
t for 1.50

ELECTRET MICROPHONE

$1.00 ea.

2 & 3 for 1.00
PG PEM 300: 2 X 1/2" INCH 360 DEGREES
SUPER SMALL SIZE
SOLDER TIPS X 1/4" LONG
OPTIMUM VOLT $1 VAC
SUMMERS DIRECTIONAL

ELECTROLYTIC AXIAL CAPACITORS

8.000 MFD 15VDC
$5.00 ea.

2 & 3 for $10.00

SPRING LOADED TERMINAL
ONE PIECE QUICK CONNECT TERMINAL

IDEAL FOR SPKR SYSTEMS
BLACK PREMIUM CABLE
2 for $1.00 10 minimum $4.00

S.P.D.T. CENTER MINI TOGGLE
STANDARD MINI TOGGLE
WITH SPACER TERMINAL RATED
5 AMP 115VAC

SOCKET'S $1.00

50K SLIDE POT
Knobs for 5/8" Dials
75 each

400 PICU 12V DC

5 Amp 115V

14.75 each

10 minimum $8.00

SEND FOR FREE CATALOG!
### Integrated Circuits

#### I.C. Sockets

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<thead>
<tr>
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#### Bobby-Blox

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#### Super-Strips

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#### Texas Instruments

For the latest information on Texas Instruments products, please visit [their website](https://www.ti.com).

#### Panasonic Electronics Calculators

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#### Guarantee

All products are guaranteed for 90 days from the date of purchase.
100W CLASS A POWER AMP KIT

Dynamic Bias Class "A" circuit design makes this unit unique in its class. Crystal clear, 100 watts power output will satisfy the most picky listener. A perfect combination with the TA-1020 low T.I.M. stereo pre-amp.

Specifications:
- Output power: 100W RMS into 8-ohm
- Frequency response: 10Hz - 100 KHz
- T.H.D.: less than 0.005%
- S/N ratio: better than 65dB
- Input sensitivity: IV max.
- Power supply: ±45V @ 5 amp

TA-1000 KIT $15.95
Power transformer $18.06 each

REGULATED VARIABLE D.C. POWER SUPPLY KIT

Uses UA723 I.C. and 2N3055 power transistor as regulator. Output voltages can be adjusted from 0-30V at an internal resistance of less than 0.005 ohms ripple and less than 1 mV, with built-in and loadable overload indicator. Kit comes with P.C. board, all electronic components, transformer, connectors, 2 panel meters for voltage and amp, and a professional look metal cabinet and instructions.

Model TR-84A = 6.5V D.C. 3 amp
Model TR-888 = 0.0V D.C. 2 amp

$59.50 each

WHISTLE ACTIVATED SWITCH BOARD

All boards are pre-assembled and tested. Your whistle to its F.E.T. condenser microphone from a distance as far as 30 feet away (sensitivity can be easily adjusted) will turn the switch on, then latch it whilst to it again then it turns off. Ideal for remote control toys, electrical appliance such as lights, coffee pots, F. M. radio or cellular phones. Simply works on 12V D.C.

Model 968...
Price...

SUB MINI SIZE FET CONDENSER MICROPHONE

Specification:
- Sensitivity: — 65dB ± 3dB
- F.E.T. Response: 50 Hz - 6 KHz
- Output Impedance: 1K ohm max.
- Polar Pattern: Omni-directional
- Power Supply: ±15V
- Sound Pressure Level: Max. 120dB
- E.M.R.P.: 30 mV
- IN...

NEW Mark III

9 Steps 4 Colors LED VU

Stereo level indicator kit with arc-shape display panes. This Mark III LED level indicator is a new design PC board with an arc-shaped 4 colors LED display (change color from red, yellow, green and the peak output indicated by red). The power range is very large, from — 30dB to +6dB. The Mark II indicator is applied to 1 watt - 200 watts amplifier voltage of 3V to 9V DC at max 400 MA. The circuit uses 10 LEDs per channel. It is very easy to connect to the amplifier. Just hook up with the speaker output.

IN KIT FORM $18.50

2 WATT AUDIO AMP

Pre-assembled units. All you need is to hook up the speaker and the volume control. Supplies voltage from 9 to 15V D.C. measured only 2" x 3½" making it good for portable or desktop applications. Comes with hook up data.

BUY 2 FOR...

MARK IV 15 STEPS LED POWER LEVEL INDICATOR KIT

This new stereo level indicator kit consists of 36 4-color LED’s per channel to indicate the sound level output of your amplifier from —36dB to +36dB. Comes with a well-designed silk screen printed plastic panel and has a selectable circuit to allow floating or gradual output indicating. Power supply is 6 to 12V D.C. with THD on board input sensitivity controls. This unit can work with any amplifier from 1W to 200W. Kit includes 70 pcs, driver transistors, 36 pcs, matched 4-color LED, all other electronic components, PCB board and front panel.

MARK IV KIT $31.50

MARK V 15 STEPS LED POWER OUTPUT INDICATOR KIT

All functions same as Mark IV but this III is with heavy duty aluminum front plate and case. Can be easily set into the front panel of your auto, truck or boat. Operates on 12V D.C.

BATTERY POWERED FLUORESCENT LANTERN

MODEL 686 R

- FEATURES
  - Citrus: designed for operation by high efficient high power silicon transistors which enable illumination to maintain in a standard level even the battery supply drops to a certain low voltage.
  - 9" 6W cool/daylight Maxiatures fluorescent tube.
  - 8 x 1.5V UM-1 (size B) dry cell battery.
  - Easy sliding door for changing batteries.
  - Stainless reflector with wide angle increase in like illumination of the lantern.

$10.50 EA

30W+30W STEREO HYBRID AMPLIFIER KIT

11watts @ 12V DC as well! Kit includes 1PC SANYO STK-043 stereo power amp IC LM45880 as pre amp, all other electronic parts, PCB board, all control pots and special heat sink for hybrid. Power transformer not included. It produces ultra hi-fi output up to 30 watts per channel (15 watts per channel) yet gives out less than 0.1% total harmonic distortion between 20Hz-20kHz.

$32.50 PER KIT

5W AUDIO AMP KIT

2 LM 386 with Volume Control Power Supply 6-12V DC

ONLY $5.00 EACH

TWO IN ONE PANEL METER D.C. VOLTAGE AND AMPS IN ONE

D.C. Volts reads 0-50
Amps reads 0-3

Meat case made of black plastic with a white scale plate and glass window.

$57-580 $2.50 EACH

0.5" LED ALARM CLOCK MODULE

ASSEMBLED NOT A KIT

Features:
- 4 digits 0.5" LED displays
- 12 hours real time format
- 24 hours, alarm audio output
- 50 min countdown timer
- 15 min snooze control

SPECIAL TRANSFORMER $2.55

SANYO UHF VARACTOR TUNER

Tuning voltage + 4V to -4V DC.
Input impedance 75 OHM. 1F bandwidth 7 to 16MHZ. Noise figure 11.5dB.

MODEL 1138-8... $59.50 EACH

$59.50 EACH

CIRCLE 7 ON FREE INFORMATION CARD
FLUORESCENT LIGHT DRIVER KIT

12V DC POWERED

Lights up 6 - 15 Watt Fluorescent Light Tubes. Ideal for camper, outdoor, auto or boat buffers. Includes high voltage, age cool, power transistor, heat sink, all other electronic parts and PC board. Light tube not included!

SUPER FM WIRELESS MIC KIT — MARK III

This new designed circuit uses high FET pretransistors with 2 stages in pre amp. Transmits FM Range (88-120 MHz) up to 2 blocks away and with the ultra sensitive microphone microphone which comes with the kit allows you to pick up any sound within 15 ft. away! Kit includes all electronic parts, OSC, CAP and P.C. $11.50 PER KIT. Board. Power supply 9V D.C.

PRESS-A-LIGHT SELF GENERATED FLASHLIGHT

EXCLUSIVE!!! $3.95 ea.

Model F-17 is never worry about battery. Because it has novel Easy to carry in pocket and handy to use. Ideal for emergency light. It generates its own electricity by squeezing grip lever. Put one in your car, boat, camper or home. You may need it some time!

ELECTRONIC DUAL SPEAKER PROTECTOR

Cut off when circuit is shorted or overloaded to protect your amplifier as well as your speakers. A must for OCL circuits.

“FISHER” 30 WATT STEREO AMP

MAIN AMP (15W x 2)

Kit includes 2 pcs. Fisher PA 301 Hybrid IC all electronic parts with PC Board, Power supply 16V DC (not included). Power band with (6F 150 + 36V). Votlage gain 3300. 0W - 200W.

SPACED WAR SOUND GENERATOR BOARD

Brand new presssembled module for a toy factory. The board gives 6 different selectable space sound with LED light effect. Sounds include UFO take off, space gun blast, wave, and space chyme. 7 LED on the board will work with the sound. Requires 9V battery to operate. Speaker not Included. SPECIAL $1.50 EACH.

ELECTRONIC PIEZO BEEP BUZZER

Unique surplus 16V 0.13 oz. piezoceramic disc on circuit board gives a distinct high free, buzz. Unit contains an IC, 2 caps, 6 resistors and a already presssembled. Requires 9V battery to operate. SPECIAL 2 FOR $1.50

2 BIT COUNTER, WARBLE PULSE ALARM BOARD

This new assembly easily converts to a counter, stop watch, warble and pulse alarm generator by adding a few components. We supply the data and typical applications. Requires 9V battery to operate. SPECIAL 2 FOR $1.99

AUDIO OUTPUT DB METER

Meter made of clear plastic with a silver white tape plate. Scale reads from -20 to 30dB. Meter also comes with an internal dual light. MODEL: LF-3 $5.50 EACH

BATTERIES

PK/16.00

2 PKS/$19.00

ILLUSTRATED LESS COVER

NICKEL CADMIUM BATTERY PACK

DELTAC $15.00

0" SIZE

1.2 Volts o.d. 3.0 Amps/Hour. Consists of three each 1.2 volt "D" size Nickel Cadmium Cells stacked into one plastic case. Each cell has individual case and plastic stack encased. Tubing is provided at each end for electrical connections. The individual cells can be cut apart if desired. Rate charge rate is 30 MA. 14-48 hours. Size 1½" dia. x 7" long. New Shpg Wt. each pack 1 lb.

9V RECHARGEABLE NI-CD BATTERY

Replace all 006P type 9V Battery. Model DC-9 BRAND NEW $4.50 EACH

NI-CO BATTERY SALE

12V Pack 450 MA/Hr Size 3" x 1" x 2" $18.00 PER PACK

AA Pack 450 MA/HR $3.50 PER PACK

All above batteries are used but late date code and we guarantee to take back all bad ones for exchange.

GELCELL 6V AGM/HR SEALED LEAD ACID RECHARGEABLE BATTERY

Sealed construction permits this battery to be operated in any position. Recharge rate 2.15 amp max. for 4 to 16 hours. All brand new. Limited quantities. Size of battery 4½" x 2½" x 5½". $15.00 each

GELCELL 6V 9AMP/HR SEALED LEAD ACID RECHARGEABLE BATTERY

That sounds and plays like the real thing. All units are brand new but without the case functions of the game include double flipper control, kicker control, 1-4 players, 3 speed control, I.F switch automatic score, extra battery case and many more. All solid state with LED panel, no moving parts. Requires 9V battery to operate. Speaker not included. A perfect gift for yourself or friends SPECIAL $18.95 EACH Speaker $21.25 EACH.

ULTRASONIC SWITCH KIT

Kit includes the Ultra Sonic Transducers, 2 PC Boards for transmitter and receiver. All electronic parts and instructions. Easy to build and a lot of uses such as remote control for TV, garage door, alarm system or counter. Unit operates by 9-12 DC. $13.50

COMPLETE TIME MODULE

0.3" digits LCD Clock Module with month and date, hour, minute and seconds. As well as stop watch function! Battery and back up light is with the module. Size of the module is 1 1/8" dia. Ideal for use in auto, computer, instrument and many others! SPECIAL 5 FOR $19.95 EACH

SOUND ACTIVATED SWITCH

All parts completed on a PC Board SCR will turn on relay, buzzer or triger switch circuit for 2 - 10 sec. (adjustable). Ideal for use as door alarm, sound controlled toys and many other projects. Supply voltage 4.5V to 9V D.C. 2 for $3.00

REGULATED DUAL VOLTAGE SUPPLY KIT

±4 30V DC 800 MA. adjustable, fully regulated by Fairchild 78M4 and 79M4 voltage regulator IC. Kit includes all electronic parts, filter capacitors, IC, heat sinks and P.C. board. $32.50 PER KIT

AA SIZE NI-CD RECHARGEABLE BATTERY

LIMITED QUANTITY AVAILABLE SPECIAL 4 FOR $5.00

SUB MINIATURE TOGGLE SWITCH 6 AMP 125V D.C.

SPDT $1.20

DPDT $1.60

3SPDT $2.20

4SPDT $2.80

SPECIAL PRICE

POWER SUPPLY KIT

0-30V D.C. REGULATED

Uses MAX33 and ZD055 Power TR output can be adjusted from 0-30V. 2-3 AMP. Compatible with PC board and all electronic parts. Transformer for Power Supply. 0-30 Power Supply 2 AMP 24V x 2 $10.00 each

FLASHER LIGHT

Unique design combines a jumbo red LED with an IC flasher chime on one package. Operates directly from 9V-7V DC. No dropping resistor needed. Pulse rate 3Hz @ 5V 20mA. 2 for $2.20

BIPOLAR LED RED/GREEN

2 colors in one LED, green and red, changes color when reverse voltage input. EACH 2 FOR $2.20

ELECTRONIC SWITCH KIT

CONDENSER TYPE

Uses 7473 I.C. and 12V relay $5.50 each

1 WATT AUDIO AMP

All parts are pre-assembled on a mini PC Board. Supply Voltage 6V D.C. SPECIAL PRICE $1.95 ea.

LOW TIM DC STEREO PRE-AMP KIT TA-10 20

Incorporates brand-new I.C. design that gives a frequency response from 20Hz to 10kHz ±0.5dB. Added features like tone control and loudness control can be added to tailor your own frequency supplies to elimnate the little power fluctuations! Specifications: - T.H.D. less than .002% + 1% from 20Hz - 10kHz. - Frequency response: DC to 100kHz ±0.5dB + RIAA deviation: ±0.2dB + 5%/ratio better than 7.0% + Sensitivity: Phone 2MV 47K (Aux. 100MV 10K). Output level: 1.3V max. output: 15V ± Tone control: bass = +10db @ 500Hz (trim) to +10db @ 15Hz + Power supply: +24 DC @ 0.5A

Kit comes with regulated power supply, all you need is a 60V C.T. transformer @ 0.5A

ONLY $44.50 X'former $4.50 ea.

WATT AUDIO AMP

SOLID STATE ELECTRONIC BUZZER

Mini Size 1 1/2" x 1/4" x 1/8" Ideal supply voltage 1.5V - 15V" Battery power supply 4.5V D.C. $1.75 ea.

FORMULA INTERNATIONAL INC.

5/81 1001 S. MISSION AVE. SAN BERNARDINO, CA 92410 PHONE (10) 392-7587 ORDER TOLL FREE 1-800-541-0868

CIRCLE 7 ON FREE INFORMATION CARD
**BULLET ELECTRONICS**

**Sound Effects Kit $18.95**

The AY3-8910 Programmable Sound Generator contains all the parts to build a programmable sound generator. Designed around the new Texas Instruments SN74177 Sound Chip, the board provides basic levels of music, sound, and effects. Dip switches and pots program the various combinations of noise, pitch, tone, volume, and other features to allow almost any sound to be produced. The kit includes an envelope generator, audio amplifier, and a computer interface to control the sound generator.

**Doomsday Alarm**

If you have trouble sleeping and you would like the rest of the neighborhood to share your misery then this little kit will be for you! There is no way to accurately describe the unearthly howls, screams and tones that come out of this kit. Four separate tone oscillators are mixed, cancelled and stepped at a varying rate. 10 Watts of crazy sound. A great fun kit or a practical burglar alarm. Complete with PC board and all necessary components less speaker. For 6-12 VDC.

**7 Watt Audio Amp Kit $3.95**

Small, single hybrid IC and components fit on a 2" x 3" PC board and are used with inexpensive parts to drive a small speaker directly. A 9V power supply is needed. There are over 1000 possible sounds available. The kit includes a 74LS160 9V power supply, 9V battery, 9V transformer, diode, resistors, capacitors, and an instruction sheet. The kit is very simple to build and is easy to use. It is perfect for an introduction to electronics.

**Overvoltage Protection Kit $4.95**

Protect your expensive equipment from overvoltage conditions. Every computer should have one! Works with any fused DC power source from 10 to 20 volts up to 25 amps.

**Super Value Power Transformer**

Well made, open transformer with mounting ears. Built-in Miniature Fuse, and 100 Watt power transformer. The transformer is designed for use with 117VAC. The kit includes all necessary components, including a transformer, diodes, resistors, capacitors, and an instruction sheet. The kit is very simple to build and is easy to use. It is perfect for an introduction to electronics.

**Apple II Plus with 48K of memory!**

With the purchase of the Apple II Plus, you will receive a complete system. The system includes a 48K Apple II Plus, a 12" monitor, a keyboard, a mouse, and a floppy disk drive.

**Apple II/Apple II Plus with 64K of memory!**

The Apple II Plus is a complete computer system that includes a 64K Apple II Plus, a 12" monitor, a keyboard, a mouse, a floppy disk drive, and a printer. The system is fully assembled and ready to use.

**Color Visicalc for Apple & Atari**

Color Visicalc is a spreadsheet application for the Apple II or Atari computers. It allows you to create worksheets with a variety of colors and fonts, and to perform basic calculations such as addition, subtraction, multiplication, and division.

**Circuit Board: 38 on Free Information Card**

**P.O. BOX 401244
GARLAND, TX. 75040
214 - 278-3553**

**The Greatest Breakthrough In Electronic Music Ever!**

**The Super Music Maker**

**Revision 2**

**$24.95**

**(Basic Kit)**

Does not include speaker or 270V ROM.

Now you can play hundreds of songs using the Bullet Super Music Maker. The unit features a single factory programmed microprocessor IC that comes with 20 pre-programmed short tunes. By adding the additional PROMS (2716's) the system can be expanded up to 1000 notes per PROM. Just think - a complete electronic instrument that will play dozens, hundreds or even thousands of selections of music. The kit comes with all electronic components (less the PROMS), and a drilled, plated and screened PC board which measures 4" x 4". The 7 watt amplifier section is on the same PC board and drives an 8 ohm speaker (not included), from a whisper to ear splitting volume. Since the unit works on 12 VDC or 12 VAC, vehicle or portable operation is possible. What do you get for $24.95 Everything but a speaker, transformer, case, switches, and PROM. Additional 2716's available to expand the system to $19.00 each or you can program your own PROMS using information provided with the kit instructions. Lists of available PROMS are available on request. Note: User plays electronic music one note at a time. It is not possible to play chords or a melody with harmony simultaneously.

- Envelope control gives decay to notes.
- "Next tune" feature allows sequential playing of all songs.
- On board inverter allows single voltage +12V operation.

**Optional Accessories**

DIP Switches, One 8 pin. One 5 pin. 2.00/kit
(Can be directly soldered to PC Bd. to access tunes)

Rotary Switches, Two 5 position 2.00/kit
(For remote writers to PC Bd. to access tunes)

Attractive Plastic Case 6.00

Waterproof Transformer 3.00
(For operation on 117VAC house voltage)

**e**

**TRS 80**

**ILS Binaryピー**

**$435.00**

**TRS CONTAINS DIP SWITCHES AND DETAILED INSTRUCTIONS**

**Concord Computer Products**

1971 South State College
Anaheim, Calif. 92806

VISA Mastercharge
American Express
**Visa Mastercharge**

**We Carry These Switches**

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Anaheim, Calif. 92806

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**Visa Mastercharge**

**American Express**

**No "Glitches" Surges**

**The WRT 80 is a wonemace transistor pair (BC547). It may exist with...**

**495.00**

**No "Glitches" Surges**

**The WRT 80 is a wonemace transistor pair (BC547). It may exist with...**

**10120**

**$665.00**

**No "Glitches" Surges**

**The WRT 80 is a wonemace transistor pair (BC547). It may exist with...**

**10120**

**$665.00**

**No "Glitches" Surges**

**The WRT 80 is a wonemace transistor pair (BC547). It may exist with...**

**10120**

**$665.00**
A Microcomputer for everyone at a Micro Price

The MicroAce - a new generation of miniature computers

A COMPLETE COMPUTER for $149.00 for 1K Kit
Post and Packing FREE
(Add 6% Tax for Shipments inside California)

The unique versatile BASIC Interpreter offers the best ever made.

- PEEK and POKE enable entry of machine code instructions, USR causes jump to a user’s machine language subroutine.
- High-resolution graphics with 22 standard graphic symbols.
- All characters printable in reverse under program control.
- Lines of unlimited length.

'Excellent value' indeed!
For just $149.00 (including handling charge) you get everything you need to build a personal computer at home... PCB, with IC sockets for all ICs; case; leads for direct connection to a cassette recorder and television (black and white or color); everything!

Yet the MicroAce really is a complete, powerful, full-facility computer, matching or surpassing other personal computers at several times the price.

The MicroAce is programed in BASIC, and you can use it to do quite literally anything, from playing chess to managing a business.

The MicroAce is pleasantly straightforward to assemble, using a fine-tipped soldering iron. It immediately proves what a good job you’ve done: connect it to your TV... link it to the mains adaptor and... you’re ready to go.

Fewer chips, compact design, volume production-more power per Dollar!

The MicroAce owes its remarkable low price to its remarkable design: the whole system is packed on to fewer, newer, more powerful and advanced LSI chips.

A single SUPER ROM, for instance, contains the BASIC interpreter, the character set, operating system, and monitor. And the MicroAce 1K byte RAM (expandable to 2K on board) is roughly equivalent to 4K bytes in a conventional computer — typically storing 100 lines of BASIC. (Key words occupy only a single byte.)

The display shows 32 characters by 24 lines. And Benchmark tests show that the MicroAce is faster than all other personal computers.

No other personal computer offers this unique combination of high capability and low price.

The MicroAce teach-yourself BASIC manual.

If the features of the BASIC Interpreter mean little to you—don’t worry. They’re all explained in the specially-written book free with every kit! The book makes learning easy, exciting and enjoyable, and represents a complete course in BASIC programming from first principles to complex programs. (Available separately; purchase price refunded if you buy a MicroAce later.)

A hardware manual is also included with every kit.

The MicroAce Kit:
$149.00 with 1K COMPLETE $169.00 with 2K

Demand for the MicroAce is very high: use the coupon to order today for the earliest possible delivery. All orders will be dispatched in strict rotation. If you are unsuccessful in constructing your kit, we will repair it for a fee of $20.00, post and packing FREE. Of course, you may return your MicroAce as received within 14 days for a full refund. We want you to be satisfied beyond all doubt — and we have no doubt that you will be.

JOIN THE REVOLUTION - DON’T GET LEFT BEHIND - ORDER YOUR MICRO ACE NOW!!

Send Check, Money Order or quote your Credit Card No. to:
MicroAce 1348 East Edinger, Santa Ana, California, Zip Code 92705.
or phone (714) 547 2526 quoting your Credit Card Number.

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Card No. | Exp. Date |
|---------|-----------|

CIRCLE 27 ON FREE INFORMATION CARD
FIRST TO OFFER PRIME PRODUCTS TO THE HOBBYIST AT FAIR PRICES!
1. Proven Quality - Factory tested products only.
2. Guaranteed Satisfaction - Call for Special School Discounts.
1981 CATALOG NOW AVAILABLE
Send $2.00 for your copy of the most complete catalog of computer products.
A must for the serious computer user.

MCROPROCESSORS

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<td>8086</td>
<td>5.0 MHz</td>
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<td>8088A</td>
<td>6.0 MHz</td>
<td>$200</td>
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STATIC RAMS

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<th>Capacity</th>
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<tbody>
<tr>
<td>1K</td>
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<td>4K</td>
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COMPUTER BOOKS

<table>
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<tr>
<th>Title</th>
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<tbody>
<tr>
<td>Advanced Topics in Computer Science</td>
<td>$29.95</td>
</tr>
</tbody>
</table>

S-HUNTER 110 SPECIAL

- Includes 110-1500
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- 100k floppy disk drive
- 130k hard disk drive
- 1000 disk files
- 500k memory

ADDRESSING MEMORY KITS

- Bank Translator 8211 200 ns
- Write Protect 8211 200 ns
- Static RAM 8211 200 ns
- Dynamic RAM 8211 200 ns

2-20 SUPPORT CHIPS

<table>
<thead>
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<tr>
<td>8085</td>
<td>2 MHz</td>
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<tr>
<td>8086</td>
<td>3 MHz</td>
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<tr>
<td>8089</td>
<td>4 MHz</td>
<td>$15.00</td>
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ADDRESS SUPPORT

- 8-bit告别 100 ns
- 16-bit告别 100 ns

MEMORY EXPANSION KITS

- 16K DRAM Kit
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SPECIFICATIONS:
Range: 20 Hz to 600 MHz
Sensitivity: Less than 10 mV to 150 MHz
Less than 50 mV to 500 MHz
Resolution: 0.1 Hz (10 MHz range)
1.0 Hz (60 MHz range)
10.0 Hz (600 MHz range)
Display: 9 digits 0.4" LED
Time base: Standard: 10,000 MHz, 1.0 ppm 20-40°C
Optional: Micro-power over 1 ppm 20-40°C
Power: 8-15 VAC @ 250 mA

7 DIGITS 525 MHz $99.95 WIRED

The CT-70 breaks the price barrier on lab quality frequency counters. Deluxe features such as three frequency ranges, each with pre-amplification, dual selectable gate times, and gate activity indication make measurements a snap. The wide frequency range enables you to accurately measure signals from audio thru UHF with 1 ppm accuracy that's .0001%! The CT-70 is the answer to all your measurement needs, in the field, lab or home shop.

SPECIFICATIONS:
Range: 20 Hz to 525 MHz
Sensitivity: Less than 10 MV to 150 MHz
Less than 50 MV to 500 MHz
Resolution: 1.0 Hz (5 MHz range)
10.0 Hz (50 MHz range)
100.0 Hz (500 MHz range)
Display: 7 digits 0.4" LED
Time base: 1.0 ppm TCXO 20-40°C
Power: 12 VAC @ 250 mA

7 DIGITS 500 MHz $79.95 WIRED

Here's a handy, general purpose counter that provides most counter functions at an unbelievable price. The MINI-100 doesn't have the full frequency range or input impedance qualities found in higher price units, but for basic RF signal measurements, it can't be beat. Accurate measurements can be made from 1 MHz all the way up to 500 MHz with excellent sensitivity throughout the range, and the two gate times let you select the resolution desired. Add the nicad pack option and the MINI-100 makes an ideal addition to your tool box for "on-the-field" frequency checks and repairs.

SPECIFICATIONS:
Range: 1 MHz to 500 MHz
Sensitivity: Less than 25 MV
Resolution: 100 Hz (slow gate)
1.0 KHz (fast gate)
Display: 7 digits 0.4" LED
Time base: 2.0 ppm 20-40°C
Power: 5 VDC @ 200 mA

8 DIGITS 600 MHz $159.95 WIRED

The CT-50 is a versatile lab bench counter that will measure up to 600 MHz with 8 digit precision. And, one of its best features is the Receiver Frequency Adapter, which turns the CT-50 into a digital readout for any receiver. The adapter is easily programmed for any receiver and a simple connection to the receiver's VFO is all that is required for use. Adding the receiver adapter in no way limits the operation of the CT-50, the adapter can be conveniently switched on or off. The CT-50, a counter that can work double-duty!

SPECIFICATIONS:
Range: 20 Hz to 600 MHz
Sensitivity: Less than 25 mV to 150 MHz
Less than 15 mV to 600 MHz
Resolution: 1.0 Hz (60 MHz range)
10.0 Hz (600 MHz range)
Display: 8 digits 0.4" LED
Time base: 2.0 ppm 20-40°C
Power: 110 VAC or 12 VDC

DIGITAL MULTIMETER $99.95 WIRED

The DM-700 offers professional quality performance at a hobbyist price. Features include, 26 different ranges and 5 functions, all arranged in a convenient, easy to use format. Measurements are displayed on a large 31/2 digit, 1/2 inch LED readout with automatic decimal placement, automatic polarity, overrange indication and overload protection up to 1250 volts on all ranges, making it virtually goof-proof! The DM-700 looks great, a handsome, jet black, rugged ABS case with convenient retractable tilt base makes it an ideal addition to any shop.

SPECIFICATIONS:
DC/AC input 100V~ to 1 KV, 5 ranges
DC/AC
current: 0.1 uA to 2.0 Amps, 5 ranges
Resistance: 0.1 ohms to 20 Megohms, 6 ranges
Input impedance: 10 Megohms, DC/AC volts
Accuracy: 1.5% basic AC volts
Power: 4 C cells

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<thead>
<tr>
<th>Type</th>
<th>Cat. No.</th>
<th>Each</th>
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<tbody>
<tr>
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<td>276-2401</td>
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<tr>
<td>4570</td>
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<td>74LS267</td>
<td>276-1855</td>
<td>1.59</td>
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</tr>
</thead>
<tbody>
<tr>
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<td></td>
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</table>

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<tr>
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<tbody>
<tr>
<td>115 VAC 15 WATTS</td>
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<tr>
<td>1-1/2&quot; DEEP</td>
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<tr>
<td>75 CFM OR BETTER</td>
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</table>

Cat No. 3106

**PIEZO ELECTRIC TWEETER HORN SOLID STATE**

<table>
<thead>
<tr>
<th>Description</th>
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<tbody>
<tr>
<td>Only 3-1/4&quot;</td>
<td>$8.88</td>
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<tr>
<td>No Voice Coil</td>
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<tr>
<td>No Crossover Network</td>
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<tr>
<td>Frequency Range: 4000 - 40,000 Hz</td>
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<tr>
<td>High Impedance: Exceeds 8 Ohms</td>
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</tr>
<tr>
<td>Handles 55 Watts Peak, 35 Watts Rms.</td>
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</table>

Cat No. 5656 QTY

**“CHROMA STROBE” 3 CHANNEL COLOR ORGAN KIT**

<table>
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<tr>
<th>Description</th>
<th>Price</th>
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<tbody>
<tr>
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<td>$59.95</td>
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</table>

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<tr>
<th>Description</th>
<th>Price</th>
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<tbody>
<tr>
<td>SHU NGART SA900 8&quot; Floppy Disk Drive</td>
<td>$30.00 ea</td>
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<tr>
<td>SHU NGART SA400 Mini Floppy 5¼&quot; Drive</td>
<td></td>
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<tr>
<td>MCC8000 (MPIBR-803) 8&quot; Floppy Drive</td>
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<tr>
<td>9&quot; VIDEO MONITOR Motorola XM-351</td>
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<tr>
<td>12&quot; VIDEO MONITOR Motorola XM-307</td>
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</tr>
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<tbody>
<tr>
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</tbody>
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<thead>
<tr>
<th>Description</th>
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<tbody>
<tr>
<td>Tested &amp; functional</td>
<td>$899.00</td>
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<tr>
<td>Data &amp; schematics included</td>
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<tr>
<td>Prices Do Not Include Shipping Costs</td>
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5/92
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Opto-Isolator Grab Bag 50 mixed opto-isolators from a major manufacturer. (Unmarked 5 and 6 lead out packages include single and dual types with diode, transistor, and darlington outputs. Test them yourself and save! Not recommended for beginners. 50/94

Terms: Can not add tax. Alaska 15% shopping access. Orders under $75 add $2 handling. VISA and Mastercard orders for $50 and over. 10% M/C handling 14%. Include seven digit address for UPS. Prices subject to change without notice. Limited quantity on many items.

Free Catalogue: Find out more about our exceptional product line. For 1st class delivery, add 41 cents in stamps. Foreign orders add $3 (refundable with order). CIRCLE 40 ON FREE INFORMATION CARD

AMAZING ELECTRONIC PROJECTS and PRODUCTS:

LONG PLAY 10 HOUR TAPE RECORDER

Top quality AC-DC cassette recorder, modified to provide 5 continuous hours of recording and playback of true fidelity, distortion-free sound on each side of cassette for a total of 10 hours. Unit has many special built-in features. $24.95 only. CIRCLE 11 ON FREE INFORMATION CARD

PHONE RECORDING ADAPTER

Record incoming and outgoing calls automatically with this all solid state unit connected to your telephone jack and tape recorder. Starts recording when phone is lifted. Stops when you hang up, making a permanent record. Easily installed. No monthly charges. FCC APPROVED. "$24.50"

VOX VOICE ACTIVATED CONTROL SWITCH

Solid state. Self contained. Excellent adjustable sensitivity. Voices or other sounds activate and control recorder. Uses recorder mike or remote mike. 2¼ x 1¼ x ¾". $24.95


FREE DATA: AMC SALES, Dept. 19 9335 Lube St. Box 928 Beverly, CA 90211, Phone (213) 888-8515.

WRITE FOR
McGEE'S

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1001 BARGAINS IN SPEAKERS
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1904 MCGEE STREET KANSAS CITY, MO. 64108

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FREE DATA: AMC SALES, Dept. 19 9335 Lube St. Box 928 Beverly, CA 90211, Phone (213) 888-8515.
The 10 most common nuisances in PA can be cured. permanently. instantly.

These 10 problem solvers in your toolbox are like 10 new tricks up your sleeve. Or 10 hours of saved time. Or money in the bank. They tailor the sound, match the lines, smooth out the peaks, fill in the valleys, make molehills out of troubleshooting mountains. Snap one in. Out go the hassles. Without soldering, or splicing, or internal equipment modifications:

<table>
<thead>
<tr>
<th>Problem:</th>
<th>Solution:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Input Overload</td>
<td>A15A Microphone Attenuator</td>
</tr>
<tr>
<td></td>
<td>prevents input overload.</td>
</tr>
<tr>
<td></td>
<td>Ideal where very strong signals</td>
</tr>
<tr>
<td></td>
<td>are applied to a microphone</td>
</tr>
<tr>
<td></td>
<td>input.</td>
</tr>
<tr>
<td>Phasing</td>
<td>A15PR Phase Reverser</td>
</tr>
<tr>
<td></td>
<td>reverses the phase of a</td>
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<tr>
<td></td>
<td>balanced line without</td>
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<tr>
<td></td>
<td>modification of equipment.</td>
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<tr>
<td>Low-Frequency Noise</td>
<td>A15HP High Pass Filter</td>
</tr>
<tr>
<td></td>
<td>provides a low-frequency</td>
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<tr>
<td></td>
<td>microphone cutoff to reduce</td>
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<tr>
<td></td>
<td>unwanted low-frequency noises</td>
</tr>
<tr>
<td></td>
<td>and proximity effect.</td>
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<tr>
<td>High-Frequency Noise</td>
<td>A15LP Low Pass Filter</td>
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<tr>
<td></td>
<td>provides high-frequency cutoff</td>
</tr>
<tr>
<td></td>
<td>to reduce objectionable</td>
</tr>
<tr>
<td></td>
<td>high-frequency noises.</td>
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<tr>
<td>Lack of Presence</td>
<td>A15PA Presence Adapter</td>
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<td></td>
<td>adds voice-range intelligibility</td>
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<td></td>
<td>and extra brilliance.</td>
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<tr>
<td>Sibilance</td>
<td>A15RS Response Shaper</td>
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<tr>
<td></td>
<td>provides excellent sibilance</td>
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<tr>
<td></td>
<td>filtering; flattens microphone</td>
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<tr>
<td></td>
<td>response.</td>
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<tr>
<td>Line Level to Mic Input</td>
<td>A15LA Line Input Adapter</td>
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<tr>
<td></td>
<td>converts balanced low-impedance</td>
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<tr>
<td></td>
<td>microphone input to line level</td>
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<tr>
<td></td>
<td>input.</td>
</tr>
<tr>
<td>Matching/Bridging/Isolating</td>
<td>A15BT Bridging Transformer</td>
</tr>
<tr>
<td></td>
<td>a balanced unit; matches</td>
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<tr>
<td></td>
<td>balanced or unbalanced devices</td>
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<tr>
<td></td>
<td>of different impedances.</td>
</tr>
<tr>
<td>Troubleshooting</td>
<td>A15TG Tone Generator</td>
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<tr>
<td></td>
<td>produces a continuous 700 Hz</td>
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<tr>
<td></td>
<td>low-impedance microphone level</td>
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<tr>
<td></td>
<td>signal — extremely useful in</td>
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<tr>
<td></td>
<td>setting-up and troubleshoot-</td>
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<td></td>
<td>ing lines.</td>
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<tr>
<td></td>
<td>Helps check levels, connections,</td>
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<tr>
<td></td>
<td>mixer inputs, and cables.</td>
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<tr>
<td></td>
<td>Allows one man to do the work</td>
</tr>
<tr>
<td></td>
<td>of two!</td>
</tr>
<tr>
<td>Microphone Impedance</td>
<td>A95 and A97 Series Line</td>
</tr>
<tr>
<td>Matching</td>
<td>Transformers make it possible</td>
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<tr>
<td></td>
<td>to connect low-impedance lines</td>
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<tr>
<td></td>
<td>to mid- and high-impedance</td>
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<tr>
<td></td>
<td>inputs (or vice-versa).</td>
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<tr>
<td></td>
<td>Completely reversible.</td>
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<td>Solves problems of excessive</td>
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<td></td>
<td>high-frequency loss and</td>
</tr>
<tr>
<td></td>
<td>objectionable hum.</td>
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</tbody>
</table>

Shown Actual Size: 114mm (4½ in.) long x 19mm (¾ in.) diameter.

Send for the free Shure brochure. AL280F
In one year our K40 antenna has become the largest selling CB antenna in the world!

1. It's more expensive...

$42.50 suggested retail

And when you pay more, you expect more!

MORE PERFORMANCE:
The K40 is guaranteed to transmit further or receive clearer than any antenna it replaces. We know it will. We've tested it with 771 CB'ers just like you for one year.

MORE FLEXIBILITY:
You can fit your K40 to any mounting surface. It will fit any vehicle you'll ever own! That includes choppers, dune buggies, gutters, mirror mounts, luggage racks, trunks, hatchbacks, through roofs, semi-trucks, pick-ups and RV's.

MORE QUALITY:
It's not imported. It's not made in Taiwan, Korea, China or Japan. It's American made. It's American made in an American town. It's made with better materials that cost more and by professional people we pay more. And we designed it right here in the U.S.A.

*including optional mounts at extra cost.

...This Antenna is so DYNAMITE you receive a...

DOUBLE GUARANTEES:

GUARANTEE I: The K40 will transmit further and receive more clearly than the antenna it replaces at the customer's expense and full refund from the Registered K40 Dealer where purchased...


AMERICAN ANTENNA
ELGIN, IL 60120
COPYRIGHT AMERICAN ANTENNA 1979

...sold exclusively by 3500 American K40 Dealers throughout the U.S. & Canada.

GOOD STUFF FOR PROS ONLY!

(SPECIAL NOTE)
If you're a BEGINNER:
Our K40 Dealers will be happy to tell you why the older style and less expensive antennas that are great bargains for a '77 beginner CB'er.

K40 POWER!

CB TIMES: "...it's not often that a product bursts onto the market scene, dominates and improves CB'ing for everyone. American Antenna and the K40 are doing it - revealed tests showed the K40 could out-perform the major competitive brands!"

RADIO-ELECTRONICS: "The results of our tests showed that, in three different positions of the monitoring receiver, the model K40 equaled or outperformed the competitive antenna. Apparently, American Antenna's advertising is not merely Madison Avenue showmanship."

PERSONAL COMMUNICATIONS: "...an impressive 95% of the trials, the K40 out-performed the existing mobile antennas. We had to try one for ourselves. And in every case, the K40 either equaled or out-performed its competitor.

"No ifs, ands, or buts! The K40 Antenna from American Antenna would have to be just about the best antenna around."

CB MAGAZINE: "Introduced in October, 1977, the K40 quickly became the top seller and in mid 1978, became the number one selling antenna in the nation."

...Here's what CB'ers all across the country said.

ANTENNA SPECIALISTS: 
"...truck driver and CB'er for 10 years...50% further than my M410 'Big Momma'."

J.H. Collett, 207 McFer, Bastrop, LA

AVANTI: "I'm an electronic technician with a Second Class FCC license..."I was able to transmit 70% further and tune the SWR 75% lower than my Avanti."

H.R. Castro, VMM, Monserrante D-57, Santa Cruz, Puerto Rico

PAL: "...20% better in transmission and reception than my S/B wave Pal Freepak."

John A. Blu, Box 446, Zelienopole, PA

SHAKESPEARE: "...I've been a CB'er for three years and the K40 is the best I've ever had. Better in reception and transmission than my Shakespeare."

H. Bachrach, Jr., 15 Kirk Rd, Park Ridge, NJ

HUSTLER: "...Compared to my Vuiler XBLT-4, the K40 can consistently transmit 40% further and the reception was better. The K40 is the perfect way to complete a CB system."

Judith R. Brown, 7800 S. Linder, Burbank, IL

R. PARKER

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