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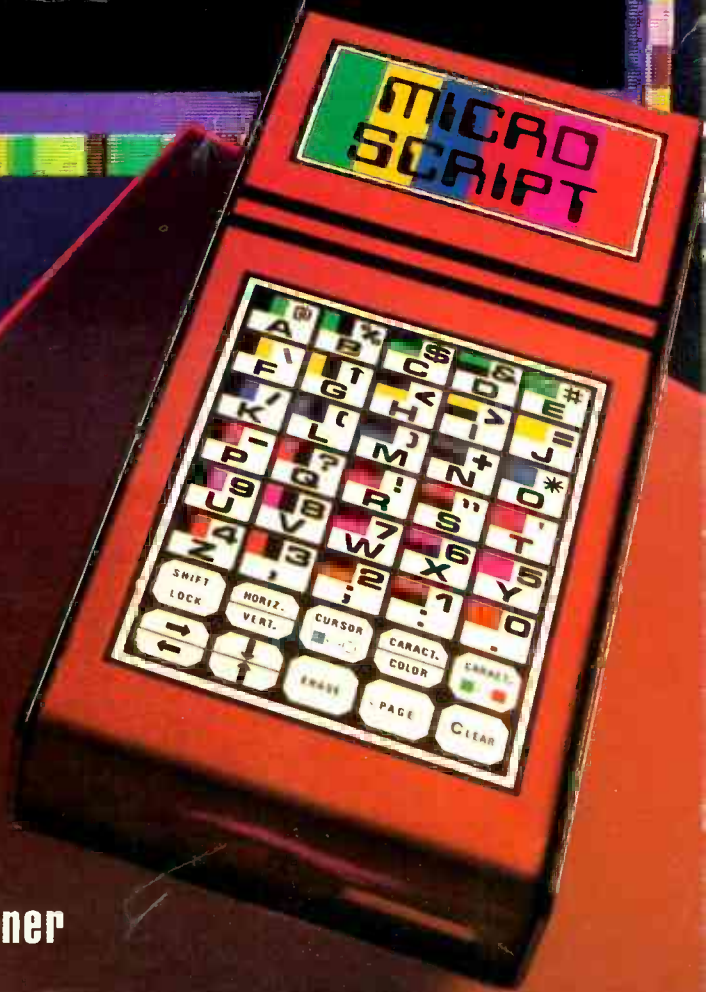

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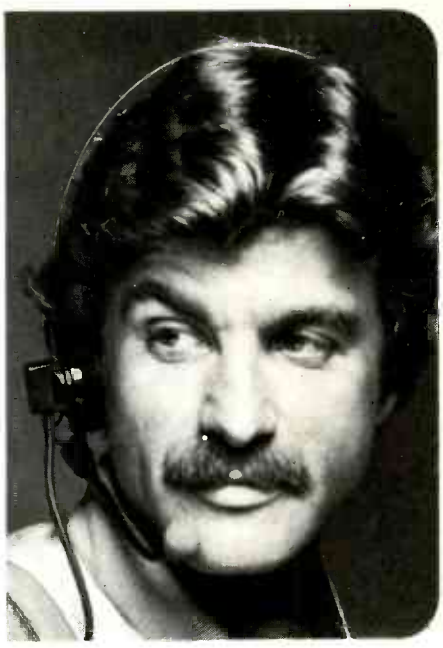

TalkTalk™

The world's first hands-free consumer mobile communication system lets you keep in touch while on the go.

Do you remember the CB fad? Six years ago Americans jammed the air waves as everybody discovered the fun of personal communications.

But like all big fads, CB soon died. People hung up their mikes and gave CB back to the truckers who started the fad in the first place.

The personal communications fad is now back with an entirely new concept. TalkTalk is a headphone with a boom mike that lets you talk hands-free with someone else blocks away. Your voice activates a transmitter. When you stop talking, the transmitter automatically shuts off and you receive. The transmitter, receiver and power supply are located in a small case thinner than a pack of cigarettes which you wear clipped to your belt or placed in your pocket.

SAFER THAN HEADPHONES

You hear the receiver through an adjustable headphone which you comfortably wear over your right or left ear. This leaves one ear free to hear the sounds around you – much safer for outside activities than the popular stereo headphones.

You can now communicate, hands-free and in safety, while you cycle, hike, jog, work or play for up to one-half mile and all on a single 9-volt battery that lasts up to 8 hours of typical use. But there's much more.

An antenna circles the headphone so there's no ugly wire protruding from the top of your head and you keep your conversations private because the range is reduced to a block. But if you want to reach out to the unit's half mile range, simply unhook the antenna wire from its clamp and presto, you have an ugly wire protruding from the top of your head.

UNIT CAPTURES SIGNAL

TalkTalk was built in Japan with the same technology used in professional communication systems. For example, the system uses frequency modulation (FM) as opposed to the amplitude modulated signal used in CB. CB frequencies tend to get crowded – with powerful stations often talking on top of each other. Not true with FM. The system's FM receiver uses a "capture effect," to reject all other signals letting you hear only the one signal closest to you. You capture a clear, crisp, easy-to-hear transmission. And since the Federal Communicatons Commission has set aside the TalkTalk's frequency of 49 megahertz for 100 milliwatt maximum power, no other higher power station will bury you. But wait; there's even more.

A voice-activated sensitivity switch lets you adjust your boom mike for all outside noise conditions – low for a motorcycle and medium or high for a bicycle. And a two-staged volume control lets you securely adjust the volume level with no fear of accidentally moving it.

You can keep the system's 6-ounce case in your vest pocket or clip it to your belt with its removable pager-styled clip. In fact, even the clip is impressive. It's a heavy-duty device that can be slipped off when you want to keep the unit in your pocket.

The boom portion of the mike is malleable. That means you can bend it in any direction and it will stay there. Wear the mike close to your mouth, far away, or even bend it out of the way completely.

Use your imagination. We used ours and came up with over 100 activities that make the TalkTalk useful or fun. Sure, the obvious ones like cycling, hiking, sports, work and play came easy. But how about using a pair in a shopping center to keep in touch? Or how about keeping in contact with your home while you walk the dog? TalkTalk can be used for outdoor treasure hunts, or by tour directors and ski instructors. The list goes on.

PLENTY OF UTILITY

And don't forget the surprise of contacting someone else on a TalkTalk like you used to on CB. If enough people use them, you'll be able to ride your bicycle down a path and meet other TalkTalkers as well. There are five separate channels to choose from. If you order a pair, we'll send you a matched frequency set. To order more on that frequency simply specify the frequency on your reorder form.

TalkTalk is manufactured by Standard Communications – an established manufacturer of professional two-way communications systems – assurance that your modest investment is well protected. The TalkTalk was designed for rugged use but if service is ever required, Standard's convenient service-by-mail center is as close as your mailbox.

To order your TalkTalk, send a check for **$119.95** per unit ($239.90 per pair) plus $4.00 postage and insured delivery to the address below. Illinois residents please add 6% sales tax. Credit card buyers may call our toll-free number below. We'll send your TalkTalk complete with one 9-volt battery, headphone, transmitter/receiver, boom mike and complete instructions along with a one-year limited warranty.

GIVE IT A WORKOUT

When you receive your unit, really give it a workout. See how far you can transmit with the antenna up or down. Use it in a shopping center, on a bike ride or in your factory. See how comfortable it feels and how safe you feel with one ear free to hear outside sounds. Then decide if you want to keep it. If for any reason you are not satisfied, return your unit in its original condition within 30 days and we'll refund your money in full including $4.00 postage and handling.

Every once in a while we discover a product that really is fun yet opens up a new dimension in convenience and utility. The TalkTalk is just that product. Order a pair at no obligation, today.

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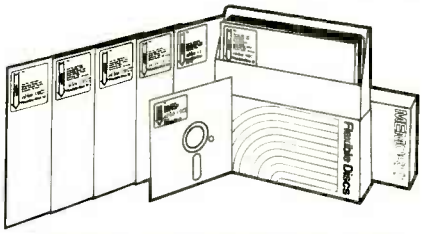

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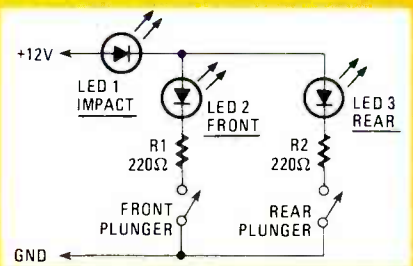
ON THE COVER

The video titler is a graphics and alphanumeric character generator for the amateur videophile. Connect it to your VCR and video camera setup and use it to add titles to your home video movies. Get started today building this microprocessor-based video accessory. The story starts on page 39.



A SIMPLE COLLISION DETECTOR is just one of six easy-to-build projects for your car that were designed especially for April 1. Turn to page 46.

IBM's PERSONAL COMPUTER is just one of the many hardware systems covered in this month's special section. Both hardware and software are covered. Turn to page 51.

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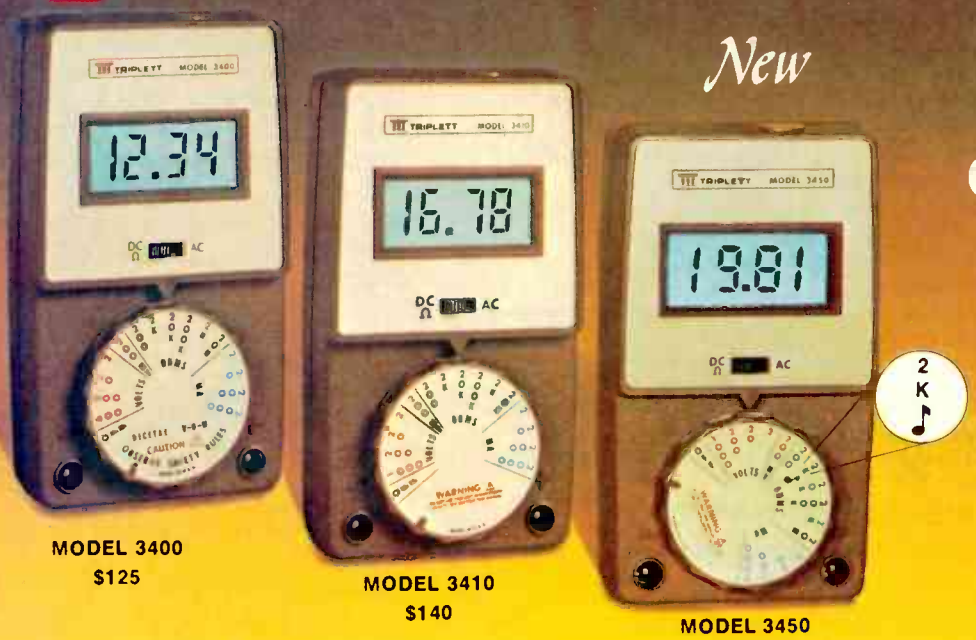

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VIDEO ELECTRONICS

DAVID LACHENBRUCH
CONTRIBUTING EDITOR

COMPACT PROJECTION TV

Projection TV sales last year totaled 121,650 sets, an increase of 113% over 1980. Now giant-screen seems poised for an even bigger year, thanks to a new projection-TV system which could be offered by at least six, and possibly as many as nine different brands. It's known as "compact projection-TV," and the word "compact", of course, is relative. Compact projection, like its room-filling relative, uses three projection tubes; but with an new miniaturized three-lens optical system, it can be contained in a console that occupies little more floor space than a 25-inch model. The compact system uses the rear-projection principle, with a translucent screen at the front of the set, so it has a conventional direct-view TV appearance. It will be offered in sizes from 40 to 50 inches in diagonal screen measurement, and should be priced in the $2,500 range. The new optics, with f/1 plastic lenses, are made by U. S. Precision Lens. Another type of compact TV, but working on a completely different principle, is Kloss Video's *Model Two*, the first "portable projection TV" (shown open and closed above). Weighing only about 60 pounds. it can be set up anywhere and projects a five-foot image on any flat. white surface. It uses the standard Kloss Novabeam tube/lens assemblies. and sells for $2.000 without tuner. The project stands just four feet from the wall. The distance is set up by means of four light beams from the projector which converge into two when it is the optimum distance from the wall. Light output is claimed to be 200 lumens.

POOR MAN's PICTUREPHONE

While the Japanese work with CCD, MOS, and charge-priming devices to get solid-state camera pickup-tubes; a Boise, Idaho Company is using dynamic RAM chips, claimed to cost 1/150 as much, as a solid-state camera imaging device. Micron Technology is turning out photcsensitive RAM's, divided into two segments, each with 128 × 256 picture elements. It has built a "Photo-Phone" prototype using a standard Pentax 35mm camera body and lens. Hooked to a standard telephone and TV set, it produces two side-by-side pictures, so that telephoner can see himself and the other party on his TV screen. It's a slow-scan monochrome picture that can be changed every 30 seconds, and can be interfaced with a computer for permanent picture storage. The system is still under development, but Micron says the same camera can be used as a black-and-white motion video camera as well.

NEW VCR STANDARDS

VCR manufacturers have been meeting in Japan for almost a year now to develop new VCR standards while giving the appearance of *not* developing new VCR standards. It's a touchy proposition, because they don't want to upset sales of VHS and Beta half-inch machines by hints about a near-future new standard. So the talks are being camouflaged by calling the engineering committee the "super 8 group" and trying to confine any reference to the comittee's work to its effort to come up with a format for portable VCR/camera combinations.

The proposed new format is designed for portables, but the general expectation is that eventually it will become a new standard for AC home machines as well.

WHAT'S NEWS

New television camera takes heat pictures

An experimental solid-state infrared camera that makes recognizable pictures of warm objects in a dark room has just been demonstrated by RCA. During the demonstration, the camera was able to picture veins in a human hand and detect residual thermal "fingerprints" on objects that had been touched by a hand.

The new research device responds to infared (heat) waves much as an ordinary TV camera responds to light waves. Its heart is a high-performance solid-state imager, containing a 64 × 128 array of Schottky-barrier platinum silicide (PtSi) detectors integrated on a silicon substrate with charge-coupled (CCD) readout registers.

The development of an integrated circuit imager is a great step forward in heat detectors. Since those PtSi devices can be constructed with conventional IC technology, they can be produced at a much lower cost than earlier devices for heating imaging.

While the picture quality is far below commercial television standards, it is a vast improvement over pictures produced by earlier, smaller imagers. That progress, according to Dr. Henry Kressel, Staff Vice President at RCA's Princeton, NJ, laboratories, indicates that the technology has the potential for approaching full-television resolution.

THIS CAMERA TAKES PICTURES WITH HEAT WAVES, much as an ordinary television camera does with light waves. Warm objects like scientist Gary Hughes' skin and lighted pipe show up white, while the mustache shows dark spots.

Novel player piano has unique features

An electronic, computerized player piano, introduced by Casio, is a 61-key instrument with 19 voices (pipe organ, flute, bassoon, etc.) as well as straight piano. It stores up to 345 melody notes and 201 accompaniment chords in its memory. Thus the user can play a tune, then flip a switch and hear it played back again.

A unique feature is the bar-code electronic scanner. Sheet music is printed in supermarket-type bar codes that are scanned with a light pen. That records the music in the instrument's memory, whence it can be played back by pressing a button.

The instrument is also used as a teaching tool In the *Melody Guide* mode, prerecorded music is played back "silently," with lights lighting over the key corresponding to each note played. The learner simply follows the lights, pressing each lighted key to sound the correct note. After a few practice runs, the student memorizes the piece and no longer need the lights.

THE CASIO CT-701 player piano records music in its memory from a supermarket-type bar chart, scanned—also in supermarket fashion—with a light pen. It is also a teaching tool, lighting lights over each key the student should press in learning a piece of music.

The new "piano," the *CT-701*, retails at $998, and according to Casio, "is ideal for the individual who has a minimum amount of musical training." It boasts several additional features, including pitch control, vibrato and sustain effects, automatic accompaniments/bass chords, and an arpeggio effect. The melody can also be raised or lowered an octave.

Video may offer creative opportunities

The combination of computer and video technologies now taking place will not only revolutionize communications and the dissemination of information—it may be a boon to "many talented people," Sony's president Koichi Tsunoda told the recent New York World Television Festival.

"High-definition video," he said, "will raise the standards of video-picture quality to that of film. When that happens, it will cut costs for major film producers. More important, though, it will make program producers out of many talented people who would otherwise have been prevented from using the medium because of cost."

Computerized video, by making possible the practical production of programs for smaller audiences, will offer another advantage to the independent artist: "Not only will independent program producers be able to produce programming for smaller and more specialized audiences, but they will also have more outlets to present the programs to these audiences, no matter what the size. This will represent a major step in the evolution of home video from a simple entertainment medium to a vital tool for day-to-day living," Mr. Tsunoda said.

Long regarded by many as "the natural enemy of intellectual development," he said, video may redeem itself and "emerge as the grestest source of information since the printed work."

CompuServe to work with Comp-U-Card

CompuServe Inc., a nationwide computer-service firm

continued on page 8

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Tektronix
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WHAT'S NEWS

continued from page 6

based in Columbus, OH has signed a five-year, $9.5-million resource-management agreement with Comp-U-Card of America, Inc.—based in Stamford, CT—the largest computerized shopping-service in the nation.

Comp-U-Card will use the CompuServe computer system, which includes six separate databases, to allow its more than two million subscribers to buy brand-name appliances, furniture, electronic goods, china, and silver at prices as much as 40% below manufacturers' suggested list prices.

Members can access the shopping service through home computers and terminals, the telephone and, in some areas, cable TV.

Newest color camera is all solid-state

A new hand-held color video camera weighing just under four pounds has been introduced to the American market by Hitachi. According to Bob O'Neil of the Hitachi Sales Corp. of America, this is the first production no-tube (metal oxide semiconductor) camera and is totally compatible with any VTR system on the market.

The camera features a ⅔-inch image senor, includes four additive complementary filters, NTSC color system, internal synchronization, and has a signal-noise ratio of more than 46 dB. It has a uni-directional boom-type electret microphone and a 1.5-inch electronic viewfinder. The C-mount lens has an aperture of f1.4, 6× zoom with macro setting, and automatic iris. Horizontal resolution is 260 TV lines.

An image appears within half a second after the camera is turned on, and such tube phenomena as sticking, lag, and burn-in are eliminated. The camera measures (without electronic viewfinder and lens) 4.25 inches high, 2.5 inches wide and 6 inches long. Power consumption is 5.3 watts.

HITACHI *VK-C1000* VIDEO CAMERA.

Power semiconductor is most complex yet

General Electric's scientists have fabricated the world's largest and most complex power semiconductor—a 0.3-inch square silicon chip containing more than 60,000 interconnected circuit elements. (Power semiconductors are the workhorses of the electronics industry, handling up to hundreds of amperes at thousands of volts.)

POWER SEMICONDUCTOR CHIPS are being inspected for impurities by GE lab technician Beatrice Hatch. Each of the chips, measuring 0.3-inch square, contains more than 60,000 separate but interconnected circuit elements. This is the first time that VLSI (*Very-Large-Scale Integration*) techniques have been applied successfully to fabricating such a large-power semiconductor chip.

The new chip, still in the developmental stage, is a power metal oxide semiconductor field-effect transistor (MOSFET). It contains three times as many circuit elements as any other power semiconductor announced to date.

The integrated chip will serve as the heart of a highly efficient synchronous rectifier, supplying current to computers and other electronic devices using switching-power supplies of 5 volts or less.

An expected application of the new rectifier is in power supplies for aircraft electronics. Schottky diodes, which are relatively inefficient, are now used for that purpose. The new chip would be at least three times as efficient as a Schottkey diode, and could therefore result in a considerable weight saving in the heat sinks required for cooling. In computer supplies, the greater efficiency would reduce power costs.

The present chips are expected to carry 20 amperes with a forward drop of only 0.25 volt. Further improvements in processing should reduce that voltage drop to somewhat less than 0.1 volts. **R-E**

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And more: 0.1% basic dc accuracy, conductance, 26 measurement ranges, battery, safety-designed test leads and a one year parts and labor warranty. A full line of accessories is also available to extend the measurement capabilities of your DMM.

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EDITORIAL

Your Own Computer

The computer's potential for becoming a mass market item has never been greater than it is right now. Several changes have taken place in the last several years to bring that potential about.

First, the cost of a home computer has decreased drastically. It has become an open-the-box-and-plug-it-in item. There are video games available today that can be easily converted into home computers. When home computers first became available, the user had to be a technical wizard before he could even figure out how to interface the computer to a terminal. The software was a problem unto itself. Once the system was up and running, there wasn't much he could do with it, since the only software source was the original manufacturer or the user's own ingenuity. Not much software was available from other sources.

Today, a variety of software for such things as word processing, data-base management, home finance, stock-market analysis, kitchen recipes, etc., is readily available. Software-via-telephone services such as The Source and Compuserve have made the availability of software and information almost endless; not to mention such things as shopping via home computer. On the horizon lie Teletext and home banking, conveniences that will be a boon to the home computer.

In this issue of **Radio-Electronics,** we present our current installment of *Your Own Computer*®. In it, you will find the newest hardware introductions since our last computer section, including NEC, IBM, Xerox, Commodore, Bally, Sinclair, and Osborne. We even cover the latest computer innovation—pocket computers. The software section covers disk-operating systems, high-level BASIC, word processing, data-base management and utility programs. After all, without software, a home computer is a very expensive do-nothing box.

ART KLEIMAN
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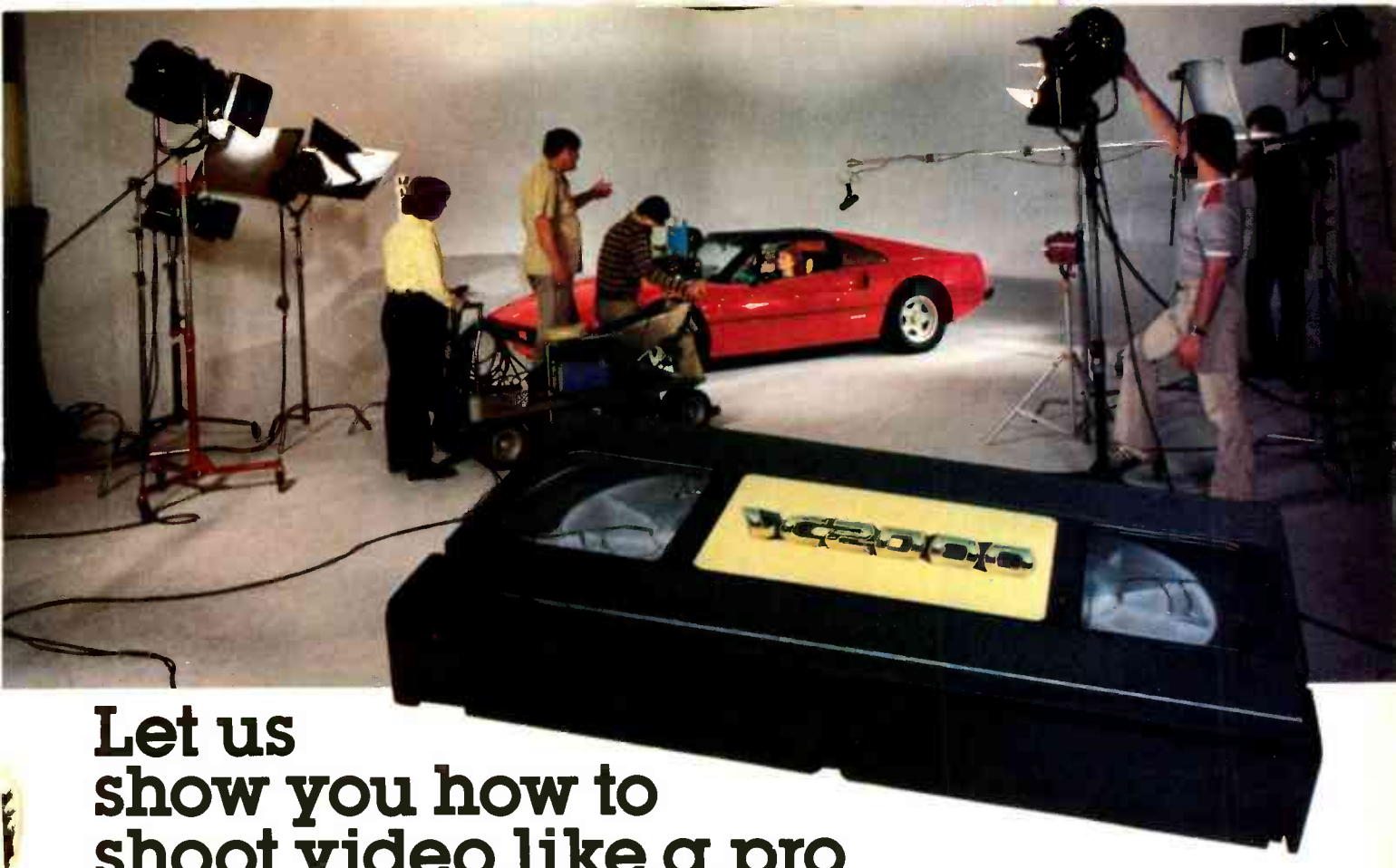

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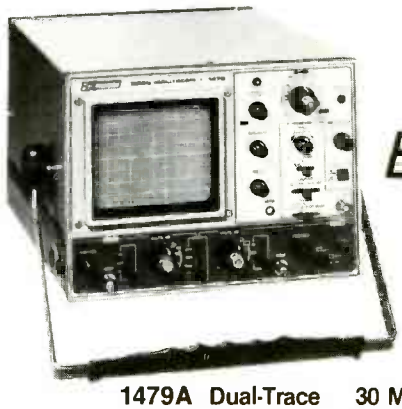

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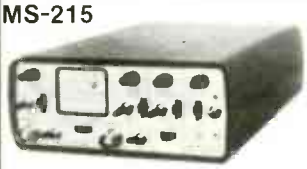

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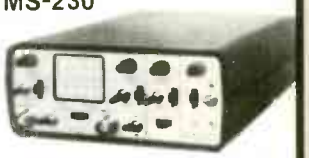

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SATELLITE/TELETEXT NEWS

GARY ARLEN
CONTRIBUTING EDITOR

COMSAT PAY TV

Not content to wait for its Direct-Broadcast Satellite plans to materialize in the latter part of this decade, Comsat's DBS subsidiary has proposed a new pay-TV service that could be operational by late 1983. The service will provide two channels of programming, one of which will be all movies, the other a mixture of films and other programs. Satellite TV Corp., the Comsat subsidiary which will operate the service, will soon select the satellite on which the programming will be carried—possibly an Anik, Intelsat, or Satellite Business Systems bird. The programming will be transmitted in the Ku band (12/14 GHz), the frequency range that will eventually be used for DBS.

STC's programming will be intended initially only for apartments, hotels, and other multi-unit buildings. Reception will be via a 2- to 3-meter disk and will be scrambled to prevent unauthorized reception, STC says. STC intends to offer the service only in the northeastern section of the U.S. at first, although it's unclear whether that is because the marketing strategy encompasses only a limited geographic region or because the footprint of the satellite to be used reaches a small area.

NEW PROGRAMMING

The latest binge of satellite programming includes upgraded services from existing networks plus a host of new shows. Black-Entertainment Network, for example, is changing satellites and expanding from one night per week to a daily service that will be offered from 8 PM to 2 AM on the new Satcom IV starting in May. A new service, called "The Preview Channel," allows TV program managers to get a sneak preview of future shows, sometimes when the programs are in very early developmental stages; the preview helps them decide whether to book the programs. "Preview Channel" is transmitted via Satcom III. UTV, one of the victors in the recent transponder auction for circuits on Satcom IV, will have a roster of 31 different shows, with an emphasis on programs which the network calls "Involvision." The shows—such as "Super Bingo," "Million Dollar Paycheck," and "Count Me In"—encourage viewers to phone in comments, take part in games, and bid on auction items. And planning into the future, CBS has bought two transponders on Satcom IV for unspecified future uses.

EUROPEAN SATELLITE LAUNCHERS

Ariane, the satellite-launch vehicle developed by the European Space Agency, will get a lot of use during the next few years. Westar VI, an advanced Western Union bird due to go up after 1984, will be carried aloft by the French-built rocket. Intelsat has just signed up for two Arianes that will be used to launch the final three Intelsat V-A birds (two aboard a single launcher). GTE Satellite Corp. plans to launch two of its satellites in 1984 using Ariane. The Ariane rockets, which lift off from a West Africa launch site, will compete increasingly with the NASA rockets, which until now have been the mainstay of U.S. satellite launches.

TELETEXT TIDBITS

WKRC-TV Channel 12 in Cincinnati has begun transmitting teletext as part of a test using the British teletext format. About 25 terminals are expected to be in place for the Cincinnati area test. Meanwhile in Los Angeles, KNBC TV Channel 4 has joined the teletext test, using French equipment; KCET and KNXT in that city are already offering teletext magazines.

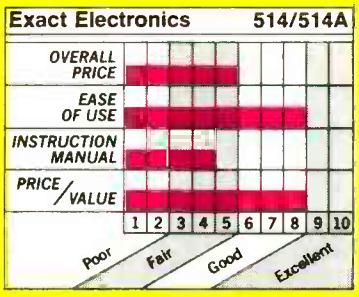
Satellite Syndicated Systems, which has been offering its CableText hybrid for nearly two years aboard its Satcom transponder. will expand its service into more home and business markets. The plan calls for SSS to feed data transmitted within the vertical blanking-interval through the full system. but making it possible for individual customers to retrieve the information only at locations authorized to pick up certain pages. Zenith is building an addressable decoder for that project: initially the direct-to-end-user plan may require installation of a microcomputer in the home or office.

The newly created Videotex Industry Association will represent the interest of the companies and people who are taking part in the teletext and videotex field. VIA (Suite 200, 2000 L Street NW, Washington, DC 20036) will provide information to prospective videotext customers. Membership in the Association is $150 for individuals. and $50 for students and faculty members; higher rates apply to corporate and institutional members.

EQUIPMENT REPORTS

Exact Electronics Model 514/514A Function/ Pulse Generator

CIRCLE 121 ON FREE INFORMATION CARD



RECENTLY, I HAD A LOOK AT TWO NEW combination function/pulse generators, the *model 514* (shown) and *model 514A*, from Exact Electronics (P.O. Box 347, Tillamook, OR 97141). Both instruments are VCF (*V*oltage-*C*ontrolled *F*requency) function generators that will generate sine, dual-polarity square, and triangle waveforms over a range of 0.001 Hz to 5MHz. Those instruments also double as pulse generators, covering a range of 0.001 Hz to 10 MHz. The effective range is extended to 20 MHz in the double-pulse mode. Frequency accuracy is claimed to be ±1% of the switch setting, plus 1% of full scale, from 10 Hz to 1 MHz; the accuracy is ±2% of setting, plus 2% of full scale from 0.001 Hz to 10 Hz and from 1 MHz to 5MHz. The DC offset is +10 to −10 volts, open circuit, and +5 to −5 volts into a 50-ohm load; the offset is variable by a front-panel control.

The *model 514* provides the output signal on two BNC-type connectors labelled HIGH and LOW. For sine, triangle, and square waves, the HIGH output is 20 volts peak-to-peak into an open circuit; 10 volts into 50 ohms. The LOW output is 2 volts peak-to-peak into an open circuit; 1 volt peak-to-peak into 50 ohms. For positive and negative pulses, the HIGH output is 10-volts peak into an open circuit; 5 volts into 50 ohms. The LOW output is 1-volt peak into an open circuit and 0.5-volts into 50 ohms. There's a 40-dB attenuator on the *model 514* that varies the amplitude at both HIGH and LOW outputs at the same time. The *model 514A* provides the output signal on a single BNC connector labelled MAIN OUTPUT. In addition, the *model 514A* has a 60-dB step attenuator (in 10-, 20-, and 30-dB steps); that model also has a continuously variable, 20-dB attenuator, for a total maximum attenuation of 80 dB.

The square-wave output has rise and fall times of less than 40 nanoseconds. The overshoot and ringing specification is less than 5% of the maxmimum peak-to-peak voltage. The TTL and ECL outputs (ECL output is available on the *model 514A* only) will drive a 50-ohm load; normal and complementary outputs are available simultaneously. Typical rise time is 8 nanoseconds for TTL, and 3 nanoseconds for ECL. Symmetry can be set (*model 514A* only) from 19:1 to 1:19. The START LEVEL (also found only on the *model 514A*) is used to vary the starting phase (from +90° to −90°) of the sine and triangle waveforms.

Three pushbuttons, RUN, GATE, and MANUAL set the mode. In the RUN mode, the generator will run continuously at the frequency set using a dial and the multiplier on the front panel. In the GATE mode, the generator will run continuously as long as a trigger signal is present. That mode is used to give you signal bursts at the triggering frequency. With all buttons released, the units will generate one burst of output for each trigger signal received. The output starts at the rising edge of the trigger signal and ends at the falling edge; the threshold (the level at which the output starts and stops) is 1.4 volts. The MANUAL pushbutton sets the generator for triggering by an external signal.

The output frequency can be externally controlled by feeding a signal into the VCF jack. Using a sine wave for that will give you a swept frequency for checking the response of filters, amplifiers, etc.

continued on page 20

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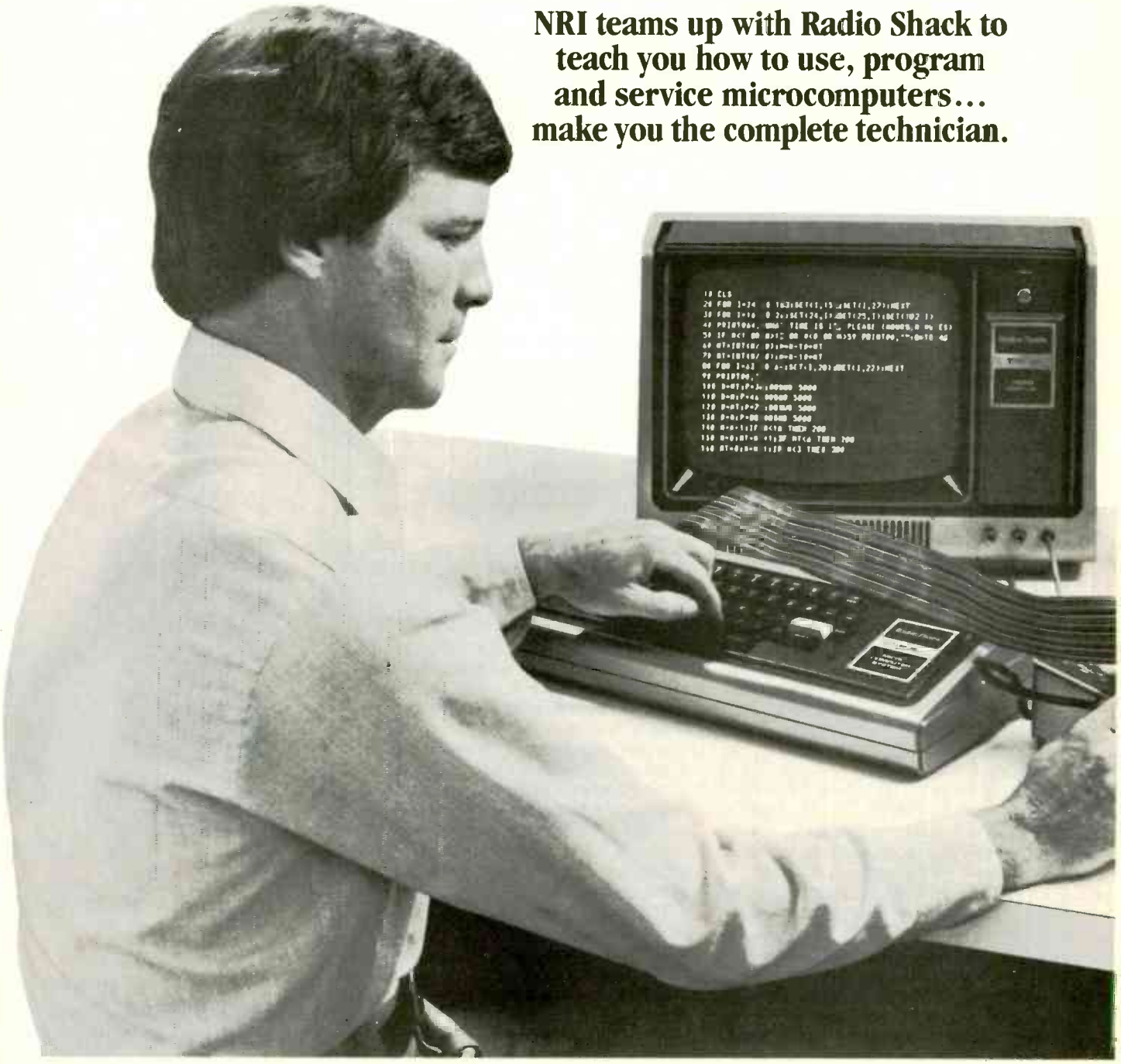

It's no longer enough to be just a programmer or a technician. With microcomputers moving into the fabric of our lives (over 200,000 of the TRS-80™ alone have been sold), interdisciplinary skills are demanded. And NRI can prepare you with the first course of its kind, covering the complete world of the microcomputer.

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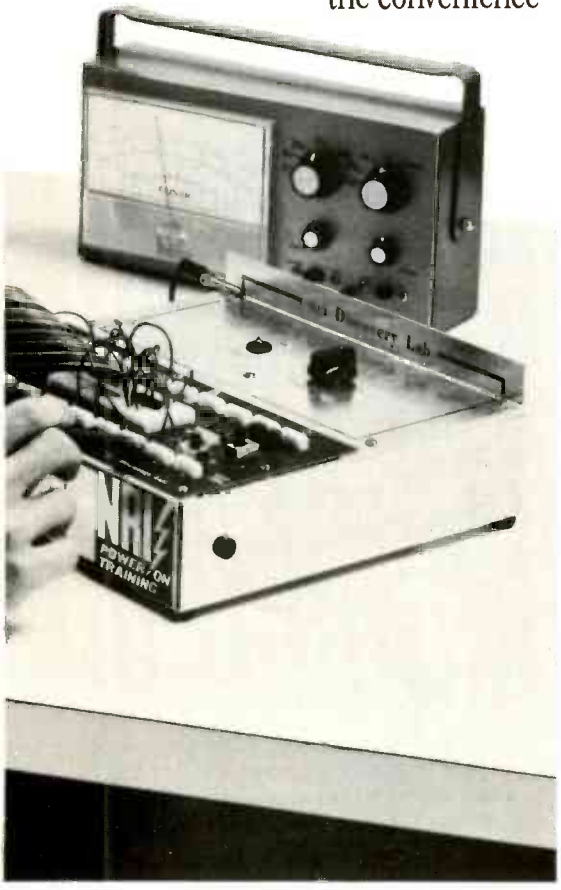

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You also build essential test instruments like a transistorized volt-ohm meter and CMOS digital frequency counter. You work with the exclusive NRI Discovery Lab, performing over 60 separate experiments in all. You learn how your trouble-shooting tools work, and gain greater understanding of the information they give you. Both microcomputer and equipment come as part of your training for you to use and keep.

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(TRS-80 is a trademark of the Radio Shack division of Tandy Corp.)

EQUIPMENT REPORTS

continued from page 15

Pulse width is continuously variable, from less than 10 nanoseconds to 100 nanoseconds; that range is covered in seven decade-steps, with a variable control for the levels between each step. The SYNC OUT jack is used for triggering scopes or other instruments; that output is a 0-4-volt square wave with the same frequency as the main output. A double-pulse function is used to generate two pulses of the same duration each cycle, instead of a single pulse. The DELAY control, which is switched into the circuit from the front panel, is used to vary the time delay between the sync pulse and the main output; it is also used to vary the spacing of the double pulse.

The operating manual that comes with the generators has a complete circuit description, gives calibration data with location of all adjustments, and has a schematic and a parts list. The panel design is clean with all functions and controls plainly marked. The only minor complaint I have is that some of the pushbuttons are too close together (I've got big fingers). The suggested retail price for the *model 514* is $645.00; it is $725.00 for the *model 514A*. **R-E**

RADIO SHACK (ONE TANDY CENTER, FT. Worth, TX 76102) has taken a solid step toward entering the small-office equipment field with the introduction of their new *PC-50* Personal Copier.

The compact lightweight copier mea-

sures only 5¾-inches high, by 13 inches deep, by 14 inches wide, and weighs in at a mere 8.2 pounds.

The unit is powered by 120V AC at 6 amps. Power consumption is 230 watts during warmup and 480 watts during the exposure period.

The 250 watt, 7500 lumen lamp has a screw base and is easily replaced.

Warmup from a cold start is about 4 minutes, with an additional 30 seconds required for exposure, and another 30 seconds for development. The *PC-50* appears to be a scaled-down version of the popular 3M thermal copier and uses identical paper, including the famous pink intermediate sheet.

The copy-size format of 8½ inches by 11 inches permits the little copier to be used on most tasks. Legal sized documents could be a problem but can, of course, be copied in portions and assembled later.

After unpacking the small unit from its box, we were eager to try it and make a comparison with a far more expensive office copier. Since the compact unit is only a few inches larger in area than a single sheet of typing paper, finding a convenient spot on the desk was easy.

Dual instructions are provided, both imprinted on the lid as well as printed on an accompanying carboard reference sheet.

Included on that sheet are several pictorial samples of incorrectly-reproduced copy along with suggestions for correction. Maintenance instructions are also provided.

Using the printed instruction sheet as our copy for this test we removed the pink intermediate sheet and inserted the pair under the lid, following instructions. The copy which resulted was sharp and clear, in fact as good as—if not better than—an identical copy made on the more expensive office copier we had been using! *We* were, needless to say, impressed.

Next we decided to test the unit in copying the pages from an open book. Although considerably more difficult than a flat sheet of paper, the results were again impressive. So long as the print was pressed flush against the intermediate sheet the copy was sharp and clear.

Although the warmup and development times are somewhat longer than those found on the larger, more expensive counterparts, the low cost of the unit seems worth the tradeoff. The compact *PC-50* is ideally suited to a small office, a home, or a service shop in which an occasional non-intensive copying of routine documents, schematic diagrams and instruction sheets would be convenient. The *PC-50* Personal Copier sells for $149.95 at Radio Shack outlets. **R-E**

THE *BYTEWRITER-1* MATRIX PRINTER, by Microtek Inc., is a 7 × 5 dot-matrix printer for the *TRS-80*, *Apple* and *Apple II*, and *Atari 400/800* computers that specifically answers the need for an inexpensive printer capable of accommodating standard letter-size sheets and paper rolls.

Priced at only $299, the *Bytewriter-1* has three individual internal connectors for the three computer systems. It is almost impossible to mix-up the connections if you move the printer from one computer system to another because the required interface cable from the computer to the printer will attach only to the appropriate connector.

The *Bytewriter-1* prints both upper and lower case—without lower-case descenders—at 10 characters-per-inch, 6 lines to the inch. It accepts 95 of the 96 standard ASCII printable character codes and three control codes.

In the ASCII "standard", the characters start at decimal code 33 and run through decimal 127. Code 127, however, is not really a character; it is the delete function. Some printers, on receiving a code 127 from the computer, will do nothing. The *Bytewriter-1*, however, translates code 127 into an open box of the type used on questionnaires. If you were printing something where you might want to check off each step with a pencil or pen, the open box would be an asset.

The *Bytewriter-1* responds to three ASCII control codes. Those are: CR (carriage return), SO (shift out), and SI (shift in). CR also provides an automatic linefeed. When the printer receives the CR code, all data stored in the print buffer is printed and the paper is advanced one line. If more than 80 characters have been received and stored in the printer's buffer before the CR is sent by the computer, the first 80 are printed on one line and the remainder are "wrapped around" on the next line.

When the printer receives the SO code, all data that follows is printed out in "bold" double-width characters. Reception of the SI code cancels the "bold" characters and all printing that follows the SI code is normal width. The SO and SI codes can be intermixed at will in the same line, permitting individual characters, words, and phrases to be printed "bold." The bold characters do not cancel at the end of a line, but will continue until the SI code is received.

Like some other printers, the *Bytewriter-1* ignores the Line-Feed (LF) code. A line feed is automatically accomplished as a result of the carriage return. If just a line feed is desired, it is necessary to send a CR code to the printer. While that provides a line feed, it also moves the printhead to the beginning of the next line; that makes it somewhat difficult, if not impossible, to line up columns.

Unlike earlier "budget" printers that used rolls of narrow, adding-machine

continued on page 24

Introducing TALKMAN™
The new two-way radio that means business.

Voice-activated, two-way communications— leaves hands free for safety and security

TALKMAN is a new two-way communications system designed for special purpose business applications such as construction, electrical maintenance, security, warehousing and manufacturing— anyplace the need to communicate exists where both hands must be left free for safety and convenience.

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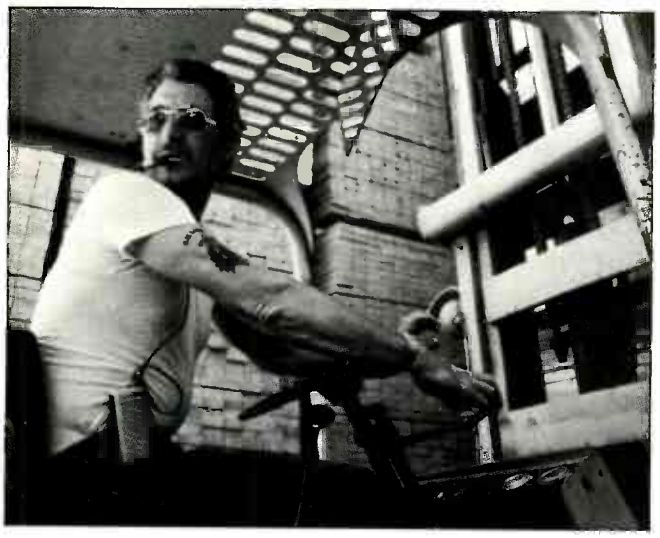
TALKMAN is easy to use and maintain. Its unique headset adapts to any headgear and features a stowable whip antenna and adjustable, boom-mounted microphone with windscreen for communications even in high wind or noise environments. Sophisticated solid state circuitry includes audio muting and microphone sensitivity control— features usually found on two-way business transceivers costing three to four times as much.

Individually cartoned, $139.95 suggested list.



Standard Communications

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Los Angeles, CA 90009
800/421-2916
(In Calif. 213/532-5300)

CIRCLE 16 ON FREE INFORMATION CARD

There is no impression adjustment for the printhead: it is set at the factory and will print up to the original and three copies. Our experience showed a somewhat irregular impression impact-density where a substantial part of the character was reproduced by a string of dots, such as the small letter "e", or the parenthesis symbols [(.)]. While sheets are inserted from the rear. Permanent brackets and a removable spindle are provided for paper rolls. The type paper that permitted lines of perhaps 16 or 30 characters, or that used a somewhat difficult to obtain and expensive heat-sensitive or electrostatic paper, the *Bytewriter-1* uses standard sheets—letter or legal size—or standard paper rolls up to 8½-inches wide. The paper feed is friction only: there are no tractor or pin-feed devices. Single bracket supports a standard 5-inch diameter teletype paper roll off the table—the user is not limited to one of the new mini-size rolls of approximately 3-inch diameter, which happen to cost more than the standard roll.

The characters are printed by a 7-wire printhead that plugs into a socket and is user-replaceable by simply loosening two screws and unplugging the connecting cable. Unlike most other printheads that are connected to their electronics by a flexible ribbon cable that "rolls" along with the printhead, the *Bytewriter-1* uses discrete, highly flexible wires to connect the printhead to the circuit. The wires flop and twist considerably as the printhead travels. While it does not appear to the eye that the twisting wires would have the life expectancy of "rolling ribbon", there is no previous experience on which to make a judgment as to life expectancy of the wires.

The printhead is driven by a grooved spindle, rather than a drive belt. Again, that is an arrangement we have not seen used in a matrix printer before; but it does work. Again, we have no idea what the life expectancy or reliability might be; but after several weeks of quite severe useage—likely more than done by the average hobbyist—we have had not a single instance of difficulty with any part of the printer's electrical or mechanical assembly.

The printhead's bi-directional drive is the "full line" system commonly found on many lower-cost printers; it is not logic-seeking. That is, the head sweeps from full left to full right, even if it prints just a single letter on the left side. It then sweeps back from full right to full left regardless how much it has to print. The printer speed is 80 characters-per-second (per line), 60 lines-per-minute.

the "top" (original) copy was legible, the copies—particularly the third—

continued on page 118

I WISH I WASN'T IN SUCH A PINCH FOR GRABBERS™

I WISH I WASN'T IN SUCH A BIND FOR BINDING POSTS.

I WISH I WASN'T SO PINNED DOWN BY PIN TIP SELECTION.

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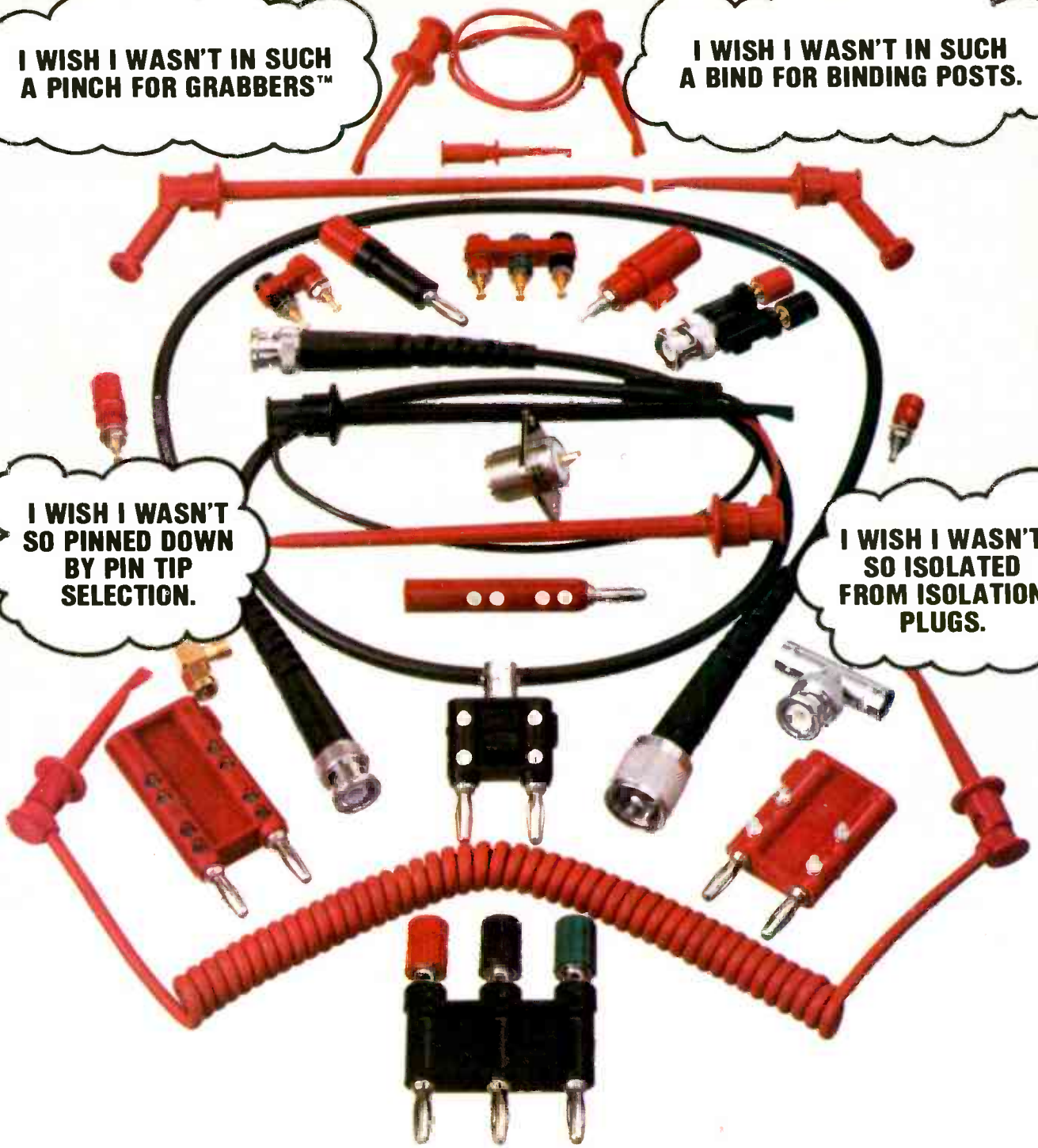

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Model 820

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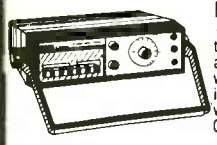
Sweep/Function Generators
Model 3015
- Frequency: 2 Hz to 200 kHz, in 3 ranges. • Outputs: Sine, square or triangle. • Variable Amplitude: 15 V p-p, open circuit; 7.5 V p-p into 600 ohms. • Pulse Output: Fixed amplitude TTL level, logic high greater than 3 volts. • Accuracy: ±5% F.S., to 20 kHz.

Model 3025
- Frequency: 0.005 Hz to 5 mHz in 7 ranges. • Outputs: Sine, square, triangle or haversine. • Variable Amplitude: 20 V p-p, open circuit; 10 V p-p, into 50 ohms. • Accuracy: ±5% F.S.

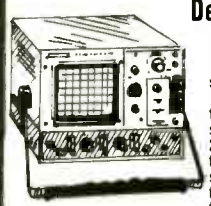
Model 3030
- Frequency: 0.001 Hz to 5 mHz in 8 ranges. • Outputs: Sine, square, triangle, pos/neg square, pos/neg ramp. • Variable Amplitude: 20 V p-p, open circuit; 10 V p-p, into 50 ohms. • Accuracy: ±(1.5% setting +1% F.S.), 0.001 Hz to 1 mHz; ±(2% setting +2% F.S.), 1 mHz to 5 mHz.

Four Instruments In One

Model 3020
Four instruments in one package – sweep generator, function generator, pulse generator, tone-burst generator • Covers .02 Hz to 2 MHz • 1000:1 tuning range • Low-distortion high-accuracy outputs • Three-step attenuator plus vernier control • Internal linear and log sweeps

Low Distortion Function Generator


Model 3010
- Generates sine, square and triangle waveforms • Variable amplitude and fixed TTL square-wave outputs • 0.1 Hz to 1 MHz in six ranges • Typical sine wave distortion under 0.5% from 0.1 Hz to 100 kHz.

Dual-Trace 30 MHz Delayed Sweep Scope


Model 1530
- Delayed sweep operation for sweep expansion up to 1000x. • 30 MHz response; usable to 50 MHz. • 5 mV/division sensitivity, selectable 2 mV to 20 mHz. • Variable hold-off for pulse train display. • Single-sweep for nonrepetitive waveforms. • Built-in triggering filters.

BECKMAN

BECKMAN 3½ Digit Multimeters

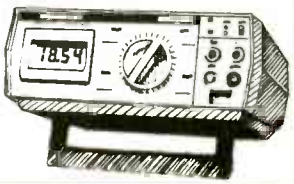
TECH 330
Has 7 functions and 29 ranges, plus 0.1% VDC accuracy and true RMS capability (AC + DC).

TECH 310
Has 7 functions and 29 ranges, plus 0.25% VDC accuracy.

TECH 300
Has 0.5% VDC accuracy and all the features of TECH 310, except the continuity test function and 10-amp current ranges.

TECH 350
Bright, 0.5" LCD display. Single easy-to-use switch. Separate diode test function. Low power resistance range. 22 megohms input resistance. 12,000 hour battery life.

TECH 360
Input jack for a standard K-type thermocoupling, enabling user to measure temp from −20°C to +1265°C. Switch selectable measurement of true RMS (AC + DC) or AC only voltages and currents.

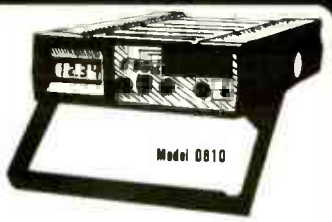


FLUKE

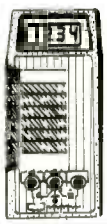
Multimeter
- Free 10 amp current shunt.
- General purpose True RMS multimeters with identical features except for power sources.

Model 810
Operates on line voltage

Model 811
Operates on line voltage and with rechargeable Ni-Cad batteries.



Hand Held DMM with free case



Model D800
Fluke's lowest priced DMM. An all purpose instrument for basic measurement needs. Five ranges for AC and DC voltage measurements. Four ranges for AC and DC current tests. Six resistance ranges.

Model D802
Same as Model D800 but has a basic DC accuracy of 0.1% and Fluke conductance function for accurate high resistance measurement.

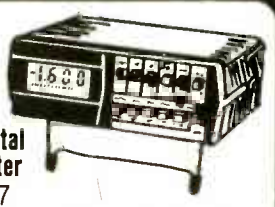
Model D804
The most powerful in the series. All features of Model D802 plus capability to check continuity and logic levels, measure temp with K-type thermocouples and capture peak readings of transients.

Simpson

Meter
Model 260-7
- 28 time-proven ranges. • Direct dial reading of Amp-Clamp ranges. • Only 2 batteries . . . one 9-volt and one 1.5 volt "D" cell
- 260-7 complete with batteries, test leads and manual
- 260-7M with mirror scale
- 260-7RT in roll case
- 260-7MRT with mirror scale, in roll top case

Available with reset pushbutton releases when overload exists.

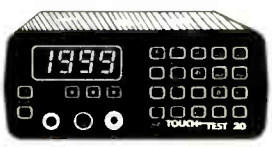
260-7



3½ Digital Multimeter
Model 467
- LCD analog bargraph to indicate nulls, peaks and trends. • Differential peak hold captures maximum (peak) and minimum values of complex waveforms. • 50 u/sec pulse detection. • True RMS measuring capability.

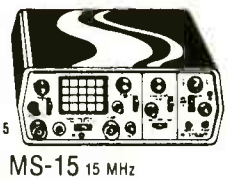
NLS

Touch/Test 20 Multimeter
- Touch selection and control of functions, ranges and power. • Large (0.55" high) LED readout. • Automatic polarity and overload indication. • In-circuit test capabilities.



TT-20

Model TT-20
Model TT-20B With batteries and charger
Model TT-21 With LCD readout
Model TT-21B With LCD readout, batteries and charger

Portable Triggered Miniscopes


Model MS-15 15 MHz
Model MS-215 15 MHz, Dual Trace
Model MS-230 30 MHz, Dual Trace

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Model 5001

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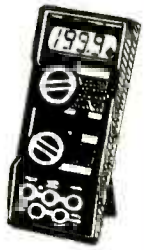
KEITHLEY

Hand-Held Beeper Digital Multimeter

Model 128

● LCD display. ● 0.5% basic accuracy. ● 3½ digit resolution. ● 'Beeper' operates on all ranges and functions.



Hand-Held Digital Multimeter

Model 130

● 0.5% basic accuracy. ● 3½ LCD display.

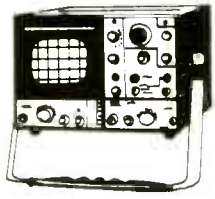
4½ Digit Multimeter

Model 135

● 0.5% basic accuracy. ● 4½ digit resolution provides wide dynamic range. ● LCD display.

HITACHI
Hitachi Denshi, Ltd.

Dual Trace Oscilloscopes



Economically priced, general-purpose oscilloscopes. Square, 5½" CRT with internal graticule (illuminated scale). High accuracy voltage axis and time axis set at ±3% (certified at 10°C and 35°C). High-sensitivity design; vertical sensitivity of 1 mV/div. available. 8-div., dynamic range ensures accurate measurement of waveforms without distortion. TV sync-separator circuit.

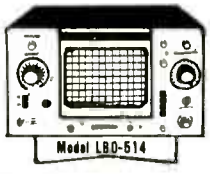
20 MHz	35 MHz	100 MHz
Model V-202	Model V-352	Model V-1050

LEADER

10 MHz at 1 mV 5" Scopes

Model LBO-513
Single Trace with probe

Model LBO-514
Dual Trace with probes



20 MHz Oscilloscopes

● Add and subtract modes (with CH-2 invert), permits differential measurements (Model LBO-508A only). ● Front panel X-Y operation ideal for phase-shift analysis, sweep alignment and vectorscope service (Model LBO-508A only). ● 17.5 nanosec rise time for easy viewing of high speed pulses and wave forms.

Model LBO-507A
Single Trace with probe

Model LBO-508A
Dual Trace with probes

LUXO

Magnifier Lamp

Model LFM-1A

Offers large viewing area for fine details, component assembly and other close work. Has unique double tension control. In grey, black, white and tan. Three diopter, 13" focus standard on all models. (45" reach).

Magna-Lux Lamp

Model LUX-2A

Magnifier utility lamp. The 3¾" diameter lens supplemented by a 40-watt standard appliance bulb A-15 incandescent bulb. Sold in black only, has an arm reach of 39" and includes a factory installed 3-diopter lens. Same magnification as LFM-1A.

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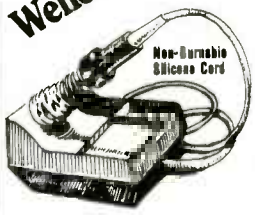
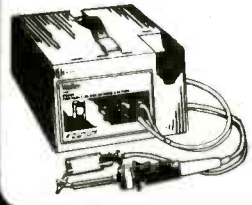


Controlled Output Soldering Station

Model WTCP-N



Portable Desoldering Stations

Model DS-600

VIZ

DC Power Supplyst

Model WP-708

It's a dual DC Voltmeter
It's a triple DC Power Supply

● Three separate completely isolated DC power supplies: two 0-20V @ 0-2A, one fixed 5V @ 4A ● Excellent line and load regulation ● Fully adj. current limiting on the two variable supplies

Weller® Xcelite®

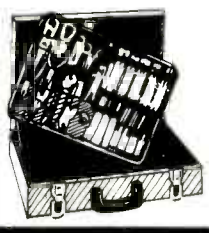
Attache Style Tool Cases

Model TC-150/ST

Contains 23 individual tools, 24 Series 99 interchangeable screwdriver/nutdriver blades and handles, 2 measuring tapes, soldering iron, recharger, solder.

Model TC-100/ST

53 individual screwdrivers, nutdrivers, pliers and wrenches, 31 Series 99 interchangeable screwdriver/nutdriver blades and handles, and two screwdriver/nutdriver sets.



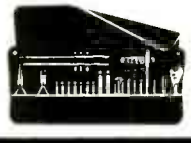
Model TC-200/ST

Smaller version of the TC-100 case. 27 interchangeable Series 99 screwdrivers and nutdrivers, for use with the straight or tee handle, plus 10 assorted snips, pliers, wire cutters and wrenches.

Service Master Tool Kit

Model 99-SM

24-piece kit



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LETTERS

Address your comments to: Letters, **Radio-Electronics,**
200 Park Avenue South, New York, NY 10003

TELETEXT

I read your editorial in the February 1982 issue on the "non-decision" of the FCC in regard to teletext. May I please offer an alternate perspective on some of the point you made?

As I understand it, the FCC was chartered to enforce the Communications Act of 1934, as amended. That Act holds that the air waves belong to the public and are to be used only for the public good. The FCC is not, and never was, a consumerist organization. It was *not intended* to decide which commercial product is OK for consumers to have, and which is not.

That suits a lot of us out here just fine! We *don't want* the government telling us what to buy, when, how, what color it should be, etc. We prefer to make our own decisions from the offerings of a free market, thank you.

You state that with three incompatible teletext services, consumers will have to purchase three separate decoders. Shame on you! As we all know, everything electronic is (or is about to be) microprocessor-driven. I suggest that the consumer will need to buy but one decoder and one, two, or three teletext programs, from it, according to which teletext service he or she wishes to use. That brings me to the next point.

You imply that, with three teletext services, the consumer will be *forced* to avail himself or herself of all three. *Why?* In the automobile market, there are sports cars, family sedans, compacts, station wagons, and pickup trucks. Does that mean that a car buyer *must* purchase one of each? Hardly. I suggest that in the television market the consumer should be equally free to select the teletext service he or she prefers.

You also seem to imply that the three teletext services will necessarily duplicate one another. Why so? I would like to suggest that, in a free market, each teletext service will specialize. Perhaps one service might cover financial affairs (stocks, bonds, metals, gems, commodities); another might choose current events (news, weather, sports); and still another could specialize in entertainment (theater, concerts, movies, lectures, community services). I like that. Specialization, it seems, has always generated a higher level of excellence than generalization. Also, so has free-market competition, over a government-controlled market.

We have a new administration in Washington—one dedicated, in part, to getting the government off our backs. That is why the FCC has decided to allow consumers to choose for themselves which teletext service they prefer, after first seeming to have made the decision for them. Please note, however, that nothing that the FCC has done (or has not done) will get in the

way of standardization in teletext.

Consider the NTSC standard, to which all broadcasters and all receiver and transmitter manufacturers must conform. Please correct me if I am wrong, but I believe that that standard was devised through voluntary cooperation within the television industry. It was not handed down from on high by the FCC, or any other government entity. If the free market so dictates, I'm willing to bet that industry will cooperate again to devise a teletext standard.

That is heady stuff, as the notion of a free market always is. I know that it sets a lot of people on edge, and has some of them gritting their teeth. But how about giving it a try for old time's sake? Who knows? You might even like it?

A.C. ACTON,
Midland, MI

LOW-FREQUENCY FILTER

Thank you for the good job on my article about the low-frequency filter kit (**Radio-Electronics,** November 1981). There are two errors that your readers should know about, however. In the schematic of Figure 7, the connection to pin "H" of the filter kernal ($-V_B$) should come from the other side of C16. Figure 3, showing the input and output noise of the low-frequency filter, is labeled as a spectrum analysis; though it *was* taken from a spectrum analyzer, those are time waveforms, not spectra.

Fortunately, neither error will affect anyone's building and installing the LFF from the layout, component locators, and interconnection drawings, all of which are error-free.

JOE GORIN

SOUND-GENERATOR CONTROLLER IC

In the December 1981 "Letters" section Mr. Stan Stephenson asks if anyone knows where he can obtain the TI SN76489A generator-controller IC. It is obtainable from CIRCUIT SPECIALISTS CO., Box 3047, Scottsdale, AZ 85257. The price is $9.95, with a $15 minimum on phone orders (1-800-528-1417), but no minimum is required for mail orders accompanied by a check or money order.

Finding an appropriate mailing address to reach the "Letters:" department isn't so easy—how about putting an address at the head of the column?

CHARLES ROBINSON,
St. Louis, MO

*Address your correspondence to: Letters, **Radio-Electronics,** 200 Park Ave. South, New York, NY 10003.*

Your suggestion is a good one and we're going to use it. See the opening of the Letters column in this month's issue.—Editor

CABLE TV

I read your editorial about cable TV in the August 1980 issue of **Radio-Electronics,** and have a few comments that I would like to share.

It is interesting indeed that cable TV is going about in the same way that Ma Bell has, but I see something more to it than just that. With such things now as select TV, Showtime, Cable News Network, ESPN, HBO, etc., offered on cable-TV systems, I can see why we are told that cable companies must do the hookups. As I see it, cable lines come into the home just as telephone lines do. It is true that they must do the hookup on a pole outside, just as one's "drop" telephone line is where it meets the main feeding cable (pairs).

But what goes on in the place of residence is actually another matter. It is choice; if the customer wants telephone-company-installed wiring, phones, etc. (they must still provide lightning protection) he would do it that way. Cable TV operates on the same principle. Coaxial cable can be supplied just as well by outside suppliers. I agree entirely that qualified people could do it that way—people with enough knowledge of how it works. If one is fairly knowledgable in electricity, electronics, and wiring methods, I can see no reason why it would not work.

As cable companies will give many reasons why it will *not* work, one probable reason begin that private investment in cable TV appears to be good, it is not a matter of who must do it. Cable TV has many offerings now, with the advent of satellites, etc. So I can see why they are proceeding in a manner like that of Ma Bell. Cable can be the provider of the service, just as telephone-line service is; but the responsibility or choice of options at home are best left to the customer. Hotels, motels, etc., that have all those extras with cable would be another matter, where cable could provide it, or an outside private contractor could.

DAVID WAGNER,
Marquette, MI

BACKWARD DIODES?

In looking over the "Hobby Corner" section of **Radio-Electronics,** October 1981, I noticed what appeared to be a mis-

take in the diagram, Fig. 4. Either the power and ground connections were shown wrong, or the six IN914 diodes were drawn incorrectly.

In reading the text, I found it stated: "All of the LED's shown in this article are common-cathode devices." I know that LED's emit light forward-biased, and IN914 conducts forward-biased—that is disregarding its reverse breakdown. So I concluded that the six IN914 diodes are drawn backwards.

JACKIE REICHLING,
Batavia, IL

You appear to be correct. Fortunately, although the circuit will not work properly as shown, at least nothing will be harmed.—Editor

TEMPERATURE MEASUREMENT

Your "Letters" column in the January, 1982 issue, included a lengthy communication from Mr. John P. Lane concerning temperature measurement. Mr. Lane is quite correct in most of his comments, including the desirability of using distilled water for the boiling-point calibration. However, there is one important point that he neglected to mention. Since he lives near sea-level, he may not be aware of the ambiguity in "official" barometric pressures.

For various, perfectly valid reasons, the barometric readings announced by the National Weather Service are normalized to equivalent sea-level values. They do not reflect the true pressure values unless you live on the beach. Since the pressure drops with altitude at the rate of one inch Hg per thousand feet (that is fairly accurate up to 10,000 feet), the tolerance of 0.03 inches suggested by Mr. Lane is equivalent to about 30 feet in altitude. Thus, in most parts of the country, that factor may well be the dominant error of the calibration process. I am not aware of any public source of "true" barometric readings, so you would be well advised to find out what your local altitude is, and then use the *Handbook of Chemistry and Physics* that Mr. Lane recommends to calculate the "true" pressure.

GARY J. VINCENT,
Richardson, TX

RADAR DETECTORS

In the December 1981 "Letters" section, Mr. Horn overrates the law as a safety device. Most drivers come with two police detectors—one on either side of the nose—and the truth is that the law has little effect on the way they drive. Driving habits reflect one's intelligence, skill, alertness, experience, self-discipline, and attitude toward respect for safety of self and others. The law makes little prescriptive contribution. Fatality rates among radar-detector-equipped drivers may tend to be lower than average, because such drivers tend to be alert and self-defensive. The law's most significant effect is in the persuasion of the public that officials have taken action. The net result of radar detectors on the nation's traffic picture will be a slight reduction in speed-trap revenue, and nothing more.

J.D. DENNON,
Warrenton, OR

SUBSCRIPTION TV

Your editorial on subscription TV (**Radio-Electronics,** December 1981) has generated a lot of thinking about cable, subscription, and free TV, as far as the public airways are concerned. Evidently, the logic at the FCC is to let those industries battle it out.

However, the real losers are the taxpayers. There is little doubt that free TV will be eliminated eventually, or greatly reduced, as the broadcasters join the cable-elite group. That isn't too bad for people living in cabled areas, and who don't mind the ever-increasing subscription fees. But what about the people living in rural and other uncabled areas of the U.S.A.?

The only possible solution for such people is signals delivered directly to their homes by satellite. And the problem here is that the premium services (HBO, Show Time, the Movie Channel, etc.) refuse to sell their programs to private TVRO owners, even though cable TV is not available to them. The irony of the mess is that the government (NASA) is supplying the space technology and the rocket boosters to place those satellites in orbit while, at the same time, another government body (FCC) allows satellite programmers to refuse to supply service for a reasonable fee to taxpayers who help pay the bills.

Come on, Congress and the FCC; it's about time that you considered the people living in the fringes.

LARRY J. WILSON,
Reynoldsburg, OH **R-E**

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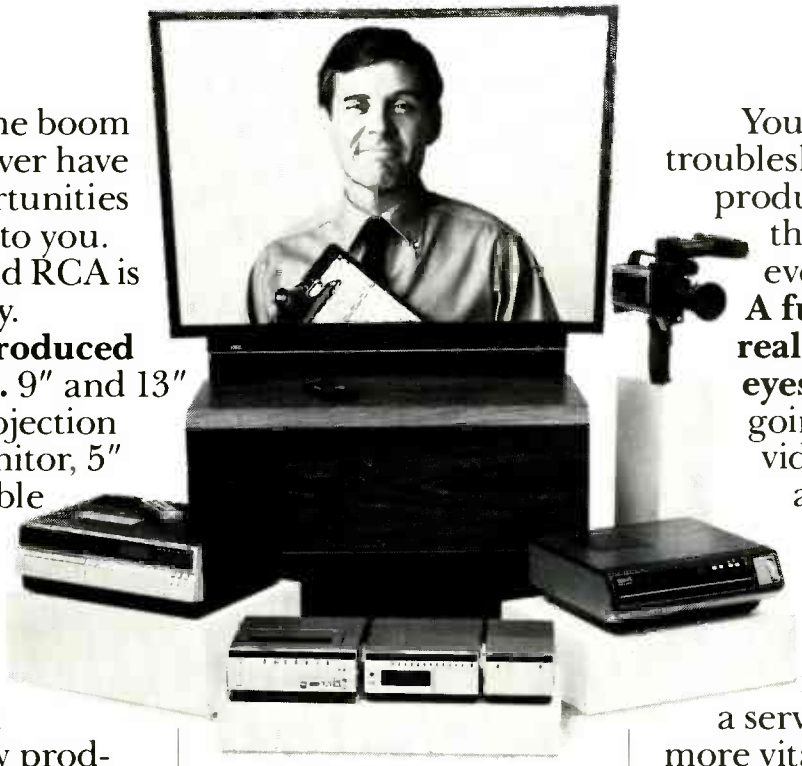

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CIRCLE 6 ON FREE INFORMATION CARD

NEW IDEAS

Automobile locater

HAVE YOU EVER HAD TROUBLE FINDING your car in a crowded parking lot? If so, here's a device that will be of some help.

This automobile locater is made up of two parts. The first is an RF oscillator, whose circuit is shown in Fig. 1. The second is a sensitive receiver; that circuit is shown in Fig. 2.

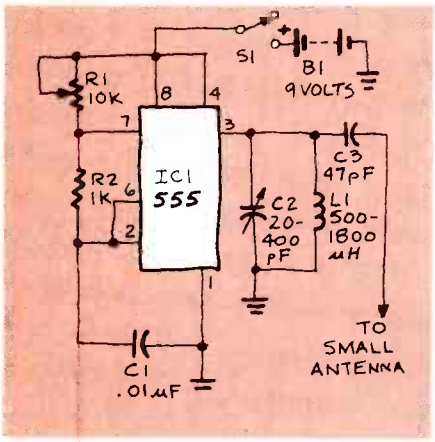

FIG. 1

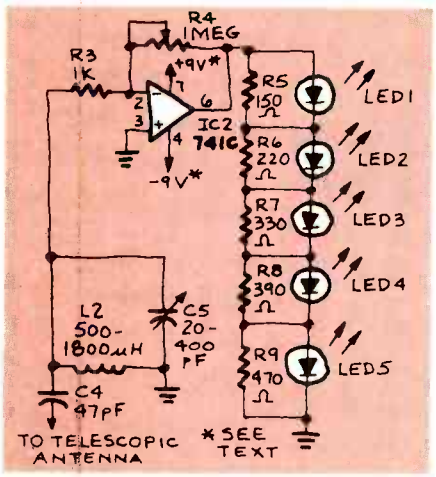

FIG. 2

The heart of the oscillator is a 555 timer IC. Its frequency—just below the AM broadcast-band—is determined by R1, R2, and C1. A tank circuit (C2 and L1) is used to tune the transmitter. The antenna is coupled to the transmitter through C3. Since efficiency is not very important here (output power should be kept under 100 mW), the length of the antenna can be kept short. A telescopic antenna or a length of hookup wire will work quite well. The only thing that is important is that the antenna be vertically polarized.

At the receiver, the incoming signal is tuned by C5 and L2 before being passed on to the 741 IC. That IC amplifies the signal up to 1000 times; the amount of amplification is controlled by adjusting R4, a linear-taper potentiometer (more on that later). The five LED's are used to indicate signal strength, they light up in order (1 to 5) as the signal gets stronger.

The 741 requires two 9-volt batteries for power. The positive terminal of one battery is connected to pin 7. The negative terminal of the other battery is connected to pin 4. The remaining terminals (one positive and one negative) are connected together and grounded.

Keep in mind that you will be carrying the receiver with you as you go about your business, so it should be installed in a case that is as small as possible.

After the devices are built, the receiver and transmitter will need to be tuned. Once that is done, however, you should not need to do it again unless the settings are tampered with. Placing the transmitter and receiver next to each other, detune the receiver so that none of the LED's light. Then tune the transmitter until all of the receiver's LED's light, indicating maximum signal strength. Potentiometer R4 should be adjusted for the minimum amplification that will give you a usable signal. Too much amplification will give you a maximum-strength indication over too wide a range. Separate the receiver and the transmitter (the farther apart they are the better) and adjust R4 until you get a maximum strength reading only when the receiver's antenna is pointed directly at the transmitter. The RF locater is now ready for use.

Since the locater will not be able to work through the metal body of your car, you will need to set up the transmitter so that the signal can radiate through a glassed-in area. That is really not much of a problem. If you are using a hook-up-wire antenna, simply tape the free end to the top of either the front or rear windshield. If you're using a telescopic antenna, place the transmitter on the dashboard and extend the antenna so that it is as long as possible. In either case remember to switch the transmitter on before you leave, and remember that the antenna should be aligned vertically for best results.

To find your car, just extend the telescopic antenna of the receiver to its full length and hold it parallel to the ground. Point the antenna to your far left, then swing it to your far right. Do that until you find in which direction the strongest signal lies, as indicated by the LED's. The antenna will be pointing at your car.—*Doug Krause*

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. Selections will be made at the sole discretion of the editorial staff of **Radio-Electronics.**

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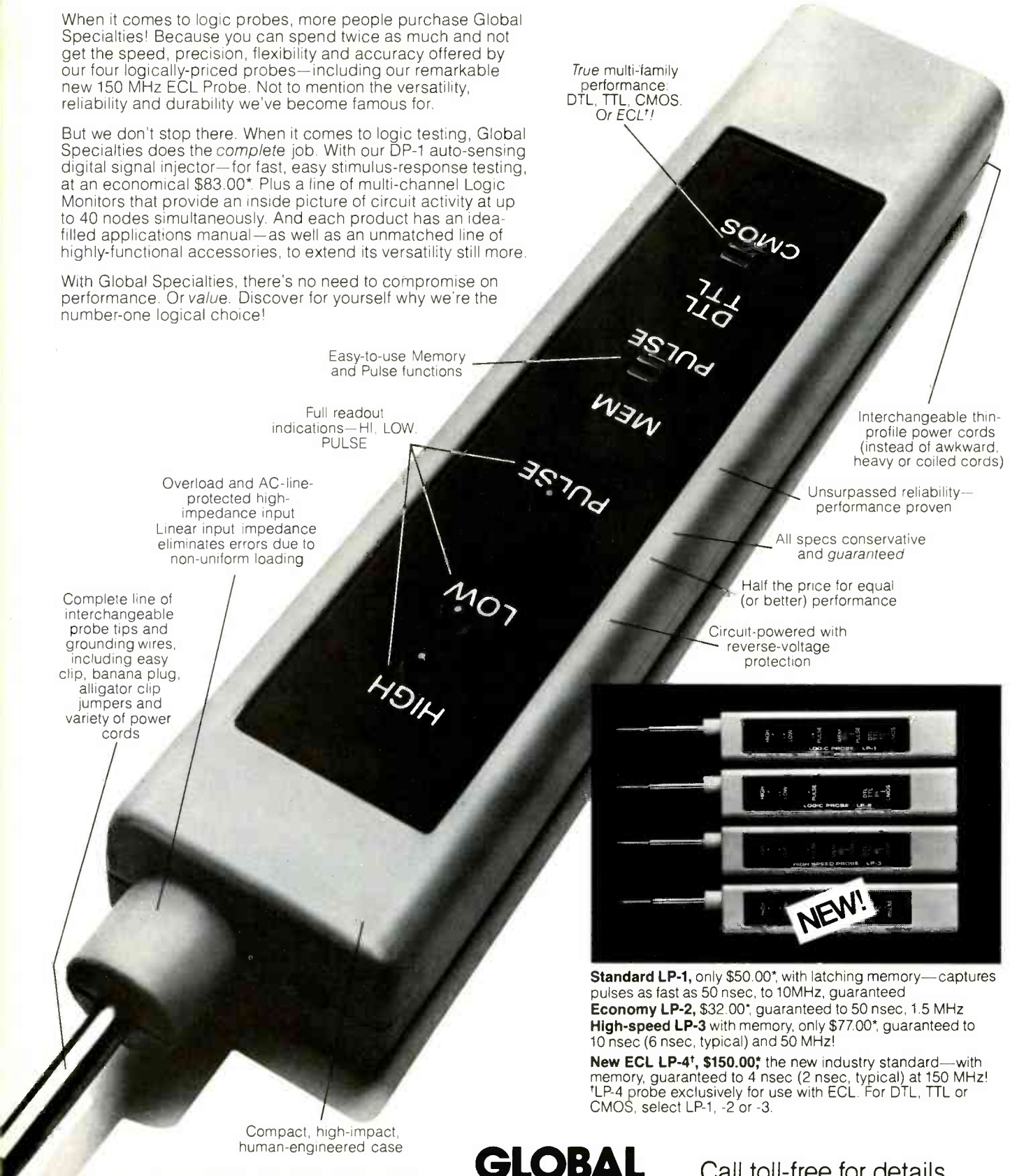

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The titler is powered by a 500 mA, 9-volt DC, wall-plug supply.

About the circuit

The circuit can be divided into three sections (see Fig. 1). The input/controller section accepts commands from the user, analyzes them, and transfers them to the second section, the memory. The video-display generator—the third section—reads the contents of the memory and produces a composite-video signal that can be fed to a TV receiver or recorded on videotape. Refer to Figs. 2 and 3 as we discuss how the titler works.

Input/controller

This part of the system is based on the low-cost and easily available 6802 microprocessor. That microprocessor has a number of interesting features. Its structure is not multiplexed, which means that it has independent address and data buses; that makes it very easy to interface with other components. Since the microprocessor contains 128 bytes of RAM, it is independent of the memory section and, even if the memory is busy with the video-display generator, the 6802 can continue to execute commands until the memory section is ready to accept them.

Programming the 6802 will be explained later, but for the moment it's enough to know that the program is stored in the 2716 EPROM (the program ROM) which is directly connected to the microprocessor's address and data buses, with its control line, $\overline{CE}$, going to decoder IC4. When the unit is turned on, the 6802's reset signal is activated by R9 and C1, forcing the address bus to FFFE (hex), the program starting-address (see the memory map in Fig. 4).

The 40-key keypad used for input is

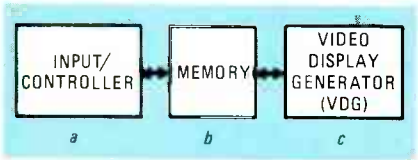


FIG. 1—VIDEO TITLER CONSISTS of three main sections. Data and address buses are bidirectional, permitting memory (*b*) to be accessed by either input/controller (*a*) or video-display generator (*c*).

Decoder IC4 uses address lines A11, A12, A13, and the VMA (*V*alid *M*emory *A*ddress) signal from the microprocessor to produce eight output-signals corresponding to eight areas of the 2K memory. Only five of those eight signals are used—but that is enough for our purposes.

The $\overline{\text{HALT}}$, MR, $\overline{\text{IRQ}}$ and $\overline{\text{NMI}}$ lines are forced to a logic-high state by R10.

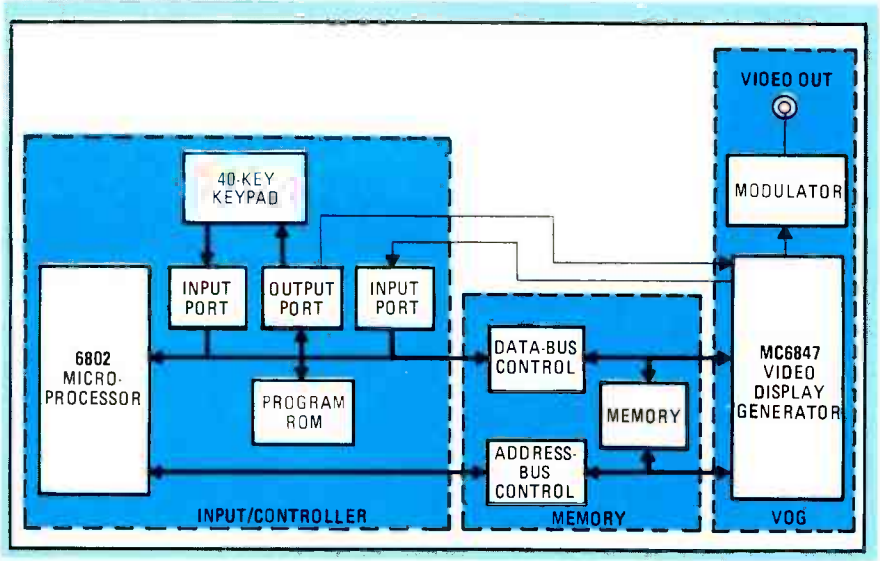


FIG. 2—DETAILED BLOCK DIAGRAM shows data flow within and between sections of titler.

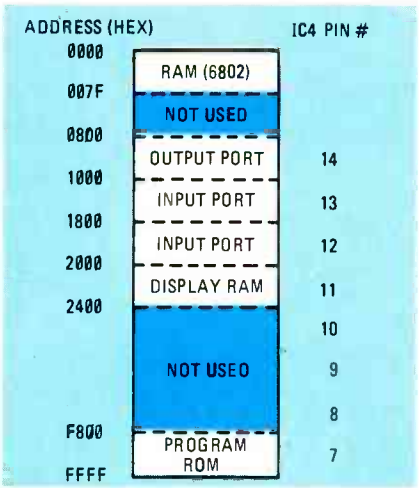


FIG. 4—MEMORY MAP of titler (not to "scale") shows how various functions are called up by decoder IC4.

organized as a 5 × 8 matrix. Its five rows are connected to the 6802 through IC1, a 74LS273 octal D-type flip-flop. Pin 37 of IC3, the 6802, outputs a clock signal of about 900 kHz. That signal is buffered by IC6-a and gates IC1, which samples the output of the keypad rows. The keypad's eight columns are connected to the microprocessor's input port via a 74LS244 octal buffer, IC2. The information from the eight columns is presented to the data bus when pins 1 and 19 of IC2 are taken low by the $\overline{\text{C}}$ output of IC4. That scanning system makes it easy to determine which key is pressed.

Memory

The display memory is made up of two 2114 (1K × 4) static RAM's, IC9 and IC10, to provide 512 bytes of memory per page. Memory-page selection uses a signal provided by pin 9 of IC1. Since the memory can be accessed by either the microprocessor or the video-display generator—but not by both simultaneously—bus-drivers IC7, IC8 and IC11 are used to disconnect the 6802 from memory when the video-display generator is operating. The R/$\overline{\text{W}}$ (*R*ead/*W*rite) signal from pin 34 on the microprocessor is used to control the direction of data flow.

The $\overline{\text{WE}}$ (*W*rite *E*nable) signal for IC9 and IC10 is generated by IC6, IC8, and Q1. That insures that when the video-display generator is active, the memory is in the READ mode; otherwise the memory is in the WRITE mode and available to the microprocessor.

PARTS LIST

All resistors ¼-watt, 5%
R1-R11—10,000 ohms
R12—1000 ohms
R13—5600 ohms
R14—360 ohms
R15—750 ohms
R16—470 ohms
R17—10 ohms
R18—1300 ohms
R19—75 ohms

Capacitors
C1, C8—10 μF, electrolytic
C2—150 μF, electrolytic
C3—5-40 pF, PC-mount trimmer
C4—47 pF, ceramic disc
C5-C7—0.1 μF
C9—470 μF, electrolytic
C10—4.7 μF, electrolytic or tantalum

Semiconductors
IC1—74LS273 8-bit D-type flip-flop
IC2—74LS244 octal non-inverting three-state driver
IC3—6802 microprocessor
IC4—74LS138 expandable 3-to-8 decoder
IC5—2716 EPROM (see below)
IC6—74LS00 quad 2-input NAND gate
IC7, IC8—74LS367 three-state hex buffer
IC9, IC10—2114L-3 1024 × 4 static RAM
IC11—74LS245 octal non-inverting bus transceiver
IC12—MC6847 video display generator
IC13—MC1372 color-TV video modulator
IC14—7805 5-volt tab-type regulator
Q1—2N3904
Q2—2N3906
D1—1N4001
XTAL1—3.579545 MHz TV color-burst-reference crystal
J1, J2—jacks to mate with power supply and video cables
Keyboard—5 × 8 matrix (Texas Instruments 11KS119 or equivalent)

Miscellaneous: 9-volt, 500 mA wall-plug DC supply, enclosure, cable, wire, etc.

The following are available from Scriptovision, Inc., P.O. Box 535, Snowdon Station, Montreal, Quebec, CANADA H3X 3T7 (all prices shown are in U.S. dollars); assembled and tested titler, $169.00; partial kit (PC board, programmed EPROM, keyboard, enclosure, keyboard label), $69.00; PC board and programmed EPROM, $49.00; programmed EPROM only, $35.00. U.S residents must add 4.7% to those prices for import duty. Please add $3.85 to each order for shipping and handling. Allow 4-6 weeks for delivery.

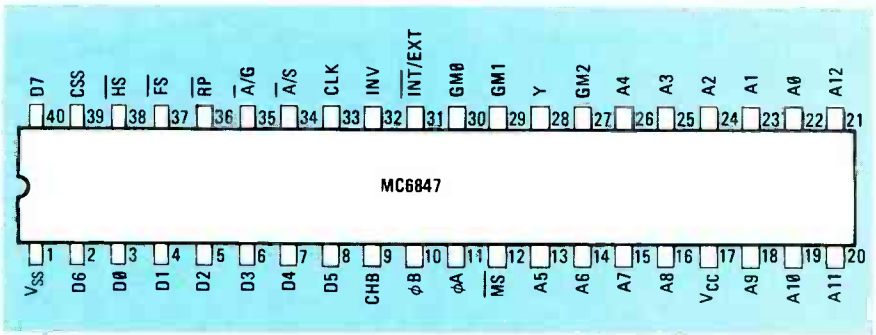


FIG. 5—VIDEO-DISPLAY GENERATOR, a MC6847, is the same IC used in the *TRS-80 Color Computer*.

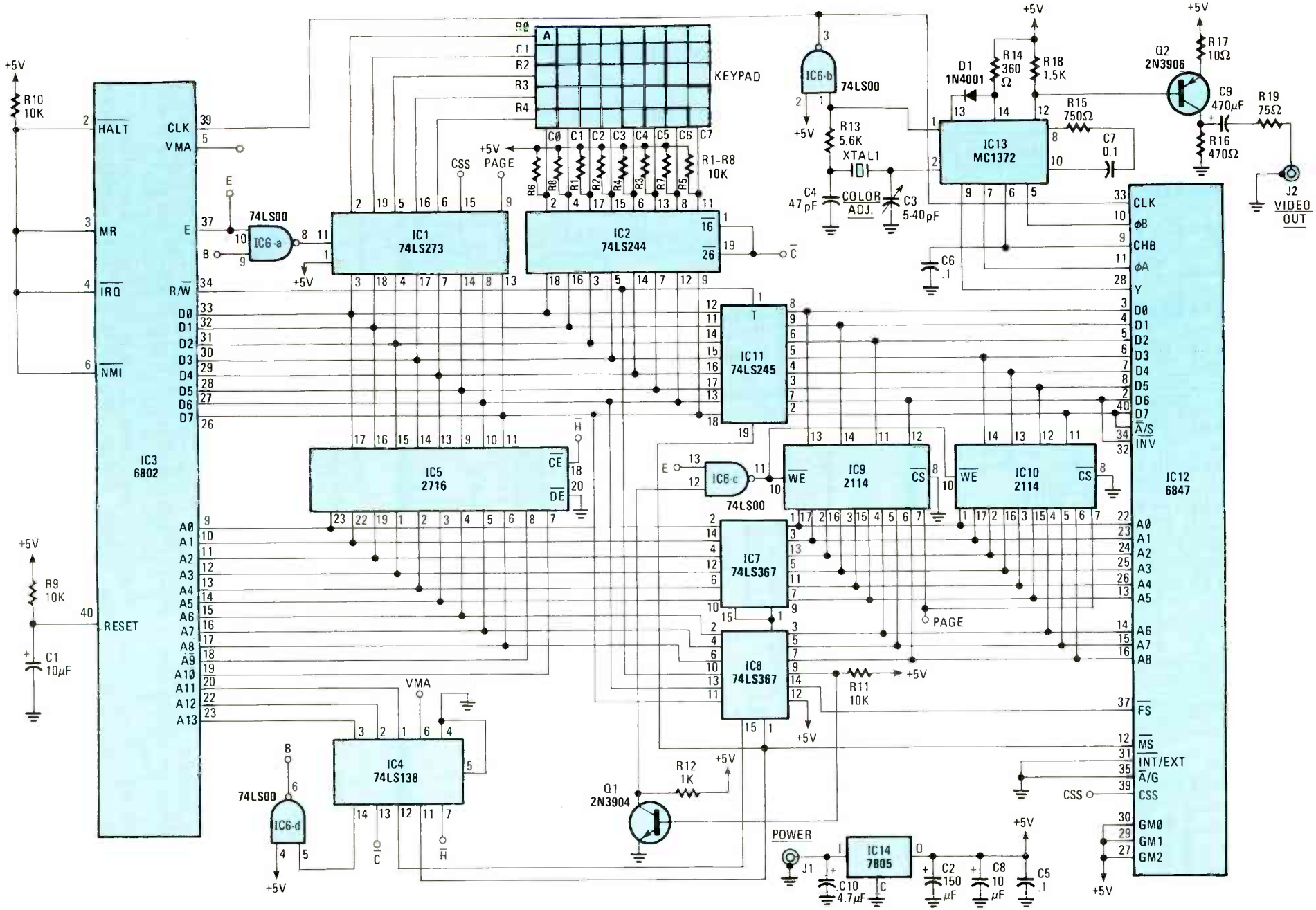


FIG. 3—TWO 2114 STATIC RAM'S are used to permit storage of two separate displays.

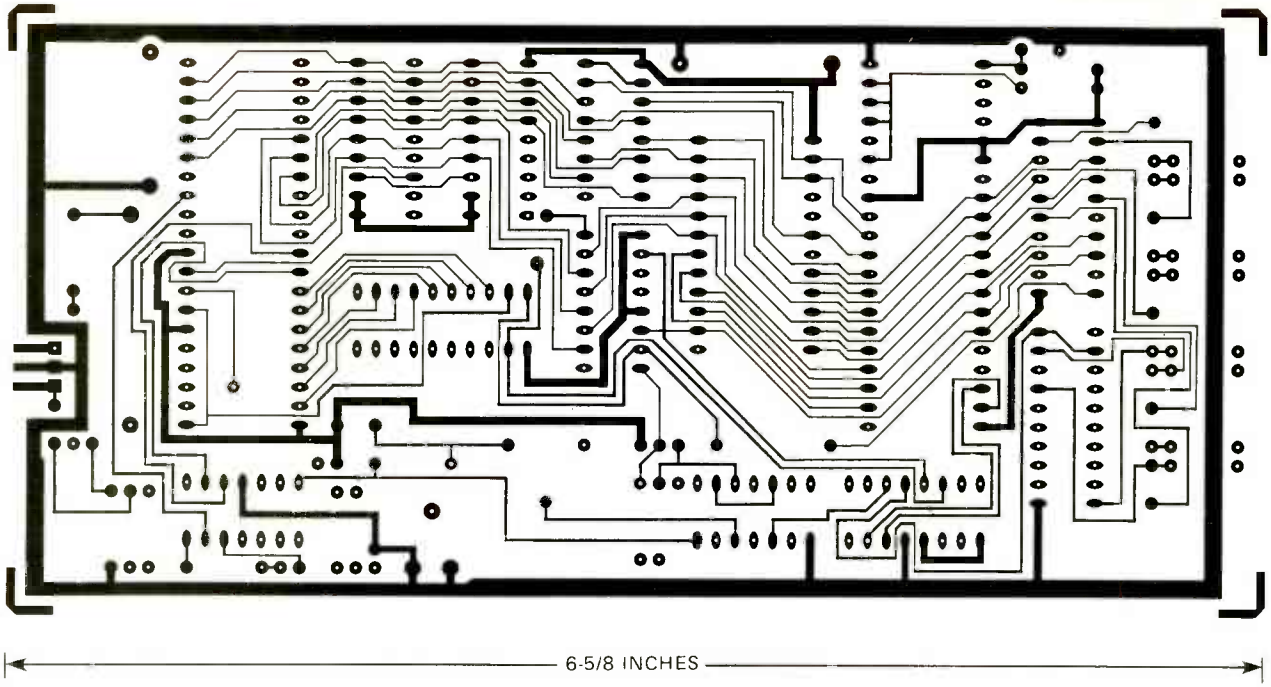


FIG. 6—PC BOARD FOR TITLER is double sided. This is the top, or component, side of board.

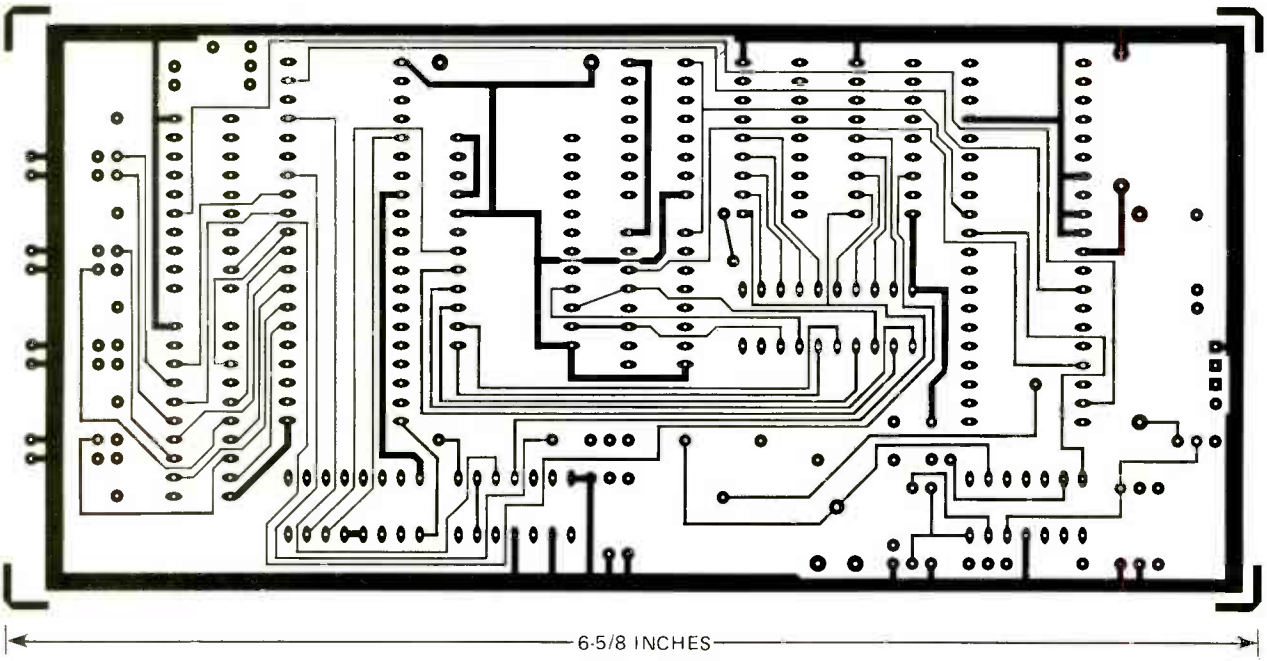


FIG. 7—"BOTTOM" OF PC BOARD. Keypad and voltage regulator will be mounted from this side.

Video-display generator

The video-display generator, IC12, is an MC6847. Its pinout is shown in Fig. 5. It reads data from the memory IC's using the address and data buses and generates both the alphanumeric and graphics characters for the display.

All clock signals are derived from IC13, a color-TV modulator IC that uses a 3.58 MHz color-burst-reference crystal and generates the composite-video signal that, after amplification by Q2, is the output of the titler. Chroma, luminance, and other information are provided by IC12. The output of the titler, which is available at jack J2, has an impedance of 75 ohms.

Construction

The titler can be built using either wire-wrap techniques, or on a double-sided PC board. A foil pattern for the component-side of the board is provided in Fig. 6; a pattern for the other side in Fig. 7. Component placement is shown in Fig. 8 and in Fig. 9.

Be sure that the capacitors and IC sockets are oriented correctly, and install jumpers through the board, soldered on both sides, where indicated by asterisks in Fig. 8. A small piece of electrical tape should be placed over the jumper that sits under XTAL1; that will keep the crystal and the jumper from shorting.

The voltage regulator is mounted from the bottom (non-component side) of the board and should have a heat sink—attaching it to the metal enclosure will do the job nicely, and will also provide a ground connection between the POWER jack, J1, and the circuit board. Be sure that J1 and J2 will mate with the 9-volt power supply and the cable to the VCR or monitor.

The keypad should be installed last. Pass its pins through the holes in the PC board *from the bottom of the board*. Make sure that all the pins are soldered. Don't forget the three insulated jumpers between resistors R1-R3 and IC2, on the component side.

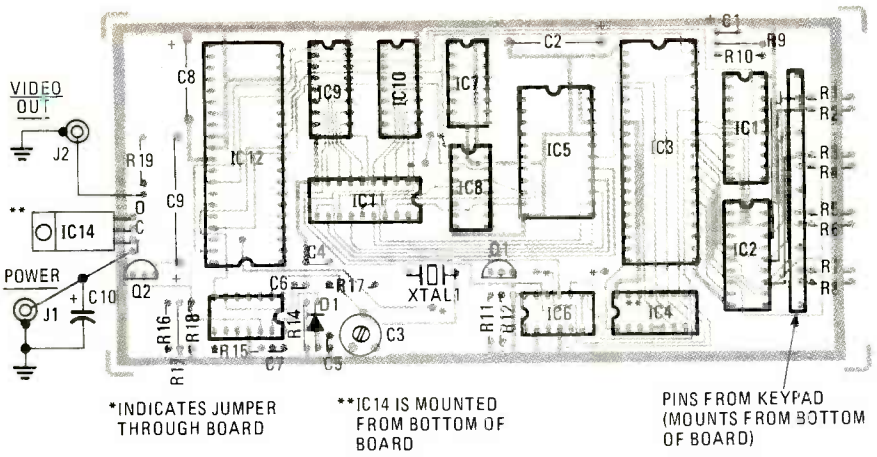


FIG. 8—VOLTAGE REGULATOR, IC14 should be mounted from "bottom" of board and attached to vertical wall of enclosure. This will provide both heat-sinking action and a connection between chassis and board grounds.

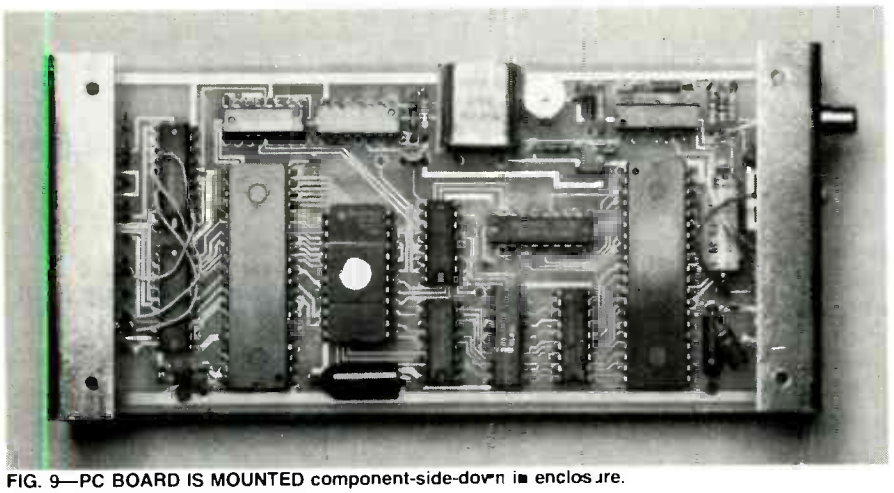


FIG. 9—PC BOARD IS MOUNTED component-side-down in enclosure.

Finally, you may find that your VCR requires a little more chroma (color) than can be provided by the titler. In that case, a jumper shorting out R15 will add it.

Checkout and operation

Connect the titler to your VCR, or to a TV set with a video input, and turn it on by plugging in the 9-volt DC power-supply. A series of color bars—green, yellow, blue, red, pearl (buff), cyan, magenta, and orange—should appear on your TV-set. Adjust C3 until the colors are correct. (Your monitor, of course, has already been correctly set up.) Unless the CLEAR key is pressed, the bars will remain in page-1 memory. If the CLEAR key is pressed, the bars will disappear from view and you will see a black screen with a cyan cursor at the top-left corner.

A look at the functions on the keypad "label" (Fig. 10) will give you an idea of how versatile the titler is. It has two basic modes of operation: alphanumeric and graphic. When the CLEAR key is pressed, the titler is in the alphanumeric mode. The shift key allows you to display the characters at the upper right—press it once to enter the shifted mode, and again to return to normal. The

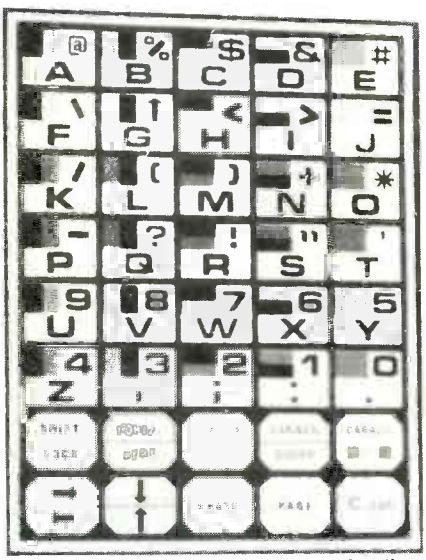


FIG. 10—KEYPAD LABEL shows many functions available. Function keys are pressed once to switch functions. Pressing them again returns you to original mode of operation.

characters can be displayed either as white-on-green, or white-on-red. The keys with arrows allow you to place characters anywhere on the screen. The shift key reverses their functions. (The cursor can be moved backward instead of forward, etc.) The ERASE key, of course, allows you to correct your mistakes.

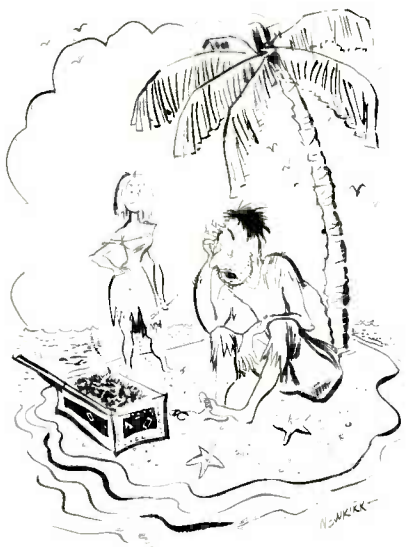
Pressing the CHARACTER/COLOR key gets you into the graphics mode. Several different color blocks—squares and rectangles—are available and, with a bit of practice, you can create some spectacular displays—maybe even better than the one in Fig. 11.

FIG. 11—NOTE HOW TITLER can combine alphanumerics and graphics in one display.

Characters and graphics can appear on the screen together. The two memories allow you to create two displays and alternate between them. Switching back and forth between two similar, but slightly different, displays can produce a very attractive, eye-catching effect.

The more you experiment with your titler, the more you'll find you can do with it. You'll be able to title home or industrial video programs, create graphs and charts, and even use it as a "message center."

You now have all the hardware information you need to build your own titler. Next month we'll discuss the software end. **R-E**



"I can't believe it—a whole trunk full of radio parts, but not a single piece of wire."

SUPER SIREN ALARM

An alarm system is useful only if its warning is noted. With the distinctive sounds that this siren can produce, that's no problem.

WILLIAM D. KRAENGEL, JR.

THIS ELECTRONIC SIREN ALARM IS THE perfect complement to your custom-designed security system. Whether you want to protect the belongings in your home, the belongings in your car, or alert your family to a fire, this low-cost but powerful alarm generates a variety of attention-getting sounds and provides 10 watts of output power to the speaker.

How the alarm is triggered is totally up to you. Indeed, a successful security system often depends upon a novel scheme that is unfamiliar to the intruder. Regardless of the detection device used—trip switches, ultrasonic detectors, fire and smoke detectors, etc.—the interface to the alarm is a simple switch or relay. Wire the alarm to an existing power source and detector, add a suitable speaker, and your system is all set to operate.

How it works

The siren alarm circuit is shown in Fig. 1. Timer IC1-a, half of a 556 (see Fig. 2), is connected as a low-frequency astable multivibrator (LFM). In that configuration, the squarewave output at pin 5 remains fixed at approximately 50 percent of the duty cycle as its frequency is varied by timing-resistor R1. With the exception of the TWO-TONE and PULSE modes, the LFM's squarewave output is integrated by R-C integrators R2 and C4, producing a triangle wave at pin 11 of IC1-b. Timer IC1-b is configured as an audio-frequency voltage-controlled multivibrator (AFM). Its frequency is controlled by the voltage on control-voltage input pin 11 and by timing resistor R3. The triangular waveform at this pin frequency-modulates (FM's) the AFM so that the squarewave output at pin 9 rises and falls in frequency to duplicate the familiar wail of a siren.

The TWO-TONE mode uses the same squarewave output from the LFM except that it is not integrated before it is used to FM the AFM. The squarewave, attenuated by R2, causes the AFM to shift frequency abruptly at the rate determined by the LFM. The resulting sound is a distinctive "twee-dell" similar to that of a European police-car siren.

The PULSE mode also uses the LFM's squarewave output, but not to FM the AFM. In this mode, the squarewave is routed to the RESET input (pin 10) of the AFM. As long as this pin is held high, the AFM will operate normally but when it is brought low, the AFM will stop running. The squarewave, alternately high and low, will gate the AFM on and off at the frequency of the LFM. The pitch of the sound will be constant since the frequency of the AFM is determined only by the value of timing resistor R3.

The YOWL mode is a combination of the SIREN and PULSE modes. The squarewave from the LFM is both routed to the RESET input of the AFM and integrated by C4 and R2 at the control-voltage input of the AFM. The AFM is gated on and off as in the PULSE mode; but every time it is gated on, it sees the rising half of the triangle wave

TABLE 1

MODE	R1 (ohms)	R2 (ohms)	R3 (ohms)	C4	J1	J2
Mechanical siren	5.6 MEG	1K	150K	1000 μF	X	—
Electronic siren	470K	10K	120K	100 μF	X	—
Warble	100K	100K	100K	10 μF	X	—
Two-tone	560K	10K	150K	—	X	—
Pulse	680K	—	150K	—	—	X
Yowl	2.2MEG	1K	100K	500 μF	—	X

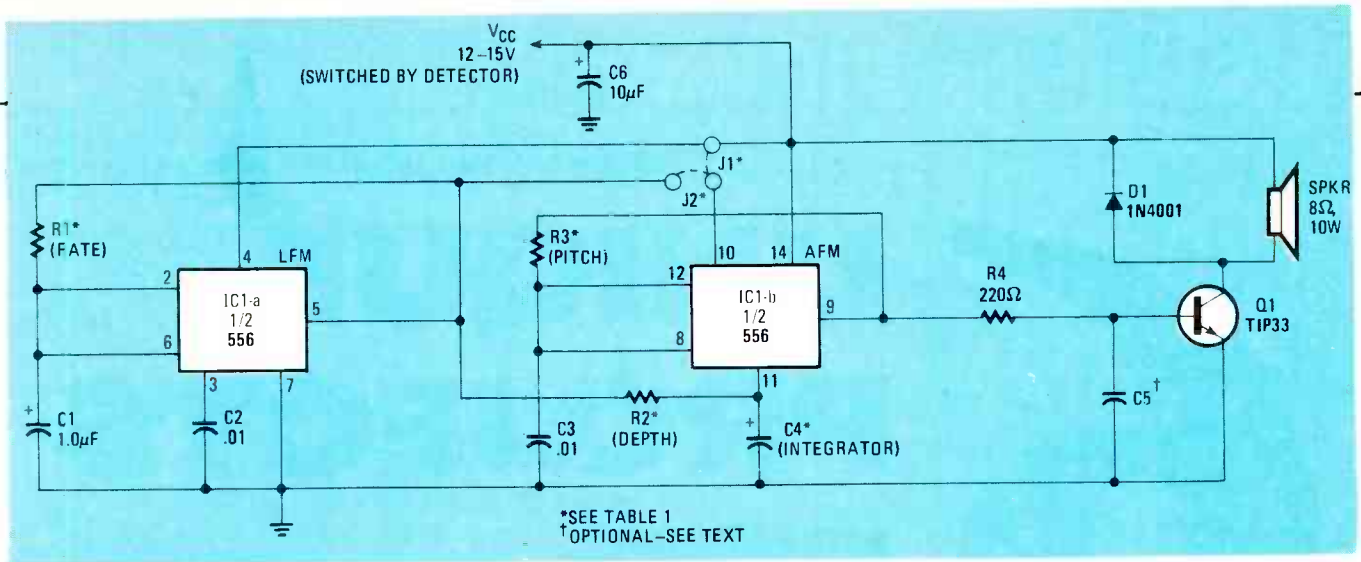


FIG. 1—SCHEMATIC DIAGRAM of the Electronic Siren Alarm. Typical values for R1-R3 and C4 are listed in Table 1.

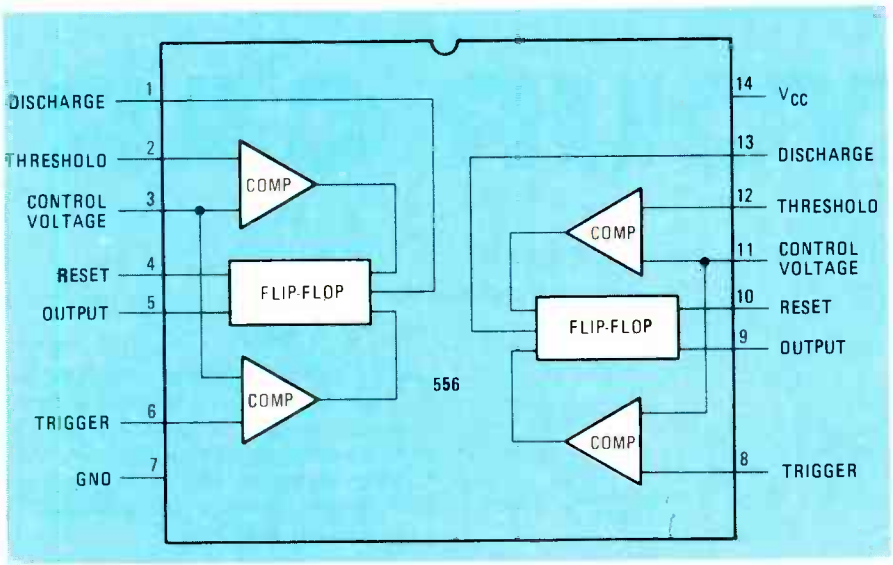


FIG. 2—PINOUT OF 556 IC will help you see how control- and signal-voltages are developed.

PARTS LIST

Resistors ¼ watt, 5% unless otherwise noted
R1-R3—See Table 1
R4—220 ohms, ½ watt
Capacitors
C1—1 μF, 35 volts, tantalum
C2, C3—0.01 μF, 50 volts, ceramic disc
C4—See Table 1, 25 volts, electrolytic
C5—0.1-1.0 μF, 50 volts, ceramic disc (see text)
C6—10 μF, 25 volts, electrolytic
Semiconductors
D1—1N4001, 1-amp, 50 PIV
Q1—TIP33 power transistor or equivalent
IC1—556 dual 555 timer
J1, J2—jumpers (see table 1)
SPKR1—8-ohm, 10-watt speaker (Radio Shack 40-1269 or similar)
Miscellaneous: Construction-or-PC board, wire, solder, etc.

at its control-voltage input. Consequently, the pitch of the sound is no longer constant during the on intervals but falls in frequency until the off interval begins.

Switching amplifier Q1 boosts the output to an attention-getting peak power of over 10 watts. If V_{CC} is increased to 15 volts from the normal 12 volts, the power output will be even greater. The squarewave output may sound harsh at some frequencies. The addition of filter capacitor C5 (from 0.1 to 1.0μF) will mellow the tone somewhat. Capacitor C5 and resistor R4 form a lowpass filter to remove some of the high-frequency components from the squarewave.

Construction

Since the alarm is meant to be part of a bigger system, no circuit layout or power-supply design is shown. The alarm may be built on the same construction- or PC-board as the detection circuitry. The circuit layout is not at all critical. Power-transistor Q1 need not be heat-sinked unless it is used in ambient temperatures greater than about 90°F. The siren draws less than 1.5 amps at 12 volts when run at its rated power output.

Operation

The sounds that can be produced are almost limitless. Table 1 gives some typical component values for different sounds as a guide to start you off. You are free to vary those values until you create a sound you like. In any case, final tweaking may be necessary, since the type of speaker and enclosure used will have an affect on the tone of the sound.

The rate at which the sound varies is determined by the value of LFM timing-resistor R1; increasing its value will decrease the rate and vice-versa. The pitch of the output is determined by both the amplitude of the modulating control voltage and the value of AFM timing resistor, R3. As the control voltage increases in amplitude, and/or the value of R3 is increased, the pitch decreases and vice-versa.

The range of modulation, i.e., the difference between the high and low frequencies of the AFM, is set by the value of R2. A small value of R2 permits a large range while a large value restricts it. About 1000-ohms is the practical minimum value for R2 as well as for R1 and R3.

The range is also controlled by the size of integrating capacitor C4. The product of the capacitor's value and that of R2 is the time constant of the integrator. The time constant establishes the linearity of each half of the triangle wave and also limits the amplitude that the triangle wave can rise to during the on time of the LFM. Because of that frequency dependency, there will be some interactions among R1, R2, and C4 as the range is set.

The alarm is best activated by switching the V_{CC} line. Not only is that a simple method, but the standby current is reduced to zero. The switching may be done directly by the detection device although that method is not suitable if the detection device cannot supply enough current. In that event, a relay or electronic switching, actuated by the detector, is recommended. **R-E**

JOSEPH GARTMAN AND MARTIN BRADLEY WEINSTEIN

6 UNIQUE PROJECTS FOR YOUR CAR

Be prepared for any eventuality with these handy automotive accessories. Build all six and make your car really "unique."

THE DESIGNERS IN DETROIT WHO TRY TO anticipate every conceivable need a driver may have often overlook the obvious. Knowing that you would never want to be guilty of that, the two of us burned up the long-distance lines for a week (Mr. Gartman in Cleveland, Mr. Weinstein in New Haven) talking about how we might provide some simple answers to some simple needs that every driver has. Through the cooperation of the **Radio-Electronics** editorial staff, we have been able to present that information to you in this April issue, just in time for the warmer weather of spring that prompts the year's highest activity in car fix-up projects.

These six projects are all based on reliable technology and use inexpensive, easy-to-find parts. All are powered by the car battery. Parts values are generally not critical.

Electric lock de-icer

For many parts of the country, winter never comes. For others, it's gone for the year. For still others, it lingers. If your home is in one of the parts of the country where winter plays the wretched wicked trick of freezing the locks on your car doors solid, you'll want to prepare yourself with this simple electric lock de-icer (Fig. 1).

The device is very simple—a resistor attached to a cigarette lighter plug via a short cable. Ohm's law tells you that the resistor criteria are chosen so as to produce approximately 20 watts of heat.

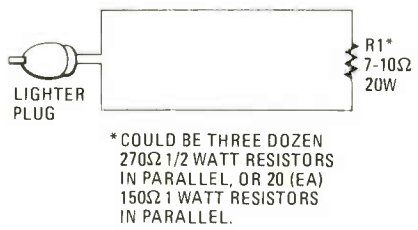


FIG. 1-SCHEMATIC DIAGRAM of the electric lock de-icer.

A single 20-watt resistor could be used, or any equivalent array. Twenty 150 ohm resistors, for example, could be connected in parallel (Fig. 2) using bus wires to simplify construction. One excellent suggestion is to use a thermally conductive spike (a darning needle, for example, or a long nail) as a central mount; the resistors then heat the spike, and the spike carries the heat right to the lock. Since the full 20 watts of heat is produced with any effective 7 - 10 ohm combination of resistors, you will probably want to sleeve the de-icer with something that's both electrically and thermally insulating.

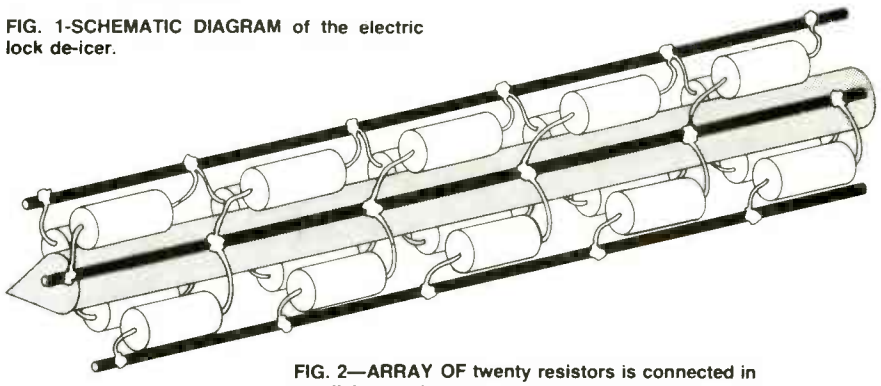


FIG. 2—ARRAY OF twenty resistors is connected in parallel around a thermally conductive spike.

By the way, if you already have a 12-volt soldering iron you are in luck, as that will simplify things as you can use it instead of building the resistor-spike unit.

Operation is the same either way. Merely plug the device into your car's cigarette lighter, then use it to unfreeze the iced-up moisture that's in your lock and doing such an effective job of keeping you out of the car.

Flat-tire alert

Nothing's more embarrassing than motoring nonchalantly along a comfortable stretch of highway only to discover you have one or more flat tires. Other drivers on the road honk and wave at you, but they're not just being friendly, nosiree. First thing you know, you've stopped at a roadside rest for a stretch of the old legs and an absolute stranger walks up to you and says "Hey buddy, you've got a flat tire!" Well! Is your face red!

But you don't have to put up with that awkward social situation. You can prepare yourself in advance with this simple flat-tire alert that not only tells you that you have a flat, it is so advanced that it even tells you which tire has let you down.

This circuit, while simple, represents a more complicated design problem than you may appreciate. Originally, we tried placing a simple visual system (camera and one light) inside each tire, but results were not promising. We even tried placing the light across from the camera hoping the change in air pressure would change the image, but it was no-go. In addition, the tires became very difficult to balance and we experienced some problem with the camera cables twisting.

Instead, we opted for an external plunger assembly located adjacent to each tire. Under normal driving conditions (Fig. 3), the plunger handily clears the road surface even when fully extended. But in the event the bottom of the tire becomes flat (Fig. 4), the bearing-mounted end wheel rides along the ground while compressing the plunger assembly.

The plunger mechanism itself (Fig. 5) consists of a rod that rides up and down against a compression spring in a slotted sleeve. An actuator tab protrudes through the slot in the sleeve and contacts the actuator leaf of a microswitch, which provides the electrical signal to the circuit (Fig. 6).

A plunger is located adjacent to each tire. LED's 2-5 correspond to each tire. In addition, LED1 is connected as a current-summing WIRED-OR indicator; it not only glows any time any tire is flat, the more flat tires, the brighter that LED glows.

Calibration of the circuit is simple. After installing the plungers, release air from the tires until they represent the tire shown in Fig. 4 (if your tire goes flat on the top or side instead of the bottom, write for advice). Adjust the switch and tab position until the corresponding LED lights. As you proceed through all four tires, you should observe LED1 glowing progressively brighter. When all four plungers have been calibrated, restore the tires to their appearance as in Fig. 3.

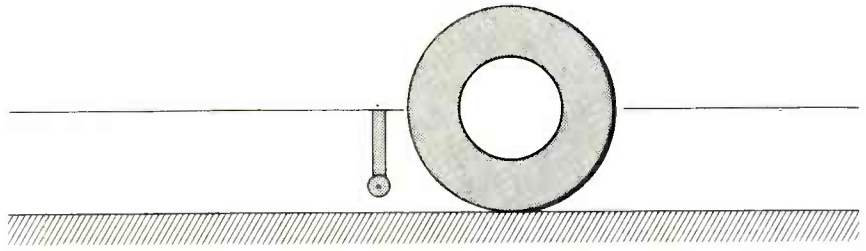


FIG. 3—FLAT TIRE ALERT is shown under normal driving conditions. Note that it clears the road surface even when fully extended.

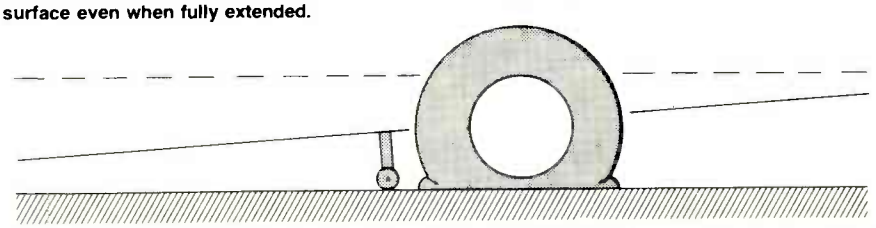


FIG. 4—BEARING-MOUNTED end wheel rides along the ground and compresses the plunger in the event of a flat.

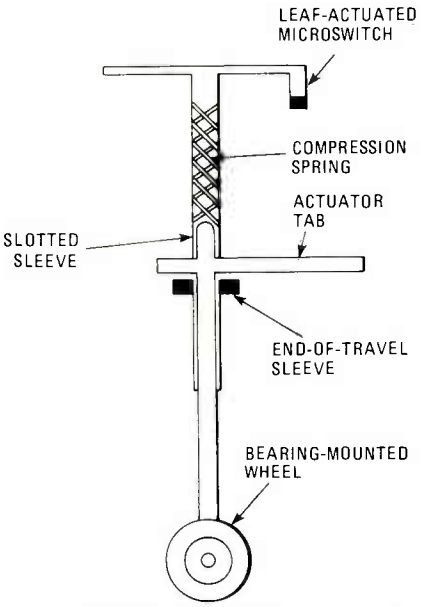


FIG. 5—PLUNGER MECHANISM consists of a rod that rides up and down against a spring in a slotted sleeve.

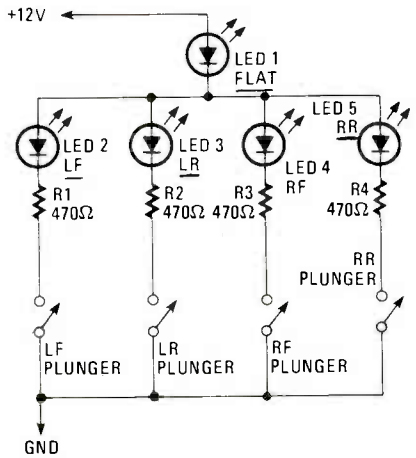


FIG. 6—WHICH TIRE is flat is indicated by LED2-LED5. Additionally, the more flat tires, the brighter LED1 glows.

This circuit should be wired into an accessory circuit, since the 80-milliamp drain that would be represented by all four tires being flat could eventually discharge the battery if you do not notice the lighted LED's.

Collision detector

The same plunger mechanism (Fig. 5) acts as the crucial switch element in a collision detector.

You know the problem. You need to go downtown and the only available parking is parallel parking. Well, everybody knows the only practical approach to parallel parking is the touch system. But let your brakes get just a little bit soft or your acceleration just a little bit peppy and before you know it, your car is an instrument of sculpture, providing design refinements that Detroit never anticipated.

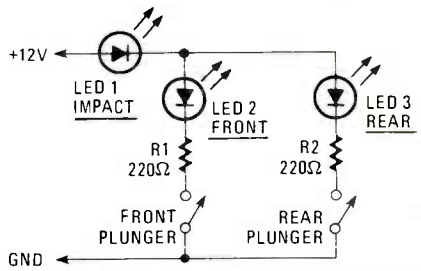


FIG. 7—COLLISION DETECTOR indicates when an impact has taken place and tell you which end has been hit.

Or you're changing lanes on the freeway, only some idiot isn't going fast enough ahead of you. You know nobody can hear horns at freeway speeds, so you give him a little nudge to get his attention.

Or you park the car on a hill in neutral and forget to set the parking brake.

Could happen to anyone. Next thing you know, your car's missing from its parking space and off on a little trip of its own.

Any of these situations could lead to a serious collision, but how can you tell when it happens? Well, our little collision detector not only alerts you to the collision, it even tells you if you've been hit from the front or the rear. And if you're simultaneously hit from both front and rear, the "impact" LED glows twice as brightly. The circuit is shown in Fig. 7.

The plungers mount to the front and rear bumpers; on recent models with impact-absorbing bumpers, they can mount between the inside of the bumper and the body—or on standard bumpers, they can mount externally, between the bumper and the colliding person or object.

Wiper-blade maintenance check

Safety officials insist that one of the worst hazards to good vision—especially in inclement climatic conditions typified by substantial precipitation—is a set of poorly-performing wiper blades. In addition to not clearing weather off the window effectively, bad blades can streak the windows miserably, further impairing a driver's view of the road, and his ability to drive safely.

This useful circuit (Fig. 8) helps you keep your wiper blades up to snuff by prompting periodic checks under actual conditions of inclemency.

An array of conductive fingers, SW1, separated by narrow non-conductive paths is used as the sensor. Copper foil cut in a manner similar to the schematic symbol and glued to the outside of the car's windshield (outside the wiper sweep area) can do the job handily. The remainder of the circuit is a simple PNP transistor switch, which turns on the CHECK WIPERS LED any time the SW1 array detects water or snow on the windshield.

This device helps assure that wipers are checked during rain and snow falls for proper operation; similar maintenance checks performed without precipitation present could precipitate inaccurate conclusions and unneeded maintenance costs.

Open-hood alert

There is one driving hazard that has never received adequate coverage in any publication! This shocking omission has at least once been alleged to be the result of concentrated suppressive efforts of pressure groups within the automotive body repair industry—the one industry that most stands to profit from any increased incidence of collision damage incidents. (This same industry has been alleged to be the force behind lobbying efforts aimed at encouraging so-called "go straight on red" legislation.)

The hazard that we are not only *daring* to report here, but *actually daring to try to prevent*, is the danger of driving with the car's hood open. This rolling death threat not only greatly diminishes a driver's ability to see ahead, it also provides an opportunity for death by electrocution in the event of extremely saggy overhead wires.

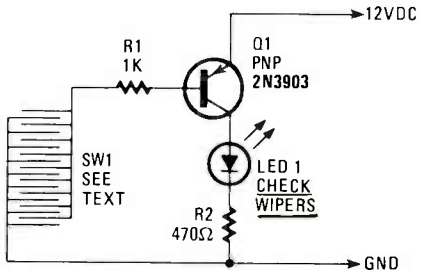


FIG. 8—AN ARRAY of conductive fingers (SW1) separated by non-conductive strips is used as a sensor.

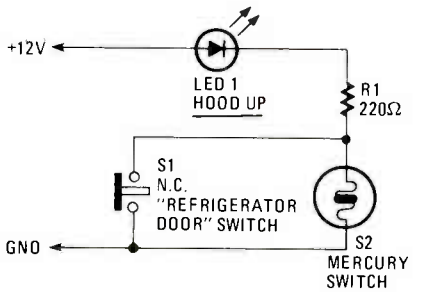


FIG. 9—OPEN-HOOD ALERT uses a refrigerator-door-style, normally closed, momentary switch.

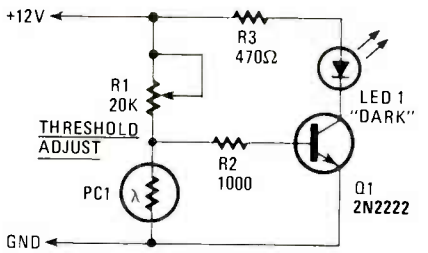


FIG. 10—THIS CIRCUIT monitors ambient light conditions and alerts the driver of insufficient light.

And there's the potential for damage to garage doors—plus the potential for damage to your engine while it's denied the protective covering of its hood.

We went through a great deal of trouble in going through several designs for an effective open-hood alert. Photoelectric techniques were tried, then rejected since the angle of a hood-mounted reflector couldn't be precisely predicted at every highway speed and road condition. Small radar transmitters alongside (but shielded from) radar detectors proved effective (an open hood bounced the signal back and triggered the radar detector), but there are licensing difficulties.

We finally arrived at the fail-safe circuit shown in the schematic (Fig. 9). Switch S1 is a refrigerator-door-style normally closed (open when held in) momentary switch, which is mounted in the engine compartment in such a way that unless the hood is closed securely, the switch is. Switch S2 is a mercury type mounted on the hood itself in such a way that it's off when the hood is down, but when the hood is up it signals "tilt."

If the hood should swing open while you're driving, the switches will close, lighting the HOOD UP LED.

Due to the severe consequences of this potentially dangerous occurrence, we strongly recommend that you check this LED often while driving.

Ambient illumination-insufficiency alert

You've been driving since dawn, about 17 hours straight. Nightfall just kind of snuck up on you—you're a little tired, anyway—and before you know it you're driving in the dark with no headlights. Or you've pulled off the bright, sunlit street and into a dark parking garage or a tunnel—and in the confusion, you forget to check your headlights.

Either way, your visibility is greatly impaired. But this handy little circuit (Fig. 10) monitors the ambient-light level and alerts you to conditions of ambient-illumination insufficiency by lighting a DARK LED (not to be confused with the D.E.D., or Dark Emitting Diode, introduced by National Semi several Aprils ago).

Light-sensitive resistor (or photocell) PC1 is placed where it can sample the ambient illumination. Potentiometer R1 adjusts the light level that triggers the dark response. Resistor R2 limits current to the base of Q1, and R3 limits current through its collector and the LED.

Here's hoping this and the other circuits presented here help make your motoring safer and more comfortable.

If you have any comments on these *Six Unique Projects for Your Car*, or can suggest some of your own, please write us at **Radio-Electronics**, Dept. Apr-1, 200 Park Avenue South, New York, NY 10003. **R-E**

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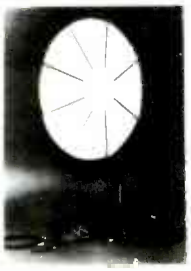

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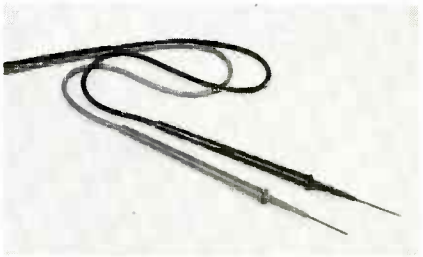

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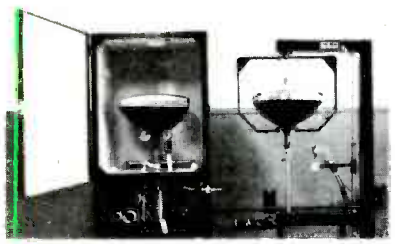

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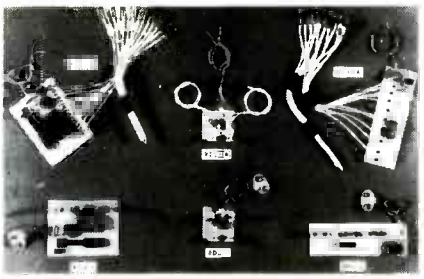

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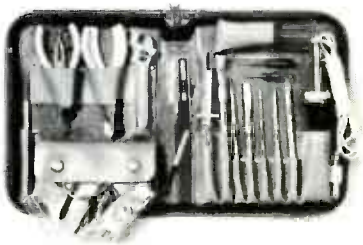

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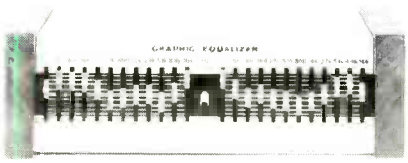

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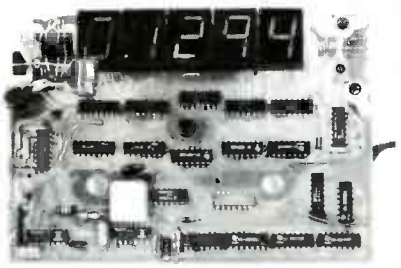

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APRIL 1982

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Radio Electronics YOUR OWN Computer Hardware APRIL 1982

Bally Arcade

MARC STERN

Add the soon-to-be-released ZGRASS-32 *unit to the Bally* Arcade *and get a personal computer capable of producing outstanding graphics.*

IN MANY INSTANCES, THE DECISION TO BUY A HOME COMPUTER is difficult. That is true especially if the ultimate use for a home computer is somewhat uncertain. Very often, the potential customer is interested in using the computer to play elaborate video games and is unwilling to spend the necessary money for a full-blown computer system. In response to that need, several manufacturers have developed programmable video games that can be expanded into a computer system at a later time. Most notable is Matell's *Intellivision*, although the computer expansion is still only in the test-marketing stage. Another system along those same lines is the Bally *Arcade*.

The name "Bally" has long been associated with the coin-operated video arcade-game field. Bally's coin-operated video games have featured high-level graphic capability with imaginative animation. However, the name "Bally" hasn't been associated with the computer field at all; in fact, it would normally seem out of place in a computer buying guide. But that isn't the case any more. "Bally" is now linked with the personal computer world, thanks to this brand-new computer offering.

Actually, it is a Bally unit in name only; while the unit was developed by Bally, it was later sold to Astrovision Inc. (6460 Busch Blvd., Suite 215, Columbus, Ohio 43229). Astrovision is currently marketing the unit, which is correctly called Astrovision's *Bally Arcade*.

The base unit, shown in Fig. 1, is a video game. It is designed to connect to the antenna terminals of a standard TV set, and comes complete with four *joysticks*. However, the joysticks are unconventional in that they are not operated by moving the joystick. Instead, there is a knob on top of the joystick that is operated using your fingers. The joystick also contains a *trigger*. The front-panel of the *Bally Arcade* contains a keypad with 24 keys and a slot for the pre-programmed cartridges. The *Bally Arcade* is capable of producing 256 colors on your TV screen, however, only four can be displayed at a time.

Internally, the *Bally Arcade* has a Z80 microprocessor that operates at 1.8 MHz. There are also two custom LSI IC's, and a video processor that operates at 7 MHz and handles all color manipulation and animation effects. The video processor provides NTSC video to the TV set. The second custom IC is the I/O processor that handles up to four joysticks, four analog-to-digital converters, and the 24-key keypad. The I/O processor also creates the music and sound effects. Three separate sound synthesizers provide both AM and FM noise over a frequency range of 2 Hz to 100 kHz. An 8K internal ROM contains the software routines for color and sound effects that are used with the plug-in cartridges. In addition to the ROM, the unit comes with 4K of RAM. Of that RAM, however, only 1800 bytes are user available; the rest of the memory is used by the video display. In its basic form, the *Arcade's* memory can not be increased.

A video game is only as good as the games available, and there are some nice ones for this unit. *Space Fortress*, shown in Fig. 2, is much like the coin-operated *Space Zap* game. *Munchie*, shown in Fig. 3, is a variant of the popular *Pac Man* game. *Coloring Book with Light Pen* (Fig. 4) lets you create your own "art work," making full use of the system's graphic capabilities.

The *Bally Arcade* supports *Astro BASIC*, which is an enhanced version of *Bally BASIC*—one of the many versions of BASIC that has come into existance. *Astro BASIC* is available as a plug-in cartridge that includes an audio-cassette interface for program storage. Programming is accomplished through the 24-key keypad.

What we've seen so far gives us little reason to classify the unit as little more than an advanced video-game. What qualifies this unit is an add-on that will be available sometime this year. That add-on is called *ZGRASS-32*. Among that unit's features are a full-size ASCII keyboard, 32K of ROM, and 16K of RAM. Resident in the ROM is ZGRASS, a powerful graphics-oriented language. With the *ZGRASS-32* add-on, all programming is done in ZGRASS.

The *Z GRASS 32* add-on makes the new system unique.

FIG. 1—THE BALLY *ARCADE* video game is shown here in it's basic form. The games shown are only a few of those available.

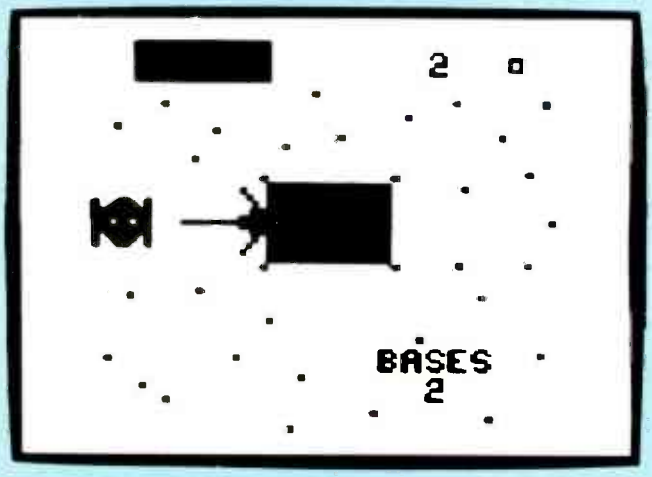


FIG. 2—SPACE FORTRESS video game.

With it a user has full graphics capability. Commands such as CIRCLE, BOX or LINE can be used for direct creation of graphics. A further indication of the potential of ZGRASS, which is also the operating system for the unit, can be shown by having a user draw a figure running across the screen using a peripheral light-pen. The user first draws the picture he wants with the pen and then indicates movement by moving the pen across the monitor screen. The figure will then run across. By using the SNAPSHOT command, the figure can be stored in memory for later recall. That indicates that there is a high degree of memory mapping in the 160 by 100 display. With this high degree of display memory-mapping, formatting displays for video games becomes easy.

The *Bally Arcade* has an interesting variation in its memory mapping. Rather than using the upper left-hand corner for 0-0 coordinates, the *Arcade* uses the center of the screen for its 0-0 location, and everything is determined from there. That makes it easier for a user to create and store graphics, rather than beginning in the upper left, which can complicate things. The graphic display is stored in memory under a macro (user-created) name.

Another indication of the power of the graphics system is typeface creation. A user has the ability to create an infinite variety of typefaces.

The *ZGRASS-32* includes two RS-232 serial input/output ports for data exchange. Data storage can be increased by adding up to two cassette recorders. Unlike other slow-speed cassette program-load systems, this one operates at a high 2000-baud rate. When a particular file is found, a menu of that particular file is displayed.

Apparently, Astrovision has plans to make this unit a full-capability personal computer. The reason is for suspecting that is that it will also interface with disk-storage systems, ranging from mini-floppies up to Winchester drives. The smallest Winchester drives provide a 5-megabyte storage capability.

As we mentioned, the *ZGRASS-32* system includes 32K of ROM and 16K of RAM. That RAM can be increased to a full 64K, allowing the use of the optional *CP/M* operating system. With *CP/M*, the *Arcade* with the *ZGRASS-32* add-on can become a versatile small business computer as it would be possible to use many of the most popular business programs.

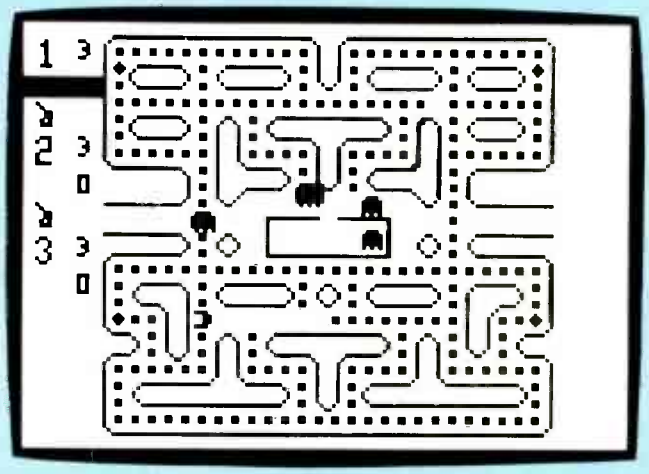


FIG. 3—MUNCHIE, a version of Pac Man.

FIG. 4—CREATE PICTURES with Coloring Book with Light Pen.

Software that runs under *CP/M* ranges from word processing to accounting to database management.

No video-game-based personal computer would be complete without some type of voice-synthesis feature, and Astrovision's *Bally Arcade* is not an exception. Included in the *ZGRASS-32* add-on is a Votrax voice-synthesis IC.

Since the *ZGRASS-32* unit has not yet appeared on the market, the pricing and distribution plans are not finalized. However, the add-on keyboard for the video unit is projected to carry a suggested retail list of $599.95. The add-on unit includes the extra ROM and the keyboard. It was unknown at press time whether there would be a printer, or what type of disk system would be available. R-E

Radio Electronics YOUR OWN Computer Hardware APRIL 1982

Commodore VIC20

Looking for a full-featured, expandable computer system at a reasonable price? The Commodore VIC-20 may be right for you.

MARC STERN

COMMODORE BUSINESS MACHINES (681 MOORE ROAD, KING OF PRUSSIA, PA 19406) has always been a leader in the personal-computer field. For example, that company has been credited with helping to start the personal-computer revolution by developing the first system that you could simply uncrate and plug in. Now, Commodore is continuing its reputation as a leader with the introduction of the *VIC 20*, a full-featured, expandable computer at an affordable price.

Don't be fooled by the suggested list price of $299.95—this is a sophisticated machine. The heart of the unit is a 6502 eight-bit microprocessor. It comes with 5K of user-available RAM; that can be expanded to 32K using plug-in cartridges. The *VIC 20* has an extended BASIC built into its operating system. That version of BASIC is a powerful language; it allows for features such as animated graphics and string manipulation, and offers such high-level commands as PEEK and POKE. Other interesting features of the extended BASIC are tape file-handling commands such as OPEN, INPUT#, PRINT#, and CLOSE. (We'll look at the *VIC 20's* cassette-tape system shortly.)

The *VIC 20* has a 65-key typewriter-like keyboard, which is set up to simplify the generation of both text and graphics. Four keys, located on the right-hand side of the keyboard, are programmable-function keys. They are unused when the computer is first turned on, but any BASIC command or instruction set can be assigned to them; that is done under program control. The keyboard also features special function keys. They include: CONTROL; RUN/STOP; RVS ON and RVS OFF (a user can reverse characters on the display from white on black to black on white); CLR/HOME (which either returns the cursor to its upper left position or clears the display); INST/DEL (that key simplifies editing); RESTORE (reset) and keys that move the cursor.

The INST/DEL key is one of the more interesting ones on the keyboard. When using that key it is possible to insert or delete a single character, rather than having to re-enter an entire line. That is a significant feature that makes editing or correcting your program much easier.

The computer is designed to get a beginner up and programming within a relatively short time. To help reach that goal, a step-by-step instruction manual and programming guide is supplied with each unit. The operating system also generates a series of English-language prompts and error messages that help make the machine even easier to use.

As with other systems, a cassette-tape recorder can be used to load and save programs. For that purpose, Commodore sells a high-quality cassette recorder called a *Datassette*. The *Datassette*, and several other peripherals for the system, are shown in Fig. 2. Incidentally, you pretty much have to use their recorder, because a special plug is used to connect the recorder to the computer.

One notable feature of the cassette system is the VERIFY command. That command allows you to check whether a program has been saved correctly on the tape. That feature is helpful because on some other systems the only way to check a program is to load it into the computer. If the recording is defective due to bad spots on the tape, low recorder voltage, etc., loading it into the computer will wipe out the good program in the computer's memory and the program will have to be re-enterd manually from scratch. If that's ever happened

FIG. 1—AMONG THE PERIPHERALS for the *VIC 20* are an 80-column printer, the *Datassette* cassette tape recorder, and a plug-in modem for use with any modular-type telephone.

to you, you know how frustrating and time-consuming it can be. The VERIFY command saves a user from those headaches; the original program is not erased.

When a program is stored on tape, it is given a file name. When you want to retrieve that program, the *VIC-20* searches the tape for that particular file and ignores all the others. A rather "human" touch is that the computer will "talk" to you while it is searching for a file. It will let you know it is searching for a file, will give you a list of the files on the tape, and finally announce when it has found the file.

One other feature of the cassette system is a rather unique method of recording data. Rather than recording it just once at a seemingly high 1,000-baud rate, the system actually records everything twice to insure the reliability of the data file when it reads back. When the tape is read, both versions are read, which effectively slows the data rate to 500 baud.

If you prefer using a disk-based system for saving your programs, Commodore offers the *VIC 1540* single disk drive, shown in Fig. 2. That disk drive allows you to store up to 170K on a standard 5½-inch floppy disk. The disk system is read/write compatible with Commodore's *PET* and *CBM* systems.

As we said earlier, the system's 5K of memory can be expanded to as much as 32K with the appropriate RAM cartridges. Cartridges are available with 3K, 8K, or 16K or RAM. A single cartridge can be plugged directly into the unit. For further expansion you'll need to purchase an expansion module. Up to six devices can be plugged into that module. Those devices include memory, program, and interface cartridges. Among the interfaces available are an RS-232 interface for modems, printers, and other devices, and an IEEE-488 interface for attaching *PET* and *CBM* peripherals.

FIG. 2—FOR THOSE WHO PREFER a disk-based mass storage system, Commodore manufactures the *VIC 1540* single 5¼-inch floppy disk drive.

Commodore has many more peripherals and program cartridges besides the ones we've already looked at. Among the peripherals are an 80-column dot-matrix printer, game controllers, and a modem that can be used with any modular-type phone. The modem, called, naturally enough, the *VICMODEM*, plugs right into the user port of the computer. It operates at 300 baud and features originate/answer and full and half-duplex capabilities.

Among the program cartridges are games, personal finance, and education programs, and a word processor. Several other program cartridges are of particular interest. One of those is the *Super Expander* cartridge. Commodore has put a great deal into that package. It includes 3K of RAM memory expansion; high resolution graphics; plotting, color, and sound commands, and graphic, text, multicolor, and music modes. It also offers better resolution than the normal 176 by 184 pixels. The programmable function keys that we looked at earlier can be used with the cartridge to make editing easier. The cartridge comes with a tutorial instruction book.

Another interesting cartridge is a *Programmer's Aid*. That cartridge offers 20 new BASIC commands that will help renumber, trace, and edit BASIC programs. It will trace any program line-by-line and permits easy editing. A special KEY command lets you redefine those special functon keys for BASIC commands, subroutines, or new commands.

The last cartridge we'll look at is for those that want to program in assembly language. It is the *VICMon* machine-language monitor; it helps programmers write fast, efficient 6502 assembly-language programs and includes a line-at-a-time assembler/disassembler.

FIG. 3—POPULAR SOFTWARE. Commodore provides a wide variety of popular software on cassette tape. A few of the titles are shown here.

There is also a wide variety of software on tape; some of the more popular titles are shown in Fig. 3. Among the tapes offered is one called *VICTerm I;* that program is a terminal emulator that converts the computer into a terminal for use with a telephone modem.

The *VIC 20* user has at his disposal several manuals to help him make the best use of his computer. One of them, the *VIC Programmers Reference Guide*, is intended for both novices and more experienced programmers. It's divided into four sections. The first is a dictionary of BASIC commands together with sample programs. The second is a layman's overview of machine-language programming. The other two sections explain how to interface the computer to a number of devices and how to program for graphics and sound.

Another is the *Introduction to BASIC Programming*, a self-instruction course using both a manual and program cassettes. **R-E**

Radio-Electronics YOUR OWN Computer APRIL 1982
Hardware

IBM

IBM's long-awaited small computer is here and it offers a surprisingly wide number of features to both personal and business users.

MARC STERN

ONE OF THE LONG-STANDING RUMORS IN THE COMPUTER INDUSTRY over the last few years had been that of IBM's entry into the personal computer field. That rumor began surfacing as early as 1976 and continued submerging and re-surfacing over the next few years.

The rumor became fact last summer when the computer giant jumped into the personal-computer fray with its IBM (IBM Personal Computer, P.O. Box 1328, Boca Raton, FL 33432) *Personal Computer*. This entry was made even more unusual by two departures from standard International Business Machine practices. First, the huge computer firm decided to use an outside software vendor for its personal computer, rather than using its own in-house resources. This was a radical departure in itself. The second departure was that the company actively encouraged software authors to write programs for the *Personal Computer* for its new Software Publishing Division.

In the past, it had been common practice for IBM to write its own computer software and set its own standards; then the rest of the industry had to follow its lead. However, this time, apparently acknowledging the long lead other software firms have had over the last few years, and recognizing the need for speed, the computer giant has changed its tack. But, despite this encouraging turn of events, there is a small fly in this ointment—the IBM disk operating system makes it mandatory that the user employ IBM's software.

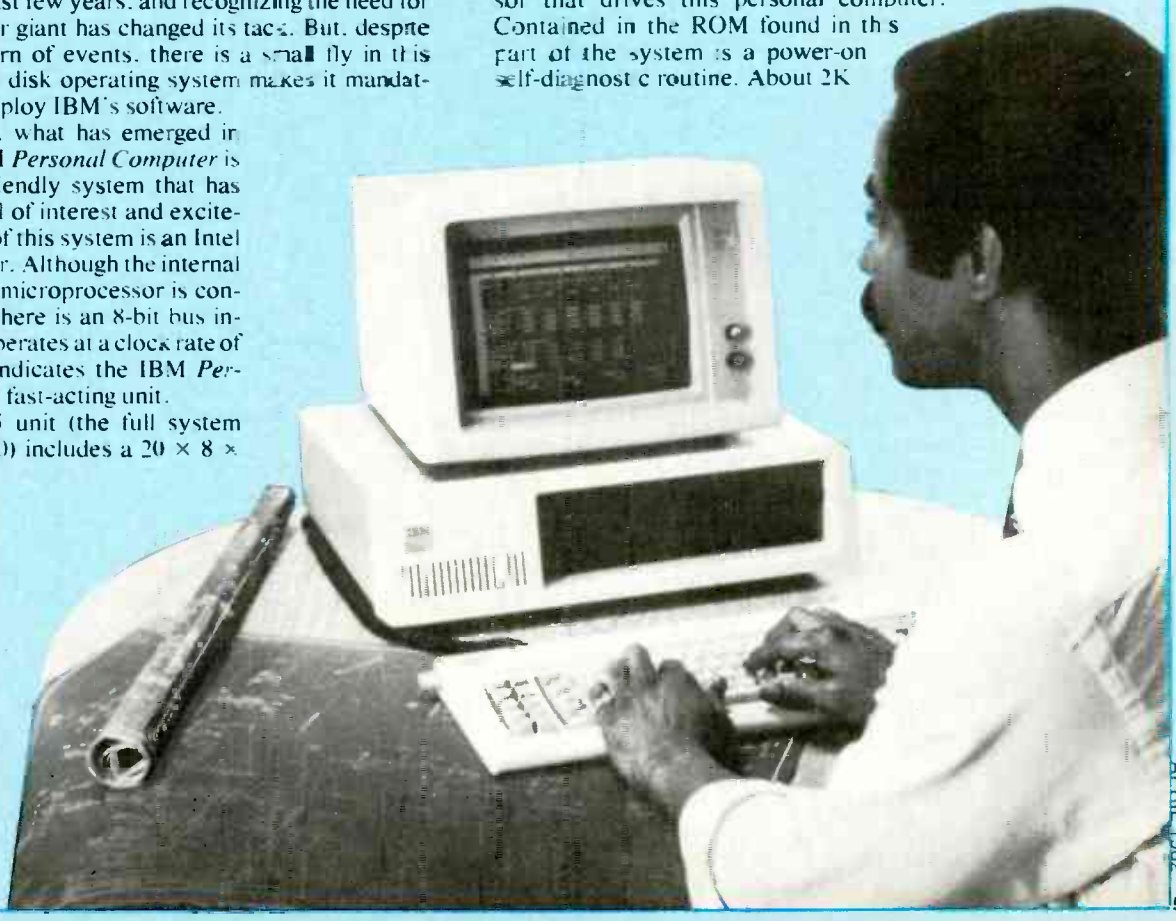
From all reports, what has emerged in the form of the IBM *Personal Computer* is a powerful, user-friendly system that has sparked a great deal of interest and excitement. At the heart of this system is an Intel 8088 microprocessor. Although the internal architecture of this microprocessor is configured as 16 bits, there is an 8-bit bus interface. The CPU operates at a clock rate of 4.77 MHz, which indicates the IBM *Personal Computer* is a fast-acting unit.

The basic $1,565 unit (the full system lists at about $4,500) includes a 20 × 8 × 2-inch sloping keyboard, that weighs 6 pounds. It has 83 full-function keys for text and data entry and includes 10 keys for numeric entry and cursor control. There are 10-special function keys for scrolling, editing and other purposes. All told, there is easy access to 256 ASCII and special characters. The keyboard is detachable from the System Unit. This latter part contains 40K of Read-Only Memory that holds the operating system and BASIC, as well as 16K of user-accessible Random Access Memory. The System Unit is the heart of the Personal Computer.

An interesting feature of the keyboard, is the 6-foot coiled cord that connects it to the System Unit. With this cord, it is possible to have a very wide work area. All the keys repeat automatically when held down.

Mass storage expansion is available by adding double-density, single-sided 5¼-inch disks. Up to 160 K-bytes can be stored on each disk, allowing for a total storage capacity of 320K-bytes. These disks are contained in the System Unit, that also houses a power supply, fan, the cassette input and output ports, and a speaker for musical programming.

The System Unit, as noted, contains the 8088 microprocessor that drives this personal computer. Contained in the ROM found in this part of the system is a power-on self-diagnostic routine. About 2K



IBM'S *PERSONAL COMPUTER* can be used in the office or schoolroom, or at home, for self-instruction or simply for pleasure.

of the ROM is used for this. It checks all parts of the unit, including the microprocessor itself. Any problems are reported to the user. The unit also contains the BASIC language interpreter and the 16K RAM. This is a fairly compact unit too. It measures 20 inches wide, 16 inches deep and 5½ inches high. By using memory add-ons (plug-in modules) the RAM can be expanded to 256K, which makes this quite a powerful system when fully configured.

Although the user has the option of adding his own printer, IBM offers its own dot-matrix unit. It is an 80-character-per-second unit that also runs its own self-diagnostic to assure proper operation. Twelve typefaces are available for various printing needs and features include page spacing and column skipping for word processing and column applications. It is a bi-directional unit for increased speed and can print 40, 66, 80 or 132 characters-per-line. It has a replaceable ribbon cartridge and print head.

The 11½-inch optional cathode-ray-tube display uses a green-phosphor screen. The 720-by-350-pixel resolution level and wide bandwidth produce a sharp, stable display. The display is 25 lines deep by 80 characters wide and includes capabilities for underlining, high-intensity blinking characters and a inverse video for highlighting information. There are also upper and lower case letters displayed for word processing and brightness and contrast controls for reading comfort. An interesting feature of the display is the potential for non-display of an area of the screen a user might consider sensitive. For users not wanting the IBM monitor, the System Unit outputs NTSC video, so you can connect the System Unit to television monitor or, using an RF modulator, to a standard TV receiver.

The IBM's *Personal Computer* also features extensive color and graphics capabilities. It can display alphanumerics using 16 foreground, and eight background, colors. In the graphics mode, four colors are available. Its medium-resolution graphics display allows an array of 320 by 200 pixels. In the high-resolution mode that increases to 640 by 200 pixels.

Communications Ability is available through the use of an asynchronous communication line. This makes it easy to interface the IBM *Personal Computer* with databases (*The Source*, *MicroNet*, *CompuServe*) other computers, laboratory instruments or any other devices with a standard RS-232C asynchronous adapter. It is reported to be programmable and compatible with different bit and parity rates.

Other optional features include the addition and use of joysticks and paddles.

There are three versions of BASIC available for the IBM *Personal Computer*. These are based on the popular Microsoft BASIC. The cassette level BASIC is included in the ROM of every system and provides all the input-output instructions needed to enter and retrieve data. It supports the use of the keyboard, display, light pen and printer and provides a full complement of editing and mathematical functions. It also allows the user to program the user-definable special function keys and will also display the function of each definable key, although this feature can be defeated.

The other two levels of BASIC—disk and advanced—are optional. The disk extension supports the use of disk, while adding date, time of day and communications capabilities to the system. The advanced extension enhances the display graphics to include features such as POINT, CIRCLE and GET/PUT display, while increasing light pen and joystick support for design work and home entertainment.

Disk BASIC is part of the IBM disk operating system and requires 32K of RAM, while the advanced level requires even more RAM—in the area of 48K. Interestingly, the disk BASIC also provides support for the system's musical functions when the PLAY command is used.

The disk operating system itself, which supports one or more disk drives, allows the user to write or read from the system's removable disks, display a directory and rename, erase, display or copy files. It is similar, but not exactly the same, as the popular operating system CP/M, which is found in many personal computers. This effectively restricts the user to IBM-supplied software—you can't use the large number of CP/M-based programs that are on the market. However, this situation should be rectified soon. IBM has been working with Digital Research, the creators of CP/M, to make the operating system available on the *Personal Computer*. It has also been working with SofTech Microsystems, Inc. to make the advanced UCSD p-System available. These two changes should provide the opportunity for current applications software to be moved over to the IBM *Personal Computer* with minimal changes.

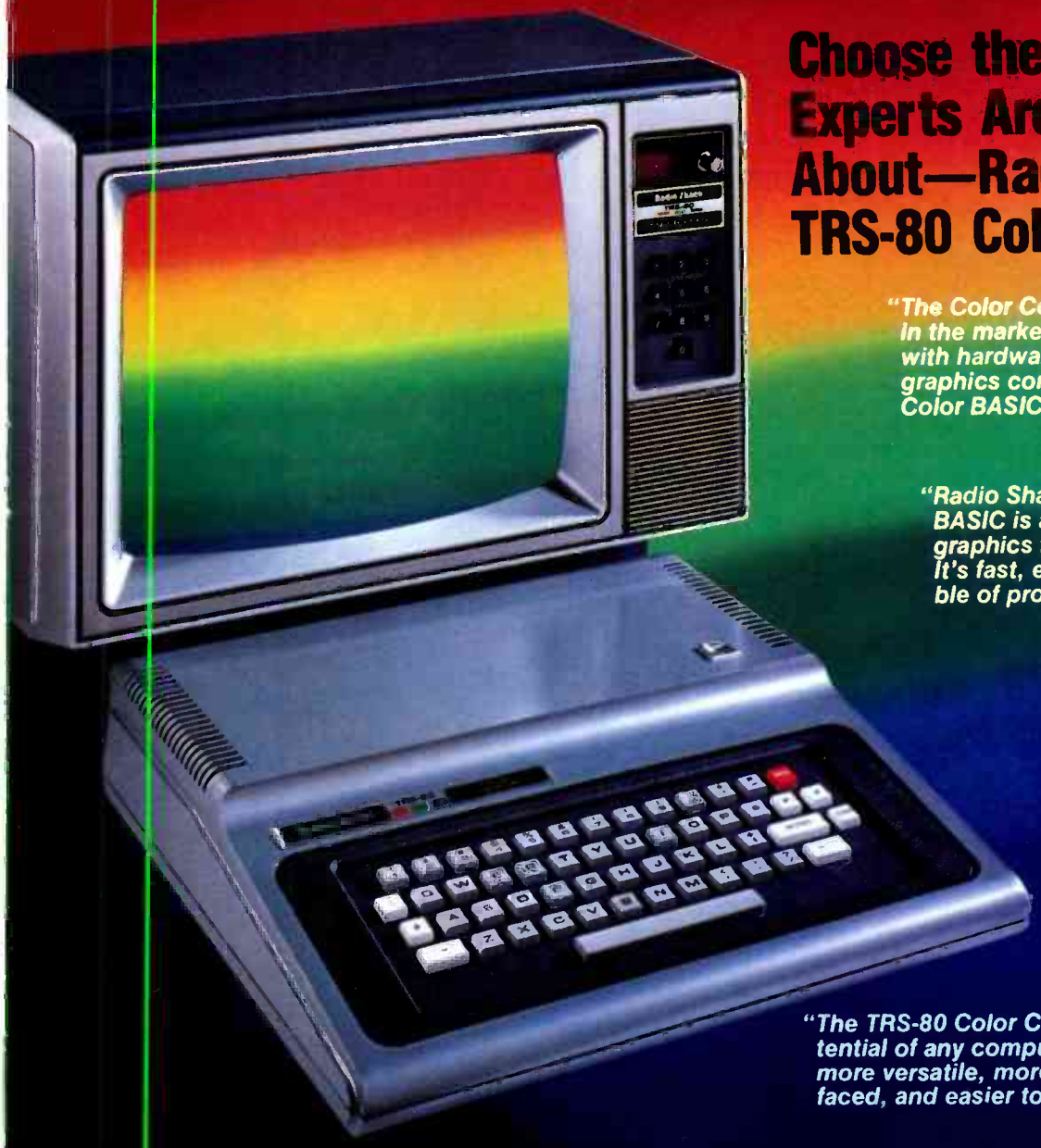
This personal computer also has another powerful language tool, a Pascal compiler. This language compiler allows separate compilations of program elements for maximum system performance. It also supports several programming features for advanced programming work.

A broad range of applications software is currently available from IBM for its new system. It includes the problem-solving program package for financial or mathematical forecasting and computations, *VisiCalc*; Peachtree Software's *General Ledger*; an accounts receivable and an accounts payable package, also from Peachtree Software; *EasyWriter*, a word processing package from Information Unlimited Software, Inc; Microsoft *Adventure*, and communications utilities.

The communications package is set up so the IBM *Personal Computer* will be able to communicate with larger systems. IBM intends to provide a full subset of 3270 emulation capabilities. As a result, this microcomputer is a good choice for both the hobbyist and the business system user and means that it can be interfaced with existing mainframes for data exchange.

And, speaking of data exchange, the Asynchronous Communications Adapter will support a baud rate of up to 9,600. This means you get a rapid and high-order data exchange.

Overall, the IBM *Personal Computer* seems to be a powerful tool for both the hobbyist and serious business user. Even though IBM entered the personal-computer fray late, it looks like its representative on the front lines of this battle is a potent contender. The competition will have its work cut out for it. **R-E**



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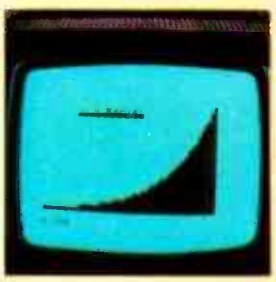

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Osborne

Considering the competition in the microcomputer field, this would not appear to be the best time for a young, small company to introduce a new computer. That is, of course, unless it has a product that is truly different.

MARC STERN

ENTERING THE MICROCOMPUTER FIELD IS A RISKY BUSINESS at any time. There are market forces to contend with, the challenge of bringing out the product on time, and the challenge of staying in business altogether. That has never been more true than today, now that two of the giants in the computer field—IBM and Xerox—have introduced their own personal computer. Add to that the strong competition from firms already established in the field, such as Radio Shack and Apple, and it's easy to see that it's a highly competitive market.

But market conditions did not deter Dr. Adam Osborne or his company, Osborne Computer Corporation (26500 Corporate Avenue, Hayward, CA 94545), from introducing their *Osborne 1* computer. There are two factors that make that system unique. The first is that it is a complete turnkey system—from plug. to hardware, to software. The second factor is that the whole system is priced at less than $2,000, with the basic system carrying a suggested retail price of $1,795.

At the heart of the portable, full-featured unit is a powerful Z80 microprocessor. The system includes a full 64K of RAM. There is also 4K of bank-switch ROM containing the operating system. The access time for the programmable memory is 250 nanoseconds; it is 350 nanoseconds for the ROM.

The *Osborne 1* comes with a detachable 70-key ASCII keyboard that connects with the monitor unit through a 10-inch ribbon cable. That makes the *Osborne 1* convenient to use because the user can separate the keyboard from the monitor unit and move it nearer to where he is working.

The beauty of the machine, aside from its instant start up and run capability, is its size. It measures 20.5 × 13 × 9 inches and closes like a small suitcase. That means that the user can take it and use it anywhere (see (Fig. 1).

Another feature of the unit is its built-in video monitor. There is one serious problem with that monitor, however: It is extremely small. While the small size—3.55 × 2.63 inches—may be adequate for field work, in most cases it just won't do for other applications. However, there is an accessory 12-inch monitor available. The display system is memory mapped, and features full scrolling.

But it takes more than a monitor to make a full-featured, fully integrated system. For example: The *Osborne 1* has two built-in 5¼-inch disk drives. That isn't an add-on, but is

part of the entire package. You can store up to 100,000 characters of data on each disk. The disks have 40 tracks each and 10 sectors per track. There are 256 bytes per sector. The maximum seek time is 12 milliseconds from track-to-track.

The *Osborne 1* also includes several built-in interfaces. One of them, a serial RS-232C interface, is used to connect the computer with serial printers, modems, or other devices. It is software-switchable, with a data rate of either 300 or 1,200 baud. It features handshaking to control the transmission rate. A nine-pin plug is included for use with an external modem. An adapter allows the connection of both a modem and printer simultaneously. Another interface is an IEEE-488 general purpose instrumentation bus for data communications with test instruments.

In an interesting departure from industry norm, Osborne is supplying EPROM's with its units in order to protect its software vendors. They are being used presently just for controlling various drive functions, but they could be encoded so that a machine's serial number would appear on the software if it were copied.

As a turnkey (plug-it-in-and-go) system, the *Osborne 1* is supplied with some sophisticated, powerful software. For starters, the disk-operating system is the industry-standard *CP/M*. Built into *CP/M* are such functions as a PIP (*P*eripheral *I*nterchange *P*rogram) that provides for file transfer between devices and disk files, and an ED text editor that allows the creation and modification of ASCII files. The ASM, fast 8080 assembler, also included in the *CP/M*, uses standard Intel mnemonics and pseudo operations with free-format input, conditional assembly, and assembly-line expressions. There is also a DDT (*D*ynamic *D*ebugging *T*ool) that contains an integral assembler/disassembler module that patches and displays memory in either assembler mnemonic or hexadecimal form, and traces program execution with full register and status display.

Some of the commands available include SUBMIT, which allows a group of *CP/M* commands to be batched together in a single SUBMIT command for submission to the operating system; a STAT command that displays and alters input-output device and file status, and a LOAD command that converts Intel hex format to absolute binary. In addition, the SYSGEN command will generate a new CP/M system diskette for backup purposes.

There are other powerful tools included in the software, including two forms of BASIC. Apparently not believing that one system of BASIC was enough, Osborne has included both the CBASIC (Digital Research) and MBASIC (Microsoft) languages.

CBASIC is a commercially oriented compiler/interpreter designed for use with *CP/M*. It consists of the compiler, the run-time monitor, and a cross-reference listing of all variables used in a CBASIC source program (XREF.COM).

MBASIC, on the other hand, is a BASIC interpreter for *CP/M* systems and is aimed more toward general computer applications. It supports many enhanced features and includes a line editor as part of the interpreter.

Because of the use of MBASIC, the *Osborne 1* has the potential to be a great personal computer. Through the PEEK and POKE commands, the user has direct access to memory. The EDIT command makes program editing easy, and provides an edit mode for subcommands.

Also included in the standard software is a *WordStar*/*MailMerge* package. That package, which is *CP/M*-compatible, provides an extensive text-processing and standard-form producing system. In addition to word processing and standardized forms, *MailMerge* lets you merge separate files and data into a single document. The standard package also includes *SuperCalc*, a management-oriented productivity tool. For a computer user who has had little or no programming expertise, that provides a way to manage and manipulate data interactively.

FIG. 1—A TRULY PORTABLE, all-in-one computer system the *Osborne 1* folds up like a small suitcase so that it can be easily transported.

There are few peripherals available since so much is included in this very-complete package. We've already mentioned the 12-inch monitor—which I think is almost necessary for serious computing. A modem cable is available for use with an acoustic coupler. There is also a battery pack available that is good for one or two hours of operation. (That power source, while useful for field work, also has a place in the office. It can provide system backup in case of power failure and could very well keep the system up and running at a crucial moment.) Mass storage capability can be increased markedly by using the accessory double-density disk drives. Those increase mass storage to 200K per drive. Further mass storage is available by using a Corvus hard-disk system, which allows the computer to be used for a broader range of industrial and commercial applications.

An optional *Micro-Link* program is available that lets microcomputers communicate over telephone lines with each other, large computer systems, and terminals. The program, which requires a minimum system memory of 16K, allows the *Osborne 1* user to contact data bases, bulletin boards, and time-sharing services.

Osborne has some aggressive marketing plans. It plans to compete head-to-head with the computer giant, IBM, in terms of units in the field. IBM is said to be targeting to have five million of its personal computers in the field over the next five years, and Osborne is aiming at the same figure.

Osborne Computer Corp. has charted an ambitious course for itself. Only time will tell if this relatively new company will succeed in that aim, or whether the industry skeptics who have said it can't be done are right. **R-E**

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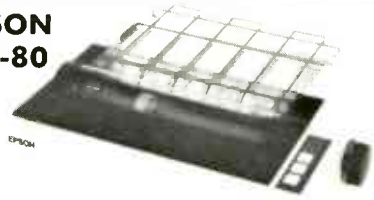

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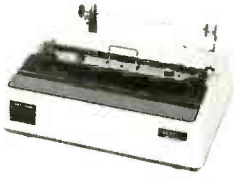

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NEC

Nippon Electric Company's (NEC) PC-8000 computer is aimed at the business and high-end personal user.

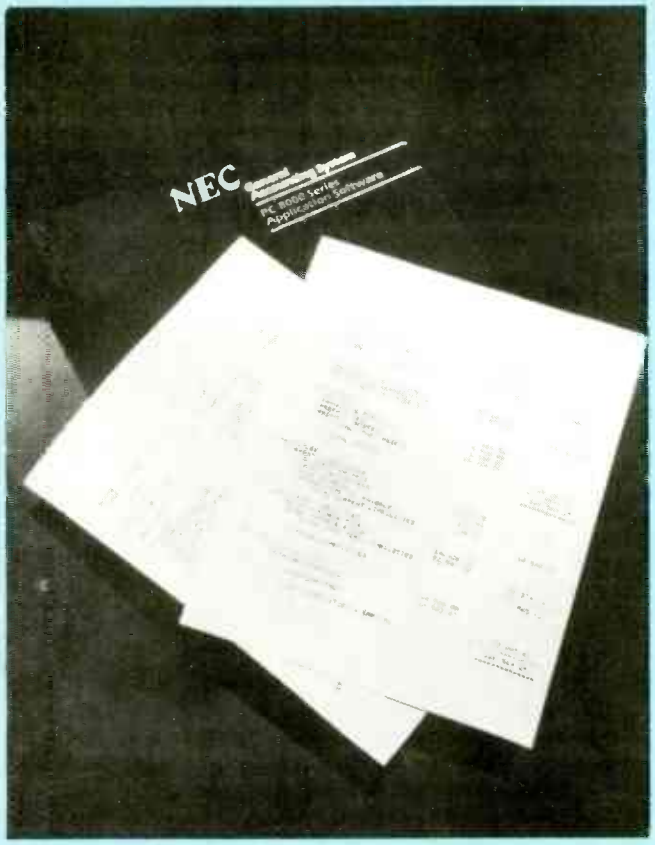
MARC STERN

NEC HOME ELECTRONICS (USA) (1401 ESTES AVENUE, ELK GROVE Village, IL 60007), is another of the many companies competing in the hotly contested microprocessor market. In fact, this microcomputer company is trying a very aggressive marketing strategy, aiming at several markets at once: the home computer market, the corporate market, and the small business market.

With such an ambitious plan of attack, what features does its system offer that set it apart from the many other systems on the market? One thing the NEC system offers that no other system on the micro market seems to offer, is a 12,000-word dictionary built right into its word-processing software package. This feature aside, the other functions of the NEC *PC-8000*-series microcomputer system are comparable to the rest of the microcomputer market.

The heart of this microcomputer system is a Z80A-equivalent microprocessing unit (MPU). It is housed inside the *PC-8001A* keyboard unit. The MPU runs at a clock speed of 4 MHz. The keyboard, with full ASCII capability, has 82 keys and includes a numeric keypad for rapid data entry. Five of the keys are user-programmable and can define 10 functions. These keys are conveniently located at the top of the keyboard, rather than at the side as in other systems, which means that the operator doesn't have a long reach to access them. But the dual nature of the keys may present a problem. Since they are capable of supporting 10 functions, it could be hard to access the functions that need control key or shift access because that adds another step to an otherwise smooth process. Perhaps smaller single keys should have been considered rather than five large dual-function keys.

There is no built-in cathode-ray terminal, although two different 12-inch monitors are available: one color and the other black-and-white. The color monitor can display 20 or 25 lines. Line length, as in other microcomputers, is variable, allowing 36, 40, 72 or 80 characters per line. A powerful editor simplifies programming and includes four-way cursor control and character insertion and deletion. There are 248 characters available which can be presented in any one of eight colors. Resolution on the screen, while not as high as that of some others on the market, is 160 by 100, and more than adequate. In the word-processing mode, N-key rollover input allows high-speed typing. An 8-pin connector is used for the keyboard-monitor interface. The display also includes a built-in sound system that greatly expands the range of



A GENERAL ACCOUNTING SYSTEM package is just one available from NEC. Others include a report manager and word processor.

possible uses.

The basic *PC-8001* keyboard unit has 25K of read-only memory. Resident in this ROM is another of the many sons of Microsoft BASIC, N-BASIC. There is also 32K of random access memory available. This memory can be expanded to 64K when the *PC-8012* input/output unit is added.

Mass storage is available with dual floppy-disk drives. The drives are interfaced with the keyboard unit through a parallel port in the rear. This same port supports the expansion interface unit, the *PC-8012A*.

The expansion interface is the heart of the expanded system. It features 2K of read-only memory. Interestingly, this ROM is available as programmable read-only memory chips, which are optional. That could make it possible to tailor this unit more closely to a user's needs. The basic random access memory in the input/output unit is 32K. It is expandable to 128K with additional plug-in boards. There are seven slots available for expansion boards and eight priority levels can be implemented with up to 16 real-time interrupts possible. The I/O unit will also support the disk drive unit. There is also another parallel port available for further system expansion.

NEC's uses a parallel printer port. The printer is a dot matrix, bi-directional 100 character per second unit. The matrix is 7 by 9 for English characters, 8 by 8 for graphic characters and 8 by 8 for dot-graphic printing. It is a full ASCII printer with complete upper and lower case capability. It also includes graphics capability for Greek, mathematic and graphic characters.

As mentioned earlier, the *PC-8000* system can address up to 32K of memory in its standard form, and this is expandable to 128K by simply adding module boards. The resident N-BASIC is a version of the many Microsoft variants on the market and includes such commands as PRINT-USING and IF-THEN-ELSE. It also allows double-precision floating-point mathematics, flexible and powerful graphics commands, plus the ability to invoke TERMinal with a single command. Interestingly, the ability to program in a BASIC language that is compatible with the nearly universally accepted industry standard Microsoft BASIC should give the user access to many existing specialty programs. The user can also access various parts of the memory with the POKE command that will put data into specific memory locations. It is part of the resident monitor. The only departure from the normal list of commands is the lack of a PEEK command to allow the user access to what is already in various memory areas. This could be a drawback if the user already has crucial information in one area and then overwrites it with new information because he didn't know anything was already there.

For the beginning computer enthusiast, NEC offers a guide called *Creative Programming*. This book is designed to help early users become comfortable and confident with microcomputer operation in four lessons. It was developed in cooperation with Eastern Illinois University and designed by Creative Programming Inc. It covers such basics as an introduction to computer language instructions and the significance of the BASIC functions; how to write a program, and how to load a program. Each lesson is accompanied by a series of exercises that allow the user to experience first-hand the concept presented.

The *PC-8000* uses the CP/M operating system and, because it does, a wide range of software is available. This is especially important if the user would like to expand the capabilities of the system, although NEC does offer a wide range of software of its own. NEC software packages include a new microcomputer program with three active calculating dimensions: Report Manager. This program creates and instantly updates a complete variety of reports for financial, accounting, engineering and scientific applications. Unlike other two-dimensional reporting systems, this program generates business reports such as income statements, balance sheets and sales forecasts. It can also produce bar charts, a feature not included in other electronic spread sheet products. Also these reports can be created from any place in the X, Y and Z axis "data cube" generated by the program.

There are other software packages available that include a General Accounting Package and the Word Processing package with the unique built-in 12,000-word dictionary.

The basic *PC-8000* system lists for under $6,000 and includes the color monitor, input-output expansion interface unit, the keyboard/Z-80A unit and two 5¼-inch disk drives. The disks, probably single-density, provide mass storage capability of up to 100K.

It's interesting to note that nowhere in any of NEC's literature is there any mention of interfacing this unit with a phone modem for data network access, although this is probably possible by adding the expansion interface. Since the unit is set up for parallel I/O, this would require a modem capable of supporting parallel, rather than serial, I/O. This is an omission that should be clarified because the system is touted as being capable of working in a small business or corporate environment. If there is no phone or network interface then it's hard to see how this system might interface with a company's existing system or how it might transmit information from a satellite office to the mainframe in the home office.

The *PC-8000* is advertised as a word-processing color-computer system, and indeed it is. But, it is hard to see how its color capabilities can be fully realized in a work environment. In a home environment, where data isn't printed out in black-and-white report form, it is a nice feature—in a $6,000 package—but in an office environment it is hard to see how this feature will be used. In a scientific environment, though, it is a valuable aspect of the system.

NEC has entered the hotly contested microcomputer market with the first color word-processing system. It's a different approach from the manufacturer of the leading personal computer in Japan. **R-E**

Radio Electronics YOUR OWN Computer APRIL 1982
Hardware

Sinclair ZX81

Small size and a low price do not have to restrict a computer's capabilities.

MARC STERN

CLIVE SINCLAIR IS THE DEVELOPER OF THE FIRST UNDER-$200 eight-bit microcomputer programmable in BASIC. He is credited with developing the first pocket calculator 10 years ago and with the development of the first miniature television, Microvision, six years ago.

It has always seemed that when someone said that something couldn't be done, Sinclair has set out to do it. So it was only natural that he brought out a full-featured eight-bit microcomputer for under $200.

That was the Sinclair *ZX80*, introduced in 1980. However, as observers noted at that time, it had display problems and a very limited memory function. Those problems, though, have been corrected in the updated *ZX81*, which was released in Boston late last year. The unit is being marketed by Sinclair Research Ltd., 50 Staniford St., Boston, MA 02114.

The basic *ZX81* consists of a 40-key, pressure-sensitive keyboard; a built-in VHF RF modulator; 1K of static RAM memory, 8K of ROM, and generates a black-on-white display (when connected to the antenna terminals of a standard TV receiver) of 24 lines by 32 characters. The heart of the system is an eight-bit Z80A central-processor unit.

The power requirements of the computer are slight. It requires 9-volts DC at about 700 mA. Although a wall-plug type supply comes with the unit, you can also, if you choose, use your own. The supply need not be regulated. (While the computer-end plug of the supply provided by Sinclair will also fit into one of the device's tape jacks, no damage, we are assured, can take place if this is done.)

The updated *ZX81* is aimed at the beginner. The target is the person who wants to learn what computers are about and how they work. As such, it is an interesting building block for the novice computer user. It is a way to approach computers without being intimidated by them.

While its graphics capabilities have been improved, the *ZX81* is still limited to a rather large dot matrix configuration. The line length is short, as compared to other units. The *ZX81* is interfaced to a TV receiver by the RF modulator, which is one of the inhibiting factors in the display. To be fair, though, the graphics capability has been upgraded.

The computer has two keyboard-selectable operating speeds: COMPUTE AND DISPLAY and FAST. The first provides a continuous display, with the computer doing the actual computing during the TV's vertical-blanking interval. The second allows the computer to run its program most of the time, displaying information only at the end of the program, or at other specific intervals.

The result is that, while the computer runs about four times faster when in the FAST mode than when in the other, most of the time you are left staring at a blank display-screen.

Apparently answering criticisms raised when the unit was first introduced, Sinclair has opted for more power in the CPU. That includes Sinclair BASIC resident in the ROM that emulates the *Apple II* BASIC.

The BASIC interpreter allows multi-dimensional string and numerical arrays, while at the same time featuring floating-point arithmetic. That provides a range of 3×20^{-39} to $+7 \times 10^{+38}$, which is accurate to 9 digits.

That indicates that there is some scientific functionality built into the unit. The *ZX81* will also handle full log, trig, and their inverse functions.

It is a user-friendly machine that features automatic syntax-error detection and program editing. It also offers randomized functions that are useful for both game and serious applications.

There is no disk-operating-system available with the *ZX81*. Instead, it relies on program loading and saving through a serial cassette-recorder interface. However, it operates at a high enough baud rate to allow random file access under a master name. That puts the *ZX81*'s operating speed in the 1,000-baud area. No special recorder is required, the company says, so a beginning computer hobbyist can use his own.

In its basic configuration, the *ZX81* is equipped with only 1K of static RAM memory. However, that can be expanded by 16K via a module which plugs into the rear of the unit.

The keyboard is easy to use in that many of the keys serve

multiple functions and have the BASIC statements assigned to them. In other words, there are various single-stroke capabilities built in. That feature makes the machine a good choice for the beginner. For instance, when using the monitor program, a user can PEEK or POKE information into specific memory locations at the touch of one key. The same is also true of such statements as THEN, TO, GOTO, GOSUB and AND. As noted, it is also possible to edit with a single keystroke, and it is possible to use one keystroke for PRINT, LIST and RUN.

Those easy functions should prove a boon to the beginning computerist, but they indicate that the system could have been more powerful. It seems there is more capability hidden in the microcomputer than this particular system allows.

One drawback that many people who are comfortable with standard keyboards may find is the use of a plastic-membrane type of keyboard. Granted, the 43-character keyboard does offer a total of 91 built-in functions (when the inverse key is hit) but it is still a membrane unit. When other manufacturers have tried that approach, they have met with little success and have had to return to typewriter-type keyboards.

When you first look at the *ZX81* it looks like a very modest microcomputer. Weighing in at only 12 ounces and with dimensions of 6 × 6.5 × 1.5 inches, it is very little larger than a coffee-table book. Yet its developer is quick to defend its capabilities. When the new version of the *ZX81* was introduced at a Boston press conference late last year, Sinclair said that it was "...not a reduced-support machine. The language it uses is complete."

One of the reasons given for the ability to keep the cost down was Sinclair's policy of doing only the tooling, development technology, and design work in house. The manufacturing is done for Sinclair by Timex in Dundee, Scotland.

Not only does Sinclair offer the plug-in memory-expansion module; it also offers its own cassette software. That includes business and household programs, as well as educational and game programming. However, outside software houses are also being encouraged to write programs for the *ZX81*.

Aside from the plug-in module, there is only one other peripheral offered: the *ZX* Printer. That is a dot-matrix unit which is rather noisy. The *ZX81* comes with a built-in printer interface.

Since this microcomputer is a learning tool, one would expect it to come with a programming course—and it does. Sinclair provides a 164-page elementary programming course.

Not only does the manual provide a rather thorough explanation of how to program the *ZX81* in BASIC, but its later chapters and appendices supply other useful information as well.

There is information on machine-language programming, which can make programs run much more quickly than in BASIC. A listing of system variables along with their memory locations is provided—knowing what information is stored where can make program debugging easier, and can also allow you to make your programs run with more style and efficiency.

There is even a section for people who already are familiar with BASIC explaining the differences between Sinclair's BASIC and others.

The Sinclair *ZX81* is priced at $149.95 in wired form. For the adventurous person, who wants to learn computers from the ground up, there is a $99.95 kit available. The memory-expansion module is priced at $99.95 and the serial dot-matrix printer is available for less than $100.

In the final analysis, the *ZX81* is a building-block unit. It is intended to train people who know little or nothing about computers. That is all it is intended to be.

If you already own a *ZX80* and want to upgrade it, a plug-in replacement ROM that contains the new 8K extended BASIC used in the *ZX81* is available. That is a user-installable IC that can be installed in the *ZX80* in a few minutes by using a screwdriver. That will allow the *ZX80* to use the new *ZX* Printer and it will also be software-compatible with programs intended for the *ZX81*. The replacement ROM and a new overlay for the *ZX80* keyboard sell for $39.95. **R-E**

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CP-208

CIRCLE 2 ON FREE INFORMATION CARD

Radio Electronics YOUR OWN Computer® APRIL 1982
Hardware

Pocket Computers

Once thought of as an impossible fantasy, a true computer that you can slip into your pocket is now a reality. Four such units are now available, with two more on the way.

MARC STERN

THE CONCEPT OF A POCKET COMPUTER BEGAN TO APPEAR IN science fiction stories, such as those by Isaac Asimov, over 30 years ago. Like many of the other ideas proposed in those stories, it was dismissed as pure speculation by most readers. But, again like many of the devices described in those stories, the pocket computer has become a reality.

The first hint that the pocket computer was indeed on its way came in the early 1970's with the introduction of hand-held calculators. While those first units were relatively simple, and rather expensive, that soon began to change.

Calculators acquired features such as memory, which allowed the user to store a single value that could be recalled or modified at any time, and functions such as roots, logs, powers, and trigonometic functions; that made the calculators much more useful in engineering, mathematical, and scientific applications. Soon after, calculators with individually addressable memories became common.

In the late 1970's, programmable calculators were introduced. The term "programmable" referred to the calculator's ability to "remember" a sequence of key strokes, and reproduce them on command. Some even had the ability to store the "program" on a small piece of magnetic material, so that it would not be lost when the unit was shut off. It was even possible to purchase plug-in ROM's for those units. Some of those ROM's were programmed to perform complicated calculations; others were programmed to—what else?—play games. But even a programmable calculator with all of the "bells and whistles" is not a computer.

That brings us to the subject of this article: true "pocket" computers. Pocket computers are sold in this country by four companies—Radio Shack (One Tandy Center, Ft. Worth, TX 76102); Sharp (10 Sharp Plaza, Paramus, NJ 07652); Panasonic (One Panasonic Way, Secaucus, NJ 07094), and Quasar (9401 W. Grand Ave., Franklin Park, IL 60131). Those units are not much larger than some of the early calculators that we talked about, but they are far more complex and powerful.

The Radio Shack/Sharp pocket computers

If the Radio Shack *TRS-80* (see Fig. 1) and Sharp *PC-1211* pocket computers seem similar, there is a good reason—both, although sold and serviced by different companies, are functionally identical. Both measure 11/16 × 6⅞ × 2¾ inches and feature a 57-key mini-keyboard, 1.9K of RAM, and 11K of internal ROM. Two proprietary four-bit CMOS microprocessors form the heart of the units. One of the microprocessors handles the arithmetic operations and the display routines; the other handles the BASIC interpreter and the input from the tiny keyboard. The units use a 24-character LCD display; each character is formed by a 7-by-5 dot matrix.

The pocket computers let you store several different programs in memory. Those programs are individually identified, and any one can be run by simply pressing a specified key. A 1,424-step memory is automatically partitioned for program and data storage, and there is a 25 data-element memory and a 48-step reservable memory for storing functions.

Although those are relatively tiny devices, they have many

FIG. 1—THE *TRS-80* POCKET COMPUTER is shown here with the slide-in printer and cassette interface. That peripheral turns the pocket computer into a complete "mini-system."

FIG. 2—AMONG THE FEATURES of the new *TRS-80 model PC-2* is a new, more powerful version of pocket BASIC.

of the features of larger units: for instance, an edit and debug mode that should make finding programming errors and correcting them easy. That function is handled by the monitor program; the monitor is contained in 4K of the ROM.

What sets the pocket computer apart from programmable calculators is that you can write and run your own programs in BASIC. The BASIC used by those devices is called pocket BASIC and appears to be related to Radio Shack's *TRS-80 Level I* BASIC, although there are considerable differences. The language is capable of supporting up to four nested subroutines or FOR/NEXT loops, and up to 15 levels of parenthesis. It can handle strings of up to seven characters.

Programs and data are entered using the 57-key keyboard. Although that keyboard is laid out much like a typewriter keyboard, don't expect to be able to touch-type: the unit's small size makes that all but impossible. If you prefer, Radio Shack offers a library of software, available on cassette. Among the subjects covered are real estate, personal finance, aviation, and games. To load those programs, or to save your own on cassette, you'll need one of the two peripherals available for the units—a slide-in cassette-tape interface.

The second peripheral is a dot-matrix printer that also includes the cassette interface. That peripheral turns a pocket computer into a complete mini-system. With that device, it is possible to get hard copies of programs, data, or results. It uses the pocket computer's PRINT and LIST commands to provide a 16-column alphanumeric printout on ordinary electronic-cash-register-type paper. The printer writes at approximately one line per second, and is powered by rechargeable nickle-cadmium batteries.

The *TRS-80 Pocket Computer* sells for $169.95. The suggested retail price for the Sharp *PC-1211* is $179.00.

As we went to press, both Sharp and Radio Shack announced the introduction of a new, more powerful pocket computer. The new units, the Radio Shack *TRS-80 model PC-2* (Fig. 2) and the Sharp PC-1500 (which, again, are functionally identical), feature a single 8-bit microprocessor and 2.6K of user-available RAM, expandable to 6.6K. The computer uses an advanced version of the pocket BASIC described earlier, and can handle two-dimensional arrays and strings of as long as 80 characters. For display, a fully addressable 7 × 156 dot-matrix LCD is used; both upper and lower case characters can be generated by the unit. Among the peripherals planned is an RS-232 interface. Currently available is a combination four-color printer/plotter and cassette interface.

The Panasonic/Quasar *HHC* pocket computers

The *HHC* pocket computer, developed jointly by Matsushita and Friends Amis of San Francisco, is sold in this country by both Panasonic (see Fig. 3) and Quasar; although the packaging is somewhat different, here is another case of two functionally identical computers.

The basic machine is available with either 2K or 4K of RAM. That user-available RAM is expandable, using external modules; up to six 8K modules can be connected to the computer at one time. The unit comes with 16K of internal ROM, which can be expanded to 48K.

The microprocessor used by the computers is a 6502. Special circuitry is used to keep the microprocessor "dormant" until it is called on to perform some task. That feature prolongs the time between battery charges (rechargeable nickle-cadmium batteries are used to power the unit and most peripherals), making the use of the 6502 possible. Without the circuitry, the microprocessor would discharge the batteries in about two hours. Other special circuitry is used to let the *HHC* retain programs and data after the unit is switched off.

The operating-system language used in those computers is SNAP, which is derived from FORTH. SNAP is used for maximum efficiency, as it is a fast-running, compact language. Programming can be done in either SNAP or BASIC, if the appropriate internal ROM is installed. The internal set of applications programs include a four-function calculator, a free-form file system, and an editor. Programming is done using the 65-key, typewriter-like keyboard. Any of the keys

FIG. 3—SOME OF THE PERIPHERALS available for the Panasonic *HHC* pocket computer, as well as the device itself, are shown here. Among them are an RS-232 interface, a modem, a color-TV interface, and a small printer.

can be redefined by the user when needed.

A 44-pin connector is used to connect peripherals to the *HHC*. Among the available peripherals are a bus expander, which lets you connect up to six different peripherals to the computer; a 15-column thermal printer; a modem; RAM, with battery back-up so memory is retained even when disconnected from the computer, and a color-TV interface. The interface will let you use a TV to display 16 lines of up to 32 characters each, or up to 48 × 64 graphic elements in eight colors and black. A monitor output is also provided.

The suggested retail price for the Panasonic *HHC* 4K pocket computer is $500.00; the suggested retail price for the 4K version is $600.00. The suggested retail price for the Quasar 4K computer is $525.00; the suggested retail for the 4K version is $595.00. R-E

Radio Electronics YOUR OWN Computer APRIL 1982
Hardware

Xerox

The king of office copiers has entered the personal computer market. Here's a close up look at the Xerox 820.

MARC STERN

THE BATTLE IN THE HOTLY contested personal computer market stepped up its pace early last summer when Xerox introduced its long-awaited microcomputer. Rumors and speculation abounded for some time about the impending entry of the copy king into the fray. It seemed like a natural extension of this company's work in the field of office automation. After all, it wasn't very long before the introduction of the *820* computer that the company introduced the *860* information processing system.

This entry into the personal computer market added another potent force in this volatile marketplace. However, Xerox's entry wasn't aimed at the personal computer hobbyist, it was targeted primarily at the business user. Although the potential for BASIC programming is more than evident with the availability of the Microsoft BASIC included in the software, Xerox downplays this aspect of the interactive nature of this machine. Instead, it emphasizes the user-friendliness and ease of use of the *820 Information Processor*.

The heart of this menu-driven system is a Z80 microprocessor. The MPU is contained in the display cabinet. It is softloaded with 64K of Random Access Memory and 4K of Read-Only Memory. The MPU operates at a clock speed of 2.5 MHz. This is slow when compared with other units on the market.

The basic system includes a 12-inch screen that displays white characters on a dark background and has a capacity of 24, 80-character lines. It includes dual RS232 serial ports, one for the printer and one for communications. Dual parallel ports are also standard.

The 96-character ASCII keyboard can be detached from the CRT unit to allow more convenient system use. A user can move the keyboard around (within the limits of the interface cable) so that the keyboard unit is nearer the work being done. This is convenience, because the user sometimes needs that kind of portability in a work area. It is also possible to position the keyboard on a user's lap for ultimate convenience. The keyboard is laid out as a conventional typewriter keyboard, but it also includes some extra function keys, such as HELP (more about this one later). To the right of the conventional keyboard are the rest of the special function keys, plus a numeric keypaid that facilitates entering statistical and numeric information.

Dual 5¼-inch floppy disk drives are included in the basic unit. With this form of mass storage, a user can store up to 92,000 characters of data on the single-sided, single-density disks. Optional 8-inch, single-sided, single-density, dual drives, that can store 250,000 characters, are also available.

A Daisywheel printer—the Xerox *630*—is available as an option. A 40-character-per-second device, it is a bidirectional unit.

Since the operating system of the *820* is CP/M and since the use of CP/M is so widespread, there are many applications packages written for it and the user can purchase a wide variety of standard business applications programs from Xerox or other vendors.

Let's face it, the Xerox *820* is not aimed at the computer hobbyist, but at the business user who may know little or nothing about computers. Since it is aimed at this user, it is menu-driven and, to be fair, those menus lead the non-knowledgeable user through the paces quite well.

For example, suppose a user presses the C (CLEAR) command to delete a file. The screen then prompts for the name of the file to be deleted. Next it returns to the Directory Menu after the deletion. To work on an existing document or to create a new one, a user presses command "A" from the Directory Menu and the screen prompts him for the name of the file. When the file is recalled to the screen, the Directory Menu is replaced by the Main Menu. The user doesn't even have to memorize keystrokes because the menus tell him what to do.

The HELP key is a special aid to the non-computer-oriented user. With it, if the user runs into trouble, simply pressing the button will bring up more information than is normally listed on the menu. This information then leads the user through the task.

The software available for the Xerox *820* includes word processing, CP/M, *Teletype* communications, MBASIC, CBASIC-2, COBOL 80, MSort and an electronic worksheet package. This is a powerful, but very expensive, selection of

software. Since there is very little ROM resident in the *820*, you can see that the software must be disk-loaded.

The software expense looks something like this. The 5¼-inch word processing package costs $500, while the 5¼-inch CP/M operating system costs another $200. The 8-inch word processing package costs $500, while the 8-inch disk CP/M operating system costs $200. And, anyone who chooses to buy the Xerox software must buy at least one software package for each system that is ordered.

The system itself is by no means inexpensive either. The minimum system costs $2,995 (display/processor, keyboard and dual 5¼-inch disk drives). The 8-inch disk-based system costs $3,795. These don't apear to be the kind of figures an average computer hobbyist would spend. The user does have the option of supplying a separate printer, although Xerox offers one for $2,900. It is interesting that the higher-level information system—the *860*—offers more and easier functionality, to boot.

One of the most interesting capabilities of this system is the potential of interfacing with the Xerox *Ethernet* network. This is, essentially, a high-speed data communications network. This is done through the *872/873* Communications Servers. Through the *871* Interactive Communications Emulator, the *820* can access a host computer at another location too.

As is obvious, though, all of these potentialities are aimed at the business, rather than the hobby, user. It is clear from the type of menu-driven system that is offered and from the lack of encouragement in programming. Of course, that potential is there should the user opt for the MBASIC package. But, it is an expensive option, much more in line with a business type of investment than with a consumer purchase. **R-E**

Radio Electronics YOUR OWN Computer APRIL 1982
Software

Disk Operating Systems

If you're not in any great hurry, a cassette-tape operating system may be adequate; but for fast and efficient loading and saving of your programs, you'll want a disk-operating system.

HERB FRIEDMAN

FOR PERSONAL COMPUTERS, FLOPPY DISKS (AND, MORE RECENTLY, hard Winchester-disks) are the most rapid and convenient way to store (save) or retrieve (load) data and programs.

The basic personal-computer package almost always includes some form of cassette data-storage system. Such a system converts the computer's digital signals to audio tones that can be recorded by an ordinary, low-cost cassette-tape recorder. However, a cassette-based system is much slower than a disk-based system. Of course, "slow" is a relative term, but to give you an approximate idea of what we mean, an income tax program that seems to take forever to load from tape—actually 3½ minutes—loads from a standard disk system in less than three seconds; a BASIC interpreter that takes over seven mintues to load from cassette tape takes about five seconds to load from disk.

For those not in a particular hurry, a cassette-tape system often proves more than adequate, expecially when you consider that the tape system is supplied with the computer (or costs an additional $50 or so for the recorder), while a basic disk system will usually cost upwards of $500.

But even when the time required to save and load isn't critical, there is still one major drawback to tape-based systems—file handling is rather difficult. If you're running software that writes data to and reads data from the tape, you must constantly jockey the tape to find "clean" (unrecorded) tape for saves, or the location of specific files to be loaded. It is true that some tape systems will search for particular files by reading the file names; but if the file is the third, fourth, or fifth recording on the tape, it can be frustrating to wait for the computer to locate and load the file, particularly when you're attempting to update the file(s) with new data.

A disk-based mass-storage system, on the other hand, handles files much more efficiently and conveniently. Files can be saved to or loaded from disks very quickly. It is possible to acess, use, or update/modify (read and write) complete files or parts of files. You can also chain files, append them, and intersperse them.

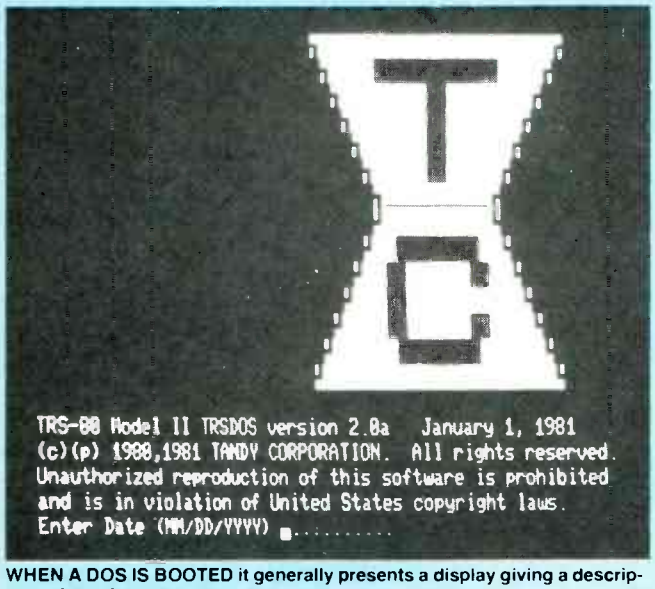
The precise method of handling disk files is determined by what's known as a DOS (*D*isk *O*perating *S*ystem), a set of control and utility programs that may also control the computer's peripherals. Primarily, the DOS performs housekeeping chores on the disk itself, reserving and managing the space on the disk and determining how the files will be accessed by the computer.

The methods used to access files are either *sequential*-

access, whereby a unit of stored data can be accessed only by reading every unit of storage that precedes it in a file (similar to a cassette-tape file), or *random access* (also known as *direct access)* whereby a block of data is accessed through a directory located on the disk that keeps track of physical location of every file on the disk.

The DOS also determines the memory requirements for files, controls the distribution of memory for files, regulates the execution of programs and utilities, controls the interchange of files between peripherals, and even gets the computer up and running.

The exact manner in which files are handled, and the types of utilities provided, are determined by the particular DOS and the computer for which it is intended. If the DOS is a "universal" one—like *CP/M*, which we'll discuss later—it can run on any computer using a microprocessor from the 8080/Z80 family. If the DOS is written specifically for one type of computer, such as *TRSDOS* for Radio Shack computers, or *HDOS* for Heath/Zenith computers, it can be used only with those types of computers. There are many reasons for that, among them are the different ways the tracks on the disk are used, different computer memory-configurations and device drivers, etc.



WHEN A DOS IS BOOTED it generally presents a display giving a description of itself and a "prompt" for the user to follow.

Another factor that can lock a computer into a particular DOS is the way it "boots" the computer. In order to run, a computer must contain a program, but in order to load a program a computer must be running. It's a sort of "Catch 22" situation: Essentially, the computer must lift itself up by its own bootstraps. In many modern computers the boot program is in a ROM which, in turn, causes the DOS to be loaded. In others, the ROM has just enough "intelligence" to read a boot program from a disk. Then *that* program loads the DOS into the computer.

There are major differences in the way various disk operating-systems handle the transfer of information between peripherals. For example, in some computers the output to a printer, modem, or other devices (such as another terminal) is memory-mapped within the computer—the device is accessed by routing the data to be output to a certain memory-address—or is available at an I/O port. Those functions are controlled by the computer's *own* internal operating system. (In an *Apple II* computer, for example, the output to the printer is usually through I/O port #1.)

In other systems, particularly *CP/M* and *HDOS*, information interchange is through device drivers or peripheral interpreters contained in the disk operating-system. Without the DOS there would be no communications with or between peripherals, because the driver routines in those cases are not contained in ROM.

Utilities are important

In addition to taking care of file management and peripheral interchange, a personal-computer DOS will include several other utility programs. Among the most popular utilities for personal-computer systems are those that permit files to be copied from one disk to another. And, to copy files—or even just to *use* a disk—it must be formatted or initialized. Thus a DOS must also include a utility for initializing and formatting, one that will make a backup copy of a disk, one that will verify that the data written to the disk has been recorded correctly, and one that will check for system errors and inform you when they occur.

Because disks are extremely delicate—far more so than tapes—there is generally a "media test" utility to check the condition of the disk. That utility will either "lock-out" any defective tracks (by noting in the disk directory that those tracks should not be used by the computer), or will let the user know which tracks are defective so that he or she will not use them.

Once a disk is in use, the DOS provides complete file-management, providing, among other things, a directory of all the files on the disk that can include a description of the file-type and its size and attributes, and, in some cases, password protection, "kill" protection, and other useful features.

Aftermarket DOS's

Sometimes a DOS will not have all the features required by a user; the solution to that problem is to use what's known as an *aftermarket* DOS. For example, consider file copying. Although, generally, disks can be copied using only one drive, some DOS's, such as *TRSDOS*, require the use of two drives. That is one of the reasons for the popularity of *NEWDOS*, an aftermarket DOS for the Radio Shack *TRS-80;* it permits file copying with a single drive. *NEWDOS* also has a "screen print" function that lets you get a printout of whatever is displayed on the screen. There are other aftermarket DOS's offering similar, and additional, features as well as utility programs that can enhance existing DOS's.

CP/M—a "universal" DOS

Digital Research's *CP/M*, which is commonly taken to stand for *C*ontrol *P*rogram for *M*icrocomputers, is intended for computers using an 8080, 8085, or Z80 CPU, or another microprocessor capable of handling the 8080 instruction set. Its configuration in terms of the number of disk drives and number and type of peripherals is determined by the computer that it is used with. *CP/M* is used by more different personal computers than any other DOS. It is often implied that, because it is the most commonly used DOS, it is also "universal" in the sense that *any* computer running *CP/M* can use *any* *CP/M* software. That isn't exactly the case. Each computer requires a *CP/M* specifically prepared for it, or for a similar "family" of computers. Once *CP/M* is available for a particular computer, the machine can generally use software written to run under that operating system. If a particular piece of software cannot be used, the problem is most likely one of media incompatibility.

Media limits

CP/M, and software using it, is normally supplied on 8-inch, single-sided, soft-sectored, single-density disks. A number of software vendors, however, can provide the operating system and programs in a format to fit your particular system (5¼-inch hard-sectored, for example). There are versions for use on almost every computer that can follow the 8080 instruction set—and even for a few that don't.

The other major hindrance to "universality" can be the memory configuration of your computer. *CP/M* normally starts at memory location 0000H (hex). Some computers, though, already use that location (and the ones following it)

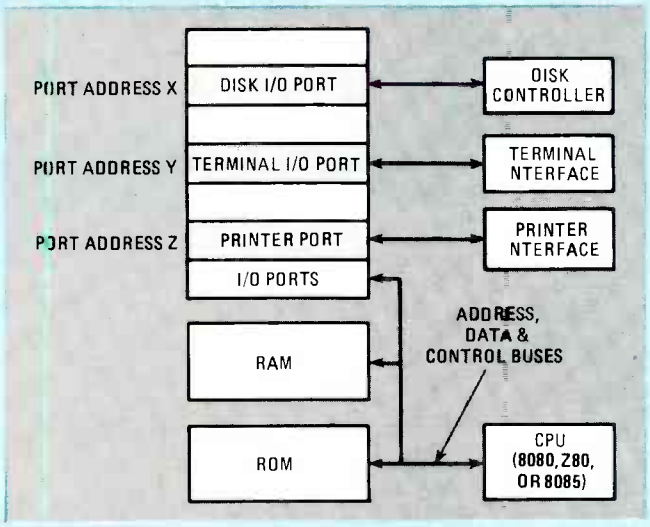


FIG. 1—HOW A TYPICAL COMPUTER SYSTEM is configured. *CP/M* eliminates the need for the programmer to worry about the exact I/O configuration of the machine by replacing the physical I/O devices with logical representations.

for their own purposes. Fortunately, customized versions of *CP/M* are available for most computers to overcome that problem.

"Logical" design

One of the problems in adapting a DOS to operate on a number of different machines is that the addresses of the I/O ports vary from machine to machine (see Fig. 1). *CP/M* solves that problem by not referring to specific addresses (in its unconfigured form). It replaces physical I/O devices with "logical" devices—programming representations of the physical devices. In effect, the DOS sees only command words and peripheral descriptions such as LPT (line printer), CON (console, or control terminal), TTY (teletypewriter), PTR (paper-tape reader), and so on.

CP/M has no idea where CON or LPT are located. Each manufacturer who takes out a license to use *CP/M* provides a BIOS (*B*asic *I*nput/*O*utput *S*ystem) that is tailored to the configuration of his computer. It is the BIOS that knows the hardware connections for the "logical" terms and recognizes, say, the command "PRINT" and directs the data that is to be printed to the proper port or memory location. If the user commands the DOS to copy a file from disk drive A to drive B, it is the BIOS that knows the I/O for the disk drives. Essentially, the BIOS serves as an interpreter between the "logical commands" and the hardware.

It is that logical structure that is primarily responsible for *CP/M's* universality, and the most important reason for its popularity. Here's an example that illustrates how it works: Assume that you are running *CP/M* on your system. When your version of *CP/M* runs a piece of software your BIOS will recognize the logical commands it contains and route data to the proper ports or memory addresses. If the software calls for an output to a printer, your own BIOS will recognize the logical instruction and see to it that the data goes to the appropriate port or address for the printer. The very same software can be used on another computer because *its* BIOS would provide the necessary hardware interpretations for the logical commands.

Should you create your own software, the program will contain only the logical commands. Assuming media compatability, you could give the disk to someone with a completely different *CP/M*-based computer and he would almost certainly be able to run the program without problems becauses his BIOS would interpret them in terms of his own computer's operating system.

Configuration

Another feature that makes *CP/M* "universal" is its flexibility regarding the use of peripherals. Each manufacturer decides specifically what peripherals and interconnects will be available through his BIOS; those can include many that were not originally intended for use with *CP/M*. A typical BIOS might include drivers for a CRT terminal, teletype, line printer, batch processor (card reader), paper-tape punch, etc. Considerable leeway is allowed as to what peripheral is used for a specific application, and the user makes the selection using a "CONFIGUR" utility. Incidentally, as is typical with many disk operating-systems for personal computers, *CP/M* comes with many commonly used utilities, including an editor and assembler.

More, more, more

As the software for personal computers becomes more sophisticated—in many instances equalling or surpassing the quality of that for the large mainframes of just a few years back—DOS's will also change and become more sophisticated to make best use of that new software. Disk operating-systems are constantly being improved, and steadily growing more complex. Even the "universal" *CP/M* may be replaced by a more versatile DOS eventually, and each innovation will generate further innovations. Every change or addition will contribute to making personal computers more powerful and easier to use. **R-E**

DOS SUPPLIERS

While nearly every manufacturer supplies a disk-operating system for his machine, operating systems are also available from many independent suppliers. The following is a partial listing of those suppliers.

ALTERNATE SOURCE
1806 Ada Street
Lansing, MI 48910

APPARAT, INC
4401 S. Tamarac Parkway
Denver, CO 80237

DIGITAL RESEARCH
PO Box 579
Pacific Grove, CA 93950

DYNAMIC MICROPROCESSOR ASSOCIATES
545 Fifth Avenue, Suite 1400
New York, NY 10017

LOGICAL SYSTEMS INC.
Mequon, WI 53092

MICRO SYSTEMS SOFTWARE, INC.
5846 Funston Street
Hollywood, FL 33023

MICRO MIKE'S INC.
905 S. Buchanan
Amarillo, TX 79101

MIDWEST SCIENTIFIC INSTRUMENTS, INC.
220 W. Cedar
Olathe, KS 66061

PHASE ONE SYSTEMS
770 Edgewater Drive, Suite 830
Oakland, CA 94621

SOFTWARE DYNAMICS
2111 W. Crescent
Anaheim, CA 92801

TECHNICAL SYSTEMS CONSULTANTS, INC.
Box 2570
1208 Kent Avenue
West Lafayette, IN 47906

Radio-Electronics YOUR OWN Computer Software APRIL 1982

High-Level Basic

What started out as a "primitive" teaching language has evolved into one sophisticated enough for creating complex programs.

JOSEPH BERNARD
TECHNICAL EDITOR

THERE'S A GOOD CHANCE THAT YOU'LL HAVE PURCHASED your computer with an eye toward using it eventually to help you in your business, or in your personal affairs.

In business, your computer can perform many of the functions that you may currently be doing by hand or "farming out" to a service that uses its own computers to process the data you supply.

At home you may want to use your computer to assist you with "homework" from your business life or just to simplify your personal record-keeping. Like many other people, these days, you may supplement your regular income with work performed at home; your computer can also prove useful for that purpose.

Whatever your purpose for using a small computer for serious applications, you should be familiar with what's involved. Other parts of this special section deal with operating systems and some of the application programs that are available. Here, we'll discuss what makes those programs run.

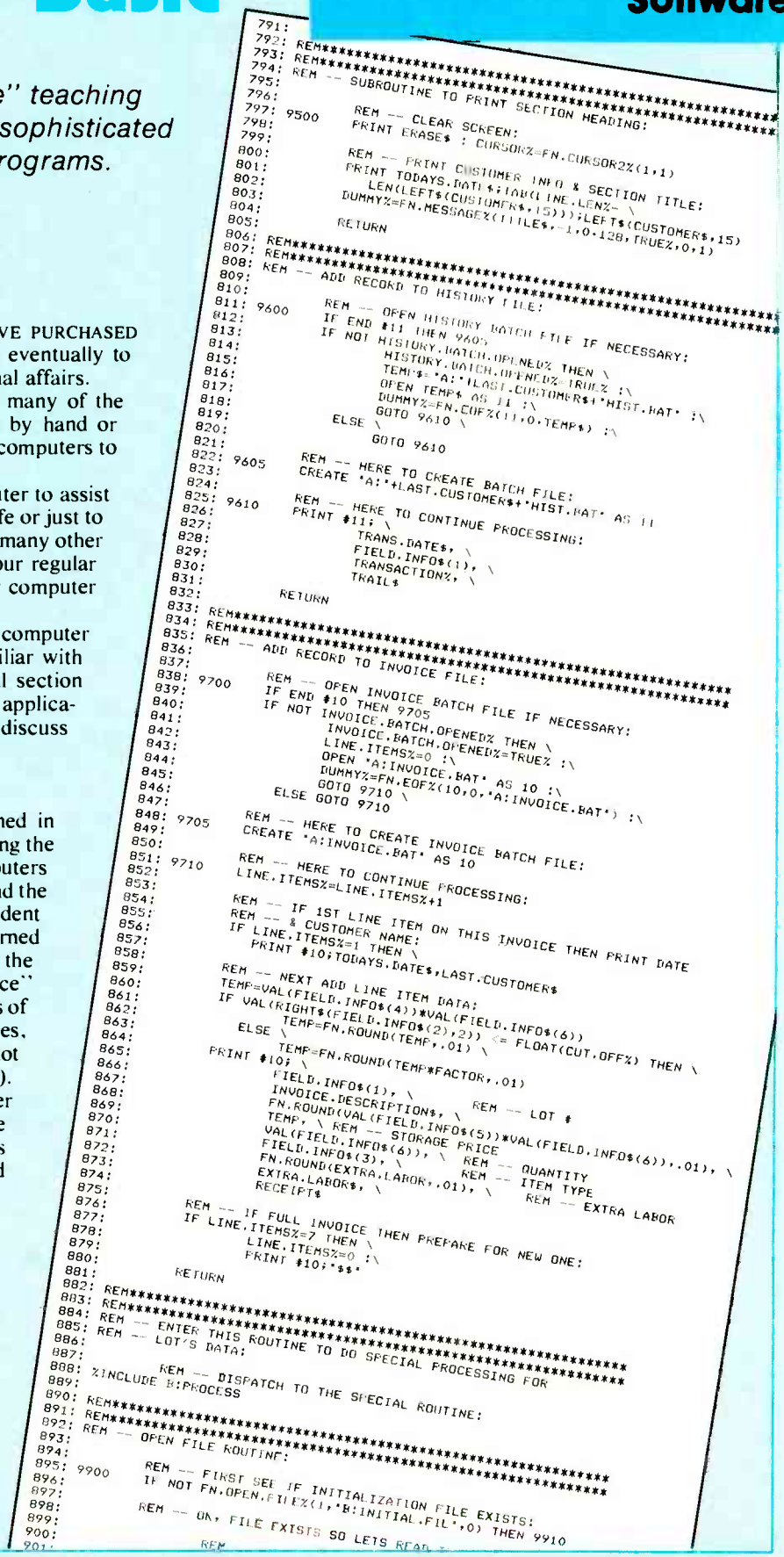
Operating systems

The monitor or operating system contained in your computer's ROM's is essential to bringing the machine to life. Without instructions, computers can do *nothing!* The first microcomputers (and the early big computers, too) didn't have resident operating systems. When the machine was turned on, a "bootstrap" program—one that gave the computer a rudimentary sense of "intelligence"—had to be entered manually through a series of toggle switches or, in the case of big machines, through punched cards (the kind you are not supposed to "bend, fold, mutilate or spindle").

The development of permanent computer memories, particulary ROM, allowed the machine to "come up" as soon as power was applied. From that point, the user could communicate with the computer and proceed to more complex tasks.

Your computer's operating system allows you to instruct the machine to perform a number of functions. Some of the ones that you probably don't think about are accepting input from the keyboard and generating the video display.

Others tell the computer how to output to a printer and how to communicate with a cassette recorder. CP/M, discussed elsewhere in this section, is a complete disk operating-system that makes use of your computer's operating system, and, in addition, adds features of its own.



A short history of BASIC

Besides coming with an operating system, your computer also contains a programming language called BASIC (*Beginners' All-purpose Symbolic Instruction Code*). The original version of BASIC was developed at Dartmouth University in 1963 by Professors J.G. Kemeny and T.E. Kurtz to allow students to program computers easily. It was what's known as an *interpreted* language, as opposed to most computer languages of the day, which were *compiled* (more about that later).

Serious programmers tended to look down on BASIC—while it was easy to use, it was quite inefficient for their purposes. The arrival of small computers change that.

The first personal computers required all data to be entered in binary form through toggle or paddle switches. The *IMSAI* computer, shown in Fig. 1, was such a machine. As you can imagine, it was extremely difficult to accomplish anything of practical value using the switches to enter data and the LED's to read it in binary form. A practical programming language was needed.

The first BASIC for personal computers was Tiny BASIC, which occupied only a couple of thousand bytes of memory (memory was very expensive in those days—4K cost about $250.00). That Tiny BASIC, a subset of the original Dartmouth BASIC, was refined and expanded in a series of articles and forums in *Dr. Dobb's Journal of Computer Calistheics & Orthodontia*.

The first "full-blown" BASIC was known as Altair BASIC, because it was written for use on a computer known as the *Altair*. It occupied 8K of memory, and was loaded into the computer from a cassette, taking several minutes to load. It was created by a company called Microsoft.

In those early days, each computer manufacturer supplied its own BASIC. Among the early BASIC's for microcomputers were a 4K (and later 8K) BASIC for the SWTP (*Southwest Technical Products*) *6800*, a BASIC for Processor Technology's *SOL*, known as "BASC5" and occupying a little under 6K (later—much later—followed by an "Extended BASIC" that required about 16K) and *Northstar* BASIC, on disk, for Northstar's *Horizon* computer. Finally there was a language called MBASIC for Microsoft. It was really the Altair BASIC, but was usable on other computers with the appropriate operating systems.

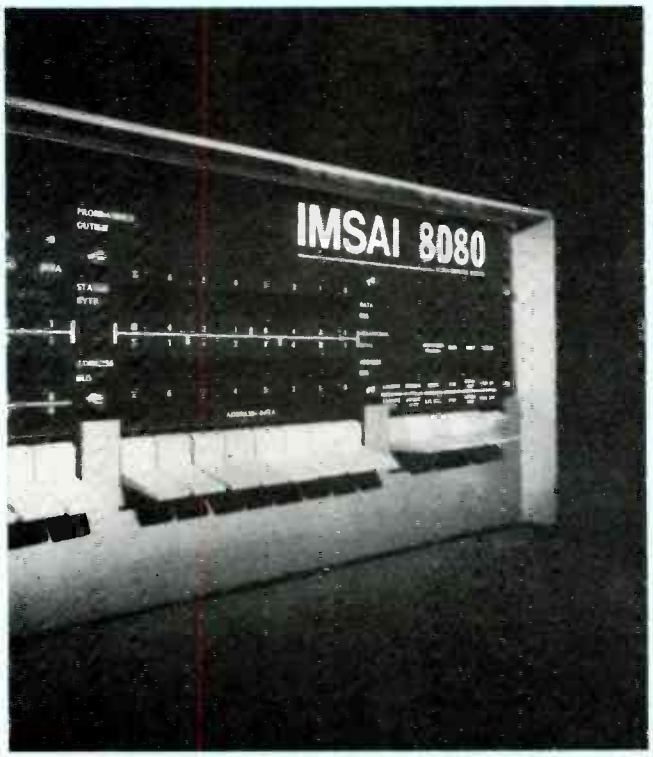


FIG. 1—AN EARLY PERSONAL COMPUTER, all data had to be entered manually, and in binary form, on this *IMSAI* computer.

BASIC's got larger and more sophisticated, but there were still problems. Each version of the language was tailored either to a particular computer and operating system or to a particular microprocessor—BASIC's were written in *machine code* (binary code using the *instruction set* specific to each microprocessor—the 8080, 6800, or 6502). There was no compatibility; BASIC for one computer would run only on that computer and, even then, all of the elements of the rest of the system had to be just right; a BASIC recorded on cassette using the Kansas City Standard could not be loaded into a system that used the Tarbell Standard. BASIC was evolving, but things were still a mess.

Even worse was the fact that what software (programs) existed had been created using a specific version of BASIC. A program, good or bad, could almost always be run on only one type of computer.

Getting it together

Finally the day arrived when the all-in-one computer made its debut. Among the first of those computers were the *PET*, the early OSI computers, the *Apple II*, and the original Radio Shack *TRS-80*.

Typically, those computers included a keyboard, cassette interface, a built-in video display (in the case of the *PET*) or output for a video monitor (which could also be used to modulate an RF carrier and be fed to an ordinary TV receiver) and—most significantly—BASIC in ROM.

That meant that you could go out and buy a computer, connect it to a monitor or TV set, turn it on, and be ready to program in BASIC right away. What a revolution!

Interestingly enough, many of the BASIC's in ROM came from the same source—Microsoft, the company that had created the original *Altair* BASIC. Sometimes the BASIC was clearly identified as coming from Microsoft and sometimes, for one reason or another, its origin was obscured.

Of course, each version of the language would run only on the computer it was designed for, due to specifications set forth by the computer manufacturer, the microprocessor (CPU) used, and the graphic and color capabilities of the computer, if any. A program written in BASIC for one computer would not run on another, even though the language in which it was written had originated from the same company.

To help cope with the proliferation of BASIC's, a book called *The BASIC Handbook* was put together by David A. Lien. It was (and still is) a cross-reference of BASIC statements and commands. The book allows you to "translate" a program written in one version of BASIC into a different version and proved especially handy when a program listing was published that you wanted to use but could not, directly, because it was written for a computer other than your own.

Despite the many different variations of BASIC abounding, the fact that Microsoft was responsible for many of them was an important step toward standardization.

Floppy disks

What probably made "universal" software possible was the floppy-disk drive. Originally developed by IBM in the 1960's, floppy-disk drives, while considerably more expensive than cassette recorders, quickly found favor among serious small-computer users.

They offered speed (a program that might take several minutes to load from cassette could be loaded in a couple of seconds from disk) and convenience. Instead of trying to locate a program manually on a cassette, or having to maintain a vast library of cassettes, each holding one program, the floppy disk, together with its DOS (*Disk Operating System*) made it possible for the user to simply request a particular program and, within seconds, the DOS would locate it on the disk—wherever it might be stored—and load it into the computer. Programming languages, too, could be stored on

disks.

Disks have other advantages, too. Almost any business program requires that files consisting of names, addresses, inventory items, accounting figures, etc., be maintained and updated. Trying to perform file maintenance using cassettes was extremely time-consuming—and risky. Each time a file was changed—even by only one item—it had to be completely rewritten on cassette. That was not only time-consuming, but also potentially dangerous, since if procedures were not followed carefully, the old file—and sometimes the new one—could be lost forever. File handling on disk was effortless; simply load in the old file, modify it, and save it on the disk under a slightly different name—perhaps keyed to the date. Both files would be readily available should either of them be needed.

Disks could hold a large amount of information—be it program, file, or language—that could be called up nearly instantaneously.

Enter CP/M

As with everything else in the early small-computer world, each disk operating-system was incompatible with any of the others. Then, in 1973, came a DOS that changed things completely.

That operating system was CP/M (usually taken to stand for "*C*ontrol *P*rogram for *M*icrocomputers"), developed by Gary Kildall, who formed a company called Digital Research. CP/M was a disk-operating system that could be used on *any* 8080 or Z80-based computer. It was designed so that it could be modified (by anyone who could interpret the six manuals that came with it) to use any computer's I/O (*I*nput/*O*utput) scheme. It was the *universal* DOS! (It has proven so popular that even computers that do not use CPU's belonging to the 8080/Z80 family—such as the *Apple II*, which uses a 6502—can now use it after certain hardware modifications have been made.)

With CP/M, and a "standard" BASIC, a program could be written on one type of computer, and run with little or no modification on any number of others. That was a giant step toward making good business software available to a large number of users at a reasonable price.

A separate article in this section discusses CP/M, and a description of its characteristics will be found there.

A standard BASIC

While Microsoft was developing BASIC's to be implanted in ROM for use in "plug-in-and-run" personal computers, it, and other companies, were developing versions of BASIC that were specifically designed to operate with CP/M. One of those companies was Software Systems, which created CBASIC (later revised to CBASIC 2, now itself known as "CBASIC").

CBASIC, which can be run on any CP/M system, brought to the world of small computers many of the features of languages that ran on the larger computers many businesses wanted to get away from. In fact, it was designed specifically with business applications in mind.

Programmers who used to scream for microcomputer version of FORTRAN and COBOL—high-level languages with which they were familiar—soon discovered that CBASIC and its relatives could do the job for them. While microcomputer versions of FORTRAN and COBOL are available, they never attained the popularity that was expected of them.

One major advantage tht CBASIC has over the BASIC's that come with most personal computers is the fact that it is *compiled* rather than *interpreted*, and consequently runs much more quickly.

By analogy, running an interpreted program is similar to your having to relearn the rules of multiplication from scratch *each* time you have to multiply two numbers. A compiled program, on the other hand, is like doing multiplication the way you normally do after having learned the rules—you just do it without thinking about it. As you can imagine, that speeds things up considerably.

A CBASIC program is written in two steps. The first is the creation of the *source* program, which looks more or less like any other BASIC program—with the exception that line numbers do not have to be used unless they are necessary to identify certain sections of the program.

The source program is then compiled—it's "boiled down" to a series of machine-language instructions which become known as the *intermediate* file. To protect their investment of time and knowledge, programmers usually sell their programs in intermediate form; while it's easy to understand (and modify) a source program, an intermediate file can only be run...the computer can understand it, but the curious human cannot.

The intermediate file is run with the aid of what's known as a *run-time program*. Without that program it's useless.

Programming in a compiled language is more difficult than working with an interpreted one. If the program is compiled and there is an error, correction is not simply a matter of editing or rewriting the incorrect line(s). Instead, the original source program must be edited, and then recompiled. Compiled-language programming and debugging can be more time-consuming than writing an interpreted-BASIC program; but the speed and efficiency resulting from a compiled language, such as CBASIC, more than makes up for that. And, you, as the end user of a software package, benefit without having to program at all.

Recently, a language called CB-80 was released. It is essentially compatible with CBASIC, but offers certain advantages to both the programmer and the end-user. (Note: Both CBASIC and CB-80 are now supplied by Digital Research.)

Among its features is a *linking* capability that allows programs to be written as a series of modules. Those modules can be easily combined to form complex programs and, in addition, allow infrequently used modules to remain on disk until called for, which means that more computer memory-space is available for data.

It also can handle (like CBASIC) extremely large numbers—up to 14 significant digits—which makes it valuable for accounting purposes.

A final look

A final (as of the time of writing) development is the arrival of *program generators*. They can generate BASIC programs without your having to know anything about formal programming. One such program is "The Last One," from D.J. 'AI' Systems, Ltd.

The program takes the shape of a flowchart: "First do this, then do that, but if *this* results in something special, then *don't* do that, but do something else."

It allows you to create your own programs in the BASIC you normally use on your system simply by responding to a series of questions presented on your video terminal. A "menu" of choices; or opportunities for you to indicate your own categories, title headings, and other items or operations to be performed, lets you create your own program in BASIC without even knowing how to program.

How that affects you

After you bought your computer, and decided to use it for business or serious at-home use, you almost certainly ran into the problem of finding software that would do what you wanted. In a few cases, if you were lucky, you found a program written specifically for your machine that served your purposes; in most cases you probably did not.

However, with CP/M, and with BASIC's far more highly developed than the original from Dartmouth (and the truncated versions of that one for the first personal computers), you now can choose from a wide variety of programs that will run under a language you can load into your computer and do precisely the job you want. R-E

Radio-Electronics YOUR OWN Computer Software APRIL 1982

Word Processing

Writing, and editing, can be a lot easier with one of these word-processing programs. Some will even check your spelling!

HERB FRIEDMAN

A COMPUTER DOES NOT REALLY know, nor does it care, whether the signals racing through its circuits represent calculations, data, graphics, or words. A computer will do what it is instructed to do by its programming. If the software tells it to allow the creation of character strings—that is, words—and how to manipulate them for editing, revision, organization, and, finally, printing, it will do just that.

As a general rule of thumb, if the computer is programmed specifically to manipulate words in any manner we say the computer is functioning as a "word processor."

In actual fact, while the term "word processing" was originally understood to mean the preparation of documents, for the modern personal computer it has come to hve a more flexible meaning, and the word-processing software available for personal computers encompasses a wide range of applications. About the only limitation to the features available in word-processing software is price—the greater the number of features, the more you will have to pay for your software.

Line-oriented editors

The simplest—and least expensive—form of word processor is the so-called "line-oriented editor," some version of which is often supplied as part of the computer's operating software, or in an editor/assembler package. In a line-oriented editor, each line of text, data, etc. in the file is displayed along with a line number. Modification of the "test" is done by referring to the line number. To rearrange the text line-by-line the user actually operates on the line numbers. To add or delete characters, strings, etc., instructions are entered referenced to specific line numbers.

It's a cumbersome method that works with modest efficiency when editing assembly-language programs, and can be used—when nothing else is available—to edit text. Given enough time, one can create, edit, and revise text with a line editor. If the final, edited, version displayed on a CRT terminal is fed to a printer, the output resembles the CRT display—with or without the line reference-numbers, as determined by the user. If a printing terminal is used for editing, the printout will resemble the original input, less the line numbers.

Full-screen editors

Editing files using a CRT terminal is handled more conveniently with something called a "full-screen editor"—software that allows the user to work directly on any portion of the screen display. With a screen editor it's no longer necessary to refer to a specific line number. The full-screen editor permits the user to make modifications to the text anywhere on the screen, starting at the position of the cursor (the square or underline on the display that indicates that "you are here"). The cursor can be positioned anywhere on the screen and the user can insert single characters or strings—words, sentences, phrases, and paragraphs—at that point. He can change data at the cursor position or delete forward or backward from the cursor-position by word, by line, to the end of the text, and so on.

In the more advanced full-screen editors, the user has total control over line and page movements, and in the "full-blown" screen editors such as *VEDIT*, the user can customize the keyboard for specific single-key commands. For example, a Heathkit/Zenith *H-19* terminal can be customized so that the blue key is BACK TAB, while the "F_1" and "F_2" keys can provide different indentations. Advanced screen-editors are almost a necessity when editing large data-files or formatted data that extends for hundreds of lines, or for the structured programs of Pascal and FORTRAN. They can be edited without a full-screen editor, but the process can seem to take forever.

Both line and full-screen editors can be memory- or disk-oriented. A memory-oriented editor retains everything in memory until the data is dumped deliberately to the storage medium. When the memory is full the user *must* do that, or lose whatever is input after the memory is full. (The editor will generally warn him when that situation is about to arise.)

Disk-oriented editors read and write a specific number of lines of screen display, or the contents of a specific amount of memory, to disk at a time. A disk-oriented system works a little slower when *macros* (large quantities of data considered as a whole, but made up of separate entities such as individual lines) are being written continuously, and it can be slow when you want to scroll back through previously written macros, but it does permit continuous creation or editing of

documents larger than the computer's memory can hold. The producer of an editor generally specifies the minimum amount of RAM required to use his software and approximately how much data or text can be stored. He may also indicate how much memory will be used before a macro is written to the disk.

Output formatting

A significant difference between software described as "editors" and "word processors" is *output formatting*: how the text, data, etc., appears in its final, printed, form. For basic line-oriented editors, the printout is exactly the same as for an ordinary file. If you want a space between lines you must imbed a carriage return (CR) or linefeed (LF), or both, within the file. If you want indentation you must imbed indents within the lines. (But as stated earlier, that's slow.)

Full-screen editors often permit formatting of the screen display, thereby allowing the software to step the cursor to the proper position for data entry. An ordinary screen-editor, however, has no provision for formatting the output to the printer. Depending on the editor, the output of the printer might be a straight line-by-line printout, or, possibly, continuous copy with the end of each line wrapping around to the next line. The printed output of a screen editor usually bears no resemblance to what was created on the screen of the CRT.

To permit formatting—that is, to specify the line and paragraph spacing, paragraph indenting, margin size, etc.—of the printout of some of the less-expensive text and screen editors, a special utility program called a "print formatter," or simply a "formatter," is usually available.

If you are budget-minded, you need not spend funds for printer software if it isn't required. The lack of print formatting should never be assumed to imply inferior software quality. Print formatting, which often includes a selection of drivers for a variety of printers, is expensive—often representing several hundred dollars of the price of good word-processing software—and if you don't need formatting there's no reason why you should spend money for it. For example, *Wordmaster*, a video text-editor, sells for about $99.00. It has many of the capabilities of *WordStar*, which many consider to be the most powerful of the word processors; but that program carries a price tag of $395.00. If you don't require hard copy (a printout), but need screen formatting and other word-processing features, *Wordmaster* may prove more than adequate, and save you a considerable amount of money.

Print formatting

The appearance of the final product is what word processing is really all about. Precisely *what* a word processor is supposed to do depends on who is describing it. The commercial, and generally expensive, word processors of the 1970's from companies such as IBM and Xerox were basically intended for the preparation of letters and similar documents by skilled typists. Many "processors" in the $8000 to $13,000 price range lacked a CRT: they weren't much more than electronic typewriters with memory, and the typist composed directly on a sheet of paper. (One could say he or she used a "printing terminal.") Now, just a couple of years into the 1980's, we find that the modern personal-computer can far outperform the commercial word-processing machines of the mid 1970's.

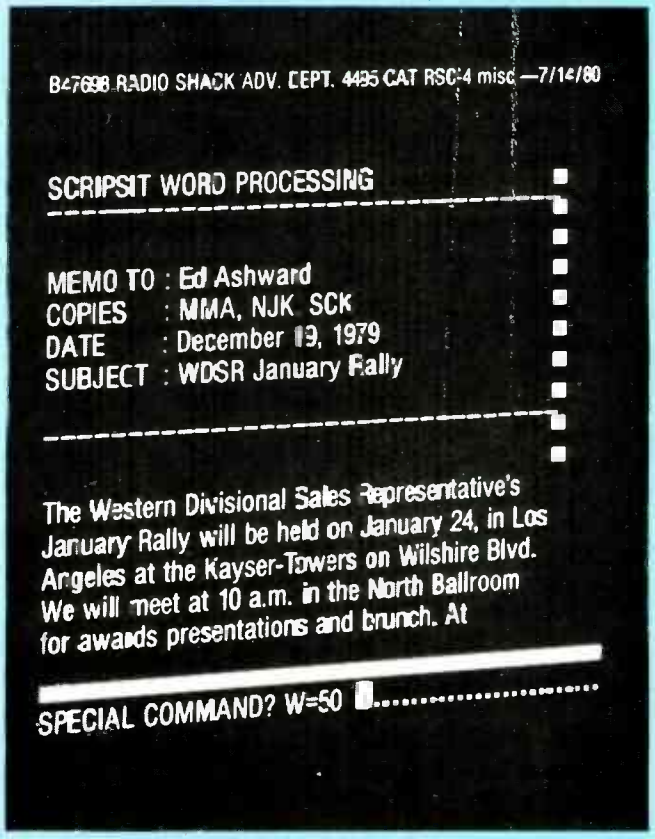
Word processors for personal computers

Personal-computer word processing got its start in 1977, which Michael Shrayer introduced a program called *The Electric Pencil*. Eventually there were over 40 different versions of the program, configured for different video-display boards, cassette interfaces, disk operating-systems, printers, etc.

Several versions were produced for Radio-Shack's *TRS-80*, and proved immensely popular. The original *TRS-80* could output both upper- and lower-case characters to a printer, but its video display had only upper-case capability. However, a simple modification that cost less than $10, and which was described in *The Electric Pencil's* documentation, could force the CRT to display both upper and lower case, and provide a keyboard CONTROL key (required by the program). Shrayer's program provided the software to display upper and lower case with the proper shift sequence, and drivers for both parallel and serial printers. The program even provided for underscore (on printers that could backspace, such as some *Selectrics*).

The cassette-based software provided just about all the editing features common to commercial word-processors of its day: insertion and deletion of characters, words or lines, block-move, string search, search-and-replace, extensive printer formatting—including right-hand justification—and tape storage. A disk version provided disk files and a disk directory. *The Electric Pencil* was a software "heavyweight" by the word-processing standards of its time. A program similar to *The Electric Pencil*, *EasyWriter*, was created for the *Apple II* computer, and has also been adapted to run on IBM's *Personal Computer*.

Though the *TRS-80* wasn't really intended for word processing—among other things it lacks an underscore—Radio Shack wasn't going to let almost a quarter-million *TRS-80* owners go somewhere else for software, so it introduced *SCRIPSIT*, a $29.95 cassette-based word processor that many consider one of the easiest, most convenient systems to use.



DESIGNED FOR USE with Radio Shack's *TRS-80* computer, *SCRIPSIT* offers the features of a word processor at a budget price.

SCRIPSIT differs from most other word-processing software in that it is organized for direct composition by an author rather than for the preparation of documents. All functions—create, edit, revise, insert, paragraph/phrase move, word and block interchange, and others—are performed in one operating mode. When a document is saved on disk or cassette the new or revised work—the last effort—is

WORD-PROCESSING PROGRAM SUPPLIERS

Word-processing programs are available from both equipment manufacturers and independent software suppliers. To help you find the proper program for you, a few of those independent suppliers are listed below.

ASTRO-STAR ENTERPRISES
5905 Stone Hill Drive
Rocklin, CA 95677

BILL'S MICRO SERVICES
210 S. Kenilworth
Oak Park, IL 60302

CHARLES MANN AND ASSOCIATES
7594 San Remo Trail
Yucca Valley, CA 92284

COGNITIVE PRODUCTS
PO Box 2592
Chapel Hill, NC 27514

COMPCO
8705 North Port Washington Road
Milwaukee, WI 53217

COMPLETE BUSINESS SERVICES
90 West Center Street
Logan, UT 84321

COMPUSOCO
26251 Via Roble
PO Box 2325
Mission Viejo, CA 92690

COMPUTER BUGS
PO Box 789
Boynton Beach, FL 33435

COMPUTERWARE
1512 Encinatas Blvd.
Box 668
Encinatas, CA 92024

COMPUVIEW PRODUCTS, INC.
618 Louise
Ann Arbor, MI 48103

CORNUCOPIA SOFTWARE
PO Box 5028
Walnut Creek, CA 94596

CREATIVE SOFTWARE
PO Box 4030
Mountain View, CA 94040

DATA STRATEGIES, INC.
PO Box 178446
San Diego, CA 92117

DUANE BRISTOW
Route 3
Albany, KY 42602

FMG CORPORATION
5280 Trail Lake Drive
Ft. Worth, TX 16020

HAYDEN BOOK COMPANY
50 Essex Street
Rochelle Park, NJ 07622

HEXAGON SYSTEMS
PO Box 397, Station A
Vancouver, B.C., Canada V6C 2N2

INNOVATIVE SOFTWARE APPLICATIONS
260 Sheridan Avenue, Suite 300
Palo Alto, CA 94306

INTERACTIVE MICROWARE, INC.
PO Box 771
State College, PA 16801

MARK OF THE UNICORN
PO Box 423
Arlington, MA 02174

MICRO PRO
1299 4th Street, Suite 400
San Rafael, CA 94901

MIDWEST SCIENTIFIC INSTRUMENTS, INC.
220 W. Cedar
Olathe, KS 66061

MONUMENT COMPUTER SERVICE
PO Box 603
Village Data Center
Joshua Tree, CA 92252

THE MUSE COMPANY
330 North Charles Street
Baltimore, MD 21201

OMIKRON
1127 Hearst Street
Berkley, CA 94702

PROFESSIONAL SOFTWARE, INC.
1666 Crescent Road
Needham, MA 0194

SMALL BUSINESS APPLICATIONS
3220 Louisiana Street
Houston, TX 77006

SMALL SYSTEMS SOFTWARE
PO Box 366
Newbury Park, CA 91320

SOFTWARE WORKS
8369 Vickers
San Diego, CA 92111

THORPE DATA SYSTEMS INC.
22968 Victory Blvd.
Woodland Hills, CA 91367

automatically saved under its original title. If, using the disk version, the revised work is saved in place of the original, a series of files representing earlier versions can be avoided, and disk storage-space conserved.

Commands for virtually any type of print formatting—on a page basis—can be imbedded in the text. (It is difficult to format on a line-by-line basis, as might be required for business applications.) Also, tabulation, which might be required for business documents is somewhat difficult, as there are few "business document' format commands. (Note: The version of *SCRIPSIT* for the *TRS-80 Model II* is a "standard" document-type system suitable for business use.)

A word-processor modifier, Acorn Software Products' *SUPERCRIPT* restructures *SCRIPSIT* to add many features that were originally left out. Those features included underscoring, kerning (i.e., slashed zeroes), subscripts and superscripts on printers capable of printing them, and, perhaps most important, drivers for virtually every possible printer, including both types of *Selectric* mechanisms available for personal computers.

A few other early attempts at word processing for personal computers were not as successful, or as easy to use. For example, one word-processing system could feed upper- and lower-case characters to the printer, but the CRT display was upper-case only; a "special mark" was used to indicate which character displayed on the CRT screen in upper case would actually print as upper case.

Then again, there was, and still is, the problem of screen size. Some CRT displays are only 40 or so characters wide. Few document lines are that short, so some form of "window" device has to be provided so the user can move off-screen to the right. It's a sort of a horizontal version of the vertical scroll.

The popularity of *The Electric Pencil* and *SCRIPSIT* was just the starting point for small-computer word processors, and over the next few years, word-processing software was introduced that rivals or excels what's available for mini and large computers. A number of computer manufacturers introduced their own word processors, such as *WordPro* from Commodore International, for use on their *PET* and *CBM* machines, and *AutoScribe II* for the Heath/Zenith *H89*.

Many "full-blown," multi-feature, word processors are available for computers that use the CP/M disk operating-system, and are also specifically structured for other computers. By "full-blown" we mean word-processing software that goes beyond the mere preparation of letter-type documents and provides a means to do more than revise thoughts, correct errors, or format for justified printing with its flush left and right margins, or centered headings.

For example, *Magic Wand*, which sells for a bit under $300, provides "spooling," which makes it possible to print one document while working on another. It also features

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1. **The NTS/Rockwell AIM 65 Microcomputer** A single board unit with on-board 20 column alphanumeric printer and 20 character display. A 6502-based unit 4K RAM, expandable. 2. **The NTS/KIM-1 Microcomputer** A single board unit with 6 digit LED display and on-board 24 key hexadecimal calculator-type keyboard. A 6502 based microcomputer with 1K RAM, expandable. 3. **The NTS/HEATH H-89 Microcomputer** features floppy disk storage, "smart" video terminal, two Z80 microprocessors, 16K RAM memory, expandable to 48K. 4. **The NTS/HEATH GR-2001 Digital Color TV (25" diagonal)** features specialized AGC-SYNC muting, filtered color and new solid-state high voltage tripler rectifier.

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automatic hyphenation, will automatically stop printing at preselected points so the user can insert text (a name, for example) directly from the keyboard, can integrate data files into a document in the correct order, will search and replace either strings or data, and can be print-formatted on a line-by-line basis.

A useful "extra" is a user-written "HELP" system, whereby a table of salutations, or introductions for specific titles or positions, etc., is available through a HELP CRT screen-menu selection.

For a few dollars more, there is the previously mentioned *WordStar*, which provides additional business-oriented features that include decimal tabulation, whereby the decimal points in a column of numbers will be aligned automatically.

Most full-blown word processors also permit formatting of the CRT screen so that what you see will exactly match the printed output. (With less-sophisticated software, the screen often displays the text in line-by-line order along with the print-format instructions. Exactly how the final copy will look isn't known until its printed.)

One of the problems with full-blown word processors is they have so many features, requiring so many control keys, that it's often necessary to make frequent reference to the instruction manual, or to an instruction-summary card, to take advantage of those features that are used infrequently.

Some systems provide the user with small tabs labelled with control functions to be attached to the terminal's keycaps. (Radio Shack initially provided a set of 15 with their budget-priced *SCRIPSIT*.) Omega's full-blown *VTS/80* word-processing system is about the ultimate in convenience, because it provides a *complete* set of replacement keycaps—one for almost every character key on the terminal!

Dictionaries

One of the most useful add-on programs for a word processor is a piece of software called an "electronic dictionary," also known as an "electronic spelling-checker." There are presently several electronic dictionaries available for personal computers, among them: *Hexspell*, *Spellguard*, and *Microproof*.

An electronic dictionary contains anywhere from about 20,000 to over 50,000 words, the entire collection being known as the "dictionary" (or "library"). It runs as an executive (control program) for your document and checks each work in the document against the words stored in it. Each time it locates a word for which it can find no match, it displays the word on the CRT screen—alone or in context with a phrase of the text, depending on the program.

The user decides whether the "unknown" word is spelled correctly or incorrectly. If the spelling is correct, he can tell the dictionary to "SKIP" (proceed with the check), or "ADD" the word to the dictionary list. If the word is spelled incorrectly, the user can enter the correct spelling and request a "REPLACEMENT" in the original document. If the replacement, or correct spelling, is still unknown to the dictionary, the user has the option of adding that word to its list. In that way the user builds his dictionary to correspond to his particular vocabulary.

For example, the version of *Hexspell* that was used to proofread this article contains a specific computer and communications vocabulary that was built up by the author each time an "unknown" word was entered, using a LEARN command. Another author-constructed version of *Hexspell* has a vocabulary tailored for electronic construction-projects. Once you have the basic dictionary you can build any number of special versions.

There are two ways in which an electronic dictionary can process a document, usually determined by the number of disk drives available. For software that requires only one disk drive, the user's document is checked rapidly against the dictionary and a listing of the "unknown" words is provided, or a character in each "unknown" word is changed to some symbol such as the "#" or the "@". Regardless of how the "unknown" word is indicated, the user must go back and correct the original document through the word-processing software.

An electronic dictionary for use with two disk drives runs the dictionary in the first drive and a copy of the original document in the second drive. (To avoid accidental loss of a document, the disk on the second drive must have enough free space for an "edited version" of the document.) The dictionary software causes the document to scroll at a fast reading pace on the screen; as it scrolls, an edited version of the document is recorded on the second drive. When the software locates an "unknown" word it will stop and allow the user to make a correction by substituting the correctly spelled word in the edited version, and/or add the word to the dictionary, or skip ahead. At the completion of the process, the edited version of the document contains all the corrections, and is automatically recorded in place of the original one, providing two fully corrected document files on the disk (one serves as a backup).

The two-drive dictionary is much slower than the single-drive one, because of the continuous writing to the edited-document file. However, the user ends up with a fully corrected document. With single drive he gets a list of "unknown" words faster—sometimes in less than a minute—but must then go back and correct the original document, so the total time involved is about the same. As a general rule more convenient.

Among the most popular uses for a personal computer is a word processor. Once you've had a taste of how easy it is to work with a word processor, you will find it's extremely difficult to go back to your typewriter. **R-E**

Radio Electronics YOUR OWN Computer Software APRIL 1982

Data Base Management

Store and retrieve data efficiently with a database management-system.

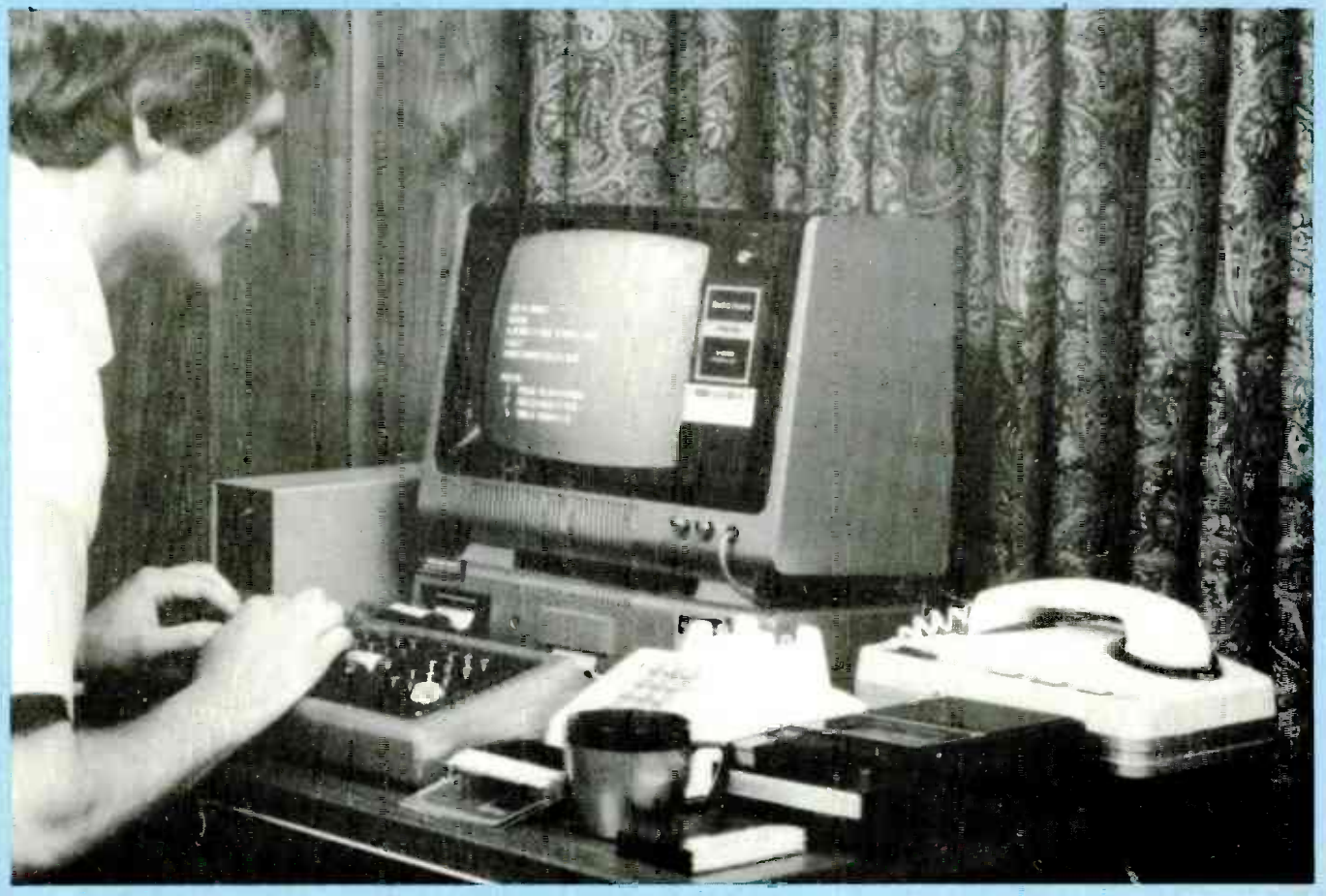
HERB FRIEDMAN

A DATABASE IS AN ELECTRONIC FILING SYSTEM. TO BE MORE precise, it is an electronic representation of a filing system such as you might find in any home or business. A database can represent nothing more than the electronic equivalent of ordinary 3 × 5 index cards, or it might contain every bit of information concerning a business or organization, and have the power to calculate "unknowns" from the data stored in the files. A database can handle all details of a business inventory, such as the accounting, the billing; it can even prepare reports, summaries, estimates, and the like, from the information in the files. It can store newspaper articles, magazines and books, games, even digitized pictures (photographs). In actual fact, a database is whatever the last programmer to write one says it is.

No matter how little or how much information the database might contain, with very few exceptions the inherent "filing" or "storage" system starts out with a base system that approximates the ordinary file cabinet.

Imagine, if you will, the common office 4-drawer file cabinet. The cabinet itself is analogous to the personal computer. What's inside the cabinet is the database. Now there might be nothing more inside the cabinet than a pack of 3 × 5 file cards, each card representing the title of an LP album you have recorded on cassette tape for your permanent music library. The primary entry on the card is the album's title; if there is more than one work on the record, you will have a list of the individual songs, arias, orchestral selections, etc., the catalog number you assigned, and possibly the name of the composer of the album or of each selection. To see what performances were on a particular tape you would flip through the cards until you came to the desired title, and then you'd read any individual entries.

If you did the same thing with a computer you would be creating what we call a database. You could very easily write a BASIC program that would permit you to store each album title, a list of the selections on each album, and its catalog number. Each entry, consisting of album title, selections, and catalog number, is called a record in our database. Each



record serves as an electronic file card that functions exactly the same as the 3 × 5 card file did. You would enter the album's title into the computer and the screen would display a list of the selection and the catalog number.

While it's clever and entertaining to have a computerized tape library, the question is *why*? If the database serves only as a substitute for a file card why use a computer? It's actually easier and faster to use a stack of 3 × 5 file cards, and they are certainly a lot less expensive than a computer. The truth is, if you can do something expeditiously with file cards, then there's no need to computerize it.

But let's expand the way we catalog the music library. With both the hardcopy and electronic file records organized by album title, it's inconvenient to locate a specific album if you know only the name of a selection, so the 3 × 5 card file requires some form of cross-indexing; most likely a separate 3 × 5 card for every selection, showing the album title along with the catalog number you assigned to the tape. That results in a separate 3 × 5 card for each and every selection, as well as for each album title. If you included the composer's name in your card-file system you'd be adding many additional file cards because each composer would require an individual file card listing only his or her works. Cross-indexing produces a lot of paper, and a lot of search-and-find by the user, as is well illustrated by the catalog system of any book library.

It is when we step into cross-indexing that the justification for an electronic database can be understood. Just to maintain a list of the individual albums or tapes in your collection we have created electronic records which are the equivalent of individual file cards. Now the very same program can, in the blink of an eye, search the individual data records for a specific song, catalog number, or whatever. No extra files are needed; the original computer data record for each album contains all the needed data. Rather than expand the total number of individual data records, we simply tell the computer what additional searches we would like to have. For example, instead of having the computer search out one selection, we might have the program search for all the albums that contained one or more items by a specific composer, or albums with songs having common words in their titles.

While all that might sound complicated, it's really quite simple to do electronically. Each entry in our database record is called a field. The album title is a field, each separate title is a field, and our catalog number is a field. The computer simply searches all the fields for the specific data.

As far as the computer is concerned, it does not care whether the data record contains information on cassette tape, and whether it's music or anything else. Enter in the data in the right order and the same program becomes a database for whatever you want. Because that type of database is both useful and relatively easy to write in BASIC, it quickly became one of the most popular database for personal computers in the form of a checkfile—a database that keeps track of your checks for budget analysis or income tax purposes. The user simply enters a list of checks for each month and assigns a category; such as charity, interest, fuel, medical, or whatever. At tax time a touch of a button can retrieve a list of all checks for a specific category, generally in the order they were entered.

If the program has some form of SORT facility—a way to sort in alphabetical or numerical order—each list could be displayed in alphabetical order, or check-number sequence, or whatever order is required. In searching for a specific check, things like misspelled names aren't really a problem, because there's usually not that much data involved. Certainly for the average user all checks in a specific category could be scanned on a CRT screen without much extra effort.

But what happens when there is seemingly endless records of data, with much new data being added almost daily? As you probably have surmised, in our music library and personal checkfile database we have created an electronic database very similar to the card-file system in a book library, only a library has thousands and thousands of individual data entries on individual file cards in its card catalog. It's often difficult enough to locate a book when you're certain of the precise spelling of its title or author, but what do you do when you're not quite certain of the exact title, or the spelling of an author's name?

A simple database for a personal computer is usually unforgiving; it must have the precise string of characters including spaces, or it returns a FILE NOT FOUND display on the screen. If your database is small enough you can display, as we've stated, all the seemingly pertinent or common data, but one could literally drown under the "common" data of a book library. To see how we handle that situation—because it's a key to the enhanced database—let's go back to our sample tape-library database and make some modifications to the software that expands its search and find feature.

One of the things we can do is program the software to search by three or four characters. For example, assume our software searches in a "Song Title" mode for a four-character string anywhere in a field. If we entered "Hell" the computer would locate the records for the songs "Hellfires", "Hello Sunshine", "Hello Happiness", and myriads of other songs starting with "Hello," because it's not that rare a word in songs. So we modify the software one more time to recognize another short string in any other string that's separated from the first by at least one space. We'll have the software search for three characters in the second string. We instruct the computer to search for the key "HELL SUN". In moments the computer puts the two key words together, finds the correct file, and displays on the screen:

HELLO SUNSHINE TAPE # 135 SONGS OF THE 60's.

Alternately, our program in an "Album Title" mode would accept the key "SON OF " (note the space after "of" because we need three characters— and a space is a character), and display:

SONGS OF THE 60's TAPE # 135.

As you can see, we can search on virtually any type of key. The partial string system we've illustrated is very sophisticated and is used by libraries and complex databases, but it is coming into common personal computer use as the programmers get more adept. A more common personal-computer key system works on complete fields, with everything spelled exactly as saved by the database.

Storage schemes

For personal-computer databases there are two types of storage schemes: in-memory, and everything else, which usually means a high speed retrieval device such as disk. In-memory schemes are almost always used for cassette-storage systems, and a few somewhat unsophisticated disk-based databases. In the in-memory database, all the operating software (program) and all the data are transferred from the tape directly into the computer's RAM memory. All operations are performed directly on the data in memory—updating, modifications, etc.—and the new database is then stored back to the tape. If it is recorded on a blank section of tape the user has tape versions of the old and new data. If the data exceeds the memory capacity of the tape, it must be broken into separate recordings.

Since in the most elementary in-memory data systems, operations are performed directly in the RAM memory, any changes made are permanent in the sense they erase previously entered data. If you goof, the data is gone and must be reloaded from the tape. In the more advanced in-memory programs, a block of RAM memory is reserved as a

DATA BASE MANAGEMENT SYSTEMS

Database management systems are available from a number of independent software suppliers. Some of those suppliers are listed below.

APPLE ORCHARD
131 Highland Avenue
Vacaville, CA 95688

ASHTON-TATE
3600 Wilshire Boulevard, Suite 1510
Los Angeles, CA 90010

BLUE LAKES COMPUTING
3240 University Avenue
Madison, WI 53705

CONDOR
PO Box 8310
Ann Arbor, MI 48104

DANA INDUSTRIES
2612 Croddy Way
Santa Ana, CA 92704

HAYDEN BOOK COMPANY
50 Essex Street
Rochelle Park, NJ 07662

HIGH TECHNOLOGY
PO Box 14665
Oklahoma City, OK 73113

INNOVATIVE SOFTWARE
9805 Holly
Kansas City, MO 64114

JINI MICRO-SYSTEMS, INC.
PO Box 274
Kingsbridge Station
Riverdale, NY 10463

LJK ENTERPRISES INC.
PO Box 10827
St. Louis, MO 63129

MICRO ARCHITECT
96 Dothan Street
Arlington, MA 02174

MICRO DATA BASE SYSTEMS, INC.
Box 248
Lafayette, IN 47902

MICRO DECISIONWARE
4890 Riverbend Road
Boulder, CO 80301

MICRO LAB
811 Stonegate
Highland Park, IL 60035

MICROPRO INTERNATIONAL CORPORATION
1299 4th Street
San Rafael, CA 94901

THE MUSE COMPANY
330 N. Charles Street
Baltimore, MD 21201

PACIFIC SOFTWARE
2608 Eighth Street
Berkeley, CA 94701

PERSONAL SOFTWARE
1330 Bordeaux Drive
Sunnyvale, CA 94086

SOFTWARE PRODUCTS INTERNATIONAL
5482 Complex Street, Suite 115
San Diego, CA 92123

SYSTEMS PLUS
3975 East Bayshore
Palo Alto, CA 94303

THE BOTTOM SHELF
PO Box 49104
Altanta, GA 30359

UNITED SOFTWARE OF AMERICA
750 Third Avenue
New York, NY 10017

temporary buffer. Data is first stored in the buffer where they can be manipulated, modified, or even erased. When the user is satisfied with the data, a PUT command (or its equivalent) transfers the data from the buffer to the memory, where it adds to, or replaces the original data. A SAVE command transfers the data from the memory to the cassette tape.

Note that just to change one single datum entry the entire database, or at least one complete tape file, must be moved into RAM memory.

Depending on the particular software, a disk-based database can be in-memory or random access. Generally, simplified disk database software will be in-memory, and simply use the disk as a more convenient and faster storage medium. A more sophisticated disk database can open a specific disk file and search for the data, moving an image of only that data into memory. Alternately, it can permit updating or modification directly to the disk data. Also, a disk-based database can reference selective data entries from several disk files; the software can search on one or more keys across multiple files and then restructure the data for a presentation on the CRT or as hardcopy in a specific format. In essence, disk files expand the simple index-card database into a complex filing system, because each disk file can represent a file folder that can be accessed independently or as a group, so that the data in several folders can be studied, or integrated into a single document.

Using a database

Let's look at a filing system database as it might apply to records for your home. If you had the hardcopy records stored in a file cabinet they would be located under the letter "H" in a folder labelled "HOME", which is a good choice for the name of the computer file consisting of the home records. Within this folder would be other folders, perhaps labelled: Mortgage Payments, Taxes, Assessments, Fuel, Utilities, Repairs, Gardening Supplies. All of those individual folders would be converted to data records for the computer database. Depending on the particular software, the database might be entered exactly as you would manually search through the file cabinet. For example, the data might be stored on a disc with several other databases. To access the house records you would call up the file HOME, which might produce a menu on the screen listing all the available records (file folders). It might appear on your screen this way:

HOME—Make Selection
1-MORTGAGE PAYMENTS
2-TAXES
3-ASSESSMENTS
4-FUEL
5-UTILITIES
6-REPAIRS
7-GARDENING SUPPLIES.

Entering the appropriate number would call up the associated record. Let's assume we wanted to check the fuel bill for last December. We would enter a "4". Next, we enter DECEMBER, and the screen would display the entire fuel record for the previous December. Similarly, we might enter all the winter months to get a visual picture of fuel consumption for the entire winter.

For a picture of how property taxes were increasing we would enter a "2" and then key on, say, the past five years, 1977 through 1982, and the screen would display the entire tax record for that period. If we had to prove we paid the property tax, in order to resolve a dispute with the tax district, we could key on the specific quarter for a given year and the screen would display the necessary information, including the number of the check used to pay each particular tax bill.

If we had really extensive files—say we owned the property for more than 30 years—we might break up each record into mini-records. For example, entering a "2" would put us into

the TAX records file which would produce its own menu, which might read:

TAX RECORDS FOR:
A-1951 TO 1960
B-1961 TO 1970
C-1971 TO 1980
D-1981 TO PRESENT

Obviously, you can see that the concept of multiple, imbedded files can be applied to any complex file structure. The same idea applied to business records would give us a database that contained virtually all business records. If sufficiently large, if might easily contain individual records and systems for accounts payable and receivables, general ledger, journal, payrolls, including automatic calculations and tax schedules, inventory for all departments, job-cost analysis, and the utilities for maintenance and updating of the individual files.

As a general rule, when we get into the area of commercial-type files, the software usually contains word- or information-processing software so that printed reports, documents, and projections can be made from the data within the files. For example, with information-processing software, the same database will generate printed billing and monthly reports. It can print automatically sales projections based on last week, last month, last year, or last decade. It can print payroll checks, W2's, and charts of accounts. Exactly how the data information is used and presented in a printout is determined by the capabilities of the inherent word or information-processing software. In fact, major differences in business-database software is often the information-processing and information handling routines.

The common mailing list can be used as a simplified example of what is meant by information processing of a database. The usual mailing list will keep a list of clients, customers, or whatever. It provides for maintenance and updating of the list, and sorting on any key: names in alphabetical order, addresses by zip code or street number, even by the number of persons living at an address if that information is included in the data record. The normal hardcopy software for personal-computer mailing lists will provide a printout of the list on a sheet of paper or on standard pre-pasted mailing labels.

If the very same database also contains an information processor, it will merge in the names and addresses into prepared text or documents. That is how computers produce personalized form letters such as:

Dear Mr. Jones:

We're happy to inform you and Mrs. Jones of Anyplace, U.S.A., that you and your children Robert and Jane have won a free trip on the first public space shuttle trip to Astro Station Number 12.

The original form-letter text might have appeared this way:

Dear Mr. N:

We're happy to inform you and Mrs. >N of >T, >S, that you and your children >B and >G have won a free trip on the first public space shuttle trip to Astro Station Number 12.

When the database information-processing software runs the letter text, it searches the data record for a surname to plug in at >N, a town for >T, a state for >S, a boy's name(s) for >B and a girls name(s) for >G. Each time it prints a letter, it searches for the appropriate information from each data record. On a previous preparation sort, only the records that indicated married couples with children might have been selected for processing.

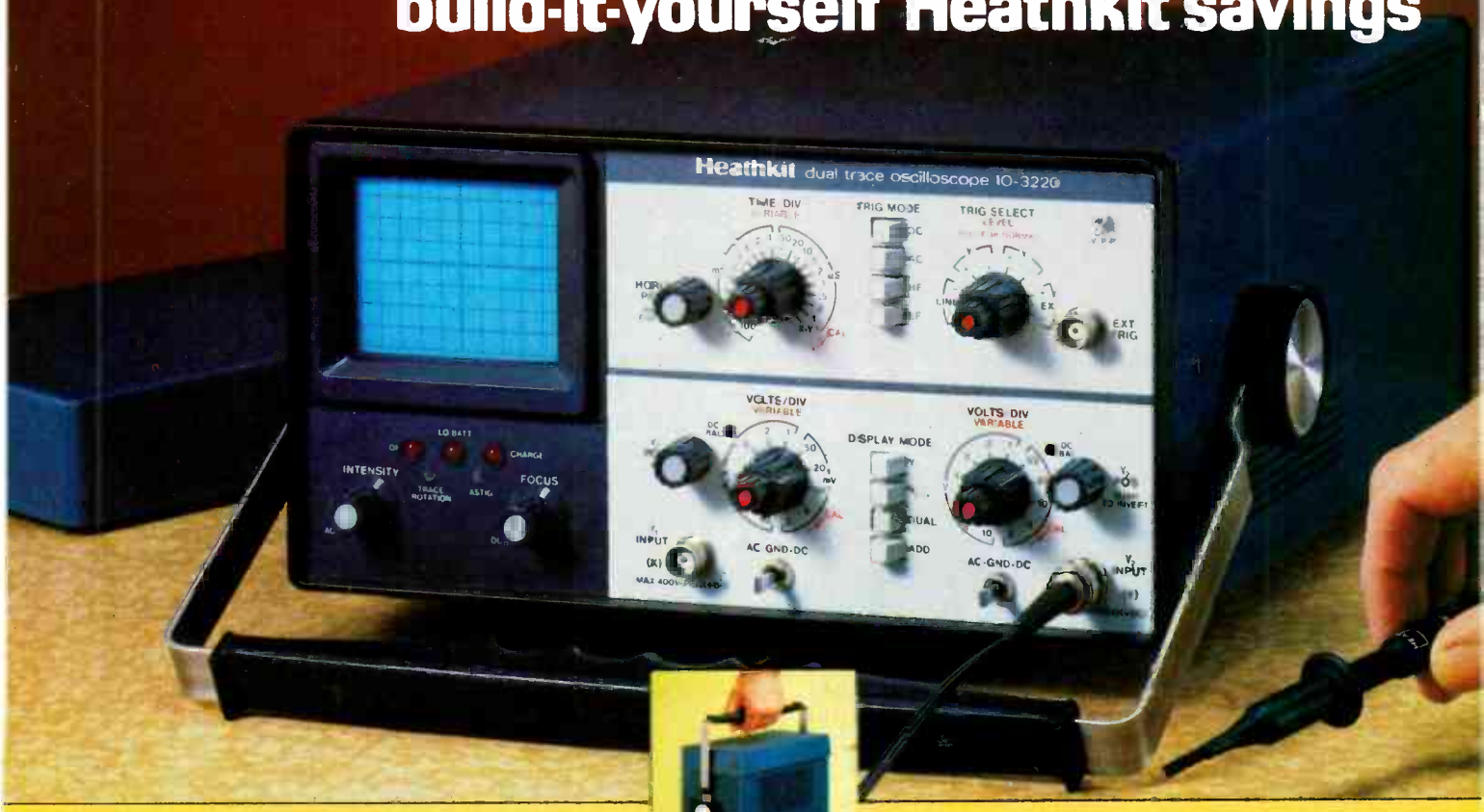
The same type of information processor works with the enhanced databases, only instead of preparing just mailing labels or form letters it can be used to create estimates, reports, summaries, and the like. The information-processing software might take daily totals (of anything) and prepare weekly or monthly summaries, even projections if accessed to some form of spread-sheet program. As a general rule, the more sophisticated the database the greater the number of enhancements that permit the data to be crunched into reports, projections, and the like; even as a modifications for data in other records.

Dial-up databases

While personal-computer databases concern themselves primarily with cataloging, business data, and mailing lists, at present, there are many different types of databases available to users of personal computers through the time-sharing services such as MicroNet. Compuserve and The Source.

Just to mention a few typical examples, there are the DOW Jones Stock and financial reports, feature articles from the *New York Times* (among other newspapers), even feature stories from the news services and...well, just about anything that someone would want to read about, and would pay a reasonable price to use...can and will be put into a general-access database. The important thing to bear in mind is: If it's in a general-access database, it can probably be downloaded into your personal computer for use at your convenience. R-E

NEW! Here's a professional, portable DC-20 MHz Oscilloscope with build-it-yourself Heathkit savings



Compact enough to fit under an airplane seat, the Heathkit IO-3220 represents outstanding value in its class. Weighing only 16 pounds, the IO-3220 is designed for field service troubleshooters who need a light, portable battery-operated scope for use where AC power is not available.

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Special invert display function: Enables you to compare two waveforms that are nearly 180 degrees out of phase – by inverting one of the waveforms.

X-Y inputs for Lissajous measurements: Feed two separate input signals to the IO-3220.

Wide DC-20 MHz bandwidth: The IO-3220 can measure a very wide range of input signals.

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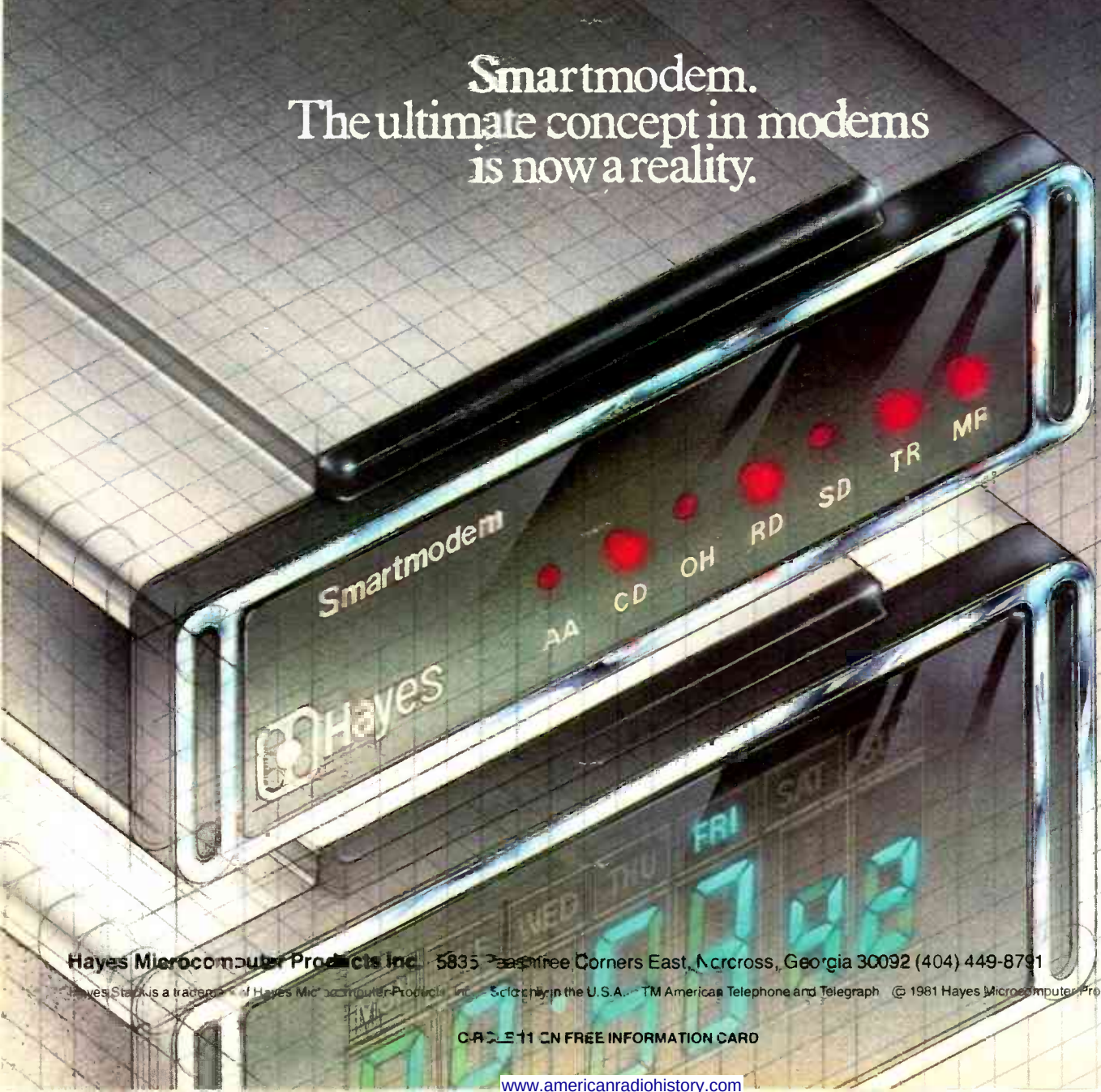

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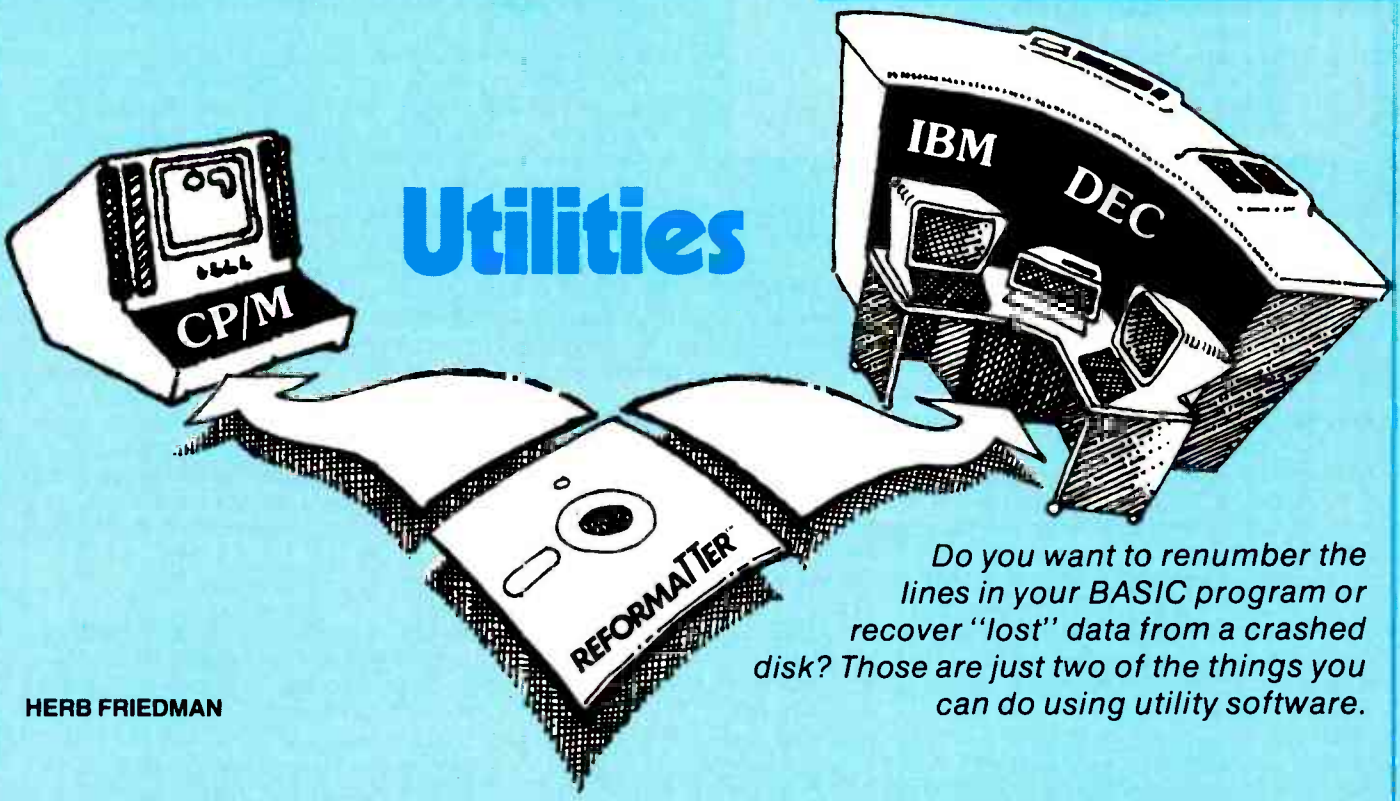
CIRCLE 11 ON FREE INFORMATION CARD

Radio Electronics YOUR OWN Computer® APRIL 1982
Software

Utilities



Do you want to renumber the lines in your BASIC program or recover "lost" data from a crashed disk? Those are just two of the things you can do using utility software.

HERB FRIEDMAN

ALTHOUGH THERE ARE MANY PIECES OF SOFTWARE FOR PERsonal computers that are described as being "utilities," there is no hard and fast rule as to what that means. Until recent times, it was more or less accepted that a utility was software that did not usually "stand-alone;" that its purpose was to support other software. Or, a utility was software that modified the monitor or operating system of a computer to provide a function or capability not originally present in that computer.

Today, just about any software that isn't a "language" or an interactive program might be called a utility; and the modern definition of a utility intended for use with a personal computer could be "...software that provides a computer or software function not originally intended, supplied, or supported by the manufacturer of the computer or its software."

As a general rule, utility software is loaded into the computer's memory and remains there in a protected area, acting as a "modifier" for the primary software or computer functions. In some instances the utility software "enhances" and becomes part of the primary software and is then no longer needed.

One of the earliest utilities for personal computers illustrates the "modifier" and "enhancer" modes.

Early personal computers—and even present day budget-priced or basic computer systems—were supplied with a BASIC in ROM as firmware, or one that was loaded into RAM from a cassette tape. When the user completed writing a BASIC program, the line numbering, which probably started out in neat steps of 10, might have become somewhat muddled. Depending on how much coding was squeezed in during debugging, a program might have wound up with numbering as shown in Table 1.

While that program will run, we have come to expect BASIC programs to have "professional-appearing" line numbering in constant increments (usually multiples of 10). Therefore, one of the earliest popular utilities was "renumbering" software for BASIC programs.

As a "modifier," the renumbering software is loaded into the computer first, followed by the BASIC program. (As far as the computer is concerned, the active software is the "renumber" program. The BASIC program is accepted as a text or data file to be processed by the renumberer.) The renumberer analyzes the BASIC program for GOTO and GOSUB statements and then renumbers the BASIC program without losing the proper GOTO/GOSUB structure.

As an "enhancer," the renumbering software is appended to the end of the BASIC program and becomes part of the BASIC program. It might either remain as part of the program (a poor way to program), or it might serve to renumber the program the first time it is run. The user then saves the new renumbered version and deletes the appended utility from the BASIC program.

When a utility is used to modify existing software, so that the new version can be run independently of the utility (as in the case of the BASIC program we've just discussed), the new software is said to be "enhanced."

As a general rule, enhancement is used to add features or commands to a language—such as *LEVEL III* BASIC, an enhancer for Radio Shack's *Level II* BASIC; or it is used to modify word-processing software, like the special utilities that can be added to Radio Shack's *SCRIPSIT* to permit the use of specialty printers that can subscript, superscript, and backspace.

Another early utility—something more popular now than ever—is some form of "terminal" software that converts a personal computer into a communications terminal that can "talk" or "communicate" with large time-sharing computers and data bases such as *The Source*, *MicroNet*, company-owned mainframes, and computer bulletin-boards. More im-

TABLE 1

```
10 PRINT
13 INPUT "TYPE YOUR NAME: ", N$
15 GOSUB 35
18 PRINT
20 PRINT "YOU HAVE PRINTED YOUR NAME"
30 PRINT "TEN TIMES. TRY PRINTING"
33 PRINT "USING LOWER CASE."
34 END
35 FOR I=1 to 10
36 PRINT N$
38 NEXT I
39 RETURN
```

portant there is an ever increasing need for personal computers to be able to communicate (swap data and programs) with other personal computers.

While all one needs in order to communicate with remote computers and data bases is a connection to the telephone line (through a modem) and a device capable of transmitting and receiving ASCII code—called a "dumb" terminal—the fact of the matter is that a personal computer isn't "dumb" enough to function directly as a terminal. Even if connected to a modem, and then into the telephone line, no personal computer currently available can function directly as a terminal.

However, if the computer has some form of RS-232 I/O port, an inexpensive utility will allow the computer to function as a terminal. There are several "terminal" utilities available for all popular models of personal computers. More important, with a utility that converts the computer into a "smart" terminal, the user can download or upload programs and data to or from other personal computers equipped to do so, as well as communicate with time-sharing systems. In fact, there are utilities—again available for most popular computers—that allow a personal computer to serve as a host computer, a "host" computer being one that is accessed by terminals and by other computers functioning as terminals.

Dumb, smart and genius

Before going any further, let's find out how a personal computer utility creates dumb and smart terminals, and host computers.

A "dumb" terminal is comparable to a simple teletypewriter, in that it can only send and receive characters. It must be connected to a host computer (one that accepts I/O from "remote" terminals), operates in real time (it transmits ASCII code the instant a key is depressed), and displays characters on a CRT or printer upon receiving an ASCII transmission from the computer. Even if a computer is equipped with 48K or 64K of RAM, and as many disk drives as it can support, if the utility only permits the computer to function as a "dumb" terminal; all it can do is transmit and receive in real time to or from another computer.

A "smart" terminal utility is completely different because, while it turns a computer into a terminal, it also allows the computer's RAM and storage system to be used on demand by the user or by the host computer.

Programs and data stored on disk or tape—or in memory—can be exchanged between the personal computer and the host computer, or between the personal computer and another smart terminal. An enhanced smart-terminal utility such as *OMNITERM* can convert binary data for transmission as ASCII code, receive or transmit directly in binary, and even convert from one format to another—like receiving IBM's EBCDIC code and storing it as ASCII and vice versa. One common use of a smart-terminal utility is to swap programs directly between different computers—like from a Heathkit to a Radio Shack—by having the utility convert the output signals to ASCII.

When we say that a personal computer can function as a "host," we mean that it will function as a full-blown computer for a remote smart or dumb terminal. The best way to illustrate that function is with a practical example. Imagine, if you will, that you are an electrical contractor, and your personal computer's active data-storage contains all the formulas, order information, and other data you need for calculating a sound-reinforcement system. The computer is connected through an auto-answer modem to a telephone line. You're out in the field calculating a job and your client wants his information *now!* You connect a portable terminal to a convenient telephone, dial your office, and when the auto-answer modem connects the computer to the phone line you can operate the computer from your portable terminal just as if it were there in the room with you. Your personal computer is serving as a host computer for your portable terminal. Similarly, another personal computer functioning as a smart or dumb terminal could access your host computer through the modem connection. (To protect your system or its database, from "unauthorized" use, you could provide for password protection at different levels.)

An unusual utility package is something called *Micro-Courier* for Apple computers. Essentially, it's a package of utilities that permits the *Apple II* computer to function as a "communications center" for access to Western Union, TWX, Telex, international cable-services, and other computers. It contains its own data base, allows pre-writing of messages, will receive remotely under control from the "other end," and it can receive and transmit under the control of a clock/calendar for fully unattended operation. It even features answer-back validation.

Tapping the "biggies"

Another utility certain to become one of the outstanding ones of the 1980's is *REFORMATTER*. Basically, it is a translator/convertor that allows personal computers to transfer data to and from "large" mainframe computers that use IBM protocols. In the "plain vanilla" configuration *REFORMATTER* transfers files between computers using CP/M, CP/M-like, or MP/M operating systems and those using IBM protocols. It performs an automatic ASCII-to-EBCDIC character-code conversion, and organizes data to the IBM 3740 disk data-entry format. It allows direct access to IBM disks for both examining and altering data.

Essentially, it gives the personal-computer user access to any software that can be transferred through IBM-format equipment. For example, it would permit a user to develop programs in FORTRAN, COBOL, Pascal, or other languages on a personal computer, convert them to IBM format, and, finally, run them on a large time-sharing system. The process could also be worked in reverse, with the original work being done on the larger system and then transferred to the smaller computer system.

In short, *REFORMATTER* moves the personal computer away from the need for special personal-computer software and into the world of commercial mainframe and time-sharing software.

Special versions of the utility are presently available for *CP/M*-to-DEC (Digital Equipment Co.)—which allows access to the DEC library—and Radio Shack *Model II TRSDOS*-to-IBM.

Because it permits direct access to the vast library of mainframe software, we can expect versions to become available for most, if not all, of the personal computers.

Users of Heath/Zenith computers also have a chance to tap the software used on the "biggies"—and the other Heath computers—through disk operating-system conversion utilities. Those utilities will convert ASCII or non-ASCII files that run under *CP/M* to run under *HDOS* (Heath's own DOS) and vice versa. ASCII files, such as a program in BASIC, will run under either DOS. However, while non-ASCII binary files can be copied they cannot be run. Those DOS conversion utilities, therefore, permit tapping only ASCII-based software and data.

UTILITY PROGRAM SUPPLIERS

In addition to the manufacturer of your computer, utility software can be obtained from many independent software companies. While, due to space, we could only include a few of those companies, the following listing may be of some help in finding the utility programs you need.

ALLEN ASHLEY
395 Sierra Madre Villa
Pasadena, CA 91107

BASIC BUSINESS SOFTWARE
PO Box 2032
Salt Lake City, UT 84110

BT ENTERPRISES
171 Hawkins Road
Centereach,NY 11720

COMPCO
8705 North Port Washington Road
Milwaukee, WI 53217

COMPUTER DESIGN LABS
342 Columbus Avenue
Trenton, NJ 08629

COMPUVIEW PRODUCTS INC.
618 Louise
Ann Arbor, MI 48103

CORNUCOPIA SOFTWARE
PO Box 5028
Walnut Creek, CA 94596

CYBERNETICS, INC.
8041 Newman Avenue
Huntington Beach, CA 92647

DATA RESOURCES CORPORATION
Business and Professional Center
8000 East Quincy Avenue
Denver, CO 80237

DELTA COMPUTER SYSTEMS
668 Chenango Street
Binghamton, NY 13901

DIGITAL RESEARCH
PO Box 579
Pacific Grove, CA 93950

DYNACOMP, INC.
1427 Monroe Avenue
Rochester, NY 14618

HAYDEN BOOK COMPANY, INC.
50 Essex Street
Rochelle Park, NJ 07662

HOWE SOFTWARE
14 Lexington Road
New City, NY 10956

INSTANT SOFTWARE
Peterborough, NH 03458

KV33 CORPORATION
PO Box 27246
Tucson, AZ 85726

LIFEBOAT ASSOCIATES
164 W. 83rd Street
New York, NY 10024

LINDBERGH SYSTEMS
41 Fairhill Road
Holden, MA 01520

LJK ENTERPRISES INC.
PO Box 10827
St. Louis, MO 63129

META TECHNOLOGIES
26111 Brush Avenue
Euclid, OH 44131

MICROSTUF, INC.
1900 Leland Drive
Marietta, GA 30067

MICROTECH EXPORTS, INC.
467 Hamilton Avenue
Palo Alto, CA 94301

OMEGA MICROWARE, INC.
220 S. Riverside Plaza
Chicago, IL 60606

PHASE ONE SYSTEMS, INC.
7700 Edgewater Drive, Suite 830
Oakland, CA 94621

RACET COMPUTES
1330 N. Glassell, Suite M
Orange, CA 92667

SNAPWARE
3719 Mantell
Cincinatti, OH 45236

SOFTWARE CONSULTANTS
6435 Summer Avenue
Memphis, TN 38134

SOFTWAREHOUSE INTERNATIONAL
5070 N. Sixth Street, Suite 103B
Fresno, CA 93710

STATCOM CORPORATION
5766 Balcones, Suite 202
Austin, TX 78731

SUPERSOFT ASSOCIATES
PO Box 1628
Champaign, IL 61820

THE ALTERNATE SOURCE
1806 Ada Street
Lansing, MI 48910

THE SOFTWARE PLANTATION
PO Box 44623
Tacoma, WA 98444

TWENTY-FIRST CENTURY SOFTWARE
1607 North Cochran
Hutchinson, KS 67501

UNITED SOFTWARE OF AMERICA
750 3rd Avenue
New York, NY 10017

WESPER MICRO SYSTEMS
14321 New Myford Road
Tustin, CA 92680

Little things mean a lot

While it's nice to be able to tap the software used by the giants of industry, for the average user the most important utilities are those that make possible new or more convenient uses for a personal computer or its associated peripherals.

For example, for $20 there's a utility that permits use of Apple's floating-point BASIC in Apple computers that don't have the *Applesoft* card.

And ten dollars is all it takes to buy a cassette-based "sort" utility with multiple sort-keys. It's not the fastest program of its kind, but it is rock-bottom priced, and not everyone has a disk system yet.

For "hackers" there's a utility that edits a BASIC program, almost instantly changing all PRINT'S to LPRINT'S or vice versa.

Another utility will duplicate Radio Shack SYSTEM format tapes. Yet another—*Locksmith*, for the *Apple* computer—permits copying "protected" disks, the kind that normally only allow two backups. (That gives you a little added protection by solving the annoying problem of what you do when the second backup "crashes.")

Admittedly, little in the way of utility software falls in the ten-to-twenty-dollar range, but much of it is reasonably priced (under $100) and is worth what it costs. For example, there are several utilities that provide a "shorthand" for BASIC programmers that lets them use a shift/single-key entry to represent a complete command, or a user-defined instruction, making entering programs easier.

Again for programmers, there are several compression utilities that will remove blanks and remarks from BASIC programs so the programs take up less memory space and run faster.

Among the most widely used utilities are those for the Epson *MX-80*, one of the most popular printers for the Apple and Radio Shack lines. (The *MX-80* is also sold under the IBM and Hewlett-Packard names.) The printer has many special features that can be accessed only through commands that are transmitted before or during the program. It's easy enough to imbed those commands within BASIC programs, but almost impossible to do so with commercial or assembly-language software.

That problem is overcome by special utilities that permit transmission of the Epson commands directly from the DOS, as commands imbedded within word-processing software, or within a customized assembly-language printer driver. (In most instances the *MX-80* utility is used to enhance the word-processing software so it all becomes one package, similar to the superscript-enhanced *SCRIPSIT* that runs as *Script*.) A special utility is also available that permits the *NEWDOS* JKL function to dump screen graphics to the printer while it remains in the standard mode, thereby retaining all the standard printer-functions while adding the capability of printing screen-graphics.

Not so well known are utilities such as *Disk Doctor* for *CP/M* and *Super Utility* for *TRSDOS*, which are used to recover "crashed" disks. Perhaps it's a defective directory that prevents any use of the disk files, or maybe a file was accidentally erased (actually only the file reference in the directory is erased, unless a new file is recorded in the space occupied by the "erased" file). In many cases, the disk-saver utilities can recreate the directory, or locate files no longer listed in there. Some can virtually repair an entire disk, losing perhaps only 256 bytes.

Sometimes the crashed-disk utilities sound better than they work. Before you purchase any of them, it's a good idea to read their specifications, to see what they don't say they do, or what they say they don't do (there's a difference). Will a utility work with the operating system you use? If so, will it have unusual side effects that might cause the loss of the data you're trying to recover? I raise that point only because the disk software may be irreplaceable, and the wrong utility can cause its loss forever.

Also in the "doctor" category are utilities that test each memory address and indicate on the memory any defects (assuming the RAM that's failed isn't used for the screen display or needed for the utility).

There are utilities that test disk drives, particularly for precision and constancy of speed. (One of the main causes of disk-read problems.) Many "disk test" utilities are provided along with other utilities in a single package, such as "*Locksmith*, for the *Apple*, which contains six utilities of various types—including a disk "bulk erase".

Finally, we come to the source of many of the most convenient and important utilities: the aftermarket disk operating-systems such as *NEWDOS 80*, *LDOS*, *VTOS*, *DOSPLUS*. In many instances the principal difference between what came with the computer and the aftermarket-DOS is the utilities provided in the new software. Certainly, the *NEWDOS* JKL screen-print function is one of the most famous and—to some computerists—the most important. To others, the ability of an aftermarket system to format different disk-track counts, change disk stepping-rates (for faster operation), or copy software from other DOS's is the most important consideration. In fact, the aftermarket DOS-systems are so extensive that much of what formerly was available as discrete utilities is now found all together in the aftermarket DOS. Many users of personal computers will find a "new" DOS offers most of the utilities they want at a moderate price—certainly less than they would have to pay for a collection of individual utilities if they were bought separately.

Something for everyone

We have tried to touch on the highlights of the utility software presently on the market. By the time you read this some may have disappeared, but many others will have appeared. No computer, peripheral, or software can ever meet 100% of everyone's needs. And as long as there is someone who is not satisfied, there is someone else who will write the utility he's looking for. **R-E**

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APRIL 1982

HOBBY CORNER

Several new sound-generator IC's

EARL "DOC" SAVAGE, K4SDS, HOBBY EDITOR

SEVERAL MONTHS AGO WE DISCUSSED Texas Instruments' 76477 sound-generator IC. If you built (or even read about) any of the circuits that were presented, you know just how versatile that IC is.

Now, Texas Instruments has come up with three additional sound generators: the SN76488, the SN76495 and the SN76489. If you want to produce any kind of sound other than a simple tone, you should be familiar with those new IC's, too.

The SN76488 is a 24-pin IC that looks just like the 76477. Functionally, it is the same in all but one respect. You will recall that the 76477 requires an external audio-amplifier to produce a useable level of sound. To the great advantage of the builder, the 76488 has a built-in audio amplifier!

You can connect the output (pin 13) directly to your speaker. The output power provided is 125 milliwatts. Actually, there should be a capacitor with a value of approximately 100 μF between pin 13 and the speaker. The volume is sufficient for games, alarms, and most other uses. Of course, the output can be routed to an external amplifier if you wish to fill a concert hall.

I won't give you any 76488 circuits because they are so similar to those of the 76477, which was covered in the previous column (see "Hobby Corner," in the February 1982 issue of **Radio-Electronics**). When using the 76488, however, do not unthinkingly copy a 76477 circuit because the pinout is different.

Perhaps more exciting for the average hobbyist, is the new SN76495. That beauty is a 16-pin sound generator that also includes a 125-mW audio amplifier. Because there are not as many pins to allow you access to its innards, the 76495 is somewhat less versatile than its 24-pin cousins but you can still get a wide variety of sounds from it. The 76495 does have the advantage of having a lower price tag, even though its internal block diagram is almost the same as the larger versions.

The theory and operation of the 76495 is similar to the discussion for the 76477 in the earlier column. To get you started, however, here are a couple of circuits developed by the TI folks.

Figure 1 shows a very simple double alarm. The application of a positive voltage (about +3-volts) at point A produces a siren-type sound, while a similar voltage at point B causes a beeping tone. If you don't like the frequency of the alarm, change the values of the capacitor connected to pin 9 and/or the value of the resistor connected to pin 10. When you build that circuit, you will find that there is plenty of volume to get your attention.

The alarm would be ideal for use as a front-and-back doorbell. Just run +3-volts to the pushbutton switch at each door and connect one to point A and the other to point B. You could not ask for a simpler-to-build doorbell for two separate entrances.

The circuit shown in Fig. 2 is more complicated, but it gives you an even better idea of what can be accomplished with the 76495. With just a handful of components, that circuit produces a veritable audio racetrack or real cops-and-robbers car chase. Press switch S1 and you will get the sound of an engine revving; S2 gives the sound of a crash; and S3 produces a tire squeal.

Now, how's that for a little 16-pin IC? I'm sure you will find many uses for that versatile IC. Incidentally, if your favorite supplier doesn't have those IC's by the time you read this, keep bugging him, (or slip away to another supplier).

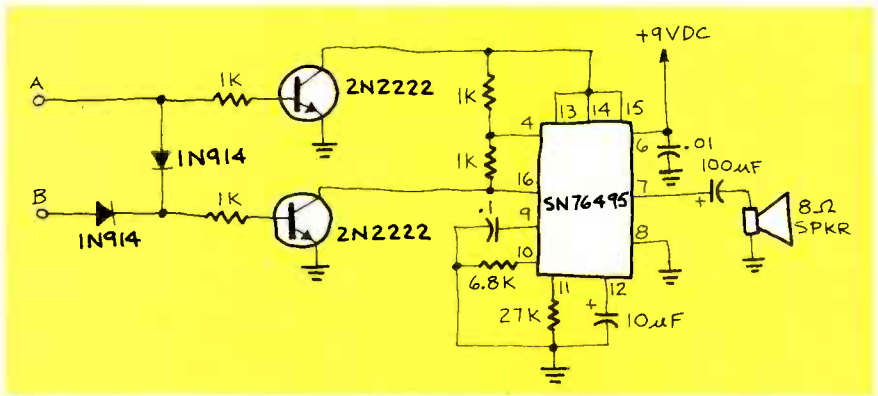

FIG. 1

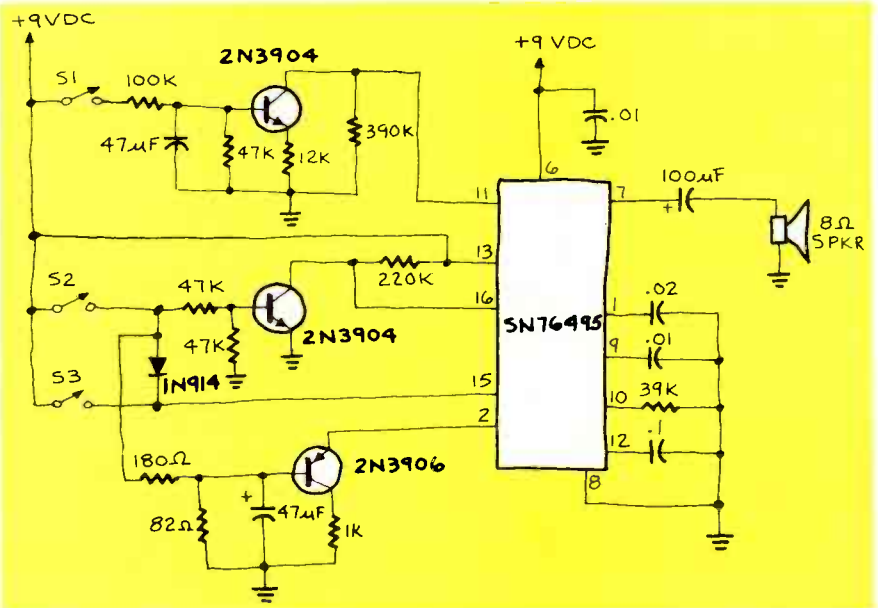

FIG. 2

The third new sound-generator IC is the SN76489. Actually, there are two similar IC's: the 76489 will drive a small speaker, while the 76489A requires an external amplifier. Those IC's are all but unbelievable. Both varieties of the 76489 contain three programmable tone generators, a programmable attenuator, a noise source with its own attenuator, and various other goodies. And—now get this—there are also registers and an interface for connection to the data lines of a computer!

As you can see, the use of the word "programmable" was deliberate. The 76489 has been designed carefully to be computer-controlled. I can hardly wait until I get mine hooked-up to my personal computer.

Since I just received the SN76489, I have not yet had the opportunity to run it through its paces. From the description in the data sheets, it is obvious that a multitude of sounds can be generated. Imagine the sound effects that you can have with your computer programs. I'll let you know in a future column what I turn up and, in the meantime, I keep wondering how those guys at TI keep doing it.

New circuit-board holder

You certainly must be aware of the variety of circuit-board holders that are currently on the market. Many of the ones available have been covered in previous columns.

Now, the folks at Bidor Engineering Company (P.O. Box 1184, Kailua, HI 96734), have come up with two new assistants for those of us who design and/or try out circuits on solderless breadboards before building them on PC boards.

One of the problems with the breadboard/PC board system has been the difficulty of drawing the circuit out on the same-size design sheets that are available. Bidor offers pads, called *Circuit-Aide*, that are made up of 8½ × 11 inch sheets. One half of each sheet contains an enlarged version of the breadboard/PC design—big enough to draw and label on. The other half of each sheet is lined for notes to give you a complete record of the circuit on one page.

The other part of the new system is a PC-board holder that is specifically designed for use with those long, narrow boards. Of course, it will work with other types of boards, too. While the new holder attaches to the front of a workbench or table top, it extends back access the top of the work surface about 6 inches. That means that when you flip the board back toward you for soldering, it is still over the table and not hanging out over the floor (resulting, among other things, in fewer holes burned by hot solder in your wife's "best" rug).

Reader requests

James McDaniel of Brookfield, IL is looking for a way to convert his direct-connection automotive timing light into one with an inductive pickup. As he points out, direct connection into an electronic ignition system can be disastrous and it is a shame to throw out an otherwise good timing light. Have any of you made that conversion?

Jim Nickel of West Allis, WI would like to find a way to make the alarm of his digital clock control an AC outlet. Perhaps Jim wants to have hot coffee when he is awakened. He has tried several approaches without notable success. How would you make that beeping sound throw a switch? Or perhaps an entirely different approach is called for.

A reader from Cincinnati, Dick needs a circuit to help him when he makes a slide presentation. He sometimes runs into some problems because he finds himself talking, changing slides, starting and stopping music, and changing the brightness of a small spotlight all within a short period of time. What he needs is a circuit that will take care of those things for him, requiring him only to push a button or two occasionlly. After all, some of those operations must take place at the same time. Does anyone have any ideas? **R-E**

COMMUNICATIONS CORNER

Digital communications are here

HERB FRIEDMAN, COMMUNICATIONS EDITOR

I'M CERTAIN THAT AT ONE TIME OR other most people have wanted something so badly they could almost taste it. Right now it's a bet that there are thousands of amateur radio operators who can "taste" operation on the newly authorized frequencies in the 10-, 18-, and 24-MHz bands. While the date for world-wide exclusive amateur use is set for 1 July 1989, the FCC has advanced the timetable for U.S. participation, and regular amateur use of 30 meters (10.1-10.15 MHz) has already began as of 1 January 1982.

And it's not just Uncle who is rushing into the new frequencies. On the other side of what our school children are taught is "The world's longest undefended border", the Canadian DOC (Department of Communications) has authorized two amateurs to experiment with digital-communication transmission in the 30-meter band. The idea is to get data on the effects of interference on digital transmission in the high-frequency bands.

I find that considerably more exciting than the prospect of simply having more operating frequencies, because digital transmission is where communications "is at." Essentially, the two Canadian experimenters are going to drag amateur radio—kicking and screaming all the way—into the twentieth century.

I say "kicking and screaming" because I well remember the seemingly endless hassle with the FCC to get 8-level ASCII permitted on the ham bands. The amateurs had been locked into Baudot (5-level) long after 8-level was virtually the standard for modern communications. The FCC was still studying the possible interference effects from ASCII when FM-station operators had already proven that digital ASCII was not a bandwidth problem by successfully transmitting digital on their SCA subcarriers (the same subcarrier that carries "background music").

Before New York City fell to the brink of bankruptcy, the school system's FM station had FCC authorization for experimenting with digital transmission of communications and data using the station's SCA subcarrier.

There were several aspects to the idea that many of you will find applicable to both amateur and commercial services.

First there was the problem of reliability. The school system used a "telephone relay" for "emergency" messages to the schools. One school called several others; and they in turn called others, etc., etc., and more etceteras. By the time it was all over, no one knew for certain who had received the message, or what the message really was about: Nothing gets as scrambled as a verbal relay after the third transmission. But the biggest problem was "accountability," otherwise known as "pinning the blame." No one could dispute a claim that a relay message was not received as originally transmitted.

The SCA digital transmission would eliminate all the "relay" problems, because every school has a tuner tuned to the school FM station; and the digital data could automatically turn on a printer and simultaneously provide every school with a "hard copy" of whatever was transmitted from headquarters. No one could claim that the message got garbled. To avoid the possibility of someone claiming a computer foul-up, all data was to be set with triple redundancy—the receiver would unscramble the data and print a proper copy.

A second aspect of the digital system—one certain to be used by amateurs and commercial services—was "store and forward." The school headquarters sends out many universal and specific messages during the course of a term. Anything of importance could easily be transmitted digitally. A typist or word processor at headquarters would simply type in the messages on a terminal connected through the dial-up phone system to a small computer at the FM station. Each message would be encoded for a specific school group of schools, district office, all schools, or whatever. The messages would be accumulated by the computer all day long. The following morning, say at 9 AM, the computer would transmit each message to the appropriate schools and offices, each receiving a hard copy printout at the start of the day. The computer could even store messages for delayed transmission—for example, special exam reminders for high schools would be stored at the beginning of the term and automatically transmitted at the appropriate times throughout the year. (The "official" description for that form of data and communications transmission is store and forward.)

Another problem to be tackled with digital-data transmission was that of pupil attendance. For some reason unknown to me, it was important to have a record of the school attendance, because that affected state aid. One idea was to have the schools phone in the data to the station's computer (using voice recognition). The computer would accumulate the data; if, by a certain time, the data were not received, the computer would automatically poll the

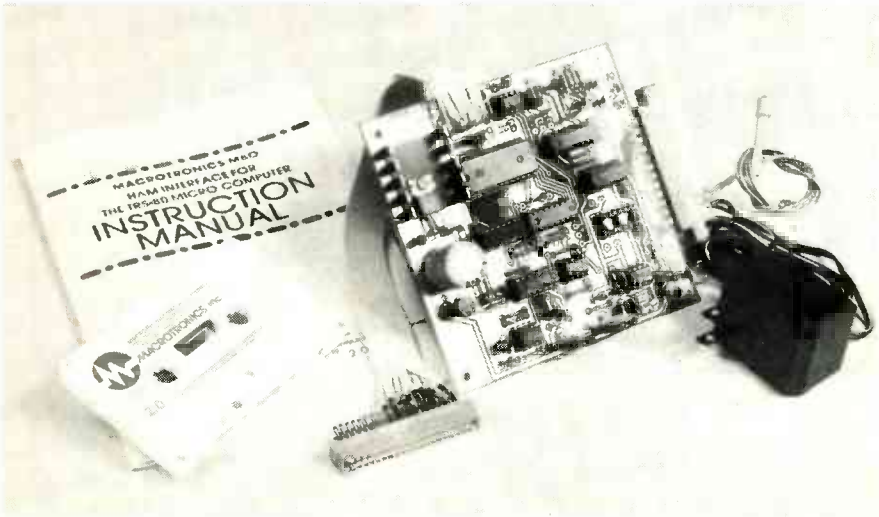

FIG.

non-reporting schools. With a hard copy of the request at the school, and a soft copy in the computer's memory, it was considered unlikely that a school would claim "they forgot."

There are many advantages to digital communications; most likely you can think of a few particularly tailored to your interests. A common bond, however, is speed and computer control. Taking the tail end first, let's take a quick look at computer control.

For many, many years amateur TTY (*Teletype*) operators have used "remote control" to leave messages for other TTY operators. It is not unusual for TTY operators to leave their receivers on and turn to a "net" frequency. Another station coming on the frequency uses control signals to activate the printers at the receiving stations. The printers start up, copy the transmission on paper, and then are turned off by the transmitting station.

Amateur radio has entered the computer age with devices such as the interface board shown in Fig. 1. A computer-based digital-communication system can do exactly the same things as a mechanical TTY system; except, instead of having the whole thing possibly controlled by a time clock, with the message transmitted from a punched paper tape or a magnetic tape recording, a small user-programmed microprocessor would substitute for both the timer and message data bank. In short, the microprocessor would simply substitute for a lot of hardware.

As far as speed is concerned, digital communications can transmit several thoughts in less time than an SSB operator can trip the VOC with an "Errr." or clearing of the throat.

As far as CW is concerned, a real slow digital transmission can print out at 300 words-per-minute, which is a mite faster than the average CW keying.

An interesting application of digital communications would involve computer voice recognition. It would be possible actually to store digitized speech in a computer, wait for a break in the QRM or QRN, transmit digital data representing the voice input in a fraction of the time it would take for a real-time voice transmission, and then restore the digital data to speed (artificial voice) at the receiving station. That is no big deal because voice-to-digital-to-hard copy (print) is done every day of the week over phone lines. Coming out voice instead of hard copy, and using radio rather than telephone line, isn't all that much different.

One of the nice features of voice-to-digital-to-anything is that there's a computer on both ends. If the receiving station gets a garbled transmission—even as little as a single character—it can automatically interrupt the transmitting computer and require a repeat.

Of course, just as it took many years for the "oldtimers" to acknowledge the superiority of SSB compared to AM, it will take many years for a new group of oldtimers to find any value in digital communications. But I can't wait for the Canadian to report the results of their digital-communication experiments, for I believe it will herald the dawn of a new era in both amateur and commercial communications. I would like to get the opinions of readers in both the computer and communications end of things regarding digital communications. If we get enough of a response, we'll consider it a survey and summarize the comment in a future column. You can write to me c/o **Radio-Electronics**, 200 Park Ave. South, New York, NY 10003. R-E

"What's my excuse? Well, for one thing ... my homemade fuzz-buster didn't work!"

COMPUTER CORNER

Computers in education

LES SPINDLE*

NO MATTER WHO YOU TALK TO, THE topic of computers in education seems to be steeped in controversy nowadays. Advocates of computer literacy emphasize the importance of computers to modern lifestyles and insist that schools must supply that knowledge in the classroom; detractors argue that more emphasis should be place on the 3 R's and less on extraneous subjects. There are those who insist that the era of a computer terminal on every desk is just around the corner, while others insist that traditional teaching methods will never give way to computerized instruction. Some teachers enthusiastically espouse the benefits to be gained from educational software, while others tremble with fear that a machine is taking over their jobs. The arguments go on and on ... but, as in most other areas of diverse opinion, the answers lie somewhere in the middle.

The use of computers in education has certainly not developed at the speed that many predicted when the CAI (*C*omputer-*A*ided *I*nstruction) concept first came into being in the late 50's. But there has been a steady growth in the use of hardware and software in the classroom. And a broader view of the whole concept is the realization that, whether in or out of the classroom, computers represent a form of learning that is applicable to all types of people. The entire revolution in information technology (including videocassettes, cable television, teletext, viewdata, and all manner of sophisticated audio/visual presentations) brings vast amounts of diverse knowledge into easy home access. Those technologies represent a form of shared knowledge that can only improve our awareness. If life is viewed as an eternal school, wherein learning is a never-ending process, modern communication technologies certainly offer the most versatile classrooms imaginable.

One of the earliest experiments with computers as a learning aid occurred at Stanford University in the early 60's. Professor Patrick Suppes led a group of educators, who developed programs wherein the school's central computers were used for student lessons, both within the university and at pilot projects in elementary schools. The results at the university were quite gratifying: Those who studied Russian through the CAI program fared better than those who took the course in traditional classroom fashion. The elementary school tests turned out to be less effective. However, a very promising conclusion was the fact that the CAI methods did seem to improve the performance of students in less-affluent schools, where the teachers often had inferior skills.

Meanwhile, one of the most successful CAI timesharing systems was under development. At the University of Illinois, Dr. Donald Bitzer used a five million dollar grant from the National Science Foundation to develop the PLATO network. The setup consists of a large central computer, accessed through the schools via telephone lines by hundreds of PLATO terminals, mostly in public schools and universities. The terminals include a keyboard and display that presents text, graphics, and animated illustrations. The catalog of canned programs offered exceed 5,000 hours of instructional material in over 240 subject areas, ranging from first-grade reading to graduate-level law and engineering. Also offering its own programming language, TUTOR, the system enables teachers to develop their own instructional programs.

While PLATO and other mainframe educational projects provide some versatile and effective teaching programs, the cost is often prohibitive for many secondary and elementary schools. So companies such as Digital Equipment Corp. and Hewlett-Packard have tapped the market by providing CAI courseware for microcomputers. Math programs form the bulk of what is available presently; there is a very pressing need for more and better courseware for microcomputers. The difficulty of finding programmers who have adequate knowledge of educational principles contributes to that shortage. And in true chicken-or-the-egg fashion, the lack of courseware deters the purchase of computers by schools.

Besides the cost of the large timesharing systems, there is another drawback that frequently hampers their acceptance by many teachers and school administrators. As more users come online, response time is slower. Young children become impatient if it takes too long to access a response. The effect of being ignored is much the

FIG. 1

*Managing Editor, *Interface Age* Magazine

same as if the student does not get proper attention from his teacher, due to an overcrowded classroom. Worse yet, the waste of valuable classroom time is not the ideal circumstance for efficient classroom procedures.

Another problem that occurs is the instance when a system "crashes," or otherwise can't be accessed. Whether due to interference on the phone line, temporary problems in the mainframe computer, or other deterrents, a teacher's schedule can be disrupted if a lesson can't be given as planned.

For those reasons, smaller computers used within the school system, rather than individual terminals connected to a remote network, are becoming more prevalent in the classroom (see Fig. 1). Systems such as the various *TRS-80* models, *Apple II*, Commodore *Pet* and the Atari *400* and *800* systems are popular, because they combine graphic capabilities with affordability and ease-of-use. Software is available for each of those systems, often by outside vendors. Besides their use in the classroom, the systems are frequently used by parents to give their children additional educational experiences at home. Available software for them includes such subjects as computer programming, languages, mathematics, music, sociology, grammar, and most other classroom studies.

CAI courses generally fall into three basic categories: drill and practice, tutorials, and simulations. Drill and practice software function essentially as a review process. In teaching basic math, for instance, a youngster is given the problem on the CRT screen, then is asked to supply an answer. If the answer is correct, another problem is presented; if incorrect, the student is asked to try again. After making two errors, the student is given the answer. Courses in state capitals, touch typing, and other subjects present questions in a trial-and-error format.

Tutorials are generally more advanced than drill programs, offering more in-depth exposure to more complex topics. Many colleges use tutorial software for such topics as matrix algebra, science, and medicine. Most such systems come with sets of cassette tapes that have two tracks, one for audio and one for the computer. The user listens to the instructions on the audio track through the television speaker, while the data track displays written information, charts, graphs, and other learning aids on the screen. At specific points, the computer stops the tape and the user is asked to answer questions on the information presented.

Simulation programs are often used in game applications, but their usefulness is much more widespread than simple recreation. Hypothetical situations are described and the user interacts with the computer, step by step, to provide solutions to problems that arise. For instance, medical students might watch as a surgical situation is being described. The students handle each phase of the operation and deal with the individual complications or unique problems that may come up. The same sort of process can apply for legal situations, equipment operations, or any other methodical process that involves making decisions.

Computers in education are neither proceeding at the break-neck pace that was originally projected, nor are they headed for the debacle that skeptics predicted. For such applications as home study, industrial training, and self-education, there is already evidence of growth.

In actual classroom situations, computers are gradually overcoming such obstacles as the shortage of courseware and prohibitive school system budgets —and such less-obvious hindrances as resistance by teachers who fear for their jobs—but the expansion is definitely occurring nonetheless. As technology in microcomputers improves on a day-to-day basis, the devices are making inroads into every aspect of our lives. Though it's taken a little longer than expected, education will certainly be no exception. **R-E**

STATE OF SOLID STATE

A look at MOS and CMOS technology

ROBERT F. SCOTT, SEMICONDUCTOR EDITOR

The past two or three years have given us many advances in the field of power semiconductors. Among those developments are increases in operating voltage, operating frequency, and switching speed. The advances in semiconductor technology were needed to keep up with those in power control, switching-type power supplies, Class-D switching-type hi-fi power amplifiers, and other applications requiring fast, efficient transistors capable of handling high voltages and current.

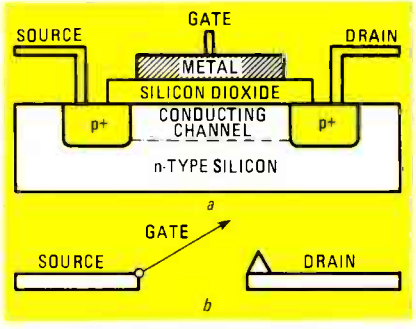

FIG. 1

It all began with the MOS (*M*etal-*O*xide *S*emiconductor) technology that gave birth to the MOSFET (MOS *F*ield-*E*ffect *T*ransistor). In the MOSFET, a metal-gate electrode is placed on a silicon dioxide insulator as shown in Fig. 1. The drain and source are carrier-doped $p+$ regions in the n-type silicon substrate. Normally, that type of MOSFET acts as an open circuit between the source and drain until a negative voltage is applied to the gate. When that happens, a conducting channel of positively charged holes permits current to flow between the source and drain. (Holes are the absence of electrons. The current carried between source and drain is equivalent to conduction by positive charges; thus p-type conduction through a p channel.) Hole conduction is enhanced (increases) as V_{GS} is made more negative.

An FET of the opposite polarity (called n-channel—for n-type conduction) can be made so current is conducted between source and drain by electrons when a positive voltage is applied to the gate.

Both n- and p-type FET's can be fabricated on the same chip to form a CMOS (*C*omplimentary MOS) or COS/MOS

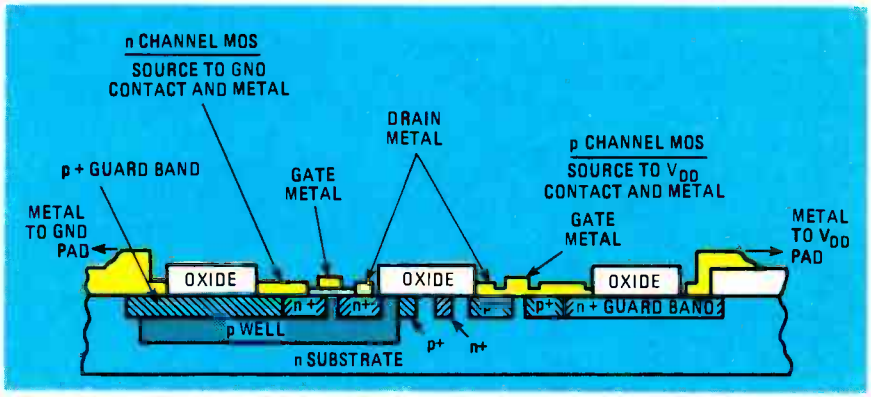

FIG. 2

(*CO*mplementary-*S*ymmetry MOS—an RCA designation) structure.

CMOS devices are most widely used as logic elements with p-type and n-type MOSFET's connected in series on the same chip as shown in Fig. 2. The devices are normally fabricated on n-type silicon material that serves as the substrate for all of the p-channel MOSFET's $p+$ channels, diodes, and resistors. A lightly doped p well is diffused into the n-type base material. Guard bands surround the n-channel and p-channel MOS devices to prevent leakage between them. The $p+$ guard band on the n-channel device serves as the internal ground or V_{SS} bus. The $n+$ guard band serves as a bus connecting the V_{DD} supply to all p-channel devices.

Figure 3 shows an inverted made using an n-channel and p-channel enhancement-mode FET. The gates are connected in parallel. When a voltage of given polarity is applied to the gates, only *one* transistor can conduct; both cannot conduct at the same time. The substrate of the p-channel transistor is at V_{DD} and the substrate for the n-channel is at V_{SS}, or ground potential.

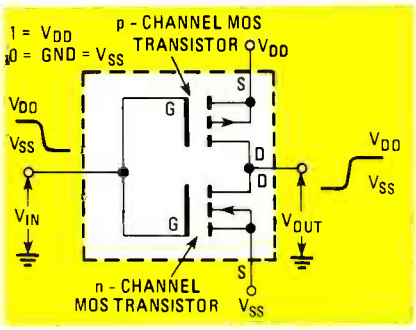

FIG. 3

If the inverter gates are HIGH (logic "1"), the n-channel MOSFET is turned on and the p-channel MOSFET is turned off. Thus the output is LOW (logic "0"). If the input to the gates is LOW, the FET's change states; the n-channel device turns on and the p-channel device turns off. Since the CMOS device can be compared to two series-connected normally-open switches, only one of which can be closed at a time, no current can flow from the supply ground.

The quiescent power consumed by the CMOS device is extremely low—equal to the product of supply-voltage V_{DD} and leakage-current I_L. The device draws appreciable current only during the transition from logic "0" to logic "1", and vice versa. Therefore, the average current, and thus the power consumed by the device, is directly proportional to the switching.

The extremely low power consumption, and the fact that thousands of MOS devices can be fabricated on a single chip, makes possible low-cost IC's with extremely complex circuits for use in calculators, microprocessors, etc.

CMOS devices are not limited to logic applications. Gates and inverters can be used as oscillators, as well as astable and monostable (one-shot) multivibrators. An example of that is the R-C oscillator used in the circuit shown in Fig. 2 in last months installment of this department (March 1982, issue).

With this introduction to MOS and CMOS technology, we are ready to examine some of the more recent technology advances. We'll do that in future columns. **R-E**

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SERVICE CLINIC

An unusual overvoltage-protection circuit

JACK DARR, SERVICE EDITOR

A READER WROTE IN ABOUT A PROBLEM in an RCA CTC-74AA chassis. Looking it up, I found that the set was a solid-state 1976 model with an unusual feature—it used an electro-mechanical relay in the overvoltage-protection circuit. Of course, that was the circuit that was giving the reader problems. I thought the circuit was unusual enough to merit discussion here.

The complete circuit is shown in Fig. 1. The relay is a DPDT type. One set of contacts is connected across the PTC (*P*ositive *T*emperature *C*oefficient) thermistor that is in series with the primary of the power transformer. The second set of contacts is in the +174-volt DC supply line to the horizontal-output stage. The action of that circuit involves some very critical timing.

At turn on, the relay's contacts are open. Having a postive temperature coefficient, the thermistor has a low resistance, about 15 ohms, when cold. As things heat up, its resistance rises rather quickly. When power is applied, the thermistor conducts just long enough to allow a pulse of AC to reach the primary. That, of course, generates a DC pulse in the secondary.

The DC pulse develops the +174-volt DC source voltage. That is dropped to about +40 volts by the 8200-ohm resistor and is fed to the relay coil. Incidently, that is a 2000-ohm coil and only a few milliamps are required to energize the relay.

The fun begins when the pulse reaches the coil, energizing the relay. Both sets of contacts close. The ones across the thermistor short it out, allowing the full AC voltage to be applied to the primary. The other set of contacts connect the DC supply with the horizontal-output stage, and we're off and running.

The most interesting part of this scheme is the overvoltage-protection circuit. There is a Zener diode connected between the +40-volt line and the base of Q201. That transistor's collector and emitter are connected across the relay coil. Normally, Q201 is cut off and has no effect on the relay's operation. But if the DC voltages go too high, the Zener diode conducts. That applies a voltage to the base of the transistor causing it to conduct and short out the relay's coil, which opens the contacts. The open contacts in the high-voltage supply kills the high voltage and the sweep, and the open contacts across the thermistor put the thermistor back in series with the primary. Putting the thermistor back in the circuit almost instantly drops the voltage to the primary to about 2-volts AC. Thus, the horizontal-output stage, the high-voltage supply, and the power transformer are protected by this circuit.

The problem that the reader who brought the circuit to my attention had was that the relay did not close. He noted that when the set was first turned on, the pulse *did* appear on the +40-volt line, but that the voltage dropped rapidly to zero. The presence of the pulse is the first thing that should be checked. If it is there, but the relay does not close, you should check the coil for continuity or an open ground connection. If the coil is good, check Q201 for a short, because that could also keep the relay from energizing; also check the Zener. If you are unsure whether that section is the cause of your problem, try pushing the relay contacts closed, using an insulated tool. If the set works, you can be certain that you are on the right track.

One final note, in the Sams *Photofact* schematic for the set (No. 1599-2), the relay is drawn in the *energized* state with the contacts *closed*. Be careful, because that can confuse you; I was confused for a moment.

It's a very interesting circuit and, fortunately, one that should be quite easy to service. Have fun! **R-E**

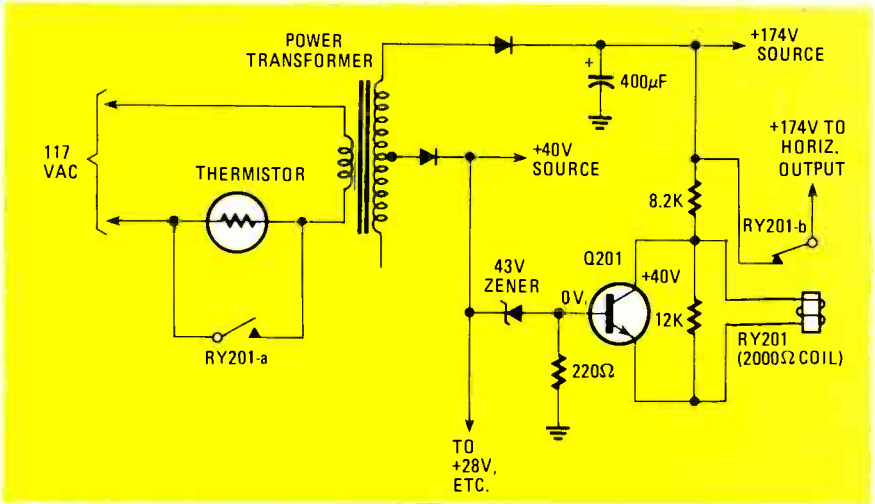


FIG. 1

SERVICE QUESTIONS

POWER TRANSFORMER NEEDED

I need a power transformer for an Allied 83 YU 146 scope that uses a 5CP1 CRT, and can't get it from Allied Radio. Can you help me?—A.Y., Beaver Dam, WI

A Triad R45C should work nicely. It has a 400-0-400-volt B+ secondary and an 800-volt HV secondary. In most scopes, the HV secondary is tied to one end of the B+ winding to produce +1200 volts and, while the 5CP1 is a PDA (*P*ost *D*eflection *A*cceleration) type, it doesn't require that high voltage—the B+ alone should do the job.

The transformer also has a 5.3-volt secondary winding rated at 0.6 amps; that should power the heater.

You've got a good old scope, and it should give you good service for a long while.

INTERMITTENT PREAMP

Eight years ago I built a Dynaco PAT-4 preamp from a kit and until recently it's worked fine. Lately, the left phono-input has gone dead about every three or four months. I traced the problem to the first preamp stage (Q1 and Q2). When I touched a screwdriver to the base of Q2, I got a "pop" and the circuit came back to life. I've resoldered all the connections on the PC board, but the circuit still dies from

time to time and has to be revived with the screwdriver. Do you have any ideas?—J.F., Manitowoc, WI

You've already done one of the things I would have suggested—bad solder joints are frequently the cause of intermittents. The other major case is intermittently open low-voltage electrolytic capacitors used for coupling. Your problem could be C1 at the input of this stage, or C4 at the output. Don't rely on testing the capacitors outside the circuit—I've found that the heat involved in desoldering them sometimes heals the open joint. I'd suggest that you replace one or both of them and see if that doesn't help.

SONY REGULATORS

Sergeant R. Hendricks writes from Germany that he has discovered something about Sony voltage regulators. He says that, after replacing bad parts, he checks the regulators without the set load. Under those conditions, the B+ voltage rises to almost the full supply-voltage. Hooking a 1500-ohm, 20-watt resistor between B+ and ground will allow you to verify that the regulator's operating properly.

TRIPLER PROBLEM

I got a Sylvania CX4161W with no vertical sweep and fixed that problem but then had bad retrace lines. I couldn't get them out by reducing screen voltages, etc., so I returned the set to its owner.

Two days later he called and said it was making a "snapping" sound. I found that the tripler had a hole burned in its underside and was arcing to ground Changing the tripler fixed that *and* the retrace problem. I never heard of that happening, but it did.—*Bill Draeb, Kewaunee, WI*

Neither have I, Bill, but I'll believe anything at this stage of the game!

LOSS OF HIGH VOLTAGE

I just saw your reply to R.A.H. of Fort Hood, TX on the loss of high voltage, where the neon lamp near the high-voltage rectifier glowed (**Radio-Electronics,** May, 1980). Your answer was correct, but you may have overlooked one thing. In many cases like that, look for an open horizontal-yoke winding, especially if all of the high-voltage tubes are OK. Unplugging the yoke will restore the high voltage on most GE and Zenith sets, but not Sears, Sylvania, etc. If the neon lights, it eliminates the flyback and tubes, and points to the yoke as the problem. Hope this works!—*Bill Suhy, Stratford, CT*

TUBE BREAKER

A Quasar TW-934 came in with the 6LF6 tube dead and the glass envelope broken. I checked several things, replaced the tube, and sent the set back. Two weeks

later, back it came—again with a dead 6LF6 and broken glass. All my readings are in the ballpark. Something's causing this problem, but I don't know what.—C.H., Alplaus, NY

This isn't a new complaint—some of the older RCA's used to have it, along with other sets. The most likely cause is a failure of the horizontal drive to the grid of the 6LF6. That will make the tube draw a tremendous current, over heating it to the point where the envelope shatters.

Check the whole horizontal-oscillator circuit—especially the connection between the plate and the 6LF6's grid. Tap on things and look closely for any signs of a bad solder-joint.

Also, find out from the owner whether the set failed at turn-on, or after it had been playing a while. If it quit when it was turned on, the oscillator may not be starting. Replace C23 and C24, the feedback capacitors across the oscillator coil.

INTERMITTENT VERTICAL SWEEP

I have a vertical sweep problem in this Admiral 2K2084. I've replaced all of the capacitors in the vertical sweep circuit, but about 10% of the time you only get a horizontal line when the set comes on. When I try to take readings, the set begins to operate normally. I've used new tubes, etc. What is going on?—J.C. Whittier, CA

It sounds like you have an intermittent solder joint somewhere in the feedback loop between the plate of the vertical-output tube and the grid of the oscillator tube. When you touch it with the test equipment, the tiny transient you cause "fixes" the bad joint. Start at the plate of the vertical-output tube and go through the whole circuit, resoldering every joint. This may be a shotgun method, but sometimes it's the best way to handle something like this. There aren't that many parts in this circuit anyway. Also, flex the PC board in this area, a hairline crack could cause the same problem.

DARK BAR

This Quasar TS-938 has a dark vertical bar near the left side of the screen. Also, if left on for a short period of time (about 2 minutes), D-12 in the power supply shorts. Changing the DA-F panel did not help.—W.D., Kewaunee, WI

That has happened before. The cause seems to be leakage or internal arcing in the high-voltage rectifier; that generates a burst of RF that blanks the raster. The cure is to try a new rectifier.

On the diode that keeps blowing, make sure that the replacement is a fast recovery type. That sounds like a typical case of using the wrong type of diode in a horizontal-frequency circuit. The wrong kind of diode usually lasts about 2 minutes or less. **R-E**

EQUIPMENT REPORTS

continued from page 24

were somewhat difficult to read. Also, bear in mind that "copy does *not* mean carbon. Using sheets of letter-size paper, the original and two NCR (No Carbon Required) copies just barely slipped through. The original and three NCR's required considerable care to load. Unless a Mylar carbon film was used it was somewhat difficult to make "carbon copies" using single sheets because it was difficult to load single sheets interspersed with ordinary carbon paper. Paper rolls that consisted of factory interleaved original, carbon and "second sheet" (copy) were more convenient because they fed through smoothly and without any bother. Actually, roll paper proves the most convenient to use; and it's certainly inexpensive if you purchase the ordinary teletype-paper grade.

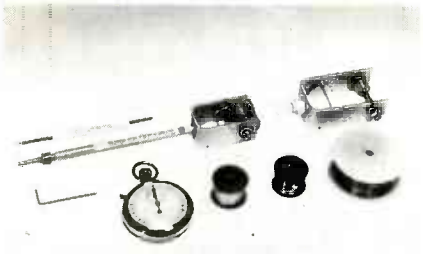
One nice feature is that the paper can be rolled backwards or forwards whether the power is on or off. Typical of matrix printers, the print line is low, out of sight. If you print one line you can roll the paper forward to check copy and then roll it back for additional printing; it's not necessary to turn off

continued on page 154

NEW PRODUCTS

For more details use free information card inside back cover.

WIRE-WRAPPING TOOL, *model P184-1* uses Vector's patented Slit-N-Wrap concept, which permits wrapped-wiring without measuring, cutting, or stripping. Tefzel-insulated 28-gauge wire is routed through the tool's center past a knife-edge in the bit where the insulation is split lengthwise. As the tool is rotated on the post, the insulation parts, making a gas-tight, metal-to-metal contact with the post.

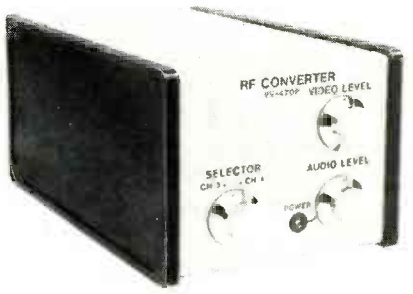


CIRCLE 131 ON FREE INFORMATION CARD

A 50-foot spool of wire permits about 200 daisy-chained or 150 post-to-post seven-turn wraps, with an average lead length of two inches. The 300-foot spool gives up to 1200 daisy-chained or 900 post-to-post terminations. The wire is available with black, blue, green, red, white, and yellow Tefzel insulation.

The *model P184-1*, with a 50-foot spool, is priced at $39.00. The optional 300-foot spool bracket is $12.40. Packages with two 50-foot spools of Tefzel insulated wire are $5.67, while 300-foot spools are $15.73.—**Vector Electronic Company,** 12460 Gladstone Avenue, Sylmar, CA 91342.

RF MODULATOR, *model VV-470P*, takes the audio and video signals from the satellite receiver, modulates an RF carrier and outputs the RF signal on a standard 75-ohm "F" connector—for viewing on



CIRCLE 132 ON FREE INFORMATION CARD

Channels 3 or 4. The interface circuit is compatible with a wide variety of satellite receivers.

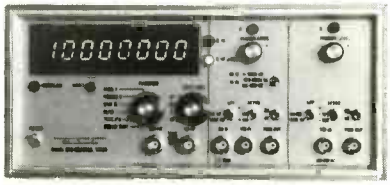
A unique feature of the *model VV-470P* is the independently controlled audio-video levels. If the user receives a strong/good video signal, the audio can be strength-

CIRCLE 44 ON FREE INFORMATION CARD

ened easily to complement the video signal.

Differential gain errors are minimized, thus decreasing the effects of chroma-nance disturbance, and adjacent-channel interference is also minimized, virtually eliminating cross-talk. The front-panel controls are easy to operate, and the size is compact: 4⅛ × 3¼ × 8¼ inches. The *model VV-470P* is priced at $121.00.—**Showtime Video Ventures,** 2715 5th Street, Tillamook, OR 94714.

COUNTER/TIMER, *model 310,* has five-functions and two-channels, and measures frequency, period, unit, frequency-ratio, and time. It has four gates times from 10 milliseconds to 10 seconds. The 8-digit display is ½-inch LED's. Stable triggering is assured from DC to the limit of all ranges, and there are also self-test features.



CIRCLE 133 ON FREE INFORMATION CARD

There is a two-step prescaler for frequency measurement. Input impedance is 1 megohm for direct and first prescaler, and 50 ohms for second prescaler. Sensitivity for the sine wave is 35 millivolts RMS across all ranges. There is a two-step low-pass filter, two-step attenuator, AC or DC coupling select for the 1-megohm input, and trigger-level control with an LED indicator.

Both channels have trigger outputs. By monitoring this output on an oscilloscope, a precise trigger point can be selected, and stable and accurate triggering can be assured for complex waveforms.

The time base is a one-part-per-million, trimmable, modular TCXO. There are 1-MHz and 10-MHz time-base outputs provided. Those time-base outputs can be connected to the inputs to test the front end, or they can be used as signal sources for other equipment. There is a test mode which applies the time base internally to the counter section, and verifies the operation of the time base and logic, apart from the front end.

The *model 310* is priced at $420.00.—**FSI,** 1894 Commercenter #105, San Bernardino, CA 92408.

LOG AMPLIFIER, *model LPA-1305,* is designed primarily to detect audio signals and eliminate the need for computations of voltage levels to relative dB levels, normally associated with swept-frequency measurements. The unit is compatible with

CIRCLE 134 ON FREE INFORMATION CARD

most low-frequency sweep generators.

The *model LPA-1305* is used to convert a linear frequency-response envelope to a logarithmic DC output, enabling relative dB values to be measured directly from a linear scale, such as an oscilloscope graticule. After setting the amplifier's attenuator controls, a standard linear scale may be calibrated to equal increments of dB values.

The unit features linear or logarithmic amplitude operation and a 20-Hz to 300-kHz bandwidth over an operating input range of −70 dBV to +40 dBV. There are three adjustable frquency markers and a built-in linear-detector circuit, which has a switchable fast/slow response time for average readings of noisy waveforms. The human-engineered front-panel design insures simple operation, making the device well suited for the production line, as well as for design environments. The *model LPA-1305* is priced at $440.00.—**Leader Instruments Corporation,** 380 Oser Avenue, Hauppage, LI, NY 11788.

VOLTAGE & CONTINUITY TESTERS. *model 202* and *model 203* are AC/DC and provide basic voltage and continuity testing with burn-out and overload protection. They cover all commonly encountered needs in the home, farm, car, boat, and most shop electrical work. These portable units may be operated on one 1.5-volt battery.

The continuity function may be used to obtain an approximate circuit-resistance reading. The meter deflection is merely referenced to an auxiliary chart to estimte the resistance of the circuit.

CIRCLE 135 ON FREE INFORMATION CARD

The voltage ranges of the *model 202* (shown at right in photo) are 12, 24, 120, 240 VAC, 1.5, 6, 9, 12, 22.5 VDC. Its continuity ranges are 0-150,000 ohms (appoximately 10,000 ohms at half scale). Overload protection is automatic on all ranges up to 250 volts.

The voltage ranges of the *model 203* (shown at left in photo) are 1.5-480 VAC or VDC, and its continuity ranges are 0-100,000 ohms (approximately 7000 ohms at half scale). Overload protection is automatic on all ranges up to 500 volts.

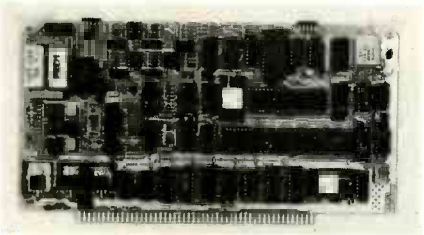
The overload protection on both models is designed internally to eliminate nuisance fuse blows

The price of the *model 202* is $19.50; the *model 203* costs $24.50.—**Triplett Corporation,** One Triplett Drive, Bluffton, OH 45187.

RADAR DETECTOR, the *Fuzzbuster Informer,* uses an advanced integral detection system that picks up all types of radar—even the "off" frequency signals that other units miss entirely. It is completely automatic; there are no knobs to turn or buttons to push: simply plug it in. It is compact and light enough so that it can be visor-mounted, and it comes with its own bracket. The suggested retail price of the *Fuzzbuster Informer* is $129.95—**Electrolert, Inc.,** 4949 South 25A, Troy, OH 45373.

CIRCLE 136 ON FREE INFORMATION CARD

HIGH-SPEED MODEM BOARD, *the M/LINK,* is an S-100 telecommunications controller that transmits data eight times faster than any other modem available on an S-100 bus. It enables a wide range of microcomputers to talk to mainframes over a standard dial-up phone line. *THE M/LINK* accommodates error-free data transmission at 2400 bits per seconds, using the Bell 201C standard and allows alternate data and voice communications. SDLC or Bi-Sync protocols are PROM-selected at the time of installation.



CIRCLE 137 ON FREE INFORMATION CARD

Where, at 300 baud, it takes 45 seconds to fill a CRT screen, *the M/LINK,* at 2400 baud, performs the same operation in 6 seconds. It provides either DTMF (*Touch-Tone*) or pulsed line dialing, and features auto-dialing and auto-answer capability. Transmit level is −9dBm, receive level is 0 to −40dBm, and RTS/CTS delay is jumper-selected 25 or 150 milliseconds. *The M/LINK* is priced at $1500.00.—**Micromation Incorporated,** 1620 Montgomery Street, San Francisco, CA 94111.

SPEAKER SYSTEM, the Realistic *Mach One* Liquid Cooled speaker *(model 40-4029)* offers 160-watt power-handling capacity and 25-20,000-Hz response. The cooling agent is "ferrofluid"—a magnetic liquid that increases power-handling capacity by improving heat-transfer away from moving driver elements. The fluid

continued on page 125

NEW BOOKS

103 PROJECTS FOR ELECTRONICS EXPERIMENTERS, by Forrest F. Mims, III. TAB Books Inc., Blue Ridge Summit, PA 17214. 308 pp, including index; 5⅛ × 8¼ inches; softcover; $8.95.

Each one of the projects in this book is devised for a particular area of electronics interest, from analog integrated circuits, digital integrated circuits, analog/digital converters and opto-electronics, through a complete range of gizmos, devices, and gadgets covering more than 30 different areas. You will find projects like miniature counters, flashers, and tone generators, as well as detailed plans for making a TTL sequence-generator; a light-activated SCR; how to use LED's as light detectors; laser diodes, voltage multipliers, and even a silicon solar cell. Written both for the novice and the experienced experimenter, there are easy-to-follow, step-by-step instructions and detailed drawings, photographs, tables, and schematics.

CIRCLE 141 ON FREE INFORMATION CARD

EARLY WIRELESS, by Anthony Constable. Midas Books, 12 Dene Way, Speldhurst, Tunbridge Wells, Kent TN3 ONX, England. 160 pp including appendix and index; 6¼ × 9½ inches; hardcover; $19.95.

This is a collector's guide, dealing with wireless from the 19th century—when David Hughes, inventor of the microphone, inadvertently produced and detected wireless waves at his home in Great Portland Street, a stone's throw from the present headquarters of the BBC—to the 1930's.

The first section deals with "Electromagentic Ripples from earliest times to about 1900;" the second continues the story, "From Coherers to Valves—From 1897 to the First World War;" and the third part tells what happened after the war: "Wireless Goes Public—from the first World War to the 1930's." **R-E**

APRIL 1 NEW PRODUCTS

SLOW COMPUTER, *model 1861,* is designed to introduce elderly victims of future shock to the world of electronics very gradually. There are 11 segregated circuits, loosely connected to a capitol, and programs must be accepted by a majority of the individual circuits before going to the capitol for implementation. Each item in a program is submitted individually, and the screen shows through black or white LED's how the random-select/reject process is proceeding. A rejected item must be revised by the user and resubmitted. The instruction manual presents a variety of simple programs that can be loaded within three months.

Feedback from users has been enthusiastic. A shut-in reports, "It's like getting a letter every week." A retired history teacher says, "Now I really understand why we lost the war." The *model 1861* is priced at 3000 Confederate dollars.—**Slow Electronics,** Swampside, GA (no zip number)

CIRCLE YY ON FREE INFORMATION CARD

ELECTRONIC COMFORT STATION, *The Allstate,* automatically adjusts itself to the bodily contours of the user, and provides a selectable variety of sounds, aromas, and stimulations. The special time-delay circuit cuts across subelectronic world-lines and, in effect, stops the clock. The user may spend as much subjective time in *The Allstate* as he or she desires without inconveniencing other potential patrons; to them it will seem as if the party before merely entered the station, closed the door, then immediately reopened it and emerged. There is a 12-variety, 5-speed massage unit, gender-adaptible. *The Allstate* carries a three-year guarantee and is priced at $69.00. —**Ideal Electronics,** Erewhon Corner, Hong Kong.

CIRCLE AA ON FREE INFORMATION CARD

SOFTWARE PACKAGES including a number of utility and application programs are available from Lackluster Software (710 E. 46th St., New York, NY 10081). Among the most recently introduced offerings are:

*The Electric Eraser—A word-processing package that uncreates files and relocates them elsewhere. Your guess is as good as ours.

*SKRAM—File scrambler/unsorter. Will garbage any disk. Gives your computer something to do when you're not using it.

*Sooper Spelgurd—The name speaks for itself.

*General Lecher—An "Interlude"-like program. For dirty old men and others.

All Lackluster Software programs run—when they do—under CP/M (please specify disk system when ordering). Prices start at $5.95.

CIRCLE XY ON FREE INFORMATION CARD

RECORD/CASSETTE PLAYER, *model 69+* (The Torturer) is an enhanced version of the earlier *model 69* (The Tormentor) with 16K bytes of ROD (*R*ead Only *D*istortion) and 16K of RAD (*R*andom *A*ccess *D*istortion), guaranteed to uglify any record or tape the user wishes to play. The popular front-panel pushbuttons ANNOYING. BRUTAL. CACAPHONOUS. DEMONIC. and EXCRUCIATING are retained in the *model 69A.* New features are the two kalaidoscope modes, whereby the five ranges will automatically escalate in order at preselected time-intervals, or will jump forward or back randomly. The unlabelled black pushbutton is for suicide only. The *model 69+* is priced at $333.33.—**S/M Electronics,** 666 $\mu\mu$ Lane, Atlantis.

CIRCLE XX ON FREE INFORMATION CARD

NEW PRODUCTS

continued from page 122

also helps to control coil travel, reducing waste motion for greater linear response.

The *model 40-4029* combines a 15-inch woofer (using a 32-ounce magnet), a

CIRCLE 138 ON FREE INFORMATION CARD

liquid-cooled sectoral midrange horn, and a heavy-duty liquid-cooled bullet tweeter horn in a 28¾ × 17⅝ × 12-inch cabinet with genuine oiled walnut veneer.

The 15-inch acoustic suspension woofer uses a four-layer voice coil, edge-wound on a brass form. That increases the magnetic flux density for improved performance. As a result, the woofer pumps out large volumes of air: the bass can be felt down to 25 Hz. The retail price of the *model 40-4029* is $239.95.—**Radio Shack,** 1800 One Tandy Center, Fort Worth, TX 76102

DESOLDERING PUMP, *model 7874,* can be operated with one hand, and uses no external power. A spring-loaded piston creates a vacuum that removes the molten solder instantly, and double "O" ring piston seals achieve maximum vacuum in a piston stroke of under two inches. The piston is set with the thumb and released by pushbutton for maximum spring force.

The *model 7874* is made of anodized

CIRCLE 139 ON FREE INFORMATION CARD

aluminum and includes a self-cleaning, no-clog teflon tip that is replaceable. It is priced at $14.95.—**Ungar,** 100 W. Manville St., Compton, CA 90220. **R-E**

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MUSICAL car horn 64 tunes. No chips to buy. Kit with case less horn. $31.95. Factory assembled with horn. $41.95. Add $2.50 shipping. **ELECTRONIC SOUND,** P.O. Box 401951. Garland. TX 75040

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7414N	.44	74185N	2.36	74LS156N	.87
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7425N	.32	74195N	.55	74LS163N	.69
7426N	.32	74196N	.79	74LS164N	.58
7427N	.32	74197N	.79	74LS165N	.89
7428N	.48	74198N	1.39	74LS166N	1.64
7430N	.23	74199N	1.39	74LS170N	1.59
7432N	.38	74221N	.68	74LS173N	.72
7433N	.42	74246N	1.70	74LS174N	.44
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7450N	.25	74283N	1.10	74LS194N	.74
7451N	.29	74293N	.95	74LS197N	.88
7453N	.29	74298N	.84	74LS221N	.89
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7484AN	1.99			74LS248N	1.09
7485N	.66	74LS00N	.21	74LS249N	1.10
7486N	.35	74LS01N	.22	74LS251N	.69
7490AN	.36	74LS02N	.24	74LS253N	.69
7491AN	.50	74LS03N	.24	74LS257N	.69
7492AN	.42	74LS04N	.25	74LS258N	.69
7493AN	.38	74LS05N	.25	74LS259N	1.49
7494AN	.65	74LS08N	.25	74LS260N	1.25
7495AN	.54	74LS09N	.25	74LS266N	.42
7496N	.59	74LS10N	.24	74LS273N	1.19
7497N	1.89	74LS11N	.28	74LS275N	3.39
74100N	1.38	74LS12N	.25	74LS279N	.44
74104N	.64	74LS13N	.46	74LS280N	1.96
74107AN	.40	74LS14N	.48	74LS283N	.88
74109N	.40	74LS20N	.24	74LS290N	.79
74110N	.52	74LS21N	.27	74LS293N	.79
74111N	.72	74LS26N	.25	74LS298N	.99
74116N	1.38	74LS27N	.29	74LS299N	2.89
74120N	1.38	74LS30N	.24	74LS320N	2.75
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74145N	.67	74LS76N	.44	74LS373N	1.39
74147N	1.50	74LS78N	.39	74LS374N	1.39
74148N	.99	74LS83N	.89	74LS375N	.64
74150N	1.25	74LS85N	.89	74LS377N	1.25
74151N	.54	74LS86N	.38	74LS378N	.99
74153N	.49	74LS90N	.42	74LS379N	1.09
74154N	1.25	74LS91N	.99	74LS390N	1.44
74155N	.58	74LS92N	.54	74LS393N	1.44
74157N	.58	74LS93N	.54	74LS395N	1.19
74159N	1.52	74LS95N	.52	74LS447N	.89
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74161AN	.69	74LS107N	.42	74LS630N	64.00
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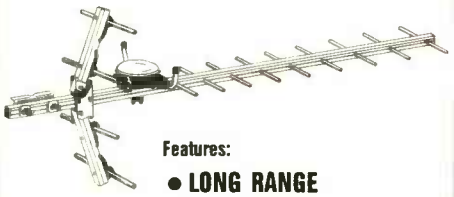

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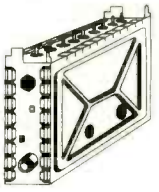

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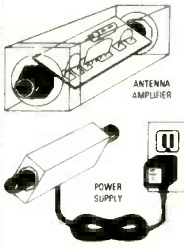

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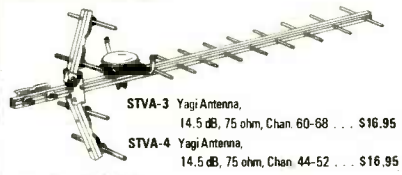

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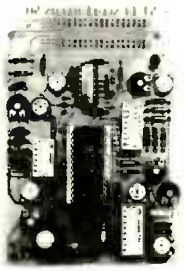

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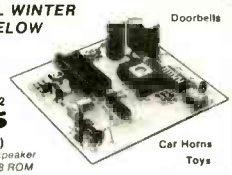

Now you can play hundreds of songs using the Bullet **Super Music Maker.** The unit **features a single factory programmed microprocessor IC** that comes with 20 pre-programmed short tunes. By adding the additional PROMS (2708's) the system can be expanded to play up to **1000 notes per PROM.** Just think . . . a compact electronic instrument that will play dozens, hundreds or even thousands of selections of music. The kit comes with **all electronic components (less the PROM),** and a drilled, plated and screened PC Board which measures 4" x 4½". 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 2708 albums containing popular tunes are available for **$9.95** each or you can program your own PROMS using information provided with the kit instructions. Lists of available PROM albums are available on request. *(Note: Unit plays electronic music one note at a time. it is not possible to play chords or a melody with harmony simultaneously.)*

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Z80-S10/0	23.95
Z80A-S10/0	28.95
Z80-S10/1	23.95
Z80A-S10/1	28.95
Z80-S10/2	23.95
Z80A-S10/2	28.95
Z80-S10/09	17.95
Z80A-S10/9	22.95
Z80B-CPU	18.95
Z80B-CTC	17.95
Z80B-P10	17.95
Z8671	39.95
Z6132	34.95

CMOS

74C00	.35	74C374	2.75	4019	.45	4098	2.49
74C02	.35	74C901	.80	4020	.95	4099	1.95
74C04	.35	74C902	.85	4021	.95	14409	12.95
74C08	.35	74C903	.85	4022	1.15	14410	12.95
74C10	.35	74C905	10.95	4023	.35	14411	11.95
74C14	1.50	74C906	.95	4024	.75	14412	12.95
74C20	.35	74C907	1.00	4025	.35	14419	4.95
74C30	.35	74C908	2.00	4026	1.65	4502	.95
74C32	.50	74C909	2.75	4027	.65	4503	.65
74C42	1.75	74C910	9.95	4028	.80	4508	1.95
74C48	2.10	74C911	10.00	4029	.95	4510	.95
74C73	.65	74C912	10.00	4030	.45	4511	.95
74C74	.85	74C914	1.95	4034	2.95	4512	.95
74C76	.80	74C915	2.00	4035	.85	4514	1.25
74C83	1.95	74C918	2.75	4040	.95	4515	2.25
74C85	1.95	74C920	17.95	4041	1.25	4516	1.55
74C86	.95	74C921	15.95	4042	.75	4518	1.25
74C89	4.50	74C922	5.95	4043	.85	4519	1.25
74C90	1.75	74C923	5.95	4044	.85	4520	1.25
74C93	1.75	74C925	6.75	4046	.95	4522	1.25
74C95	1.75	74C926	7.95	4047	.95	4526	1.25
74C107	1.00	74C927	7.95	4049	.55	4527	1.95
74C150	5.75	74C928	7.95	4050	.55	4528	1.25
74C151	2.25	74C929	19.95	4051	.95	4531	.95
74C154	3.25	74C930	19.95	4053	.95	4532	1.95
74C157	1.75	4000	.35	4060	1.45	4538	1.95
74C160	2.00	4001	.35	4066	.75	4539	1.95
74C161	2.00	4002	.25	4068	.40	4543	2.70
74C162	2.00	4006	.95	4069	.35	4555	.95
76C163	2.00	4007	.29	4070	.35	4556	.95
74C164	2.00	4008	.95	4071	.30	4581	1.95
74C165	2.00	4009	.45	4072	.30	4582	1.95
74C173	2.00	4010	.45	4073	.30	4584	.95
74C174	2.25	4011	.35	4075	.30	4585	.95
74C175	2.25	4012	.25	4076	.95	4702	12.95
74C192	2.25	4013	.45	4078	.30	4724	1.50
74C193	2.25	4014	.95	4081	.30	80C07	.95
74C195	2.25	4015	.95	4082	.30	80C95	.85
74C200	5.75	4016	.45	4085	.95	80C96	.95
74C221	2.25	4017	1.15	4086	.95	80C97	.95
74C373	2.75	4018	.95	4093	.95	80C98	1.20

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2716 EPROMS 450NS (5V) 8/4.95 ea.

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8085	12.95
8085A-2	16.95
8086	99.95
8088	39.95
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8156	11.95
8185	29.95
8185-2	39.95
8741	39.95
8748	29.95
8755	44.95

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6800	5.70
6802	10.95
6808	9.95
6809	24.95
6809E	29.95
6810	4.60
6820	4.95
682[illegible]	4.95
6828	14.95
6834	16.95
6840	14.95
6843	42.95
6844	44.95
6845	16.95
6847	15.95
6850	4.75
6852	5.75
6860	10.95
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6875	6.95
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68B00	10.95
68B21	12.95
68B50	12.95

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Jumbo Red	10/1.00
Jumbo Green	6/1.00
Jumbo Yellow	6/1.00
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MAN74 .3"CC	.99
MAN72 .3"CA	.99

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8202	45.00
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8212	1.85
8214	3.85
8216	1.80
8224	2.50
8226	1.80
8228	4.90
8237	19.95
8238	4.95
8239	4.85
8243	4.45
8250	14.95
8251	4.75
8253	9.25
8253-5	9.85
8255	4.75
8255-5	5.25
8257	8.75
8259	6.90
8272	39.95
8275	29.95
8279	9.50
8279-5	10.50
8282	6.65
8283	6.65
8284	5.70
8286	6.65
8287	6.50
8288	25.00
8289	49.95

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LM386	1.50
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- ULTRA-QUIET APPLE FAN DRAWS COOL AIR THROUGH YOUR COMPUTER
- ELIMINATES DOWN TIME
- SAVES REPAIR CHARGES
- INCREASES RELIABILITY
- CLIPS ON — NO HOLES OR SCREWS
- COLOR MATCHES APPLE
- LONG LIFE LOW NOISE MOTOR

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PE-14	78.50
PE-14T (with timer)	108.50
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	1-99	100
8 pin ST	.13	.11
14 pin ST	.15	.12
16 pin ST	.17	.13
18 pin ST	.20	.18
20 pin ST	.29	.27
22 pin ST	.30	.27
24 pin ST	.30	.27
28 pin ST	.40	.32
40 pin ST	.49	.39
ST = SOLDERTAIL		
8 pin WW	.59	.49
14 pin WW	.69	.52
16 pin WW	.69	.58
18 pin WW	.99	.90
20 pin WW	1.09	.98
22 pin WW	1.39	1.28
24 pin WW	1.49	1.35
28 pin WW	1.69	1.49
40 pin WW	1.99	1.80
WW = WIREWRAP		

CONNECTORS

RS232 MALE	3.25
RS232 FEMALE	3.75
RS232 HOOD	1.25
S-100 ST	3.95
S-100 WW	4.95

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4 POSITION	.85
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8 POSITION	.95

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PN2222	10/1.00	100/ 8.99
2N2222	.25	50/10.99
2N2907	.25	50/10.99
2N3055	.79	10/ 6.99
2N3904	10/1.00	100/ 8.99
2N3906	10/1.00	100/ 8.99
1N4148 (1N914)		25/ 1.00
1N4004		10/ 1.00

VOLTAGE REG's

7805T	.79	7905T	.89
7808T	.99	7912T	.89
7812T	.79	7915T	1.19
7815T	.99	7924T	1.19
7824T	.99		
7805K	1.39	7905K	1.49
7812K	1.39	7912K	1.49
7815K	1.39	79L05	.79
78L05	.69	79L12	.79
78L12	.69	79L15	.79
78L15	.69		
		LM317K	3.95
LM309K	1.49	LM323K	4.95
LM317T	1.95	LM337K	3.95

T = TO-220 K = TO-3 L = TO-92

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LM301V	.34
LM308V	.98
LM309K	1.49
LM311	.64
LM317T	1.95
LM317K	3.95
LM318	1.49
LM323K	4.95
LM324	.59
LM337K	3.95
LM339	.99
LM377	2.29
LM380	1.29
LM386V	1.50
LM555V	.39
LM556	.69
LM565	.99
LM566V	1.49
LM567V	1.29
LM723	.49
LM733	.98
LM741V	.29
LM747	.79
LM748V	.59
LM1310	2.90
MC1330V	1.89
MC1350V	1.29
MC1358	1.79
LM1414	1.59
LM1458V	.69
LM1488	.99
LM1489	.99
LM1800	2.99
LM1889	2.49
LM3900	.59
LM3909V	.98
LM3914	3.95
LM3915	3.95
LM3916	3.95
75451V	.39
75452V	.39
75453V	.39

74S00 SERIES

74S00	.44	74S74	.69	74S163	3.75	74S257	1.39
74S02	.48	74S85	2.39	74S168	4.65	74S258	1.49
74S03	.48	74S86	1.44	74S169	5.44	74S260	1.83
74S04	.79	74S112	1.59	74S174	1.09	74S274	19.95
74S05	.79	74S113	1.98	74S175	1.09	74S275	19.95
74S08	.48	74S114	1.50	74S181	4.47	74S280	2.99
74S09	.98	74S124	2.77	74S182	2.95	74S287	4.75
74S10	.69	74S132	1.24	74S188	3.95	74S288	4.45
74S11	.88	74S133	.98	74S189	14.95	74S289	6.98
74S15	.70	74S134	.69	74S194	2.95	74S301	6.95
74S20	.68	74S135	1.48	74S195	1.89	74S373	3.45
74S22	.98	74S138	1.08	74S196	4.90	74S374	3.45
74S30	.48	74S139	1.25	74S197	4.25	74S381	7.95
74S32	.98	74S140	1.45	74S201	14.95	74S387	5.75
74S37	1.87	74S151	1.19	74S225	8.95	74S412	2.98
74S38	1.68	74S153	1.19	74S240	3.98	74S471	9.95
74S40	.44	74S157	1.19	74S241	3.75	74S472	16.85
74S51	.78	74S158	1.45	74S244	3.98	74S474	17.85
74S64	.79	74S161	2.85	74S251	1.90	74S482	15.60
74S65	1.25	74S162	3.70	74S253	7.45	74S570	7.80
						74S571	7.80

7400 SERIES

7400	.19	7451	.23	74136	.50	74186	18.50
7401	.19	7453	.23	74141	.65	74190	1.15
7402	.19	7454	.23	74142	2.95	74191	1.15
7403	.19	7460	.23	74143	2.95	74192	.79
7404	.19	7470	.35	74144	2.95	74193	.79
7405	.22	7472	.29	74145	.60	74194	.85
7406	.22	7473	.34	74147	1.75	74195	.85
7407	.22	7474	.35	74148	1.20	74196	.79
7408	.24	7475	.49	74150	1.35	74197	.75
7409	.19	7476	.35	74151	.65	74198	1.35
7410	.19	7480	.59	74152	.65	74199	1.35
7411	.25	7481	1.10	74153	.55	74221	1.35
7412	.30	7482	.95	74154	1.40	74246	1.35
7413	.35	7483	.50	74155	.75	74247	1.25
7414	.55	7485	.65	74156	.65	74248	1.85
7416	.25	7486	.35	74157	.55	74249	1.95
7417	.25	7489	4.95	74159	1.65	74251	.75
7420	.19	7490	.35	74160	.85	74259	2.25
7421	.35	7491	.40	74161	.70	74265	1.35
7422	.29	7492	.50	74162	.85	74273	1.95
7423	.29	7493	.49	74163	.85	74276	1.25
7425	.29	7494	.65	74164	.85	74279	.75
7426	.29	7495	.55	74165	.85	74283	2.00
7427	.29	7496	.70	74166	1.00	74284	3.75
7428	.45	7497	2.75	74167	2.95	74285	3.75
7430	.19	74100	1.00	74170	1.65	74290	.95
7432	.29	74107	.30	74172	5.95	74293	.75
7433	.45	74109	.45	74173	.75	74298	.85
7437	.29	74110	.45	74174	.89	74351	2.25
7438	.29	74111	.55	74175	.89	74365	.65
7440	.19	74116	1.55	74176	.89	74366	.65
7442	.49	74120	1.20	74177	.75	74367	.65
7443	.65	74121	.29	74178	1.15	74368	.65
7444	.69	74122	.45	74179	1.75	74376	2.20
7445	.69	74123	.55	74180	.75	74390	1.75
7446	.59	74125	.45	74181	2.25	74393	1.35
7447	.69	74126	.45	74182	.75	74425	3.15
7448	.69	74128	.55	74184	2.00	74426	.85
7450	.19	74132	.45	74185	2.00	74490	2.55

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Stock No.	Braid Size	Ft/Spool	Price
50041	1/16	6	$2.10
50042	5/64	6	2.25

ELECTRO SPACE PRINTED CIRCUIT CARD EJECTORS

For 1/16 thick cards (.072 slot)

Stock No.	Color	1-24	24-49	50-Up
11450	White	$.25	$.21	$.19
11451	Red	.25	.21	.19

ARIES ZERO INSERTION FORCE SOCKETS

- Cam actuated, true zero insertion force
- tin plated solder tail pins
- capable of being plugged into DIP sockets

Stock No.	No Pins	1-24	25-49	50-Up
11055	24	$4.06	$3.60	$3.25
11056	28	4.25	3.77	3.40
11057	40	4.90	4.34	3.91
11058	64	9.89	8.76	7.90

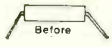
ELECTRO SPACE PRINTED CIRCUIT CARD INJECTOR/EJECTORS FOR 1/16 THICK CARDS

11452	White	$.27	$.23	$.20
11453	Red	.27	.23	.20

Texas Instruments Low Profile Sockets, tin plated phosphor bronze contact pins with gas-tight seal

Stock No.	No. Pins	1-24	25-99	100-Up
11201	8	$.15	$.13	$.12
11202	14	.18	.15	.14
11203	16	.21	.18	.16
11204	18	.24	.21	.19
11205	20	.27	.24	.21
11206	22	.30	.26	.23
11207	24	.33	.30	.25
11208	28	.36	.34	.29
11209	40	.53	.45	.40

Pin Straightening Tool puts devices on their true row to row spacing. One side is for .300 center devices, flip tool over for devices on .600 centers. Put device in tool, squeeze, bowed leads come back to proper spacing.



Stock No. 11059 ..... $12.95

ELPAC POWER SUPPLIES SOLV SERIES FULLY REGULATED

Stock No.	Output Voltage	Output Current Rating	Dimensions (HxWxD) In Inches	Price
13802	5	3.0A	4-7/16x4x2	$38.00
13803	12	1.5A	4-7/16x4x2	38.00
13804	15	1.2A	4-7/16x4x2	38.00
13806	24	0.75A	4-7/16x4x2	38.00
13808	5	6.0A	5-5/8x4-7/8x3-3/16	57.00
13809	12	4.0A	5-5/8x4-7/8x3-3/16	57.00
13810	15	3.3A	5-5/8x4-7/8x3-3/16	57.00
13812	24	2.0A	5-5/8x4-7/8x3-3/16	57.00

RCA C/MOS

Stock No.	RCA No.	1-24	25-Up
44001	CD4001BE	$ .36	$ .33
44002	CD4001UBE	.36	.33
44007	CD4007UBE	.36	.33
44011	CD4011BE	.36	.33
44012	CD4011UBE	.36	.33
44013	CD4013BE	.56	.52
44015	CD4015BE	1.07	1.01
44016	CD4016BE	.59	.55
44017	CD4017BE	1.07	1.01
44019	CD4019BE	.59	.55
44020	CD4020BE	1.18	1.12
44023	CD4023BE	.36	.33
44024	CD4024BE	.92	.87
44025	CD4025BE	.36	.33
44027	CD4027BE	.68	.64
44030	CD4030BE	.59	.55
44040	CD4040BE	1.18	1.12
44046	CD4046BE	1.56	1.48
44049	CD4049BE	.57	.54
44050	CD4050BE	.57	.54
44051	CD4051BE	1.18	1.12
44052	CD4052BE	1.18	1.12
44053	CD4053BE	1.18	1.12
44054	CD4054BE	1.96	1.85
44056	CD4056BE	1.96	1.85
44060	CD4060BE	1.48	1.40
44066	CD4066BE	.78	.74
44069	CD4069UBE	.36	.33
44070	CD4070BE	.44	.41
44071	CD4071BE	.36	.33
44076	CD4076BE	1.26	1.20
44081	CD4081BE	.36	.33
44093	CD4093BE	.78	.74
44098	CD4098BE	1.56	1.48
44502	CD4502BE	1.72	1.64
44511	CD4511BE	1.26	1.20
44522	CD4520BE	1.18	1.12
44590	CD22100E	2.49	2.35
44591	CD40103BE	1.96	1.85
44592	CD40106BE	.84	.80

RCA POWER

SINTEC	RCA No.	1-24	25-49
40122	C122D	$1.22	$1.16
42322	T2322D	1.46	1.38
42700	T2700D	2.07	1.96
42800-1	T2800B	1.58	1.50
42800-2	T2800D	1.90	1.79
42850	T2850D	2.06	1.95
40029-1	TIP29	.60	.57
40029-2	TIP29A	.64	.61
40031	TIP31A	.74	.70
40121	TIP121	1.43	1.35
40125	TIP125	1.37	1.29
42955	MJ2955	1.16	1.10
43055	RCA3055	1.03	.97
42102	2N2102	1.28	1.22
42270	2N2270	.82	.78
43053	2N3053	.61	.58
43054	2N3054	1.37	1.29
43055-1	2N3055	1.03	.97
43055-2	2N3055HOM	1.62	1.54
43439	2N3439	1.73	1.65
43440	2N3440	1.25	1.19
43771	2N3771	2.92	2.78
43772	2N3772	3.18	3.00
43773	2N3773	3.22	3.04
44036	2N4036	1.08	1.02

SINTEC	RCA No.	1-24	25-49
44037	2N4037	$ .86	$ .82
45294	2N5294	.80	.76
45296	2N5296	.80	.76
45320	2N5320	1.25	1.19
45321	2N5321	1.02	.96
45322	2N5322	1.61	1.53
45415	2N5415	1.60	1.52
45416	2N5416	2.17	2.06
45784	2N5784	1.37	1.29
46044	2N6044	2.04	1.93
45101	2N6101	1.25	1.19
46103	2N6103	1.25	1.19
46107	2N6107	.82	.73
46109	2N6109	.82	.78
46111	2N6111	.80	.76
46254	2N6254	2.16	2.05
46290	2N6290	.80	.76
46292	2N6292	.80	.76
46386	2N6386	1.05	.99
46387	2N6387	1.15	1.09
46388	2N6388	1.28	1.22
46474	2N6474	1.03	.97
46667	2N6667	1.49	1.44
46668	2N6668	1.60	1.52
40347	40347	1.22	1.16

TI STATIC RAMS, EPROMS, AND DYNAMIC RAMS

Stock No.	TI No.	Description	1-24	25-Up
47625	TMS2708-45JL	1KX8 EPROM 450 NS	$ 9.50	$ 8.75
47630	TMS2516-45JL	2KX8 EPROM 450 NS	15.45	14.25
47635	TMS2532-45JL	4KX8 EPROM 450 NS	23.80	22.00
47640	TMS2114-45NL	1KX4 SRAM 450 NS	9.50	8.75
47645	TMS40L44-45NL	4KX1 SRAM 450 NS	11.90	11.00
47650	TMS4116-20NL	16K DRAM 200NS	6.60	6.10

IC Insertion/Extraction Kit, includes DIP IC extractors and inserters to accomodate all IC's from 14 to 40 pins. C/MOS safe.
Stock No. 13309 ..... $34.95

ELPAC POWER SUPPLIES DC/DC CONVERTERS

Stock No. 300 MW Type	Input Voltage (VDC)	Output Voltage (VDC)	Output Current (MA)	Dimensions (HxWxD) In Inches	Price
13825	3.0-7.0	12±0.6	0-25	.48x.51x3.05	$7.00
13826	3.0-7.0	12±0.6	0-25	.48x.51x3.05	7.00
13827	3.0-7.0	15±0.7	0-20	.48x.51x3.05	7.00
13828	3.0-7.0	15±0.7	0-20	.48x.51x3.05	7.00
13829	3.0-7.0	28±0.7	0-10	.48x.51x3.05	7.00
13830	3.0-7.0	28±0.7	0-10	.48x.51x3.05	7.00
1.5 W TYPE					
13831	4.0-7.0	12±0.6	125	.651x1.2x1.77	23.00
13832	4.0-7.0	12±0.6	125	.651x1.2x1.77	23.00
13833	4.0-7.0	15±0.7	100	.651x1.2x1.77	23.00
13834	4.0-7.0	15±0.7	100	.651x1.2x1.77	23.00
13835	4.0-7.0	28±1.4	50	.651x1.2x1.77	23.00
13836	4.0-7.0	28±1.4	50	.651x1.2x1.77	23.00

"Floppy Disc" power supply for 8" drive, as built by Shugart, CDC, Wango, etc., three outputs (+5V, +24V, -5V). Output current max (2.5A, 3.0A/3.4A PK, O.SA). Stock No. 13801 ..... $109.00

MODUTEC

- VOLT/OHM Milliammeter (Stock No. 13725) $34.75
- Battery Tester for small batteries from 1.35V to 4.5V (Stock No. 13733) $13.95
- Miniclamp AC Volt-Ammeter

Stock No.	AC Amperes Ranges	Price
13730	0-25A	$39.50
13731	0-50A	39.50
13732	0-100A	39.50

- LINE SPLITTER allows fast & accurate readings of AC power consumption (Stock #13727) ..... $ 9.95
- VOM-MULTITESTER Versatile Volt-Ohm Milliammeter (Stock #13729) $13.95

Bow Rosin Core Solder (60/40 Alloy)

Stock No.	Dia.	Length (feet)	Weight (Oz)	Price
50075	.062	9	1.5	$3.28
50076	.062	25	4	4.38
50077	.062	50	8	6.02
50078	.032	33	1.5	4.08
50079	.032	89	4	5.18
50080	.032	175	8	8.82

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WR2H1 4-3/4" Sq.
115 VAC 7 Watt

5 VOLT STEPPING MOTOR $20.00

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5.2 V @ 1.44 A 48 Steps/Rev.
¼" Shaft ⅝" L. Mtg. Holes 2-3/16" C-C

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Fits SHUGART 800/801
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4K x 1 300 ns
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TMS 4030 22 Pin
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PROM
Harris 7640
512 x 8 VOL OC
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UART
COM 2502 25KHz
40 Pin + 5 -12
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4 - 10K Linear pots
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OUTPUT
+ 5 VCD - 5 Amp.
+ 12 VCD - 1 Amp.
- 12 VDC - 1 Amp.

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Matrix Head #24800
Fits DIABLO 1660
$95.00

BRIDGE 10 AMP 600 VOLT 200 ns Tr

VARO VJ648X
⅛" Leads
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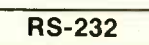
1000 VOLT 12 AMP DIODE

MR 1130 R
$1.25 10 for $10.00

RS-232 CONNECTOR

DBC-25P male
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DB-25 cover $1.25

LM 323 5 VOLT 3 AMP

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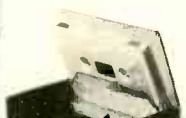
1/4" 2 conductor
with Switch

7812 12 VOLT 1 AMP

90¢ 10 for $7.50
Heat Sink 25¢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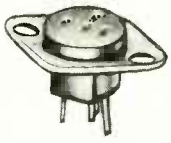

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Four-pin type with mounting flange. **276-548** . . . . . **Pkg. of 6/1.69**

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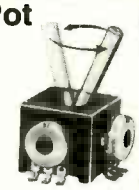
- *Top Quality at A Low Price*



Twin pots controlled by a single one-inch shaft. Body: 1 7/16" square. Solder lugs. **271-1705** **4.95**

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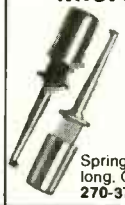

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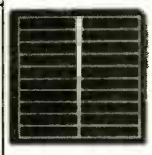

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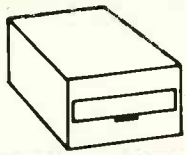

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	LIST	ACP
Apple II 16K	$1330 00	$1029 00
Apple II 48K	1530 00	1099 00
Apple II 64K	1729 00	1225 00
Apple II 64K	2519 00	1775 00
w/Z80 Softcard & Vision 80		
★ Apple III 128K	3495 00	★ 2895 00
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Apple Disk II w/interface	$ 645 00	$ 529 00
Apple Disk II w/o	525 00	449 00
Silentype Printer	395 00	355 00
Prototype Card	24 00	21 95
IEEE-488 Interface	450 00	375 00
1 year ext warranty	225 00	175 00
Parallel Printer Interface	180 00	159 95
Communications Card	225 00	189 00
Pascal Language System	495 00	425 95
High Speed Serial Interface	195 00	174 95
Applesoft II ROM Card	200 00	159 95
Language Card	195 00	174 95
12" Green Monitor III	320 00	275 00
★ Profile Hard Disk Subsystem	3495 00	2995 00
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	Numeric Pad	119 00
Mountain Computer	ROMplus	169 00
	ROM Writer	159 00
	RAMPlus	call
	CPS Multifunction	229 00
	Expansion Chassis	699 00
	Thunderclock	125 00
	X-10 option	49 00
	Pascal option	29 00
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Parallel I/O		99 00
M & R Enterprises	Apple Fan	45 00
	SupR'Mod	29 95
	Aux Switcher Supply	199 00
	SupR'Term	299 00
ALS Smarterm		299 00
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10Mb		4325 00
20Mb		5240 00
Apple 16K Upgrade Kit		15 95
Votrax Voice Box		call
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VisiTerm	129 00
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MPI B52 5 1/4" Dual	348 00
WANGO/SIEMENS 2	290 00
MPI 91 Double Track Density Single Side, 80 Tracks	375 00
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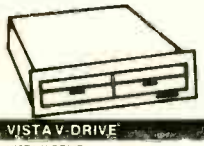
★ Vision 80© 80x24 display card	$395 00	$299 00
Vision 40© 40 col. enhancement	199 00	149 00
Vision 20© lower case ROM	29 95	25 00
★ A800 8" D/D FDC	595 00	★ 499 00
MM9 9 voice music	195 00	99 00
GB75 IBM Regent/Apple I/O	195 00	169 00
POS PROM development	595 00	399 00
TYPE AHEAD BUFFER	49 95	35 00



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A405 1/4" 160K Drive	449 00	365 00
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ARMBASIC Software For TRS-80	39 95
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HP-38C Prog Business		150 00	119 00
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MX-80 Dot Matrix	$645 00	★ $429 00
★ MX-80/FT	745 00	529 00
MX-100	999 00	725 00
Apple I/O & cable	110 00	89 00
Graftrax option	95 00	89 00
IEEE I/O & cable	130 00	95 00
Serial I/O & cable	130 00	95 00
Serial w 2K & cable	175 00	149 00
Universal Graphics Utility	39 95	★ 35 95

NEC

8023 Dot Matrix	795 00	649 00

DIABLO

★ 630 Daisywheel	2965 00	★ 2295 00
Tractor	249 00	189 95

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★ Starwriter/V300	25 cps	1895 00	★ 1495 00
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8510	100 cps	749 00	★ 675 00

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9500/9501	1650 00	1350 00

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460G w/graphics	1395 00	899 00
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TELEVIDEO		
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912C	950 00	699 00
920C	995 00	799 00
950C	1195 00	999 00
SOROC		
IQ120		699 00
IQ135		899 00
IQ140		1149 00

SANYO

MONITORS

	LIST	ACP
SANYO		
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9" Green	259 00	199 95
12" B&W	340 00	249 00
12" Green	360 00	279 00
13" Color	550 00	429 00
13" RGB	1195 00	995 00

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MODEMS

NOVATION

	LIST	ACP
Cat	$199 95	$149 00
D-Cat	199 95	169 00
Apple-Cat	349 95	309 00
Auto-Cat	299 95	239 95
HAYES		
Micromodem	$379 00	$299 00
Smartmodem	279 00	249 00

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★ 256K Add-on memory	$1145 00	★ $899 00
PC Communications	295 00	269 00
Graphics		call
Wire Wrap kit w extender	95 00	89 00

ATARI COMPUTER

	LIST	ACP
400 w 16K RAM	$399 00	$339 95
400 Basic Language Module	49 00	47 00
800 w 16K RAM	899 00	699 00
410 Prog Recorder	90 00	80 00
825 Printer	799 95	699 00
830 Acoustic Modem	199 95	159 00
850 Interface Module	219 95	189 95
MTK 16K RAM	99 50	84 00
MTK 32K RAM	199 50	139 00
ATARI VisiCalc	200 00	160 00
ATARI Pac-Man	44 95	36 95

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Telelink 1	Compuserve Pkg
Total Value $444 85	ACP $379 95

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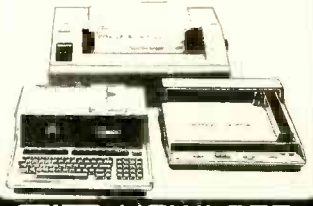
★ 820-2	8" system	3795 00	★ 3195 00
CP/M		200 00	169 95
SuperCalc		295 00	239 95
Word Processing		500 00	429 95



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HEWLETT-PACKARD COMPUTERS

	LIST	ACP
HP-125 CPM Microcomputer	$3750 00	$3090 00
HP-85 Microcomputer	2750 00	2375 00
HP-83 Microcomputer	2250 00	1889 00
82903A 16K Memory Module	195 00	174 95
7225 Graphics Plotter	2450 00	2125 00
7225 Personality Module	750 00	675 00
HP-125080 8" Disk	1210 00	1085 00
HP-9895A 8" Disk	6850 00	5750 00
HP-9111A Graphics Tablet	2050 00	1790 00

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ROCKWELL	
AIM 65 w/1K	$435 00
AIM 65 w/4K	475 00
8K BASIC ROM	99 00
4K Assembler ROM	84 00
Power Supply	64 95
Enclosure	49 95
Total system w/4K	669 00
SYNERTEK	
SYM-1	239 00
SD SYSTEMS	
Z80 Starter Kit	367 00
Z80 Starter A & T	450 00
SBC 100 A & T	367 00
SBC 200 A & T	399 00
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Z80A-SIO/0	4 0 MHz	29 95
Z80-SIO/1	2 5 MHz	24 95
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TMS 4060 4K RAM (22 Pin)	1 49
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5262	1 95
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2901	9 90
2901A	14 95
TMS 9900JL	49 95
6502	9 95
6502A	16 95
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2112-1	2 95	2 85	2 65
2101-1	2 90	2 70	2 55
2114N (450ns)	3 75	3 50	3 25
2114L-250ns (4045)	6 50	5 95	5 50
2114L-450ns (4045)	4 75	4 25	3 95
4044 250ns	8 95	7 50	6 90
4044 450ns	5 95	5 95	4 75
EMM4200A	9 75	8 75	7 95
EMM4402	7 95	7 25	6 25
AMD9140-41	10 95	10 25	9 25
AMD9130 31	12 95	11 95	10 25
1101	1 95	1 75	1 25
P2125 93425 (45ns)	9 95	8 35	8 25
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1408L8 8 bit	5 95
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2525	1 49	2847	4 95
2527	1 49	3341	4 95
2528	1 49	3351	17 95
2529	1 49	3357	6 95
2533	1 49	9403	24 95
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7400

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SN7403N	22	SN74128N	59
SN7404N	22	SN74132N	69
SN7405N	23	SN74136N	75
SN7406N	23	SN74139N	95
SN7407N	23	SN74141N	79
SN7408N	26	SN74142N	2 95
SN7409N	23	SN74143N	2 95
SN7410N	22	SN74144N	2 95
SN7411N	29	SN74145N	62
SN7412N	29	SN74147N	1 95
SN7413N	39	SN74148N	1 20
SN7414N	59	SN74150N	1 09
SN7416N	29	SN74151N	67
SN7417N	29	SN74152N	67
SN7420N	22	SN74153N	67
SN7421N	35	SN74154N	1 19
SN7422N	29	SN74155N	78
SN7423N	29	SN74156N	78
SN7425N	29	SN74157N	69
SN7426N	29	SN74158N	1 65
SN7427N	25	SN74160N	88
SN7429N	45	SN74161N	88
SN7430N	23	SN74162N	89
SN7432N	29	SN74163N	87
SN7437N	25	SN74164N	87
SN7438N	29	SN74165N	87
SN7439N	29	SN74166N	1 20
SN7440N	19	SN74167N	1 95
SN7441N	78	SN74170N	1 69
SN7442N	57	SN74172N	4 75
SN7443N	95	SN74173N	79
SN7444N	95	SN74174N	89
SN7445N	79	SN74175N	85
SN7446N	79	SN74176N	75
SN7447N	65	SN74177N	75
SN7448N	79	SN74179N	1 34
SN7450N	19	SN74180N	75
SN7451N	19	SN74181N	1 75
SN7453N	19	SN74182N	75
SN7454N	19	SN74184N	2 25
SN7459N	25	SN74185N	2 25
SN7460N	23	SN74186N	9 95
SN7470N	29	SN74188N	3 90
SN7472N	29	SN74190N	1 15
SN7473N	34	SN74191N	1 15
SN7474N	34	SN74192N	85
SN7475N	38	SN74193N	85
SN7476N	34	SN74194N	85
SN7479N	4 60	SN74195N	68
SN7480N	49	SN74196N	85
SN7482N	95	SN74197N	85
SN7483N	55	SN74198N	1 39
SN7485N	65	SN74199N	1 39
SN7486N	35	SN74221N	1 19
SN7489N	1 75	SN74251N	95
SN7490N	39	SN74273N	1 05
SN7491N	57	SN74279N	75
SN7492N	45	SN74283N	1 40
SN7493N	45	SN74284N	3 90
SN7494N	69	SN74285N	3 90
SN7495N	65	SN74290N	1 25
SN7496N	69	SN74298N	95
SN7497N	2 90	SN74365N	68
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74LS08N	28	74LS173N	89
74LS09N	35	74LS174N	89
74LS10N	28	74LS175N	89
74LS11N	39	74LS181N	2 20
74LS12N	33	74LS190N	1 15
74LS13N	47	74LS191N	1 15
74LS14N	95	74LS192N	98
74LS15N	33	74LS193N	98
74LS20N	26	74LS194N	1 15
74LS21N	33	74LS195N	95
74LS22N	33	74LS196N	89
74LS26N	33	74LS197N	89
74LS27N	33	74LS21N	1 15
74LS28N	33	74LS240N	1 69
74LS30N	26	74LS241N	1 69
74LS32N	33	74LS242N	1 69
74LS33N	55	74LS243N	1 69
74LS37N	45	74LS244N	1 49
74LS38N	39	74LS245N	2 20
74LS40N	26	74LS247N	1 10
74LS42N	79	74LS248N	1 10
74LS47N	79	74LS249N	1 19
74LS48N	95	74LS251N	1 40
74LS51N	26	74LS253N	1 40
74LS54N	29	74LS257N	85
74LS55N	29	74LS258N	98
74LS73N	45	74LS259N	2 95
74LS74N	42	74LS260N	65
74LS75N	59	74LS261N	2 49
74LS76N	45	74LS266N	59
74LS78N	45	74LS273N	1 75
74LS83AN	79	74LS275N	4 40
74LS85N	1 19	74LS279N	59
74LS86N	45	74LS283N	99
74LS90N	57	74LS290N	99
74LS92N	75	74LS293N	99
74LS93N	75	74LS295N	1 10
74LS95N	88	74LS298N	1 19
74LS96N	98	74LS324N	1 75
74LS107N	45	74LS347N	1 95
74LS109N	45	74LS348N	1 95
74LS112N	43	74LS352N	1 19
74LS113N	43	74LS353N	1 19
74LS114N	43	74LS363N	1 49
74LS122N	55	74LS365N	69
74LS123N	1 19	74LS366N	69
74LS124N	1 35	74LS367N	69
74LS125N	89	74LS368N	69
74LS126N	52	74LS373N	1 89
74LS132N	79	74LS374N	1 89
74LS136N	49	74LS375N	69
74LS138N	85	74LS377N	1 95
74LS139N	85	74LS385N	1 95
74LS145N	1 25	74LS386N	65
74LS148N	1 49	74LS390N	1 95
74LS151N	79	74LS393N	1 95
74LS153N	79	74LS395N	1 70
74LS154N	1 70	74LS399N	2 35
74LS155N	1 19	74LS424N	2 95
74LS156N	99	74LS668N	1 75
74LS157N	85	74LS670N	2 29
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2101-1	$2.70	2112-1	$2.80	2147	$6.64
2102	3.20	2114	3.20	8155	7.40
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7400 SERIES TTL

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7401	.19	7426	.25	7496	.50	74181	1.65
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7403	.19	7432	.25	74121	.35	74184	2.05
7404	.19	7438	.30	74123	.50	74185	2.05
7406	.29	7442	.40	74125	.48	74193	.70
7407	.29	7448	.75	74132	.55	74199	1.10
7410	.20	7474	.35	74141	.80	74221	.80
7416	.32	7483	.50	74156	.50		
7417	.32	7486	.35	74161	.60		

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74LS04	.25	74LS93	.55	74LS194			.60
74LS08	.25	74LS96	.70	74LS195			.60
74LS10	.25	74LS112	.35	74LS196			.80
74LS11	.30	74LS122	.40	74LS241			1.10
74LS12	.30	74LS123	.70	74LS242			1.79
74LS15	.30	74LS125	.45	74LS243			1.79
74LS20	.25	74LS132	.65	74LS244			1.10
74LS21	.30	74LS133	.79	74LS245			2.85
74LS26	.30	74LS136	.35	74LS248			.90
74LS27	.30	74LS138	.55	74LS257			.55
74LS28	.45	74LS139	.79	74LS266			.65
74LS32	.30	74LS151	.55	74LS283			.65
74LS38	.40	74LS153	.55	74LS295			.85
74LS42	.50	74LS156	.60	74LS352			1.00
74LS47	.80	74LS157	.79	74LS366			.45
74LS54	.30	74LS158	.50	74LS367			.69
74LS51	.35	74LS161	.70	74LS368			.45
74LS74	.35	74LS163	.70	74LS373			1.79
74LS76	.35	74LS166	2.10	74LS393			1.20
74LS83	.60	74LS169	.95	74LS395			1.20
74LS85	1.00	74LS174	.60	74LS323			5.29

DIODES & 2N TRANSISTORS

DIODES

1N270	$.12	1N3600	$.15	1N4002	$.07
1N914	.08	1N4154	.10	1N4003	.08
1N916	.08	1N4001	.07	1N4004	.08

2N TRANSISTORS & SCR's

2N2222A	$.26	2N3053	$.32	2N4441	$2.10
2N2905A	.25	2N4401	.10	2N4442	2.15
2N2906A	.25	2N3055	.80	2N4443	2.95
2N2907A	.25	2N5194	.60	2N4444	4.60

LINEAR

LINEAR IC's

LM301N	$.32	LM319N	$1.65	NE566N	$1.65
LM306H	.75	LM324N	.50	NE567N	.85
LM307N	.40	LM339N	.50	LM723N	.45
LM308N	.50	LM380N	1.10	LM741N	.35
LM310N	1.75	LM384N	1.75	LM747N	.55
LM311N	.45	NE555N	.36	LM1458	.40
LM312N	1.15	NE556N	.70	LM1488	.80
LM318N	1.95	NE565N	.85	LM1489	.80

VOLTAGE REGULATORS

VOLTAGE REGULATORS

LM317T	$1.15	LM340T-12	1.15	7815CT	1.15
LM320T-5	1.15	LM340T-15	1.15	7905CT	1.15
LM320T-8	1.15	7805CK	1.60	7908CT	1.15
LM320T-12	1.15	7805CT	1.15	7912CK	1.60
LM320T-15	1.15	7808CT	1.15	7912CT	1.15
LM337N	1.50	7812CK	1.60	7915CK	1.60
LM340T-5	1.15	7812CT	1.15	7915CT	1.25
LM340T-8	1.15	7815CK	1.60		

4000 SERIES CMOS

4000 SERIES CMOS

4001	$.30	4015	$1.00	4040	$1.05	4077	.40
4002	.30	4016	.50	4041	1.05	4086	.90
4006	1.05	4019	.50	4042	.80	4510	1.05
4007	.28	4021	.90	4047	1.20	4511	1.25
4008	.90	4022	.90	4049	1.40	4512	1.00
4010	.50	4023	.30	4050	1.40	4516	1.05
4011	.30	4024	.75	4051	.85	4526	1.75
4012	.28	4028	.70	4066	.55	4528	1.75
4013	.40	4032	2.00	4070	.40	4532	1.50
4014	1.00	4034	2.60	4072	.30	4538	1.50
4073	$.36						

16K RAM EXPANSION KIT

For TRS-80 (Model I or III), Apple or PET

Set of 8 pcs. UPD416C-2 (200ns) $15.95

Data furnished with purchase on request.

OPTO-ELECTRONICS

7 SEGMENT LED DISPLAYS

FND357	$1.50	MAN3620	$2.00	MAN6640	$4.10
FND500	1.50	MAN3630	2.00	MAN6650	4.10
FND507	1.50	MAN4610	2.10	MAN6710	3.10
FND800	1.95	TIL311	10.26	MAN6750	2.90

LED LAMPS

MV5023 $.25 MV5252 $.30

SPECIAL

ALPHA/NUMERIC DISPLAYS

AND-5010 RAJB Red, Common Anode $5.25

AND-5010 GEJB Green, Common Cathode 6.95

GLOBAL SPECIALTIES

LOGIC PROBES		QUICK TEST SOLDERLESS BREADBOARD ELEMENTS			
LP-1	$48.75	QT-59S	$12.00	QT-59B	$2.75
LP-2	29.95	QT-47S	9.50	QT-47B	2.50
LP-3	72.99	QT-35S	7.25	QT-35B	2.10
IC TEST CLIPS		QT-18S	4.25		
PC-14	$4.50	4001 Pulse Generator			$235.00
PC-16	4.75	5001 Universal Counter			$360.00
PC-24	10.00	Logic Monitor		JUMPER WIRE KIT	
PC-40	16.00	100K Impedance			
		LM-1	$75.00	WK-1	$9.00
POWERED PROTO-BOARD SOCKETS				EXPERIMENTOR SOCKETS	
PB-104	$70.00			EXP-300	$10.50
PB-102	32.90			EXP-300PC	2.40
PB-101	26.00			EXP-350	6.10
PB-100	20.10				

E-Z HOOK TEST CONNECTORS

Available in 10 colors (Red, Black, Blue, Green, Orange, Yellow, White, Brown, Violet or Grey). **Please Specify Color When Ordering.**

MINI-HOOK

X100W Specify Color When Ordering . . . . . $.80

JUMPER—MINI-HOOK TO MINI-HOOK

204-12W 12" wire length. Specify Color . . . $1.68

204-24W 24" wire length. Specify Color . . . $1.70

ZERO INSERTION FORCE IC SOCKET

24-516-10 24 Pin IC Socket $5.57

28-516-10 28 Pin IC Socket $5.82

40-516-10 40 Pin IC Socket $6.73

DIP BOARD TO DIP BOARD JUMPERS

14-006-100 14 Pin, 6" overall length . . . $5.42

16-006-100 16 Pin, 6" overall length . . . $5.95

24-006-100 24 Pin, 6" overall length . . . $8.45

VECTOR BOARDS

S-100 TYPE PLUGBOARD

5.3" x 10" x 1/16"

8804DP $27.65

4610DP Std Bus Compatible Plugboard . . . $23.70

S-100 TYPE MOTHERBOARD

8.5" x 11" x .062"

8803DP $32.75

4609DP Apple II Compatible Plugboard . . . $26.80

CARD EXTENDER FOR S-100 CARDS

50 contact strips on each side with .125" centers.

3690-12DP . . . $30.70

CONNECTORS

INSULATION DISPLACEMENT CONNECTORS

Straight header with single key slot & ejector

52-120-4 20 pin $2.33 52-140-4 40 pin $3.75

52-126-4 26 pin 2.78 52-150-4 50 pin 3.75

52-134-4 34 pin 3.40

Right angle header with single key slot & ejector

52-220-4 20 pin $1.70 52-240-4 40 pin $3.13

52-226-4 26 pin 2.49 52-250-4 50 pin 3.75

52-234-4 34 pin 2.78

Socket connectors

51-120-1 20 pin $4.10 51-140-1 40 pin $7.50

51-126-1 26 pin 4.95 51-150-1 50 pin 8.10

51-134-1 34 pin 6.30

D TYPE SUBMINIATURE RECTANGULAR

DE-9P	$1.65	DE-25P	$2.85	DE-37S	$5.95
DE-9S	2.25	DE-25S	4.35	DE-50P	4.75
DE-15P	2.40	DE-27P	3.85	DE-50S	7.95
DE-15S	3.10				

SPECIAL — 50V CERAMIC DISC CAPACITORS

1pf 9pf 18pf 39pf 100pf
3pf 10pf 22pf 47pf 220pf
5pf 12pf 27pf 68pf 330pf
6pf 15pf 33pf 82pf 470pf

QTY	PRICE
1-49	7c ea
50-99	5c ea
100 up	3c ea

.001mf .0047mf .033mf
.0018mf .01mf .047mf
.0022mf .022mf

QTY	PRICE
1-49	9c ea
50-99	7c ea
100 up	5c ea

TECHNICAL BOOKS

OSBORNE McGRAW-HILL

CP/M User Guide	$12.00
Apple II User's Guide	15.00
MP's for Measurement and Control	15.99
Interfacing to S-100/IEEE 696 MP's	15.00
PET and the IEEE 488 Bus (GPIB)	15.99
The 8086 Book (Includes the 8088)	16.99
Science and Engineering BASIC Programs/ Apple II Edition	15.99
CBASIC User's Guide	15.00
4 & 8 Bit Microprocessor Handbook	19.95
16 Bit Microprocessor Hanbook	19.95
Z80 Assembly Language Programming	16.99
6502 Assembly Language Programming	16.99
68000 Microprocessor Handbook	6.99
8080A/8085 Assembly Language Prog.	15.99
Z8000 Assembly Language Programming	19.99
6809 Assembly Language Programming	16.99
CRT Controller Handbook	6.99

SAM's BOOKS

TTL Cookbook	$11.95
CMOS Cookbook	12.95
8085A Cookbook	13.95
I.C. Converter Cookbook	13.95
T.V. Typewriter Cookbook	11.95
I.C. Op-Amp Cookbook	15.95
Z80 Microcomputer Handbook	11.95
Programming and Interfacing the 6502 with Experiments	15.95
Using the 6800 Microprocessor	8.95
The Cheap Video Cookbook	7.95
The S-100 and other Micro Buses (2nd Ed.)	9.95
Apple Soft Language	10.95
Z80 Microcomputer Design Projects	15.95
Circuit Design Programs for TRS-80	14.50

SYBEX MICROCOMPUTER BOOKS

The CP/M Handbook (with MP/M)	$14.95
Programming the 6502	13.95
Microprocessor Interfacing Techniques	17.95
Intro to Pascal (Includes UCSD Pascal!)	14.95
The Pascal Handbook	18.95
Inside BASIC Games	14.95
Fifty BASIC Exercises	12.95
Microprocessors: From Chips to Systems	14.95
6502 Applications Book	12.95

TAB BOOKS

MP Interfacing Handbook: A/D to D/A	$8.95
The A to Z Book of Computer Games	7.95
Handbook of Microprocessor Applications	8.95
The Basic Cookbook	4.95
The Power Supply Handbook	9.95
The GIANT Handbook of Computer Projects	9.95
The FORTRAN Cookbook	8.95
How To Design/Build Remote Control Devices	12.95
How To Build Your Own Self-Programming Robot	7.95
How To Make Your Own Solar Electricity	5.95
The Complete Handbook of Robotics	7.95
The GIANT Book of Hobby Projects	12.95
How To Build Your Own Working MP	9.95
How To Troubleshoot and Repair Electronic Circuits	9.95
The Master IC Cookbook	10.95
101 Microprocessor Software and Hardware Projects	8.95
How To Design, Build and Use Electronic Control Systems	8.95
The Master Handbook of Acoustics	12.95
Handbook of Remote Control and Automation Techniques	10.95
80 Practical Time -Saving Programs for the TRS-80	9.95
The Complete Handbook of Amplifiers, Oscillators and Multivibrators	8.95

Votrax SPEECH SYNTHESIZER

- Single CMOS Chip
- 70 Bits Per Second
- 9 ma Current Drain
- Wide Voltage Supply Range
- Latched 5V Compatible Inputs
- Automatic Inflection
- On-chip Master Clock Circuit
- Optional Ext. Master Clock
- Variety of Voice Effects
- Sound Effects

This single chip phonetically synthesizes continuous speech, of unlimited vocabulary, from low data rate inputs. The SC-01 Speech Synthesizer contains 64 different phonemes which are accessed by a 6-bit code

SC-01 Speech Synthesizer $70.00

UV EPROM ERASERS

Erases up to 15 EPROM's in 30 Minutes

QUV-T8/2A Steel enclosure with timer and safety switch $97.50

QUV-T8/2B Same as above without timer & safety switch 68.95

QUV-T8/1 Plastic enclosure without timer and safety switch 49.95

CARBON FILM RESISTORS

¼ and ½ WATT, 5% TOLERANCE

ONLY VALUES LISTED (IN OHMS) AVAILABLE

2.2	10	56	270	1K	5.6K	39K	330K
2.7	12	68	330	1.2K	6.8K	47K	470K
3.3	15	82	390	1.5K	8.2K	56K	560K
3.9	18	91	470	1.8K	10K	68K	680K
4.7	22	100	510	2.2K	12K	82K	820K
5.6	27	120	560	2.7K	15K	100K	1.0M
6.8	33	150	680	3.3K	18K	120K	1.2M
8.2	39	180	820	3.9K	27K	180K	1.8M
9.1	47	220	910	4.7K	33K	220K	

¼ W 10 pcs $.40 100 pcs $3.50 500 pcs $15.00

½ W 10 pcs $.50 100 pcs $4.50 500 pcs $20.00

APRIL 1982

CIRCLE 74 ON FREE INFORMATION CARD

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

Incorporates brand-new D.C. design that gives a frequency response from 0Hz-100KHz ± 0.5dB! Added features like tone defeat and loudness control let you tailor your own frequency supplies to eliminate power fluctuation! Specifications: ● T.H.D. less than .005% ● T.I.M. less than .005% ● Frequency response: DC to 100KHz ± 0.5dB ● RIAA deviation: ± 0.2dB ● S/N ratio: better than 70dB ● Sensitivity: Phono 2MV 47K/Aux. 100MV 100K ● Output level: 1.3V ● Max output: 15V ● Tone control: bass ± 10dB @ 50Hz/treble ± 10dB @ 15Hz ● Power supply: ± 24 D.C. @ 0.5A

Kit comes with regulated power supply, all you need is a 48V C.T. transformer @ 0.5A.

ONLY $44.50
X'former
$4.50 ea.

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 fans. A perfect combination with the TA-1020 low T.I.M. stereo pre-amp.

Specifications:

- Output power: 100W RMS into 8-ohm
  125W RMS into 4-ohm
- Frequency response: 10Hz-100KHz
- T.H.D.: less than 0.008%
- S/N ratio: better than 80dB
- Input sensitivity: IV max.
- Power supply: ± 40V @ 5 amp
- One channel, needs two for stereo

TA-1000KIT
$51.95
Power transformer
$24.00 each

50 WATTS AUTO STEREO BOOSTER BY VERTRONIX

Model V-Amp 500
REG. PRICE
$119.00 EACH
OUR SPECIAL PRICE
$55.00 EACH

Specifications:

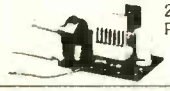
- 50 watts RMS total (25W + 25W)
- Frequency Response: ± 0.5dB, 20Hz ~ 20KHz
- T.H.D.: 0.2% at full rated output
- Input Impedance: 20K ohms
- Crosstalk: Better than 90dB
- Sensitivity: 1.5V for full rated output
- S/N Ratio: Greater than 95dB
- Speaker Load: 2 ~ 8 ohms
- Voltage Supply: 9 ~ 18V D.C.

"FISHER" 30 WATT STEREO AMP

Super Buy
Only $18.50

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 (KF 1% ± 3dB). Voltage gain 33dB. 20Hz-20KHz.

5W AUDIO AMP KIT



2 LM 380 with Volume Control
Power Supply 6 18V DC
ONLY
$6.00 EACH

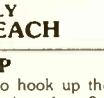
2 WATT AUDIO AMP

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

BUY 2 FOR
$4.99

1 WATT AUDIO AMP

All parts are pre-assembled on a mini PC Board. Supply Voltage 6~9V D.C.
SPECIAL PRICE $1.95 ea.



NEW MARK III 9 Steps 4 Colors LED VU

Stereo level indicator kit with arc-shape display panel!!! This Mark III LED level indicator is a new design PC board with an arc-shape 4 colors LED display (change color from red, yellow, green and the peak output indicated by rose). The power range is very large from −30dB to +5dB. The Mark III indicator is applicable to 1 watt - 200 watts amplifier operating voltage is 3V-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

MARK IV 15 STEPS LED POWER LEVEL INDICATOR KIT

This new stereo level indicator kit consists of 36 4-color LED (15 per channel) to indicate the sound level output of your amplifier from −36dB +3dB. Comes with a well-designed silk screen printed plastic panel and has a selector switch to allow floating or gradual output indicating. Power supply is 6 12V D.C. with THG on board input sensitivity controls. This unit can work with any amplifier from 1W to 200W!

Kit includes 70 pcs. driver transistors, 38 pcs. matched 4-color LED, all other electronic components, PC 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 is with heavy duty aluminum front plate and case. Can be easily slot into the front panel of your auto, truck or boat. Operates on 12V DC.

$41.50 EACH KIT

SOLID STATE STEREO GRAPHIC EQUALIZER PRE AMP KIT TA-2500

Specifications:

- Total Harmonic Distortion: Less than 0.05%
- Intermodulation Distortion: (70Hz:7KHz = 4:1 SMPTE Method) Less than 0.03%
- Frequency Response: Overall 10Hz ~ 100KHz +0.5dB, −1dB.
- RIAA Curve Deviation: (Phono) +0.2dB, −0.2dB (30Hz ~ 15KHz)
- Channel separation (at rated output 1KHz)
- Phono, Tuner, Aux and Tape Monitor better than 70dB.
- Input sensitivity and impedance (1KHz for rated output)

Phono: 2MV 47K ohms Aux: 130MV 50K ohms
Tuner: 130MV 50K ohms Tape: 130MV 50K ohms

Graphic Equalizer control: 10 Band Slide Control
Frequency Bands: 31.5Hz; G3Hz: 125Hz; 250Hz; 500Hz; 1KHz; 2KHz; 4KHz; 8KHz; 16KHz also with on panel selector for Phono, Tuner, Aux 1 and Aux 2.
Power Supply: 117 VAC

Kit comes with all electronic components, transformer, instructions and a 19" rack mount type metal cabinet.

MODEL TA-2500
$119.00 PER KIT

ELECTRONIC DUAL SPEAKER PROTECTOR

Cutt off when circuit is shorted or over load to protect your amplifier as well as your speakers. A must for OCL circuits.

KIT FORM **$8.75 EA.**

PROFESSIONAL REGULATED VARIABLE D.C. POWER SUPPLY KIT

All solid state circuitry with high efficiency power transistor 2SD388 and I.C. voltage regulator MC1733. Output voltage can be adjusted from 0-30V at 1 amp current limited or 0-15V at 2 amp current limited. Internal resistance is less than 0.005 ohm; ripple and noise less than 1 MV, dual on panel meter for voltage and amp reading, also with on board LED and audible over load indicator. Kit comes with predrilled P.C. board, instructions, all necessary electronic components, transformer and a professional look metal cabinet. The best project for school and the most useful instrument for repairman. Build one today!

MODEL TR 88A 0 ~ 15V D.C. 2 amp
MODEL TR 88B 0 ~ 30V D.C. 1 amp

$59.50 PER KIT

REGULATED DUAL VOLTAGE SUPPLY KIT

± 4 ~ 30V DC 800 MA adjustable, fully regulated by Fairchild 78MG and 79MG voltage regulator I.C. Kit includes all electronic parts, filter capacitors, I.C., heat sinks and P.C. board.

$12.50 PER KIT

POWER SUPPLY KIT

0-30V D.C. REGULATED

Uses UA723 and ZN3055 Power TR output can be adjusted from 0-30V, 2 AMP. Complete with PC board and all electronic parts. Tranformer for Power Supply. 2 AMP 24V x 2 **$9.50**

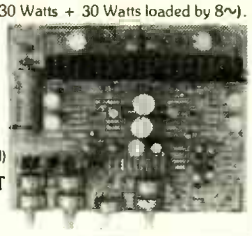
0-30 Power Supply
$10.50 each

TA-323 6 WATTS TOTAL 30W + 30W STEREO AMP KIT

This is a solid state all transistor circuitry with on board stereo pre-amp for most microphone or phone input. Power output employs 2 pairs matching Darlington Transistors. Driven by the popular 2N3053 Driver Transistors. Four built on board controls for; volume, balance, treble and bass. Power supplies requires 48 VET 2.5 amp transformer. T.H.D. of less than 0.1% between 100 Hz and 10KHz at full power. (30 Watts + 30 Watts loaded by 8~).

★ SPECIAL ★
EXCELLENT PRICE!

MODEL 001-0034
Transformer (Optional)
$29.50 PER KIT
$10.50 EACH



200 WATTS CLASS 'A' STEREO POWER AMP KIT TA-2600 (WITH LED POWER LEVEL DISPLAY AND RACK MOUNT TYPE CABINET)

TA-2600 is a kit that combines two sets of TA-1000 class A power amplifiers that can give you 100 watts of true power per channel. The kit also has the latest "V" shape LED power level display with memory Peak Hold on the front panel. For speaker protection it also has separate electronic speaker protection circuits. Kit comes with the 19" rack mount type metal cabinet with a professional quality black anodized front panel; all electronic parts and components; P.C. boards; filter capacitors and a heavy duty transformer.

Specifications:

- Power Level Display: Electronic LED type. 12 LED per channel from — 18 dB to 0 dB with Peak Hold memory
- Power Amplifier: Output power 100 Watts per channel into 8 Ohm load; 125 Watts into 4 Ohm load. Total Music power output 250 Watts Max
- Frequency Response: 10 Hz to 100 KHz
- Total Harmonic Distortion: Less than 0.008% at full power
- Signal/Noise Ratio: better than 80 dB
- Input Sensitivity: 1V Max

MODEL TA-2600
$225.00 KIT FORM
$285.00 FULLY ASSEMBLED

FORMULA INTERNATIONAL INC.

	SHIPPING AND HANDLING CHARGES Under $50.00 purchase	Over $50.00 purchase
Inside California	10%	5%
Outside Calif. (includes Mexico & Canada)	15%	10%
Overseas	25%	20%

Minimum Order $10.00/Calif. Residents Add 6% Sales Tax
Phone Orders Accepted on Visa or MC ONLY, NO C.O.D./Store Hours 10-7 Mon. thru Sat

Send $1.00 For Detailed Catalogue

VISA

12603 CRENSHAW BLVD., HAWTHORNE, CA 90250
PHONE: (213) 973-1921 • (213) 679-5162

FOR COMMERCIAL FREE TV BOX BUILDERS

MC 1358	$2.50	LM 7815	$1.20
MC 1350	$2.00	NE 565	$2.00
MC 1330	$3.00	Connectors Set	$1.00
LM 1458	$1.00	I.C. Socket Set	$2.00
LM 380	$2.00	Matching Transformer	$1.40
Sanyo UHF Tuner	$35.00	Tolriod Coils	
Capacitors Set	$12.50	(Set of 4)	$3.00
Resistors Set	$2.00	Speaker Cabinet	$12.95
Trim Pots:		Transformer	
Trim Caps Set	$13.50	18V 800MA	$3.00
Pots and Knobs	$2.00		

We sell you all the above components in a package for **$125.00** and you will receive a free predrilled P.C. board and instructions at no charge!

SANYO UHF VARACTOR TUNER

For UHF CH 14 83

Tuning voltage +1V~+28V D.C. Input impedance 75 OHM. I.F. band width 7~16 MHz. Noise figure 11.5dB MAX. Size 2⅝" x 1¼" x ¾". Supply voltage 15V D.C. Sound I.F. = 58.0 MHz. Video I.F. = 62.5 MHz.

All units are brand new from Sanyo.
MODEL 115-B-405A
$35.00 EACH

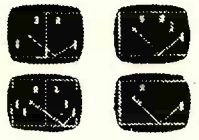
Tuner is the most important part for the circuit. Don't let those $19.00 tuners fool you!

TV GAME BOARD

PLAYS 4 GAMES: TENNIS; HOCKEY; HANDBALL AND JAI-ALAI.

All boards complete with all parts ready to play. Requires 6C size batteries and a small speaker for sound effects. The boards were surplus from a famous game manufacturer. They will play on all US standard black and white or color TV sets. (Regular price for these games were $39.50 each) **OUR PRICE ONLY $6.50 EACH**

PART #57456



TENNIS JAI-ALAI HOCKEY HANDBALL

ELECTRONIC PIN BALL MACHINE

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 ball control, tilt switch, automatic score, extra bonus cave 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 **$8.99** EACH SPEAKER **$1.25** EACH

ELECTRONIC MUSICAL TELEPHONE REST KIT

This telephone rest can be used as a door charm, an audible indicator and for many other sound projects. The special custom made I.C. is pre programmed with 4 musical tunes. Kit comes with a nice looking plastic case, pre-drilled P.C. board, volume control, special sound I.C. speakers and all electronic components and instructions. Ideal for home or school projects.

BUY NOW!

SPECIAL PRICE! ONLY

$15.50 PER KIT

MODEL FIH-3000

DIGITAL TIMER/CLOCK

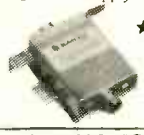
- 24 Hour preset time to turn on or off
- 12 Hour green 0.5" display for time
- operated on 12~16V A.C.

The whole timer is self contained in a compact plastic case (as seen in photo). Designed for VTR with push button switch for easy setting. Limited quantity available.

NOW ONLY $12.94 MODEL VEQ 0143

SANYO ANTENNA SIGNAL BOOSTER

This Booster is specially designed for UHF Channels (14-83). After installed this unit (between the antenna input cable and the UHF tuner) will have a minimum of 10dB gain, that is approximately 2 times better than what you are seeing now. Ideal for those who live in apartments that cannot put up an outdoor antenna. Size is so small; only 2" x 1½" x 1". Supply voltage is 15 VDC.



★ **NEW ITEM** ★

MODEL 001-0076

$12.50 EACH

13 FUNCTIONS LCD TIME MODULE

MODEL 001-0062

$7.94 EACH

- Displays month, date and day of the week
- Displays hour, minute and second
- AM, PM Indicator
- Alarm 1 and Alarm 2 (Independent)
- 10 Hours Stop Watch
- 12 Hours presettable count down time
- Hour Charm Indicator
- Back light by touch of the switch

These modules are brand new and made by LITRONIX. Designed for a man's watch. Can be used for many applications. Comes with 2 silver batteries and the ceramic round transducer.

MATCHED PAIR POWER TRANSISTORS BY MOTOROLA

MJ2955 PNP 2N3055 NPN	150 Watts	BV=60 V I.C.=15 A	**$3.50** per pair
MJE2955 PNP MJE3055 NPN	90 Watts	BV=60 V I.C.=10 A	**$3.00** per pair
MJ15003 NPN MJ15004 PNP	250 Watts	BV=140 V I.C.=20 A	**$12.00** per pair

All above parts guaranteed to be prime and come with data sheets.

MUFFIN FANS FOR EQUIPMENT COOLING

These fans are pulled out from used computers. But carefully cleaned by ultrasonic cleaner. All in "like-new" condition. Size 4 11/16" x 1-1/2" x 4 11/16"
MODEL MF505
$9.50 EACH

FLUORESCENT LIGHT DRIVER KIT

12V DC POWERED

Lights up 8~15 Watt Fluorescent Light Tubes. Ideal for camper, outdoor, auto or boat. Kit includes high voltage coil, power transistor, heat sink, all other electronic parts and PC Board. light tube not included!

$6.50 Per Kit

PRESS-A-LIGHT SELF GENERATED FLASHLIGHT

Never worry about battery, because it has none! 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!

EXCLUSIVE! **$3.95 ea.**

Model F-179

No FCC license required.
OUR PRICE $49.50
ADDITIONAL MICROPHONE (TRANSMITTER) AVAILABLE AT **$28.00** EACH

CRYSTAL CONTROLLED WIRELESS MICROPHONE SYSTEM

MURA WMS-49

Transmitter: FET mic for flat 30~18 KHz response extra controlled 49MHz AM Band for drift-free performance. 100 MW output (range approx. ¼ mile) for reliable long range transmission. Powered by a 9V radio battery (included).
Receiver: Extra controlled locks on 49MHz transmitter signal. With on panel VU meter monitors the signal strength from the microphone. Standard phone jack outlet connection to a P.A. or other phone input. 9V battery included. This professional set is ideal for on stage, in field, church, in house or outdoor use.

SUPER FM WIRELESS MIC KIT— MARK III

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

FMC-105 **$11.50 PER KIT**

WEM-36 FM WIRELESS MICROPHONE

TEET MODEL WEM-36 is a factory assembled FM wireless microphone powered by two AA size batteries. Transmits in the range of 88-108 MHz with 3 transistor circuits to meet with F.C.C. part 15 regulations. Element is built in a plastic tube type case with an omni-directional electret condenser microphone unit. By using a standard FM radio, signal can be heard anywhere on a one-acre lot. Sound quality was judged "very good."

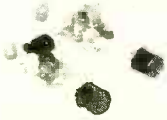
MODEL WEM-36 **$16.50 EACH**

WHISTLE ACTIVATED SWITCH BOARD

All boards are pre-assembled and tested. Your whistle to its FET condenser microphone from a distance, as far as 30 feet away (sensitivity can be easily adjusted) will turn the switch on, then match your whistle to it again, then it turns off. Ideal for remote control toys, electrical appliance such as lights, coffee pots, TV, Hi-Fi, radio or other projects. Unit works on 9V D.C.

MODEL 968
$4.50 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. **$15.50**

ELECTRONIC SWITCH KIT

CONDENSER TYPE
Touch On Touch Off
uses 7473 I.C. and
12V relay

$5.50 each

FORMULA INTERNATIONAL INC.

	SHIPPING AND HANDLING CHARGES Under $50.00 purchase	Over $50.00 purchase
Inside California	10%	5%
Outside Calif. (includes Mexico & Canada)	15%	10%
Overseas	25%	20%

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Phone Orders Accepted on Visa or MC ONLY, NO C.O.D./Store Hours 10-7 Mon. thru Sat.

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12603 CRENSHAW BLVD., HAWTHORNE, CA 90250
PHONE: (213) 973-1921 • (213) 679-5162

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8080A	3.75	8155	11.95
8085A	3.50	8251	5.75
AMD 2901	8.95	8255	6.95
8202	35.00	8259	6.95
8212	2.25	8257 (AM9517)	7.95
8214	3.60	8X300	25.00
8216	2.90	Z80A CPU	6.75
8224	3.25	Z80A S10	12.95
MM5307	9.95	Z80A P10	6.00
8226	2.75	TMS 9927 NL	9.95
8228	4.50	8276	16.95

RAM's

8264 (4164-2)	10.95
2114L-3	1.85
4118-3	1.45
4118-2	2.25
21L02-3	.90
TMS 3409	1.75
MK4027-3	3.50
MK4096-11	2.95
MS4050NL	3.95
MM5280	1.75
2101-1	2.45
2610A-4	2.50
MK4008P	1.95
IM7001	4.95
5101E	2.95
2111AL	2.45

ROM's

2708	2.95
2716 - 5V	4.95
2732	16.95
1702A	4.95
2532	16.95
2732	14.95
82S23	1.50
82S115	2.50
82S123	1.50
82S129	1.50
82S130	1.50
82S131	1.50
82S181	3.00
8628A-3	3.00
AM27HC	2.95
5256-5 (74188A)	1.25

UART's

AY5-1013	3.75	M8868A	8.95
TR1602B	3.95	COM2017	3.75
PT1482B	3.25	AY3-8700	2.25

INTERFACE & DRIVERS

FD1791	$4.95
1488	.98
1489	1.10
8130	2.50
8830	2.50
8833	2.50
8834	2.00
8837	2.00
8838	2.00
MM5321	9.50
MM5369	2.50

SHIFT REGISTERS

MM1402	1.75
MM1403	1.75
MM1404	1.75
MM5013	2.50
MM5055	2.50
MM5056	2.50
MM5057	2.50
MM5058	2.50
MM5080	2.50

14 PIN HEADERS	3/$1.00
16 PIN HEADERS	.40
24 PIN HEADERS	.75
40 PIN HEADERS	1.10
50 PIN EDGEBOARD CONN.	3.95
26 PIN EDGEBOARD CONN.	2.50
50 PIN RIGHT ANGLE CONN.	3.95
20 PIN RIGHT ANGLE CONN.	2.25

50 PIN RIBBON CONNECTORS	$3.25
40 PIN RIBBON CABLE CONN	$2.75
20 PIN RIBBON CABLE CONN	$2.25
10 PIN RIBBON CABLE CONN	$1.50

PRINTED CIRCUIT BOARD
4" - 5" DOUBLE SIDED EPOXY BOARD 1/16" THICK
5.60 ea. 5 $7.60

EPOXY GLASS VECTOR BOARD

1/16" thick with 1/10" spacing
4½" x 6½" $1.95

DATEL'S DAC-08EQ
8 bit DAC — $ 4.95

CRYSTALS

2.000		3.000	5.000	8.000
18.432	$4.25 ea	3.579	6.000	10.000 $3.25
20.000		4.000	6.144	18.000 ea.

REDICON SAD 1024 ANALOG DELAY LINE . $10.95

74S00	30	74S74	70	74LS158	1.25
74S02	30	74S85	60	74LS188	1.75
74S03	30	74S89	1.90	74S174	1.40
74S04	40	74S112	.85	74S175	1.40
74S05	45	74S133	1.40	74S194	1.10
74S08	40	74S138	1.50	74S257	1.50
74S10	30	74S138	1.25	74S258	1.40
74S11	35	74S139	1.10	74S260	1.50
74S15	40	74S140	1.00	74S280	1.90
74S20	40	74S153	1.10	74S283	2.25
74S30	40	74S151	1.25	74S373	
74S32	40	74S157	1.25		

7 WATT LD 65 LASER DIODE(IR) $8.95

25 watt Infra Red Pulse (SG 2006 equiv.)
Laser Diode (Spec sheet included) $24.95

2N3820 P FET	$ .45
2N 5457 N FET	$ .45
2N2646 UJT	$ .45
ER 900 TRIGGER DIODES	4/$1.00
2N 6028 PROG. UJT	$ .65

DISC CAPACITORS

.1UF 16V	10 $1.00	100/$8.00
.01UF 35V	16 $1.00	100 $5.00

IN4148 (IN914) 15/1.00

TANTALUM CAPACITORS

.47UF 35V	5/$1.00	10UF 35V	$ .40
.68UF 35V	5/$1.00	22UF 10V	$ .30
1UF 35V	5/$1.00	15UF 16V	3/$1.00
2.2UF 20V	5/$1.00	30UF 6V	5/$1.00
3.3UF 20V	4/$1.00	33UF 20V	$ .60
4.7UF 35V	4/$1.00	47UF 20V	$ .85
6.8UF 35V	3/$1.00	68UF 10V	$1.00
		120UF 6V	$ .75
		200UF 20V	$1.75

SANKEN AUDIO POWER AMPS

Si 1020 G 20 WATTS .$12.50
Si 1050 G 50 WATTS .$27.50
200 PRV 1A LASCR .95

RS232 CONNECTORS

DB 25P male $2.75
DB 25S female 3.75
HOODS 1.25

C/MOS

4001	.20	4027	.40	4081	.20	74C74	.50
4002	.20	4028	.55	4082	.20	74C76	.70
4006	.65	4029	.75	4093	.60	74C83	1.30
4007	.27	4030	.35	4099	1.75	74C85	1.40
4008	.65	4034	2.25	4501	.95	74C86	.50
4009	.45	4035	.75	4510	.65	74C90	.90
4010	.45	4040	.65	4511	.65	74C93	.95
4011	.20	4042	.55	4514	1.40	74C151	1.75
4012	.20	4043	.65	4515	1.50	74C157	.75
4013	.30	4044	.55	4516	.75	74C160	1.20
4014	.55	4046	.90	4518	1.25	74C161	1.15
4015	.55	4047	.90	4520	.70	74C163	1.15
4016	.30	4049	.40	4563	2.75	74C165	1.25
4017	.60	4050	.40	74C00	.27	74C173	1.30
4018	.50	4051	.80	74C02	.27	74C174	1.30
4019	.45	4052	.75	74C08	.30	74C175	1.20
4020	.70	4053	.75	74C10	.27	74C192	1.30
4021	.55	4066	.50	74C14	1.20	74C901	.50
4022	.80	4069	.20	74C20	.27	74C914	1.75
4023	.20	4071	.25	74C32	.45		
4024	.45	4072	.20	74C73	.75		
4025	.25	4076	.65				
		4077	.35				

SPECIALS

2114L-4 ..... $ 1.65
8 x 300 — SIGNETICS 16 BIT MICROCONTROLLER 49.00
10 ea 8164E 64K RAM (150NS) 99.50

DOUBLE SIDED DIP RIBBON CABLE JUMPER ASSEMBLIES
16 PIN 4" LONG ..... **$ 2.00**
14 PIN 12" LONG ..... **$ 2.50**

RS 232 CABLE

10 Conductor, # 22 color coded wire, gray PVC outer cover, 3/8" diameter
.40 per ft. — 100'/$30.00
Add 20% postage for orders under 100'.
Add 10% postage for orders over 100'.

8080A	3.75	4116-2	1.85
Z80A CPU	6.00	MS9927NL	
8264 (4164-2) 64K RAM		CRT CONTROLLER	9.95
	14.00	8275 CRT CONTROLLER	
2732 - 32K ROM	14.95		16.95
		FD1791	34.95
		6845	16.95

SPECIALS GOOD THRU APR. 1982

MINIATURE MULTI-TURN TRIMMING POTS
50, 100, 500, 1K, 5K, 10K, 50K, 250K ...$75 each 3/$2.00

NO. 30 WIRE WRAP WIRE
SINGLE STRAND 100' ..$1.40

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CTS 206	4	4 POSITION 1.25
CTS 206	7	7 POSITION 1.40
CTS 206	8	8 POSITION 1.50
CTS 206	10	10 POSITION 1.95

TOGGLE SWITCHES

106D	SPDT	1.10
206D	DPDT	1.50
206P	DPDT CENTER OFF	$1.75

SCR's

	1.5A	6A	35A	110A
100	.45	.60	1.40	
200	.70	.80	1.90	9.00
400	1.20	1.40	2.60	12.00
600		1.80	3.60	15.00

TRIAC's

PRV	1A	10A	25A
100	.45	.80	1.55
200	.84	1.30	2.10
400	1.30	1.90	3.10
600	2.00	2.75	4.30

L1411 IR DETECTOR	3 $1.00
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IL-5 OPTO ISOLATOR	$ .45
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SFC 3301 — 50 PRV 30A
FAST RECOVERY DIODE (35ns) ..$2.25
20KV 250MA DIODE $1.90

SILICON POWER RECTIFIERS

PRV	1A	3A	12A	50A	125A	240A
100	.06	.14	.35	.90	4.25	6.00
200	.07	.20	.40	1.30	5.25	9.00
400	.09	.25	.65	1.50	6.50	12.00
600	.11	.30	.80	2.00	8.50	15.00
800	.15	.35	1.00	2.50	10.50	18.00
1000	.20	.45	1.25	3.00	12.50	26.00

CLOCK CHIPS

MM5314 ..$4.75 MM5316 $4.95
MM5387AA ..5.95

.5V at 800ma SOLAR CELLS
3" diameter $4.35

7 SEGMENT DISPLAYS

FSC8024-4 digit	
C.C. 8" display $5.95	
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FND 510 C.A. .5" ...$ .85	
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DL-707 C.A. .3" ...$ .75	
DL 747 C.A. .6" ...$1.50	
FND810 .8" CA $1.95	
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TIP 111 — 150 — TIP 145	$1.35
2N6233 NPN SWITCHING POWER	$1.95
MRF 8004 CB RF TRANSISTOR NPN	$ .75
2N3772 NPN Si TO-3	$1.00
2N4908 PNP Si TO 3	$1.00
2N3137 NPN Si RF	$ .55
2N3919 NPN Si TO 3 RF	$1.50
2N1420 NPN Si TO-5	3 $1.00
2N2222 NPN Si TO 18	5 $1.00
2N2907 PNP Si TO 18	5 $1.00
2N3055 NPN Si TO-3	$ .60
2N3904 NPN Si TO 92	6 $1.00
2N3906 PNP Si TO 92	6 $1.00
2N5296 NPN Si TO 220	$ .55
2N6109 PNP Si TO 220	$ .55
TIP 31B NPN Si TO 220	$ .60
TIP 32B PNP Si TO 220	$ .65
TIP 34 PNP Si	$ .95
TIP 121 PNP Si U84	$ .80
TIP 141 NPN Si U87	$1.00
MJE 3055	$ .80

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7400	.17	7472	.35	74163	.60
7401	.17	7473	.35	74164	.60
7402	.17	7474	.40	74165	.60
7403	.17	7475	.40	74166	.70
7404	.24	7476	.40	74170	1.25
7405	.24	7480	.45	74173	1.60
7406	.33	7483	.50	74174	.75
7407	.35	7485	.65	74175	.65
7408	.27	7486	.42	74180	.75
7409	.24	7490	.45	74181	1.90
7410	.17	7491	.45	74182	.45
7411	.22	7492	.45	74190	.70
7412	.30	7493	.45	74191	.75
7413	.42	7494	.60	74192	.70
7414	.50	7495	.60	74193	.79
7416	.33	7496	.60	74194	.85
7417	.37	74107	.35	74195	.45
7420	.17	74121	.35	74196	.75
7425	.30	74122	.39	74197	.75
7426	.33	74123	.42	74273	.85
7427	.30	74125	.45	74279	.60
7430	.17	74126	.45	74365	.65
7432	.27	74145	.75	74367	.65
7437	.27	74148	1.25	74368	.65
7438	.27	74150	1.10	74390	.90
7440	.17	74151	.50	75324	1.75
7441	.75	74153	.40	75325	1.50
7442	.45	75154	1.10	75492	1.05
7445	.70	74155	.50	8T31	2.00
7446	.75	74157	.50	8T32	2.75
7447	.65	74160	.85	9601	.75
7448	.65	74161	.65	9602	.75
7450	.17	74162	.60	DS0056H	1.50

FULL WAVE BRIDGE

PRV	2A	6A	25A
100		1.40	
200	.80	1.30	2.20
400	1.00	1.65	3.30
600	1.30	1.90	4.40

12V DC RELAYS TTL SIZE

S P 1200 ohm coil 95
D P 400 ohm coil 1.25

DIP SOCKETS

8 PIN	17	22 PIN	30
14 PIN	20	24 PIN	35
16 PIN	22	28 PIN	40
18 PIN	25	40 PIN	60

74LS SERIES

74LS00	17	74LS93	39	74LS194	1.10
74LS01	18	74LS95	55	74LS195	.90
74LS02	22	74LS107	.41	74LS196	.85
74LS03	22	74LS109	.38	74LS197	.85
74LS04	22	74LS112	.38	74LS221	.80
74LS08	22	74LS113	.45	74LS240	.89
74LS09	22	74LS114	.55	74LS241	.89
74LS10	20	74LS123	.59	74LS242	.89
74LS11	22	74LS124	1.25	74LS243	.89
74LS12	22	74LS125	.45	74LS244	1.10
74LS13	45	74LS126	.45	74LS245	1.50
74LS14	40	74LS132	.50	74LS247	.75
74LS15	35	74LS136	.45	74LS248	1.10
74LS20	18	74LS138	.48	74LS251	.55
74LS21	18	74LS139	.48	74LS253	.55
74LS22	25	74LS151	.40	74LS257	.55
74LS26	35	74LS153	.40	74LS258	.55
74LS27	28	74LS155	.60	74LS259	1.10
74LS28	45	74LS156	.70	74LS266	.60
74LS30	18	74LS157	.48	74LS273	1.15
74LS32	35	74LS158	.48	74LS279	.48
74LS37	30	74LS160	.75	74LS280	1.80
74LS38	30	74LS161	.58	74LS283	.75
74LS40	40	74LS162	.70	74LS290	.72
74LS42	44	74LS163	.58	74LS365	.52
74LS47	65	74LS164	.58	74LS366	.52
74LS51	20	74LS165	.75	74LS367	.52
74LS54	20	74LS166	1.10	74LS368	.52
74LS73	35	74LS169	1.75	74LS373	1.25
74LS74	35	74LS170	1.50	74LS374	1.25
74LS75	35	74LS173	.59	74LS377	1.25
74LS76	45	74LS174	.45	74LS386	.50
74LS83	75	74LS175	.40	74LS390	.98
74LS85	85	74LS181	1.95	74LS393	.98
74LS86	40	74LS190	.72	74LS670	1.60
74LS90	39	74LS191	.72	81LS97	1.10
74LS92	45	74LS192	.65	81LS98	1.10
		74LS193	.60	8T26	1.25

LINEAR CIRCUITS

LM201	.75	LM348	.90	709	.25
LM301	.748	LM358	.50	710	.45
741CV	.25	LM361	1.75	711	.95
741C	.35	LM377	1.60	711CH	.40
A7	.50	LM380	.95	LM1808	1.75
1456	.80	LM382	.80	LM1889	1.95
1458	.50	LM383	2.50	CA758	1.75
4136	.85	LM386	.80	CA3018	1.95
3900	.45	LM387	1.25	CA3078	1.50
LM307	.30	LM393	1.00	CA3080	.95
LM308	.75	LM553	2.25	CA3086	.95
LM324	.65	LM565	.85	CA 3140	1.20
LM339	.65	LM566	.85	LM2901	.95
LF351	.75	5648	3.95	8038CC	3.90
LF353	1.25	566	1.40	NE566	1.50
LF355	1.25	567	.85	TL062 CP	.95
LF356	1.35			TL064 CN	1.50
LM311	.50				
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20 PIN	LP	.22	.195	.170	.160
22 PIN	LP	.25	.230	.210	.178
24 PIN	LP	.26	.240	.220	.195
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20 PIN	WWT	.68	.64	.704	.620
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PRICES

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The CT-90 is the most versatile, feature packed counter available for less than $300.00! Advanced design features include; three selectable gate times, nine digits, gate indicator and a unique display hold function which holds the displayed count after the input signal is removed! Also, a 10mHz TCXO time base is used which enables easy zero beat calibration checks against WWV. Optionally; an internal nicad battery pack, external time base input and Micro-power high stability crystal oven time base are available. The CT-90, performance you can count on!

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 oven-0.1 ppm 20-40°C
Power:	8-15 VAC @ 250 ma

7 DIGITS 525 MHz $99.95 WIRED

SPECIFICATIONS:

Range:	20 Hz to 525 MHz
Sensitivity:	Less than 50 MV to 150 MHz Less than 150 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

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 1.0 ppm accuracy - that's .0001%! The CT-70 is the answer to all your measurement needs, in the field, lab or ham shack.

PRICES:

CT-70 wired, 1 year warranty	$99.95
CT-70 Kit, 90 day parts warranty	84.95
AC-1 AC adapter	3.95
BP-1 Nicad pack + AC adapter/charger	12.95

7 DIGITS 500 MHz $79.95 WIRED

PRICES:

MINI-100 wired, 1 year warranty	$79.95
AC-Z Ac adapter for MINI-100	3.95
BP-Z Nicad pack and AC adapter/charger	12.95

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 "in-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

NEW READ RECEIVER FREQUENCY

SPECIFICATIONS:

Range:	20 Hz to 600 MHz
Sensitivity:	Less than 25 mv to 150 MHz Less than 150 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

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 Receive 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!

PRICES:

CT-50 wired, 1 year warranty	$159.95
CT-50 Kit, 90 day parts warranty	119.95
RA-1, receiver adapter kit	14.95
RA-1 wired and pre-programmed (send copy of receiver schematic)	29.95

DIGITAL MULTIMETER $99.95 WIRED

PRICES:

DM-700 wired, 1 year warranty	$99.95
DM-700 Kit, 90 day parts warranty	79.95
AC-1, AC adaptor	3.95
BP-3, Nicad pack + AC adapter/charger	19.95
MP-1, Probe kit	2.95

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 3½ digit, ½ 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 bail makes it an ideal addition to any shop.

SPECIFICATIONS:

DC/AC volts:	100uV 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:	0.1% basic DC volts
Power:	4 'C' cells

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74LS48	1.15	74LS161	1.15	74LS353	1.29
74LS49	1.15	74LS162	1.15	74LS365	.69
74LS51	.35	74LS163	1.15	74LS366	.69
74LS54	.35	74LS164	1.15	74LS367	.69
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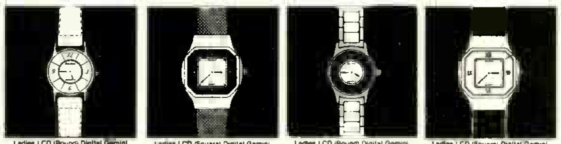

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DL-[illegible] (Red)				[illegible]	—	[illegible]					1.75	2/2.95
DLG-[illegible] (Grn)		C.C.		[illegible]	[illegible]	[illegible]					4.95	2/7.95
DL-[illegible]A (Red)		4OA-MPX		[illegible]							2.49	2/2.95

MULTI-DIGIT REFLECTOR ARRAYS

Part Number/Color	Char Ht	Polarity	Description Segment/Digit	Overall Size	Light Output typ	min	@mA	Forward Voltage typ	max	Continuous Forward Current	Price	2 FOR SALE
DL-[illegible] (Red)	[illegible]	C.C. MPX	7 Seg. 2-Digit RHDP	[illegible]	[illegible]	[illegible]	[illegible]	1.7	[illegible]	[illegible]	.79	2/.99
DLG-[illegible] (Grn)	[illegible]	C.A. MPX	7 Seg. 2 Digit	[illegible]		[illegible]	[illegible]		[illegible]	[illegible]	.89	2/1.19
DL-[illegible] (Red)	[illegible]	C.C. MPX	7 Seg. 4 Digit RHDP	[illegible]	[illegible]	[illegible]	[illegible]	1.7	[illegible]	[illegible]	1.49	2/1.95
DL-[illegible] (Red)	[illegible]	C.A. MPX	7 Seg. 3 Digit RHDP	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	2.25	2/3.49

NATIONAL Stick Display Sale

LIMITED QUANTITY! — SALE!

LED NUMERIC ARRAYS

PART NO	DIGIT SIZE (RED)	FORMAT	DRIVE Comm. Cathode/Comm. Anode	OVERALL SIZE	PRICE	SALE
NSA1[illegible]	100 (8 Bubble Stick)	888888	C.C. 8 Digit Multiplexed	2"L x .72"H x .27"D	$ .50	2/.99
NSA1[illegible]	100 (8 Bubble Stick)	888888888	C.C. 9 Digit Multiplexed	2"L x .72"H x .27"D	[illegible]	2/.99
NSA2[illegible]	100 (8 Bubble Stick)	888888888	C.C. 9 Digit Multiplexed	1.[illegible]"L x .72"H x .27"D	[illegible]	2/.99
NSA1140	100 (8 Bubble Stick)	88 88	C.C. 4 Digit Multiplexed	2"L x .72"H x .27"D	[illegible]	2/.79
NSA1180	100 (8 Bubble Stick)	8 88 88	C.C. 5 Digit Multiplexed	2"L x .72"H x .27"D	[illegible]	2/.59
NSA1[illegible]	140 (8 Bubble Stick)	88888888	C.C. 8 Digit Multiplexed	2-3/8"L x .72"H x .27"D	[illegible]	2/1.19

MULTI-DIGIT LED NUMERIC DISPLAYS

PART NO	DIGIT SIZE (RED)	FORMAT	DRIVE Comm. Cathode/Comm. Anode	OVERALL SIZE	PRICE	SALE
NSN373	.3 No Decimal	88	C.C. 2 Digit Direct	.80"L x .80"H x .228"D	$ .69	2/.79
NSN374	.3 No Decimal	88	C.A. 2 Digit Direct	.80"L x .80"H x .228"D	.79	2/.99
NSN601	.6 No Decimal	88	C.A. 2 Digit Direct	1.40"L x 1.14"H x .32"D [illegible]	[illegible]	2/1.49
NSN602	.6 No Decimal	88	C.A. 2 Digit Direct	1.40"L x 1.14"H x .32"D [illegible]	[illegible]	2/1.49
NSN[illegible]	.5	88	C.C. 2 Digit Multiplexed	1"L x 1.08"H x .28"D [illegible]	[illegible]	2/1.79
NSN[illegible]	.5	88	C.C. 2 Digit Direct	1"L x 1.08"H x .28"D [illegible]	[illegible]	2/1.79
NSN781	.7	88	C.C. 2 Digit Multiplexed	1.2"L x 1.28"H x .3"D	1.19	2/1.95
NS82100	.3	[illegible]	C.C. 8 Digit (10 Spaces)	4"L x .60"H x .280"D	.75	2/[illegible]
NS83001	.3	8888	C.C. 4 Digit Multiplexed	1.[illegible]"L x .[illegible]"H x .25"D [illegible]	.75	2/[illegible]
NS83[illegible]	.3	±1888	C.A. 3½ Digit Multiplexed	1.00"L x .80"H x .228"D	[illegible]	2/1.49
NS83411	.3	[illegible]	C.C. 4 Digit — Colon/PM Indicator	1-9/16"L x 13/16"H x 3/16"D	[illegible]	2/1.19
NS8[illegible]	.3	[illegible]	C.C. 6 Digit — AM/PM, Failure Ind	3"L x 1.10"H x 7/32"D	2.[illegible]	2/3.[illegible]
NS8[illegible]	.3	88888888	C.A. 8 Digit Multiplexed	3"L x 1-3/32"H x 3/16"D	2.[illegible]	2/3.[illegible]
NS8[illegible]*	.3	8888	C.C. 4 Digit Multiplexed	1.[illegible]"L x .80"H x .228"D	2.[illegible]	2/4.[illegible]
NS8[illegible]*	.3	8888	C.A. 4 Digit Multiplexed	1.[illegible]"L x .80"H x .228"D	2.[illegible]	2/4.[illegible]
NS8[illegible]*	.5	±1888	C.A. 3½ Digit Multiplexed	1.[illegible]"L x 1.00"H x .28"D	3.49	2/[illegible]
NS8[illegible]441	.5	[illegible]	C.C. 4 Digit — AM/PM, Colon Ind.	3.00"L x 1.10"H x .282"D	2.[illegible]	2/[illegible]
NS8[illegible]*	.5	8888	C.C. 4 Digit Multiplexed	1.[illegible]"L x 1.00"H x .280"D	3.49	2/[illegible]
NS8[illegible]*	.5	8888	C.A. 4 Digit Multiplexed	1.[illegible]"L x 1.00"H x .280"D	3.49	2/[illegible]
NS8[illegible]19	.5	±8888	C.C. 3½ Digit Multiplexed	3.00"L x 1.10"H x .282"D	2.49	2/[illegible]
NS8[illegible]22	.5	88888	C.A. 5 Digit Multiplexed	3.00"L x 1.10"H x .282"D	2.[illegible]	2/3.49
NS87[illegible]	.7	888888	C.C. 6 Digit Multiplexed	3.00"L x 1.38"H x .282"D [illegible]	3.[illegible]	2/4.95

*Standard Stocked Items — only pin-out specifications available on non stocked items

COMPUTER GRADE CAPACITORS

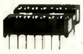
1¢ SALE!

MFD	WVDC	PRICE	MFD	WVDC	PRICE	MFD	WVDC	PRICE
250	150	1.95	10,000	16	2.95	24,000	20	2.95
500	200	2.49	10,000	[illegible]	3.95	27,000	10	2.95
1,250	3	.99	11,000	19	[illegible]	32,500	25	4.95
1,500	25	1.95	11,000	55	[illegible]	40,000	25	5.95
1,500	50	2.95	11,000	60	[illegible]	43,000	10	5.95
2,000	10	2.95	[illegible]	10	2.95	50,000	20	7.95
2,250	100	3.95	14,000	[illegible]	2.95	52,000	20	5.95
2,300	33	2.95	14,000	[illegible]	[illegible]	55,000	15	5.95
2,500	15	2.95	[illegible]	10	[illegible]	58,000	20	5.95
3,000	25	[illegible]	20,000	20	2.95	65,000	10	7.95
3,600	40	[illegible]	20,000	55	3.95	73,800	5	7.95
4,500	50	3.95	21,000	15	3.95	80,000	15	8.95
5,500	25	4.49	23,000	7	1.95	90,000	10	8.95
6,100	40	2.49	23,000	10	2.95	160,000	10	8.95
6,600	50	4.95	23,000	20	3.95	200,000	3	12.95

SALE — 2 FOR THE PRICE OF 1 PLUS 1¢ MORE

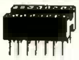
OVER 200 OTHER VALUES AVAILABLE — CALL OR WRITE FOR YOUR REQUIREMENT

LOW PROFILE (TIN) SOCKETS



	1-24	25-49	50-100
8 pin LP	.17	.16	.15
14 pin LP	.20	.19	.18
16 pin LP	.22	.21	.20
18 pin LP	.29	.28	.27
20 pin LP	.34	.32	.30
22 pin LP	.37	.36	.35
24 pin LP	.38	.37	.36
28 pin LP	.45	.44	.43
36 pin LP	.60	.59	.58
40 pin LP	.63	.62	.61

SOLDERTAIL STANDARD (TIN)



	1-24	25-49	50-100
14 pin ST	.27	.25	.24
16 pin ST	.30	.27	.25
18 pin ST	.35	.32	.30
24 pin ST	.49	.45	.42
28 pin ST	.99	.90	.81
36 pin ST	1.39	1.26	1.15
40 pin ST	1.59	1.45	1.30

SOLDERTAIL (GOLD) STANDARD

	1-24	25-49	50-100
8 pin SG	.39	.35	.31
14 pin SG	.49	.45	.41
16 pin SG	.54	.49	.44
18 pin SG	.59	.53	.48
24 pin SG	.79	.75	.69
28 pin SG	1.10	1.00	.90
36 pin SG	1.65	1.40	1.26
40 pin SG	1.75	1.59	1.45

WIRE WRAP SOCKETS (GOLD) LEVEL #3

	1-24	25-49	50-100
8 pin WW	.59	.54	.49
10 pin WW	.69	.63	.58
14 pin WW	.79	.73	.67
16 pin WW	.85	.77	.70
18 pin WW	.99	.90	.81
20 pin WW	1.19	1.08	.99
22 pin WW	1.49	1.35	1.23
24 pin WW	1.39	1.26	1.14
28 pin WW	1.69	1.53	1.38
36 pin WW	2.19	1.99	1.79
40 pin WW	2.29	2.09	1.89

1/4 WATT RESISTOR ASSORTMENTS – 5%

ASST. 1	5 ea.	10 Ohm 12 Ohm 15 Ohm 18 Ohm 22 Ohm / 27 Ohm 33 Ohm 39 Ohm 47 Ohm 56 Ohm	50 pcs.	$1.95
ASST. 2	5 ea.	68 Ohm 82 Ohm 100 Ohm 120 Ohm 150 Ohm / 180 Ohm 220 Ohm 270 Ohm 330 Ohm 390 Ohm	50 pcs.	$1.95
ASST. 3	5 ea.	470 Ohm 560 Ohm 680 Ohm 820 Ohm 1K / 1.2K 1.5K 1.8K 2.2K 2.7K	50 pcs.	$1.95
ASST. 4	5 ea.	3.3K 3.9K 4.7K 5.6K 6.8K / 8.2K 10K 12K 15K 18K	50 pcs.	$1.95
ASST. 5	5 ea.	22K 27K 33K 39K 47K / 56K 68K 82K 100K 120K	50 pcs.	$1.95
ASST. 6	5 ea.	150K 180K 220K 270K 330K / 390K 470K 560K 680K 820K	50 pcs.	$1.95
ASST. 7	5 ea.	1M 1.2M 1.5M 1.8M 2.2M / 2.7M 3.3M 3.9M 4.7M 5.6M	50 pcs.	$1.95
ASST. 8R		Includes Resistor Assts. 1-7 (350 pcs.)		$10.95 ea.

$10.00 Minimum Order — U.S. Funds Only
California Residents Add 6% Sales Tax
Postage — Add 5% plus $1.50 Insurance
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4/82

INTERSIL

Part No.	Function	Price
7045IPI	CMOS Precision Timer	14.95
7045EV/Kit*	Stopwatch Chip, XTL	24.95
7106CPL	3½ Digit A/D (LCD Drive)	16.95
7106EV/Kit*	IC, Circuit Board, Display	34.95
7107CPL	3½ Digit A/D (LED Drive)	15.95
7107EV/Kit*	IC, Circuit Board, Display	29.95
7116CPL	3½ Digit A/D LCD Dis. HLD.	18.95
7117CPL	3½ Digit A/D LED Dis. HLD.	17.95
7201IDR	Low Battery Volt Indicator	2.25
7205IPG	CMOS LED Stopwatch/Timer	12.95
7205EV/Kit*	Stopwatch Chip, XTL	19.95
7206CJPE	Tone Generator	5.15
7206CEV/Kit*	Tone Generator Chip, XTL	12.95
7207AIPD	Oscillator Controller	6.50
7207AEV/Kit*	Freq. Counter Chip, XTL	13.95
7208IPI	Seven Decade Counter	17.95
7209IPA	Clock Generator	3.95
7215IPG	4 Func. CMOS Stopwatch CKT	13.95
7215EV/Kit*	4 Func. Stopwatch Chip, XTL	19.95
7216AIJI	8-Digit Univ. Counter C.A.	32.00
7216CIJI	8-Digit Freq. Counter C.A.	26.95
7216DIPI	8-Digit Freq. Counter C.C.	21.95
7217IJI	4-Digit LED Up/Down Counter	12.95
7218CIJI	8-Digit Univ. LED Drive	10.95
7224IPL	LCD 4½ Digit Up Counter DRI	11.25
7226AIJL	8-Digit Univ. Counter	31.95
7226AEV/Kit*	5 Function Counter Chip, XTL	74.95
7240IJE	CMOS Bin Prog. Timer/Counter	4.95
7242IJA	CMOS Divide-by-256 RC Timer	2.05
7250IJE	CMOS BCD Prog. Timer/Counter	6.00
7260IJE	CMOS BCD Prog. Timer/Counter	5.25
7555IPA	CMOS 555 Timer (8 pin)	1.45
7556IPD	CMOS 556 Timer (14 pin)	2.20
7611BCPA	CMOS Op Amp Comparator 5MV	2.25
7612BCPA	CMOS Op Amp Ext. Cmvr. 5MV	2.95
7621BCPA	CMOS Dual Op Amp Comp. 5MV	3.95
7631CCPE	CMOS Tri Op Amp Comp. 10MV	5.35
7641CCPD	CMOS Quad Op Amp Comp. 10MV	7.50
7642CCPD	CMOS Quad Op Amp Comp. 10MV	7.50
7660CPA	Voltage Converter	2.95
8038CCPD	Waveform Generator	4.95
8048CCPE	Monolithic Logarithmic Amp	21.60
8069CCQ	50ppm Band—GAP Volt Ref. Diode	2.50
8211CPA	Volt Ref/Indicator	2.95
8212CPA	Volt Ref/Indicator	2.95

74C

74C00	.39			74C221	1.95
74C02	.39	74C95	1.59	74C240	2.25
74C04	.39	74C107	1.89	74C244	2.25
74C08	.39	74C151	2.95	74C373	2.49
74C10	.39	74C154	3.95	74C374	2.59
74C14	.75	74C157	2.25	74C901	.69
74C20	.39	74C160	1.69	74C903	.69
74C30	.39	74C161	1.60	74C911	10.95
74C42	1.39	74C162	1.49	74C912	10.95
74C48	1.95	74C163	1.69	74C915	1.69
74C73	.79	74C164	1.59	74C917	10.95
74C74	.79	74C173	1.39	74C922	5.49
74C85	1.95	74C174	1.39	74C923	5.75
74C86	.99	74C175	1.19	74C925	7.50
74C89	6.95	74C192	1.69	74C926	7.50
74C90	1.29	74C193	1.69	80C95	.79
74C93	1.29	74C195	1.59	80C97	.79

LINEAR

LH0002CN	6.85			LM702H	.79
LM10CLH	4.50			LM703CN	.89
LM11CLH	4.75	LM340T-5	1.25	LM709N	.29
LH0070-OH	4.95	LM340T-12	1.25	LM710N	.79
TL071CP	.79	LM340T-15	1.25	LM711N	.79
TL072CP	1.39	LM341P-5	.75	LM723N	.69
TL074CN	2.49	LM341P-12	.75	LM733N	1.00
LH0082CD	35.80	LM341P-15	.75	LM739N	1.19
TL082CP	1.19	LM342P-5	.69	LM741CN	.35
TL084CN	2.19	LM342P-12	.69	MC1741SCG	3.00
LH0094CD	36.80	LM342P-15	.69	LM747N	.79
LM300H	.99	LM348N	1.25	LM748N	.59
LM301CN	.35	LM350K	5.75	LM1014N	2.75
LM302H	1.95	LF351N	.60	LM1310N	1.95
LM304H	1.95	LF353N	1.00	LM1458CN	.59
LM305H	.99	LF355N	1.10	LM1488N	1.25
LM307CN	.45	LF356N	1.10	LM1489N	1.25
LM308CN	1.00	LM358N	1.00	LM1496N	1.95
LM309H	1.95	LM359N	1.79	LM1556V	1.75
LM309K	1.25	LM370N	4.49	LM1800N	2.95
LM310CN	1.75	LM373N	3.25	LM1871N	5.49
LM311/CN	.90	LM377N	2.95	LM1872N	5.49
LM312H	2.49	LM380N	1.25	LM1877N-9	3.25
LM317MP	1.15	LM381N	1.95	LM1889N	3.20
LM317T	1.75	LM382N	1.79	LM1896N	1.75
LM317K	3.95	LM384N	1.95	LM2002T	1.49
LM318CN	1.95	LM386N-3	1.29	LM2877P	2.05
LM319N	1.95	LM387N	1.45	LM2878P	2.25
LM320K-5	1.35	LM389N	1.35	LM2896P-1	2.25
LM320K-12	1.35	LM392N	.69	LM3189N	2.95
LM320K-15	1.35	LF398N	4.00	LM3900N	.69
LM320T-5	1.25	LM399H	5.00	LM3905CN	1.25
LM320T-12	1.25	TL494CN	4.49	LM3909N	1.15
LM320T-15	1.25	TL496CP	1.75	LM3914N	3.95
LM323K	5.95	NE510A	6.00	LM3915N	3.95
LM324N	.99	NE529A	4.95	LM3916N	3.95
LM329DZ	.65	NE531H	3.95	RC4136N	1.25
LM331N	3.95	NE536H	6.00	RC4151NB	3.95
LM334Z	1.30	NE540H	6.00	RC4194TK	6.95
LM335Z	1.40	NE544N	4.95	RC4195TK	5.49
LM336Z	1.75	NE550A	1.30	LM4500A	3.25
LM337T	1.95	NE555V	.39	ICL8038B	4.95
LM337MP	1.15	LM556N	.99	LM13080N	1.29
LM338K	6.95	NE564N	3.95	LM13600N	1.49
LM339N	.99	LM565N	1.25	75138N	1.95
LM340K-5	1.35	LM566CN	1.95	75450N	.89
LM340K-12	1.35	LM567V	1.25	75451CN	.39
LM340K-15	1.35	NE570N	4.95	75492	.89

CAPACITOR CORNER

50 VOLT CERAMIC DISC CAPACITORS

Value	1-9	10-99	100+	Value	1-9	10-99	100+
10 pf	.08	.06	.05	.001µF	.08	.06	.05
22 pf	.08	.06	.05	.0047µF	.08	.06	.05
47 pf	.08	.06	.05	.01µF	.08	.06	.05
100 pf	.08	.06	.05	.022µF	.09	.07	.06
220 pf	.08	.06	.05	.047µF	.09	.07	.06
470 pf	.08	.06	.05	.1µF	.15	.12	.10

100 VOLT MYLAR FILM CAPACITORS

.001mf	.12	.10	.07	.022mf	.13	.11	.08
.0022mf	.12	.10	.07	.047mf	.21	.17	.13
.0047mf	.12	.10	.07	.1mf	.27	.23	.17
.01mf	.12	.10	.07	.22mf	.33	.27	.22

+20% DIPPED TANTALUMS (Solid) CAPACITORS

.1/35V	.39	.34	.29	1.5/35V	.41	.37	.29
.15/35V	.39	.34	.29	2.2/35V	.51	.45	.34
.22/35V	.39	.34	.29	3.3/25V	.53	.47	.37
.33/35V	.39	.34	.29	4.7/25V	.63	.56	.45
.47/35V	.39	.34	.29	6.8/25V	.79	.69	.55
.68/35V	.39	.34	.29	15/25V	1.39	1.25	.95
1.0/35V	.39	.34	.29	22/6V	.79	.69	.55

MINI. ALUMINUM ELECTROLYTIC CAPACITORS

Axial	1-99	100-499	500+	Radial	1-99	100-499	500+
.47/50V	.16	.14	.10	.47/25V	.15	.13	.12
1.0/50V	.19	.16	.12	.47/50V	.16	.14	.13
3.3/50V	.17	.15	.11	1.0/16V	.15	.13	.12
4.7/25V	.18	.15	.11	1.0/25V	.16	.14	.13
10/25V	.18	.15	.11	1.0/50V	.17	.15	.14
10/50V	.19	.16	.12	4.7/16V	.15	.13	.12
22/25V	.19	.16	.12	4.7/25V	.16	.14	.13
22/50V	.24	.20	.18	4.7/50V	.17	.15	.14
47/25V	.25	.21	.19	10/16V	.15	.13	.12
47/50V	.29	.25	.23	10/25V	.16	.14	.13
100/25V	.28	.24	.22	10/50V	.17	.15	.14
100/50V	.41	.37	.34	47/50V	.25	.21	.19
220/25V	.39	.34	.33	100/16V	.21	.17	.14
220/50V	.49	.45	.41	100/25V	.25	.23	.21
470/25V	.54	.49	.45	100/50V	.37	.34	.31
1000/16V	.79	.69	.61	220/16V	.25	.21	.19
2200/16V	.89	.79	.69	470/25V	.35	.31	.27

UTIC

MINI STEREO FM RECEIVER WITH HEADPHONES

For Joggers, Cyclists, and Skaters!

FEATURES: Lightweight headphones. Left/right balance control. Full fidelity stereo sound. Additional black soft carrying case & shoulder strap. Belt clip (hands free). Operates on 3 AA cell batteries (not incl.). Compact size: 3¼" x 4⅞" x 1". Wt. 6 oz.

Model 1810 List Price $89.95 ..... **$29.95**

SPEAKERS

	1	2-9
Part # A0201	1.25	.99

2¼" Round — 8 Ohm
.25 Watt (4" Leads)
Size: 2¼" x ¾"

	1	2-9
Part # SF-25016	1.39	1.25

2½" Square — 16 Ohm
.25 Watt (4 mount. holes)
Large Ceramic Magnet
Size: 2⅝" x 2⅝" x ¾"

National Semiconductor

RAM SALE

STATIC RAMS

MM2114N-2 4K (200NS) ..... **$2.49 each**
(8 EACH $16.95/lot) (100 EACH $195.95/lot)

MM2114N-2L 4K (200NS) Low Power .... **$2.95 each**
(8 EACH $19.95/lot) (100 EACH $225.00/lot)

MM2147N 4K (70NS) ..... **$4.95 each**
(8 EACH $34.95/lot) (100 EACH $419.95/lot)

MM6116P-4 16K (200NS) ..... **$14.95 each**
(8 EACH $99.95/lot) (100 EACH $1195.00/lot)

DYNAMIC RAMS

MM4164N-20 64K (200NS) ..... **$14.95 each**
(8 EACH $99.95/lot) (100 EACH $1195.00/lot)

MM5290N-2 16K (150NS) 4116 ..... **$2.95 each**
(8 EACH $19.95/lot) (100 EACH $225.00/lot)

MM5290N-4 16K (250NS) 4116 ..... **$1.95 each**
(8 EACH $14.95/lot) (100 each $175.00/lot)

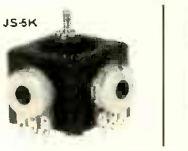
EPROM Erasing Lamp

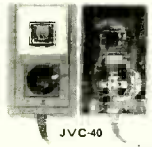
- Erases 2708, 2716, 1702A, 5203Q, 5204Q, etc.
- Erases up to 4 chips within 20 minutes.
- Maintains constant exposure distance of one inch.
- Special conductive foam liner eliminates static build-up.
- Built-in safety lock to prevent UV exposure.
- Compact — only 7-5/8" x 2-7/8" x 2"
- Complete with holding tray for 4 chips.

UVS-11EL Replacement Bulb $16.95

UVS-11E $79.95

JOYSTICKS





JS-5K 5K Linear Taper Pots $5.25
JS-100K 100K Linear Taper Pots $4.95
JVC-40 40K (2) Video Controller in case $4.95

MUFFIN® FAN

The **dependable, low cost, largest selling fan** for commercial cooling applications.

- 105cfm free air delivery
- 4.68" sq. x 1.50" depth. Weight - 17 oz.
- acoustical rating as low as NC-38
- more than 10 yrs. cont. duty at 10°C
- impedance protected
- for ambients to 70°C
- UL yellow card recognized & CSA approved

115V, 50/60Hz, 14 Watts, 105cfm — Ultrasonically cleaned & tested.

MU2A1 .... $9.95 ea.

JE215 Adjustable Dual Power Supply

NEW!

General Description: The JE215 is a Dual Power Supply with independent adjustable positive and negative output voltages. A separate adjustment for each of the supplies provides the user unlimited applications for IC current voltage requirements. The supply can also be used as a general all-purpose variable power supply.

FEATURES:

- Adjustable regulated power supplies, pos. and neg. 1.2VDC to 15VDC.
- Power Output (each supply): 5VDC @ 500mA, 10VDC @ 750mA, 12VDC @ 500mA, and 15VDC @ 175mA.
- Two, 3-terminal adj. IC regulators with thermal overload protection.
- Heat sink regulator cooling
- LED "on" Indicator
- Printed Board Construction
- 120VAC input
- Size: 3-1/2"w x 5-1/16"L x 2"H

JE215 Adj. Dual Power Supply Kit (as shown) .. $24.95

(Picture not shown but similar in construction to above)

JE200 Reg. Power Supply Kit (5VDC, 1 amp) .. $14.95
JE205 Adapter Brd. (to JE200) ±5,±9 & ±12V. $12.95
JE210 Var. Pwr. Sply. Kit, 5-15VDC, to 1.5amp. $19.95

MICROPROCESSOR COMPONENTS

8080A/8080A SUPPORT DEVICES

INS8080A	CPU	4.95
DP8212	8-Bit Input/Output	3.25
DP8214	Priority Interrupt Control	5.95
DP8216	Bi-Directional Bus Driver	3.49
DP8224	Clock Generator/Driver	3.95
DP8226	Bus Driver	3.49
DP8228	System Controller/Bus Driver	4.95
DP8238	System Controller	5.95
INS8243	I/O Expander for 48 Series	9.95
INS8250	Asynchronous Comm. Element	16.95
DP8251	Prog. Comm. I/O (USART)	6.95
DP8253	Prog. Interval Timer	8.95
DP8255	Prog. Peripheral I/O (PPI)	5.95
DP8257	Prog. DMA Control	9.95
DP8259	Prog. Interrupt Control	9.95
DP8275	Prog. CRT Controller	39.95
DP8279	Prog. Keyboard/Display Interface	9.95
DP8303	System Timing Element	6.95
DP8304	8-Bit Bi-Directional Receiver	3.95
DP8307	8-Bit Bi-Directional Receiver	3.95
DP8308	8-Bit Bi-Directional Receiver	3.95
DP8310	Octal Latched Peripheral Driver	5.25
DP8311	Octal Latched Peripheral Driver	5.25

6800/6800 SUPPORT DEVICES

MC6800	MPU	7.95
MC6800CP	MPU with Clock and RAM	14.95
MC6810AP1	128x8 Static RAM	4.95
MC6821	Peripheral Interf. Adapt (MC6820)	7.49
MC6828	Priority Interrupt Controller	17.95
MC6830L8	1024x8-Bit ROM (MC68A30-8)	14.95
MC6850	Asynchronous Comm. Adapter	6.95
MC6852	Synchronous Serial Data Adapter	6.95
MC6860	0-600bps Digital MODEM	10.95
MC6862	2400bps Modulator	12.95
MC6880A	Quad 3-State Bus. Trans. (MC8T26)	2.25

MICROPROCESSOR CHIPS

Z80 (780C)	CPU (MK3880N) (2MHz)	11.95
Z80A (780-1)	CPU (MK3880N-4) (4MHz)	13.95
CDP1801	CPU	19.95
2650	MPU	16.95
IDM2901ADC	CPU—4-Bit Slice (Com. Temp. Grade)	19.95
MC5602	MPU w/Clock (65K Bytes Memory)	11.95
INS8035N-6	MPU—8-Bit (6MHz)	7.95
INS8039N-4	CPU—Sgl. Chip 8-Bit (128 bytes RAM)	9.95
INS8040N-6	CPU (256 Bytes RAM)	24.95
INS8070N	CPU—64 Bytes RAM	24.95
INS8073N	CPU w/Basic Micro Interpreter	29.95
P8085	CPU	9.95
TMS9900JL	MPU—16-Bit	39.95
1173AN-1	30 Tune Musical MPU Chip	8.95

SHIFT REGISTERS

MM500H	Dual 25-Bit Dynamic	.50
MM503H	Dual 50-Bit Dynamic	.50
MM506H	Dual 100-Bit Static	.50
MM510H	Dual 64-Bit Accumulator	.50
MM1402N	256-Bit Dynamic	2.95
MM5013N	1024-Bit Dynamic/Accumulator	1.95
MM5016H	500/512-Bit Dynamic	1.95
MM5034N	Octal 80-Bit	9.95
MM5036N	Octal 80-Bit	9.95
2504V (1404A)	1024-Bit Dynamic	1.95
2518N	Hex 32-Bit Static	3.95
2522V	Dual 132-Bit Static	2.95
2524V	512-Bit Dynamic	.99
2525V	1024-Bit Dynamic	2.95
2527V	Dual 256-Bit Static	2.95
2528V	Dual 250-Bit Static	4.00
2529V	Dual 240-Bit Static	4.00
2532N	Quad 80-Bit Static	2.95
3341PC	Fifo (Dual 80)	6.98

DATA ACQUISITION

AF100-1CN	Universal Active Filter 2.5%	5.95
AF121-1CJ	Touch Tone Low Band Filter	19.95
AF122-1CJ	Touch Tone High Band Filter	19.95
LM308CH	Super Gain Op Amp	1.15
LM134Z	Constant Current Source	1.30
LM335Z	Temperature Transducer	1.40
LF356N	JFET Input Op Amp	1.10
LF398N	Sample & Hold Amplifiers	3.95
LM399H	Temp. Comp. Prec. Ref. (.5ppm/C°)	5.00
ADC0804LCN	8-Bit A/D Converter (1 LSB)	4.95
DAC0806LCN	8-Bit D/A Converter (0.78% Lin.)	2.25

DATA ACQUISITION (CONTINUED)

ADC0809CCN	8-Bit A/D Converter (8-Ch. Multi.)	5.25
ADC0817CCN	8-Bit A/D Converter (16-Ch. Multi.)	10.95
DAC1000LCN	10-Bit D/A Conv. Micro. Comp. (0.05%)	13.95
DAC1006LCN	10-Bit D/A Conv. Micro. Comp. (0.20%)	8.95
DAC1020LCN	10-Bit D/A Converter (0.05% Lin.)	8.49
DAC1022LCN	10-Bit D/A Converter (0.20% Lin.)	5.95
DAC1222LCN	12-Bit D/A Converter (0.20% Lin.)	9.95
CD4051N	8-Channel Multiplexer	1.19
AY-5-1013	30K BAUD UART	6.95

RAM'S

1101	256x1 Static	1.49
1103	1024x1 Dynamic	.99
2101 (8101)	256x4 Static	3.95
2102	1024x1 Static	1.75
21L02	1024x1 Static	1.95
2111 (8111)	256x4 Static	3.95
2112	256x4 Static MOS	4.95
2114	1024x4 Static 450ns	2.25
2114L	1024x4 Static 450ns Low Power	2.49
2114-2	1024x4 Static 200ns	2.49
2114L-2	1024x4 Static 200ns Low Power	2.95
745200	256x1 Static	6.95
4116N-4 (UPD416)	16K Dynamic 250ns (MMS290N-4)	1.95
4164N-3	64K Dynamic 200ns	14.95
MM2147N	4096x1 Fast 70ns	4.95
5101	256x4 Static	7.95
MM5261	1024x1 Dynamic Fully Decoded	.99
MM5262	2Kx1 Dynamic	.49
MM5280/2107	4096x1 Dynamic	4.95
MM5290N-2 (4116)	16K Dynamic 150ns (UPD416C-3)	2.95
MM5298J-3A	8K Dyn. 200ns (lower ½ of MM5290J)	1.98
HM6116-4	16K (2Kx8) Static 200ns	14.95
82S25	64 Bit RAM (16x40C)	3.49
UPD414/MK4027	4K Dynamic 16-pin	4.95
TMS4044-45NL	4K Static	9.95
TMS4046	1024x4 Static	9.95

PROMS/EPROMS

1702A	2K UV Erasable PROM	5.95
2708	8K EPROM	2.95
TMS2716	16K EPROM (-5V, +5V, +12V)	9.95
2716Intel(2516)TI	16K EPROM (Single +5V)	8.95
2732Intel TI	32K EPROM	17.95
2758	8K EPROM (450ns) (Single +5V)	7.49
2764Q	64K EPROM (Hitachi HN462764)	49.95
5203	2048 PROM	14.95
82S23(74S288)	32x8 PROM (Open Collector)	3.95
82S115	4096 Bipolar PROM	14.95
82S123(74S288)	32x8 Tri-State Bipolar PROM	3.95
82S185	8K PROM	16.95

— Over 30 More PROMS Listed in Our Catalog —

ROM'S

2513(2140)	Character Generator (UPPer Case)	9.95
2513(3021)	Character Generator (LOwer Case)	9.95

NMOS READ ONLY MEMORIES

MCM66710P	128x9x7 ASCII Shifted w/Greek	13.50
MCM66740P	128x9x7 Math Symbol & Pictures	13.50
MCM66750P	128x9x7 Alpha, Control Char, Gen.	13.50

MICROPROCESSOR MANUALS

M-Z80	User Manual	7.50
M-CDP1802	User Manual	7.50
M-2650	User Manual	5.00

SPECIAL FUNCTION

DS0025CN	Dual MOS Clock Driver (SMZ)	3.50
DS0026CN	Dual MOS Clock Driver (SMZ)	1.98
INS1771N-1	Floppy Disc Controller	24.98
INS2651N	Communication Chip	19.95
MM5167N	Microprocessor Real Time Clock	8.95
MM5871MN	Microprocessor Compatible Clock	11.95
COP402N	Microcontroller with 64-Digit RAM and Direct LED Drive	6.98
COP402MN	Microcontroller with 64-Digit RAM & Direct LED Drive w/N Buss Int.	7.49
COP470N	32-Seg.VACFluor. Driver (20-pin pkg.)	1.25

TELEPHONE/KEYBOARD CHIPS

AY-5-9100	Push Button Telephone Dialer	14.95
AY-5-9200	Repertory Dialer	14.95
AY-5-9500	CMOS Clock Generator	4.95
AY-5-2376	Keyboard Encoder (88 keys)	11.95
HD0165-5	Keyboard Encoder (16 keys)	7.95
74C922	Keyboard Encoder (16 keys)	5.49
74C923	Keyboard Encoder (20 keys)	5.75
MM53190N	Push Button Pulse Dialer	7.98
MM57499N	96/144-Key Serial Keyboard Encoder	8.95

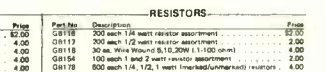
2400-10

EECO Rocker DIP Switch — "Mini-Dip™ 2400 Series
THE MOST UNIQUE DIP SWITCH AVAILABLE!

MINI-DIP is designed to retrofit all major brands of Dip switches. Unique features include locking rod design to prevent accidental actuation and gold self-wiping contact. One-piece housing and press-fit terminals prevent contamination. 2-10 station Form "A" and 1-5 station Form "C." • Terminals on .100 x .300 (2.54 x 7.62) centers • PCB or dip socket mountable • Positive cleaning/wiping action with gold contact • Total seal and bottom seal

Part No.	Pos.	Configuration	Socket	Price
2400-2	2	12	8 pin	.79 - 10/ 6.95
2400-3	3	123	8 pin	.89 - 10/ 7.95
2400-4	4	1234	8 pin	.99 - 10/ 8.95
2400-ABC0	4	ABCD	8 pin	.99 - 10/ 8.95
2400-5C	6	C54321	14 pin	1.09 - 10/ 9.95
2400-6	6	123456	14 pin	1.09 - 10/ 9.95
2400-7	7	1234567	14 pin	1.19 - 10/10.95
2400-8	8	12345678	16 pin	1.29 - 10/11.95
2400-9	8	12345678	16 pin	1.39 - 10/12.95
2400-10	10	0123456789	20 pin	1.49 - 10/13.95

GRAB BAG SPECIALS



GB180 (Pictured Above)

CAPACITORS

Part No.	Description	Price
GB100	100 each Ceramic Disc (10pf--1mf)	$2.00
GB101	60 each Mylar	4.00
GB102	50 each Electrolytics	4.00
GB103	40 each Tantalum (tubular & dipped)	4.00
GB176	40 each Dipped Micas (10pf-1000pf @ 100-500V)	4.00

INTEGRATED CIRCUITS

GB108	80 each TTL Series — marked (7400, 74107, 74123, etc.)	$4.00
GB109	30 each Linear — marked (LM301, 307, 741, 308, etc.)	4.00
GB148	30 each Exar — marked (XR320, 1310, 4136, etc.)	4.00
GB150	20 each Shift Registers — marked (2510, 2518, 2532, 2533, etc.)	4.00
GB157	50 each DTL Series — marked (DM830, 832, 936, 946, etc.)	3.00
GB158	5 pcs. Positive Voltage Regulators (TO-3 case)	4.28
GB159	8 pcs. Negative Voltage Regulators (TO-3 case) (7908, 06, 12, 15, 18, 24, etc.) Linear marked	4.00
GB170	25 each Assorted 74LS TTL Series	4.00
GB173	10 pcs. 78M Positive Volt. Reg. (TO-5 case) (78M05, 8, 12, 15, 20, 24, etc.) Linear marked	5.00

LEDS — LAMPS — READOUTS

GB110	100 each Assorted LEDs (colors & sizes)	$6.00
GB111	40 each NE-2 Neon Type Lamps	3.00
GB112	30 ea Multiple Readouts, calculators, clocks, timers, LEDS to Panaplex — new, used and rejects various colors and types	4.00
GB162	50 each 7-Segment Displays	5.00

POTENTIOMETERS

GB113	30 each Miniature Trimmers (100 ohm-1 Meg)	$4.00
GB134	24 each 3/8" square single-turn PC Mount (untested — 10 ohm to 500 ohm) marked	3.00
GB135	24 each 3/8" square single-turn PC Mount (untested — 1K to 50K) marked	3.00
GB136	24 each 3/8" square single-turn PC Mount (untested — 100K to 5 Meg) marked	3.00
GB173	100 ea 3/8" sq. single-turn (U Test & Sort)	5.00
GB174	25 ea ¾ inch thumbwheel single-turn (500 ohm-5 Meg)	2.00

DIODES

GB171	80 each Assorted Germanium (1N34, 1N58, 1N270)	$2.00
GB107	100 each Silicon (1N914/1N4148)	2.00
GB164	200 each marked, unmarked rectifiers & zeners	2.00
GB175	100 ea ¼ amp 2 amp (cathode band) silicon rectifiers	3.00

RESISTORS

GB116	200 each 1/4 watt resistor assortment	$2.00
GB117	300 each 1/2 watt resistor assortment	2.00
GB118	30 ea. Wire Wound 5,10,20W (1-100 ohm)	4.00
GB154	100 each 1 watt 2 watt resistor assortment	2.00
GB178	600 each 1/4, 1/2, 1 watt (marked/unmarked) resistors	4.00

SWITCHES

GB120	25 each Miniature slide	$3.00
GB122	20 ea. Reed relays with coil and magnet — glass tube	5.00
GB165	40 asst. toggle, rocker, push-button	10.00
GB179	20 each Dip Switches (asst. positions)	9.95

HARDWARE

GB139	40 each Terminal Strips (solder and screw types 13 to 8 terminals)	$3.00
GB140	150 each Spacers, standoff, insulators (metal, nylon and plastic)	2.00
GB141	200 each Washers and Spacers (nylon and teflon)	2.00
GB143	50 ea. Cable mounting (wet rubber and plastic)	2.00
GB144	200 each Solder lugs (small)	2.00
GB145	100 each Lugs — crimp on (some insulated)	2.00
GB146	100 each Spring cord stain reliefs and hole plugs	2.00
GB147	500 each Hardware mix (nuts, bolts, screws, lugs)	5.00
GB166	48 Threaded metal and plastic spacers (¾-2" long)	2.00
GB167	200 pcs sheet metal and metal tapping screws	2.00
GB168	200 pcs. angle and mounting brackets	3.00
GB169	100 pcs tie wraps and harness clips (3-6")	3.00
GB180	100 ea. Rotary/Slide Cap gears shafts, wheels, motors	9.95

MISCELLANEOUS

GB123	30 each Heat Sinks — assorted sizes	$3.00
GB124	8 each assorted calculator type keyboards	5.00
GB126	50 each Opto-Isolators (Li-T Series illuminated)	2.00
GB127	100 each Transistors — plastic and power	3.00
GB128	20 each RF Coils — molded type	4.00
GB129	50 each Photo Transistors (LPT)	4.00
GB130	1 each Tape Drive — 6V motor with reed/write/erase head and 2 cassette tape (no amplifier)	5.00
GB131	30 each 6" shrink tubing, asst. sizes and colors	4.00
GB137	80 ea. Chokes, coils and inductors (molded-wire-epoxied)	3.00
GB138	2 each Speakers, 2¼", 8 ohm, 1/4 watt	1.95
GB155	200 each mixed resistor, capacitors diodes, transistors, chokes	3.00
GB160	Printed Circuit Board Contains 80-15 components on each board	2.00
GB163	30 ea. Sockets (Asst. IC and transistor)	4.00
GB177	200 each 1" Shrink tubing, asst. colors and sizes	3.00

$10.00 Minimum Order — U.S. Funds Only
California Residents Add 6% Sales Tax
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BOOKS

National Semiconductor — Intersil — Intel

30001	**National CMOS Data Book** (640 pages) 74C, CD4000, and A/D Converters	$6.95
30002	**National Interface Data Book** (704 pages) DP, DS8000, DS3600, DS75000, etc.	$5.95
30003	**National Linear Data Book** (1375 pages) LM, LF, ADC, DAC, LH Series	$8.95
30004	**National Series 80 — Board Level Computer** (224 pages)	$4.95
30005	**National TTL Logic Data Book** (624 pages) 7400,LS,L,H,S, and DM8000 Series	$8.95
30006	Buy above (3) 30001,3,5 as a set	$19.95/lot
30009	**Intersil Data Book** (1074 pages)	$6.95
010400	**Intel Component Data Catalog** Full data sheets for Intel's products incl. memory devices, microproc., peripherals & indust./mil. products (1328 pages)	$10.00
205610	**Intel Peripheral Design Handbook** Full data sheets, appl. notes for Intel peripheral device components (644 pages)	$7.50

AC and DC Wall Transformers

With Universal Plug and 9V Battery Snap

Selective voltages: 6,9,12VDC. Polarity selection (+/-). six-foot line from adapter to plugs — six-inch line from adapter to battery snap. 120V/60Hz. 300mA.

Part No.	Input	Output	Price
AC 250	117V/60Hz	12VAC 250mA	$3.95
AC 500	117V/60Hz	12VAC 500mA	$4.95
AC1000	117V/60Hz	12VAC 1 amp	$5.95
AC1700	117V/60Hz	9VAC 1.7 amp	$3.95
DC 800	120V/60Hz	8VDC 400mA (batt. charger)	$2.49
DC6912 (above)	120V/60Hz	6,9,12VDC 300mA	$9.95
DV9200	117V/60Hz	9VDC 200mA	$3.25
DC900	120V/60Hz	9VDC 500mA	$3.95
DC1200	120V/60Hz	12VDC 300mA	$3.95

CONNECTORS

DB25P	D-Subminiature Plug	$2.95
DB25S	D-Subminiature Socket	$3.50
D20418-2	Screw Lock Hdwr. (2) DB25S/P	2/$.99
DB51226	Cover for DB25P/S	$1.75
22/44SE	P.C. Edge (22/44 Pin)	$2.95
UG88/U	BNC Plug	$1.79
UG89/U	BNC Jack	$3.79
UG175/U	UHF Adapter	$ .49
SO239	UHF Panel Recp.	$1.29
PL258	UHF Adapter	$1.60
PL259	UHF Plug	$1.60
UG260/U	BNC Plug	$1.79
UG1094/U	BNC Bulkhead Recp.	$1.29

TRS-80 16K Conversion Kit

Expand your 4K TRS-80 System to 16K
Kit comes complete with:

- 8 ea. MM5290 (UPD416/4116) 16K Dyn. Ram (*ns)
- Documentation for conversion

TRS-16K2 *150ns 19.95
TRS-16K3 *200ns 16.95
TRS-16K4 *250ns 14.95

KEYBOARDS

Limited Quantity

Datanectics 74-Key Keyboard

Uses EA 20134 Chip (Electronic Arrays). Size: 16¾"L x 5¼"W x 1-3/8"H. White, black, blue, grey key caps. (No Data Sheet) —

Part No. KB354 ..... $29.95 ea.

Micro Switch 69-Key Keyboard

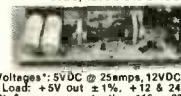
Uses AMI SW20350K Chip. Size: 16-3/8"L x 5¼"W x 1-5/8"H Metal Frame. Light & dark grey key caps (No Data Sheet)

Part No. KB69SD12-2 ..... $19.95 ea.

Boschert Multi-Voltage Power Supply

5VDC, 12VDC and 24VDC

Limited Quantity



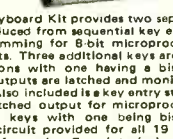
FEATURES: Voltages*: 5VDC @ 25amps, 12VDC @ 4amps, & 24VDC @ 4amps. Reg. Load: +5V out ± 1%, +12 & 24V out ±5% (20-100% load). Overvolt. & overcurr. protection. 115 or 230VAC input. Wt. 4 lbs. Size: 4.85" x 2.50" x 15.00"
***Total average output shall not exceed 200 watts.**

General Description: The "Boschert" Power Supply was originally designed for application with ITT Advance Terminal Controller (ATC). This open frame switching power supply provides user with high current requirements common in use with computer systems. Its compact size provides versatility for mounting into electronic enclosures. Each supply has 6 threaded fasteners (pem nut type) for mounting. Specification requirements to be used with ATC enclosed.

Part No. 200-3010 ..... $69.95 each
— MANY OTHERS AVAILABLE • WRITE FOR INFORMATION —

JE600 Hexadecimal Encoder Kit

FULL 8-BIT LATCHED OUTPUT 19-KEY KEYBOARD



The JE600 Encoder Keyboard Kit provides two separate hexadecimal digits produced from sequential key entries to allow direct programming for 8-bit microprocessor or 8-bit memory circuits. Three additional keys are provided for user operations with one having a bistable output available. The outputs are latched and monitored with 9 LED readouts. Also included is a key entry strobe. Features: Full 8-bit latched output for microprocessor use. Three user-define keys with one being bistable operation. Debounce circuit provided for all 19 keys. 9 LED readouts to verify entries. Easy interfacing with standard 16-pin IC connector. Only +5VDC required for operation. Size: 3½"H x 8¼"W x 8¾"D

JE600/DTE-HK (After assembled as pictured above) **$99.95**

JE600 Hte 19-Key Hexadec. Keyboard, PC Board & Cmpnts. (no case) .. **$59.95**

K19 19-Key Keyboard (Keyboard only) **$14.95**

DTE-HK (case only — 3½"H x 8¼"W x 8¾"D) **$44.95**

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21 Band EQ	235.

11 Band EQ 119.

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11 Band High-Low Mixer Equalizer

LED METER

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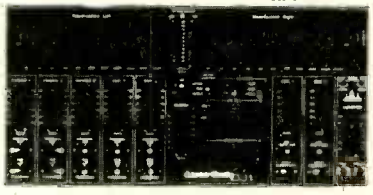
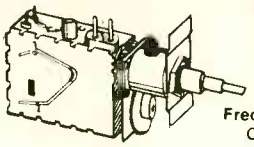
Dual LED Meter



Call or write for full product information, specifications and pricing to: *Aaron-Gavin*, 123 South McClay Street, Unit F, Santa Ana, CA 92701, (714) 957-8710.

MORE GAIN

THAN A VARACTOR UHF TUNER



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Output Channel 3. Available on request: Ch 2 or 4.

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Order 10 each of the 3 items ..... $ 85.00/set

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LS04	.25	1.23	LS138	.75	3.56	LS240	1.80	8.55
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LS08	.35	1.66	LS145	1.20	5.70	LS244	1.75	8.31
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LS74	.45	2.14	LS163	.95	4.51	LS368	.70	3.33
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LS90	.60	2.85	LS174	.95	4.51	LS378	1.18	5.61
LS92	.60	2.85	LS175	.95	4.51	LS620	2.25	-
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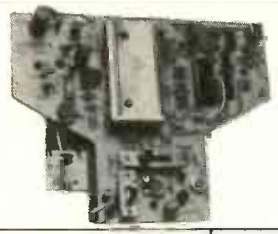

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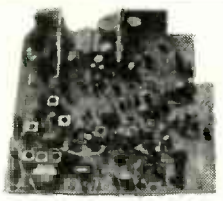

C.B. SPECIAL

CONVERT THESE TO 10 METER FM

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(Double Side)

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513-002
.196" Dia. .080" High
3.5-20pf

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SMALL ENOUGH TO FIT IN YOUR WATCH

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2¼" square, no shunt required. Easy-to-read dial.
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Schematic Diagram Supplied

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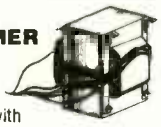

Primary – 115 vac
Secondary – 32 v with 24 v tap at 15 amps
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with On-Off ¼" hole mount, ⅛" D shaft, ¾" thread section.

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10" l x 5" h x 5" w

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PLASTIC CASE FOR REMOTE NOT INCLUDED. SOLD AS IS **$29.95**

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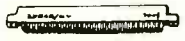

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3" Diam., 8 OHM, 5 Watts.

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+ 12 vdc .1 amps
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$1.95 ea.
5/**$8.00**

Has 3 slide switches, 26 different keys, key pad removable by 4 screws

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Conn & Hood	22 AWG # Cond	Length
25 P	14	15'
25 S	10	17'

7' POWER CORD

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Molded 3 Prong Plug with molded receptacle Belden 16 AWG

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MFG By Rotron Inc.
3 Blades 4¾" Square

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NEW
110 VAC Model MU2A1
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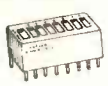

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25 P **2.50**
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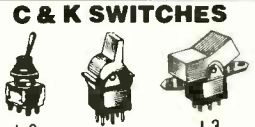
COVER FOR DB2 SP/S (PLASTIC) **1.25**

C & K SWITCHES



L-3 J-60 J-3

Part #		Movement
J-60	7101	SPDT
L-3	7108	SPDT (momentary)
J-3	7201	DPDT (special large rocker)

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New Type Element .....$21.00ea. I/O Selectric ..... **$399.00ea.**

Add $20 for Packaging and Handling - Pay Shipping on Delivery

WORD PROCESSOR CPU ASSEMBLY

Linked to and used with the above machine, this unit completes a system which originally sold for over $3000.00 each! Features include: standard cassette deck, auto centering, auto repeat, auto underline, suppressed notations, record/playback, auto merge, editing, margin adjusting and much, much more. Parts include tape or "mag" card deck, cabinet, fans, power supply, mother board, connectors, cables, LEDS and more. Worth much more than our price for the parts alone. Includes schematics and data. Tested and functional.

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CIRCLE 96 ON FREE INFORMATION CARD

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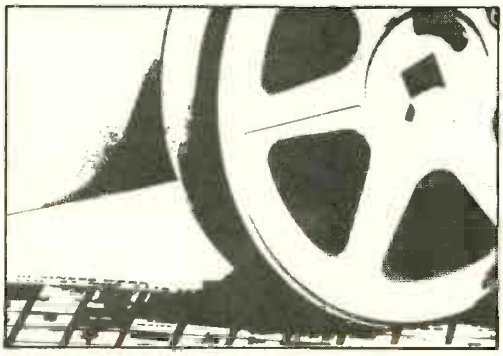

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SN7437N	.26	SN74160N	.89
SN7438N	.24	SN74161N	.65
SN7440N	.18	SN74163N	.85
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SN7443N	.42	SN74165N	.55
SN7445N	.64	SN74174N	.88
SN7451N	.19	SN74175N	.79
SN7454N	.19	SN74180N	.75
SN7474N	.27	SN74181N	1.15
SN7475N	.35	SN74393N	1.65

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74LS00	.28	74LS158	.69
74LS02	.28	74LS161	.83
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74LS04	.28	74LS163	.98
74LS05	.22	74LS164	.65
74LS08	.29	74LS165	.66
74LS09	.28	74LS169	1.55
74LS10	.26	74LS170	1.75
74LS14	.89	74LS174	.85
74LS20	.22	74LS175	.85
74LS21	.28	74LS190	.85
74LS26	.40	74LS191	1.25
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74LS48	.77	74LS244	1.55
74LS74	.38	74LS245	2.45
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74LS90	.59	74LS257	.85
74LS93	.65	74LS259	1.95
74LS95	.80	74LS260	.55
74LS107	.43	74LS273	1.55
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74LS126	.79	74LS367	.75
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74LS139	.59	74LS374	1.45
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74LS153	.49	74LS669	1.55
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LM741	.25		
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	10/5.70	16	10/1.40
	10/8.70	18	10/1.80
	10/9.70	20	10/2.70
	10/12.70	22	10/2.70
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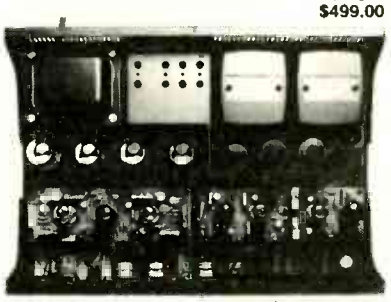

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EQUIPMENT REPORTS

continued from page 118

the printer to roll the paper backwards.

The ribbon is supplied in a cartridge that spans almost the full length of the printer. It simply drops into place; there is no threading or positioning. It is one of the easiest ribbons to install, even for someone who is all thumbs. Replacements are priced at $7.95.

The printer is rather small. Without the paper-roll adapter, it measures 15 × 9¼ × 3-inches. (You must allow some room at the rear for loading paper.) The power switch is located at the left rear outside the paper path. The interface cable comes out the right rear, also outside the paper path. (Even some of the best of other printers are known to get their cables tangled up with the paper because the cables are right in the feed path.) On the top right is a recessed, toothed knob for manual paper positioning.

While the *Bytewriter-1* has some obvious limitations, such as variable impact density and lack of direct-line feed, it does quite a creditable job for its price. Certainly, at $299 (plus $19.95 for the interface cable and $15 for shipping) it is one of the least expensive "full size" printers around. For information, or to order a *Bytewriter-1*, write to Microtek Inc., 9514 Chesapeake Dr., San Diego, CA 92123. R-E

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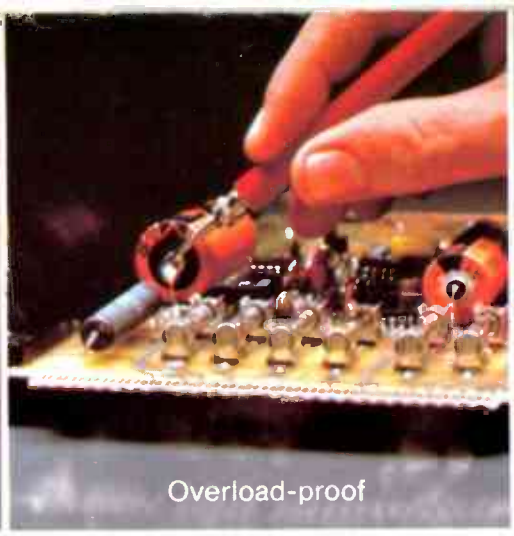

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